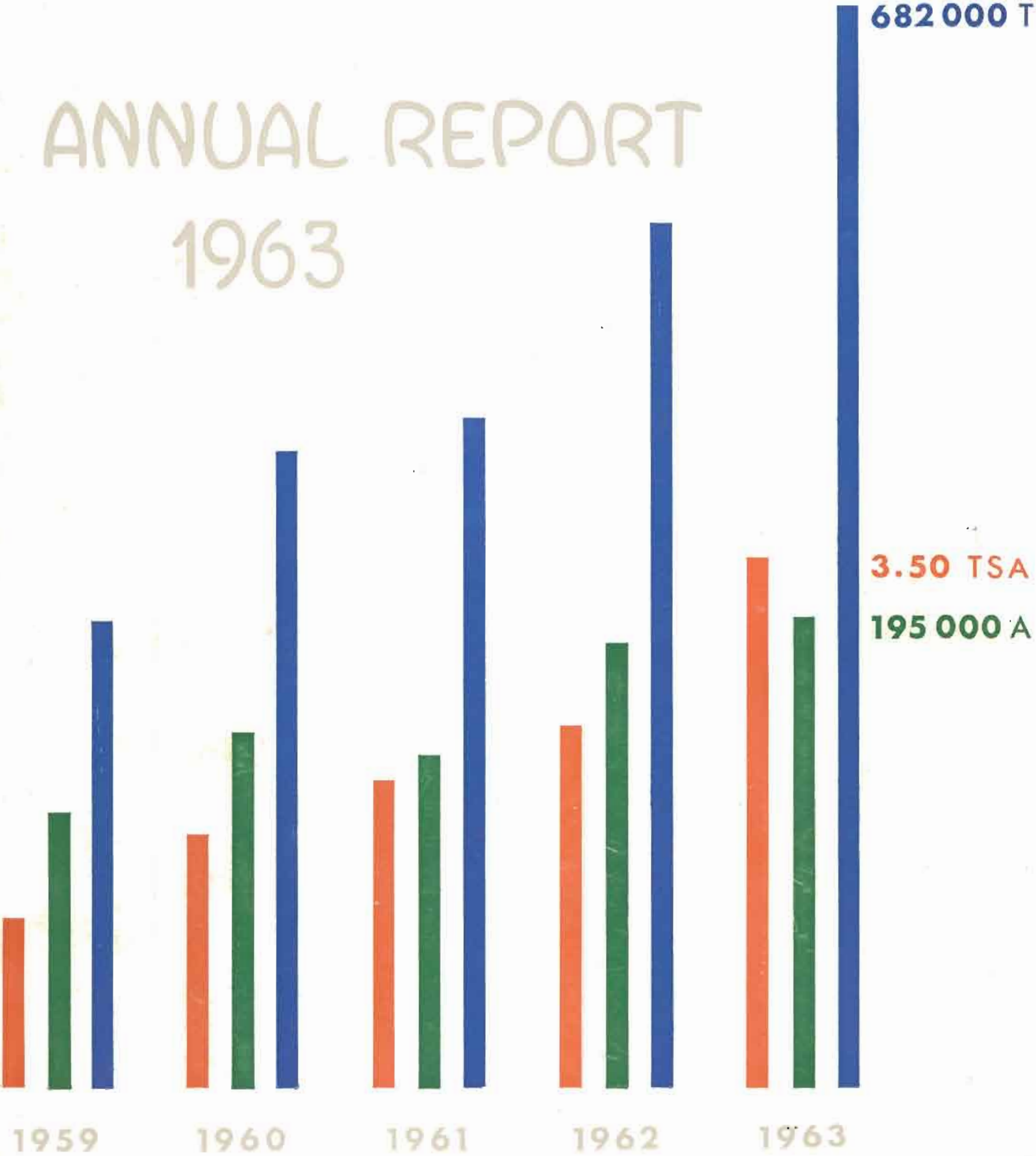
Mauritius Sugar Industry Research Institute

ANNUAL REPORT 1963



Mauritius Sugar Industry Research Institute

ANNUAL REPORT 1963

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1964

CORRIGENDUM

Mauritius Sugar Industry Research Institute

Annual Report 1963

Page 138, 6. Chemical Control Notes

First sentence should read " ...*apparent* purity of juices often lies very close to, and sometimes even exceeds, the *gravity* purity".

CONTENTS

			Page
MEMBERS EXECUTIVE BOARD AND RESEARCH ADVISORY COMMITTEE		...	3
STAFF LIST		...	4
REPORT OF CHAIRMAN EXECUTIVE BOARD		...	5
REVENUE AND EXPENDITURE ACCOUNT		...	7
IN MEMORIAM : S. M. FEILLAFE		...	8
RESEARCH ACTIVITIES			
INTRODUCTION	P. O. Wiehe	...	9
CANE BREEDING	E. F. George & W. de Groot		
1. Arrowing		...	37
2. Crossing		...	40
3. Selection		...	42
4. Variety and pre-release trials		...	43
5. Studies on seedling populations		...	46
NUTRITION AND SOILS			
1. Chemical fertilization	D. H. Parish	...	51
2. Foliar diagnosis observed in 1963 on the permanent sampling units	Pierre Halais	...	69
3. High sucrose response to nitrogen fertilization — an important varietal characterestic	Pierre Halais	...	71
4. Silica and manganese contents of cane leaf sheaths in relation to soil and nutrition	Pierre Halais & D. H. Parish	...	74
CANE DISEASES	R. Antoine & C. Ricaud		
1. General considerations		...	77
2. Ratoon stunting disease		...	77
3. Chlorotic streak		...	81
4. Testing disease reaction of cane seedlings		...	85
5. Pineapple disease		...	88
6. Fiji disease in Madagascar		...	88
CANE PESTS	J. R. Williams		
1. The red locust		...	91
2. The army worm		...	92
3. The stalk borer		...	92

WEED CONTROL .. .. E. Rochecouste

1.	Substituted ureas *versus* substituted triazines in the super-humid zone		93
2.	Investigations on the comparative effectiveness of certain herbicide mixtures		95
3.	Varietal susceptibility to DCMU ...		96
4.	The effect of Dalapon, Paraquat and Fenac on cane and sugar yields of several commercial varieties		96
5.	Evaluation of new herbicides		98

CLIMATE, IRRIGATION, CULTIVATION

1.	Climatic conditions during the 1963 campaign	Pierre Halais	103
2.	Moisture content of 4-5 joint : a valuable addition to tissue testing	Pierre Halais & Michel Hardy	109
3.	Highlights of final variety trials, 1960 series	Pierre Halais	111
4.	Selective harvesting and trashing	G. Rouillard	115
5.	Germination studies with M.93/48	E. Rochecouste & C. Mongelard	118

SUGAR MANUFACTURE

1.	The performance of sugar factories in 1963	J. D. de R. de Saint Antoine & H. F. Wiehe	121
2.	The calorific value of bagasse of a few commercial cane varieties	E. C. Vignes & M. Randabel	125
3.	Notes on the power consumption of C. Massecuite crystallizers	F. Le Guen & J. D. de R. de Saint Antoine	127
4.	Automatic regulation of Magma crystal content ...	H. F. Wiehe	131
5.	Further studies on the presence of osmophilic yeasts in sugar products	R. Antoine, R. de Froberville & C. Ricaud	134
6.	Chemical Control Notes		
	(a) The influence of glucose and fructose on the difference between apparent and gravity purities of juices and molasses	E. C. Vignes & M. Randabel	138
	(b) The use of basic lead acetate for juice preservation	J. D. de R. de Saint Antoine & M. Abel	140
	(c) The direct determination of fibre in cane ...	J. D. de R. de Saint Antoine & R. de Froberville	142

BY-PRODUCTS . D. H. Parish

1.	The use of protein in cane juice as an animal feed		147
2.	The amino-acid composition of the hot-water insoluble nitrogen fraction of cane leaves, cane juice, and factory filter-muds ..		151

Table 89. The average crude protein content of dried filter muds produced during the 1963 crushing season.

Factory	*Type of Filter*	*Crude Protein % D M*
F.U.E.L.	Rotary (cloth)	14.9
Médine	Rotary (cloth)	14.6
Mon Trésor	Rotary (normal)	11.7
Highlands	Filter press	16.7
Rose Belle	Filter press	15.2

No feeding stuff containing up to 18% of crude protein, as dried scums do, has such a low content of digestible crude protein, and therefore, although from the point of view of total protein content scums would be equated to a good quality dried grass, from the point of view of animal feeding they are the equivalent of only a poor quality hay.

The possible causes for the low digestibility of scums protein are :

(a) precipitation of the protein from a strong solution of sucrose and reducing sugars at a temperature of 100°C and under slightly alkaline conditions, resulting in serious denaturation of the protein.

(b) The coating of the protein particles with wax which could prevent enzymic degradation of the protein.

(c) The effect of the temperature used in drying the scums. Air-drying has been shown by PARISH (1962) to improve the digestibility of the scums protein, but this is a difficult method of drying on an industrial scale, and in any case the digestibility of the protein is still fairly low, being only around 30%.

(d) The composition of the basic ration to which the scums are added may possibly affect the digestibility of the protein they contain.

Research into the cause of the low digestibility of scums-protein is in progress, but it does seem that some treatment of the dried scums will be necessary before the full nutritional potentiality of the protein they contain can be exploited. Should it prove possible to dry the scums carefully, and if dewaxing improves the digestibility, then this material may play a valuable role in ruminant livestock production in Mauritius; in the meantime, as a protection against possible financial loss, it is desirable that they be considered only as the equivalent of a poor quality meadow hay.

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STAFF LIST

Director	P. O. Wiehe, C.B.E., D.Sc., A.R.C.S., F.L.S.
Agronomist	P. Halais, Dip. Agr. (Maur.)
Botanist	E. Rochecouste, B.Sc., Ph.D., F.L.S.
Asst. Botanist	C. Mongelard, B.Sc.
Chemist	D. H. Parish, B.Sc., M. Agr. (Q.U.B.), F.R.I.C.
Asst. Chemist	L. Ross, Dip. Agr. (Maur.)
Plant Breeder	W. de Groot, M.Sc. (Wag. Holland)
Senior Asst. Plant Breeder ...	L. P. Noël, Dip. Agr. (Maur.) — *i/c Belle Rive Experiment Station.*
Geneticist	E. F. George, B.Sc., A.R.C.S.
Asst. Geneticist	J. A. Lalouette, Dip. Agr. (Maur.)
Plant Pathologist	R. Antoine, B.Sc., A.R C.S., Dip. Agr. Sc. (Cantab.), Dip. Agr. (Maur.)
Asst. Plant Pathologist ...	C. Ricaud, B.Sc., D.I.C.
Sugar Technologist	J. D. de R. de Saint Antoine, B.S., Dip. Agr. (Maur.)
Associate Sugar Technologist ...	H. F. Wiehe, B.S., Dip. Agr. (Maur.)
Associate Chemist (S.T.) ...	E. C. Vignes, M.Sc., A.R.I.C., Dip. Agr. (Maur.)
Asst. Chemist (S.T.)	M. Randabel, Dip. Agr. (Maur.)
Asst. Sugar Technologist ...	R. H. de Froberville, Dip. Agr. (Maur.)
Asst. Sugar Technologist ...	F. Le Guen, B.Sc., D.N.C.L.
Entomologist	J. R. Williams, M.Sc., D.I.C.
Chief Agriculturist	G. Rouillard, Dip. Agr. (Maur.)
Senior Field Officers	G. Mazery, Dip. Agr. (Maur.)
	P. R. Hermelin, Dip. Agr. (Maur.) — *i/c Réduit Experiment Station.*
Field Officers :	
Headquarters ...	M. Mamet, Dip. Agr. (Maur.)
	R. Ng Ying Sheung, Dip. Agr. (Maur.)
	M. Hardy, Dip. Agr. (Maur.) — *Irrigation.*
North	R. Béchet, Dip. Agr. (Maur.) — *i/c Pamplemousses Experiment Station*
South	F. Mayer, Dip. Agr. (Maur.) — *i/c Union Park Experiment Station.*
Laboratory Assistants :	
Chemistry	L. C. Figon
	C. Cavalot
Entomology ...	M. A. Rajabalee
Foliar Diagnosis ...	Mrs. G. Caine
Sugar Technology ...	L. Le Guen
	M. Abel
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	Mrs. A. Baissac
	Mrs. M. Rae
	Mrs. J. R. Williams

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Mr. M. D. ffrench-Mullen, *representing Government.*

Mr. Auguste Harel
Mr. R. de Chazal
Mr. René Noël
} *representing factory owners.*

Mr. Georges Rouillard, *representing large planters.*

Mr. M. Kisnah
Mr. H. Lallmahomed
} *representing small planters.*

MEMBERS RESEARCH ADVISORY COMMITTEE

Dr. P. O. Wiehe, C.B.E., *Chairman.*

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Mr. Lutchmeenaraidoo, *representing the Extension Service of the Department of Agriculture.*

Mr. G. P. Langlois, *representing the Chamber of Agriculture.*

Mr. P. de L. d'Arifat
Mr. A. Wiehe
} *representing the Société de Technologie Agricole et Sucrière.*

and the senior staff of the Research Institute.

REPORT OF THE CHAIRMAN

EXECUTIVE BOARD 1963

FOR the second time in its short history, the Institute has lost the services of one of its senior workers. Mr. Sydney M. Feillafé, Senior Assistant Chemist, died on the 14th March at the age of 46 after a brief illness. Mr. Feillafé had been transferred to the Institute in January 1954, after working for the Department of Agriculture's Sugar Cane Research Station since graduating at the College of Agriculture in 1939. The last years of his life had been spent in close association with the soil survey of Mauritius, and his absence will be keenly felt. On behalf of the Board and of the Staff, I wish to express here, to his wife and family, our most sincere sympathy.

The Board held 13 meetings during the year, two of which jointly with the Research Advisory Committee. Messrs. Richard de Chazal, René Noël, and H. Lallmahomed replaced Messrs. G. S. de la Hogue, P. de Comarmond, and S. Bunjun.

Mr. Yves Wong You Chong was appointed to replace Mr. Feillafé and assumed duty on 1st January, 1964.

Mr. C. Cavalot was transferred during the year from the Sugar Technology to the Chemistry Division as field assistant to work on soil problems.

Mr. Maurice Abel, who has been employed since September 1957 as temporary laboratory attendant in the Chemistry Division, was promoted on 1st July 1963 to the post, vacated by Mr. Cavalot, of laboratory assistant in the Sugar Technology Division.

Messrs. C. Ricaud and C. Mongelard have been awarded one year post-graduate scholarship at the Imperial College, the former by the British Council, and the latter by a Commonwealth organization.

Mr. Adrien Wiehe informed the Board that he would be unable to continue serving the Institute as Consulting Sugar Technologist at the end of 1963. I wish to place on record my deep appreciation of the invaluable services he has rendered to the Institute over the past six years.

The Sugar Estates of Mauritius have kindly offered to erect on the Institute's grounds a building which will serve to house the World Sugar Industry Exhibition which had been on show during the ISSCT Congress in 1962. The building is due to be completed in April 1964. I am pleased to record here the Board's appreciation of this gestuie which will enable the Institute to have a memorial of the Congress.

I am pleased to report that the first beneficiary of the Aimé de Sornay Scholarship, Mr. Raymond Maurel, has brillantly terminated his studies by becoming the 1963 laureate of the College of Agriculture, with an exceptionally high percentage of marks. Mr. Lim Sow Tin, our second scholar, is proceeding satisfactorily with his studies. The third scholarship was awarded to Mr. A. S. Gopaul who came out third at the entrance examinations.

In the last two Reports, my predecessor and I have made strong pleas for the increase of the level of cess. The final accounts of the Institute indicate a cash balance of Rs. 213,000 at the end of the financial year, from which several commitments amounting to Rs. 100,000 have to be deducted. It is clear, therefore, that until the revenue of the Institute is placed on a sounder basis, the present financial situation of the Institute will remain insecure. The Board studied carefully this vital aspect of the work of the Institute and recommended to Government in April 1963 that the level of the cess should be increased as early as possible in order to stabilize the finances of the Institute whilst creating a reasonable reserve to meet fixed commitments during years of short production.

In closing this Report, I should like to express to my Collegues of the Board my gratitude for their precious assistance, and record once again all my appreciation of the valuable services of our Director and his Staff.

Chairman

31st January 1964

IN MEMORIAM

SYDNEY F. FEILLAFÉ

1917 - 1963

Sydney Feillafé, born on the 2nd March 1917, died suddenly after a brief illness twelve days after his 46th birthday. This sad news was heard with dismay by all his friends, and, in particular, by his colleagues of the M.S.I.R.I. who held him in high esteem.

Feillafé obtained the Dilpoma of the College of Agriculture in 1939, and began his career shortly thereafter as Field Assistant at the Sugarcane Research Station. He joined the Royal Artillery in 1941, returning to the S.R.S. in 1945.

When the M.S.I.R.I. was founded in 1954, he was seconded from Government Service to join the division of Chemistry, being appointed Senior Assistant Chemist in 1957. During the last six years of his life, he actively studied the soils of Mauritius, being helped in this task by knowledge acquired abroad, in particular at Rothamsted Experiment Station and Macaulay Institute of Soil Science in 1956, and in Hawaii in 1960, after attending the 9th International Soil Congress held in Madison, U.S.A.

Feillafé had acquired an unequalled knowledge of local soil types, and was well informed on problems of soil fertility and cane nutrition. His passing away leaves a gap in the research team of the M.S.I.R.I. where he is sadly missed by all his colleagues.

REVENUE AND EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1963

Running & Administrative Expenses ...	1,601,585.97	Cess on sugar exported	1,724,423.42
Herbarium Expenses	3,367.97	Miscellaneous receipts	136,299.50
Interest paid	27,748.49	Excess of Expenditure over Revenue for the year, deducted from Accumulated Funds ...	7,520.66
Leave and Missions Fund	100,000.—		
Depreciation	135,541.15		
Rs.	1,868,243.58	Rs.	1,868,243.58

BALANCE SHEET

AS AT 31st DECEMBER, 1963

ACCUMULATED FUNDS	1,465,512.87	FIXED ASSETS (at cost less depreciation and amounts written off)		
		Land & Buildings ...	1,623,108.12	
REVENUE FUNDS	104,128.21	Equipment & Furniture :		
		Laboratories, Houses & Offices	49,768.76	
AIMÉ DE SORNAY FOUNDATION ...	25,000.—	Agricultural Machinery & Vehicles	45,856.—	
				1,718,732.88
LOAN FROM ANGLO MAURITIUS ASSURANCE SOCIETY LTD. ...	285,107.—	CURRENT ASSETS		
		Sundry Debtors ...	38,117.89	
		Aimé de Sornay Foundation Account	25,000.—	
GOVERNMENT OF MAURITIUS (Purchase of Buildings)	140,491.45	Cash at Banks & in hand ...	238,388.76	
				301,506.65
Rs.	2,020,239.53	Rs.		2,020,239.53

(sd) Ph. ESPITALIER-NOEL }
(sd) D. H. FFRENCH MULLEN } *Board Members*

(sd) P. O. WIEHE *Director*

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December 1963, and have obtained all the information and explanations we have required. In our opinion, proper books of accounts 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 31st December 1963, 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) P.R.C. Du MÉE,
C.A.(S.A.), F.S.A.A.

p.p. de CHAZAL, DU MÉE & Co.

Chartered Accountants

Port Louis,
Mauritius,
February, 1964.

INTRODUCTION

THE Sugar Industry Research Institute has completed in 1963 its tenth year of active work, and the cover of this Annual Report depicts the major changes which have taken place during this period in terms of yields of sugar, cultivated area, and sugar production.

A review of the development and progress of the sugar industry since 1954 will form the main theme of the annual conference of the *Société de Technologie Agricole et Sucrière* due to be held in May 1964. Suffice it to say, at this stage, that a better understanding of the factors involved in production, together with the determination of producers to go forward in the most efficient manner, have resulted in an increased production of 35%, accounted for by 20% increase in yields, and by an extension of 15% in the cultivated area. In this connection, it should be emphasized that the lands which have been brought under cultivation in recent years are generally of lower potential, being either very rocky, or situated under unfavourable climatic conditions. Consequently, the overall increase in yield of nearly 600 kgs of sugar per arpent during the last decade may be considered a creditable achievement, although there are still many prospects for further improvements.

THE 1963 SUGAR CROP

The major climatic factors influencing the crop, namely rainfall and temperature, were nearly normal in 1963 (fig. 1), and resulted therefore in a production year which can be regarded as representing the present normal sugar potential of Mauritius.

From a detailed analysis of weather conditions and the sugar crop, which appears elsewhere in this report, it will be noted that during the growing season notable moisture stress was experienced on two occasions only : early February and March. Average air temperatures were nearly normal, while wind velocity was slightly above the average in December and January. On the other hand, relative insolation was below normal, except in March. The prevailing climatic conditions from November 1962 to June 1963 were therefore very close to those of a long-period average and are reflected both in the normal cane growth recorded (fig. 2), and the yields of virgins and ratoon canes (fig. 3).

During the harvest season, dry conditions prevailing from August to early October, together with abnormally low minimum air temperature and calm weather, were all extremely favourable for good maturation. Consequently, the final value of 11.93 recoverable sugar % cane was disappointing. This mediocre result may be accounted for partly by the low relative insolation experienced for six consecutive months from April to December, and partly because

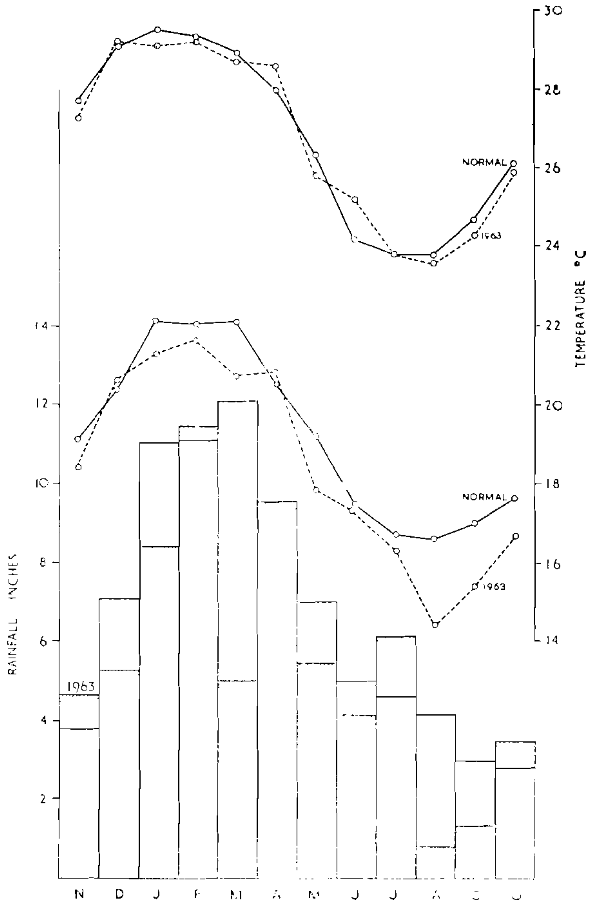

Fig. 1. Rainfall and temperature during the period November 1962 to October 1963.

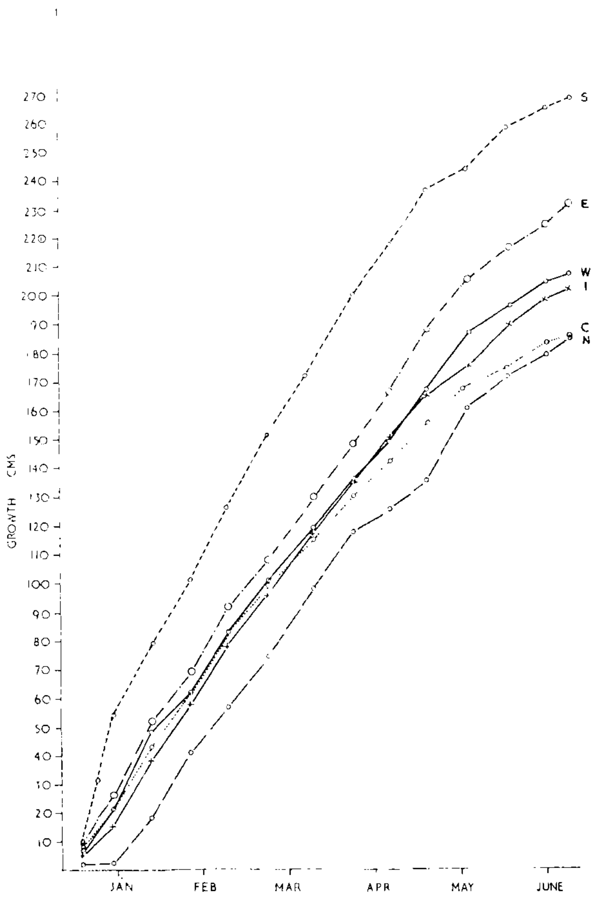

Fig. 2. Cane growth in different sectors of the island January-June 1963.

of the early start of the grinding season. It will be noted from fig. 4 that approximately 18 % of the crop was processed during June and July, a period during which recoverable sugar % cane averaged 10.74. To these two adverse factors should be added the effect of varieties of an intrinsic lower sucrose content such as M. 147/44, B. 3337 and M. 93/48 which represented an aggregate of 39 % of the total cane produced (fig. 5).

The 23 factories of the island crushed an average of 263,000 tons of canes weekly during 22 weeks, the weight of cane processed (5,747,000 metric tons) being the highest on record. Crushing began on the 17th June and ended on 19th December.

The more important production data of the season under review are given below in comparison with those for 1954 to indicate the changes which have taken place in the industry during the last decade.

	1963	*1954*
Area cultivated, arpents	205,000	178,800
Area harvested, „		
Estates	99,560	
Planters	93,440	
Total	193,000	168,400
Weight of canes, met. tons	5,747,000	4,280,000
Tons cane per arpent :		
Estates	35.1	31.0
Planters	24.2	21.0
Average, Island	29.8	25.4
Recoverable sugar % cane	11.93	11.65
Tons sugar per arpent :		
Estates	4.19	3.61
Planters	2.89	2.44
Average	3.55	2.96
Number of factories	23	27
Duration of harvest (days)	153	140
Tons cane per hour	97.8 (50 to 222)	67.8 (43 to 141)
Tons canes crushed weekly	263,300	214,000
Sucrose % cane	13.47	13.41
Fibre % cane	13.11	11.68
Molasses % cane	2.67	2.91
Purity mixed juice	86.3	86.1
Reduced mill extraction	96.0	94.8
Sucrose % bagasse	2.08	2.71
Reduced Boiling house recovery	90.2	88.5
Reduced overall recovery	86.6	83.4
Total losses sucrose % cane	1.70	2.00
Tons sugar 98.7 pol.	685,600	498,600

In view of the fact that the 1963 crop may be considered to approach very nearly that of a normal year, it is interesting to analyse briefly the yields obtained by estates and planters in different sectors of the island. These data, which are shown graphically in fig. 7, indicate that the West was the most productive area both as regards cane yields and sucrose content, followed by estates in the Centre, East, North and South respectively. The order was not the

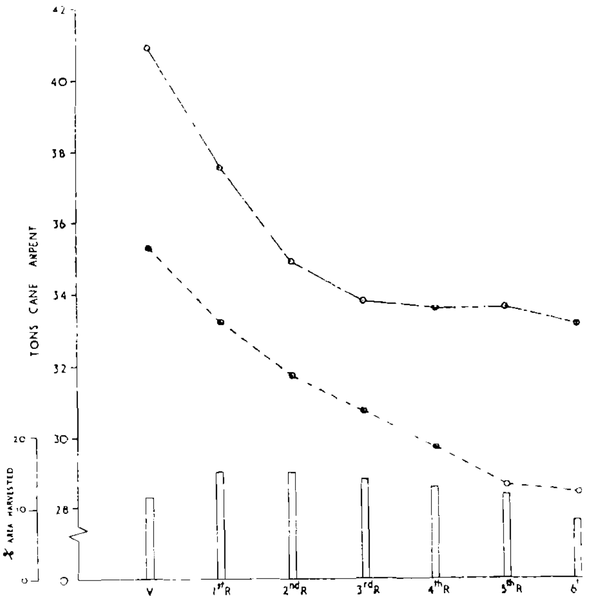

Fig. 3. Average yields of virgins and ratoon canes on estates. Plain line: 1963; broken line: average 1956-1962. Columns show the percentage area harvested for each category.

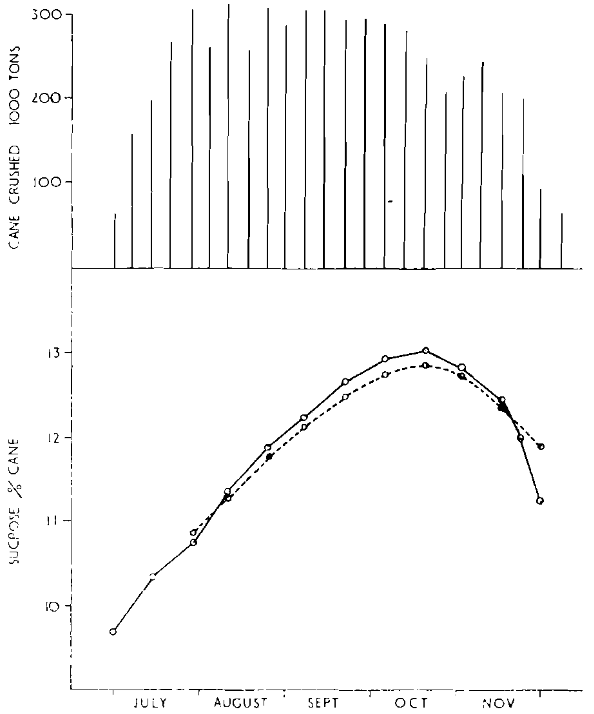

Fig. 4. Maturation curves, island average. Plain line: 1963 ; broken line : average, 1956-1962. Columns indicate weekly crushing.

same concerning planters whose yields of sugar per arpent were below the average island yield by nearly 30% in the East, and approximately 17% in the North, South and Centre, the average difference for all planters being 680 kilos sugar per arpent from the island mean, and 1.3 tons from estates mean. In terms of island production, these shortfalls are equivalent to 35,000 and 120,000 tons sugar respectively.

It is important to point out, however, that marked progress has been achieved recently by planters. The trend of sugar yield per arpent is shown in fig. 6, from which it may be observed that increases of approximately 20% took place between 1954 and 1963, but while improvement shown by estates was gradual, that of planters occurred only during the last three years.

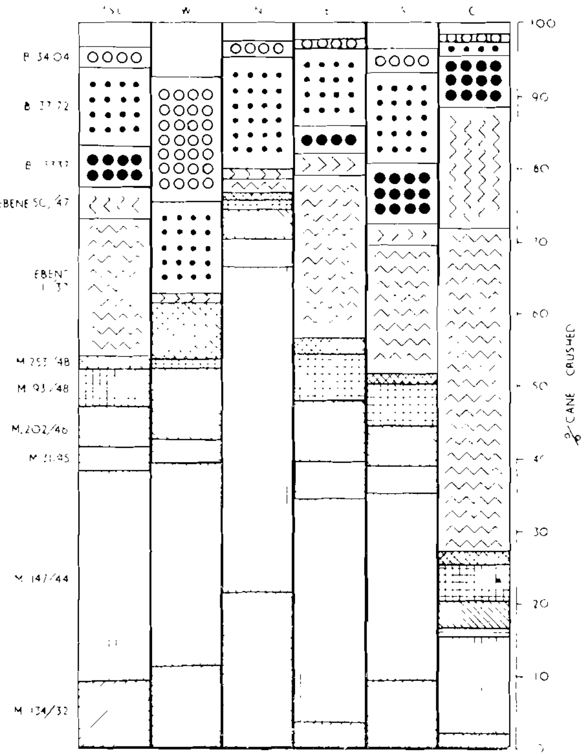

Fig. 5. Varietal composition of the 1963 crop in different sectors of the island.

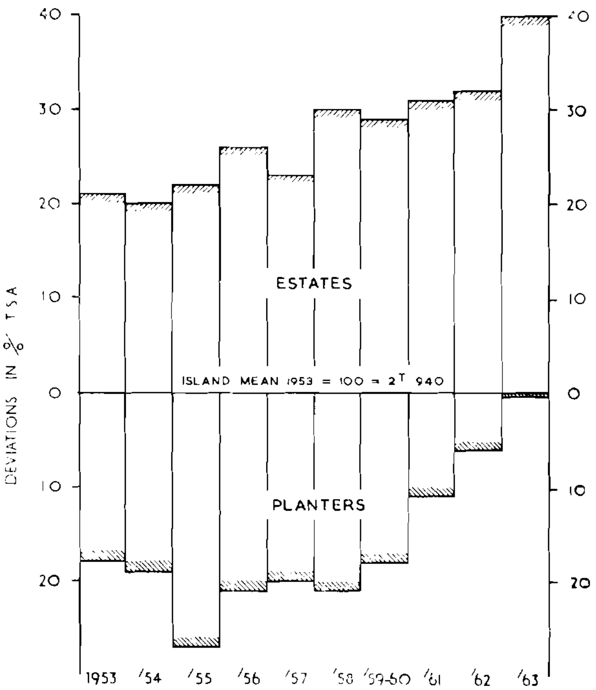

Fig. 6. Progress in sugar yields, 1953-1963. Yields adjusted for normal rainfall and temperature.

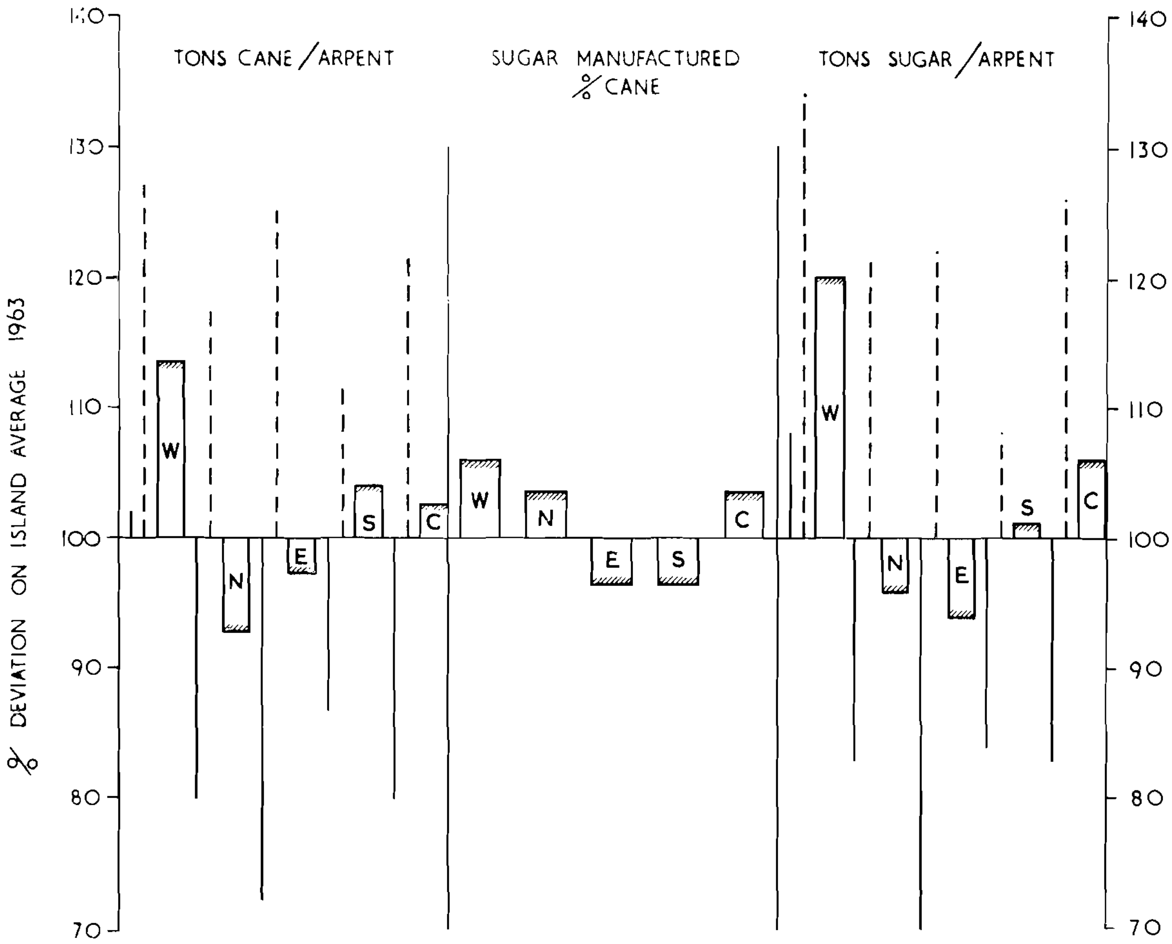

Fig. 7. Deviations in cane and sugar yields in different sectors in relation to the island average in 1963. Plain line : planters ; broken line : estates ; column : sector average.

CANE VARIETIES

Reference to Tables X and XVII (i) of the Appendix shows the interesting feature that the percentage area cultivated under different varieties in 1963 and the varietal composition of the crop in weight coincided almost exactly. This observation indicates that, in the absence of disturbing climatic factors, the spectrum of varieties cultivated at present in Mauritius is in equilibrium with the different environments under which sugar cane is cultivated in the island. The relative proportion of cane varieties processed in different sectors is shown in fig. 5, which forms an interesting contrast with preceding similar diagrams, in particular with that published for the first time in these reports (*vide Ann. Rep. Sug. Ind. Res. Inst. Mauritius, 1957* : *12*, fig. 5).

There were in 1963 eight major cane varieties in cultivation, of which four showed an increase in area over 1962, namely M. 147/44 + 3%, M. 202/46 + 2%, M. 93/48 + 2% and Ebène 50/47 + 1%. The area under Ebène 1/37 decreased from 21 to 18%, that under M. 134/32 by 4%, the Barbados varieties remaining approximately at the same level.

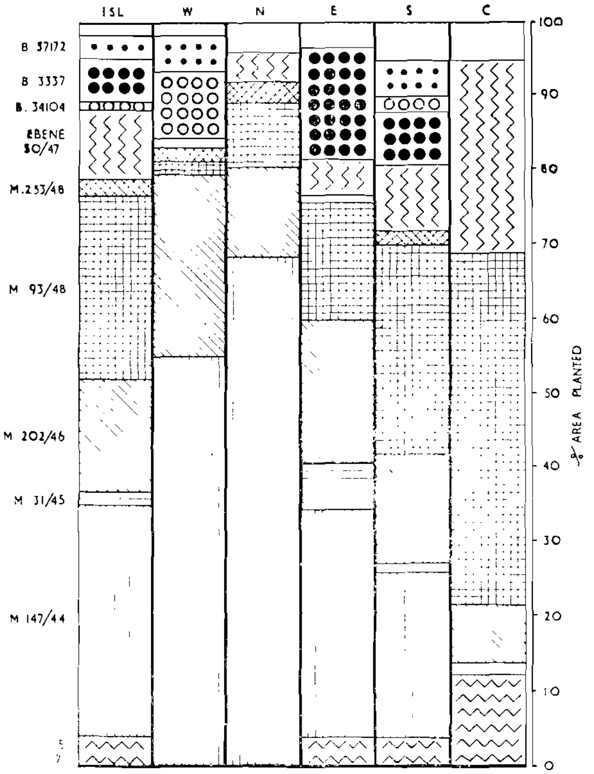

Fig. 8. Varietal composition of plantations made on estates in 1963.

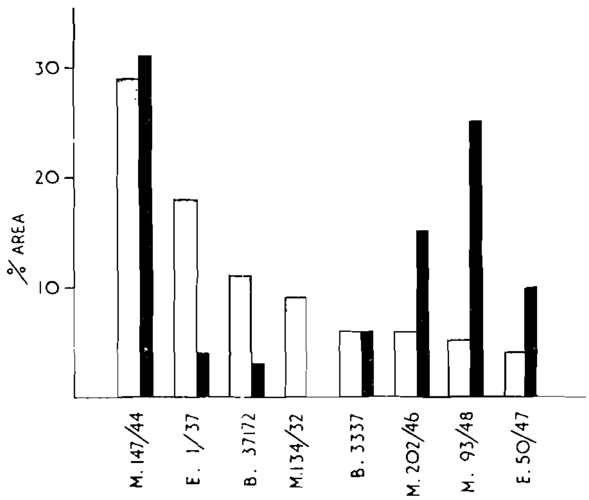

Fig. 9. Area cultivated (plain columns) and area planted (shaded columns) under different cane varieties on estates in 1963.

The present trend in varieties may be gauged in a better way by reference to the areas planted during the year (figs. 8 & 9). M. 147/44, M. 93/48, M. 202/46 and Ebène 50/47 were the four leading varieties, representing more than 80% of plantations made in 1963. As regards the distribution of varieties in different sectors, M. 147/44 was dominant in the West, North and East, followed by M. 202/46. In the South and Centre, M. 93/48 was the most popular variety, followed by M. 202/46 in the South, and by Ebène 50/47 in the Centre. The high resistance to cyclones of M. 147/44 and M. 93/48 is no doubt an important factor which has guided the choice of these varieties for new plantations in areas where they are well adapted. On the other hand, the highly desirable character of high sucrose shown by Ebène 50/47 and the many qualities exhibited by M. 202/46 have also been operating in giving these varieties high priority in spite of their susceptibility to high winds.

Yields of cane of the more important commercial varieties on all estates of the island (approximately 100,000 arpents harvested) are shown below and in fig. 10. Because the proportion of virgins to ratoons is high for varieties which were released during the last 4 years, data are presented in two groups :

	Tons cane per arpent Average all estates	Difference from mean in brackets
(*a*) Varieties released before 1959		
M. 147/44	35.8	(+0.7)
Ebène 1/37	34.8	(–0.3)
B. 37172	34.7	(–0.4)
M. 31/45	33.9	(–1.2)
B. 34104	33.2	(–1.9)
M.134/32	32.6	(–2.5)
B. 3337	30.8	(–4.3)
(*b*) Varieties released after 1959		
M. 253/48	42.5	(+7.4)
M. 202/46	39.7	(+4.6)
Ebène 50/47	39.2	(+4.1)
M. 93/48	37.1	(+2.0)
General weighted average	35.1	

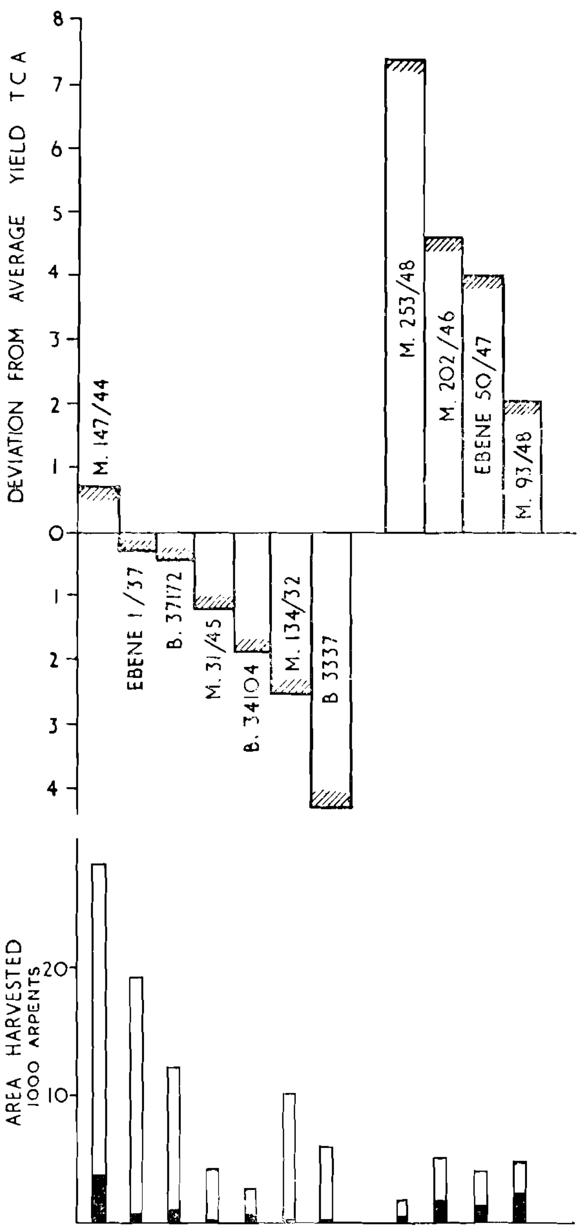

Fig. 10. Yield deviation of commercial cane varieties on estates in 1963. Varieties released after 1959 are shown on the right. Lower columns indicate area harvested, proportion in virgin canes shaded.

It should be pointed out that the high yields of M.253/48 were obtained on a relatively small harvested area (1500 arpents as opposed to approximately 4000 arpents for the other new varieties). M. 253/48 had also the distinction of producing the thickest stalk : 8.47 cms mean maximum diameter; this stalk came from La Gaieté, FUEL. In spite of its great vigour, it is improbable that the cultivation of M.253/48 will be extended much beyond its present limits because of inherent defects, such as low sucrose and veiy low fibre.

The individual record yield was scored by Ebène 50/47 at Highlands S.E. (Béga). A field of two arpents, 17 months old virgins harvested in September produced 11.88 tons of sugar per arpent (92.7 TCA, 12.82 recoverable sugar) equivalent to 1.65 tons sugar per hectare per month. In the stalk diameter 'competition', Ebène 50/47 came second, with a mean maximum diameter of 7.80 cms, Savannah S. E. (La Baraque.)

The results of 10 «final variety/fertilizer» trials including the 4 varieties M. 202/46, M. 93/48, M. 253/48 and Ebène 50/47 compared to M. 147/44 and Ebène 1/37, will now be briefly examined :

Data obtained in 1963 confirmed those of 1962 with regards to sucrose content, fibre, maturity behaviour and cyclone resistance. But, while in 1962 the results indicated the high rank of M. 147/44 and M. 93/48 because of their cyclone resistance, those of 1963 place the emphasis on the high sugar productivity of two other vaiieties, M. 202/46 and Ebène 50/47. Any general recommendation therefore must, to some extent, take these complementary results into account.

The following table based on two years observations* shows the major characteristics of these varieties; data are expressed as deviations fiom the general mean.

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* Individual data represent the average of 360 observations 10 trials, 6 replicates, 3 dates of harvest, 2 ratoons.

Variety	*IRSC**	*Fibre %**	*Tons profitable sucrose per Arpent†* Cyclone year 1962	Normal year 1963
M.147/44 ...	—0.65	+ 1.7	−0.17	—0.01
M.202/46 ...	−0.10	— 0.4	0.00	+0.11
M.93/48 ...	—0.25	+ 1.4	− 0.13	—0.08
M.253/48 ...	—0.75	— 1.6	—0.07	—0.03
Ebène 1/37 ...	−0.55	— 0.9	—0.15	—0.07
Ebène 50/47 ...	0.75	+ 0.3	—0.07	+0.05
General Average	11.6	12.1	1.74	2.28

Concerning maturity behaviour and cyclone resistance, sufficient data are now available to group the four new commercial varieties as follows :

	Maturity Behaviour	*Cyclone Resistance*
M.147/44	Early to mid-season	Highly resistant
Ebène 1/37	Early to mid-season	Very susceptible
M.202/46	Late	Susceptible
M.93/48	Mid-season to late	Highly resistant
M.253/48	Mid-season	Susceptible
Ebène 50/47	Early	Susceptible

Since environments which suit best the two standard varieties Ebène 1/37 and M. 147/44 are well established, it has been thought preferable to group the ten trials according to the relative behaviour of these two varieties. Three main environments may thus be distinguished :

(*a*) localities where M. 147/44 outyields Ebène 1/37 ;

(*b*) intermediate localities where the 2 standards perform equally well ;

(*c*) areas where Ebène 1/37 outyields M. 147/44.

The results grouped on the above basis are shown in fig. 11, which represents the average of three harvest dates.

In the M. 147/44 type areas, only the varieties Ebène 50/47 and M. 202/46 approached the standard.

In intermediate localities, all four varieties outyielded the two standards, in particular M. 202/46, M. 93/48 and Ebène 50/47.

Finally, in Ebène 1/37 areas, only M. 202/46 deserves some credit.

The ultimate recommendations concerning the choice of varieties, however, are to provide for each group of ecological conditions, varieties which are most productive at different periods of the crop. With this object in view and in the light of results discussed above, the following recommendations are proposed concerning the varieties M. 202/46, M. 93/48, M. 253/48 and Ebène 50/47. No mention is made in this table of other commercial varieties, the behaviour of which is already well known.

	M. 147/44 type areas 1st choice	Tentative choice	*Areas where M.147/44 & Ebène 1/37 are equally good* 1st choice	2nd choice	*Ebène 1/37 type areas* 1st choice	2nd choice
For Early Harvest	M.147/44	Ebène 50/47	Ebène 50/47		Ebène 1/37	
Middle Harvest	M.147/44	M.253/48	M.93/48	M.202/46	M.93/48	
Late Harvest		M.202/46	M.93/48	M.202/46	M.93/48	M.202/46

* Average of 360 observation. IRSC = Industrial recoverable sucrose % cane (0.9 x Sucrose % Cane) — 1.8.

† Average of 180 observations. Tons Profitable Sucrose per arpent = TCA x $\frac{(IRSC - 4)}{100}$

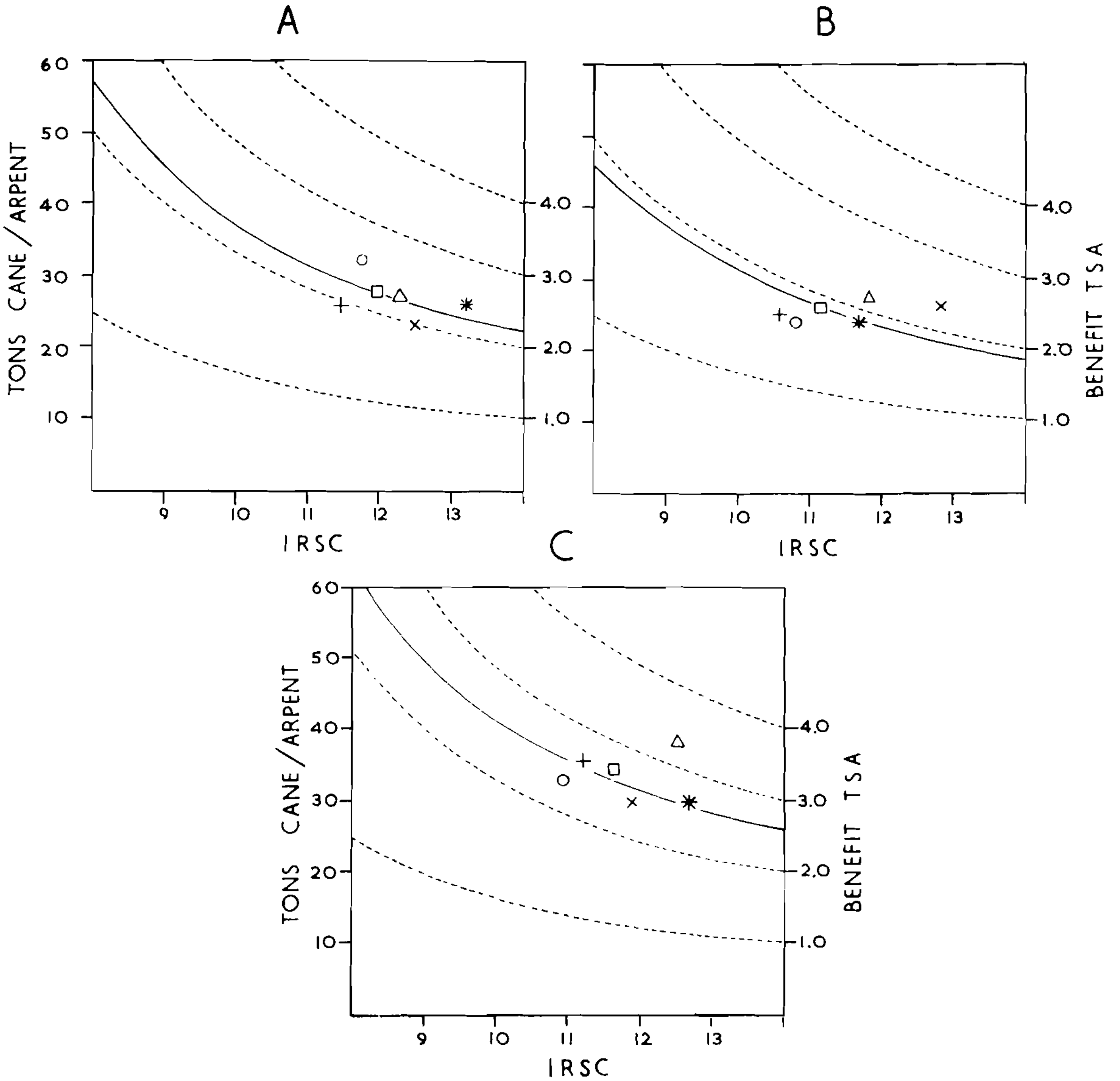

Fig. 11. Benefit curves at levels of 1.0 to 4.0 tons of commercial sugar per arpent with corresponding yields of six varieties A. M 147/44 type localities ; B. Ebène 1/37 type localities ; C. Areas where M 147/44 and Ebène 1/37 perform equally well.
O = M 147/44 ; Δ = M 202/46 □ = M 93/48 ; + M 253/48 ; × = Ebène 1/37 ; ∗ = Ebène 50/47.

The characteristics and performance of new unreleased varieties are discussed in full elsewhere in this report. Mention should be made here, however, of the variety M442/51 derived from the cross B 37172 × M213/40 made at Réduit in 1951. The possible release of this variety for commercial cultivation is, at the time of writing, under consideration by the Cane Release Committee which as also been provided with data concerning six other promising canes.

M. 442/51 is a vigorous, erect variety with yellowish stalks of thin to medium size. Its qualities include : vigour, good ratooning, easy trashing, high resistance to cyclones. On the debit side, it has a low sucrose content and is very highly susceptible to chlorotic streak. M. 442/51 is typically a late maturing variety, as exhibited by the following data based on the result of 3 trials, 2 of which were harvested in virgins & 1st ratoons, and one in virgins, 1st and 2nd ratoons.

	Early harvest	Mid harvest	Late harvest
		I.R.S.C.	
M.147/44	9.4	10.8	9.7
M.442/51	8.6	10.4	10.8
	Tons profitable sucrose per arpent		
M.147/44	2.22	2.88	2.27
M.442/51	1.89	3.11	2.56

From experimental results it would appear that M.442/51 has a useful role to play as a substitute for M.147/44 in areas suited for that variety, provided it is harvested not earlier than beginning of September, and this feature cannot be too strongly emphasized.

CANE BREEDING AND SELECTION

Another year of profuse arrowing made it possible to complete a wide crossing programme. Over 1000 crosses were made, the majority being accomplished at Réduit S.E.S.

About 200 parent varieties were used in different combinations. Especially interesting results were obtained in the cubicles of the new greenhouse constructed in 1962 and used throughout the crossing season. Nearly 300 arrows were pollinated in these cubicles in area crosses employing the acid solution technique which was used with much greater success than in the past.

Ripe fuzz was dried and stored in a deep freezer to be sown three to four months later. Some seed which had been kept in the deep freezer since 1962 was found to germinate very well when sown at the end of the year.

A total of 847 crosses were sown : 323 did not germinate at all, and a further 282 were discarded on account of poor germination. The 242 crosses which were retained gave an estimated number of 90,000 seedlings. Once again a proportion of fuzz (239 crosses) is being stored for sowing next year in case the crossing season is not so favourable.

Potting started towards the end of the year and the seedlings will be planted in the field in February/March 1964.

Experimental work concerned with inheritance of parental characters and with the efficiency of selection techniques continued. Some evidence was obtained on the nature of com petition in singly planted stools, while in other investigations, selection for adaptation was studied.

Physiological constants were estimated for several parental clones and their progenies to see if these characters could be of use in selection. Results so far suggest that selection on the physiological basis of these characters would not be more reliable than selection by current techniques.

The number of seedlings and varieties now in course of selection is given below :

(i)	Seedlings from 1962 crosses planted in 1963	87,200*
(ii)	1960–1961 series Varieties in bunch selection plots	9,066
(iii)	1959–1961 series Varieties in propagation plots to be selected in 1st Ratoons in 1964	2,046**
(iv)	1956-1959 series Varieties in 1st selection trials	422***

* Of which about 13% planted singly, the remainder in bunch.

** 1800 of these varieties are represented in two environments : four selection stations in the humid, and four in the super-humid zone.

*** 65 varieties represented in two climatic areas.

Plate 1.

Left : 11 months old 1st Ratoon M. 147/44, Belle Vue (Mon Rocher), 45.8 tons cane per arpent. *Right :* 16 months old Virgin M. 202/46, F.U.E.L., 78.1 tons per arpent.

Plate 2. 16 months old Virgin M. 93/48, F.U.E.L., 75.0 tons cane per arpent.

(v) 1953–1958 series
Varieties in multiplication plots for establishing field trials in 1964 — 40

(vi) Varieties in variety and pre-release fields trials

1946-1957 series	102	
Ebène varieties	9	
Foreign varieties	6	
	——	117

Of the latter group, the following varieties may have a commercial future : M.39/49, 409/51, 442/51, 658/51, 13/53, 361/53 and Ebène 88/56. Their characteristics are described in another section of this report.

The valuable assistance of Mon Désert-Alma S.E. was obtained in establishing a sub-station on that estate for selection purposes. An area of 25 arpents is to be utilized by stages over the coming years. This station is more conveniently situated than that of Britannia which it will replace.

The propagation plot established in 1962 through the kind co-operation of Médine S.E. produced an abundance of planting material of new varieties for establishing 25 trials on estates. It will be recalled that each variety is now represented in four environments. The design of these trials has also been modified to accommodate a larger number of varieties. This new procedure will greatly assist in obtaining more reliable information in less time. 38 selections were planted during the year in another propagation plot at Médine for use in 1964.

NUTRITION AND SOILS

Before we discuss briefly the various aspects of cane nutrition, it is useful to consider the 10-year trend in fertilizer consumption by the sugar industry of Mauritius. This is shown in fig. 12, in which the amounts of NPK used per arpent are indicated.

Since 1954 nitrogen has increased by 12 kilos, and is now used at the average rate of 39 kilos per arpent. Phosphorus has passed from 5 kilos to 23 kilos per arpent, while the use of potassium has increased by 10 kilos to reach 26 kilos per arpent.

Nitrogen. The interaction of varieties and nitrogen fertilization was mentioned for the first time in these reports in 1957, while attention has been repeatedly drawn to the importance of eliminating phosphate and potash deficiencies in order that the full effect of nitrogen may be translated in increased sugar production per unit area.

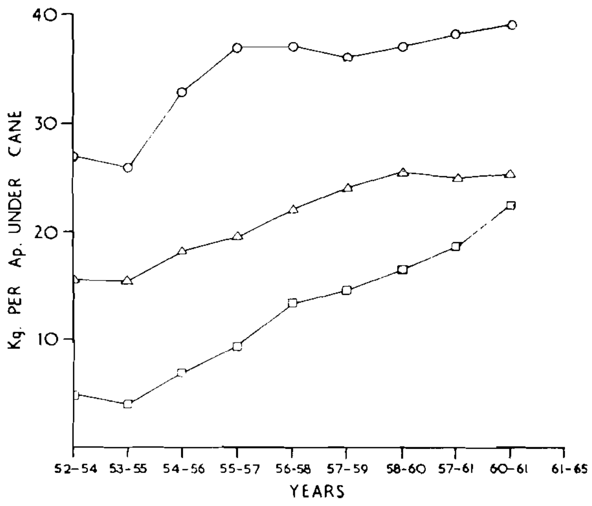

Fig 12. Fertilizer trend, 1952-1963. Circles : N ; triangles K ; squares : P.

Concerning the first question, further evidence was obtained in 1963 that cane varieties may be classified as nitrogen-tolerant or intolerant. In the first group, increasing nitrogen dressings do not lower the sucrose content. Consequently, the nutritive effect of nitrogen, which results in increased leaf and stalk production, is fully recovered at harvest in terms of sucrose. Fig. 13, based on data obtained in «final variety/fertilizer» trials, shows clearly the superior potential of M.202/46 and Ebène 50/47, in so far as nitrogen is concerned. The effect of different levels of nitrogen on sucrose content of these varieties is given below :

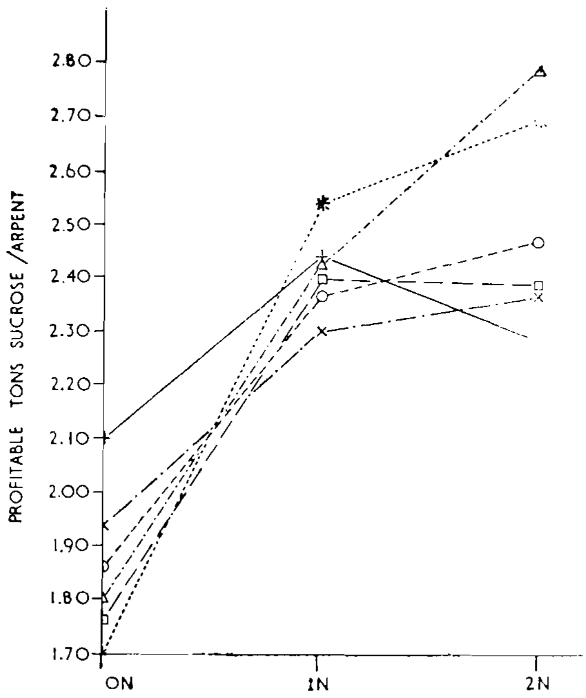

Fig. 13. Varietal response to nitrogen. O = M 147/44 ; Δ = M 202/46 ; □ = M 93/48 ; ⊥ M 253/48 ; × = Ebène 1/37 ; * = Ebène 50/47.

	I R S C		
	0 N	*1 N*	*2 N*
M. 202/46	12.05	12.10	12.14
Ebène 50/47	12.53	12.90	12.84
M.147/44	11.53	11.42	11.18
Ebène 1/37	12.71	12.19	12.34
M. 93/48	11.73	11.78	11.35
M. 253/48	11.40	11.40	10.95

The often heard slogan «high nitrogen-low sucrose» must therefore be restricted to «nitrogen-susceptible» varieties, until it becomes completely obsolete through the exclusive cultivation of nitrogen-tolerant varieties.

It follows that with the extension of such varieties, and with the gradual elimination of phosphate and potash deficiencies, nitrogen fertilization will tend to increase. It is therefore important to have full information on the effect of form, placement, and time of application on the efficiency of nitrogenous fertilization.

Studies on nitrification and the movement of nitrate in the soil have continued, and field trials to study the effect of form and placement are in progress. The results obtained so far have demonstrated the extreme mobility of nitrate and the rapidity of the nitrification process under conditions prevailing in Mauritius. On this basis, it appears that nitrate-containing fertilizers cannot be considered as having special merits.

The biggest breakthrough in nitrogen fertilization may be the recent discovery of chemicals which impede nitrification. Field trials with a proprietary compound which shows promise in this way were laid down during the year, laboratory studies having demonstrated that the material does, in fact, inhibit nitrification in our soils.

Phosphate. A review is made in this report of all experimental data obtained locally on phosphatic fertilization. The sugar industry of Mauritius is now very «phosphate-conscious», and imports have increased more than fourfold in recent years. There has also been a marked diversification in the types of phosphate imported : soluble phosphates which were hardly used in 1954 now form an important part of estate supplies and are used as supplements to the basic rock phosphate fertilization. On estates with high soil pHs the soluble forms of phosphate have replaced rock phosphates completely.

On a field scale, phosphate applied to ratoons has given good results in terms of cane yield, but it is important that this treatment should be used only in lands known to be deficient in phosphate.

Potash. Although the use of muriate of potash has been normal practice for many years, the guidance offered by the Institute concerning the level of potassic fertilization is not always followed. This state of affairs was reflected in the results of foliar diagnosis which are discussed below.

The effect of possible leaching losses of potassium has often been stressed, and estates in the super-humid zone generally have applied levels of potash sufficient to ensure that no deficiency occurred in their plantations. In the drier areas of Mauritius, however, some estates have quite unwarrantedly retrenched on these potash applications with resulting deterioration of the potash status of their cane lands. This is a particularly unfortunate trend as potash is known to improve the drought resistance of crops.

It should be stressed that only in the presence of absolute proof of excessive fertility build-up can a marked reduction in potash applications be made, and even then, the principle of returning to the soil that which is taken from it becomes operative. With the large amounts of potash removed with the cane, potash application should always be far heavier than the twenty kilogrammes of muriate per arpent which were applied to some cane lands in 1963.

Foliar Diagnosis. The «permanent sampling units» referred to in the 1962 Annual Report were used in 1963 for obtaining leaf samples for foliar diagnosis. 816 such units were selected, and sampling was carried out twice during the grand period of growth. This project is a «follow-up» procedure which will disclose, by means of three-year averages, the trend of NPK nutritional status, thus constituting a permanent check on current fertilizer practice.

It would be dangerous to use the single set of results obtained in 1963 for general recommendations. It is possible, however, to interpret these data on a sector basis in order to evaluate the potential loss of sugar production due to phosphorus and potassium deficiencies. The results are expressed graphically in fig. 14, and indicate, contrary to the belief held in some quarters, that the present nutritional P & K status of sugar plantation is less favourable in the drier west and north sectors of the island than in the wetter east, south, and central sectors.

Calcium, Magnesium and Trace Elements. With the heavy dressings of nitrogenous fertilizers now being used, the soils of Mauritius are being slowly acidified. The principal effect of this acidification is a loss of soil calcium, but secondary effects such as an increase in soluble manganese or aluminum may be deleterious to cane growth.

Although the rate of acidification in the tropics is not apparently as intense as it is under temperate conditions, this is a factor to be carefully watched, as the pH in the cane line of old ratoons can fall by almost one pH unit below the pH level of the soil in the interlines.

Because of this increasing acidity, a study has been made of the calcium and magnesium status of cane growing over the whole range of soil and climatic conditions occurring in Mauritius.

The results are presented in detail in this report and show that calcium and magnesium levels are generally satisfactory.

A study was also made of the manganese and silica levels of the 3 - 6 sheaths collected on 153 permanent sampling units for foliar diagnosis. This investigation indicates wide variation in both silica and manganese content, from about 1% S_1O_2 in canes growing on ferruginous humic latosols, which are almost senile, to about 5% in sheaths of canes growing on gravelly soils of the sub-humid zone. The manganese content of the leaf sheaths varies from 5 ppm on coral sand (a figure suggestive of deficiency) to 300 ppm on strongly acid soils, in which cases manganese toxicity may be suspected.

The ratio of manganese to silica contained in the leaf sheath may prove to be a valuable criterion concerning the occurrence of manganese toxicity and this is being studied in conjunction with liming and basalt incorporation.

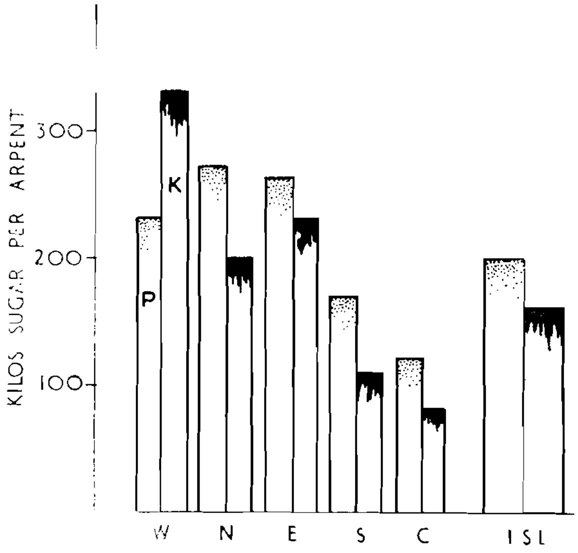

Fig. 14. Potential loss of sugar per arpent in different sectors due to deficiencies of phosphorus and potassium.

The best soils of the island for sugar cane growing contain between 50 and 75 ppm of manganese in the leaf sheath.

During the year the molybdenum spray trials laid down in 1962 were harvested, but although there was a slight indication of response in the vegetative stage, yields of cane and sugar were not affected.

Field trials with copper, zinc and molybdenum singly, or in combination, were laid down during the year, and the results as they become available will show if any danger of trace element deficiency exists on our cane lands.

Soil Analyses. In 1963, sixteen estates sent their chemists to work in the Chemistry laboratory. Some eleven hundred soil samples were analysed for available phosphate and pH.

We are now approaching the stage when the available phosphate and soil pH of most estate areas is known, and this information is proving of great assistance to cane growers in rationalizing their fertilizer programmes.

With the increasing interest in soil acidity, it is essential that all estates with lands in the super-humid zone should have full information on the soil pH in these areas.

CANE DISEASES

The absence of cyclonic conditions and environmental factors which were on the whole favourable to cane growth, have been conducive to an uneventful year from the pathological angle. The two major bacterial diseases, gummosis and leaf scald, although still present in the two collections of old varieties, have disappeared from commercial plantations through a severe screening of promising seedlings and imported canes before their release for cultivation. Red rot and smut have assumed minor importance through the cultivation of resistant varieties. Chlorotic streak and ratoon stunting, however, continue to be the two important pathological problems with which the sugar industry has to contend.

Preserved material of galled sugar cane leaves received from Réunion Island and Southern Rhodesia revealed, upon examination, a histological structure similar to the one observed in material affected by «Pseudo-Fiji» in Madagascar. Such galls were present on the same varieties in Mauritius.

Several cases of inflorescence rot were observed in a field of Ebène 50/47. Examination revealed the presence of a species of *Cephalosporium*.

Ratoon Stunting Disease. Results in the ratoon stunting trial were obtained at Pamplemousses in fifth ratoons. The average reduction in yield for virgins, first, third, fourth and fifth ratoons varied from 8% in Ebène 1/37 to 19% in M. 147/44. In a country where a high number of ratoons are taken, and where the occurrence of a violent cyclone in any one year may render experimental results totally unreliable, the assessment of varietal reaction should be decided after obtaining data over several years. Of the varieties released after 1959, results obtained in other trials indicate that M. 253/48 is the least susceptible. Ebène 50/47 showed an average reduction in yield of 11% in virgins and first ratoons; M. 202/46 and M. 93/48 are of about the same order of susceptibility. So far three varieties, M. 253/48, Ebène 1/37 and B. 34104, have reacted as moderately susceptible to the disease. M.147/44, formerly rated as moderately susceptible, has alarmingly shown the highest reduction in yield in two trials this year.

Experiments were conducted in co-operation with the Manager of the Central Nursery on the effect of the time of treatment at 50°C on the germination of treated cuttings. After temperature equilibrium in the bath, the following times of treatment were given : 2, 2¼, 2½, 2¾ and 3 hours. An increase by 15 and 30 minutes of the normal treatment time of 2 hours results in a drop of 50% in germination of treated setts, and an increase by 45 and 60 minutes led to a 75% reduction. The installation of an automatic device for controlling the time of treatment of cuttings at the Central Treatment Plant is under study. With such a device, the operation of the treatment tanks would be under complete automatic control.

Chlorotic Streak. As evidence on soil transmission of chlorotic streak is building up, more attention is being paid to the production of resistant varieties In a resistance trial conducted in the super-humid zone, the eight commercial canes contracted infection within a year. In fact, all varieties cultivated in Mauritius, when grown under conditions favourable to the disease, are susceptible. In a trial at Union Park, out of 124 varieties subjected to natural infection, 33 had not developed symptoms before harvest. After ratooning, that number was reduced to only 14. Of these, one is known to be susceptible, and another variety showed symptoms when planted out. In another trial at Belle Rive, out of 33 varieties, 9 were symptomless before, and only 3 after ratooning. The varieties which failed to show symptoms were left under observation, and in addition have been planted in larger plots.

Several hot-water treatment installations were inspected during the year, and temperature determinations made by means of needle thermocouples inside the cuttings during treatment. On one estate where a high incidence of chlorotic streak in treated cane had been seen, it was observed that the required treatment temperature for the inactivation of the virus was not reached inside the cuttings.

The area planted with treated cuttings amounted to 4,760 arpents or 38.7% of the total area planted.

Leaf Scald. The new method of inoculation has led to a high level of infection in the resistance trial. The varieties under test were flanked by inoculated susceptible canes, and in each varietal plot of four rows of 20 feet, the two middle rows were inoculated, and the outer rows left to natural contamination. All varieties under test, except M. 147/44, a variety highly susceptible in Réunion, contracted infection through inoculation. However, only the susceptible controls became naturally infected. A trial including the promising seedlings and imported canes has been established at Belle Rive.

Gumming disease. Forty-two seedling canes under selection were included in the gumming trial for routine assessment of their reaction. Studies on the natural infection of sugar cane and *Thysanolaena* by gummosis, which were initiated after the identification of two strains of the gumming disease pathogen in the sugar cane and *Thysanolaena*, are being continued.

Pineapple disease. Seven fungicides were compared to the standard organo-mercurial preparation in the control of pineapple disease. Although infection was, on the whole, fairly low in the trial, four fungicides as well as the standard significantly controlled the disease.

Reactions of seedling canes to major diseases. The whole procedure used in testing the disease reaction of seedlings has been streamlined (fig. 28). Resistance trials for gummosis and leaf scald, the two diseases which lead to unconditional discard of susceptible seedlings, are conducted early during selection; gummosis, on selected varieties from first selection trials, and leaf scald a year later. A preliminary chlorotic streak trial is conducted at the same time as the leaf scald trial. Two years later, seedlings selected in first ratoons from the variety trials in four environments are included in a chlorotic streak trial, and additional cuttings are subjected to the long hot-water treatment and planted at the central nursery for inclusion, the following year, in two ratoon stunting trials, one in the super-humid and the other in the sub-humid zone. Assessment of the varietal reaction to other diseases, chiefly red rot and smut, will be conducted as in the past, during inspection of the various selection trials in different localities.

Control of Ratoon Stunting disease. The central hot-water treatment plant treated 510 tons of cuttings against ratoon stunting for the central nursery. In addition 2,500 tons of planting material were given the short hot-water treatment (50°C for 30 minutes) against chlorotic streak.

Plantations made on estates with healthy material derived from their A nurseries, established with cuttings treated at the central treatment plant in 1962, amounted to 962 arpents or only 7.8% of the total area planted. However, B nurseries established in 1963 on individual estates with cuttings obtained from the central nursery covered a total of 610 arpents. This should plant 6,000 arpents, or 50% of the area of regular plantations in 1964. Such an area represented, in 1963, 11.6% of the total area under cane on estates.

The Central Nursery supplied nearly 2,000 tons of cuttings to estates. In 1963, the total area under A nurseries amounted to 150 arpents. This should supply sufficient planting material to establish at least 1500 arpents of B nurseries on estates in 1964. Such an area would be adequate to meet the total planting requirements of estates the following year, and to provide the agreed supply of cuttings to small planters in the various factory areas.

Fiji disease in Madagascar. The Pathologist visited the East coast of Madagascar in March and was able to assess the progress made in the eradication of Fiji disease. The replacement of susceptible canes by resistant varieties, mainly Pindar, has been carried out in the commercial plantations, and it is expected to complete the eradication campaign in the innumerable scattered village plantations in the whole province by the end of the year. In 1964, the roguing gangs will be concerned mainly with the control of volunteer stools.

The control measures adopted by the Malagasy Government to prevent the entry of sugar cane into the port area of Tamatave, to control the sale of cane for chewing in the markets of the town, and to replace susceptible canes by resistant varieties in the vicinity of Tamatave, continued to operate satisfactorily during the year.

In the resistance trial at Brickaville, M.202/46 has shown resistance to the disease so far. The variety is, however, highly susceptible to the strain of the leaf scald pathogen present in Madagascar.

CANE PESTS

As mentioned in the preceding report, unusual attacks of the Red Locust (*Nomadacris septemfasciata* Serv.) occurred in December, 1962. The attacks were the result of high populations of the young stages, or hoppers, and they continued to be reported throughout January and into February of the year under review when development to the adult stage was completed. Badly attacked fields were restricted to more or less limited areas in the North, East, and Centre of the island, and immediate treatment with insecticides was required to suppress the outbreaks and prevent intensification and extension of cane damage. A total of about 850 arpents of cane were treated, being either sprayed or dusted with Aldrin. Though often hindered by the height and density of the vegetation, insecticide application was generally effective and all serious attacks were suppressed. As a consequence of these high hopper populations, (reproduction occurs only during the hot season), adult locusts were extraordinarily abundant in some regions from March onwards, and though they themselves caused no appreciable damage, threatened to give rise to more serious hopper outbreaks when breeding commenced at the end of the year. Fortunately, such new outbreaks did not materialize in December, probably owing to the abnormally dry conditions prevailing in that month which adversely affected development of the eggs in the soil.

The red locust, always present in cane fields to some extent, is normally innocuous and seen only as odd individuals. During the recent outbreaks, many of the phenomena associated with swarming of locusts, such as changes of body colour and gregarious behaviour, were observed and they are of considerable biological interest. The reason for this increased activity of the red locust is not known. While it may be a result of weather factors favourable to the insect, it is interesting to recall that locusts appear to have been the first entomological problem that confronted the agriculturalist in Mauritius and that the «Martin» or Indian Minah Bird (*Acridotheres tristis*) was purposely introduced in 1763 as a predator. It has been considered that the introduction of this bird reduced the locust problem to negligible proportions, and the recent outbreaks of locusts may perhaps be attributable to the effect of the successive cyclones of 1960, 1961, and 1962, on the bird population.

The army worm (*Leucania loreyi* Dup.) was again troublesome in many fields of young ratoon cane. As previously described (*Ann. Rep. Sug. Ind. Res. Inst. Mauritius*, 1961 : 62), the adults of this insect congregate in fields which are burnt at harvest, presumably because the smell of fermenting matter attracts them, and the eggs they then deposit give rise to very large numbers of caterpillars. The new ratoon shoots may consequently suffer almost complete defoliation about four weeks later, but thereafter, when the caterpillars transform to moths, the shoots usually recover quickly because the moths disperse and further defoliation is negligible. Experiments to determine the effect of defoliation on ratoon canes have now shown that removal of leaf blades 4-6 weeks after previous harvest may cause an appreciable loss of yield, amounting to several tons of cane per arpent, despite the rapidity with which shoots recover their foliage. When fields are burnt at harvest, it is therefore advisable to inspect them closely about two weeks later and to apply insecticide immediately if army worms are detected.

Studies on the sugar cane scale insect, (*Aulacaspis tegalensis* Zehnt.) and on the stalk moth borer (*Proceras sacchariphagus* Boj.) were continued. In the continuing search for parasites which will attack the latter, *Trichospilus diatraeae* C. & M. was imported from India and several thousands reared in the laboratory for release in the field. Other parasites received from India, *Stenobracon deesae* Cam. and *S. nicevillei* Bingh., were also released.

It was not possible during the year to arrange further importations of *Diatraeophaga striatalis* Sn. from Indonesia for trial against *Proceras*, but this project is still given high priority and close contact is maintained with the Director of the Commonwealth Bureau of Biological Control.

The appearance in Mauritius of the notorious rhinoceros beetle, *Oryctes rhinoceros* (L.), cannot be passed without mention. This insect, a major pest of coconut, was found during the year by Government officers to be so well established in the Baie du Tombeau region that no hope of eradication existed. The beetle is recorded elsewhere to occasionally feed upon sugar cane stalks and it may well do so under local conditions. However, it is not considered that the presence of this new pest constitutes any danger to cane plantations.

CANE GERMINATION

Studies on the effect of different growth substances on the germination of M.93/48, using three types of cuttings – top, middle, and bottom – were continued. Gibberellic acid, arginine and sodium nitrate were tested at concentrations varying from 1 p.p.m. to 260 p.p.m. Single-eyed cuttings, 3 ins. in length and pre-treated at 52 C for 20 minutes, were used and immersed for 20 minutes in respective solutions of the growth substances.

From the data obtained, it was established that :

(i) The three chemicals did not improve the germination of bottom cuttings throughout the concentration range used.

(ii) Gibberellic acid promoted germination of top and middle cuttings at concentrations up to 50 p.p.m., but exercised an inhibitory effect above that concentration.

(iii) Arginine and sodium nitrate behaved in a similar manner in stimulating the germination of top and middle cuttings at all concentrations used (16 p.p.m. N to 64 p.p.m. N).

Experiments were also carried out on the germination of M.93/48 at two seasons of the year, May-June and August. The germination of the three types of cuttings, – top, middle, bottom – was compared to that obtained from a mixture of the three categories, which is the usual practice on sugar estates. The cuttings were derived from stalks of different physiological age (10-13 months) and were subjected to the short hot-water treatment before planting. Germination counts were recorded six and twelve weeks after planting, respectively.

From the results obtained, it was concluded that physiological age had a marked effect on germination, cuttings derived from the youngest stalks giving the highest germination counts. In general, top cuttings germinated better than middle and bottom cuttings, particularly in the hot-water treated series.

WEED CONTROL

Ten trials were laid down in 1963 to compare the effectiveness of substituted ureas versus substituted triazines in the super-humid zone. DCMU, CMU, Simazine and Atrazine were applied before cane emergence at rates of 3-4 lb active material per arpent. Weed surveys carried out 3 months after herbicide application showed that at equivalent dosages DCMU gave consistently better results than CMU and the two substituted triazines Simazine and Atrazine.

Combination of various herbicide mixtures consisting of Urox, Lorox, Fenac or CMU with Sodium Chlorate; Simazine, Atrazine or Atratone with Pesco 18/15, were compared to Pesco 18/15, to DCMU with Sodium Chlorate, and to DCMU with a low volatile ester of 2,4-D. The results obtained showed that in the high rainfall areas, Pesco 18/15 used alone gave very poor results. The mixture DCMU-sodium chlorate proved more effective than the mixture DCMU-ester. Of the combinations Simazine, Atrazine or Atratone with Pesco 18/15, the Atrazine combination proved the more effective, particularly in trials laid down in the humid areas.

Studies on the effects of DCMU on germination and early growth of the following commercial varieties M. 147/44, M. 202/46, M. 93/48, M. 253/48, Ebène 1/37, Ebène 50/47, B.3337, B. 34104 and B. 37172, were carried out. DCMU at rates of 3,4,5 and 6 lb active material was applied a week after planting. Visual observations were made at fortnightly intervals and cane measurements were recorded three months later. From the data obtained, it was established that DCMU, at rates of application used, produced no adverse effects on the germination and early growth of these varieties.

A series of 10 trials were conducted on the effect of Dalapon, Paraquat, and Fenac, on yield of cane and sugar. The herbicides were applied in first ratoons from one week to one month after harvest on the following varieties: Ebène 1/37, Ebène 50/47, M. 147/44, M.93/48 and B. 37172. From the results obtained, it was found that Dalapon at rates varying from 4-16 lb. per arpent affected cane yield in all the varieties except Ebène 1/37. Decrease in sugar content was observed in two varieties : Ebène 50/47 and B.37172, but only at the higher rates of application. Paraquat produced a scorching effect on young cane shoots with few malformations, but no adverse effect on yield of cane and sugar was registered. Fenac applied at rates of 2-3 lb active material per arpent affected cane yield in one experiment out of four, but had in general no adverse effect on sugar content. There are indications, however, that at 3 lb per arpent it might prove toxic to cane growth.

Substituted Uracils. Hyvar isocil and Hyvar X bromacil were again tested in 1963 The herbicides were logged-sprayed at rates varying from 5.0 to 0.7 lb active ingredient per acre a week after planting and before weed emergence. The two chemicals affected cane growth at all rates above 0.8 lb. Excellent weed control was obtained throughout the concentration range used, and of the two Uracils, Hyvar X bromacil was the better. Experiments on the effect of these herbicides on cane and sugar yields in first ratoon crop are in progress. Exploratory work on the use of these two chemicals in combination with DCMU has given very promising results.

Tordon, a derivative of picolinic acid, proved slightly less effective than DCMU at equivalent dosages but proved toxic to cane growth at all concentrations used (5.0 — 0.7 lb).

Cotoran was comparatively less effective than DCMU and had no adverse effects on cane growth.

The two substituted triazines Ametryne and Prometryne gave very similar results but proved, in general, to be less effective than DCMU.

IRRIGATION

A survey of cane areas under irrigation was carried out during the year and revealed the following salient features. A total of 28500 arpents is irrigated at present, of which 70% by furrow and 30% by overhead. Of the latter type, three main systems are used : high pressure water distribution (100 lbs/sq. in) over a very small area; medium pressure sprayers (70 lbs/sq. in.) over 8000 arpents, water being delivered either by rainers placed at 120 feet intervals (48%), or by mobile «booms» (47%); low pressure water distribution (20 lbs/sq. in), used under special circumstances, the total area irrigated by such system being approximately 500 arpents.

Cane growers are becoming increasingly conscious of the value of complementary irrigation, and the advice of the Institute was sought on several occasions for the installation of irrigation systems. There is no doubt that better utilization of our water resources, both surface and underground, would result in a significant increase in the island's sugar production.

In view of the interest shown in the development of irrigation, it is important that the M.S.I.R.I. should obtain as much information as possible on the fundamental, as well as the economic aspects of irrigation. Much data are already available on the water requirements of various soil types for different climatic conditions, as well as on effect on yields, and relative costs of different systems. A comprehensive experiment, however, was initiated in 1963 at Médine S.E. (Palmyre), on the same experimental site which had been used since 1957. The installation of six lysimeters was completed to study the consumptive use of water in relation to soil and climatic factors. The recording of data began in June 1963, and will continue for a planned period of three years. The variety used is M. 147/44, and the soil types include low humic latosols (Richelieu and Réduit families), and latosolic reddish prairie (Médine family).

In an endeavour to evaluate irrigation practice by physiological tests, a large number of samples were gathered from six of the «final variety/fertilizer» trials in order to study the moisture status of the plant, as revealed by the humidity of the 4-5 joints, in relation to growth. These data, which are reviewed in detail elsewhere, showed that :

(i) Moisture content of the 4-5 joints was the same for two varieties tested and was not affected by fertilizers during the grand period of growth.

(ii) Young ratoons showed a slightly higher moisture content in the joints than older ones.

(iii) A highly significant correlation was found between 4-5 joints moisture and spindle elongation during the summer months. The range of moisture content in relation to elongation varied from 91%, 10 cms. elongation per week, to 85%, no elongation.

The testing of moisture content of the 4-5 joints probably constitutes one of the soundest physiological clues to the evaluation of irrigation practice, starting when the canes are three months old (virgins or ratoons), and ending six to eight weeks before harvest.

CLIMATIC MAP

In an effort to improve our understanding of the various ecological conditions which obtain in Mauritius, more specially for areas devoted to sugar cane cultivation as well as for experimentation, the Institute is planning the publication of a detailed climatic map and has, in this connection, obtained the full co-operation of the Director of the Meteorological Services.

The world-wide system of classification of climates elaborated in 1948 by Thornthwaite is followed, and the scale of the map will be the same as that chosen for the soil map already available at the Institute (1 in 100,000).

Two sets of basic data are needed for arriving at the symbols used in the final classification : accurate records of air temperature and of rainfall, both on a monthly basis, for a large number of well distributed stations.

The more difficult problem of air temperature has been solved satisfactorily by comparing observations made in recent years at contrasted heights and exposures, on four reliable stations on the windward side of the island, and on four others on the leeward side. The fall of temperature per 100 metres elevation has been calculated for each month and for each exposure, windward, leeward, and transition.

Six months winter rainfall (May to October) expressed as a percentage of the annual value has been found to be of considerable help in judging exposure correctly.

Graphs have been drawn to find out monthly potential evapotranspiration according to Thornthwaite's formula, expressed in millimetres of water as a function of temperature, i.e. of height and exposure.

On the other hand, monthly rainfall data have been brought up to date by the Meteorological Services for the 221 selected stations, covering the 30-year period, 1930 - 1959.

Starting for the monthly potential evaporation values computed from air temperature for the various stations selected, and from the monthly rainfall observed, and assuming a standard available water capacity of 75mm for the soils of the island, the water balance can be calculated, giving the magnitude of the water deficits and excesses for each month of the year on an average. This water balance sheet allows for the computation of the special indices required for the classification of climates.

Four groups of thermal efficiency, and seven groups of moisture efficiency have been observed on the island. They give rise locally to some fifteen types of climate which will be represented on the climate map of Mauritius.

Apart from the classification and mapping described above, a special study will be made on the drier climates. Water balance will be computed separately for each of the thirty years, and the sixth moisture deficit from the highest one observed will serve as a measure of the peak water requirement for a normal period of five years. Such information will be of great value for the rational planning of irrigation schemes.

FIELD EXPERIMENTATION

A full programme of field experiments was carried out during the year, concerning variety testing, fertilisation and amendments, cultural operations, resistance to pests and diseases, irrigation, potentialities and phytotoxicity of herbicides. In addition to experiments on stations, 150 field trials were harvested, and 92 planted for future observations on estate land. Grateful acknowledgment is made to the managers of sugar estates for the facilities granted to carry out this programme of field experimentation.

Five series of trials on cultural operations will be mentioned specifically in this section. They include spacing between rows; ridge versus furrow planting in relation to environment; earthing up and cultivation of interlines; trashing at different dates; and finally selective harvesting. It should be pointed out that valid results from experiments on cultural practice are probably amongst the most difficult to obtain, not only because of the interaction of many factors, but also because differences in yields between comparative treatments may be smaller than the experimental error. By pursuing these experiments over a long period of time, however, it might be possible to obtain reliable information which will prove or disprove the validity of several agricultural practices which are peculiar to cane agriculture in Mauritius.

Field experiments standing for the 1964 harvest, but excluding many trials in which weights are not recorded, are summarised below.

Variety :

(i)	First Selection trials ...	... 22
(ii)	Variety trials ...	... 60
(iii)	Final variety/fertilizer trials	... 10
(iv)	Ratooning capacity ...	... 2

Cultivation :

(i)	Ridge versus furrow planting ...	4
(ii)	Spacing of cane rows ...	10
(iii)	Clean versus selective harvesting ...	14
(iv)	Interline cultivation	10

Fertilization and amendments :

(i)	Nitrogen	14
(ii)	Phosphate	9
(iii)	Calcium and magnesium ...	4
(iv)	Organic matter	9
(v)	Basalt	6

Diseases	4
Pests	9
Effect of herbicides on yields	10

SUGAR MANUFACTURE

The main research projects studied during the year were :

(*a*) **Juice Preservation in Clarifiers during shut-downs**. A survey made during the inter-crop having shown that the purity drop in clarifiers during week-end shut-downs amounted, on the average, to several degrees in most factories, it was decided to study the problem under local conditions. From the results of tests carried out in several factories, it was shown that purity drops can be markedly reduced by exercising strict control on the pH, and particularly on the temperature of the juice during the shut-down period, resulting in substantial savings at very little cost.

(*b*) **Direct Determination of Fibre in Cane**. Following the adoption in Queensland of the «Jeffco Cutter Grinder» for the determination of fibre in planters' canes, a machine was ordered for testing under local conditions and ascertaining its advantages, if any, over the «Cutex» fibrator used by the Central Board at present. From the large number of comparative tests made, it was concluded :

(i) That the «Jeffco» is a better machine than the «Cutex» for defibrating cane samples with a view to determining their fibre content. Whereas the «Cutex» can take only clean canes, the «Jeffco» can be fed with the raw material as fed to the mills, and sampled prior to, or after, chaffing by the cane knives to be defibrated by a shredder.

(ii) That the method of cold water extraction of the shredded material during 24 hours, is neither very accurate, nor reproducible, and should be replaced by the so-called disintegrator - method developed in Hawaii, and followed at the M.S.I.R.I.

(*c*) **Power Consumption of C-Massecuite Crystallizers**. A study of the power consumption of various types of C-massecuite crystallizers has yielded interesting information. It was observed, for example, that most of the energy consumed by a crystallizer fitted with revolving cooling coils is taken up by the reducing gear, and that the increase in power consumption between hot and cold massecuite is, under average operating conditions, of the order of 20 per cent only.

(*d*) **Magma of regular crystal content**. A number of tests were carried out at Riche-en-Eau to judge the merits of a device designed by the Factory Manager to produce magma of more regular crystal content. The device consists essentially in a small tank which is fitted with pneumatically controlled valves and which delivers a pre-set volume of syrup each time the C-sugar afterworker centrifugal discharges. The tests have shown that, with this device, the magma produced has a much more regular crystal content than when the addition of syrup is manually controlled.

(*e*) **Calorific value of bagasse.** The determination of the calorific value of bagasse from several new cane varieties has yielded results which differ very little from those obtained by previous workers on cane varieties grown in Mauritius in the past.

(*f*) **Studies on Osmophilic Yeasts.** Fermentation tests and plate counts on osmophilic agar were conducted on 33 sugar samples from factories, and 23 from the docks. In addition, 61 samples of massecuite were studied.

The results obtained indicate that the yeast population of raw sugars fluctuates considerably from factory to factory, and from the beginning to the end of the crushing season.

Studies on samples, taken during discharge of the crystallizers, showed that the yeast content of the massecuite was low and fairly constant, except towards the end of the crop when the last few samples taken showed a considerable increase in yeast population.

No conclusions could yet be drawn on the effect of a germicidal treatment of the crystallizer on the control of osmophilic yests in the massecuite.

(*g*) **Glucose : Fructose Ratio.** For a number of years it was observed that the Apparent Purity of juices is often higher than their Gravity Purity. The tentative explanation put forward was that the glucose: fructose ratio of certain varieties may be different from that of others. A study carried out during the last crop showed that the amounts of glucose and fructose in juices and molasses may vary considerably from sample to sample, hence causing differences between Apparent and Gravity Purities of final molasses.

(*h*) **Maxwell Boulogne scale.** In most factories of Mauritius, final molasses are weighed in Maxwell Boulogne scales, and in all cases the tare of the scale is obtained by weighing water. This is an incorrect procedure which is bound to yield a larger tare than if final molasses were used. As a result, the weight of molasses registered is inflated and undetermined losses deflated. From a series of tests carried out in one factory during the crop a difference in tare of 38 kgs per dump was recorded on the average for a 1000 kg. scale when taring with molasses, as compared to the tare obtained with water. If the weight of molasses of the factory were corrected accordingly, its undetermined losses per cent cane would incerase by 0.03. Hence it is recommended that Maxwell Boulogne scales used for weighing final molasses be tared with the product itself, but a still better proposition would be to use a self-taring scale such as the Servo-Balans.

(*i*) **Preservation of juice.** Tests carried out on the preservation of composite juice samples with basic lead acetate have shown that when the sample is kept in a refrigerator overnight, the amount of lead salt to use is 10 grams per litre, or half the amount normally used when a refrigerator is not available.

Advisory Work. It is gratifying to record that the advice of the Sugar Technology Division is being sought more and more every year. It has even been found necessary to turn down one or two requests for advice as the work involved would have taken up too much time and would have been detrimental to the research duties of the staff. Further, although it is always with pleasure that studies are made and reports written for individual factories or corporate bodies, the policy of the Institute must be, as far as possible, to study only problems which are of general interest, rather than those which are specific to an individual factory.

The most important studies made during the year on various aspects of manufacture and chemical control, on items of machinery and on plant lay-out, included the following items :

(*a*) **Milling.** Modifications to milling tandem; calculation of mill settings; calculation of IHP of milling engines.

(*b*) **Processing.** Calculation of amount of steam that may be bled from evaporator for juice heaters; chemical cleaning of evaporator tubes; analysis of bagacillo, and recommendations on filtration; recommendations on the capacities of vacuum pan and crystallizer departments; stopping the development of fine grain in B. massecuite; modifications to magma mixer; study of capacity of C centrifugal battery.

Chemical Control. Due to various reasons, difficulties were encountered in the chemical control of several factories. In some of them the undetermined losses appeared to be abnormally low, whilst in others they seemed abnormally high. A number of visits were paid to these factories, and recommendations made in two of the cases after a full study of the main factors involved.

Instrumentation. The services of the Instrumentation Engineer are being sought more and more every year. Thus in 1963 he was called upon to: check or repair 9 pH controllers, 8 refractometers, 5 saccharimeters, 4 analytical balances, 3 pH meters, 3 salometers, 4 cuitometers, 4 muffle furnaces, 3 thermo-regulators; calibrate 15 temperature, pressure and vacuum gauges and recorders, as well as two flowmeters and two thermocouples; advise on a number of problems, including the installation of temperature controllers, pressure reducers and lift integrators, the measurement of furnace temperatures and the governing of turbines.

BY-PRODUCTS

The suggestion made in 1960 that the large amount of protein being dumped in the fields with the factory muds could possibly be recovered and used for animal feeding, led to two distinct lines of work: the extraction and nutritional values of protein from cane juice, and the nutritional value of filter muds.

Concerning the industrial recovery of protein, little progress was achieved in 1963. The Sugar Technologist studied, while on leave, types of continuous separators that would be suited for protein separation on a factory scale. Unfortunately, the machine which was thought to be best adapted for that purpose was disposed of elsewhere, where tests similar to those initiated in Mauritius have been carried out. It is hoped that during the 1964 campaign the necessary equipment will be available for industrial test runs in one of the local factories.

A certain amount of the heat coagulate of cane juice, however, was collected and purified in the laboratory. This material, which contains more than 50% of crude protein (N x 6.25), is being used for assessment of the value of its protein as a dietary supplement.

As regards the feeding value of scums, recent work with sheep confirms the findings published in previous reports that the digestibility of the protein of hot-air dried scums is low, and that this material can be considered as only a low grade feed for ruminants.

The results of the amino acid analyses of cane leaf protein, scums protein, and the purified juice protein are given in this report.

LIBRARY

The work of expansion and organization continued throughout the year. New accessions numbered 636 volumes, bringing the stock to a total of 7183 bound volumes. Some new periodicals were received mainly through exchange, and these now number 307 titles. A special effort was made to review all the sets of journals and to compile an up-to-date list of missing items in order to take steps to complete the collection. This list of «wants» and «offers» was sent to 200 libraries in the world. This gave us an opportunity of broadening our contacts by approaching the main University Libraries, as up to now our exchange programme had included mainly the Sugar Research Institutes and leading Agricultural Centres.

The growth of the Library has brought up the problem of storage for the first time, and much thought had to be given to the planning of storage capacity and new shelving arrangement for the next few years.

This year, a long search came to a satisfactory conclusion. It was possible by means of photostats to complete our set of the *Revue Agricole : Agriculture-Horticulture-Acclimatation et Industries qui s'y rattachent, destinée aux Pays Inter-tropicaux, spécialement à Maurice, La Réunion et Madagascar*, founded by M. A.

Daruty de Grandpré. This journal which started publication in 1887, continued to appear with various alterations of title until 1902. It is believed that this may be the only complete collection still extant, and it is with gratitude that we record the help of the Director, Royal Botanic Gardens, Kew, who provided us with microfilms of the parts available in the Library at Kew. One future task will be the indexing of this journal.

We also record our deep gratitude to the family of the late Mr. Maxime Kœnig who bequeathed his valuable library of meteorological and geological works to this Institute.

One step forward in the compilation of the *Union List of Scientific Periodicals* received in Mauritius was made when the Librarian of the Department of Agriculture provided us with a list of periodicals received in the Department. It is evident, however, that special help will be needed to cope with the arduous work of preparing a sound catalogue.

Another indispensable tool of research, the catalogue of *Mauritiana* available in the Library and the Herbarium, will have to be compiled in the near future. Preliminary work on this has already been started.

We would like to close this short account of the work in the Library with an acknowledgment of the generous help and co-operation received from many libraries, and in particular from the British National Book Centre and the United States Book Exchange.

THE MAURITIUS HERBARIUM

The work of the Mauritius Herbarium, housed at the M.S.I.R.I., is reviewed hereunder by Dr. R. E. Vaughan, its Honorary Curator.

This is the second review on the work of the Herbarium since it became a separate and independent organization at the beginning of 1962.

It has now been possible to arrange for field work and collecting trips to selected sites throughout the island at least once a week. The material thus obtained, together with specimens from other sources kindly presented by private collectors, has enabled over 900 specimens (mostly flowering plants) to be mounted and added to the Herbarium. This material may be roughly divided into three groups : indigenous species, mainly from the forests of the south-western plateau; weeds and naturalised immigrants; and cultivated plants from various localities.

Priority has been given to acquiring good representative material in flower and fruit of our indigenous vegetation. The purpose of this is twofold. In the first place, for reasons which it is not possible to discuss in this brief review, Mascarene plants are poorly represented in the big national herbaria overseas, and requests are often received to supplement them. Secondly, there is, going on year by year, a gradual elimination of the original vegetation of the island. This is due partly to the population explosion and the resulting urgent need to bring all available land under some kind of productive use, and also to the fact that the indigenous species are always losing ground against the inexorable pressure of aliens and exotics. In consequence of this, many indigenous plants are so rare, or on the verge of extinction, that their further study will have to be based on herbarium material, supplemented as far as possible by ecological notes made by collectors.

Good progress has been made in our knowledge of local orchids, and critical material has come to hand of species which are, either new, or only vaguely known, because of very poor herbarium specimens or inadequate descriptions. Other additions to the Herbarium include a collection of 36 plants from Seychelles, presented by the Royal Botanic Gardens, Kew, made during a recent botanical survey of the Islands by Mr C. Jeffrey of the Kew Herbarium staff.

Monthly visits have continued to the Royal Botanic Gardens, Pamplemousses, to obtain specimens of unnamed or doubtful species with a view to preparing a revised large scale plan of the Gardens and a new catalogue of the plants therein. This work has been expedited by the willing assistance given by all members of the Gardens staff. It will be some time before a census of the plants in the Gardens can be completed. The main reason for this is that it is only now, four years after the great hurricanes of 1960, that many trees are showing definite signs of recovery and producing fresh growth and new wood which will in turn give rise to fertile flowers and fruit.

Specimens from the Herbarium have been sent on loan, or as donations, to several institutions. These include 17 sheets of *Coffea* to Dr J. F. Leroy, *Laboratoire d'Agronomie Tropicale, Paris*, who is monographing the Malgache and Mascarene members of the genus. Other material has been sent to specialists studying certain genera or families.

It has been a busy year for overseas visitors who are coming here in increasing numbers to study Mascarene vegetation at first hand, and to obtain living plants or herbarium material for various institutions. In April, Prof. F. G. Schweickerdt (University of Pretoria) spent a few days here, his main interest being ferns from our upland forests. Through his kind offices we have been able to acquire the missing numbers to complete our set of Medley Wood's well known six-volume treatise on Natal Plants.

In June, collecting expeditions to the reefs were arranged for Dr. Richard E. Norris (Marine Algologist, Smithsonian Institution, Washington) who was visiting Mauritius on the research vessel *Anton Bruun* in connection with the International Indian Ocean Expedition. A tour of Madagascar, Réunion and Mauritius was undertaken by Dr William Rauh (University of Heidelberg), the main object of which was collecting living orchids for the Botanical Gardens of Heidelberg University. During his stay in Mauritius, consignments of living orchids were sent to Heidelberg where they have become successfully established. On his return to Germany, we were pleased to receive from him some living specimens of orchids gathered in Madagascar. At the end of October, Dr Richard A. Howard, Director of the Arnold Arboretum, Harvard, and Dr. George R. Cooley, also of the Harvard botanical group, arrived here for a short visit. Dr. Howard's main object was to see the principal vegetation types of the island and to collect material of endemic genera for anatomical study. He took much interest in the Royal Botanic Gardens, Pamplemousses, in his capacity of President of the International Association of Botanic Gardens.

Work is proceeding on the Weed Flora of Mauritius, and leaflets on the following weeds were published during the year, or are in the press : *Centella asiatica* (Herbe Boileau), *Hydrocotyle bonariensis* (Herbe Bol), *H. sibthorpioides* and *Heliotropium amplexicaule* (Herbe Bleue). Some progress has been made on the compilation of a bibliographical guide to Mascarene botany which, it is hoped, will prove useful to students of our local vegetation.

Among additions to the Herbarium library may be mentioned the first three volumes of the *Flora Malesiana*. This remarkable plant cyclopedia contains figures, descriptions, and phyto-geographical notes on many Indo-Pacific plants reaching the Mascarene Islands. In addition, valuable biographical entries are given concerning botanists, explorers, and collectors many of whom visited Mauritius and Réunion. Regional items added to the library include a copy of J. Vaughan-Thompson's rare *Catalogue of Exotic Plants...* (1822), a *Report on the Seychelles Islands* by John Horne (1873), and an obituary notice on J.G. Baker, author of the standard Flora of Mauritius and the Seychelles (1877), with his portrait from the Kew collection, kindly presented by the Royal Botanic Gardens, Kew.

Two small exhibits have been set up in the Herbarium. One shows timber specimens of selected indigenous trees; the other has been arranged to illustrate a few outstanding aspects of the principal vegetation types of Mauritius and some topographical and climatic features.

During the year under review many routine enquiries, both verbal and written, on various botanical matters have been answered, and some hundreds of specimens from different sources have been identified as far as possible.

It may be said, in conclusion, that the financial grants necessary to meet our basic needs would not go far without the support, assistance, and co-operation given in so many ways by the Director and his Staff.

PUBLICATIONS

Annual Report 1962. 110, XLI p., 46 figs.
French summary in *Rev. agric. sucr. Maurice* **42** (2) 1963 : 85-118.

Occasional Papers

No. 15 SINTENAC, R. Recherches d'eau souterraine à l'Ile Maurice.
II. Secteurs de Pamplemousses, Rivière du Rempart, Plaine des Roches, Nouvelle Découverte. 28 p.; 9 figs.

No. 16 III. Secteurs de Flacq, Grand Port. 29 p.; 10 figs.

No. 17 IV. Secteurs de Plaines Wilhems-Rivière Noire, Chamarel. Conclusion Générale. 24 p.; 4 figs.

Leaflets

No. 7 ROCHECOUSTE, E. and VAUGHAN, R. E. Weeds of Mauritius.
9. *Hydrocotyle bonariensis* Lam. (Herbe Bol, Herbe Tam-Tam).
10. *Hydrocotyle sibthorpioides* Lam.
11. *Centella Asiatica* (L) Urban. (Herbe Boileau, Bevilaqua). 5 p.; 2 pl.

No. 8 12. *Heliotropium amplexicaule* Vahl. (Herbe bleue, Verveine sauvage). 3 p.; 1 pl.

Technical Circulars

No. 20 WILLIAMS, J. R. A guide to the use of anticoagulent rodenticides in cane fields. 10 p.; 2 figs.
(French version : Guide pratique pour l'emploi de Rodenticides Anticoagulants dans les plantations de cannes).

No. 21 WILLIAMS, J. R. Locusts as pests of sugar cane in Mauritius. 20 p., 4 figs., 2 tables.
(French version : La sauterelle, ennemie de la canne à sucre à l'Ile Maurice).

Private Circulation Report

No. 17 XIth Congress I.S.S.C.T. Report of delegates on the Post Congress Tour to South Africa. October 1962. 39 p.; 1 table.

Articles in «La Revue Agricole et Sucrière de l'Ile Maurice.»

ANTOINE, Robert. Quelques aspects de l'industrie sucrière sud-africaine. **42** (1) : 19-35.

ROCHECOUSTE, E. La lutte contre les mauvaises herbes dans les plantations de canne à sucre. **42**(2) : 119-133.

ROCHECOUSTE, E. Notes sur la phytotoxicité de certains herbicides. **42**(4) : 234-242.

ROUILLARD, G. Le centenaire d'une sucrerie: Bénarès. **42**(1) : 15-18.

I.S.S.C.T. Proceedings of the International Society of Sugar Cane Technologists. XIth Congress, Mauritius, 24th September - 5th October 1962, ed. by J. R. Williams, and published by the Executive Committee of the I.S.S.C.T. Réduit, Mauritius. Amsterdam, Elsevier Publishing Company, 1963. 1250 p.; illus.

GENERAL

1. **Meetings.** The Research Advisory Committee met on the 22nd January, 17th August, 12th October, and 10th December, when current research work was discussed and experimental sites visited.

Lectures given by members of the Staff are recorded below. These meetings, with the exception of those of 17th and 19th December, were held in the Bonâme Hall at Réduit.

24th January — P. O. WIEHE. Introducing the programme of lectures to Extension Officers.*

21st February — P. HALAIS. Foliar Diagnosis*.

29th March — G. MAZERY. Irrigation.*

26th April — E. F. GEORGE. Cane Varieties.*

16th May — J. VINSON. L'agonie d'une Ile (l'Ile Ronde).††

23rd May — P. O. WIEHE. A review of the work of the M.S.I.R.I. in 1962.

27th May — Review of year's work at M.S.I.R.I. (1962). Talks by specialist officers for the annual conference of the *Société de Technologie Agricole et Sucrière de L'Ile Maurice.*

30th May — J. R. WILLIAMS. Locusts as pests of sugar cane in Mauritius.

31st May — ROBERT ANTOINE. Control of Cane Diseases.*

28th June — D. H. PARISH. Fertilization.*

3rd July — A. NORTH COOMBES. Aperçu de l'évolution de l'Agriculture à l'Ile Maurice.†

26th July — J. D. DE R. DE SAINT-ANTOINE. Cane Analysis.*

30th August — E. ROCHECOUSTE. Phytotoxicity of Herbicides.*

27th September — G. ROUILLARD. Cultural Methods.*

30th September — Présentation du Saccharimètre Electronique de la Société des Brevets Gallois, par M. BOUSQUET, Electronicien.**

25th October — J. R. WILLIAMS. Insect Pests.*

17th December & 19th December — J. R. WILLIAMS. Recommendations on measures to be adopted in the control of locusts, at Pamplemousses and Belle Rive Experiment Stations.

18th December — F. STAUB. Documentary film on the bird life of Rodrigues Island.††

In addition, the Director gave lectures on *Research and the Sugar Industry* at the College of Agriculture in January, at the Royal College School in April, and at Queen Elizabeth College in October. He was also the guest speaker at the Education Officers' Conference in August, the theme of which was *The Challenge of our Time.*

2. **Staff Movements.** The following officers went on leave overseas in 1963 : J. D. de R. de Saint-Antoine, J. R. Williams, G. Mazery, and L. C. Figon.

Mr. de Saint Antoine established contacts with a number of firms and personalities, and had discussions with them in connection with the choice of equipment for the industrial recovery of protein from sugar cane juice. He thus visited the Alfa-Laval Company in Sweden, Westfalia Separator A. G. in Germany, the Plymouth factory of International Protein Products, and the Alfa-Laval works at Brentford. He also discussed the problem with Dr. Douwes-Dekker of the S.M.I.R.I., and with Mr. Warburg of Alfa-Laval in Durban.

Mr. Williams, while on leave, visited Rothamsted Experiment Station; the Anti Locust Research Centre, London; Plantenziektenkundige Dienst, Wageningen; and attended the Vth International Pesticides Congress, London.

Mr Mazery visited several irrigation schemes in Réunion and France. He also established contacts with industrial firms specialised in agricultural machinery.

Mr Figon spent three months at «Pyrex» Wear Glass Works, Sunderland, and was trained as a glass blower. During 3 weeks he worked in the chemistry laboratory af Rothamsted Experiment Station under Dr Y. L. Nowaskowski, and for 2 weeks visited the Grassland Research Institute looking for up-to-date methods in various chemical analyses.

Mr Robert Antoine spent two weeks in Madagascar in March in connection with the control of Fiji disease on the East Coast. He returned to Madagascar on 1st June, and made a disease survey in the innumerable small sugar cane

* Talks specially prepared for Extension Officers of the Department of Agriculture and for the field staff of sugar estates.

** Joint meeting with the *Société de Technologie Agricole et Sucrière de l'Ile Maurice.*

† Joint meeting with the Royal Society of Arts and Sciences, Mauritius, and the *Société de Technologie Agricole et Sucrière de l'Ile Maurice.*

†† Joint meeting with the Royal Society of Arts and Sciences, Mauritius.

plantations in the South. Mr Antoine was joined later by the Director, and they both attended the 12th meeting of the *Comité de Collaboration Agricole Maurice-Réunion-Madagascar*, which was held in Tananarive from 12th to 19th June.

Mr C. Mongelard obtained a one-year Commonwealth scholarship, and left in September. He is studying plant-water relationship in the Botany Department of the Imperial College of Science and Technology.

At the end of September, Mr D. H. Parish spent three days in Madagascar working with Mr Velly of I.R.A.M. on the Chaminade method for pot experiments. This method, which is highly standardized and is used in many tropical territories, should prove useful to the sugar industry in that it allows a rapid determination of the sequence in which specific nutrient can be expected to occur.

3. **Miscellaneous.** The usual close contacts with sugar estates and cane planters were maintained, and 2125 visits were made by members of the staff.

The M.S.I.R.I. continued to assist the College of Agriculture for courses of lectures in Sugar Manufacture, Plant Pathology, Entomology, Botany and Agriculture of the sugar cane, and Statistics. Close liaison was also maintained with the Extension Service of the Department of Agriculture and with the Manager of the Central Cane Nursery of the Sugar Planters Rehabilitation Fund.

Cane production at the four stations of the Institute were : Réduit 526 tons, Pamplemousses 620, Belle Rive 549, Union Park 356, making a total of 2,051 tons, the highest on record.

I should like, in concluding this summary of the work of the M.S.I.R.I. in 1963, to express my thanks to all members of the staff for their co-operation during the year.

Director

15th February, 1964.

Plate 3.

Left: Arrows inside a crossing cubicle. These stalks are preserved in solution. *Right*: Collecting the fuzz on marcotted stalks. The arrows have been pollinated inside the greenhouse.

Plate 4. Seedling nursery. Seedlings in polythene pots await transplanting in the field.

CANE BREEDING

E. F. GEORGE & W. de GROOT

1. ARROWING

(i) Conditions in 1963

MOST varieties flowered profusely this year. The good weather conditions that favoured excellent cane growth also seemed to have increased the proportion of flowering canes. On one side, this may be the result of the greater average size of canes, with a higher tendency to flower; on the other hand, there may be a direct influence of climatic conditions on flowering.

Since 1958 the percentage of arrows in various varieties has been estimated by the staff of the estates, and once again thanks are due to all those who co-operated in these counts.

These flowering estimations were initiated by DE SORNAY, who wanted to establish from these results the following points :

(*a*) difference in percentage of arrowing canes between borders of a field and the middle;

(*b*) difference in percentage of arrowing between virgin canes and ratoon canes;

(*c*) effect of date of previous harvest on flowering percentage in ratoon canes.

As an extra result, the relative amount of arrowing in the commercially grown varieties was obtained. In Table 1, results for 1963 are presented; while in Table 2, results of two varieties over the years are summarized.

It can be seen from the first table that arrowing was very high all over the island, being greater than that which occurred the previous year.

The second table shows that ratoons of the two varieties listed tend to flower more than virgins, while a higher arrowing intensity appears to occur at the edges of fields than in the centre. The significance of these differences has not yet been tested, but both results tend to confirm general beliefs about flowering behaviour and are derived from counts on many thousands of canes.

The very clear effect of date of previous harvest on flowering intensity has been illustrated in these reports since 1956. It has emerged from the study of several commercially grown varieties that the relationship is not the same in all varieties, and that it varies with years. Varieties which arrow heavily show a more rapid decline in flowering intensity in late-harvested canes than do those which arrow sparsely. This fact is well illustrated from the graphs shown in fig. 15. It will be seen that on average, 31 percent of the canes of M.202/46 produced flowers when the harvest was in the previous July, but that in ratoons cut in December the percentage arrowing was little more than in the sparse-flowering variety M.147/44.

The effect of date of previous harvest on the flowering intensity of M. 147/44 is small as may be seen from the graph of the means of four years' data. The mean flowering percentage in this variety was higher than average in 1963.

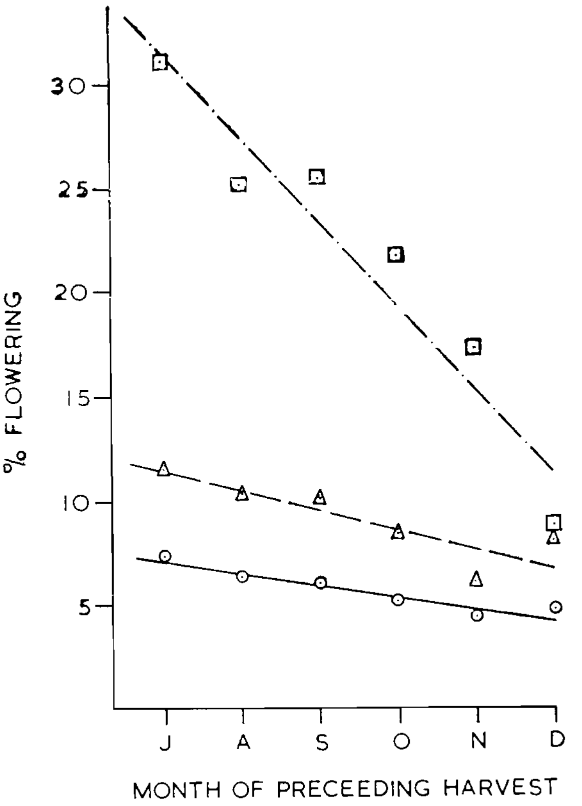

Fig. 15. The relationship between date of previous harvest and percentage of flowering in the varieties M.147/44 and M.202/46.

Plain line : M.147/44, mean of 4 years.

Broken line : M 147/44, 1963 census.

Line of dots and dashes : M.202/46, 1963 census.

(ii) Control of flowering

A further photoperiod experiment was conducted during the year using this time the free flowering variety U.S. 48-32. The object of the experiment was to see whether light intensity had an effect in inhibiting flowering, or whether duration only was important. Combined with this enquiry, the timing of a lighting treatment to give maximum delay was also investigated. A full report of this work will eventually be published elsewhere.

In fig. 16 are illustrated the particular results of this experiment which demonstrate the relationship between percentage of flowering canes and the delay in flowering achieved relative to the control. In this experiment, a gain of one day's delay in flower emergence resulted on average in a loss in flowering percentage of 1.42 per cent. In a similar investigation which was reported previously, (GEORGE *and* LALOUETTE, 1963) it was suspected that the relationship between delay and flowering percentage was not linear. The results in fig. 16 were therefore examined for evidence of curvilinearity, but this was not found to be significant ($P=0.1 - 0.5$). The linear regression was highly significant ($P=0.001$).

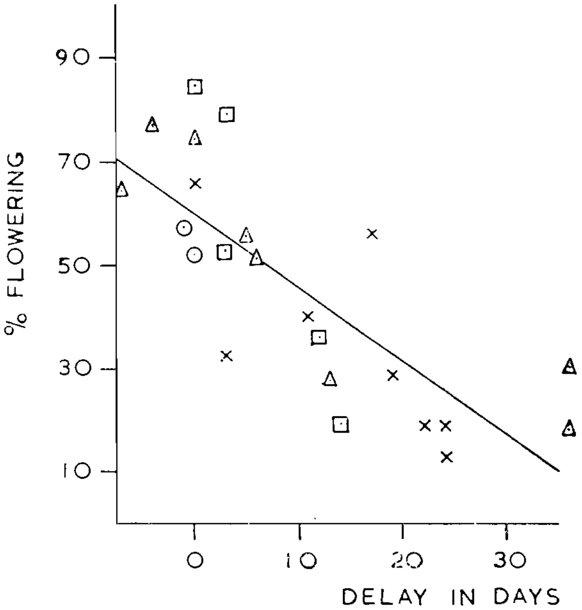

Fig. 16 The relationship between delay in arrow emergence relative to the controls, and percentage of flowering canes, in a photoperiod experiment conducted during the year. The different symbols denote four regimes of artificial lighting.

Table 1. Average percentage arrowing in 1963*

Variety		*North*	*South*	*East*	*West*	*Centre*	*Average*
M.134/32	...	7,6	26,5	—	5.2	—	10,6
Ebène 1/37	...	—	16,4	26,1	—	13,5	16,4
M.147/44	...	6,1	10,9	16.5	6.3	3,5	9,2
M.31/45	...	—	0,2	3,0	—	—	1,7
M.202/46	...	13,9	25,6	24,0	19,3	22,7	21,5
Ebène 50/47	...	—	(19,6)	—	—	8,2	9,6
M.93/48	...	—	4,7	(18,3)	—	—	6,1
M.253/48	...	—	—	—	1,7	—	1,7
B.3337	...	—	1,0	(3,1)	—	0,3	1,0
B.34104	...	—	7,7	(29,1)	4,7	—	7,2
B.37172	...	0,5	4,6	4,3	4,2	—	3,3
Averages	...	5,6	9,9	12,9	6,8	8,4	8,8

* Estimations derived from less than 5000 canes are placed in brackets.

Table 2. Mean percentage of flowering over the whole island

Variety/year		*Virgins*	*Ratoons*	*Border*	*Middle*
M.134/32 —	1956	18,0	24,8	25,0	23,3
	1957	9,4	9,5	12,0	9,1
	1958	3,5	6,1	8,0	5,7
	1959	2,8	7,1	8,5	6,7
	1961	1,7	1,1	1,2	1,1
	1962	9,6	10,6	11,2	10,5
	1963	11,0	10,0	12,3	10,4
Mean		8,0	10,6	11,3	9,5
Ebène 1/37 —	1956	10,6	14,6	13,3	12,1
	1957	10,9	11,6	12,9	10,5
	1958	6,5	6,6	8,7	5,8
	1959	4,7	6,8	6,7	6,4
	1961	2,5	1,9	2,4	1,8
	1962	14,6	14,0	13,1	13,7
	1963	15,6	17,0	17,7	9,1
Mean		9,3	10,4	10,7	8,5

2. CROSSING

(i) Programme

The number of crosses executed during this year was nearly the same as last year, due to the fact that arrows were once again abundant. Newly imported varieties (quarantine period 1960-1962), as well as many locally bred parents, were used in this year's programme for the first time. The total number of crosses made was 1033. A summary of crossing work is given in Table 3, while the list of successful crosses is given in the Appendix, (Table XXII)

Marcottes were not used so extensively this season, although the results obtained with this method are still very good. The method is however expensive in time and man-power. Further experiments were conducted on the value of SO_2-solution as a medium to keep cut canes alive. Discussions during the recent ISSCT Congress in Mauritius led to various improvements in technique which seemed to be responsible for increased success. These were :

(*a*) *Method of preparing the solution.* In the past, solutions of the required strength were prepared in every container (about 2 gallons) used. This year, quantities of solution were prepared freshly each day in 45-gallon casks. Containers were filled with this prepared solution, using a hose pipe.

(*b*) *Changing the solution.* Containers were kept as clean as possible and the solution in them was changed at frequent intervals. In an experiment, the effect of changing the solution in the containers every 1,2,3, or 4 days was compared. Results are summarized in Table 4. Although results were not significantly different, a change of solution after a maximum of 3 days was adopted as general practice. On the other days, fresh solution was added until the containers were overflowing.

(c) *Removal of leaves.* As a third change, all leaves of the cut stalks to be placed in solution were completely removed to diminish evaporation losses as far as possible. Previous practice had been to leave one third of the leaf blade intact, in the belief that photosynthesis was necessary for seed setting.

These changes made it possible to use the cubicles in the new greenhouse during the season for big area-crosses in which many female varieties were pollinated by one male variety. All stalks were kept in solution until harvest. Stalks were left in the cubicles for 15 to 20 days after which they were transferred to a ripening area. Due to the fact that a proper area was not available, many canes broke and shedded their fuzz prematurely. This can be expected to have diminished the number of seedlings per arrow which might have been obtained.

A total of 298 arrows was pollinated in the cubicles from which 59 were stored for sowing next year. The other 239 gave 35,887 seedlings, or a mean number of 150 seedlings per arrow compared to 93 seedlings per arrow for crosses made inside the greenhouse. This difference is largely due to the fact that most varieties used in the solution crosses were known to normally give many seedlings per arrow.

Conditions inside the cubicles were found to be excellent for the induction of male fertility in various varieties which are usually male sterile in the field. This made the parentage of some seedlings obtained from the solution crosses to be doubtful.

Observations of the germination of pollen on stigmas were continued along the lines mentioned in last year's report, but without any conclusions being drawn.

(ii) Sowing of fuzz

The fuzz obtained this year was again placed in a deep freezer until sowed three months later. From the 53 crosses made in 1962 and stored in the freezer for 15 months, 9349 seedlings were obtained, or 176 per arrow. This compares favourably with fuzz viability last year (109 seedlings/arrow). Thus a comparatively long period of storage in the deep freezer was not harmful to the seeds. This year, 239 crosses were stored for sowing in 1964. By continuing this practice every year, it should be possible to have reserve fuzz for sowing in years when conditions for crossing are poor.

A small attack of disease in the boxes was controlled with the proprietary fungicide «Natriphene». In an experiment conducted in co-operation with the Pathologist, various methods of soil sterilisation were tested. It was found that sterilization with methyl bromide resulted in better growth of the seedlings than in the control boxes which contained heat-sterilised soil. As sterilization with methyl bromide is more effective, it will be used exclusively next year.

All the sowing was done during November, and the transplanting which started immediately afterwards was finished towards mid January 1964. Once again all seedlings were potted in bunches of three. A fertilizer mixture, made up according to advice from the Chemist, was used in preparing the soil for potting. Seedlings did grow very well in this soil.

Table 3. Summary of crossing work 1963.

No. of crosses made	*Greenhouse*	*Field*	*Solution*	*Total*
Réduit	601	14	298	913
Pamplemousses	—	120	—	120
	601	134	298	1033
Stored for next year	155	25	59	239
Sown in 1963	446	109	239	794
Idem from 1962 season	18	35	—	53
	464	144	239	847

Result of sowing	*Number*	*Number of seedlings*
Crosses not germinated	323	—
Crosses discarded	285	5489
Crosses kept for potting	239	104197
Total	847	109686

Table 4. Effect of changing SO_2-solution on the dropping of fuzz from non-marcotted flowering sugar cane stalks.

	Number of days until fuzz started to drop			
	Solution changed every			
Variety	*1 day*	*2 days*	*3 days*	*4 days*
M.147/44	37	30	30	30
M.85/53	42	37	40	37
M.241/40	33	33	40	30
B.34104	33	35	35	31
Totals ...	145	135	145	128

3. SELECTION

The increased number of seedlings produced in 1960, compared to the number of seedlings obtained in previous years, reached the stage of initial selection during 1962 and this year were selected in bunch selection plots and propagation plots. Due to the limited availibility of labour, selection work had to be continued until early November. Unfortunately during the latter part of the harvesting season, selection became more and more unreliable, because the sugar content of the cane had already reached its highest point and was falling in many varieties. This may be of value in the later stages of selection for the evaluation of late-ripening varieties; in the case of initial selection, however, it is responsible for the loss of one of the selection characteristics as brix readings have lost all their value. Starting earlier in the season is no possible solution of the problem as sugar contents in June are still too low to be used as a selection criterion.

The summary of selection work is given in Table 5 . If this table is compared with the same one in last year's report, the increase in selection work is clearly indicated.

A sub-station was established this year at Minissy, with the kind co-operation of the Manager of Mon Désert-Alma. This station was established to replace the one at Britannia.

Once again the promising varieties selected from First Selection trials were planted at Médine for rapid propagation. Included were 7 varieties selected from the observation plot of imported varieties at Réduit. These will be planted in the trials which are to be established on estates in 1964. Among the 32 varieties selected from first selection trials, the following ones are interesting.

M.256/56 (M.149/49 x Ebène 1/37). This variety gave a good yield at Union Park, and its sugar content was comparable to that of the standards (M.93/48 and Ebène 1/37). Some flowers were found, but the percentage of arrowing seems rather low. In the preceding stage of selection, yield was good at Union Park, but bad at Pamplemousses. The stalks have a medium diameter, trash comes off without difficulty, and the variety has a semi erect habit.

M.16/57 (N:Co. 310 x M.147/44) was originally selected at Réduit for high brix and planted at Belle Rive and Réduit in First Selection trials. Better results were obtained at Belle Rive, where it gave a higher yield than Ebène 1/37 and had the same sugar content. At Réduit, yields were not as good. The percentage of arrowing is nearly the same as that of Ebène 1/37, the stalks have a medium diameter, but trashing seems to be rather difficult.

M.96/57 (N:Co. 310 x M.213/40) was selected at Réduit for a consistently good sugar content over three years. The yield is nearly as good as that from M.147/44. The percentage of arrowing is rather low, which is queer for a seedling from the cross mentioned above, as both parents flower rather freely. The variety was also tested at Belle Rive, where sugar content was also good, but the yield low. It is a thin, semi-erect cane, with sometimes clinging trash.

M.115/58 (Ebène 1/44 x M.202/46). This variety was planted in two First Selection Trials : one at Pamplemousses and one at Union Park. The clone was selected at Pamplemousses because of a very good weight combined with a good sugar content. At Union Park, sugar content was also very good, but the yield this time in the super-humid region was not good. M.115/58 has thick stalks, is semi-erect and flowers sparsely.

Table 5. Summary of selection work in 1963.

Station		*No. of stalks planted in B.S.P.*	*No. of varieties planted in Prop. plots*	*No. of selections made in Prop. plots*	*No. of selections made in 1st Select. trials*
Réduit ...	...	636	273	42	15
Pamplemousses	...	3873	421	85	9
Belle Rive ...	...	–	646	88	7
Union Park ...	...	618	577	63	1
FUEL—Union	...	—	464	—	—
FUEL—Bois Clair	...	—	361	—	—
Minissy ...	...	—	353	—	—
Total	...	5127	3095*	278**	32

* From this number, 1511 have been planted in two regions, and 73 varieties have been planted in one region only, making a total of 1584 different varieties planted.

** From the 278 varieties planted in First Selection Trials, 247 are unique, as 31 varieties have been planted in two environments.

4. VARIETY AND PRE-RELEASE TRIALS

The decision to plant all new promising varieties emerging from First Selection Trials in all four regions as soon as possible, was implemented during the year. Six series of trials, each containing 10 new varieties plus two standards, were planted in four regions simultaneously. In addition to these 24 trials, three others were also planted. These were of a smaller size and replicated some varieties in regions where so far they had not been grown, besides including two other varieties of which there was only restricted planting material. During 1963, results were obtained from a total of 100 varieties included in 30 Variety Trials and 10 Pre-release Trials. Varieties established in trials which are being carried forward for further study, are as follows :

M.—46 series	1
M.—48 series	3
M.—49 series	1
M.—51 series	7
M.—52 series	2
M.—53 series	5
M.—54 series	14
M.—55 series	31
M.—56 series	24
M.—57 series	14
Ebène varieties	9
Imported varieties	6
Total	117

Table 6. Distribution of trials.

Year of planting	*Sub-humid*	*Humid*	*Super-humid*	*Irrigated*	*Total*
1957		1			1
1958				1	1
1959		1	2	1	4
1960			2	2	4
1961	2	5	3	2	12
1962	5	6	2	3	16
1963	6	7	7	7	27*
Total	13	20	16	16	65

* 24 of these trials contain twice as many varieties as previous trials.

A summary of the performance of the most interesting varieties still in the course of testing is given below.

M.442/51, which has been mentioned in these notes during the past two years is now being considered for general release.

The variety was raised from the cross B.37172 x M.213/40 made at Réduit S.E.S. in 1951, and subsequently planted in early, trials on the same station.

All the original selections from the cross were noted as being erect, and this is a characteristic attribute of M.442/51. Stalks are of thin to medium thickness by Mauritius standards, and are of a yellow colour. The trash is removed easily, and the leaf sheaths are not noticeably hairy. These factors suggest that it will be a better variety to cultivate and harvest than M.147/44. Data collected in 1960 and in 1962 indicate that the variety is cyclone resistant. The stems are not liable to breakage by the wind.

In comparison with M.147/44, the new variety M.442/51 has produced, in trials, a higher tonnage of cane (105%), while the average sucrose content is almost exactly equivalent.

However, early in the season, the sucrose is very poor, but is equivalent to M.147/44 by mid-season, and thereafter is definitely superior (fig. 17). IT CANNOT BE TOO STRONGLY EMPHASIZED THAT M.442/51 SHOULD NOT NORMALLY BE REAPED AT THE BEGINNING OF THE CROP. It is a late maturing variety.

Information on the performance of M.442/51 in the wet regions of the island where Ebène 1/37 is a standard cane, is not as complete as in regions where M.147/44 is accepted. Nevertheless, results so far available seem to show that its late-maturing quality is maintained, and that it can give a high tonnage of harvested cane. In these circumstances, it might be an alternative to the variety B.3337.

The reaction of the variety to pests and diseases is not yet clear, but at present it appears that it is fairly susceptible to stalk borers, and very highly susceptible to chlorotic streak. It is therefore essential that, in super-humid and irrigated regions, no plantation is made without the prior treatment of cuttings at 52°C for twenty minutes.

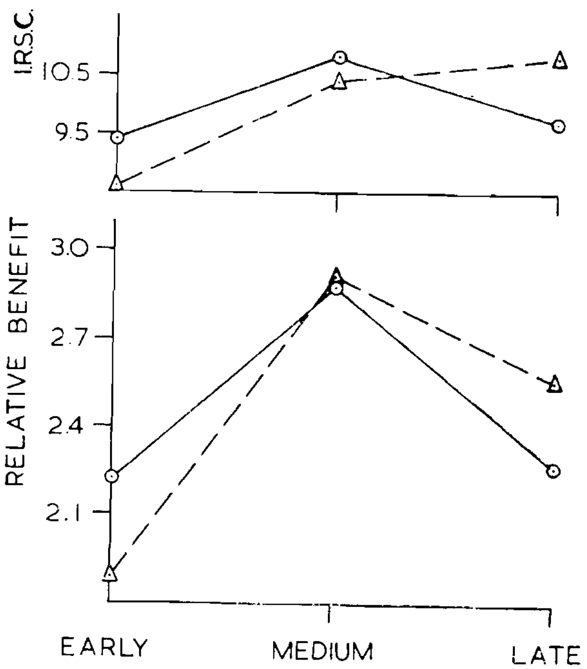

Fig. 17. The maturity behaviour of M. 442/51.
Plain line : M. 147/44
Line of dashes : M. 442/51
The top graph compares industrial recoverable sugar per cent cane, the bottom graph relative benefit calculated according to Hugot's formula.

A summary of the results of M.442/51 in trials over the past few years is given in Table 7.

M.39/49. Trials are still continuing with this variety, which has so far been found to give good results only in super-humid regions. The sucrose content is medium to high at all seasons, but unfortunately the variety appears to be fairly susceptible to cyclone damage. A summary of the results obtained with M.39/49 in comparison with Ebène 1/37 and with M.147/44 is as follows :

Ebène 1/37 areas.
Average 2 trials, 4 harvests.

	T.C.A.	*I.R.S.C.*	*T.S.A.*	*Relative benefit*
Ebène 1/37	33.4	10.0	3.34	2.00
M.39/49	35.6	11.0	3.94	2.49

M.147/44 areas.
Average 2 trials, 2 harvests.

M.147/44	42.9	10.3	4.42	2.70
M.39/49	28.1	11.7	3.29	2.16

Table 7. The percentage superiority of M.442/51 over the standard in variety and pre-release trials

The actual results of the standard are given in brackets.

REGION	*HUMID*	*SUB-HUMID*	*IRRIGATED*	*SUPER-HUMID*
Trial ...	P.B. 10/59 (Ferney)		P.B. 12/59 (Solitude)	P.B. 4/57 (Sans Souci)
Standard ...	M.147/44		M.147/44	Ebène 1/37
No. Harvests ...	Virgin and 2 ratoons		Virgin and 2 ratoons	Virgin and 3 ratoons
Date of Harvest	*Middle*		*Middle*	*Middle*
T. C. A. ..	103% (29.1)		110% (26.6)	126% (34.1)
I. R. S. C. ...	104% (9.7)		110% (11.3)	86% (10.6)
T. S. A. ...	107% (2.8)		117% (3.0)	103% (3.6)
Relative Benefit	110% (1.7)		121% (1.9)	97% (2.3)

REGION	*HUMID*			*SUB-HUMID*			*IRRIGATED*			*SUPER-HUMID*		
Trial .	P.B. 20/61 (Mount, California)			P.B. 21/61 (Mon Loisir)			P.B. 13/60 (Solitude)			P.B. 19/61 (F.U.E.L.)		
Standard ...	M.147/44			M.147/44			M.147/44			M.93/48*		
No. Harvests ...	Virgin and 1 ratoon			Virgin and 1 ratoon			Virgin and 2 ratoons			Virgin and 1 ratoon		
Date of Harvest	*Early*	*Middle*	*Late*	*Early*	*Middle*	*Late*	*Early*	*Middle*	*Late*	*Early*	*Middle*	*Late*
	%	%	%	%	%	%	%	%	%	%	%	%
T. C. A. ...	90 (38.2)	117 (32.8)	97 (35.7)	108 (39.0)	98 (44.8)	106 (38.4)	98 (46.9)	98 (47.8)	84 (45.9)	116 (36.3)	109 (38.6)	115 (36.3)
I. R. S. C. ...	85 (9.1)	99 (10.1)	108 (9.9)	95 (10.1)	97 (12.4)	103 (10.9)	94 (8.9)	101 (10.2)	122 (8.5)	101 (9.5)	86 (11.6)	101 (10.4)
T. S. A. ...	76 (3.5)	115 (3.3)	104 (3.6)	101 (3.9)	96 (5.5)	103 (4.2)	95 (4.2)	100 (4.8)	103 (3.8)	117 (3.4)	102 (4.1)	117 (3.8)
Relative Benefit	67 (2.0)	114 (2.0)	110 (2.1)	100 (2.4)	94 (3.7)	111 2.7))	87 (2.3)	101 (3.0)	119 (2.1)	118 (2.0)	98 (2.5)	117 (2.3)

* The standard Ebène 1/37 which was also planted in this trial gave abnormally variable results.

M.409/51 is a semi-erect variety with stalks of medium thickness. It trashes easily and has a low arrowing intensity. The sucrose content is medium to high, and it is fairly resistant to cyclones. The data so far obtained suggest that the variety is slightly superior to M.147/44, chiefly on account of its better sugar content. The comparison with Ebène 1/37 is not so accurate but is encouraging, as will be seen below.

Ebène 1/37 areas.
Average 1 trial, 2 harvests.

	T.C.A.	*I.R.S.C.*	*T.S.A.*	*Relative benefit*
Ebène 1/37	27.9	10.5	2.92	1.81
M.409/51	28.5	11.6	3.31	2.17

M.147/44 areas.
Average 5 trials, 9 harvests.

M.147/44	41.2	10.3	4.24	2.60
M.409/51	38.4	11.3	4.34	2.80

M.423/51 is a rich variety which once held great promise. It seems, however, to be a variety which is liable to a setback if conditions are not optimal. In some trials it has been better than the standards, and in others worse. Similarly, in some years it has performed much better than in others. As will be seen below, in general average performance, M.423/51 is inferior to both Ebène 1/37 and M.147/44, so that this, combined with its variable and inconsistent performance, suggests that it is not worth testing further. It could never be a variety which would be released to planters with confidence.

Ebène 1/37 areas.
Average 2 trials, 6 harvests.

	T.C.A.	*I.R.S.C.*	*T.S.A.*	*Relative benefit*
Ebène 1/37	31.0	10.6	3.28	2.05
M.423/51	27.6	11.2	3.09	1.99

M.147/44 areas.
Average 5 trials, 12 harvests.

M.147/44	37.9	10.3	3.90	2.39
M.423/51	29.4	11.2	3.29	2.12

N:Co.310 and N:Co.376 have continued to give interesting results in the irrigated regions of the island, and the latter variety in the superhumid region in addition. Both varieties are heavy arrowers, and have very difficult trash which means that fields usually have to be burnt. Neither variety is popular on those estates which have laid down a limited acreage.

For this reason, N:Co.310 which has only performed well in the irrigated regions, will probably be dropped from the testing programme, while a decision on N:Co.376 will be postponed until the results of a new series of trials become available.

R.397. The remarks on N:Co.310 above are equally applicable to R.397. This again is a heavy-flowering variety which, after extensive trials, has only been found to give passable results in the irrigated region. It does not possess the high sugar content of the former variety, is liable to cyclone damage, and on account of its limited adaptability, could not be recommended for general release.

Other varieties, which at present appear to be promising and which have a high sugar content are M.658/51, M.13/53, M.359/53, M.361/53, and Ebène 88/56.

5. STUDIES ON SEEDLING POPULATIONS

E. F. GEORGE

(i) Selection for adaptation

The performance of current commercial clones is not uniformly good over all the environments of Mauritius. This emphasizes the need to pay attention in the breeding programme to the particular adaptation of clones.

One approach to this problem was to plant populations of original seedlings in areas representative of the major environments which are encountered. Selection of these seedlings, and of the two subsequent stages established from cuttings, *viz.* Propagation Plot and First Selection Trial, was conducted on the same experimental station (i.e. within the same environment) as that in which the seedlings were originally planted.

Two objections to this scheme were that it was wasteful of seedlings which were discarded in one environment, but which could have been selected in another, and that it was found that the selection of individual, original seedlings was imprecise in the super-humid region.

It was decided to try an alternative method of selection. This entails selection of original seedlings as far as the single stool stage in the humid region where selection is more efficient. Thereafter, clones are propagated and selected at two sites simultaneously, the sites being chosen to represent the main environmental differences.

It is assumed that initial selection in the humid region is effective both for the humid and super-humid regions and that selection for adaptation is not very important at this stage. That is to say, ideally the same clones would have been selected in both environments if the efficiency of selection had been high at both sites.

(*a*) **Selection of seedlings.** To test these assumptions, 20 clones were selected from each of 3 crosses. A random sample of 20 clones from each cross was also taken, and all 120 clones were planted with standard commercial clones in single line plots, 15 ft in length at both Pamplemousses, in the humid region, and Union Park, in the super-humid region.

Because of more satisfactory growth it was possible to weigh the Pamplemousses experiment in plant cane. In both experiments in the following year, the average brix of each clone was measured along with average diameter, number of canes and weight of millable cane per plot.

At Pamplemousses, in the two years, and at Union Park, in first ratoon, the mean weight of cane was significantly higher in the selected clones. Selection expectations, based on the genetic variance, confirmed that at Pamplemousses the selections were indeed more likely to give commercial clones than the randomly chosen clones. At Union Park, however, it appears from similar calculations that selections and randoms were of equal worth. Although the selections gave higher mean yield, they appeared to suffer in a drop of variability. This plot was however subject to a large amount of environmental error, which could have been the cause of this apparent failing. Further experiments are necessary to confirm that variation is not curtailed in selections from another environment, for if this were so, it would show that much of the adaptation to the super humid region is lost by selecting in the humid region. Advance will not be rapid if selections are only of the same final worth as random clones.

(*b*) **Selection in propagation plots.** 107 clones, all selected at Pamplemousses, were planted at both Pamplemousses and Union Park in propagation plots in 1960. Both plots were cut on the same day when in plant cane and weighed. Seven clones which were good only at Pamplemousses were selected, as well as seven different clones which were good only at Union Park These groups were taken to represent extremes of adaptation. A final group of seven clones was chosen which had been superior at both sites. 4 different commercially cultivated clones were added to make a total of 25. These were planted in two 5 x 5 balanced lattice squares, one at Pamplemousses, the other at Union Park.

These two trials were harvested this year in first ratoon. Analysis of variance has shown that there was a very highly significant (P=0.001) clone environment interaction. Table 8 shows the means of the three selection groups in the Pamplemousses trial, and Table 9 similar results in the trial at Union Park.

Table 8. Significant differences between mean selection group weights, Pamplemousses trial. (S.E. mean ± 0.99 tons/arpent)

Selection Group	*Mean Wt. T.C.A.*	*(c)*	*(b)*	*(a)*
(a) Selected at Pamplemousses	47.73	**		
(b) Selected at both Pamplemousses and Union Park ...	46.13	**		
(c) Selected at Union Park	42.12			

Table 9. Significant differences between mean selection group weights, Union Park trial. (S.E. mean ± 1.45 tons/arp.)

Selection Group	*Meant Wt. T.C.A.*	*(c)*	*(b)*	*(a)*
(a) Selected at Union Park	33.05	**		
(b) Selected at both Pamplemousses and Union Park ...	29.59	*		
(c) Selected at Pamplemousses	25.24			

* Means significantly different at 5% level.

** Means significantly different at 1% level.

It will be noticed that selection at Pamplemousses resulted in a groups of varieties which were significantly better in the Pamplemousses trial than the group selected at Union Park. In an exactly analogous fashion, at Union Park the varieties selected for performing well at Pamplemousses comprised, in the trial, a significantly inferior group. At both sites, the varieties which were selected from the propagation plot for a good performance in the two environments formed an intermediate group.

This experiment seems to indicate that a population of seedlings selected originally at Pamplemousses, still possesses variation for adaptation which can be utilised at the following propagation plot stage of selection.

Results of experiments so far, therefore, tend to confirm that the present system of selection is along the right lines, but further investigations would be advisable.

(ii) Physiological characters in selection

An experiment was conducted during the year to determine some physiological constants of sugar cane clones and their progenies. Five female clones were crossed with each of two males. Measurements were made on sample plants of these 7 clones together with plants from the 10 progenies.

Significant differences were detected between the clonal and progeny means of all the characters measured which were as follows :

(i) Assimilation rate. This is the increase in dry weight per unit leaf area per unit time.

(ii) Relative growth rate. Increase in dry weight per unit time.

(iii) Leaf area ratio. Leaf area per unit dry weight.

(iv) Mean leaf area.

The efficiency with which any of these characters could be utilised in selection depends on the repeatability of measurements from one generation to the next. Expected repeatibilities in this experiment were as follows :

Assimilation rate	0.58
Relative growth rate	0.57
Leaf area ratio	0.82
Mean Leaf Area	0.57

The transmission of the characters from parents to offspring was also examined. The reliability of the observed, or phenotypic, value of parents as a guide to their breeding value is given by the heritability of a character. Estimates of heritability in the present calculations are as follows :

Assimiliation rate	0.35
Leaf area ratio	0.23

From analysis of variance, it was found there was a significant interaction between male and female parents in each of the characters examined. This represents variation which cannot be predicted in advance and which makes difficult the task of the breeder in forecasting the outcome of a cross.

It is hoped to present a full account of the work in the course of 1964.

(iii) Competition between varieties planted as single stools

It seems clear that competition is one of the causes of inefficient selection in singly planted seedlings or single stool plots established from cuttings. An experiment was conducted to assess the effect of competition both on, and by, five different clones which served in turn as surrounding, or partly surrounding competitors in two different treatments, and also as the surrounded single stools. Measurements were made of the average diameter and average length of the plants, as well as number of canes and weights per stool. A score representing the condition of the top foliage was also recorded.

A first analysis of the data shows most clearly that number of canes, and hence weight, are the two characters most affected by competition between stools, but some other characters are also affected. It has been noticed that the competitional depression caused to this set of 5 clones by one of the clones acting as competitor was directly related to the gain that clone made when surrounded in turn by the other clones as competitors. The position and slope of the regression line were determined by the type of competition.

(iv) Other selection experiments

Characters were recorded in two other experiments during the harvest season. One is concerned with selection, and especially with selection for adaptation, in single stools, while the other concerns the inheritance of components of of yield and brix in progenies of seven parent clones. The assistance of students from the College of Agriculture in compiling the field data from these trials is gratefully acknowledged.

REFERENCE

GEORGE, E. F. *and* LALOUETTE, A. (1963). Photoperiodic experiments on the sugar cane variety C. P. 36-13. *Proc. int. Soc. Sug. Cane Tech.* **11** 516—526.

NUTRITION AND SOILS

1. CHEMICAL FERTILIZATION

D. H. PARISH

NITROGEN

THE sugar industry spends more money on nitrogen than on phosphate and potash together, and it is therefore essential to have full information on the efficiency of the different forms of nitrogen fertilizers available in supplying nitrogen to the cane, and on the most suitable timing, rates, and methods of application of these fertilizers.

With potash, and with phosphate particularly, the soil acts as a reservoir so that reserves of these two elements can be built up and no dramatically quick change from adequate supply to deficiency conditions occurs. Nitrogen applied as fertilizer nitrogen is, unless it is synthetized into organic nitrogen, rapidly nitrified, and is then leached from the soil in the rainy season.

Because of the increasing production and consumption of complex fertilizers, all of which contain about one-third of their nitrogen as nitrate nitrogen, it is essential that the degree of nitrate-nitrogen losses under field conditions be known.

The diagram (fig. 18) shows the effect of a heavy rainfall on the distribution of nitrate applied to the soil surface a few days previously.

The soil at the site of the experiment is a deep free-draining soil with good infiltration characteristics, giving little or no run-off even under the heaviest showers. The effect of the five inches of rain, which fell in about four hours, has been to leach the nitrate down the soil profile to an average depth of eight inches. There is no doubt from these figures, that, on the shallow gravelly soils which form about half the cane acreage of Mauritius, soil nitrate would be removed almost completely from the soil with such a heavy shower.

Many comparative tests between nitrate-of-soda and ammonium sulphate have been carried out in the various sugar producing areas and the results indicate a general equality of efficacy for these two forms of nitrogen.

The results of experiments carried out in Mauritius have also shown equality between the two forms, but nevertheless a new series of comparisons was laid down in 1961 to reassess the information available, and more specifically, to study the effect of these two fertilizers on soil acidity.

The results of the 1963 harvests are given in Table 10 together with the vegetative index and leaf-nitrogen content data (V.I. and leaf N % D.M.) obtained at the boom phase of vegetative growth.

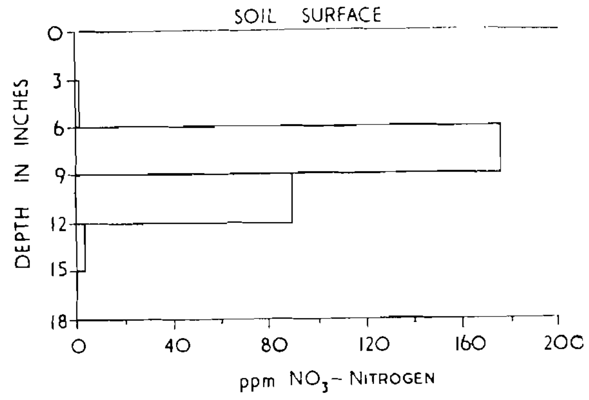

Fig. 18 The distribution of surface-applied nitrate after a heavy (5″ in two days) fall of rain.

Of the series of experiments, one did not respond to applied nitrogen, one responded only to one treatment, and the remaining two trials responded well. Although, on the average ammonium sulphate produced more cane than sodium nitrate, the differences are not significant.

Some of these experiments are now beginning to respond well to nitrogen, and future results may enable a definite conclusion as to the relative merits of nitrate and ammonium forms of nitrogen to be made.

The essential requirement for a comparative test of two fertilizers is that a treatment response be obtained; in other words, the factor being studied must be limiting crop yields and it must be the major or the only factor limiting yields.

Often in the first year of a nitrogen fertilization study, crop response to applied nitrogen is low, but as the experiment is repeated year after year, responses improve and the sensitivity of the experiment therefore improves.

The two diagrams (figs. 19 and 20) show the actual yields of plots receiving 0, 30 kgs and 60 kgs of nitrogen from virgins through the crop cycle up to fifth ratoons, expressed as tonnages and as a percentage of the 60 kgs nitrogen plots.

These two figures are very interesting, as they show that depletion of the nitrogen supplying power of the soil occurs with time, but that an apparent flattening of the curves takes place, indicating that the soil is approaching an equilibrium supply equivalent in these experiments to about 12 kgs nitrogen per annum.

The amount of nitrogen falling on to an area of one acre with the rainfall varies widely between various countries and sites within those countries. Koch (1941) gives the highest figures of 12 lb of ammonium, nitrite, and nitrate–nitrogen/acre/annum for Ceylon, but as he points out, most of this nitrogen falls with the heavy rains and much of it will pass into the drainage waters.

It has been suggested that non-symbiotic fixation of nitrogen occurs on latosols under graminaceous cover. Moore (1963) found that with bare soil, there was no increase in soil nitrogen with time, but that where a cover of *Eleusine coracana* was grown, nitrogen gains equivalent to from 100-130 lbs of nitrogen/acre, spread to a depth of six inches, occured. These data are taken as supporting, but not proving, the hypothesis of non-symbiotic fixation in the soil.

The data presented in the two graphs are certainly indicative of a steady supply of nitrogen of about 25 lbs/acre/annum from non-symbiotic and/or rainfall sources.

The reason that field experiments have failed so far to show a difference between nitrate and ammonium nitrogen could be due to the

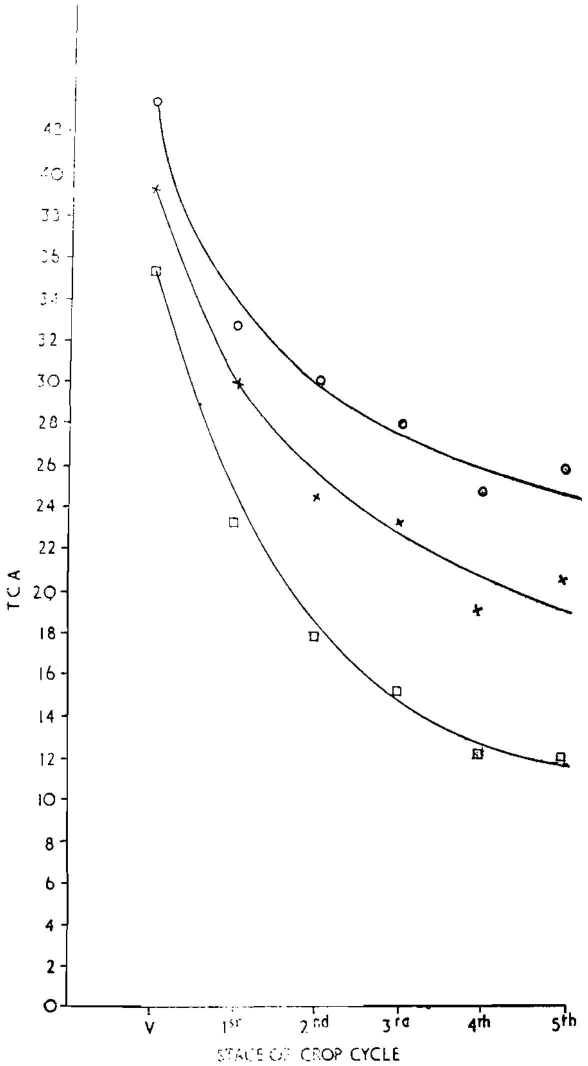

Fig. 19 The effect of nitrogen and time on the yields of cane.

Crosses and plain line : 60 Kgs. Nitrogen annually.
Circles and plain line : 30 Kgs. Nitrogen annually.
Squares and plain line : O Nitrogen.

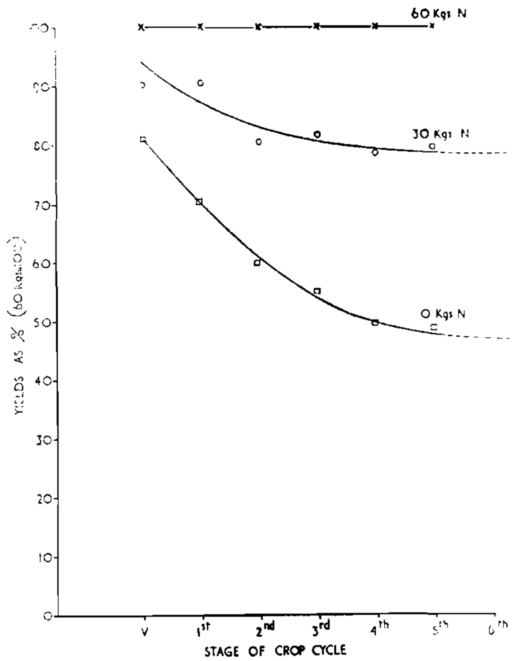

Fig. 20. The effect of nitrogen and time on the yields of cane expressed as a percentage of the 60 Kgs. nitrogen plots.

Crosses and plain line : 60 Kgs Nitrogen annually.
Cicles and plain line : 30 Kgs Nitrogen annually.
Squares and plain line : O Nitrogen.

fact that the efficacy of the ammonium form of nitrogen itself is low. Data for Mauritius published by Craig (1947) show that a crop of thirty-five tons of cane, an average local yield, removes only around 20 kgs of nitrogen per acre; when some of the green tops are removed for fodder, this figure increases to around 25 kgs of nitrogen. As the average application of nitrogen to our cane land is 45 kgs per arpent, then the amount of fertilizer nitrogen recovered is apparently only about one-half of that applied.

If the soil under cane is capable of receiving around 12 kgs of nitrogen each year by non-symbiotic fixation, and/or rainfall, then very large losses of nitrogen from the soil must occur.

Only two processes can be considered as being of any importance in causing nitrogen losses under our conditions and they are loss of nitrate by leaching and denitrification. If nitrification, i.e. the change from ammonium to nitrate, could be blocked, then a marked improvement in the efficacy of applied nitrogen should occur, and in fact, chemicals with the property of stopping or slowing down nitrification have been developed with this aim in view. One of these materials* is currently being tested on a field scale, as it has been shown in the laboratory (fig. 21) that it does in fact slow down appreciably the nitrification rate of ammonium sulphate. In order that these "partial sterilants" be effective on a field

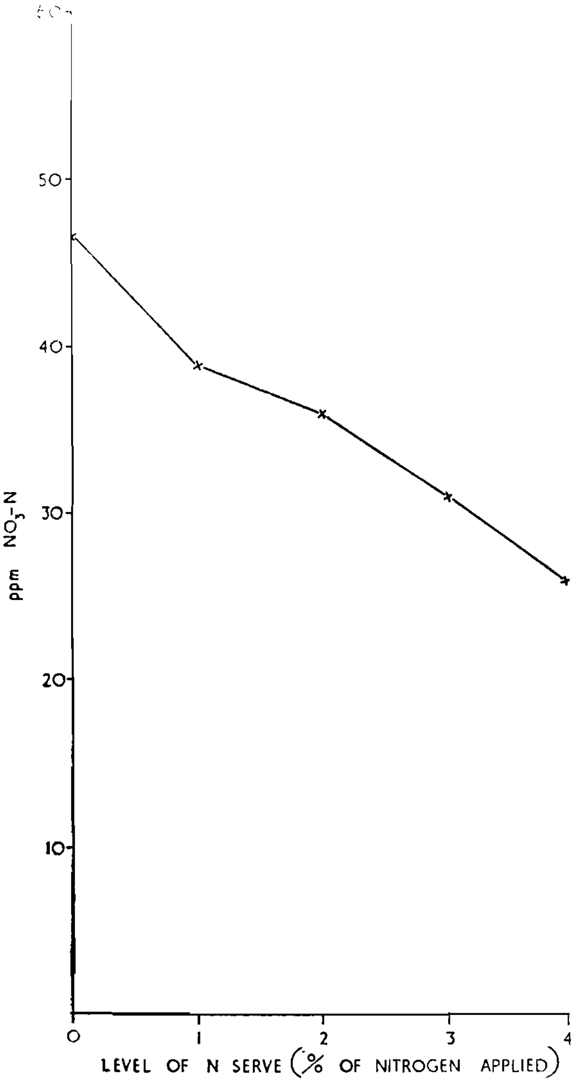

Fig. 21. Effect of «N-Serve» on the nitrification rate of treated ammonium sulphate sprinkled between two soil layers (analyses made after 20 days).

* "N — Serve" produced by Dow Chemicals.

scale in Mauritius, where nitrogen is applied in many areas three or four months before active growth begins with the heavy summer rains, they would have to have very long lasting effects. The material currently being tested is volatile, and therefore will probably not show long lasting effects, and because of its volatile nature it cannot be used on the soil surface, but must be buried; this will limit any uses it may have to less than one half of the cane acreage.

Other field work on nitrogen at present being carried out is on the effect of placement on the efficacy of applied nitrogen.

PARISH and FEILLAFÉ (1960) showed that surface-applied urea was of low efficacy in supplying nitrogen to cane under Mauritius conditions, a result which has been confirmed for other sugar countries (STICKLAND, 1963).

Urea, because of its high nitrogen content (45% N), is a potentially attractive material from the point of view of freight economy, and as the principal cause of its poor efficacy is due to its decomposition by soil urease to ammonium carbonate, an unstable salt, then burying or watering on urea solutions should improve its performance.

Laboratory experiments (PARISH *et al*, 1962) had previously shown that losses by volatilization were eliminated if the urea were buried about six inches deep and it was decided to test this on a field scale, and at the same time to include ammonium sulphate in the trials : as many of the local soils are rocky, burying of the fertilizer is impossible, and therefore on these sites the fertilizer was disssolved in water and watered on.

The results of individual trials have been erratic and it has been necessary to combine years and sites in order to obtain significant results.

Generally, the results show that ammonium sulphate is superior to urea and that burying both urea and sulphate of ammonia improves their efficacy, although even when both are buried, ammonium sulphate remains slightly better than urea. The most interesting point is that the sulphate of ammonia applied on the surface at a rate of 60 kgs of nitrogen/arpent was inferior by about one ton of cane an acre to the same amount of sulphate of ammonia buried or watered on.

Further work is being carried out to find the reason for this inferiority of surface-applied nitrogen, as all the soils of the experimental sites were acid to slightly acid, and would not normally be expected to cause ammonia loss by decomposition of the ammonium salts.

A possible cause for the improvement in yields by burying is a reduction of fertilizer burn, as much fertilizer burn occurs in Mauritius due to fertilizers salts falling into the bases of open leaves and into the cups made by the unfurled younger leaves. The amount of loss caused by fertilizer burn is being studied; but as locally the cost of applying fertilizer is low, there is no reason why any burn at all should occur if a little extra time and care were spent in applying the fertilizer.

The most economical rate for applying nitrogen varies with the cost of nitrogen relative to the cost of sugar and with variety. Current recommendations on the amounts of nitrogen to apply are based on the results of many field experiments, but an improvement on this method would be if plant and or soil analyses could be used as guides to the nitrogen requirements of individual areas.

These two points are being actively studied, particularly the determination of the composition of the soluble nitrogen fraction of leaf laminae.

The level of total nitrogen in leaf tissue in sugar cane is low, being only about 2% on a dry matter basis, and the level of soluble nitrogen too is low, compared with most plants.

The principal amino-acid in the free-amino-acid pool of cane leaf tissue is alanine, but twenty-nine other ninhydrin reacting spots are easily detectable and work on the qualitative and quantitative determination of individual amino-acids is in progress.

To summarize, it would seem that the efficacy of applied nitrogen is low, and that a field of applied research with important financial implications for improving nitrogen utilization by the cane plant, is open.

Table 10. A comparison of ammonium sulphate and sodium nitrate as nitrogen sources for sugar cane.

Treatments	*Yields T. C. A.* Expt. No. 8/61	Expt. No. 9/61	Expt. No. 10/61	Average Yields	*V. I. & leaf N% D. M.* Expt. No. 8/61	Expt. No. 10/61
O Nitrogen	27.8	40.6	35.4	34.3	100 / 1.80	100 / 1.71
30 Kgs N as S of A	34.6*	43.7	44.2**	40.6	103 / 2.08	119 / 1.91
60 Kgs. N as S of A	34.1*	48.5**	49.2**	43.9	110 / 2.17	122 / 2.08
30 Kgs N as N of S	34.8**	42.4	44.4**	40.5	108 / 2.03	119 / 1.87
60 Kgs N as N of S	37.0**	44.0	46.4**	42.5	114 / 2.08	123 / 1.87

* Treatment effects significant at 5% level.

** Treatment effects significant at 1% level.

PHOSPHATE

Introduction

In 1954, the amount of phosphatic fertilizer imported into Mauritius was at a very low level, and as there was widespread phosphate deficiency, serious yield losses were occurring.

The only sources of phosphate used by the sugar industry at that time were guano-phosphaté, a soft rock-phosphate, imported from neighbouring islands, and factory filter-press muds which contain about 2% P_2O_5 on a dry matter basis.

Both the rock phosphate and the filter muds were banded in the furrow at planting, at rates supplying about 25 kgs P_2O_5 each, i.e. 125 kgs guano-phosphaté and 3 tons scums. This dressing of phosphate on, in many cases, extremely deficient soil, was expected to last the cane crop for about seven years, giving an annual rate of application of only 7 kgs/annum/arpent of P_2O_5.

As large areas of ratoons were deficient and it was apparent that the basic fertilization was in many cases inadequate even for the virgin crop, the problems to be solved were :

(a) What is the optimum fertilization at planting as regards both rate and form of fertilizer ?

(b) Can phosphate deficient ratoons be treated with phosphate to correct the deficiency, and if so, what is the most efficacious form and method of placement ?

(c) Is it a better policy to attempt to build up soil phosphate reserves by the use of heavy applications of phosphate at planting, or to use smaller annual applications ?

Generally accepted tenets concerning phosphate fertilization are that :

(a) Rock phosphates are of value only on acid soils and that they should be intimately mixed with the soil for maximum efficiency.

(b) Soluble phosphates, particularly on the acid ferralitic soils of the tropics, are rapidly fixed and will have poor residual values.

(c) That on soils with a high phosphate fixing capacity, small frequent applications of soluble phosphate are probably superior to massive dressings widely spaced in time.

(d) That super-phosphate is a suitable standard for comparative purposes because of its good performance over a wide range of soil conditions in supplying phosphate to plants.

The programme of field work initiated in 1954 to study the whole problem of phosphate fertilization has produced many results of value, particularly as regards the long term effects so important in a crop which grows seven or more years without replanting, and the results obtained to date are summarized below.

Experimental results

Experiments at Planting

The forms of phosphate used in these experiments were single super-phosphate, triple super-phosphate, ammonium phosphate, and three forms of rock phosphate.

The forms of rock phosphate used were Agrophos, a material ground to the generally accepted degree of fineness of 95% through a hundred mesh B.S. sieve, Novaphos and guano-phosphaté. The latter material a rock phosphate imported from neighbouring islands, is not standardized as regards analysis and fineness of grinding and samples of the material have varied in phosphate content from 16 to 32% P_2O_5 and would give up to almost 50% not passing a 36-mesh B.S. sieve.

First Series.

The materials compared were single-super-phosphate, Agrophos, Novaphos and guano-phosphaté applied in the furrow at planting time at a rate of 125 kgs/P_2O_5/arpent. The soils of the various sites had an average pH of 5.4 and all the sites had previously been under cane.

Results for the virgin crop are given in Table 11 and show that all but one trial responded to phosphate application. When the results of these experiments are pooled, single-super-phosphate is significantly better ($P = 0.01$) than Agrophos, the only other standardized phosphate used in these experiments. The three rock-phosphates were similar in efficacy.

It should be noted that ammonium sulphate (applied at about 200 kgs/arpent) was the nitrogen source and in these experiments, the effect of super-phosphate is not therefore a sulphate effect.

The residual values of the different forms of phosphate are shown graphicaly in fig 22.

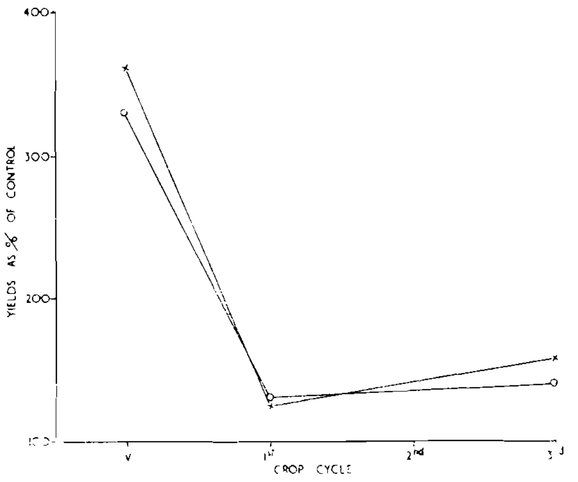

Fig. 22. The residual values of superphosphate and rock phosphate.

Crosses and plain lines : Superphosphate.

Circles and plain line : Rock phosphate.

Table 11. A comparison of single superphosphate, Agrophos, Novaphos and guano phosphaté applied at the rate of 125 Kgs P_2O_5/arpent in the furrow at planting. Figures are T.C.A. for the virgin crop.

Site No.	*Control*	*Super*	*Agrophos*	*Novaphos*	*Guanophos*
1	17.0	24.8**	23.2**	22.0**	22.0**
2	19.3	23.2*	21.3	20.6	19.6
3	17.5	23.5**	23.2**	27.1**	22.3**
4	7.6	27.4**	24.6**	25.6**	24.6**
5	12.5	18.2*	15.6	—	—
6	22.8	25.6	23.4	21.0	21.6

* Treatment effects significant at 5% level.

** Treatment effects significant at 1% level.

Second Series.

In these trials triple-super-phosphate, ammonium phosphate and guano-phosphaté were compared at three rates, viz. 0 ,60 and 120 kgs P_2O_5 in the furrow at planting.

Results for the virgin crop yields and leaf weights and P_2O_5 contents for both the virgin and first ratoon crop are given in Tables 12 and 13.

Table 12. A comparison of triple super-phosphate, ammonium phosphate and guano phosphaté applied at rates of 60 & 120 Kgs P_2O_5/arpent. Yields T.C.A. for the virgin crop.

Site No.	*pH of soil*	*Control O P_2O_5*	*Triple Super 60 Kgs*	*Triple Super 120 Kgs*	*Amm. phosphate 60 Kgs*	*Amm. phosphate 120 Kgs*	*Guano phosphaté 60 Kgs*	*Guano phosphaté 120 Kgs*
13	4.7	8.7	23.1**	26.0**	18.6**	24.4**	23.7**	24.2**
14	5.3	18.6	24.2**	22.9	23.5	26.1**	25.6**	22.8
15	5.1	9.9	31.2**	30.8**	26.3**	34.0**	28.9**	30.7**
16	5.6	13.8	29.3**	28.1**	26.5**	29.6**	22.7**	23.7**
Average yields		12.75	26.95	26.95	23.73	28.75	25.28	25.35

* Treatment effects significant at 5% level.

** Treatment effects significant at 1% level.

Table 13. The effect of rate and form of phosphate at planting on the V. I and P_2O_5* content % D.M. of the leaf laminae (Virgin Crop).

Site No.	*Control* $0\ P_2O_5$	*Triple Super* *60 Kgs*	*120 Kgs*	*Amm. Phosphate* *60 Kgs*	*120 Kgs*	*Guano Phosphaté* *60 Kgs*	*120 Kgs*
13	100 / 0.36	131 / 0.42	143 / 0.45	127 / 0.42	141 / 0.45	128 / 0.42	135 / 0.45
14	100 / 0.39	122 / 0.40	120 / 0.39	116 / 0.39	114 / 0.41	117 / 0.41	120 / 0.41
15	100 / 0.34	153 / 0.38	157 / 0.42	148 / 0.40	156 / 0.42	150 / 0.42	158 / 0.47
16	100 / 0.33	119 / 0.38	113 / 0.39	113 / 0.37	122 / 0.39	114 / 0.34	116 / 0.35
Av.	100 / 0.35	132 / 0.40	134 / 0.41	125 / 0.39	134 / 0.41	128 / 0.40	133 / 0.42

P_2O_5* % D.M. of leaf laminae (1st Ratoon Crop).

Site No.	*Control* $0\ P_2O_5$	*Triple Super* *60 Kgs*	*120 Kgs*	*Amm. Phosphate* *60 Kgs*	*120 Kgs*	*Guano Phosphaté* *60 Kgs*	*120 Kgs*
13	0.36	0.38	0.41	0.39	0.40	0.38	0.41
14	0.36	0.40	0.43	0.41	0.41	0.38	0.40
15	0.33	0.33	0.38	0.37	0.39	0.39	0.40
16	0.38	0.38	0.39	0.36	0.44	0.37	0.39
Av.	0.36	0.37	0.40	0.38	0.41	0.38	0.40
Av. V.I**	100	108	118	110	122	113	118

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* The P_2O_5 contents have not been corrected for variety and age and are presented only for comparisons between treatments.

** Some cyclone damage occurred before sampling and therefore average V Is have been used.

For the virgins, if the leaf weights of the 60 kgs P_2O_5 treatments are compared with the leaf weights of the 120 kgs P_2O_5 treatments, then the latter are significantly higher ($P=0.01$) indicating a growth response to the additional 60 kgs. The leaf weights and analyses for the first ratoons are given in Table 13 and are also indicative of a better growth with the 120 kgs P_2O_5 level than with the 60 kgs level.

The residual effects of the applied phosphate are shown in fig. 23.

In first ratoons at trial Site No. 13, where the pH was very low, guano-phosphaté at the 120 kgs P_2O_5 rate was significantly better (5 % level) than the lower level of ammonium phosphate, but in second ratoons no significant treatment difference was obtained.

For the trials Site Nos. 14 & 15 treatment effects on yields of cane in ratoons were not significant.

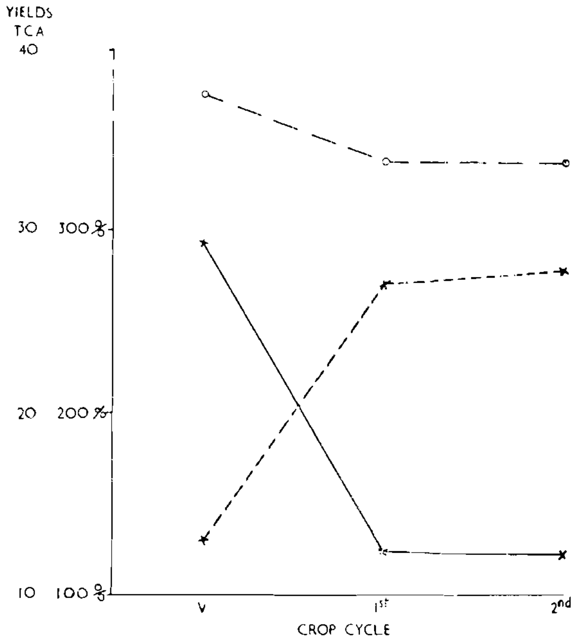

Fig. 23 The effect of phosphate on cane yields in virgin and 1st and 2nd ratoon crops.

Circles and broken line : Yields of phosphate-treated plots.
Crosses and broken line: Yields of control plots.
Crosses and plain line : Yields of phosphate-treated plots expressed as percentage of control plot yields.

Table 14. The effect of form and level of phosphate on cane yields from the pooled results of three harvests (Virgins, 1st and 2nd ratoons) for an experiment which responded to phosphate in the three consecutive years.

Treatment	*Mean plot yields*	*Treatment differences*		
		1	6	5
1. Amm. phosphate @ 120 Kgs P_2O_5 ...	298	137**	51**	36**
2. Triple super @ 120 Kgs P_2O_5 ...	293	132**	46**	31**
3. Triple super @ 60 Kgs P_2O_5 ..	288	127**	41**	26
4. Amm. phosphate @ 60 Kgs P_2O_5 ...	272	111**	25	10
5. Guano phosphaté @ 120 Kgs P_2O_5 ...	262	101**	15	
6. Guano phosphaté @ 60 Kgs P_2O_5 ..	247	86**		
7. Control	161			

* Treatment effects significant at 5 % level.

** Treatment effects significant at 1 % level.

The trial Site No. 16 responded extremely well to the phosphate treatments in both first and second ratoons; all treatments were significantly better than the control (P=0.01) and 120 kgs of P_2O_5 as ammonium phosphate and triple super-phosphate were superior to 120 kgs. of P_2O_5 as guano-phosphaté. The results also suggest that the 120 Kgs levels of P_2O_5 are generally superior to the 60 kgs levels. (Table 14).

Third series.

In these trials ammonium phosphate, triple super-phosphate, precipitated phosphate and guano-phosphaté were compared : the comparisons were therefore of noncalcium, monocalcium, dicalcium and tricalcium phosphates as phosphate sources for cane.

The phosphates were applied at a rate of 60 Kgs of $P\ O_5$/arpent in the furrow at planting. Results for the yields of the virgin crop are given in Table 15 and once again show the superiority of water soluble phosphates.

Table 15. Form of phosphate at planting (60 Kgs P_2O_5 applied furrow)

Yields in T.C.A. (Virgin Crop)

Site No.	*Control*	*Monocalcium phosphate*	*Dicalcium phosphate*	*Tricalcium phosphate*	*Ammonium phosphate*
4 a	5.3	† 15.3**	9.8*	12.9**	11.9**
3 a	35.6	38.8	36.7	38.8	38.5
2 a	44.1	53.0**	50.4*	51.9*	54.8**

* Treatment effects significant at 5% level.
** Treatment effects significant at 1% level.
† Monocalcium phosphate is significantly better (1% level) than dicalcium phosphate.

Fourth series.

Because of the possibility that calcium was a limiting factor for growth and the interaction of calcium and phosphate, trials were laid in which tricalcium phosphate and ammonium phosphate were compared, when applied in the furrow with, and without, three tons of coral sand.

Table 16. Coral sand and form of phosphate (guano-phosphaté and mono-ammonium phosphate applied at 125 Kgs P_2O_5/arpent in the furrow at planting)

Yields in T.C.A. (Virgin crop) †

Treatments	*Sites* 12/61	13/61	15/61	17/61	*Average*
1. Control	14.4	11.2	13.6	21.9	15.3
2. Guano-phosphaté ...	16.7	19.3**	19.3**	27.5	20.8
3. Amm. phosphate ...	19.5**	20.4**	21.9**	22.9	21.2
4. 3 tons coral sand ...	15.0	11.6	14.8	23.4	16.2
5. Treatments 2 + 4 ...	15.1	16.8*	19.9**	23.3	18.2
6. ,, 3 + 4 ...	16.9*	21.6**	19.3**	29.7*	21.9

* Treatment effects significant at 5% level.
** Treatment effects significant at 1% level.
† None of these experiments responded to any treatment in 1st ratoons.

Table 17. Leaf sheath calcium levels % D.M.

Treatments		Sites		
		12/61	*15/61*	*17/61*
1.	Control	0.254	0.156	0.176
2.	Guano-phosphaté ...	0.293	0.205	0.186
3.	Amm. phosphate ...	0.283	0.186	0.196
4.	3 tons coral sand ...	0.303	0.196	0.225
5.	Treatments 2 — 4 ...	0.274	0.215	0.254
6.	,, 3 — 4 ...	0.293	0.205	0.234

The yield results and sheath analyses for the virgin crop are given in Tables 16, 17. The results show the general superiority of ammonium phosphate over tricalcium phosphate and the depressing effect of sand on the availability of the phosphate in guano-phosphaté.

No significant responses to either phosphate or sand applications were obtained with the first ratoon crops.

Results of an earlier series of experiments in which soluble and insoluble phosphates were compared with, and without 2 tons of slaked lime applied in the furrow before planting, were re-examined. Table 18 shows the depressing effect of liming on the availability of the phosphate in rock phosphate, whilst the efficacy of super-phosphate is unaffected. These results were for the virgin crop; in the first ratoon crop no effect of liming on phosphate availability could be detected.

Table 18. The effects of two tons of slaked lime, applied in the furrow at planting, on the efficacy of superphosphate and rock phosphate similarly applied. (Figures are yields in T.C.A./arpent for the virgin crop)

Site	*Superphosphate*		*Rock phosphate*	
	Unlimed	*Limed*	*Unlimed*	*Limed*
1	24.8	24.8	23.2	18.3
2	23.2	19.4	21.3	17.1
3	23.5	27.8	23.2	21.0
4	27.4	28.6	24.6	21.5
5	18.2	16.9	15.6	14.8
Average	23.4	23.5	21.6	18.5

*The unlimed rock phosphate yields are significantly higher (P — 0.05) than limed rock phosphate yields.

Experiments with ratoon crops.

First series.

Four sites, in areas known to be generally deficient in phosphate, were chosen, the basic treatment being 40 kgs P_2O_5 applied on the trash, which, as is current practice, was wind-rowed on alternate interlines.

Four forms of phosphate were used, guano-phosphaté, super-phosphate, triple super-phosphate and ammonium phosphate.

The experimental results of the first harvest are given in Table 19 together with the leaf analyses.

Table 19. The effect on yields (T.C.A.) of 40 Kgs of P_2O_5/arpent applied on the trash to third ratoon crops in the form of single superphosphate, triple superphosphate, guano phosphaté and ammonium phosphate

Site	*Control*	*Super*	*T. Super*	*Guano Phosphaté*	*Amm. Phosphate*	*Soil pH*
17	37.1	37.1	38.7	38.5	41.4*	4.9
18	29.9	31.0	29.9	28.6	30.4	5.4
19 †	28.2	31.6*	31.4*	29.5	32.8**	–
20	28.4	30.2	29.1	29.3	27.3	6.2

* Treatment effects significant at 5% level.

** Treatment effects significant at 1% level.

† Ammonium phosphate is significantly better (P = 0.05) than guano phosphaté.

Third ratoon V. Is and P_2O_5 % D.M. of leaf laminae

Site No.	*Control*	*Super*	*Triple Super*	*Guano Phosphaté*	*Amm. Phosphate*
17	100 / 0.38	103 / 0.40	104 / 0.40	101 / 0.41	104 / 0.42
18	100 / 0.39	99 / 0.43	98 / 0.46	98 / 0.46	105 / 0.41
19	100 / 0.37	106 / 0.42	103 / 0.45	105 / 0.41	104 / 0.46
20	100 / 0.46	100 / 0.48	105 / 0.49	101 / 0.45	100 / 0.50

Only at one site was there a marked yield response to phosphate fertilization, but the leaf analyses show increased phosphate uptake in all cases.

In the trial Site No. 19, ammonium phosphate was significantly better than guano phosphaté. Because of the good response to phosphate, this trial was continued for another two years, the treatments being repeated each year. The results for all three harvests from this experiment are given in Table 20. These results show that after the first year, a response to guano-phosphaté is obtained, and that then there is no significant difference between forms of phosphate.

Table 20. The effect on yields of 40 Kgs. P_2O_5 applied annually on the trash of ratoon crops (T.C.A.)

Harvest	*Control*	*Super*	*Triple Super*	*Guano Phosphaté*	*Amm. Phosphate*
1957	28.2	31.6*	31.4*	29.5	32.8**
1958	29.6	33.6*	33.2*	33.9**	32.6*
1959	30.2	33.0*	34.9**	34.1*	33.4*
Total	89.0	98.2	99.5	97.5	98.8
Increase in yield		9.2	10.5	8.5	9.8

* Treatment effect significant at 5% level.

** Treatment effect significant at 1% level.

Second series.

This series of experiments was an attempt to establish the most suitable form of phosphate and method of placement, i.e. on the cane line or the trash interline, for use annually in ratoons. The forms of phosphate used were triple superphosphate, guano phosphaté and ammonium phosphate at a rate of 25 Kgs/arpent of P_2O_5 applied annually.

Of this series of experiments, only one trial gave results of interest, the remaining trials gave no results of value, being either not deficient in phosphate, or being affected by one of the many hazards existing for field experiments.

The results for the trial which responded are given in Table 21, together with the V. I. and P% D. M. figures.

For the 1961 harvest, triple super-phosphate applied on the trash was superior to guano-phosphaté applied on the trash; for the 1962 harvest however, all treatments were equal and highly significant.

Table 21. Effect of phosphate applied to ratoons at a rate of 25 Kgs P_2O_5/arpent/annum. (Yields in T.C.A.)

Harvest year	*Control*	*Guano phosphaté*		*Triple Super*		*Amm. Phosphate*	
		Stool	*Trash*	*Stool*	*Trash*	*Stool*	*Trash*
1958 ...	34.8	34.9	33.5	33.3	33.0	34.4	34.1
1959 ...	34.2	35.2	34.6	37.2	34.6	33.9	36.4
1961 ...	17.4	20.2	17.8	20.7*	21.0*	19.2	20.8*
1962 ...	24.8	35.3**	33.4**	31.7**	35.4**	35.3**	33.1**
Average yields ...	27.75	31.4	29.8	30.7	31.0	30.7	31.1
V.I. and P% D. M. for 1963 ...	100 / 0.165	125 / 0.182	122 / 0.190	117 / 0.185	113 / 0.185	119 / 0.170	124 / 0.180

* Treatment effects significant at 5% level.

** Treatment effects significant at 1% level.

Discussion

In the late 1950's, large areas of ratoon and even virgin cane growing in Mauritius showed the typical leaf discoloration of phosphate deficiency, and the yearly foliar diagnosis figures (some 5.000 leaf samples a year were analysed for phosphate content) showed a worsening phosphate status of our cane land.

Three factors operative at that time were causing this unfortunate trend: the clearing and planting of new lands extremely deficient in phosphate; the de-rocking of old lands with heavy equipment, resulting in large amounts of subsoil being brought to the surface; and finally the complete inadequacy of the basic phosphate fertilization practices.

No guidance from local results was available to indicate the optimum level and type of phosphatic fertilizer to use, but as most of the soils were acid, and a cheap local rock phosphate was the only material traditionally used, this fertilizer was the obvious initial choice for a crash programme to build up adequate soil phosphate levels.

Many areas of Mauritius which had received no phosphate other than guano-phosphaté had a good phosphate status; moreover a study of all the leaf phosphate analyses available (some 40,000 individual samples), did not show any marked changes in phosphate status with stage of the crop cycle. The latter point was taken as indicating that no dramatic changes in phosphate availability were occurring in the five or six years following the application of guano phosphaté ; it had seemed a possibility with the ferruginous latosols of Mauritius that coating of the rock phosphate particles with an insoluble iron-aluminum phosphate could occur, thus reducing the availability of the rock phosphate to very low levels. It will be noticed that Table 21 does suggest an aggravation of the phosphate status with time; however the foliar phosphate levels for the control plots at this site were as low at the start of the experiment.

Estates were therefore recommended that the use on phosphate-deficient lands of one ton of guano-phosphaté or its equivalent as standard rock phosphate, mixed with the soil wherever possible, was probably the soundest way to ensure a rapid build-up of the phosphate status of their lands.

Because soluble phosphate (*vide* Table 11) proved superior to rock phosphate for the virgin crop, and because it was already known that filter muds gave better yields in virgins than their equivalent in rock phosphate and nitrogen, then for virgin crop the use in the furrow depending on the phosphate status of the soil of 5 tons of filter cake, or 25 — 50 Kgs of soluble phosphate, was also recommended.

As can be seen from the field trials carried out at planting, an average yield increase of more than 10 tons per arpent in the virgin crop with the addition of 120 Kgs P_2O_5 was obtained in seventeen trials covering a wide range of local soils.

In financial terms, this return in yield increase is equal to a 300% return on money spent on phosphate in one year, excluding any residual effects the phosphate may have.

Many of the experiments continued to respond in the ratoon crops, thus stressing fully that any deficiency of phosphate was causing tremendous yield losses and that a deliberate policy of over-fertilization was called for until such times as more precise guidance could be given.

As the cost of clearing new land, de-rocking old land and replanting with cane is very high and can rise to Rs. 3,000/arpent, the cost of the phosphate fertilizer is therefore only a relatively minor item of expense.

An examination of Tables 12, 13 and 14 shows that responses above a dressing of 60 Kgs are almost certainly occurring and that a dressing of 500 Kgs of guano phosphaté in the furrow is not adequate for the virgin crop; this is an extremely high requirement and similar to the situation found by CLEMENTS (1958) in Hawaii. The total amount of phosphate used by a cane crop of 40 tons, including trash and green tops, is only about 35 Kgs P_2O_5 thus indicating a poor initial utilization of the applied phosphate; a situation not uncommon for most crops and most countries.

Phosphate treatment of plant canes gives a tremendous initial growth, but the low phosphate plots improve with time, and the dramatic differences between the two treatments after a few weeks growth, lessen with time. With the ratoon crops, as can be seen from figs. 22 and 23, response to phosphate even with soils very low in phosphate is not high in comparison with the virgin crop, but nevertheless can reach about six tons cane/arpent/annum.

From the phosphate-at-planting experiments several points of interest arise, namely the value of water-soluble phosphates on soils high in aluminium and iron and their high residual values under these conditions, and the quasi-equality of the coarser local rock phosphate with the finely ground rock phosphate.

The work with rock phosphates applied in the furrow at planting could be criticised, as it is generally accepted that for maximum availability of rock phosphates thorough mixing with the soil is necessary. However, scattering 500 Kgs of a fine powder into furrows about two feet wide and twelve inches deep cannot be considered as excessive placement, and certainly as regards the ratoons crops when earthing up has taken place, placement cannot be considered as having any effect.

The fact that soluble phosphate after four years had the same residual value as a standardized rock phosphate ground for 95% to pass a 100 mesh B.S. sieve is a striking and rather unexpected result, *vide* fig. 23.

The small difference between the finely ground phosphate and the local guano phosphaté (Table 11) is suggestive on the fact that, although grinding to 95% through a 100 mesh B.S. sieve is generally regarded as essential for good assimilability of the phosphate (COOKE, 1954), under tropical conditions of high rainfall and high soil temperature, the degree of fineness of grinding may be of less importance than elsewhere though, obviously, a minimum grinding standard must be set.

With phosphate deficient ratoons, a choice of ploughing out or attempting to correct the phosphate deficiencies, arises.

The results of the trials presented in tables 20 and 21 show that phosphate can be got into the cane plant, and that worthwhile increases in yield can be obtained by the use of phosphate on ratoons.

An interesting point is that guano phosphaté, although it did not give a yield response in the first year, did so in the second year, implying that if phosphate is applied annually then the form of phosphate used is unimportant.

With the second series of trials with phosphate applied to ratoons, some sites which should have responded to phosphate in terms of yield of cane, did not, even though the phosphate level in the leaves indicated that a response could have been expected.

This lack of yield response could be due to the fact that although phosphorus was limiting yields, some other factor, such as disease, was exerting an overriding influence. Yield losses due to ratoon stunting disease and chlorotic streak, two common diseases of old ratoons, would nullify the beneficial effects of a superior phosphate status.

The key question of the phosphate-in-ratoons experiments is therefore : "Did the phosphate enter the plant or not ?" The results of the five experiments show conclusively that it did. In terms of yield benefit, the value of phosphate applied to ratoons is dependent on disease or other limiting factors, but the phosphate applied is not lost as it enters the general soil pool and is therefore not wasted. With healthy cane, whose yields are limited only by phosphate, yield responses of the order of two tons of cane can then be expected if phosphate is applied in ratoons.

The large basic dressings at planting now being used will almost certainly lead to ratoons which do not require phosphate, a situation which is now common in the Hawaiian islands; and the recommended 250 Kgs of P_2O_5 as rock phosphate, for use on very deficient soils will almost certainly drop to around 125 Kgs once that replanting is due.

POTASSIUM

Little new information was obtained on this element during the year but the idea propagated by this Institute, that, as potash is needed in large quantities by the sugar-cane and as it is the cheapest of the three major nutrients, no deficiency of the element should be allowed to occur, has not been fully followed.

Some areas yielding forty tons of cane (the equivalent to the removal of about 125 kgs of muriate of potash an acre yearly) received low potash applications, in many instances, as low a level as 25 kgs muriate of potash/acre annually, with resultant adverse effects on the potash status of the crop, as indicated by foliar diagnosis.

An interesting point is that estates in the super-humid zone, conscious of the leaching effects of heavy rainfall, now have a generally better potash status than estates in dry areas.

CALCIUM AND MAGNESIUM AND SOIL ACIDITY

In order that maximum yields may be obtained, no nutritional stress of any element must be allowed to occur. For the cane soils of Mauritius, the adequacy of the nitrogen, phosphate, and potash nutrition is regularly checked and corrective measures, should deficiencies occur, are applied. After these three major elements come calcium and magnesium, of which only the former is at present of any interest: the soils of Mauritius being derived from basalts contain, in relation to their calcium contents, relatively large quantities of magnesium.

The soils of the super-humid zone are highly leached and low in base status, and it is on these soils that calcium deficiency, if it occurs, would be expected. These soils have all, however, received dressings of tricalcium phosphates and factory filter muds in the past and so, despite a low level of exchangeable bases, no absolute deficiency of calcium has so far been demonstrated.

The experimental results given in Table 16 show that no response to calcium occurred in any of the four trials, which were all sited on old cane land in the super-humid zone.

Specific increases in cane yield, following calcium application, have been reported from Hawaii by AYRES (1958) and CLEMENTS (1961) on soils which had received tremendous dressings of nitrogen and potash salts and only ammonium phosphate as the source of phosphate, with resultant heavy losses of calcium.

Attention was first drawn to the low calcium status of these lands when experiments comparing super-phosphate and ammonium phosphate showed a marked superiority in yield response in favour of the super-phosphate; in Mauritius, the experiments comparing ammonium phosphate with calcium containing phosphates have not shown any marked differences. The yield responses to coral sand found by d'HOTMAN (1947), and to lime found by FEILLAFÉ (1955), were ascribed by these authors to non-calcium effects.

The data for leaf-sheath calcium figures given in Table 17 show the marked effect of calcium containing materials on plant uptake.

The leaf-sheath calcium levels considered by CLEMENTS (*loc. cit.*) to be adequate are from 0.17 to 0.20% calcium on the dry sugar-free leaf-sheath. The figures presented here were expressed on the total dry matter of the leaf sheaths and will therefore be lower than if they had been expressed in Clements' way. Even the lowest figure obtained (the control plot of site 15/61) is far higher than the levels met with in the calcium deficient areas of Hawaii on which yield response to calcium has occurred. The effect of 500 Kgs of guano phosphaté, an average phosphate dressing, (treatment 2) has been to bring the levels of calcium to acceptable levels, and the effect of three tons of coral sand has been to increase leaf-sheaths calcium levels by 0.05%.

With the large amounts of sulphate of ammonia and muriate of potash now being used annually, calcium losses from the soils are heavy and a careful watch must be kept to prevent a calcium deficiency situation from arising ; therefore sheath calcium levels are now being determined on a routine scale.

The use of tricalcium phosphates at planting certainly helps by supplying calcium, but the use of coral sand at amounts of from three to five tons/arpent thoroughly mixed with the soil is the simplest method of ensuring an adequate calcium supply and is currently recommended when the pH of the soil falls below pH 5 in the cane lines of old ratoons.

A low soil pH is an indication of a low base status, but even when the bases are not limiting yields, other factors associated with soil acidity, such as high aluminium and manganese levels may reduce yields.

The acidification of the soil by fertilizer salts is a continuous process and as the fertilizers in Mauritius are banded along the cane row, areas of extremely acid soil may develop even though the soil mass itself has a fairly high pH.

Table 22 (a) shows the effect of banding fertilizers in the cane line on the pH of the soil in the cane line; the soil was sampled to a depth of 9″ and so this lowering of the pH can be considered as very dramatic.

The fact that the narrow strip of soil in which the cane stands is acidified in this way, may well cause «poisoning» of older ratoon crops by the solubilization of manganese and aluminium, or in some other way.

In the presence of adequate calcium, there is no general agreement thet the effect of a low pH is in fact a depression of cane yields, but as coral sand is freely available in Mauritius, it is almost certainly not sound practice to let the pH of the soil mass fall much below pH 5.4.

Table 22 (b) shows the effect on pH after three years of applying dressings of raw coral sand on the pH of the soil of a humic ferruginous latosol. The effects are quite dramatic for such low levels of sand application, because of the low buffering capacity of the surface layers of this great soil group. The latosolic brown forest soils are more highly buffered, but as they contain large amounts of rocks and gravels, the pH effect of dressings of three to five tons of coral sand will probably be of the same order with them as with the humic ferruginous latosols.

Table 22. (a) The effect of fertilizers applied on the cane line on the soil pH of old ratoons.

Site No.	*Soil pH in cane line*	*Soil pH in interline*
1	4.8	5.2
2	4.9	5.7
3	4.7	5.5
4	4.7	5.1
5	5.3	5.7

Table 22. (b) The effect of dressing of coral sand on the pH of the soil mass.

Dressing of coral sand	*pH before treatment 1961*	*pH after treatment 1963*
3,000 Kgs	5.0	5.7
,,	5.2	5.5
,,	5.0	6.1
,,	5.0	5.6
5,000 Kgs	5.4	6.4

The use of coral sand applications in the past, although attempted from time to time, did not prove at all popular and it is now possible, with the aid of the results shown in Tables 16 & 18 to explain the reasons for this unpopularity.

Because of local conditions, the tradition has developed of placing all the fertilizers used for the virgin crop in the furrow ; as the only source of phosphate used in the past was guano-phosphaté, then the use of lime or sand in the furrow caused an average yield loss of about three tons of cane in the virgins crop due to a lowering of the efficacy of the guano-phosphaté, *vide* Tables 18 & 19.

Heavy dressings of sand must be mixed with the soil, so far as is humanly possible, and some soluble phosphate applied in the furrow to overcome the effects of the temporarily high pHs occurring, following recent sand applications.

An intensive programme of research is now under way to study the effects of small dressings of sand, i.e. calcium nutrition effects, and the effects of massive dressings which will affect the whole of the biological, physical, and chemical systems in the soil.

SUMMARY

With nitrogen, placement studies have indicated a higher efficacy with buried or watered-on ammonium sulphate than with surface applied ammonium sulphate.

No differences in yields have yet been shown to occur when nitrate-nitrogen and ammonium-nitrogen are compared.

Nitrate is extremely mobile in the soil and leaching losses would therefore be expected; the failure of experiments to demonstrate any difference between the two forms of nitrogen could be due to the low efficiency of ammonium sulphate nitrogen *per se*. The efficiency of nitrogen utilization by cane is less than 50% and therefore it is imperative that the mechanisms of nitrogen loss be actively studied.

The practice of using 500-1000 Kgs of guano phosphaté at planting, depending on soil phosphate levels, plus a booster dose of soluble phosphate, has certainly ensured that yield losses for the virgin crops due to phosphate deficiency have been eliminated.

The use of phosphate on ratoons will give yield increases, provided that the ratoon crop is deficient in phosphate and that no other factor, particularly disease, is limiting yields.

There can be no doubt that the best placement for phosphate is deep in the soil or mixed thoroughly with the soil at planting, and the annual application of phosphate on the surface is an emergency approach only.

The potash requirements of cane are high and the levels recommended by the Institute should be used.

The calcium status of Mauritius cane lands is being carefully watched. The use of 3-5 tons of coral sand, should the pH of the soil in the cane line of old ratoons fall below five, has been recommended for some years now as a precautionary measure against both low calcium status and any possible adverse effects of high soil acidity.

Work with very heavy dressings of sand and lime is in progress, as well as on the nutritional effects of calcium and magnesium.

Finally, each arpent of cane land may now receive up to 250 Kgs of ammonium sulphate, 100 Kgs of muriate of potash and 50 Kgs of soluble phosphate salts, i.e. a total dressing of 400 Kgs of salt, and as this salt is commonly applied in one dose on the cane line, damage to the cane may be occurring. The salt, falling into the spindle of young cane and into the leaf bracts, causes severe fertilizer burn and this effect on the aerial parts of the cane cannot but be harmful as regards final yields; more over the effect on the surface roots of such concentrated salt additions must be detrimental.

On areas with open fields, the mechanical application of fertilizers should seriously be considered as offering the surest means of distributing fertilizers accurately and applying them carefully.

Where fields are such that mechanical equipment cannot be used, careful spreading of the fertilizer around the stool would seem to be the best practice.

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2. FOLIAR DIAGNOSIS OBSERVED IN 1963 ON THE PERMANENT SAMPLING UNITS

PIERRE HALAIS

During the summer months of 1963, leaf blade sampling for nutritional diagnosis, following well established rules was restored to full swing as a result of the normal climatic conditions which prevailed during the critical boom stage of ratoon crops.

Eight hundred and sixteen permanent sampling units, each representing an area greater than 10 arpents, had been specially chosen, after consultations with the interested parties, as fully representative of the soil types encountered and of the actual fertilizer treatments practised by the millers and large planters on regular plantations in the vicinity of the selected units.

The project is a follow-up procedure which will disclose, by means of three-year moving averages, the trend of nutritional N P K status of each unit in order to constitute a permanent check on regular fertilizer practices as they evolve in time.

Leaf sampling was carried out at two favourable occasions in most of the cases. Age and variety corrections were practised as recommended.

Table 23 gives the variety correction derived from the Series Agro/60 comprising ten differently located variety trials. The correction for older varieties has been given in the 1962 Annual Report of the Institute.

Table 23. Variety correction for foliar diagnosis N, P and K % D.M. of the 3rd leaf blade

	Ebène 1/37	*M.147/44*	*M.202/46*	*Ebène 50/47*	*M.93/48*	*M.253/48*
N	+ 0.11	— 0.03	+ 0.04	+ 0.03	— 0.06	— 0.10
P	+ 0.012	+ 0.001	+ 0.012	+ 0.016	— 0.002	— 0.017
K	— 0.06	+ 0.08	— 0.05	+ 0.06	+ 0.11	— 0.12

It has been thought desirable, at this early stage of the project, to disclose the preliminary observations made on a sugar sector basis in order to evaluate the average potential loss in production, expressed in terms of commercial sugar per arpent, resulting from phosphorus and potassium shortage in cane nutrition. The quantitative relationship between sub-optimal and optimal nutrition used as the yardstick is derived from the field and laboratory experimentation carried out by the Institute on the series Agro/57 of eight trials reaped in 1959 and 1961, when the crops did not suffer from the ill-effects of cyclonic winds or of moisture shortage.

Table 24 gives the regression equations obtained to calculate the average potential sugar losses — tons per arpent — to be expected from sub-optimal nutrition observed by foliar diagnosis expressed in terms of N, P and K % leaf dry matter.

Table 24. Potential sugar losses, in tons per arpent, to be expected from F.D. data expressed as N, P and K % D.M. of 3rd leaf blade.

Nitrogen	Potential loss	$4.00 - 2.10\ N_{F.D.}$
Phosphorus	,, ,,	$2.18 - 10.31\ P_{F.D.}$
Potassium	,, ,,	$2.16 - 1.62\ K_{F.D.}$

In order to rule out any uncertainty resulting from possible moisture stress on the cane plant at the time of leaf sampling in 1963, a condition which could invalidate foliar diagnosis *per se*, only those permanent units which have actually shown nitrogen leaf contents above the high figure of 1.80 were kept for the interpretation of the P and K status. Such selection of the data is justified from the physiological point of view since a very close association is known to occur between high moisture status of the cane plant and high nitrogen in the tissue selected for FD if no real nitrogen shortage prevails. In doing so, 287 permanent units were rejected this year out of a total of 816, as possibly suffering from inadequate moisture conditions at leaf sampling time.

Table 25 gives the results obtained on the 529 permanent field units kept, expressed in terms of potential sugar losses — tons per arpent — as a result of sub-optimal P and K nutrition.

Table 25. Potential losses from P and K shortage in tons sugar/arpent.

Sugar Sector	*Number of permanent sampling units kept*		*Potential losses in tons sugar per arpent*	
	Millers	*Large Planters*	*Phosphorus*	*Potassium*
West	23	22	0.23	0.33
North ...	68	50	0.27	0.20
East	42	16	0.26	0.23
South... ...	211	33	0.17	0.11
Centre ...	56	8	0.12	0.08
Island ...	*400*	*129*	*0.20*	*0.16*

In practice, the potential losses for each sampling unit will have to be considered individually as representative of the regular plantations in the vicinity for each miller or large planter interested. However, the above table shows that, broadly speaking, there is room for further improvement in fertilizer practices, at least as regards the use of phosphatic and potassic fertilizers in general.

In addition, and contrarily to the belief still held in some quarters, the present nutritional P and K status of the sugar plantations is less favourable in the drier West and North sectors of the island than in the wetter East, South and Central ones, where greater effort has been made in the past, and sustained up to the present, to redress natural conditions which were initially far from ideal.

3. HIGH SUCROSE RESPONSE TO NITROGEN FERTILIZATION — AN IMPORTANT VARIETAL CHARACTERISTIC

PIERRE HALAIS

The results observed in the series Agro/60 of ten «final variety/fertilizer» trials reaped in 1962 (cyclone year) and in 1963 (normal year) as 1st and 2nd ratoons respectively, clearly show the predominant part played by nitrogen fertilization when climatic conditions are normal.

In this series of trials, three doses of nitrogen were tested 0, 30 and 60 Kgs. N per arpent applied in a single dose early after ratooning on the same six cane varieties, including two established standard canes Ebène 1/37 and M.147/44, and four new varieties, M.202/46, Ebène 50/47, M.93/48 and M.253/48, at ten representative locations on the island.

Table 26 gives the mean results for the ten trials for the two standard varieties expressed in tons of recoverable sucrose per arpent.

Table 26. Mean results of 10 M.S.I.R.I. trials series Agro/60 Varieties Ebène 1/37 and M.147/44

	0 N	*30 N*	*60 N*	*Kg./arpent*
Cyclone year 1962 (1st ratoon)	2.45	2.68	2.76	tons recoverable sucrose per arpent
Normal year 1963 (2rd ratoon)	2.85	3.54	3.68	,, ,, ,, ,, ,,

The figures observed in the ten M.S.I.R.I. trials for the medium application of 30 Kgs. N were 2.68 for 1962, and 3.54 for 1963. These values are practically the same as the general averages of sugar per arpent for the island as a whole. 2.75 for 1962, and 3.56 for 1963. It is therefore legimate to attempt evaluating the overall contribution played by nitrogen fertilization in the general economy of the two contrasted sugar campaigns (Tables 27, 28).

Table 27. Estimated response of sugar cane to nitrogen fertilization in Mauritius.

	Tons N. for cane	*Area reaped (1000 arpents)*	*Estimated response to N. from trials. Tons sugar/arpt.*	*Sugar Production (1000 tons)* Total	*Sugar Production (1000 tons)* Attributed to N. fertilizers
Cyclone year 1962 ...	7,000	194	0.25	533	45
Normal year 1963 ...	9,000	194	0.75	686	136

If all N is converted to sulphate of ammonia equivalent, gross and net responses in terms of sugar produced for each ton of fertilizer used can be calculated as well as the total value of the net response in millions of rupees.

Table 28. Gross and net responses for each ton of sulphate of ammonia equivalent used, expressed in tons of commercial sugar.

	Cost	*Gross Response*	*Net Response*	*Net response for Island Production (Million Rs.)*
Cyclone year 1962 ...	0.68	1.33	0.65	9.4
Normal year 1963 ..	0.55	3.20	2.65	61.9

It follows that during normal years nitrogen fertilization is one of the most paying propositions at the disposal of sugar cane agriculture. In fact, the return in cash for N fertilization has been 6.5 times higher in 1963 than in 1962. Hence the urgent necessity of improving our knowledge on nitrogen fertilization in order to be in a position to take full advantage of this powerful means at our disposal for reaching high and profitable sugar production when normal climatic conditions prevail.

The favourable results obtained with N fertilization in 1963 are most helpful in this connection as the six cane varieties tested in ten trials of the Agro/60 series have had the opportunity during this normal year to freely express their relative potentialities towards nitrogen fertilization Table 29 gives the mean results obtained on the ten trials in 1963 for each of the six varieties separately.

Table 29. Mean results of ten trials Agro/60 series reaped as 2nd ratoons in 1963.

Recoverable sucrose % cane			*Variety*	*Tons recoverable sucrose/arpent*		
0 N	*30 N*	*60 N Kgs./arpt.*		*0 N*	*30 N*	*60 N Kgs./arpt.*
12.1	12.1	12.1	M.202/46	2.70	3.63	4.17
12.5	12.9	12.8	Ebène 50/47	2.51	3.68	3.90
11.4	11.4	11.2	M.147/44	2.87	3.66	3.85
12.7	12.2	12.3	Ebène 1/37	2.83	3.42	3.51
11.7	11.8	11.3	M.93/48	2.67	3.61	3.70
11.4	11.4	10.9	M.253/48	3.24	3.74	3.40

Two out of the six varieties tested, M.202/46 and Ebène 50/47, do not show any fall in recoverable sucrose % cane following heavy nitrogen fertilization, a fact already observed with these same two varieties when the trials Agro/60 series were reaped in virgins (1961) and 1st ratoons (1962). It should be also noted that the response in tons of recoverable sucrose per arpent to 60 Kgs. of N is considerably higher with M.202/46 than with the other varieties tested.

Observations carried out in two earlier series of «final variety/fertilizer» trials, Agro/54 — six trials — and Agro/57 — eight trials — had shown the same favourable behaviour towards high N fertilization for two imported cane varieties, namely B.3337 and B.37172. All the other varieties tested in a total of 24 highly replicated «final variety/fertilizer» trials during the last ten years, have shown a variable but definite fall in their recoverable sucrose content following heavy N fertilization, and a poor response to N in terms of recoverable sucrose per arpent. It follows that the twelve varieties thoroughly tested up to now for their reaction towards high N fertilization can be classed into three groups : high, medium, and low response to heavy N fertilization corresponding to no change, some lowering, and definite lowering of the sucrose content respectively.

Class I	*Class II*	*Class III*
High response to N	*Medium response to N*	*Low response to N*
B.3337	M.147/44	M.134/32
B.37172		B.34104
M.202/46		B.37161
Ebène 50/47		Ebène 1/37
		M.31/45
		M.93/48
		M.253/48

Table 30 gives the response to heavy N fertilization, 60 Kgs. N/arpt., compared to medium fertilization, 30 Kgs. N. in terms of recoverable sucrose per arpent for the 2nd ratoon crop reaped in 1962. The ten trials of the Agro/60 series have been separated on the basis of the differential profitable sucrose production of the two established standard varieties, M.147/44 and Ebène 1/37, as observed at each location.

Group I. — M.147/44 outyields Ebène 1/37 considerably. The ecological conditions are high temperature, low rainfall with, or without irrigation.

Group II. — M.147/44 and Ebène 1/37 perform equally well. The ecological conditions are medium temperature and rainfall.

Group III — Ebène 1/37 outyields M.147/44 considerably except during a severe cyclone year. Ecological conditions are low temperature and high rainfall.

Table 30. Response of six varieties to 60 Kg. N over 30 Kg. N/arpent in 2nd ratoons 1963, expressed in tons recoverable sucrose per arpent.

	Group I	*Group II*	*Group III*	
Location of trials	Médine St. Antoine (2) Mon Trésor Riche-en-Eau	Bénarès F.U.E.L. Trianon	St. Aubin Mon Désert - Alma	
Best suited standards	M.147/44	M.147/44 & Ebène 1/37	Ebène 1/37	General Average of ten trials
M.202/46 ...	+ 0.60	+ 0.65	0.24	+ 0.54
Ebène 50/47 ...	- 0.34	– 0.21	— 0.05	– 0.22
M.147/44 ...	+ 0.22	– 0.07	+ 0.26	– 0.18
Ebène 1/37 ...	– 0.06	0.26	0.00	– 0.09
M.93/48 ...	0.00	0.08	+ 0.37	– 0.09
M.253/48 ..	— 0.28	— 0.66	– 0.01	– 0.34

It should be noted that the accuracy of the observation is affected to some extent because the number of trials is not the same in each group; thus Group I comprises five trials, Group II three trials, and Group III only two trials. The high contrast, however, between the behaviour towards N fertilization of the two extremes M.202/46 and M.253/48 needs special mention.

Conclusions

(1) The statement often made in technical reports on sugar cane that «high nitrogen fertilization results in low sucrose in the canes at harvest» only holds for intolerent cane varieties. Four commercial varieties out of the twelve already tested in this connection in Mauritius during the last ten years deny this statement.

(2) The ability to furnish high sucrose response to heavy nitrogen fertilization is one of the numerous desirable characteristics of a modern sugar cane variety, as it allows the nutritive effect exhibited by increased leaf area and bigger stalks to be recovered at harvest time in terms of profitable sucrose per unit area cultivated.

(3) Throughout selection, the cane varieties should be given ample nitrogen fertilization in order to screen out those varieties showing undesirable reaction towards the major nutrient which is nitrogen.

(4) Field trials dealing with different forms or methods of application of nitrogen carriers should be carried out with nitrogen-tolerant varieties such as B.3337, B.37172, M.202/46 and Ebène 50/47 in order to avoid the disturbing effect produced by the lowering of the sucrose content at harvest.

(5) The assessment of the right dose of nitrogen to apply — at least for normal climatic conditions — is a complex problem as, for obvious reasons, the varieties presently recommended vary considerably as to their behaviour towards nitrogen fertilization. In actual practice, for the determination of the nitrogen requirement for individual cases, different sets of information should be taken into account : the potentialities of the climate and soil including irrigation, as well as the known reaction of the planted variety towards high nitrogen fertilization.

4. SILICA AND MANGANESE CONTENTS OF CANE LEAF SHEATHS IN RELATION TO SOIL AND NUTRITION

P. HALAIS and D. H. PARISH

The first silica and manganese survey of 3-6 leaf-sheaths collected on 153 permanent sampling units selected for foliar diagnosis studies, has been completed during 1963 and has shown very wide ranges of levels for the two elements, linked with known soil properties, and possibly with cane nutrition.

The Silica and Maganese contents of cane sheaths in relation to soil properties.

As expected the lowest SiO_2 content — less than 1 % on the dry matter basis of the leaf-sheaths — was observed on regosols derived from coral sands. The range of SiO_2 content of the leaf-sheaths from cane growing on the soils derived from basaltic rocks of comparable chemical composition is very wide and closely correlated with the loss of silica which has occurred during rock weathering and soil formation. About 1 % SiO_2 of silica was found in sheaths collected from cane growing on humic ferruginous latosols, soils which are almost senile, the level rising to about 5 % in sheaths from cane growing on gravelly soils in the sub-humid area, soils still in the juvenile stage, i.e. the latosolic reddish prairie soils.

The manganese content of the leaf sheaths is lowest, as would be expected, — down to 5 ppm on dry matter basis — on canes growing on the coral sands. The manganese content is moderately low for those basalt-derived soils on which the sheaths of canes show a high silica content. On the other hand, the fully weathered soils, which have lost almost all their silica as well as bases, produce canes of low silica and high manganese content (1% SiO_2 and up to 300 ppm of Mn in the sheaths).

Table 31 gives a summary of the survey of the silica and manganese contents of cane leaf-sheaths carried out in 1963 on the 153 field units grouped according to the five sugar sectors; the regosols derived from coral sand have been excluded from the table.

From these observations it is seen that the best soils of the island, so far as cane growing is concerned, produce leaf-sheaths containing 2.50% SiO_2 or more and between 50 to 75ppm of manganese.

Table 31. Silica and manganese contents of 3rd – 6th leaf sheaths. Results of 1963 survey.

Sectors	*Number of field units*	*SiO_2 % D.M.*	*Mn ppm. on D.M.*	*ppm Ratio Mn/SiO_2 %*
West ...	15	3.79	57	15
North ...	30	3.53	74	21
East ...	20	2.81	76	27
South ...	69	2.74	126	46
Centre ...	19	2.36	153	65

Silica and manganese contents of cane leaf-sheaths associated with cane nutrition.

It has been repeatedly observed in Mauritius that massive applications of finely powdered basalt dust on certain highly weathered soils which have lost most of the silica and bases, are invariably followed by a permanent rise in sugar cane yields. As the level of application used was of the order of 100 tons/acre, and as no significant effect on the potassium, calcium, magnesium, or phosphate status of the cane was obtained, it was felt that this yield increase was probably due principally to physical effects. However, VLAMIS and WILLIAMS (1957) have demonstrated a close link between silica levels in leaves and manganese toxicity; silica and manganese levels were therefore determined on samples from the basalt experiments.

Table 32, which gives the results obtained, shows that silica in the sheaths increases, and manganese decreases, as a result of massive incorporation of basalt dust to the soil. No other significant changes in the mineral composition of the cane plants from the treated plots occurs; the physiological significance of this finding is however still open to conjecture.

Table 32. SiO_2 and Mn contents of 3rd - 6th leaf sheaths. Series of field trials with basalt dust. SiO_2 expressed in % and Mn in ppm both on D.M. basis.

Treatment tons basalt per arpent	*Cascade Rose Belle 4/55*		*Belle Rive Highlands 20/57*		*Cascade Rose Belle 21/61*	
	SiO_2	*Mn*	*SiO_2*	*Mn*	*SiO_2*	*Mn*
Control	1.65	106	2.11	137	2.26	100
45	2.19	87			2.45	100
90	2.35	77	2.34	107	2.60	70
180	2.66	82	2.37	95	2.66	70

It does seem, however, that from the practical point of view, leaf sheaths surveys for silica and manganese may constitute a valuable guide for delimiting areas where metal ion toxicity may be occurring.

REFERENCE

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Plate 5. Cane Nursery, Pointe aux Sables. Fields of cane free from ratoon stunting disease.

Plate 6. Inoculating cane to provide infection in gumming disease resistance trial.

CANE DISEASES

R. ANTOINE & C. RICAUD

1. GENERAL CONSIDERATIONS

ENVIRONMENTAL conditions were, on the whole, favourable to cane growth and the deleterious effects of cyclonic conditions did not occur during the year. In consequence, the range of pathological problems usually encountered in the field was considerably restricted. Furthermore, with the severe screening of cane varieties prior to release for commercial plantings, the two major bacterial diseases, gummosis and leaf scald, no longer occur in plantations. Also, varieties cultivated at present are highly resistant to red rot and smut. However, after such an auspicious preamble, it should be mentioned that chlorotic streak and ratoon stunting continue to be the two important pathological problems with which the sugar industry has to contend. Results of investigations on both diseases are discussed further on.

A spectacular attack of eye spot (*Helminthosporium sacchari*) was observed in the super-humid zone. It is of interest to mention that half of a field of B.3337 suffered, while the other half showed no signs of the disease. The large patch of shorter canes with heavily spotted leaves was adjoining a stack of factory scums dumped on the top part of the sloping field and which had been partly washed down. The influence of unbalanced fertilization on the severity of the disease was thus clearly demonstrated.

Preserved materials of galled leaves of Eros, 39MQ2717 and 39MQ831 were received from Réunion Island. Examination revealed the same histological structure as the one observed in material affected by «Pseudo-Fiji» (*vide Ann. Rep. Sug. Ind. Res. Inst. Mauritius, 1959* : 59-60). Similar galls were observed on the same varieties in Mauritius. Preserved leaves of PR 1000 and Co. 462 received later in the year from Southern Rhodesia, where it was reported that several varieties were affected with leaf galls, again revealed, upon examination, the presence of «Pseudo-Fiji». It would be of considerable interest if an assessment of the world distribution of «Pseudo-Fiji» could be made.

Several cases of top rot distributed right through a field of Ebène 50/47 were observed during the year. Examination revealed that the canes which were about to flower had failed to do so on account of a deterioration of the inflorescence. A species of *Cephalosporium* was isolated from diseased tissues.

2. RATOON STUNTING DISEASE

(a) Varietal reaction.

Experimental results given in Table 33 summarize the performance of varieties in the resistance trial planted in November 1957 under sub-humid conditions. As no data were collected in the cyclone year 1960, figures are averages for virgins, 1st, 3rd, 4th and 5th ratoons, and give a good indication of the reactions of the commercial varieties, of longer standing, to the disease. Indeed, in an island where a high number of ratoons are taken and where the occurrence of violent cyclones in any one year may affect considerably the reliability of experimental results, the assessment of varietal reaction should be decided after obtaining data over several years. Of the varieties still grown on a fair to large scale, Ebène 1/37, B.3337 and B. 37172 show more or less the same order of susceptibility whereas M.147/44, formerly rated as moderately susceptible, has alarmingly shown the highest reduction in yield.

Tables 34 and 35 give the results for the varieties released more recently in sub-humid and super-humid environments respectively. The data collected in the dry zone are for 1st, 2nd, and 3rd ratoons, and in the wet zone for virgins, 2nd, and 4th ratoons. The results discarded are for those years in which cyclonic conditions considerably affected cane yields: thus, 1960 for all trials, and 1962 for the super-humid zone only, when yields as low as 8.5 tons/arpent were recorded in the experiment.

Allowing for the experimental error in the Belle Rive trial, it would appear that both M.202/46 and M.93/48 are susceptible to the disease whereas M.253/48 appears to show promise of resistance.

In another trial, now only in 1st ratoons, in the humid zone, another of the recently released canes, Ebène 50/47, showed an average reduction in yield of 11 % in virgins and first ratoons.

Table 33. Summary of results obtained in a ratoon stunting trial laid down at Pamplemousses in 1957.

	TONS CANE/ARPENT			TONS SUGAR/ARPENT		
Varieties	*Figures are averages for virgin, 1st, 3rd, 4th and 5th ratoons*					
	Treated	*Untreated*	*Reduction %*	*Treated*	*Untreated*	*Reduction %*
M.134/32 ...	27.9	23.8	15	4.07	3.45	15
M.112/34 ...	30.7	26.7	13	4.57	3.85	16
M.147/44 ...	39.6	32.0	19	5.22	4.19	20
M.31/45 ...	34.8	31.3	10	4.98	4.56	8
Ebène 1/37 ...	28.9	26.6	8	4.32	3.91	9
B.34104 ...	31.0	28.2	9	4.44	3.94	11
B.3337 ...	35.1	31.2	11	4.68	4.19	10
B.37161 ...	31.9	27.1	15	4.46	3.73	16
B.37172 ...	34.3	31.4	8	4.89	4.53	7

Table 34. Effects of ratoon stunting disease on yields in cane and sugar in 1st, 2nd and 3rd ratoons at Pamplemousses Experiment Station.

		TONS CANE ARPENT		TONS SUGAR/ARPENT	
Varieties	*Crop*	*Treated*	*Untreated*	*Treated*	*Untreated*
M.202/46	1st ratoon ...	30.4	26.8	3.89	3.16
	2nd ,, ...	28.4	20.7	3.35	2.21
	3rd ,, ...	32.9	26.3	4.84	3.89
	Average	30.6	24.6	4.03	3.09
	Average reduction %	20		23	
M.93/48	1st ratoon ...	29.3	26.1	3.72	3.42
	2nd ,, ...	40.7	34.9	4.44	4.12
	3rd ,, ...	32.0	26.8	4.70	3.91
	Average	34.0	29.3	4.29	3.82
	Average reduction %	14		11	
M.253/48	1st ratoon ...	36.0	34.0	4.46	4.25
	2nd ,, ...	32.4	37.8	3.53	3.48
	3rd ,, ...	26.3	31.3	3.76	4.66
	Average	31.6	34.4	3.92	4.13
	Average reduction %	—9		—5	

Table 35. Effects of ratoon stunting disease on yields in cane and sugar in virgins, 2nd and 4th ratoons at Belle Rive Experiment Station.

		TONS CANE ARPENT		TONS SUGAR/ARPENT	
Varieties	*Crop*	*Treated*	*Untreated*	*Treated*	*Untreated*
M.202/46	Virgins	38.1	30.9	4.66	4.11
	2nd ratoons* ...	39.0	38.6	4.49	4.55
	4th ,, ...	32.8	33.2	3.94	3.78
	Average	36.3	34.2	4.36	4.15
	Average reduction %	7		5	
M.93/48	Virgins	18.5	14.7	2.36	1.76
	2nd ,, ...	35.0	26.8	3.71	3.06
	4th ,, ...	33.6	28.0	3.53	2.91
	Average	29.0	23.0	3.20	2.57
	Average reduction %	20		19	
M.253/48	Virgins	29.4	21.5	3.79	2.52
	2nd ratoons ...	36.4	31.8	4.11	3.15
	4th ,, ...	24.4	28.4	2.76	2.78
	Average	30.1	27.2	3.55	2.82
	Average reduction %	9		20	

* Planting material taken from healthy plot before weighing.

(b) Progress in control measures.

With the implementation of the central nursery scheme, the requirement of the treatment plant has reduced considerably. Thus, 510 tons of cuttings were treated against ratoon stunting disease for the establishment of A nurseries at Pointe aux Sables. However, in order to keep the plant working at full capacity, 2,500 tons of planting material were given the short hot-water treatment (50 C for 30 minutes) against chlorotic streak for neighbouring estates.

During the year under review, plantations made on estates with healthy material derived from their own A nurseries, established with cuttings treated at the central treatment plant in 1962, amounted to 962 arpents or only 7.8 % of the total area planted. The situation is improving rapidly with the increasing supply of healthy planting material from the central nursery. Thus, in 1963, an aggregate area of 610 arpents of B nurseries were established on estates with 1,900 tons of healthy cuttings provided by the central nursery. The potential output should plant 6,000 arpents or 50 % of the regular plantations in 1964, representing just under 12 % of the total area under cane on estates.

In 1963, the area established under A nurseries at Pointe aux Sables amounted to just over 100 arpents. With nearly fifty additional arpents of A nurseries in first ratoons, the total area of 150 arpents should supply sufficient planting material to establish 1,500 arpents of B nurseries on estates in 1964. Reckoning that the ratio of nursery to regular plantation is approximately 10 to 1, such an area should meet the total planting requirements of estates the following year, and in addition should provide the agreed supply of cuttings to small planters in the various factory areas. It appears therefore that the implementation of the central nursery scheme, as the initial step in the production of planting material free from the ratoon stunting virus, has proved to be the right approach to the problem and should lead to positive results in the control of the disease in Mauritius.

The observation of occasional germination failures for no apparent reason, at the Central Nursery, led to the assumption that a longer treatment time could have been conducive to the detrimental effect. It was decided to conduct experiments in co-operation with the Manager of the Central Nursery on the effect of the time of treatment at 50 C on the germination of treated cuttings. After temperature equilibrium in the bath, on an average 15 minutes after the immersion of cuttings, the following times of treatment were given : 2, 2¼, 2½, 2¾, and 3 hours. The effects of time of treatment on germination are given in Table 36.

Increases by 15 and 30 minutes in the normal treatment time of 2 hours resulted in a drop of about 50 % in germination of treated setts, and increases by 45 and 60 minutes led to reductions of 72 % and 79 % respectively.

Time of treatment is the only operation which is not automatically recorded at the central treatment plant. Steps are being taken to instal an automatic recorder in order to make sure that cuttings do not inadvertently receive a longer time of treatment.

Table 36. Effect of time of treatment on germination of treated setts

Treatment	*No. of cuttings planted*	*No. of cuttings germinated*	*Reduction expressed as % of standard treatment*
50 C for 2 hours	1200	509	--
50 C for 2¼ hours	600	118	54
50 C for 2½ hours	600	126	50
50 C for 2¾ hours	600	71	72
50 C for 3 hours	600	53	79

3. CHLOROTIC STREAK

As the evidence on soil transmission of chlorotic streak is building up, it is now being accepted that the casual agent belongs to the group of soil-borne viruses. This poses more and more the problem of disease control, a task which, at the moment, appears very difficult. Indeed, three methods of control could be applied to a soil-borne virus : crop rotation, chemical treatment of the soil, or the use of resistant or immune varieties. Crop rotation is still inconceivable in Mauritius; the application of chemicals to the soil, if at all possible on a field scale, would depend on a knowledge of the biology of the virus and of its vectors, questions not yet answered; consequently, the use of resistant varieties would appear to be most tempting approach, if such varieties exist.

While experimentation on the mechanism by which the diseases is transmitted is being actively pursued, the direct approach to the production of resistant varieties has already started.

It is known that all varieties cultivated at present in Mauritius are susceptible to cholrotic streak. One variety, M.112/34, formerly classified as resistant and cultivated solely in the sub-humid area, proved to be highly susceptible when planted in a ratoon stunting trial in the super-humid zone where the disease is commonly encountered. It follows, therefore that a sound rating cannot be given to any variety unless it has been observed in an environment favourable to disease transmission. In Mauritius, the super-humid zone provides an excellent environment for that purpose. To that effect, trials are being conducted in that area in order to assess the reactions of a large number of varieties to chlorotic streak and thus screen the resistant canes which could be used in breeding work, if such canes exist.

In a resistance trial at Belle Rive the following eight commercial canes : M.147/44, M.202/46, M.93/48, M.253/48, B.3337, B.37172, Ebène 1/37, and Ebène 50/47, all contracted infection within one year, abundant leaf symptoms being present in plots established with untreated as well as treated cuttings.

In another trial at Belle Rive out of 33 varieties, 9 were symptomless before harvest, and only 3 were still apparently free from infection after ratooning, as shown in Table 37.

Table 37. Appearance of chlorotic streak symptoms, before and after ratooning, in 33 varieties

Symptoms (present or absent —)

Variety	*Before ratooning*	*After ratooning*	*Variety*	*Before ratooning*	*After ratooning*
M.99/34 ...	—		MP131	-	-
M.147/44 ...	—		Uba Marot ...	—	—
M.99/48 ...			*S. spontaneum*		
M.423/51 ...			(Kletak) ...	—	—
M.272/52 ...			Co.281	·	-
M.85/53 ...			Co.290	—	—
M.98/54 ...			Co.419	—	
M.462/54 ...	—	-	Co.779	·	
M.55/55 ...			36MQ2717 ...		
M.415/55 ...		—	47R2777	—	—
M.146/56 ...			R.397	-	·
M.209/56 ...	·		C.B.38-22 ...	-	·
M.219/56* ...			N:Co.376 ...	-	—
M.361/56 ...	-		B.34104	+	- -
M.307/57 ...			D.109	—	
Ebène 1/37 ...			P.O.J.2727 ...	·	—
Ebène 50/47			P.O.J.3016 ...	—	—

* Extremely susceptible.

The three varieties which failed to show symptoms: Uba Marot, Co.290 and *Saccharum spontaneum* (Kletak) were left under observation, and, in addition, have been planted in larger plots.

In a trial at Union Park, out of 124 varieties subjected to natural infection, 33 had not developed the characteristic leaf streaks before harvest. After ratooning, however, only 14 varieties were still apparently disease-free, as shown in Table 38. Of these, one (B.34104) is known to be susceptible, and another (N:Co.310) contracted infection when planted out. The twelve varieties which appear to be resistant so far, M.35/47, M.63/47 (white), M.209/47, M.487/47, M.53/48, M.286/49, M.305/49, M.336/50, M.405/50, M.18/51, M.43/51 and M.92/51, are still under observation and, in addition, were all planted out at the time of harvest.

Table 38. Appearance of chlorotic streak symptoms, before and after ratooning, in 124 varieties

Symptoms (present or absent —)

Variety		*Before ratooning*	*After ratooning*	*Variety*		*Before ratooning*	*After ratooning*
M.134/32	...		+	M.494/47	...	—	+
M.165/38	...	-		M.536/47	...		
M.198/40	...	-		M.4/48	...		
M.213/40	...	-		M.53/48	...	—	—
M.24/41	...	-		M.91/48	...		—
M.147/44	...			M.93/48	...		—
M.31/45	...			M.99/48	..		
M.174/46	...	—		M.146/48	...		
M.202/46	...	—	—	M.183/48	...		
M.241/46	...	—	-	M.204/48	...		
M.303/46	...	—		M.248/48	...		-
M.345/46	...			M.25/49	...		
M.348/46	...	—		M.39/49	...		
M.363/46	...			M.41/49	...		
M.366/46	...			M.51/49	...		-
M.25/47	...			M.73/49	...		
M.35/47	...	—	—	M.106/49	...		—
M.44/47	...			M.176/49	...	-	
M.63/47 (red)	...	—		M.239/49	...		+
M.63/47 (white)	...	—	—	M.252/49	...		—
M.115/47	...	—		M.271/49	...	—	
M.209/47	...	—	—	M.285/49	...	-	—
M.246/47	...			M.286/49	..	—	
M.255/47	...		-	M.303/49	...	-	
M.283/47	...			M.305/49	...	-	—
M.294/47	...			M.306/49	...	—	
M.295/47	...		-	M.442/49	..		
M.305/47	...			M.151/50	...		
M.341/47	...		-	M.153/50	...	—	
M.347/47	...	—	+	M.198/50	...	+	+
M.424/47	...		+	M.199/50	..		
M.444/47	...		-	M.209/50	...		
M.487/47	...	—	—	M.326/50	...	+	—

Symptoms (present + or absent —)

Variety		*Before ratooning*	*After ratooning*	*Variety*		*Before ratooning*	*After ratooning*
M.328/50	...	+	·	M.241/51	...	·	+
M.336/50	...	—	—	M.250/51	...	—	—
M.344/50	...		—	M.277/51	...	—	—
M.437/50	...	—	—	M.463/51	...	·	+
M.405/50	...	—		M.861/51	...	·	—
M.406/50	...			M.151/56	...	·	—
M.486/50	...	·	·	M.320/56	...	·	—
M.429/50	...	—		Ebène 1/37	...	—	+
M.502/50	...	—	—	Ebène 1/44	...		—
M.507/50	...	—		Ebène 3/48	...		+
M.18/51	...	—	—	Ebène 1/50	...	·	—
M.19/51	...	·	—	B.3337	...	·	—
M.30/51	...	—	—	B.34104	...	—	—
M.36/51	...	—	—	B.37161	...	·	—
M.39/51	...	—	—	B.37172	...	+	—
M.43/51	...	—	—	B.41227	...	—	—
M.45/51	...	—		B.4362	...	·	—
M.50/51	...	—		U.S.48-54	...	·	—
M.52/51	...	—	·	C.P.34-120	...		—
M.57/51	...	—		H.37-1933	...	—	—
M.71/51	...	·		P.R.1000	...		—
M.72/51	...	—	—	N:Co.310	...	—	—
M.92/51	...	—	—	P.O.J.3016	...	—	—
M.150/51	...	—		B.H.10/12	...		—
M.155/51	...	+		Pindar	...	—	+
M.198/51	...	—		R.366	...	·	—
M.221/51	...	·		R.397	...	·	—
M.223/51	...		—	Co.421	...	—	—
M.228/51	...	—		Co.779	...	—	·

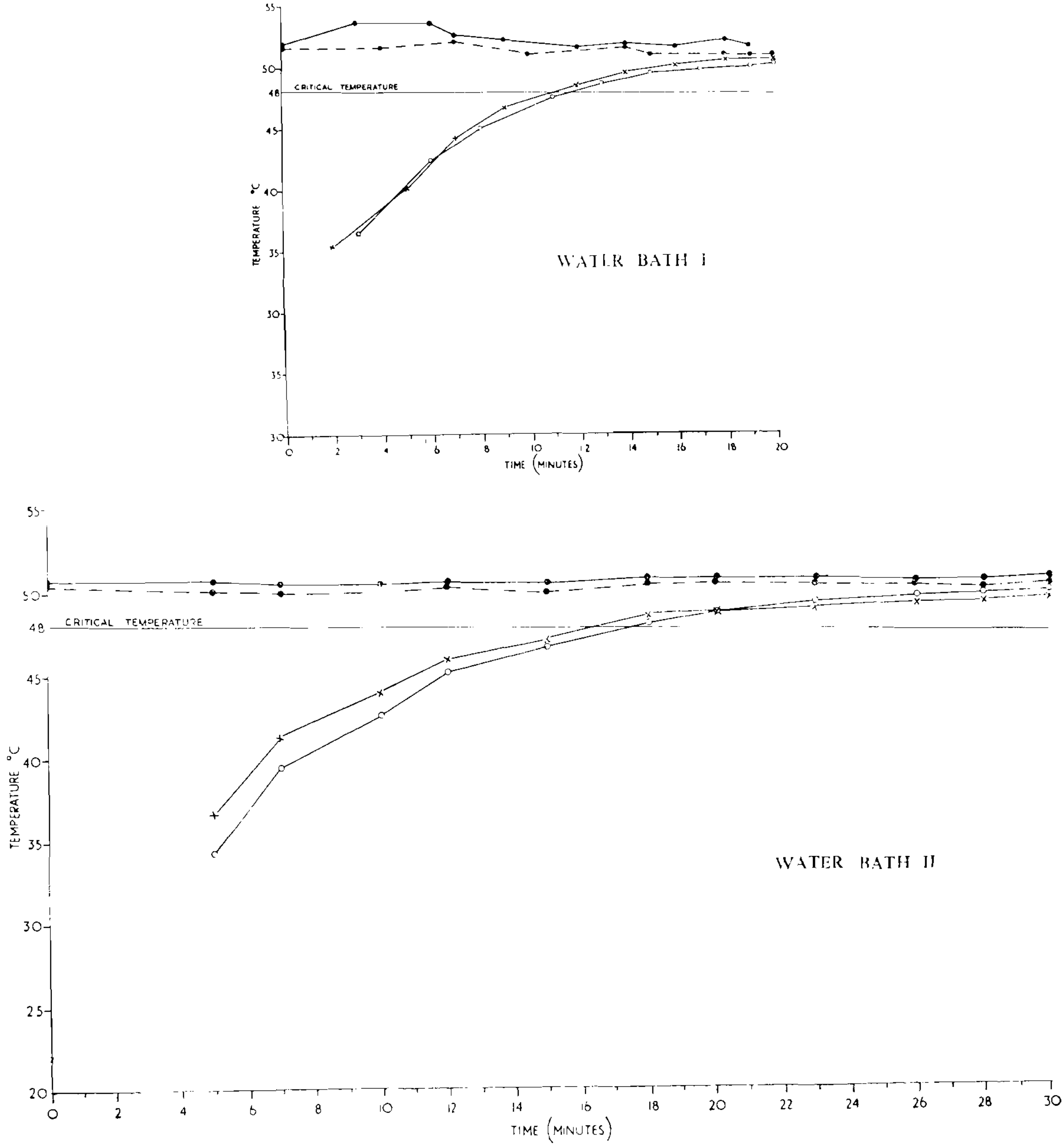
It follows that the prospects of breeding varieties highly resistant or immune to chlorotic streak do not appear very bright at this stage.

Another method of control is through the short hot-water treatment of planting material. Such treatment, generally 52°C for 20 minutes and occasionally 50°C for 30 minutes, is used on a large scale in Mauritius for plantings in the wet areas where the disease prevails. The area planted with treated cuttings during the year amounted to 4,760 arpents or 38.7% of the total area planted.

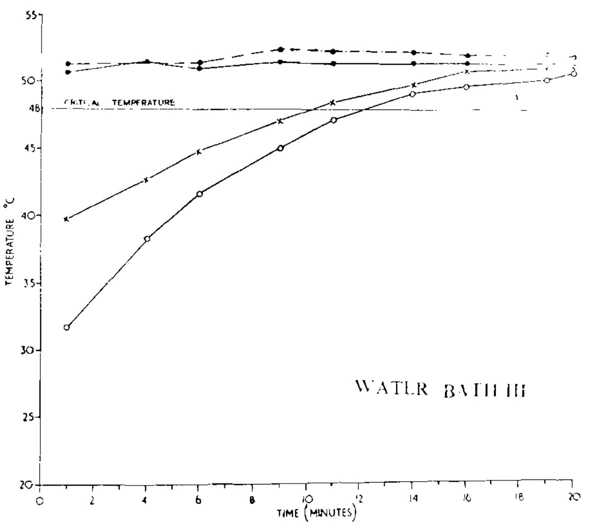
Several estates have their own hot-water installations for the treatment of cuttings against chlorotic streak. Unfortunately, the hot water tanks are no ton the same pattern, and if some are highly efficient, others are much less so. Several hot-water treatment installations were inspected during the year and temperature determinations made by means of needle thermocouples inside the cuttings during treatment.

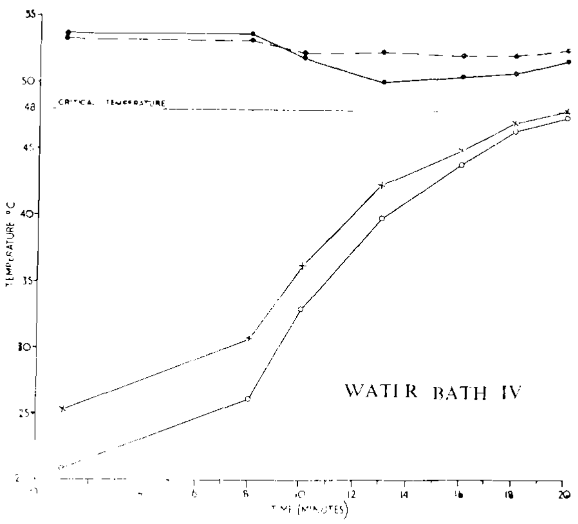
It has been proved that temperatures above 45 C inactivate the virus in a cutting of average size. However, in order to allow for variation in diameter of cuttings, a treatment installation is passed as efficient if temperatures of 48 C or over are rcordeed in cuttings of average diameter.

Results of tests carried out at four treatment installations are expressed graphically in figs. 24 to 27. It will be noted that no water circulation is provided in fig. 24 and fig. 27. However, treatment in bath I was effective on account of the very high water-cane ratio, 21:1. In bath IV, although the bath temperature appeared adequate for effective treatment, with the lack of water circulation and the low water-cane ratio, 6:1, temperatures inside the cuttings barely reached 48 C, the minimum required. The high incidence of chlorotic streak in treated cane planted in that area is the result of inadequate treatment temperature for the inactivation of the virus inside the cuttings.



Figs. 24 - 25 Temperature determinations inside cuttings (lower graphs) and in the water baths (upper graphs): for explanation, see text.





Figs. 26 - 27 Temperature determinations inside cuttings (lower graphs) and in the water baths (upper graphs); for explanation, see text.

Records taken in bath II (fig. 25) treating at 50 C for 30 minutes, and bath III (fig. 26), treating at 52 C for 20 minutes illustrate the importance of a good water circulation, even with a low water-cane ratio, in the hot-water treatment of cuttings.

However, an important precaution which should be taken, and which is seldom observed, is to ensure that the mass of cuttings is totally immersed in the water bath. Cuttings escaping the treatment may consitute new foci of infection in the plantation.

4. TESTING DISEASE REACTION OF SEEDLINGS

(a) Gumming disease

Thirty-eight seedling canes under selection, in the 1954 to 1957 series, and four Ebène canes were included in the gumming trial for routine assessment of their reaction.

The identification of what appear to be two different strains of the gumming disease pathogen has led to investigations on the natural infection of the sugar cane and *Thysanolanea maxima*. It is known that the *Thysanolaena* pathogen can, as a result of artificial inoculation, induce a disease resembling gummosis in the sugar cane and the cane pathogen, also after inoculation, can produce symptoms resembling those of «gumming disease» in *Thysanolaena*. Experimentation is being continued in order to find out whether there is an endemic disease of *Thysanolaena* caused by a bacterium which, although close to, is still distinguishable from the true *Xanthomonas vasculorum* attacking the sugar cane.

It is interesting to note that the *Thysanolaena* strain of the gumming disease pathogen apparently does not exist in Réunion island.

(b) Leaf scald

The new method of inoculation (*vide Ann. Rep. Sug. Ind. Res. Inst. Mauritius, 1961* : 55-56) has led to a high level of infection in the resistance trials, thus providing a good infective environment. It was therefore decided to expose the varieties under the test to both artificial and natural infection. To that effect, the trial was conducted in the following way. The varieties under test were flanked by inoculated susceptible canes : M.112/34, Sealey's seedling, White Tana and

M.81/52. Each varietal plot consisted of 4 rows of 10 feet, the two middle rows were inoculated, and the outer rows left exposed to natural infection. Varieties under test were : M.147/44, M.31/45, M.202/46, M.93/48, M.253/48, M.423/51, Ebène 1/37, Ebène 50/47, R.397, B.3337 and B.34104. The controls were : M.134/32 (resistant), M.112/34 and M.81/52 (highly susceptible).

All varieties under test, except M.147/44, which has shown high susceptibility in Réunion, contracted infection through inoculation of the pathogen. However, only the susceptible controls became naturally infected.

Considering the high level of infection in the environment, it can be inferred that varieties cultivated at present in Mauritius are highly resistant to leaf scald.

A similar trial including the following promising seedlings and imported canes has been established at Belle Rive : M.99/48, M.39/49, M.409/51, M.428/51, M.442/51, M.658/51, M.13/53, Ebène 88/56, R.397, N:Co. 310 and N:Co.376. In addition, the following commercial canes have been included for further testing : M.147/44, M.202/46, M.93/48, M.253/48, Ebène 1/37, Ebène 50/47, B.34104 and B.37172. The controls are : M.134/32, M.112/34, M.81/52 and H. 37-1933.

(c) General procedure.

The whole procedure used in testing the reaction of seedlings to the major diseases existing in Mauritius has been streamlined and is summarized in fig. 28. At present, of the six major diseases, gummosis, leaf scald, red rot, pineapple disease, chlorotic streak and ratoon stunting — smut being of very restricted importance — the first two lead to unconditional discard of susceptible seedlings. Hence disease resistance trials have to be conducted as early as possible during selection. Consequently, gumming trials requiring a limited number of cuttings, eight for each variety, are laid down with selected varieties from first selection trials, the cuttings being available in June-August. For leaf scald trials, requiring a larger number of cuttings, 80 for each variety, testing is carried out the following year, after propagation of selected varieties from first selection trials in a nursery, cuttings being available in February-March. Results can thus be obtained in both gumming and leaf scald trials within two years after selection from first selection trials.

Although a preliminary chlorotic streak trial is conducted at the same time as the leaf scald trials, testing for resistance to the other major diseases are carried out at a later stage in the selection programme on promising varieties selected in 1st or 2nd ratoons from variety trials established in four different environments. For ratoon stunting, the cuttings have first to be long-hot-water-treated and established in the central nursery at Pointe-aux-Sables in July-August. The following year, 1500 cuttings of each variety serve to plant the two resistance trials in the sub-humid and super-humid zones in March-April.

Cuttings for the chlorotic streak trial are obtained concurrently with those for ratoon stunting and planted directly in a super-humid environment, 320 diseased and 320 short-hot-water-treated setts being required for each variety.

Assessment of varietal reaction to red rot and smut is not made in specific trials. Ratings are given during inspections made at harvest time in pre-release and final variety trials conducted in the various localities of the island.

There is evidently no need to breed varieties resistant to pineapple disease, which attacks the planted cuttings only, and is easily controlled by organo-mercurial fungicides.

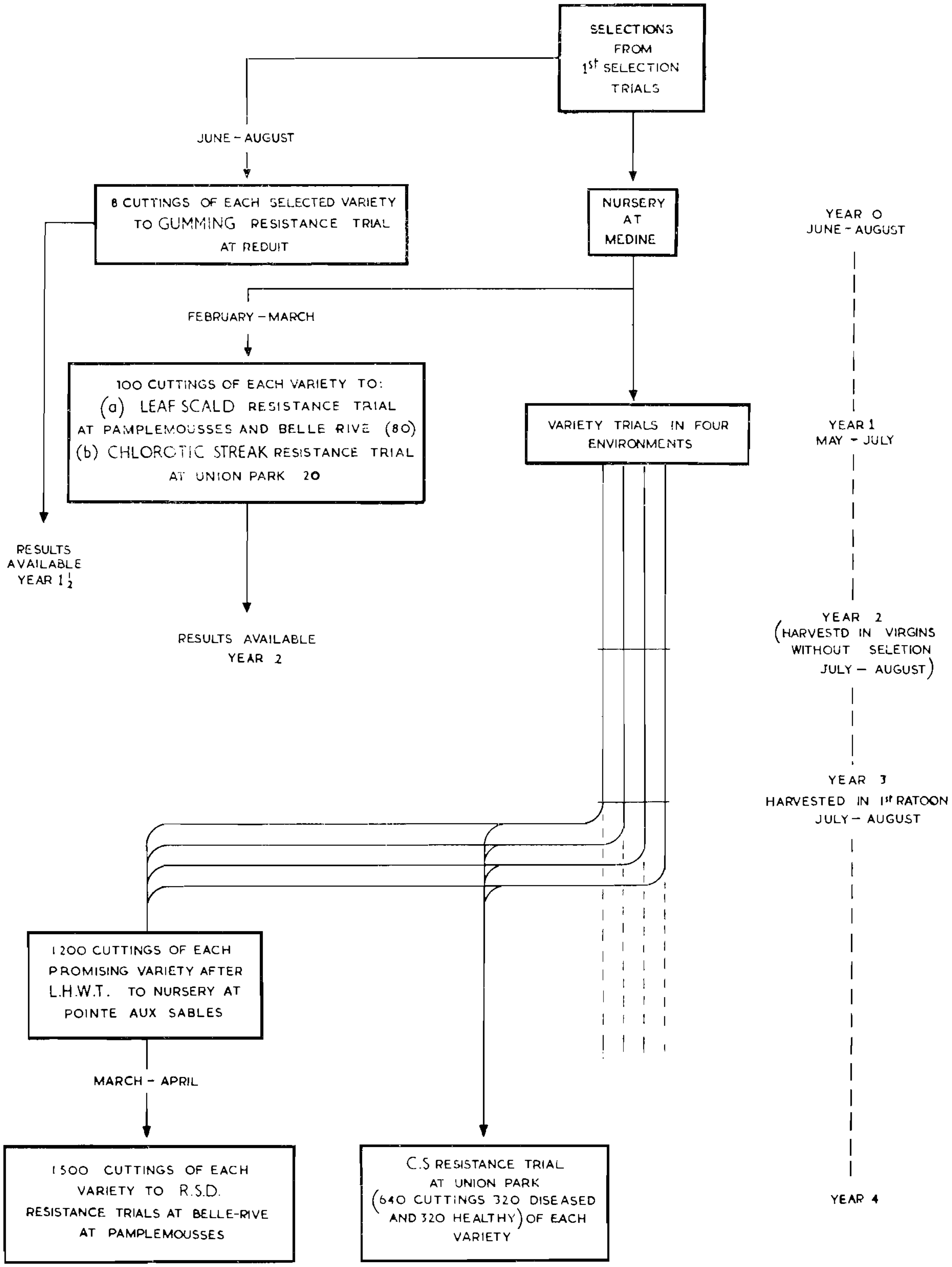


Fig. 28. Scheme illustrating the procedure in testing disease reaction of seedlings during selection.

5. PINEAPPLE DISEASE

The routine testing of fungicides in the control of pineapple disease was continued during the year. The following products, Occo Sugar San, B.S.M.11, Brestan, Ciba 3434, Unisol 6, A.7218 and B.6106, were compared to the standard organo-mercurial preparation.

The products were tested at three doses : low, medium, and high, as given in Table 39.

Table 39. Doses used in the assessment of fungicides.

Dose	*Standard 6 % Hg.*	*Occo Sugar San*	*B.S.M. 11*	*Brestan*	*Ciba 3434*	*Unisol 6*	*A. 7218*	*B.6106*
Low	0.5 %	0.80 ml. l.	1.75 ml./l.	0.5 %	1.75 ml./l.	0.25 %	0.5 %	0.5 %
Medium	1.0 %	1.75 ..	3.50 ..	1.5 %	3.50 ..	0.50 %	1.0 %	1.0 %
High	1.5 %	3.50 ..	5.00 ..	2.5 %	5.00 ..	0.75 %	1.5 %	1.5 %

In order to obtain uniform infection in the trial, cuttings attacked by pineapple disease and containing an abundance of black spores were split open and placed at planting time alongside the setts which consisted of 1/3 top, 1/3 middle, and 1/3 bottom cuttings for each plot.

The results are given in Table 40. It will be observed that although infection was, on the whole, very low in the trial, on account of the good environmental conditions which prevailed, four fungicides, Occo Sugar San, B.S.M. 11, Ciba 3434 and Unisol 6, as well as the standard, significantly controlled the disease.

Table 40. Assessment of fungicides in the control of pineapple disease.

Dose	*Control*	*Standard*	*Occo Sugar San*	*B.S.M. 11*	*Brestan*	*Ciba 3434*	*Unisol 6*	*A. 7218*	*B.6106*
			Germinated buds % total buds planted						
Low ...		70	65	68	60	54	59	59	59
Medium	60	62	70	70	63	62	70	59	59
High ...		63	69	65	67	71	71	54	59

Significant difference at 5% level = 9.1.

6. FIJI DISEASE IN MADAGASCAR

Considerable progress has been made in the eradication of Fiji disease on the East Coast of Madagascar and very encouraging results obtained. The replacement of susceptible canes, mainly M.134/32, in commercial plantations almost exclusively by the resistant Pindar is now completed and the roguing gangs are concerned with the removal of volunteer stools.

Progress, however, although slower in the innumerable small plantations, where sugar cane is grown for chewing and for the production of the local fermented beverage known as betsa-betsa, has improved considerably as a result of two important factors. The first is the effective enforcement of legislation relating to the compulsory cultivation of resistant varieties, and the second is the release of a cane, which is becoming popular in peasant cultivation, the "soft" S.17 which has proved to be as highly resistant to Fiji disease as the "hard" Pindar.

Three resistant canes, Pindar, S.17, and Q.57 have been propagated in order to meet planting requirements. Another resistant variety, M.31/45, is not very popular on account of its susceptibility to borer attacks.

With the exception of the outlying sector of Vavatenina, in which efforts will be concentrated in 1964, on the whole, approximately 80% to total eradication of susceptible canes was expected to be completed in the various districts by the end of 1963. Sustained vigilance will continue and the roguing gangs will concentrate their efforts on the uprooting of volunteer stools in 1964. The replacement of sugar cane by banana plantations, a crop more and more in favour, particularly in the district of Tamatave, has helped considerably in the eradication campaign.

The prohibition on the transport and sale of cane in the whole province of Tamatave was lifted in the town of Tamatave in 1962 after adequate control measures were enforced. The ban was lifted in the towns of Brickaville and Fenerive during the year.

The control organization which was set up in Tamatave in order to prevent the entry of any part of the sugar cane plant into the port area continued to operate satisfactorily in 1963. The control, which is being financed by the Governments of Mauritius and Réunion, should be maintained until the eradiction of Fiji disease is achieved on the East Coast of Madagascar.

Inspections of several small sugar cane plantations in the vicinity of the ports of Tulear, Fort Dauphin and Mananjary indicated that Fiji disease is still confined to the infected province. It is contemplated to survey the region of Vohemar in 1964.

In the resistance trials carried out at Brickaville, the following varieties have been proved to be highly resistant : Pindar, S.17, M.31/45, Q.57, Trojan, Ragnar and Co.290. The more recent assessments have shown that B.4362, N:Co.310 are highly susceptible and Co.421, Jason, M.112/34, C.P.29/116, R.383 and Pepecuca are susceptible. In the trial more recently established, B.4098, PR980, Ebène 1/37 appear highly susceptible, andM.93/48 M.272/52 and Q.47 moderately susceptible. Fiji disease has not been observed so far in virgins on B.41227, Co.281, CP44-101, M.165/38, M.63/39, M.76/39, M.213/40, M.202/46, Q.50 and R.331. Assessment in ratoons is forthcoming.

The following varieties : Q.58, Q.70, B.42231, B.45151, B.46364, B.49119, CL41-223, M.253/48, N:Co.376 and POJ3067 have been included in the 1963 trial.

In addition, M.99/48, M.39/49, M.409/51, M.442/51, M.658/51, M.225/53, M.117/55 and Ebène 88/56 will be released shortly from quarantine and included in the 1964 trial.

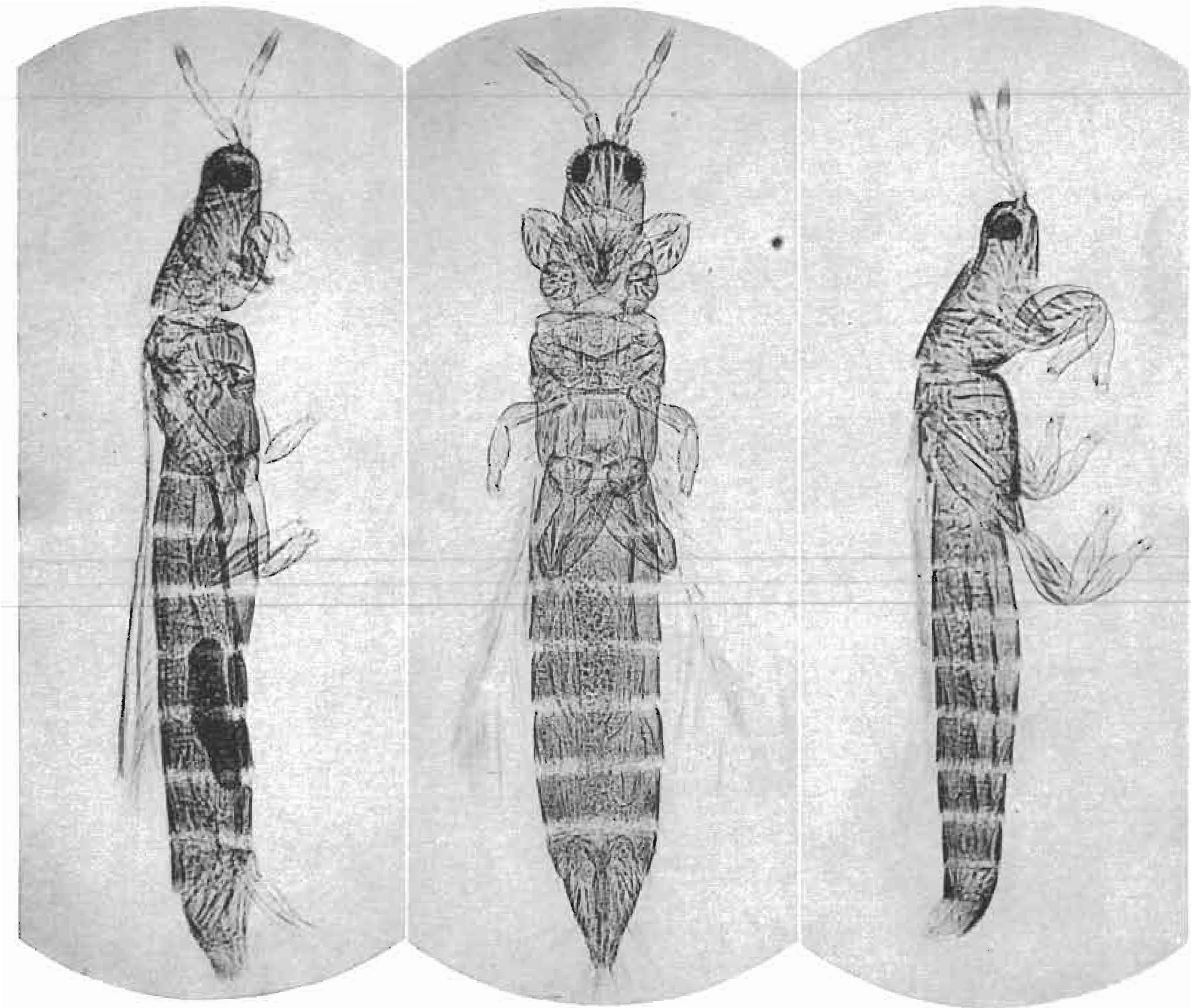


Plate 7. The sugar cane thrips, *Fulmekiola serrata* Kobus. Actual length about 1.25 mm.
Left : Adult female, lateral view. *Middle* : Adult female, ventral view. *Right* : Adult male, lateral view.

Plate 8. The nature of leaf injury caused by the sugar cane thrips.

Left : Dessication and curling of leaves. The leaf extremities remain tied together owing to dessication and death of the tips before expansion from the spindle.
Centre : Irregular yellowish streaks on expanded leaves. These indicate former feedings sites; the insect lives only in rolled leaves of the spindle, never on expanded leaves.
Right : A leaf showing chlorotic streak disease. Thrips injury is sometimes confused with disease symptoms.

CANE PESTS

J. R. WILLIAMS

1. THE RED LOCUST

OUTBREAKS of the red locust (*Nomadacris septemfasciata* Serv.), an insect which is normally innocuous, began in December 1962 and attacks continued to be reported throughout January and February 1963. Photographs of this insect and of attacked cane are to be seen in the Annual Report for 1962.

The outbreaks consisted of dense populations of the hoppers in restricted localities in the north, east and centre of the island, and severe defoliation occurred in many of the affected fields. The control measures adopted were spraying or dusting with Aldrin at the rate of about 2 oz. active ingredient/arpent, and a total area of about 850 arpents of cane was so treated. The treatments were generally effective, despite difficulties owing to the height and density of cane growth in some fields, and were instrumental in suppressing all serious attacks and preventing extension of crop damage. Aside from fields where hopper populations were dense and defoliation was occurring rapidly, the locust was numerous in fields elsewhere, but not to an extent which warranted application of insecticides, and it was evident that some factor had resulted in a general island-wide increase in the rate of the insect's multiplication.

As a consequence of the high hopper populations in December-February, adult locusts were extraordinarily abundant in some regions from March onwards (the locust has only one generation a year). These adults seemed to cause no significant injury to cane fields, but their presence in such large numbers constituted a threat of extensive hopper outbreaks when breeding would again start at the end of the year. Preparations to cope with new hopper attacks in early 1964 were therefore made.

Several interesting features of locust behaviour were observed during these outbreaks. The morphological and behavioural changes associated with phase were evident to a marked degree in some hopper populations, and the body colours of individuals ranged from the uniform light green of the solitary phase to the orange-red, yellow and black colour pattern of the gregarious phase. It was also clear that both hoppers and adults prefer some varieties of cane to others and congregate on the preferred ones; thus there was a marked liking for M.31/45 and M.147/44, while Ebène 1/37 and Ebène 50/47 tended to be avoided.

The red locust has long been known in Mauritius, and solitary individuals are always to be seen here and there in cane fields. The species is probably the one which proved so troublesome to early agriculturalists in the island and led to the introduction of the insectivorous Mynah Bird or "Martin" (*Acridotheres tristis*) in 1763. It has been considered that the introduction of this bird reduced the locust problem to negligible proportions and, while the recent outbreaks may be entirely attributable to weather factors, it is possible that a reduction of the Mynah Bird population by the successive intense cyclones of 1960, 1961, and 1962 was also a contributing factor.

2. ARMY WORM

As described in reports of recent years, the army worm (*Leucania loreyi* Dup.) has become a not infrequent pest in fields which are burnt before harvest, and a considerable number of fields were affected during the year under review. The attacks develop on the new ratoon shoots which appear after cropping and defoliation of fields may be severe, if not complete, when the new growth is about 4 weeks old. As only one generation of the moth is responsible for the cane injury, the canes recover their foliage quickly after pupation of the caterpillars, and there has been some doubt as to whether temporary defoliation of such small shoots could have any appreciable effect on final yield of cane. To elucidate this point, six experiments were laid down in fields of young ratoon cane in October-November 1962. Each consisted of a randomised block with 3 treatments and 5 replications, plot size being 4 rows of 40 feet. Treatments comprised (1) control ; (2) shoots defoliated once when a few weeks old ; and (3) shoots defoliated twice, at an interval of a week, when a few weeks old. Defoliation of shoots was effected by grasping the leaf blades in one hand and slicing them off completely, leaving the cylinder of leaf-sheaths intact. Exact duplication of army worm damage was not possible, since the insects either do not eat the leaf mid-rib, or they eat part of it, depending upon its hardness. The double defoliation was perhaps more representative of natural defoliation which, of course, extends over a certain period of time as the caterpillars mature. Yield of cane at harvest in August-October, 1963, was assessed on the two middle rows of each plot. The experiments and their results are summarized in Table 41, and it is seen that defoliation invariably resulted in a reduced yield of cane, the reductions being frequently statistically significant. The average reduction of cane yield in all experiments following a single defoliation was nearly 3 tons/arp., and when shoots were twice defoliated the reduction averaged about 5½ tons. These results are conclusive and show clearly that, despite the apparent swift recovery of a field after attack by army worms, final loss of cane yield which is liable to occur warrants control measures. These are neither difficult, nor expensive, and involve careful inspection of burnt fields about two weeks after cropping and the immediate application of an appropriate insecticide if army worms are apparent.

3. THE STALK BORER

Four consingments of *Trichospilus diatraeae* C. & M. (Eulophidae), a pupal parasite which attacks cane borers of the genera *Proceras* and *Sesamia* in India, were received from the Commonwealth Institute of Biological Control during August-October. The parasite was multiplied in the laboratory and about 85,000 locally reared specimens were liberated in five different localities. Breeding and liberation of the insect were being continued at the end of the year.

In addition to the above-mentioned parasite, a few consingments of *Stenobracon deesae* (Cam.) and *S. nicevillei* Bingh. (Braconidae) were also received from the C.I.B.C. (Indian Station). The insects were released directly in the field, 305 of the former, and 951 of the latter being liberated.

Table 41. Results of randomised block experiments on defoliation of ratoon canes

Locality	*Date previous harvest*	*Variety*	*Category*	*Cane Yield, metric tons/arp.*			*Age of shoots (days) when defoliated*	
				Control	*Defoliated once*	*Defoliated twice*	*Defoliated once*	*Defoliated twice*
Bel Ombre	6.10.62	B.37172	9th Ratoon	28.3	25.5	20.5*	40	40,47
Plaisance	16.10.62	B.37172	2nd Ratoon	44.8	41.5	40.8	28	28,35
Gros Bois	22.10.62	B.37172	3rd Ratoon	31.7	28.8	25.1**	29	29,36
Case Noyale	15.10.62	M.147/44	1st Ratoon	29.1	26.8	28.1	37	37.42
Sauveterre	26.11.62	M.147/44	1st Ratoon	26.7	24.5	20.0**	26	26.33
Gros Bois	25.10.62	M.147/44	5th Ratoon	32.2	28.2*	24.3**	26	26,33
Average reductions of yield				—	2.9	5.7		

* Significantly different from control at 5% level.

** Significantly different from control at 1% level.

WEED CONTROL

E. ROCHECOUSTE

1. SUBSTITUTED UREAS *VERSUS* SUBSTITUTED TRIAZINES IN THE SUPER-HUMID ZONE

FURTHER experimental work was carried out last year with the substituted ureas DCMU, CMU and the substituted triazines Simazine, Atrazine, so as to evaluate their respective effectiveness under the wet conditions of the super-humid zone. In that respect, ten trials were laid down in different localities of that zone and the herbicides were applied in plant canes a week after planting and before weed emergence. With the exception of DCMU which was applied at rates of 3 - and 4 - lb active material per acre, all the three other chemicals were used at a uniform dosage of 4 - lb active material per acre. Weed assessment was made by the frequency abundance method 3 months after herbicide application.

Results and Conclusions

Data obtained in these trials, and summarized in Table 42, indicate that at equivalent dosage rates, DCMU was outstandingly more effective than CMU and the two triazines Atrazine and Simazine. Although at the 3-lb rate it also proved more effective than the three other weed killers, yet its effectiveness on the weed population is considered unsatisfactory from a practical view point. Of the two triazines, Atrazine has, in general, proved somewhat better than Simazine.

With regard to the performance of the herbicides on the weeds, DCMU exercised its phytotoxic effects over a broader weed spectrum than CMU or the two triazines, and the major weeds more effectively controlled by that herbicide were : meinki (*Digitaria timorensis*) Herbe bambou; H. bassine (*Setaria barbata*) Millet sauvage. (*Setaria pallide-fusca*) Herbe bouc; (*Ageratum conyzoides*) and *Crepis japonica*. It must be observed, however, that Plantain (*Plantago lanceolata*) was in general better controlled by the substituted trizaines than by the substituted ureas.

2. INVESTIGATIONS ON THE COMPARATIVE EFFECTIVENESS OF CERTAIN HERBICIDE MIXTURES

Combinations of herbicide consisting of Urox, Lorox, Fenac, CMU with sodium chlorate and Simazine, Atrazine, Atratone with Pesco 18/15 were compared to Pesco 18/15 and to mixtures of DCMU plus sodium chlorate, and of DCMU plus a low volatile ester of 2,4-D. The trials were laid down in different localities of the humid and super-humid zones, and the herbicides were applied in ratoon canes about a fortnight after harvest. Observations were made at monthly intervals, and a weed assessment was carried out about 3 months after after herbicide application.

Results and conclusions

From the data obtained and presented in Table 43, it may be inferred that in the super-humid zone DCMU – sodium chlorate was the best treatment and that in general that treatment was to be preferred to DCMU – ester of 2,4-D. In the humid zone Atrazine – Pesco 18/15 was the most effective combination. Pesco 18/15 used alone was ineffective in the wet areas but gave fairly satisfactory results in the humid areas with the exception of the Union Vale trial where exceptionally poor weed control effect was obtained. Urox was, in general, more effective than Fenac, while Lorox with the exception of the Beau Climat trial gave fairly satisfactory results.

It is interesting to observe here that Atrazine, although more soluble than Simazine, yet proved as effective as that chemical in the super-humid zone. On the other hand, CMU which is more soluble than DCMU did not prove more effective than that herbicide in the humid zone. This observation is of importance because it indicates that the effectiveness of an herbicide in an area with a particular rainfall régime is not necessarily correlated with its solubility. It must be emphasized that these trials were conducted during the months of August to December and that a fairly dry season prevailed during these months.

3. VARIETAL SUSCEPTIBILITY TO DCMU.

Experiments on the effects of DCMU on germination and early growth of the following commercial varieties M.147/44. M.202/46, M.93/48, M.253/48, Ebène 1/37, Ebène 50/47, B.3337, B.34104 and B.37172, were laid down last year in different localities of the island. The statistical layout was a randomized block with 4 replications, and each experimental plot consisted of 4 rows of canes, each row containing 30 three-eyed cuttings. DCMU was applied at rates of 3, - 4, - 5 - and 6 - lb active material per acre a week after planting. Visual observations were made at fortnightly intervals and cane measurement was recorded three months after herbicide application

Results and conclusions

No visual damage was observed on any of the varieties tested throughout the duration of the experiments. From the data obtained and presented in Table 44, it was found that bud germination and early growth were not significantly affected in all the varieties included in these trials throughout the concentration range used. These data are of great significance for they clearly indicate that DCMU has no deleterious effect on cane growth when applied under normal field conditions.

4. STUDIES ON THE EFFECT OF DALAPON, PARAQUAT AND FENAC ON YIELD OF CANE AND SUGAR OF CERTAIN COMMERCIAL VARIETIES

Investigations on the effect of Dalapon, Paraquat and Fenac on yield of cane and sugar of the following varieties, Ebène 1/37, Ebène 50/47, M.147/44, M.93/48 and B.37172 were completed in 1963. The trials were distributed in the three climatic zones of the island, sub-humid, humid and super-humid, and the herbicides were applied in ratoon canes a week from a month after harvest. The statistical layout consisted of a randomized block with 4 replications, and each experimental plot was 1/80th' of an acre. Rates of application were 4-, 8-, 12-, and 16 lb active material per acre for Dalapon, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1 lb active material per acre for Paraquat an 1-, 2- and 3- lb active material per acre for Fenac. Visual observations were made at monthly intervals until the canes closed in and also during the first three months following the harvest of the trials.

Table 42. Comparative effectiveness of substituted ureas and substituted triazines in the super-humid zone

Treatments (lb active material per arpent)	*Astraea Trial No. 1*	*Astraea Trial No. 2*	*Belle Rive Trial No. 1*	*Bois Sec*	*Val Riche*	*Beau Bois*	*Bar le Duc*	*New Grove*	*Belle Rive Trial No. 2*	*Belle Rive Trial No. 3*
	Weed Infestation % Control about 3 months after herbicide application									
DCMU 4 lb	23.6	30.0	41.9	13.1	22.9	26.2	20.3	14.7	16.1	14.6
CMU 4 lb	38.0	—	77.7	32.1	28.7	38.5	39.8	49.5	30.2	25.8
Atrazine 4 lb	58.2	59.7	75.3	30.8	32.9	29.5	34.2	36.3	30.0	22.1
Simazine 4 lb	40.9	62.1	73.0	30.8	36.1	33.1	36.8	39.4	30.8	25.8
DCMU 3 lb	29.8	45.7	51.6	17.7	30.4	40.4	31.2	25.3	35.0	27.0
Duration										
From time of spraying to survey (days)	83	91	101	123	91	98	92	96	98	98
Rainfall										
Total rainfall (inches)	39.5	34.8	34.1	31.5	20.6	20.8	25.5	19.5	14.7	14.7
No. of rainy days	58	62	84	77	32	69	69	60	62	62

Table 43. Comparative effectiveness of different herbicide mixtures in ratoon canes

Treatments (lb. active material per acre)	*WEED INFESTATION % CONTROL*									
	HUMID ZONE				*SUPER-HUMID ZONE*					
	Mon Désert	*Val Riche*	*Union Vale*	*Gros Bois*	*Bois Sec*	*Beau Climat*	*Riche-en-Eau*	*Bonne Veine*	*Belle Rive*	*New Grove*
DCMU (4.8) Sodium Chlorate (4)	19.0	15.8	30.1	21.5	15.4	20.0	18.6	14.8	25.0	22.4
DCMU (3.2) ester 2.4-D (2.0)	29.1	25.6	34.1	17.4	17.1	37.1	25.4	24.5	30.6	21.6
CMU (4.8) Sodium Chlorate (4)	37.9	25.6	35.8	18.7	18.8	39.3	24.5	39.6	24.2	36.5
Urox (4.8) + Sodium Chlorate (4)	31.6	25.6	31.7	–	17.1	52.1	–	27.3	26.6	–
Lorox (4.8) + Sodium Chlorate (4)	26.6	18.8			22.2	40.7	–	17.4		–
Simazine (4.0) + Pesco 18/15 (1.7)	22.8	20.3	33.3	16.6	20.5	43.6	25.4	27.3	26.6	29.9
Atrazine (4.0) + Pesco 18/15 (1.7)	18.9	22.5	22.8	15.6	22.2	34.3	22.4	31.4	29.0	23.1
Atratone (4.0) + Pesco 18/15 (1.7)	39.3	18.1	35.8	24.3	30.7	58.6	34.3	28.9	32.3	32.1
Fenac (3.0) + Sodium Chlorate (4)	24.1	46.6	33.3	28.1	27.4	55.0	39.2	42.9	40.0	41.0
Pesco 18/15 (3.5)	27.8	24.8	45.5	22.2	31.6	52.9	35.2	42.9	37.9	46.2
Duration (days)	127	106	93	82	107	94	101	109	89	104
Total Rainfall (ins.)	11.7	10.0	9.7	13.0	18.1	22.4	23.2	21.5	17.6	23.3
No. of rainy days	57	18	46	59	47	51	64	53	52	60.0

Results and Conclusions

(*i*) *Visual effects.*

Dalapon, as already described by the writer (1962)*, produced malformations of various kinds, and of the varieties tested. Ebène 1/37 was the only on which showed some tolerance to that chemical as far as morphological malformations are concerned. Subsequent observations made 3 months after the canes in the trials had been harvested indicated that in the susceptible varieties the chemical was still exercising its phytotoxic effects because a certain proportion of the new shoots formed exhibited diverse malformations.

Paraquat produced a scorching effect on the young cane shoots, and that effect was most severe at the two highest concentrations. Affected shoots either died or produced malformed buds which, during their subsequent development, produced various morphogenetic effects. At the lowest concentration, the visual effects did not persist longer than 6 to 8 weeks, after which the plant resumed its normal growth again.

(*ii*) *Effects on yield of cane and sugar.*

From the results obtained and presented in Table 45, the following information may be derived.

Dalapon had in general a deleterious effect on cane, growth and varieties Ebène 50/47 and M.147/44 proved the most susceptible for their yield was significantly affected throughout the concentration range. The yield of M.93/48 and B.37172 was also affected at all concentrations, but significance was reached only as from the 8-lb per acre treatment. In two out of the three trials with Ebène 1/37, there are definite indications that the chemical had depressed the yield although significant effects were not obtained, thus suggesting that this variety is somewhat tolerant to the chemical. Sugar content was significantly affected in the two varieties Ebène 50 47 and B.37172 but only at the 12-lb per acre concentration.

Paraquat did not affect cane yield and sugar content throighout the concentration range.

Fenac affected cane yield only in one treatment but had no effect on sugar content.

5. EVALUATION OF NEW HERBICIDES

The herbicidal properties and the phytotoxic effects of the following herbicides were evaluated by the logarithmic spraying technique at Belle Rive Experiment Station.

Hyvar (*Isocil*)	–5–bromo–3–isopropyl–6–methyl uracil
Hyvar x (*Bromacil*)	–5–bromo–3–*sec*. butyl. 6. methyl uracil
Ametyne	–4–ethylamino–6–isopropylamino–2–methylthio 1–3–5–triazine
Prometryne	–4–6–bisisopropylamino–2–methylthio–1,3,5–triazine
Pyramin	–1–phenyl–4–amino–5–chloropyridazone (6)
HS 95	–N–p–chlorophenyl–N–methyl–N–isobutinyl urea
Casoron	–2,6–dichlorobenzonitrile
Shell H 5792	–2,6–dichlorothiobenzamide
Tordon	–4–amino–3,5,6–trichloro–picolinic acid.
Cotoran	–N–(3–trifluoro methyl-phenyl)–N', N'– dimethyl urea.

The herbicides were applied in pre-emergence treatment of both weeds and canes and were tested in comparison to DCMU. Two trials were laid down, one in April and the other in September, and there were at least 2 replicates for each treatment. The cane variety used was Ebène 1/37 and the cuttings were subjected to the short hot-water treatment before planting. Visual observations were made at fortnightly intervals both on germination and early growth. Weed assessment and cane measurements were made about three months after herbicide application.

* Rochecouste, E. Phytotoxic effects of Herbicides. *Ann. Rep. Sug. Ind. Res. Inst, Mauritius*, 1962 : 72-73.

Table 44. Effect of DCMU on Cane Growth — 3 months after planting

A. — Mean shoot length in cms.

Treatments (lb. active material per arpent)	M.147/44 *St. Aubin*	M.202/46 *St. Aubin*	M.202/46 *Union Park*	M.93/48 *Beau Bois*	M.93/48 *Union Park*	M.253/48 *Médine*	Ebène 1/37 *Beau Bois*	Ebène 1/37 *Union Park*	Ebène 50/47 *Beau Bois*	Ebène 50/47 *St. Aubin*	B.3337 *Beau Bois*	B.3337 *Union Park*	B.34104 *Médine*	B.37172 *St. Aubin*
DCMU 3 lb.	20,4	16,0	13,4	16,3	14,7	22,8	18,5	14,5	12,9	17,3	17,8	13,5	22,0	24,0
DCMU 4 lb.	22,6	15,4	12,8	16,5	14,1	23,0	17,8	14,8	14,6	16,8	17,2	13,3	21,3	22,6
DCMU 5 lb.	20,1	15,1	12,9	15,6	14,5	20,5	17,5	14,3	14,3	18,5	16,3	13,4	22,2	23,8
DCMU 6 lb. .. .	21,5	15,2	12,9	15,0	14,0	23,4	17,7	14,8	14,1	17,1	17,5	12,7	21,7	22,8
Control	21,3	16,0	11,1	15,7	12,8	21,8	18,7	12,6	14,4	18,4	15,9	11,8	21,7	23,4

B. — Mean number of shoots per plot

Treatments (lb. active material per arpent)	M.147/44 *St. Aubin*	M.202/46 *St. Aubin*	M.202/46 *Union Park*	M.93/48 *Beau Bois*	M.93/48 *Union Park*	M.253/48 *Médine*	Ebène 1/37 *Beau Bois*	Ebène 1/37 *Union Park*	Ebène 50/47 *Beau Bois*	Ebène 50/47 *St. Aubin*	B.3337 *Beau Bois*	B.3337 *Union Park*	B.34104 *Médine*	B.37172 *St. Aubin*
DCMU 3 lb.	255,2	134,0	68,7	51,3	72,0	209,7	77,3	61,7	69,5	105,2	79,3	64,7	228,7	272,5
DCMU 4 lb.	244,5	120,7	73,2	57,0	65,5	205,0	64,5	53,5	83,3	109,7	70,0	62,7	253,5	259,5
DCMU 5 lb.	272,7	132,5	67,5	59,0	64,5	220,5	80,5	56,7	73,5	121,5	76,3	60,0	242,0	287,2
DCMU 6 lb.	265,5	143,2	66,2	54,5	63,5	230,7	77,8	60,5	77,8	108,2	74,0	58,5	260,0	273,2
Control	256,0	123,2	60,0	47,0	60,2	206,7	56,8	52,5	78,8	102,5	68,3	59,7	235,2	269,5

Table 45. Effect of Dalapon, Paraquat and Fenac on Cane Yield and Sugar Content

Treatments (in lb/arpent)	Ebène 1/37 *Mon Désert Alma Super-Humid* Yield	IRSC	*Super-Humid* Yield	IRSC	*Humid* Yield	IRSC	*St. Aubin Humid* Yield	IRSC	Ebène 50/47 *M.D. Alma Humid* Yield	IRSC	*St. Aubin Humid* Yield	IRSC	M.147/44 *Bel Ombre Sub-Humid* Yield	IRSC	*Beau Champ Sub-Humid* Yield	IRSC	M.93/48 *Bel Ombre Humid* Yield	IRSC	B.37172 *Beau Champ Sub-Humid* Yield	IRSC
Control ...	32,0	10.4	35,0	10,2	34.2	10,5	35.2	11,3	44,3	13,1	55,8	9,7	43,0	10,2	25,3	12,6	32,2	8,6	29,8	13,8
Dalapon 4 (com)	30,1	10,4		-	32,7	11,2	35,5	11,9	32,7**	12,8	50,3*	9,8	34,1**	9,9	21,9*	13,2	27,1	8,5	27,3	13,4
,, 8 (,,)	28,9	10,0			32,0	10,7	35,6	10,9	27,5**	12,8	49,1*	9,8	34,2**	10,0	21,5**	13,4	22,1**	8,2	26,9*	13,7
,, 12 (,,)	30,1	10,8			31,5	10,5	35,2	11,3	20,1**	12,1*	42,4**	9,3	33,3**	10,0	20,7**	13,4	20,9**	8,5	26,3*	13,1*
,, 16 (,,)					—	—	31,5*	11,4			41,5**	9,2	33,3**	9,8	—	—		-	—	
Paraquat ¼ a.i.	-		33,9	10,2	35,7	10,4			—	-				—	—	—	26,9	8,5	—	—
,, ½ a.i.	-	—	31,2	10,3	29.1	10,7	-	—		—						—	27,5	8,3	—	
,, ¾ a.i.		-	32,8	10,3	28,2	10,9											26,8	8,6		
,, 1 a.i.			31,9	9,9	33,3	10,2											-			
Fenac 1 a.e.			32,0	9,7			34,6	11,4			55,3	9,9	43,2	9,8			-			
,, 2 a.e.			32,6	9,7	-		36,5	11,1			56,0	9,3	37,9*	10,0			—	—	-	
,, 3 a.e.	—	—	34,8	9,4		—	33,1	11,3	-	-	52,3	9,3	36,6*	9,6	—		-	-		—

* Significant at 5% level.
** Significant at 1% level.

Table 46. Effects of new herbicides on Weed Infestation and Cane Growth, 12 weeks after planting

Trial No. 1 April 18th – July 7th 1963

Treatments	*WEED INFESTATION % CONTROL*					*MEAN SHOOT LENGTH % CONTROL*				
	Dosage Range per acre (lb. active) per 3 yd. logarithmic strip					*Dosage Range per acre (lb. active) per 3 yd. logarithmic strip*				
	5.0 3.8	3.8 2.8	2.8 2.1	2.1 1.6	1.6 1.2	5.0 3.8	5.8 2.8	2.8 2.1	2.1 1.6	1.6 2.1
DCMU[1]	5.6	6.3	9.5	9.5	15.7	89.0	114.4	104.5	92.3	101.5
Hyvar (Isocil)	13.5	11.2	11.9	15.1	25.4	48.2	68.8	54.5	59.2	98.7
Hyvar x (Bromacil)	3.2	5.6	7.1	12.6	14.8	53.9	52.5	50.5	49.9	67.2
Ametryne ..	20.6	20.6	23.8	24.6	27.8	97.2	98.4	82.9	87.2	85.1
Prometryne ..	19.8	23.0	29.4	33.3	37.3	118.6	118.0	97.7	97.1	95.4
Pyramin ..	34.5	38.5	43.6	45.6	51.4	78.5	102.5	77.7	75.7	98.2
HS 95 ..	22.2	25.4	31.0	36.5	42.9	102.5	104.0	92.5	87.3	108.8
Casoron ..	42.9	40.9	43.7	50.8	55.6	89.0	92.7	78.9	83.1	82.1
Shell W 5792	25.6	31.0	33.3	38.9	41.3	107.2	93.6	96.4	91.2	95.8
Cotoran	17.5	19.0	23.0	32.5	37.3	81.4	78.8	64.2	78.1	90.1
Tordon ..	11.2	9.5	14.3	20.6	27.0	33.9	43.2	34.0	40.2	55.6

Duration of Experiment	81 days
Total rainfall (inches)	30.66
No. of rainy days	73

Table 47. Effects of new Herbicides on Weed Infestation and Cane Growth, 12 weeks after planting

Trial No. 2. September 11th December 23rd, 1963

Treatments	*WEED INFESTATION % CONTROL* *Dosage range per acre (lb. active) per 3 yd. logarithmic strip*					*MEAN SHOOT LENGTH % CONTROL* *Dosage range per acre (lb. active) per 3 yd. logarithmic strip*				
	5.0 - 3.8	3.8 - 2.8	2.8 - 2.1	2.1 - 1.6	1.6 - 1.2	5.0 - 3.8	3.8 - 2.8	2.8 - 2.1	2.1 - 1.6	1.6 - 1.2
DCMU ..	6.6	7.5	8.5	10.4	12.3	108.6	97.3	98.9	127.7	101.1
Hyvar (Isocil)	1.9	1.9	4.7	9.4	10.4	30.9	32.4	39.7	54.9	58.7
Hyvar x (Bromacil)	0.9	1.9	1.9	3.8	4.7	38.6	28.8	32.5	40.2	50.3
Ametryne ...	17.0	19.8	20.0	22.6	24.5	135.4	118.3	123.8	124.0	133.9
Prometryne ...	18.9	18.9	21.7	22.6	26.4	93.5	99.6	106.2	107.5	106.3
Shell W 5792	22.6	27.4	34.0	40.6	49.1	97.2	96.7	87.9	109.7	105.3
Cotoran ...	12.3	15.1	17.9	21.7	22.6	114.9	109.2	96.2	108.5	89.8
Tordon ..	9.4	12.3	15.1	17.0	21.7	35.4	28.0	47.6	65.7	75.6
	3.0 - 2.2	2.2 - 1.7	1.7 - 1.3	1.3 - 1.0	1.0 - 0.8	3.0 - 2.2	2.2 - 1.7	1.7 - 1.3	1.3 - 1.0	1.0 - 0.8
Hyvar (Isocil)	2.8	4.7	5.6	8.5	12.3	49.8	43.8	62.8	77.4	89.1
Hyvar x (Cromacil)	0	1.9	3.8	4.7	6.6	35.8	35.6	52.4	56.2	84.0
Tordon .	8.5	8.5	17.9	17.9	19.8	43.4	46.5	66.7	76.4	71.6

Duration of Experiment	104 days
Total rainfall (inches)	24.66
No. of rainy days	74

Results and Conclusions.

Data obtained in these logarithmic trials are presented in Tables 46 & 47.

Effects on canes. The two Uracil compounds, Hyvar and Hyvar x and Tordon had a deleterious effect on cane growth up to the concentration of 1 lb active material per acre. The other herbicides had no adverse effect on cane growth.

Effects on Weeds. Hyvar x (Bromacil) was outstandingly the most effective chemical. Hyvar (Isocil) proved as effective as DCMU in the September trial but was not as good as that chemical in the April trial. Tordon gave better weed control effects than Cotoran particularly in the September trial. Ametryne, Prometryne and Pyramin gave comparatively similar results and there was little to choise between the effectiveness of HS.95 and Shell 5792. Casoron was disappointing with regard to its weed control effects.

CLIMATE, IRRIGATION, CULTIVATION

1. CLIMATIC CONDITIONS DURING THE 1963 SUGAR CAMPAIGN

PIERRE HALAIS

AVERAGE climatic conditions which prevailed over the sugar producing area of the island fluctuated close to normal values for twelve months in succession from November 1962 to October 1963, covering both the eight months vegetative, and the four months maturation periods of the sugar campaign.

Such was, unfortunately, not the case during the two previous campaigns when cane growth was hindered in 1961 by drought, and in 1962 by cyclonic winds, and cane maturation was adversely affected in 1961 by warm and wet weather which prevailed from July to October, and in 1962 by wet weather during the same months. Table 48 gives the cane and sugar output per arpent reaped for the three consecutive campaigns.

Table 48. Cane and sugar output of Mauritius per arpent reaped

			Tons cane/arpent	*Sugar made % cane*	*Tons sugar made per arpent reaped*
Drought year	1961	...	26.4	11.19	2.95
Cyclone year	1962	...	23.9	11.52	2.75
Normal year	1963	...	29.8	11.93	3.56

Close analysis of the four selected climatic data, rainfall, wind, temperature, and sunshine, observed during the normal sugar campaign 1963 becomes possible when examining the four comparative graphs (figs. 29 - 32) published in this note.

Observations for the vegetative period November - June of the 1962 - 1963 campaign show that :

(a) Notable moisture stress was experienced only on two occasions during the middle of February and during the first decade of April when beneficial, but not excessive rains, eased the situation.

(b) Average mean air temperature was more or less normal throughout.

(c) Highest wind velocity was slightly above normal during the months of December 1962 and January 1963, fortunately at a time when the standing canes were still short.

(d) Relative insolation exceeded the normal values for only one month in March; otherwise it was below normal.

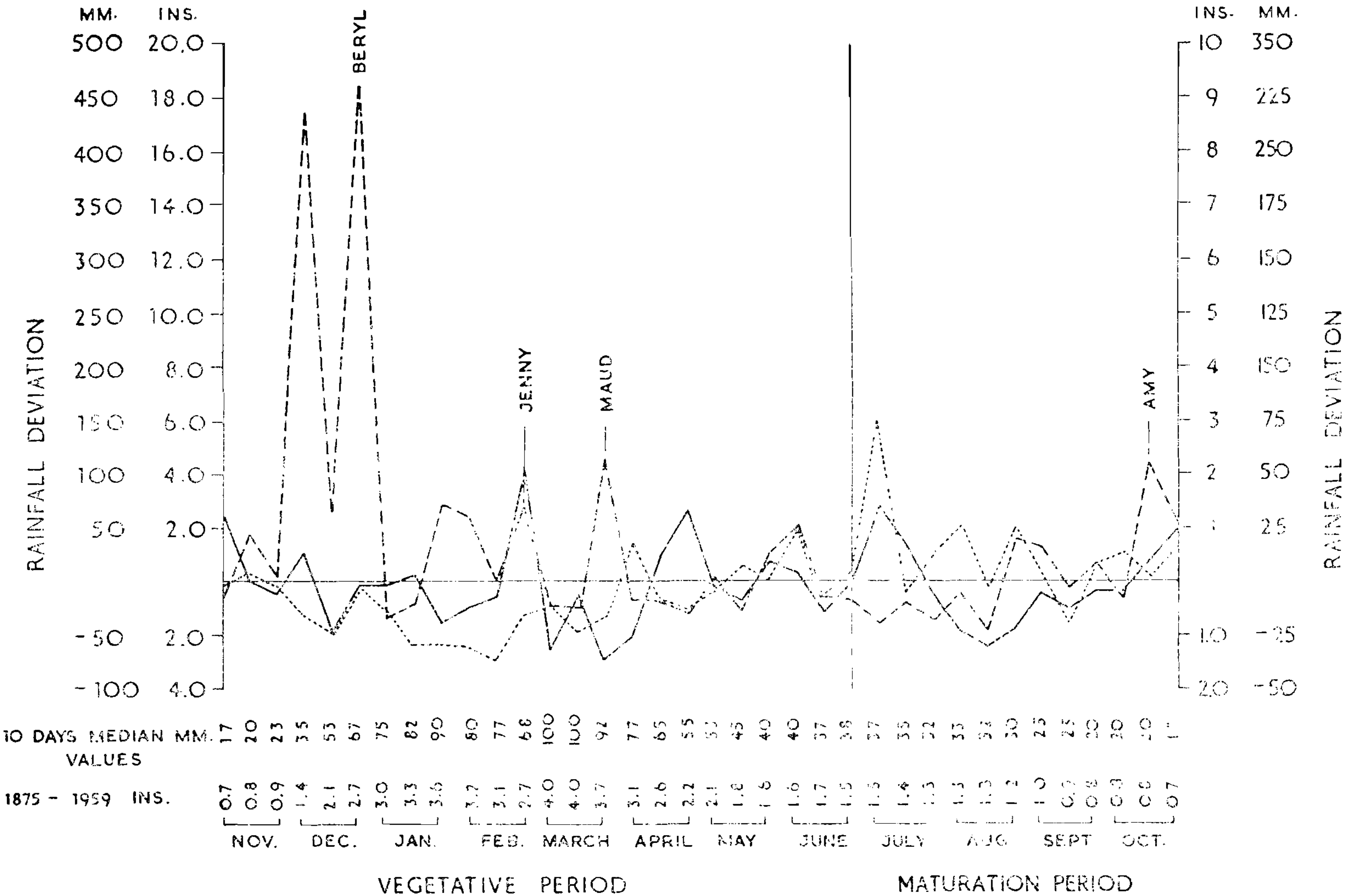


Fig. 29. Rainfall deviation from 10 days median values
Dotted line: 1960–61. Broken line: 1961–62. Plain line: 1962–63.
Scale used for maturation period is double that of vegetative period.

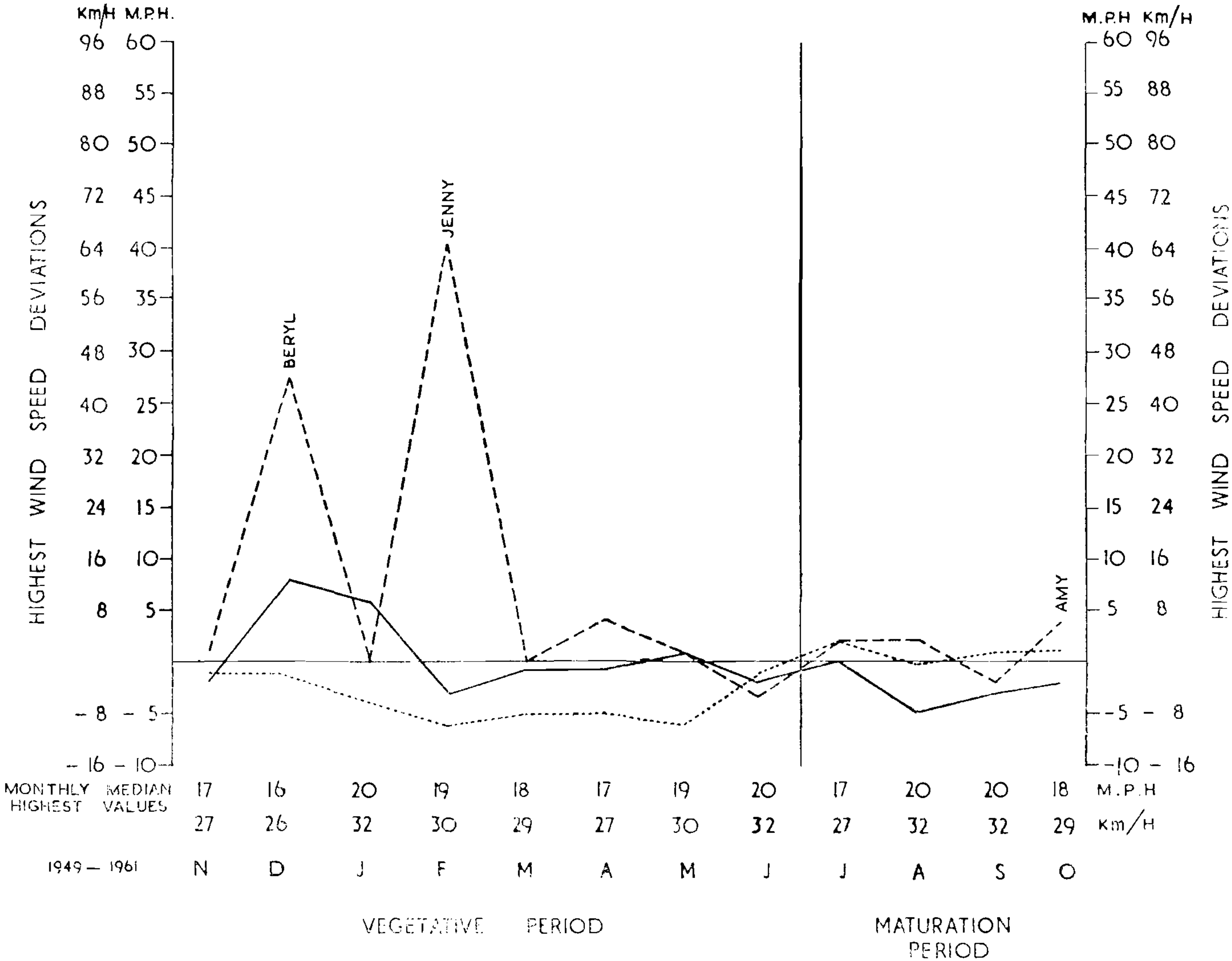


Fig. 30. Deviations of highest wind speed during one hour from corresponding monthly median values.

Dotted line : 1960-61. Broken line 1961-62. Plain line 1962-63.

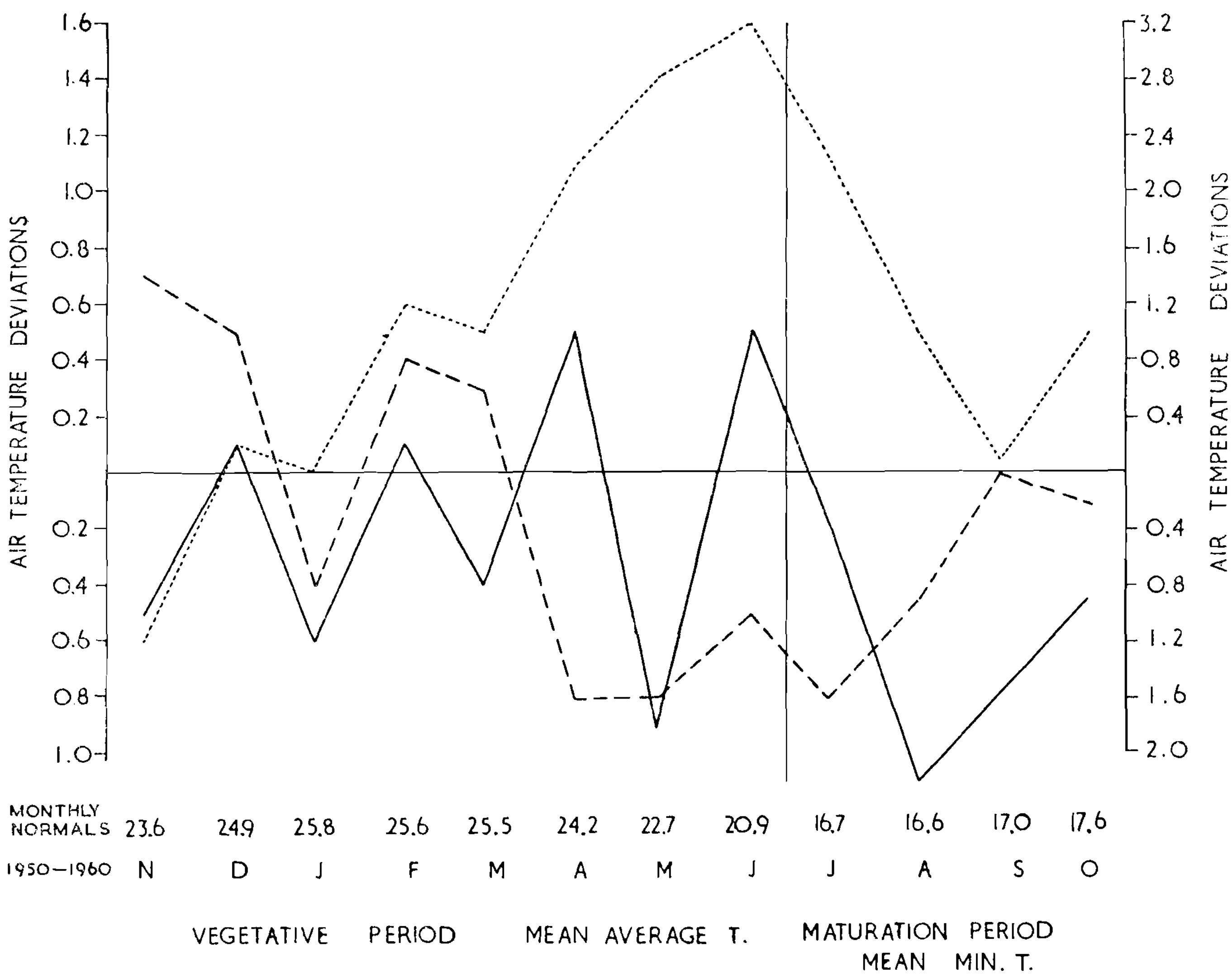


Fig. 31. Air temperature deviations from monthly normals, average mean T for vegetative periods, and average min. T for maturation period.

Dotted line : 1960 - 61. Broken line : 1961 - 62 Plain line : 1962 - 63.

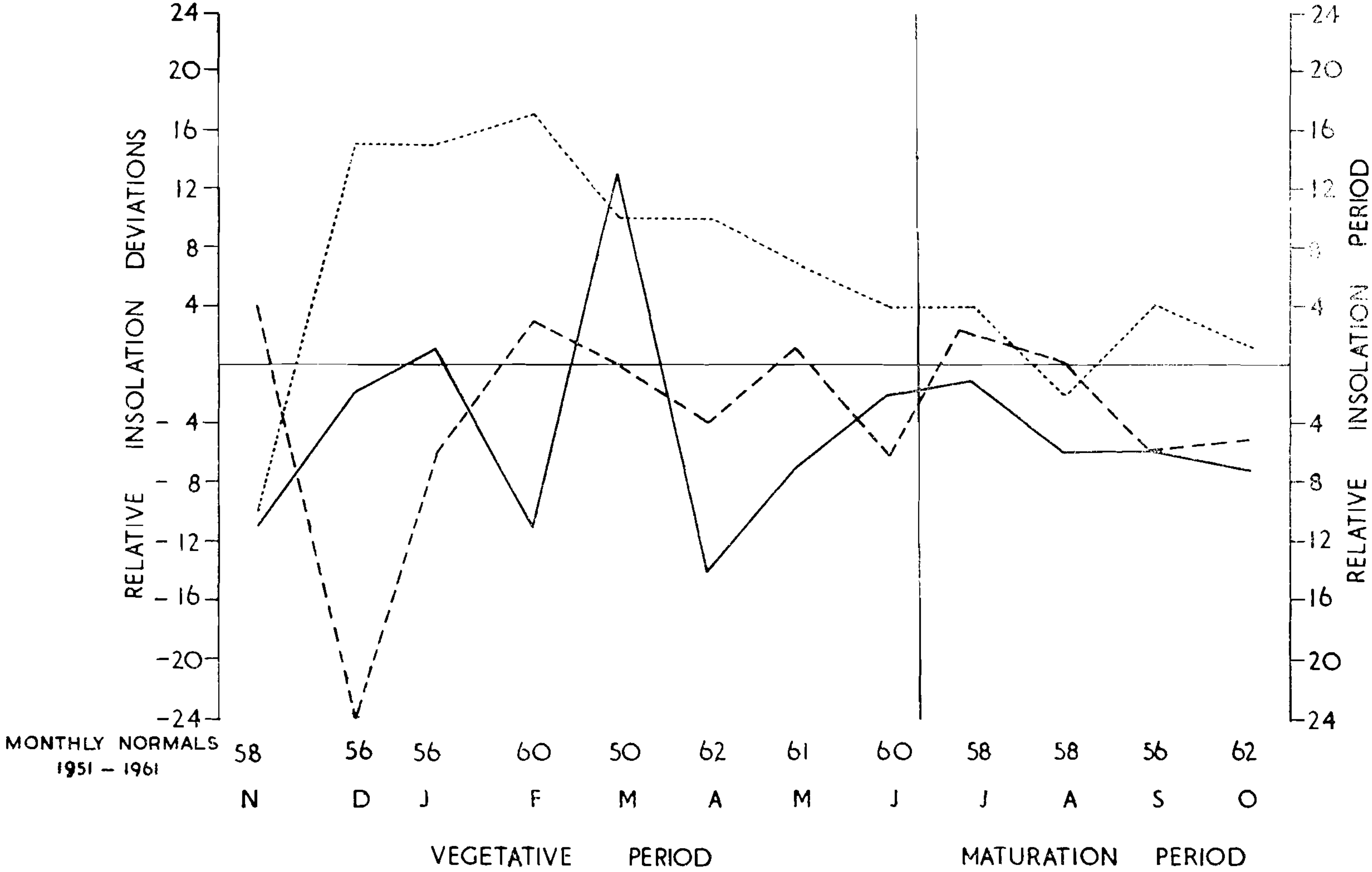


Fig. 32. Relative insolation deviations from monthly normals.

Dotted line : 1960 - 61. Broken line : 1961 - 62. Plain line : 1962 - 63.

Observations for the maturation period July - October 1963 show that :

(a) At the start, for the first two decades of July, and at the end, for the last two decades of October, weather was wetter than usual. However, during the long interval of eighty days, drought prevailed which brought conditions for maturity close to ideal through the months of August, September, and early October, as far as the moisture factor is concerned.

(b) Average minimum air temperature was abnormally low, 1.3°C below normal, a condition conducive *per se* to high sucrose content of the cane.

(c) Calm weather was experienced during the whole maturation period, another favourable condition for good maturation.

(d) Relative insolation was below normal for six consecutive months from April onwards. This observation needs further emphasis as the final value for sugar manufactured % cane obtained was below expectation in the light of two favourable climatic conditions : temperature and wind; and of one normal factor : moisture.

Climatic conditions prevailing over the period under discussion, in comparison with the two preceding years, are summarized in Tables 49 & 50.

Table 49. Average climatic data for vegetative period (Nov. - June) for the last three sugar campaigns.

	Sum of monthly Nov.-June rainfall deficits	*Average mean air temperature*	*Average highest monthly wind speed miles/hr.*	*Average relative insolation*
Drought year 1961	28.7 inches	24.7°C	14	67
Cyclone year 1962	5.7 ,,	24.0	27	54
Normal year 1963	13.9 ,,	24.0	19	54
Normal values	*15.0*	*24.1*	*18*	*58*

Table 50. Average climatic data for maturation period (July - October) for the last three sugar campaigns.

	Sum of monthly July-Oct. rainfall excesses	*Average min. air temperature*	*Average highest monthly wind speed miles/hr.*	*Average relative insolation*
Warm & wet year 1961	4.8 in.	18.1	20	65
Wet year 1962	3.4 ,,	16.4	21	61
Normal year 1963	2.2 ,,	15.7	17	55
Normal values	*2.5*	*17.0*	*19*	*63*

2. MOISTURE CONTENT OF 4-5 JOINT: A VALUABLE ADDITION TO TISSUE TESTING

P. HALAIS & M. HARDY

TANIMOTO (1961) has proposed the 4-5 joint as the best tissue available for disclosing the moisture status of the cane crop. The sampling technique is briefly described :

(1) Canes should be at least 3 months old.

(2) Sampling should be done early in the morning before 8 a.m.

(3) Five representative primary stalks are selected in each field, and the tops are sectioned at the centre of the sixth internode, that is a few inches below the attachment of sheath six, the first partially unfolded leaf being taken as number one. Without removing this sheath, section and eliminate immediately all the leaf blades above the growing point in order to prevent evaporation of the sampled tops. Place the five labelled tops, which constitute a regular sample unit, in a box or a bag and bring them to the laboratory for preparation prior to dessication.

(4) Cut sheath six just near node six and discard this sheath which serves as a protection against dessication during transport etc.

(5) Cut sheath five just near node five and discard this sheath.

(6) Obtain 4-5 joint by sectioning with a sharp knife the top just right through node six and just below the base of sheath four still adhering.

(7) Divide longitudinally in four, each of the five 4-5 joint.

(8) Place in a tared piece of mosquito net weighing five grams.

(9) Obtain the green weight of the sample on a balance with a precision of 0.1 g.

(10) Place in a forced-draft electric oven maintained at 85-90°C. Drying should be completed within 24 hours without charring the pieces. It has been found convenient elsewhere for routine work to run the dessication in two stages, the first one lasting for 24 hours, the weighed green tissue being held enclosed inside the mosquito net pieces over a large table surmounted by properly placed infra-red bars. The second stage lasting for 2 hours consists in completing the dessication inside a forced-draft electric oven maintained at 85-90°C. It is important to check at regular intervals if the drying technique followed is satisfactory by weighing again after a further stay of 1 or 2 hours in the oven. No appreciable change in weight should be observed.

(11) Moisture is calculated as % of the green weight of the 4-5 joint. The range observed varies from 93 to 73%.

Tanimoto's proposition was put to the test on six variety-fertilizer final 2nd ratoon trials–of the Agro./60 series. The 4-5 joint were sampled regularly at two weeks interval starting from the end of February 1963 down to the last harvest in November 1963. Spindle elongation rates of the primary stalks were run concurrently.

Table 51 gives a summary of the results obtained grouped according to the average age of the ratoons, the control plots receiving no nitrogen, and those with 60 Kg N/arp., and finally the varieties M.147/44 and M.93/48.

Table 51. Moisture content of 4-5 joint from six Agro./60 2nd ratoon trials

	Average age of ratoons			*Plots*		*Varieties*	
	5 m	*7 m*	*9 m*	*No N*	*60 K N/arpt.*	*M.147/44*	*M.93/48*
Vegetative period March - June	90.7	90.2	90.0	90.3	90.3	90.3	90.2
Maturation period July - November				86.2	86.2	86.9	85.4

The above table shows that :

(1) Contrarily to all other tissues proposed (3 - 6 sheaths or 8 - 10 internodes), the moisture content of the 4 - 5 joint is absolutely independent of nitrogen fertilization. Response to nitrogen was however high in the above mentioned trials as at harvest, the control plots (No N) yielded 2.77 tons of recoverable sucrose per arpent, and the 60 Kg N plots, 3.77 tons.

(2) During the vegetative period, moisture content of the two varieties is identical. On the other hand, significant differences were observed during the maturation period.

(3) Young ratoons show slightly higher moisture levels in the joints than older ones grown in the same trials and sampled on the same day.

(4) During the months of March - April, when temperature is not limiting, a highly significant correlation of - 0.661*** was observed between moisture of the 4 - 5 joint and spindle elongation. The rapid rate of elongation of over 10 cm per week coincided with a moisture content above 91 % and elongation was at a standstill at this favourable time of the growing season when moisture falls to 85 % as a result of moisture shortage.

Table 52 gives further data for each of the six trials. The average moisture content of the 4 - 5 joint is shown for the vegetative and maturation periods and at harvest time (E), mid (M), and late (L) in the season, with corresponding recoverable sucrose % cane as averages for the two varieties tested, M.147/44 and M.93/48. Figures for the high sucrose content of the canes and the low moisture content of the 4 - 5 joint at harvest time are underlined.

Table 52. Six Agro/60 series trials 2nd ratoons 1963. Data on moisture content of 4 - 5 joint and Recoverable Sucrose % cane

Location of Agro./60	*Vegetative Period March-June*	*Maturation Period July-Nov.*	*At Harvest time*					
			Moisture of 4 - 5 joint			*Recoverable Sucrose % cane*		
			E	*M*	*L*	*L*	*M*	*L*
Médine (irrigated)	91.0	88.4	89.5	89.5	89.6	10.6	12.1	11.6
St. Antoine, (6/60)	89.0	82.9	86.3	*80.7*	*80.6*	10.3	*13.3*	*13.9*
St. Antoine, (13/60)	88.8	81.7	84.7	*76.4*	*81.1*	10.5	*13.3*	*13.5*
Sauveterre ...	90.5	86.2	91.8	87.1	*81.1*	11.0	12.1	*14.1*
Bénarès ...	91.3	88.7	89.7	88.0	88.6	10.5	12.6	11.6
Trianon ..	91.2	89.1	91.5	88.6	87.9	10.0	11.6	12.6

As mentioned earlier, if the interpretation of the moisture content of the 4 - 5 joint offers no exception and applies to all varieties and cultural conditions during the vegetative period, the problem is more complex when dealing with the maturation period as each variety shows a specific moisture content of the 4 - 5 joint at harvest time corresponding to the optimal sucrose content in the stalks for that variety.

From the above observations, it appears that for variety M.147/44 after the desirable moisture content of the 4 - 5 joint in the neighbourhood of 91 % throughout the vegetative period which is the general rule, the moisture should fall gradually during the drying off stage of the maturation period to reach about 81 % at harvest time, if both high cane tonnage and best cane quality for the variety are to be achieved at the same time. For M.93/48 the corresponding desirable moisture contents of the joints should be respectively 91 % and 79 %.

From observations carried out during 1963 at Nossibé, Madagascar, Halais and Syfrig have observed optimal moisture content of the joints at harvest of 85% for N:Co.310, 82% for B.4362, and 77% for B.37172.

General Conclusions.

(1) Moisture content of the 4 - 5 joint of primary stalks from canes 3 months old onwards is the most reliable index available for disclosing directly the moisture status of any sugar cane crop during the vegetative period. The index is independant of variety and nitrogen nutrition, and only slightly influenced by age of the crop.

(2) The main practical purpose of this new index is to check irrigation practices. However, it can be used as a valuable information for the selecting of canes free from moisture stress during the fortnight prior to leaf sampling for foliar diagnosis purposes.

(3) Special studies for each commercial variety must be made before attempting to use this moisture index during the drying off stage of the maturation period.

REFERENCE

TANIMOTO, T. (1962). 4-5 joint as indicators of moisture tension of the sugar cane plant. *Hawaii Sug. Tech. Rep.* 20 : 265 -

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3. HIGHLIGHTS OF FINAL VARIETY TRIALS, 1960 SERIES

PIERRE HALAIS *

Ten variously located and highly replicated final variety trials of the series Agro/60 were reaped in 2nd ratoons during 1963, a normal year as far as climatic conditions are concerned. No attempt was made last year to publish the results obtained *in extenso* on these same trials harvested in the 1st ratoons as the canes had been damaged by the cyclone Jenny, specially on high grounds. However, the combined results for the two reapings appear to offer much interest and are discussed before attempting the usual recommendations concerning the plantation of new varieties.

The chief characteristics of the six varieties tested, two established standards M.147/44 and Ebène 1/37, and four new varieties M.202/46,

* *With the collaboration of the Chief Agriculturist and Field Officers of the Institute.*

Ebène 50/47, M.93/48 and M.253/48 are given in Table 53, expressed as deviations from the general means of the six varieties grouped together. The profitable recoverable sucrose per arpent is derived from (tons of cane x $\frac{\text{IRSC}-4}{100}$) and is given separately for 1962, a cyclone year, and for 1963, a normal one, in order to show the differential behaviour of the varieties. Table 53 gives average information for the two years 1962 and 1963, except for response to high nitrogen fertilization which pertains to 1963 only.

Table 53. Deviations from general means of six varieties tested in ten trials of the Agro/60 series in 1st ratoons 1962 and 2nd ratoons 1963.

	IRS % cane	*Fibre % cane*	*Tons profitable IRS arpent*		*Response to high N*	*Best season to harvest*
			1st ratoons 1962 (cyclone year)	*2nd ratoons 1963 (normal year)*	*60 kgs over 30 kgs in tons IRS arpent*	*12 months ratoons*
Ebène 1/37	0.55	−0.9	−0.15	−0.07	+0.04	early & mid
M.147/44	−0.65	1.7	0.17	−0.01	0.06	early & mid
M.202/46	+0.10	−0.4	0.00	0.11	+0.41	late
Ebène 50/47	+0.75	−0.3	−0.07	0.05	0.09	early
M.93/48	−0.25	+1.4	0.13	−0.08	−0.04	mid
M.253/48	−0.75	1.6	0.07	0.03	−0.47	mid & late

If recoverable sucrose and fibre contents are fairly stable characteristics for the varieties studied and have remained relatively constant for the two contrasted years, profitable sucrose production shows considerable divergence : M.147/44 and M.93/48 coming to the front in the cyclone year 1962, and M.202/46 and Ebène 50/47 on top in the more normal year 1963. It therefore follows that varietal recommendation must be considered as an inevitable compromise. The average results for the two years may be a little too conservative as there is normally no cyclone every two years.

The exceptionally good quality of Ebène 50/47 needs high commendation and the good resistance of M.147/44 and M.93/48 to cyclonic winds is a valuable asset for these varieties. It may be mentioned, in this last connection, that these two varieties are the highest of the lot in fibre content. On the other hand, M.253/48 is typically an "aqueous" variety, as it is low both in sucrose and in fibre.

The differential behaviour of the two established standard varieties Ebène 1/37 and M.147/44 when compared at the same location offers the possibility of classifying the ten trials of the Agro/60 series, reaped in 1962 and 1963, into three ecological groups which will appeal directly to the sugar planters interested. Group I comprises five trials in which M.147/44 generally outyields Ebène 1/37 in terms of profitable sucrose production per arpent by a net margin; these trials are located at Médine, St. Antoine (2), Rivière des Créoles, and Sauveterre. Group II consists of the three trials where M.147/44 and Ebène 1/37 are at par; they are situated at Bénarès, Unité and Trianon. Group III includes only two trials where Ebène 1/37 outyields M.147/44 by a good margin except during a severe cyclone year; they are located at Beau Bois (St. Aubin) and Valetta. The climatic conditions of Group I are high temperature and low rainfall with, or without, irrigation: of Group II, medium temperature and rainfall; of Group III, low temperature and high rainfall.

Table 54 gives in a summarised form the results observed for the three groups separately and for early (E), mid season (M) and late (L) harvesting of 1st and 2nd ratoons aged 12 months. Absolute figures for the tons of profitable recoverable sucrose per arpent $\frac{\text{IRSC} - 4 \times \text{ICA}}{100}$ are given for the standard varieties that are best suited to the group. Deviations from the standards are given for the other new varieties.

Table 54. Deviations of profitable recoverable sucrose per arpent from best suited standard varieties for 10 trials of the Agro/60 series reaped in 1st ratoons 1962, and 2nd ratoons 1963.

	Group I			*Group II*			*Group III*		
Location of Agro/60 trials	*Médine St. Antoine (2) R. des Créoles Sauveterre*			*Bénarès Unité Trianon*			*Beau Bois (St. Aubin) Valetta*		
Best suited standards	*M.147/44*			*M.147/44 & Ebène 1/37*			*Ebène 1/37*		
Harvesting date	*E*	*M*	*L*	*E*	*M*	*L*	*E*	*M*	*L*
M.147/44	*2.37*	*2.53*	*2.25*	*2.01*	*2.57*	*1.97*	—0.24	—0.35	—0.50
Ebène 1/37	—0.48	—0.48	—0.70	*1.91*	*2.44*	*1.95*	*1.60*	*1.94*	*1.68*
M.202/46	—0.26	—0.49	—0.15	—0.06	+0.20	+0.30	—0.22	—0.24	—0.19
Ebène 50/47	—0.26	—0.49	—0.37	—0.29	—0.07	+0.01	—0.33	—0.36	—0.06
M.93/48	—0.48	—0.06	—0.35	—0.14	-0.36	+0.24	—0.24	—0.11	—0.09
M.253/48	—0.40	—0.12	—0.27	—0.04	+0.05	-0.17	—0.54	—0.62	—0.43

General recommendations for future plantations are outlined in Table 55. In group I, where the standard cane M.147/44 generally outyields by a large margin Ebène 1/37, none of the four varieties studied in these trials was better than M.147/44 in profitable sucrose production. It seems, however, that M.202/46 if given extra nitrogen specially where irrigation is available, and reaped late in the season may outyield M.147/44 which generally shows some weakness late in the season.

In Group II where conditions are equally suited to both standards M.147/44 and Ebène 1/37 as far as profitable recoverable sucrose per arpent is concerned, three out of the four new varieties offer proved advantage when reaped at the convenient time. They are Ebène 50/47 for early harvesting, M.93/48 and M.202/46 for mid and late harvesting.

In Group III where the standard cane Ebène 1/37 normally outyields M.147/44, the problem is somewhat dominated by the high susceptibility of Ebène 1/37 to cyclonic winds under these special ecological conditions which means that substitute varieties must be found for an important fraction of the new plantations. The best compromise at hand is to keep Ebène 1/37 for early harvesting, to plant some M.93/48 (good resistance to cyclone) for mid and late harvesting, and to choose M.202/46 for late harvesting too.

Table 55. General recommandations for future plantations

	Group I		Group II		Group III	
Suited Standards	*M.147/44*		*Both M.147/44 & Ebène 1/37*		*Ebène 1/37*	
Best season for harvesting 12 months ratoons	*Choice*		*Choice*		*Choice*	
	1st	*2nd*	*1st*	*2nd*	*1st*	*2nd*
Early	M.147/44	—	Ebène 50/47	—	Ebène 1/37	—
Mid	M.147/44	—	M.93/48	M.202/46	M.93/48	—
Late	M.147/44	M.202/46	M.202/46	M.93/48	M.202/46	M.93/48

Additional nitrogen fertilization to supplement normal applications which presently amount to approximately 40 Kg. N. per arpent should be given to the two new varieties M.202/46 and Ebène 50/47 in order to take the best advantage of their potentialities.

For M.202/46 planted under ecological conditions represented by Group I, an additional dose of 30 Kg. N. per arpent should be provided for on irrigated land, and of 10 Kg elsewhere; when grown in Group II, the additional dressing should be 20 Kg N. per arpent, and in Group III, an additional dose of 10 KgN should be sufficient.

For Ebène 50/47 when planted in Group II, an additional dose of 20 Kg. N per arpent should be practised.

It will be essential for all varieties to keep a vigilant eye on the phosphorus and potassium status of the crops in order to adjust the fertilizer programme according to the requirements of the plant.

Evolution of final variety testing during the last ten years.

It has been thought desirable to recapitulate below the salient features of the three series of final variety trials initiated ten years ago.

The series AGRO/*54* — six trials — has shown that the standard variety of that time, M.134/32 was outyielded by new varieties three in number, Ebène 1/37, B.37172 and B.3337, the last one being a hardy cane for marginal lands. Results observed in 3rd ratoons in 1958, a cyclone year, gave the alarm as far as the high susceptibility of Ebène 1/37 is concerned.

The series AGRO/*57* — eight trials — has brought to the front M.147/44 as being superior to B.37172. The newly recommended variety is highly productive, and offers great resistance to cyclones, but is unfortunately poor in sucrose content.

The series AGRO/*60* — ten trials — has shown that for conditions of moderate temperature and rainfall three varieties have outstanding merit, they are Ebène 50/47, M.93/48 and M.202/46. The first one has the highest early sucrose content of any commercial variety yet observed in Mauritius. M.93/48 is good for mid season harvesting and offers considerable resistance to cyclone. M.202/46 is the most adaptable of the three varieties but should be reaped late in the season to produce the best results.

Plate 9. Observations in "final variety-fertilizer" trials.

Plate 10. Propagation plots of new cane varieties for planting out variety trials.

4. SELECTIVE HARVESTING AND TRASHING

GUY ROUILLARD

Selective harvesting which consists in leaving bull shoots — locally called "babas" — that are too immature to be sent to the mill is a long established practice in the super-humid zone of Mauritius, particularly at elevations exceeding 500 feet. Planters claim that when "babas" are cut at harvest, the stool is weakened and the ensuring ratoon is consequently less productive. A common practice in this same climatic zone is to trash the fields in March and June. In order to test the validity of these agricultural operations, 8 trials were laid down on newly cut virgins in 1961, and harvested in 1st ratoons 1962, and 2nd ratoons 1963.

The trials consisted of 8 randomized blocks of 4 treatments, plot size being 6 rows of 50 feet :

(a) Selective harvesting and trashing.

(b) Selective harvesting, no trashing.

(c) Clean shaving and trashing

(d) Clean shaving, no trashing.

Four trials were planted with Ebène 1/37 and four with B.3337. In order to determine if yield of cane under the above experimental conditions was affected by the date of harvest, four blocks in each trial were reaped early (July), and four were harvested in late season (November).

Plot weight and sucrose content were determined according to the method generally adopted for field trials at the M.S.I.R.I.

The results obtained are presented below :

(i) Effect of selective harvesting (Table 56).

(ii) Effect of trashing (Table 57).

(iii) Interaction between selective harvesting and trashing (Table 58).

(iv) Effect of date of harvest on selective harvesting (Table 59).

(v) Effect of variety (Table 60).

(vi) Year effect (Table 61).

(i) Effect of Selective Harvesting

This method of harvesting produced a marked increase in cane weight but had no effect on sucrose content. The net increase in commercial sugar produced per acre economically justifies the practice. It may be pointed out, however, that selective harvesting may tend to increase early infestation by stalk borer, because the bull shoots that are left may harbour borers which otherwise would have been largely destroyed.

Table 56. Results obtained from selective harvesting compared to clean shaving

	Tons cane per arpent	*Industrial Recoverable sugar % cane*	*Tons sugar per arpent*
Selective harvesting	25.8	10.3	2.67
Clean shaving	23.0	10.3	2.37
Difference	+ 2.8	+ 0.0	0.30

LSD 1% = 1.3

(ii) Effect of trashing

Trashing carried out during the summer months (March) and early winter (June), before harvest, had no significant effect on either cane yield or sucrose content. This operation however helps to maintain the field clean and free of rats. Late trashing is a useful practice to produce clean canes for harvest. If, however, yields are high and canes have a tendency to lodge, trashing may be a cause of breakage that can be very detrimental to yield and sucrose content. Consequently, it should be carried out with care and only a few days before the field is harvested, otherwise burning with all its disadvantages becomes necessary to prevent trash from being sent to the mill.

Table 57. Effect of trashing on cane yield and sucrose content.

	Tons cane per arpent	*Industrial Recoverable sugar % cane*	*Tons sugar per arpent*
No trashing	24.6	10.2	2.52
Trashing	24.2	10.4	2.52
Difference	− 0.4	0.2	0.00
LSD 5%	1.0		

(iii) Interaction between selective harvesting and trashing.

It is sometimes said that summer trashing promotes the production of bull shoots, "babas de mars", but the counts made on this series of experiments show that there is no such effect. The results on cane weight have shown no interaction between selective harvesting and trashing, the operations should thus be considered independently of each other, their actions being different.

Table 58. Stalk counts and cane weight in relation to selective harvesting and trashing

	Selective Harvesting		*Clean Shaving*		*Difference*
	No. canes per gaulette	*Tons cane per arpent*	*No. canes per gaulette*	*Tons cane per arpent*	*Tons cane per arpent*
No trashing	31	25.9	31	23.5	− 2.4
Trashing	31	25.9	30	22.5	− 3.4
LSD 5%		1.4			

(iv) Effect of date of harvest on selective harvesting.

The dates at which canes are reaped during the crop do not affect the results produced from selective harvesting on the following crop. The slight difference in favour of late harvesting is not significant. Consequently, the operation should be practised with the same care irrespective of the date of harvest.

Table 59. Results expressed in tons cane per arpent obtained from the interaction between selective harvesting and date of harvest.

Treatment	*Early harvest (July)*	*Late harvest (November)*
Selective harvesting	27.2	24.5
Clean shaving	24.6	21.3
Difference	· 2.6	· 3.2

LSD 5% = 1.4

(v) Effect of selective harvesting on variety.

Only two varieties, Ebène 1/37 and B. 3337. were tested in this series of trials, and the results show a significant but small difference in favour of B.3337. Other trials have been laid down to study the effect of selective harvesting on different varieties adapted to the super-humid zone. Results so far indicate that they all respond to the treatment.

Table 60. Results expressed in cane weight to compare the effect produced by by selective harvesting on Ebène 1/37 and B.3337.

Treatment	*Ebène 1/37*	*B.3337*
Selective harvesting	23.5	28.3
Clean shaving	21.4	24.6
Difference	· 2.1	3.7

LSD 5% = 1.4

(vi) Year effect of selective harvesting.

The effect on cane yield due to selective harvesting was less pronounced in 1962 than in 1963. This can be explained by the fact that after the heavy crop of 1961 there were few "babas" left, a large proportion of which were broken during the cyclone Jenny (28th February 1962). As a result of the low yields obtained in 1962, a large number of "babas" were formed which contributed to produce the good yields obtained in 1963. In other words, the maximum advantage is obtained from bull shoots during a good year free of cyclones following a bad year. The reverse is also true.

Table 61. Results expressed in tons cane per arpent produced by selective harvesting in 1952 and 1963.

Treatment	*Year harvested*	
	1962	*1963*
Selective harvesting	20.4	31.3
Clean shaving	18.9	27.1
Difference	1.5	· 4.2

LSD 1% 1.9

Conclusion

The results obtained from this series of trials have shown that selective harvesting is a sound operation for the super-humid zone, particularly at altitudes exceeding 500 feet. The operation is of value, independent of climatic conditions, of date of harvest; it also appears that varieties with different characteristics respond to selective harvesting.

Intercrop trashing produces no increase in sugar, but is a useful operation for preparing clean canes for the mill.

5. GERMINATION STUDIES WITH M.93/48

E. ROCHECOUSTE & C. MONGELARD

Experiments were carried out last year with a view to determining some of the factors which might be responsible for the slow germination of M.93/48 at certain seasons of the year. With that aim in view, four trials were laid down, two in May-June and two in August, in the three different localities of the island, Alma, Gros Bois and Sans Souci. In those trials, the germination of the three types of cuttings—top, middle, bottom—,was compared to a mixture of the three categories, subsequently called "estate practice" in this study. The cuttings were derived from stalks of four different physiological age 10, 11, 12 and 13 months, and the experimentation was conducted with two series of cuttings : short hot-water treated, and untreated.

The statistical layout consisted of a randomized block with 4 replications. In each experimental plot, 180 three-eyed cuttings were planted, representing a total of 540 buds per plot. Germination counts were made at six and twelve weeks after planting respectively.

Results and Conclusions

From the data obtained, presented in Table 62, and graphically in fig. 33, the following information may be derived :

(i) Hot-water treatment had a stimulating effect on the germination of top cuttings only.

(ii) Germination of top cuttings, whether hot-water treated or not, was significantly better than all the other treatments.

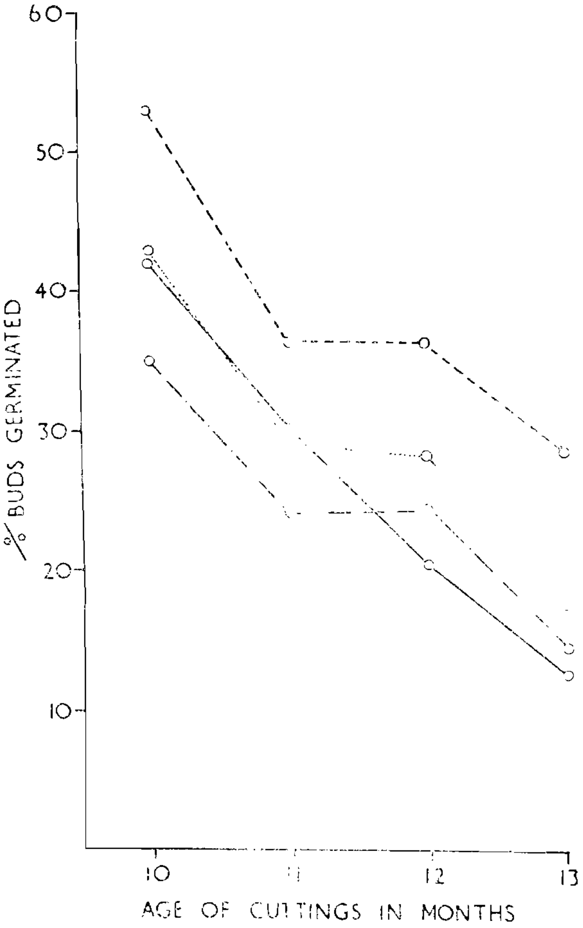

Fig. 33 Relationship between germination and physiological age.

Circles and broken line	:	Top cuttings
Circles, broken line and points	:	Middle cuttings
Circles and plain line	:	Bottom cuttings
Circles and dotted line	.	Estate practice

Table 62. Germination of M.93/48 in relation to physiological age

Locality	*Month planted*	*Physiological age (months)*	*Hot-water treated*				*Untreated*				*Significant difference*	
			Top	*Middle*	*Bottom*	*Estate Practice*	*Top*	*Middle*	*Bottom*	*Estate Practice*	*5% level*	*1% level*
Gros-Bois	June	10	342	266	193	248	285	225	187	232	20	27
Sans-Souci (a)	August	11	245	184	137	158	195	162	129	158	36	49
Alma	May	12	268	106	121	160	195	109	130	151	31	42
Sans-Souci (b)	August	13	214	67	80	107	153	64	76	92	31	43

(iii) There is a close relationship between physiological age and germination, the highest germination rate being obtained from cuttings derived from 10 months old cane. This effect of physiological age on germination is obtained irrespective of the hot-water treatment. It must also be observed that, in the case of bottom cuttings, germination rate falls down rapidly as we pass from 10 to 13 months old canes.

Results obtained in those trials are of importance because they might explain why at times the germination of M.93/48 is unsatisfactory in commercial plantations. It appears from this work that cane stalks older than 10 months should be avoided when that variety is planted to obtain successful germination results.

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1963

J. D. de R. de SAINT ANTOINE & H. F. WIEHE

A synopsis of the chemical control figures of the twenty three factories of the island is given in Appendix XVII (i) - (v).

Cane and Sugar Production.

The climatic conditions that prevailed in 1963 during both the growing and maturity periods were favourable so far as rainfall distribution, wind velocity and air temperatures are concerned. As a result, a record crop of 5,747,000 metric tons of cane was harvested on a total area of 193,000 arpents, and 685,600 tons of 98.7 pol sugar were produced. Table 63 gives the area harvested, cane crushed and sugar produced during the period 1958-63, the abnormal year 1960 having been excluded from this and from the following tables.

Table 63. Area harvested (thousand arpents), cane crushed and sugar produced (thousand metric tons), 1958-63

	1958	*1959*	*1961*	*1962*	*1963**
Area harvested ...	177	180	188	193	193
Cane crushed ...	4,329	4,743	4,943	4,624	5,547
Sugar produced ...	525.8	580.4	553.3	532.6	685.6

Cane Quality

Sucrose per cent cane averaged 13.48 for the crop. As pointed out in the introduction to this report, this is a disappointing figure since, except for low relative insolation from April to December, climatic conditions were very favourable to maturity. On the other hand, the crop started earlier — as early as mid June for a number of factories — when sucrose content was still low; further the percentage of relatively low sucrose content varieties harvested was higher than in previous years, amounting on estate lands to about 40 per cent of the tonnage reaped.

Sucrose content figures for the various sectors of the island are given in Table 64 for the period 1958-1963.

* Provisional figures.

Table 64. Sucrose per cent cane, 1958-63

	Island	*West*	*North*	*East*	*South*	*Centre*
1958	13.77	13.99	14.53	13.76	13.25	13.62
1959	13.76	14.09	14.67	13.66	13.23	13.66
1961	12.81	13.06	13.46	12.53	12.42	12.91
1962	13.19	13.61	13.73	12.85	12.85	13.26
1963	13.48	14.26	13.97	12.91	13.18	13.79

As may be observed from Table 65, mixed juice Gravity Purity was the highest on record since 1959, whereas fibre per cent cane which had been steadily going up during the past few years shows now a downward trend.

Table 65. Fibre per cent cane and mixed juice Gravity Purity, 1958-63

	Fibre % cane	*Mixed Juice Gravity Purity*
1958	12.21	87.2
1959	11.96	87.3
1961	12.61	85.2
1962	13.85	85.9
1963	13.11	86.3

The drop in fibre per cent cane may be attributed to the absence of drought in 1963 and to a slight change in varietal composition as shown in Table 66. Thus the percentage of high fibre varieties harvested on estate lands has dropped from 51.2 in 1962 to 50.2 per cent in 1963, whilst during the same period the percentage of low to medium fibre varieties has increased from 36.9 to 38.7 per cent.

Table 66. Percentage of varieties harvested on estate lands, 1962-63

	1962	*1963*
M.147/44	30.6	28.9
B.37172	13.6	11.0
B.3337	5.5	5.6
M.93/48	1.5	4.7
Ebène 1/37	17.7	19.1
M.134/32	13.7	9.3
M.202/46	3.5	5.9
Ebène 50/47	2.0	4.4

Milling

A synopsis of crushing data and milling figures is given in Table 67.

Table 67. Milling results, 1958-63

	1958	*1959*	*1961*	*1962*	*1963*
No. of factories	25	24	23	23	23
No. of crushing days ...	108	110	123	116	123
No. of net crushing hours/day ...	20.89	20.32	18.86	19.08	20.82
Hours of stoppages/day* ...	0.80	0.82	0.80	1.03	0.88
Time efficiency	96.3	96.1	95.8	94.9	95.9
Tons cane/hour	76.1	87.7	92.8	91.0	97.8
Tons fibre/hour	9.03	10.49	11.70	12.60	12.82
Imbibition % fibre	261	230	222	222	221
Pol % bagasse	2.63	2.32	2.09	2.18	2.08
Moisture % bagasse	47.5	48.3	48.6	47.1	48.4
Reduced mill extraction ...	95.3	95.7	95.8	95.8	96.0
Extraction ratio	37.1	34.1	33.3	33.9	31.7

* Exclusive of stoppages due to shortage of cane.

Milling efficiency has been very good in 1963, an average reduced mill extraction of 96.0 being recorded, with two factories obtaining 96.9, and only one being still below 95.0, as may be seen from Table XVII (v) of the Appendix. It would appear that Mauritius is one of the cane sugar producing countries where mill extraction is highest. Table 68 shows the comparative milling results of a few countries for which figures were readily available.

Table 68. Comparative milling results for recent years

	Mauritius		*South Africa*	*Jamaica*	*B. Guiana*	*Trinidad*	*Philippines*
	1959	*1963*	*1962–63*	*1959*	*1962*	*1961*	*1958–59*
Sucrose % cane	13.76	13.48	13.28	11.76	11.47	11.97	13.14
Fibre % cane	11.96	13.11	15.50	14.20	15.15	13.68	11.72
Imbibition % fibre	230	221	266	131	194	140	98
Pol % bagasse	2.32	2.08	2.24	2.48	3.11	3.28	3.86
Moisture % bagasse	48.3	48.4	52.2	48.3	49.7	50.6	49.6
Extraction ratio	37.1	31.7	37.7	43.7	58.7	61.4	64.8
Mill extraction	95.9	95.8	94.2	93.8	91.1	91.6	92.4
Red. mill extraction	95.3	96.0	95.4	94.7	92.9	92.4	91.9

It is unfortunate that milling figures are not available from other areas like Queensland and Taiwan where milling efficiency is known to be high. Thus in 1955-56, reduced mill extraction averaged 96.2 in Taiwan, with a moisture content of bagasse as low as 41.35 per cent. It should also, in all fairness, be pointed out that conditions favourable to good mill work prevail in Mauritius where clean cane of medium fibre content are crushed in tandems of large capacity, and that similar conditions do not prevail in many other areas.

The only major changes brought to the milling tandems of the island for the 1963 crop were the replacement of steam engines by steam turbines at Médine, and the installation of a new set of heavy duty cane knives at Mon Désert where the old second set was replaced by one of 92 knives running at 750 RPM and working at a clearance of $\frac{5}{8}''$ from the slats of the cane carrier. The chute to the 4th and 5th mills were also increased from 4 to 8 feet, but the marked improvement in milling work — 96.2 reduced mill extraction in 1963 as against 95.8 in 1962 — may be attributed mostly to the better preparation obtained with the new set of knives. It is anticipated that within a few years most of the factories not equipped with shredders will follow suit and that consequently average mill extraction will go up higher still

Processing

Mixed juice Brix and purity figures are given in Table 69.

Table 69. Brix and Gravity Purity of Mixed Juice, 1958-63

	Brix	*Gravity Purity*
1958	14.90	87.2
1959	14.67	87.3
1961	14.11	85.2
1962	14.33	85.9
1963	14.65	86.3

It will be observed from the above figures that juice purity was higher in 1963 than in 1962 and 1961, but was still about one point lower than that obtaining in 1958 and 1959, in spite of the favourable climatic conditions that prevailed. The explanation for this may be found in the varietal composition of the crop which has changed considerably during the past few years. Thus, whereas in 1959 the percentage of M.134/32 and Ebène 1/37 harvested on estate lands amounted to 61.8 per cent, in 1963 the percentage of high purity varieties (M.134/32, Ebène 1/37 and Ebène 50/47) amounted to only 32.8.

Investigations were carried out in several factories with the object of reducing losses in clarifiers during shut down periods. Juice deterioration in clarifiers may be either microbiological or chemical, depending on the temperature at which the juice is stored. At temperatures below 70-74°C, the destruction of sucrose is mostly due to micro-organisms, whereas at higher temperatures the deterioration is chemical and increases rapidly with rise in temperature and drop in pH. The investigations carried out have shown that by reducing the juice temperature to about 82°C, and increasing the pH of the clarified juice by about half a point three hours prior to stopping the mills, it is possible to reduce appreciably the losses during shut down periods. Thus the drop in clarified juice purity during week-end stoppages could be cut down from 3-4 degrees to less than one degree in most cases.

Filter station performance was good in 1963, pol per cent cake averaging 2.28 as compared to 2.38 in 1962. However, more strict control of the station should result in still better performance. In this connection, the necessity of determining retention daily, as recommended by SAINT ANTOINE and VIGNES (1961), is again stressed.

As may be gathered from Table 70, pan and crystallizer work was satisfactory in 1963, an average purity drop between massecuite and runnings of 22.3 being obtained. Crystal content per cent Brix in C massecuite was higher than in 1962 by 1.3 points, whilst the gravity purity of final molasses was lower by 0.6 points. This better exhaustion may be partly attributed to the higher reducing sugar content of final molasses, comparative figures for 1962 and 1963 being 13.8 and 15.0 respectively.

Table 70. Syrup, Massecuites and Molasses, 1958-63

	1958	*1959*	*1961*	*1962*	*1963*
Syrup purity	87.3	87.9	85.3	86.5	86.6
A massecuite purity	81.0	81.7	82.0	82.2	83.0
Purity drop : A massecuite ...	20.8	20.1	22.3	20.3	20.3
B massecuite ...	20.8	21.1	22.2	21.2	22.2
C massecuite ...	22.7	23.6	24.6	22.9	24.3
Crystal % Brix in					
C massecuite ...	34.1	35.3	36.0	34.6	35.9
Magma purity	81.0	81.5	82.3	82.4	82.8
Final molasses :					
Gravity purity ...	37.9	36.7	35.7	36.2	35.6
Red. Sug. % Brix ...	15.8	14.6	16.6	13.8	15.0
Tot. Sug % Brix ...	53.7	51.3	52.4	50.1	50.4
Wt. % cane @ 95° Brix	2.59	2.53	2.81	2.67	2.72

Table 71. Losses and Recoveries, 1958-63

	1958	*1959*	*1961*	*1962*	*1963*
Sucrose lost in final molasses % cane	0.93	0.88	0.96	0.92	0.89
Undetermined losses % cane ...	0.17	0.16	0.21	0.21	0.18
Industrial losses % cane ...	1.18	1.13	1.24	1.21	1.14
Boiling House Recovery ...	91.1	91.4	89.9	90.4	91.2
Reduced Boiling House Recovery	89.3	89.6	89.7	89.7	90.2

Losses and recoveries data are presented in Table 71. The decrease in industrial losses % cane from 1.21 in 1962 to 1.14 in 1963 resulted in a reduced Boiling House Recovery which improved by 0.5 points, increasing from 89.7 in 1962 to 90.2 in 1963, the highest figure ever recorded.

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2. THE CALORIFIC VALUE OF BAGASSE OF A FEW COMMERCIAL CANE VARIETIES

E. C. VIGNES & M. RANDABEL

In any well balanced raw sugar factory, the amount of bagasse produced is normally in excess of that required to meet all the steam requirements of manufacture. Yet, difficulties are sometimes encountered in keeping up the steam pressure when certain varieties of cane are crushed, and this has led a few people to believe that the calorific value of the bagasse from these varieties is lower than that of other varieties. However, it has more than once been shown that bagasse from different varieties growing in different countries have very similar calorific values in spite of their somewhat considerable difference in physical appearance.

With the view of proving once more that the failure in steam pressure cannot be caused by the inferior calorific value of the bagasse, it became necessary to carry out the present investigation. For this purpose, samples of bagasse were collected in four mills. Moisture and pol were immediately determined, the remainder of the samples being stored in deep-freeze and analysed later for their calorific value by means of a bomb calorimeter. The data obtained are shown in Table 72.

Table 72. Calorific Value of Bagasse from Different Cane Varieties

Variety	*Locality*	*H.C.V.* of dry fibre Kcal/kg*	*H.C.V.* of dry Bagasse Kcal/kg*
M.147/44	Bel Ombre	4465	4455
B.37172	Bel Ombre	4455	4440
M.147/44	Mon Trésor	4543	4530
Ebène 1/37	Mon Trésor	4526	4512
M.93/48	Mon Désert	4608	4595
M.202/46	Mon Désert	4516	4504
Ebène 50/47	Mon Désert	4583	4570
M.134/32	Beau Plan	4508	4495
Average		*4526*	*4513*

* Mean of three determinations.

The results are very close to those obtained in this country by CRAIG (1928), namely 4568 Kcals/Kg for dry fibre. Such agreement is easily understandable, for it is well established that the chemical composition of cane fibre varies but slightly from variety to variety.

However, the higher calorific value (H.C.V.), as determined in the laboratory, gives only a measure of the heat available theoretically from combustion of the bagasse. In actual practice, the water vapour arising from combustion is not condensed, and its latent heat is therefore unavailable for use in the boiler. Hence, it is of greater industrial importance to calculate the nett or lower calorific value (L.C.V.) of the bagasse, especially of the wet bagasse that is actually burnt. Taking the H.C.V. of dry bagasse equivalent to 4500 Kcals/Kg, the formula for the L.C.V. of local wet bagasse has been worked out and reads as follows :

$$\text{L.C.V.} = 4150 - 6.9\,S - 47.5\,W \text{ Kcals/Kg}$$
$$\text{or} \quad 7470 - 13.5\,S - 85.5\,W \text{ B.T.U./lb}$$

S being the pol, and W the moisture content of the bagasse.

Since it is established that bagasse from different varieties have theoretically the same heating value, it must be presumed that other factors intervene to lower the steam raising capacity of certain kinds of bagasse. According to DYMOND (1942) who made a special study of the problem, it appears that the physical quality of the fibre has a direct influence on the thermal value. On this account P. GEERLIGS (1924) comes to the same conclusion when he notes that high fibre canes give bagasse of an apparent higher density with a high fuel value. On the other hand, there are indications that steam pressure drops in the factory result from incomplete combustion brought about, in large part, by the fineness of the bagasse. Modern methods of cane crushing, relying as they do on the extensive use of efficient preparatory devices and of high pressures at the mills, undoubtedly yield bagasse with a large proportion of fine particles. Because of their lightness, these particles tend to be entrained before proper combustion has been achieved. Thus, depending on the physical qualities of the fibre, certain varieties are liable to give a greater proportion of fines than others.

It is of material interest to recall here the conclusions reached by RAMANUJAM (1956) who investigated the steam raising quality of cane variety Co.419 in a factory which crushed mainly this variety and where steaming difficulties had become acute. He observed that, while the moisture and fibre content of the bagasse did not vary noticeably from those of other varieties, Co.419 gave 18% of fine particles «dust» as compared with 12% and 8% for two other varieties. An anatomical study of internodal tissue of several cane varieties led to the conclusion that the structure of this tissue had a considerable influence on the behaviour of different canes during milling. In Co.419 the parenchyma cells were thin and loose, and liable to give more fibre «dust». It would appear that the degree of disintegration of bagasse depends on the following factors :

(i) the structure of the parenchyma cells,
(ii) the ratio of parenchyma to sclerenchyma cells, and
(iii) the length of the parenchyma cells.

Obviously to these factors should be added : (a) the tensile strength of the individual vascular bundles and (b) the number of vascular bundles per unit area of cross section. The tensile strength of the vascular bundles makes for toughness in cane, the greater strength of individual fibre insures that they do not break easily in the course of milling, as observed in Queensland (1958). It has been found that the tensile strength of individual fibres is the feature which showed the most specific characteristic between varieties and is reasonably independent of environmental factors; a high tensile strength in individual vascular bundles is necessary in obatining good milling qualities and low bagasse moisture.

The question of moisture retention in bagasse after milling can be very important. Comparing the steam raising qualities of Co.290 and Co.281, DYMOND observed that the former variety contained on an average 1.5% more moisture. After thirty minutes grinding of this variety, steam pressure invariably fell by

25 pounds. Canes with a high proportion of pith cells retain a larger amount of moisture than usual, and the calorific value is not utilised to the full.

According to GEERLIGS, «this is especially the case with bagasse having a water content of over 50% because this does not burn properly, but merely smoulders and produces a large quantity of products of distillation, chiefly hydrocarbons which escape unburnt and are thus lost».

Thus it is not sufficient, nor indeed very useful, only to compare the calorific values of different kinds of bagasse. An adequate knowledge of cane structure, as well as of the physical properties of cane fibre, can provide a satisfactory basis for the proper assessment of the steam raising quality of commercial varieties of cane.

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3. NOTES ON THE POWER CONSUMPTION OF C. MASSECUITE CRYSTALLIZERS

F. Le GUEN & J. D. de R. de SAINT ANTOINE

Little information is available in recent literature on the power consumption of Blanchard-type crystallizers used for the cooling of C massecuites. HONIG (1959) quotes the following values given by various authors for the power required per 100 hectolitres of crystalliser content, but does not mention the type of crystallizer to which they apply.

Noel Deerr	(1921)	0.30 — 0.35	H.P.
Emmen	(1926)	0.5 — 1	H.P.
Honig Alewijn	(1929)	0.5 — 3	H.P.
Tromp	(1946)	0.6 — 1	H.P.
Hugot	(1950)	.66	H.P.

As these values range from 0.3 to 3 H.P. per 100 hectolitres, or .85 to 8.5 H.P. per thousand cu. ft., they do not provide a reliable guide for any particular installation, the more so that no mention is made of the speed of rotation of the cooling elements. Further, with modern high speed centrifugals, it is possible to handle more viscous massecuites than could be done in previous years. The tendency is therefore nowadays to reduce the water content of C massecuites to a higher degree in order to obtain better molasses exhaustion, and Honig mentions the possibility that even the highest figures he quotes might be insufficient.

When individual drives were first adopted in Mauritius for C massecuite crystallizers, the tendency was to install small motors. But it was soon evident that these motors were not powerful enough, as water or molasses had of be added to the massecuite prior to the end of the cooling cycle to avoid the motors being overloaded. Gradually, more powerful motors have been installed as may be observed from the following figures (Table 73).

Table 73. H. P. of motors driving industrial Blanchard crystallizers used for cooling C massecuites (1963)

Factory		*Effective capacity of the crystallizer in cu. ft.*	*Speed of rotation of the cooling elements in r.p.m.*	*H.P. of motor*	*H.P. installed per cu. ft.*
Bel Ombre	..	1.000	0.67	5 0	5.0
Rose Belle		800	0.45	4 0	5.0
Union Flacq	...	850	0.33	5 0	5.9
Mon Désert	.	1,250	0.33	7.5	6.0
Mon Trésor	...	800	0.33 & 0.50	5.0	6.3
Réunion ...	...	750	1.00	5.0	6.7
Riche-en-Eau	...	1,100	0.33	7.5	6.8
St. Félix ...	...	900	0.50	7.5	8.3
Belle Vue ...	...	800	0.67	7.5	9.4
The Mount	...	530	0.60	5.0	9.4

The present tendency is to go towards still higher values. Thus a factory has recently placed an order for 1200 cu. ft. crystallizers to be driven by 12.5 H.P. motors, with the cooling elements revolving at 0.30 r.p.m.

Lack of driving power causes the motor to cut-out frequently, or even to burn out if the cut-out is set to operate at too high a value, and calls for C massecuites of relatively high water content, at the expense of good exhaustion of final molasses. It would, however, be undesirable to install a considerable excess of driving power since induction motors working at a small fraction of the full load operate at a low power factor.

In order to obtain some data on the power requirements of Fletcher-Blanchard crystallizers under the operating conditions prevailing in Mauritius, it was decided to study the main factors that affect the power taken by these crystallizers. A number of experiments were carried out at Riche-en-Eau. In this factory, the crystallizers are of the Fletcher-Blanchard type and have a total capacity of 1200 cu. ft. each; the elements rotate at 1/3 revolution per minute and are driven by a 7.5 H.P. motor through a reduction gear box in series with a worm and wheel reduction gear.

For each experiment, the instantaneous power consumption of the crystallizer during the whole cooling cycle was measured with the help of a recording watt-meter. Representative samples of massecuite and molasses were also taken, and the following analyses carried out :

(a) Brix of massecuite

(b) Brix of molasses

(c) Crystal content of massecuite

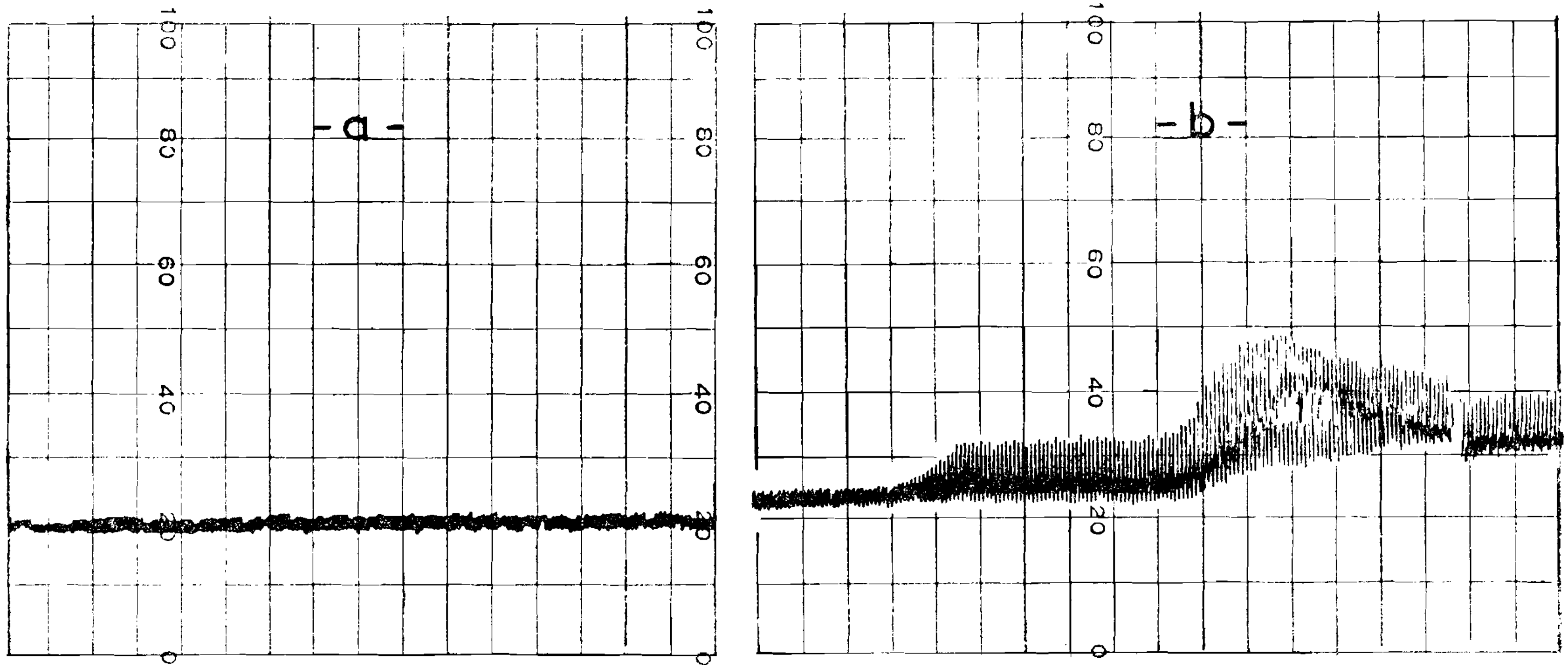
(d) Consistency of massecuite at 30°C

(e) Viscosity of molasses at 30°C after dilution of each sample to 80° Refractometer Brix.

A Synchrolectric Brookfield Viscometer was used for obtaining (d) and (e) above.

From the data obtained, it was soon apparent that, for the conditions prevailing at Riche-en-Eau, the characteristics of the massecuites handled by the crystalliser affected to only a slight extent the power consumption. The driving motor of the crystallizer had always ample power reserve, and whenever it was necessary to add water, this was only to allow the battery of C fugals to handle the amount of massecuite to be centrifuged at a reasonable rate.

These findings were confirmed by recording the instantaneous power consumption through the whole cycle of a crystallizer, namely from the time of filling to that when discharging was completed. Two of the charts thus obtained are given in fig. 34.



1 inch of chart scale = 1 hour

Fig. 34. (a) Record of power consumption of a Fletcher Blanchard crystallizer at the beginning of the cooling cycle.
(b) Record of power consumption of the same crystallizer for the same massecuite at the end of the cooling cycle and during the discharge period.

Brix of massecuite = 100.5. Purity of massecuite = 61.1. Brix of molasses = 97.7.
Purity of molasses = 36.7. Apparent viscosity of massecuite = 410,000 centipoises.
Crystal content of massecuite = 38.5. Total length of cooling time about 30 hrs.
Massecuite temperature, hot 48°C. Massecuite temperature cold, 33°C.

It was found that the power requirements when the crystallizer was empty amounted to as much as eighty per cent of the power requirements when the crystallizer was full of massecuite. During discharge, however, regular fluctuations of considerable amplitude in the power consumption were obtained. These fluctuations had a frequency twice the frequency of revolution of the elements and were apparently due to the variations in resistance encountered as the elements cut into and out of the massecuite. Moreover, during discharge, the mean power consumption of the crystallizer increased instead of decreasing, whenever a viscous massecuite was being handled. With the above mentioned fluctuations in power consumption superimposed, the maximum power consumption during discharge therefore increased, with certain massecuites, up to three times that required when the crystallizer was full.

The increase in mean power consumption observed when the crystallizer is half-empty seems to be due to two factors. Firstly, work has to be done to force the elements out of, and into, the massecuite; secondly, in a half-empty crystallizer, the massecuite is piled up to one side by the rotating elements, and this causes an additional resistance to their motion.

The fluctuations in power consumption during discharge of the crystallizer were attributed to the S shape of the cooling elements of the Fletcher-Blanchard crystallizer. In order to test this assumption, records of the power consumption were taken at another factory upon a Blanchard crystallizer. This crystallizer has straight radial arms mounted spirally upon the rotating shaft; the radial elements are quite numerous and the rotating shaft can therefore be considered to be, for practical purposes, symmetrical about its axis. Although an increase in the mean power consumption of the crystallizer was observed when the crystallizer was being discharged, large fluctuations of power consumption did not occur in that case, nor when the experiment was repeated with a crystallizer having disc-type cooling elements.

During some of the tests carried out at Riche-en-Eau, it had been observed that the crystallizers required as much as about 1.6 H.P. when empty. It was therefore decided to measure the power consumption of the motor and gear box when disconnected from the worm-and-wheel, as well as that of the motor alone. The characteristics of the driving gear are as follows :

(a) Motor — 7.5 H.P., 960 RPM, 400 V 3 phase 50 cycles with coupling on motor shaft.

(b) Gear box — Radicon RHW 8, ratio 35:1.

(c) Final reduction — Wheel : machine moulded cast iron, 80 teeth, 3″ pitch, 8″ face, 76.39″ pitch circle dia; worm : steel machine cut, 3″ pitch, 15″ face, 9″ pitch circles dia.

The results obtained are given in Table 74.

Table 74. Breakdown of power consumption

Units	*Motor*	*Motor + Gear box*	*Driving gear complete and cooling elements with :* (a) *crystallizer empty*	(b) *crystallizer full, massecuite cold*	(c) *crystallizer half-empty, massecuite cold*
Watts ...	700	900	1200	1400–1700	1400–4200
H. P. ...	0.9	1.2	1.6	1.9–2.3	1.9–5.7

From the observations made, the following conclusions may be drawn :

(1) the power losses in the driving gear of a crystallizer are far from negligible as the power requirements of an empty crystallizer may amount to as much as eighty per cent of the power requirements of the same crystallizer when full of massecuite

(2) With viscous massecuites the mean power consumption during discharge is higher than that of the crystallizer when full.

(3) The S shaped Fletcher-Blanchard type of cooling elements give rise to fluctuations of power requirements as they rotate in a crystallizer which is not quite full. These fluctuations, which may attain a considerable amplitude, do not occur with Blanchard radial cooling elements nor with disc-type elements.

(4) During the discharge of a Fletcher-Blanchard crystallizer, the combined effect of (2) and (3) may increase the power consumption to three times that required when the crystallizer was full. It is therefore advantageous when the crystallizer motor is under-powered to stop agitating the massecuite whenever the crystallizer is being emptied. DEERR (1921) says that it is important to see that the rotating elements of a crystallizer be always submerged during the cooling cycle, and that the elements should be stopped whilst the crystallizer is being emptied in order to avoid forcing air into the massecuite.

(5) For the conditions that prevailed at Riche-en-Eau during the 1963 crop, a 7.5 H.P. motor was sufficient to drive the cooling elements of a 1200 cu. ft. Fletcher-Blanchard crystallizer at 1/3 r.p.m., even with viscous massecuites when the crystallizer was being emptied. For the same massecuite conditions a 5 H.P. motor would have been sufficient if stirring had been discontinued during the discharge.

For those factories where more viscous massecuites are encountered, and bearing in mind that it is desirable to reduce as much as possible the water content of the final massecuite, more powerful motors would probably be necessary. It is therefore intended during the 1964 crushing season to carry out further experiments in those factories and to investigate the effect of speeds higher than 1/3 r.p.m. on the power consumption in order to collect more data upon the power requirements of Blanchard crystallizers.

ACKNOWLEDGMENTS

The authors would like to convey their thanks to the management and factory personnel of Riche-en-Eau, in particular to Mr P. Couve, for their most helpful collaboration.

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4. AUTOMATIC REGULATION OF MAGMA CRYSTAL CONTENT

H. F. WIEHE

Introduction

In Mauritius as well as in many other cane sugar producing countries where the refining quality of the raws as regards filterability is not a major problem, the usual way of disposing C sugar is to use it as footing for the A and B massecuites. The practice followed is to discharge the C sugar into a mixer located underneath the centrifugals where it is mingled with syrup. The resulting magma is pumped to a receiver and stored for further use, any excess being remelted and sent to the syrup storage tanks.

As pointed out by HUGOT (1960), this method of C sugar disposal is the simplest and most economical as far as pan capacity and steam consumption at the pan floor are concerned. It has, however, an inherent drawback; the flow of syrup to the mixer being manually controlled, there results a magma of variable consistency with a crystal content which is either too high or too low, depending on the inflow of syrup to the mixer. The final crystal content of A and B strikes built up on such magma footings is thus adversely affected. It is a well known fact that formation of secondary crystals when a strike is tightened up before dropping is often the consequence of inadequate crystal surface. Such faults may be usually traced back to the very start of the strike, namely the footing which was originally too thin and of insufficient crystal content.

With the object of improving the regularity of the magma crystal content, the after-worker C sugar centrifugal of Riche-en-Eau factory was equipped in 1963 with an automatic doser designed by the Factory Manager, Mr P. Couve, for controlling the inflow of syrup to the magma mixer.

Description of Apparatus.

A diagram of the automatic device is given in fig. 35 and the principle of operation is as follows :

Syrup vessel M is equipped with a float B and counter weight C which are connected together by means of chain F passing over idler D and sprocket wheel E which is fixed to the shaft of adjustable cam A. Assuming the vessel is being filled, float B moving upwards will rotate cam A until the latter opens the normally closed contact of micro-switch G, when the syrup has reached the desired level in vessel M. Solenoid valve I is thus de-energized, cancelling the impulse to universal relay J which closes piston-operated valve K, located on the syrup line L, to vessel M. The normally opened auxiliairy contactor H actuated by the motor high speed contactor is provided in order to ensure that the system will function only once for each cycle of the centrifugal. The contents of vessel M is emptied into the magma mixer by means of piston-operated valve N which is pneumatically actuated from the plough-operating pressure line. Flow regulator P and delay receiver O are incorporated in the air line ahead of valve N, so as to provide the necessary time lag between the moment ploughing starts and the moment syrup is discharged into the mixer Q. In this way, proper mixing of sugar and syrup is achieved. Vessel M being now empty, float B has sunk to the bottom, closing micro switch G. When the centrifugal reaches high speed, auxiliary contactor H closes and completes the circuit to solenoid valve I which opens valve K and permits vessel M to be filled again.

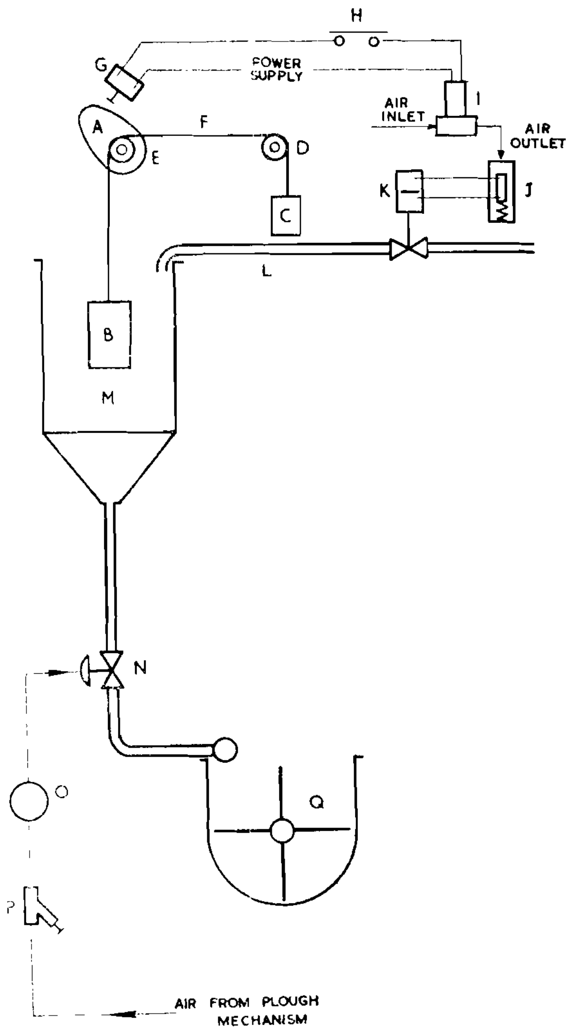

Fig. 35. Flow diagram of syrup doser and control device.

At each dump of the centrifugal, a fixed volume of syrup can thus be metered to the mixer.

Experimental

A series of tests were conducted in order to assess the convenience of automation for such purposes. With the automatic syrup doser in operation, samples of magma and of mother liquor were taken from the magma receiver, the mother liquor being obtained with the help of a vacuum sieve. The samples were analysed for Brix and Pol and the crystal content per cent Brix calculated. The crystal content expressed in volume per cent volume was also determined on each magma sample by means of the Gillett apparatus (1948). The same tests were repeated while the syrup flow to the mixer was manually controlled by the centrifugal operator.

Discussion and Conclusion

The results obtained are presented in Table 75. Analysis of these figures shows that automatic regulation of syrup flow to the magma mixer improved considerably the crystal content regularity of the magma. Thus the maximum variation in crystal content per cent Brix was only 3.7 points when the syrup flow was automatically controlled as compared to 17.3 points with manual operation. The variations in crystal content expressed in volume per cent volume also speak in favour of the automatic doser.

Table 75. Comparative figures for automatic and manual control of syrup flow

		Mother Liquor		*Magma*			
Date	*Run No.*	*Brix*	*App. Pty.*	*Brix*	*App. Pty.*	*Crystal Content % Brix*	*Crystal Content Vol. % Vol.*
			AUTOMATIC CONTROL				
5-8-63	1	81.3	54.2	91.9	81.8	55.4	62.0
6-8-63	2	81.0	60.9	91.9	84.9	56.0	72.0
7-8-63	3	83.9	51.9	94.3	80.5	56.1	72.0
9-8-63	4	88.1	54.0	92.2	81.2	54.4	62.0
13-8-63	5	80.7	63.8	91.4	85.3	54.3	63.0
17-8-63	6	84.7	57.7	91.9	81.8	52.4	69.0
18-8-63	7	82.9	53.9	91.4	80.5	52.7	64.0
20-8-63	8	81.0	63.9	92.5	85.4	55.1	74.0
21-8-63	9	77.9	70.7	90.4	88.3	54.3	71.0
23-8-63	10	77.7	75.9	88.6	90.7	54.4	75.0
Average		81.9	60.7	91.7	84.0	54.5	68.4
			MANUAL CONTROL				
29-8-63	1	82.3	56.2	91.9	80.3	50.6	—
30-8-63	2	78.5	64.2	93.3	81.9	46.1	58.0
31-8-63	3	80.7	62.2	89.9	82.7	48.8	59.0
2-9-63	4	73.5	84.8	89.4	93.6	51.8	70.0
3-9-63	5	77.4	77.3	89.4	91.6	56.3	70.0
4-9-63	6	78.5	70.5	91.9	90.3	61.7	78.0
5-9-63	7	78.9	70.5	89.1	85.2	44.4	54.0
6-9-63	8	80.7	60.9	90.4	84.0	53.2	64.0
7-9-63	9	87.3	54.5	95.1	84.0	61.4	79.0
9-9-63	10	78.9	68.5	89.9	86.2	50.5	65.0
Average		79.7	67.0	91.0	86.0	52.5	66.3

It may thus be concluded that the installation of a syrup doser has proved beneficial under the conditions prevailing at Riche-en-Eau during the 1963 crop. By regularizing the crystal content of the footings, boiling of A and B strikes becomes easier, fuller advantage is taken of pan capacity, and grain regularity of the bagged sugar is probably slightly improved.

Since in many other sugar factories the crystal content of the magma is probably as irregular as it was at Riche-en-Eau prior to the installation of the syrup doser, consideration should be given to the adoption of this simple apparatus in other factories, in particular those in which double-curing of C sugar is practised as in that case the installation is much simpler than when single-curing with a large battery of centrifugals is resorted to.

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5. FURTHER STUDIES ON THE PRESENCE OF OSMOPHILIC YEASTS IN SUGAR PRODUCTS

ROBERT ANTOINE, R. de FROBERVILLE & C. RICAUD

Studies on the presence of osmophilic yeasts in sugar products were continued during the year. Investigations were conducted on (a) the massecuite, and (b) the raw sugar sampled at the factory and at the docks.

Plate counts were made on osmophilic agar which was prepared by dissolving 50 g of Oxoid Malt Extract Agar in 1 litre of distilled water and adding sugar to 40% concentration in order to obtain a brix of approximately 34°. The medium was sterilized at 10 p.s.i. for 10 minutes. Solutions of the massecuite and raw sugar samples were prepared by dissolving 10 g of the product in 10 ml of sterile water. Two series of dilution cultures were prepared by adding 0.4 ml and 0.2 ml respectively to 15 ml of osmophilic agar. The solution was distributed, drop by drop, using an Ostwald pipette, over the bottom surface of a sterile Petri dish. The sterilized osmophilic agar was poured into the Petri dish and mixed gently with the massecuite or sugar solution. There were three replications. The plates were kept in the incubator at 27°C and examined daily usually for up to 10 days, and in some cases longer as some osmophils frequently appeared first as micro-colonies. Yeast counts were made and contaminants recorded. In the latter series of experiments, 10% lactic acid was added to the osmophilic agar in order to suppress bacterial growth.

(a) Massecuite

The first series of experiments was conducted at a factory where a high yeast population had been observed in the raw sugar in 1962 As previous experimentation had indicated that contamination apparently took place in the crystallizers, it was decided to study the build-up of the yeast population in a crystallizer washed by the injection of steam before feeding the massecuite, an unwashed crystallizer serving as control. Plate examinations made on osmophilic agar, without the addition of lactic acid, as shown in Table 76, revealed the presence of large numbers of bacterial colonies and very few yeasts.

Table 76. Massecuite — Micro-organism plate count on osmophilic agar (without lactic acid) — Factory A

Date		*Crystallizer No. 17 (not washed)*	*Crystallizer No. 18 (washed)*
5.8.63	...	Several bacterial colonies, few yeasts.	Large number of bacterial colonies.
6.8.63	...	Several bacterial and yeast colonies.	Several bacterial colonies.
7.8.63	...	Bacteria numerous, few yeasts.	Bacteria numerous, few yeasts.
8.8.63	...	Few bacterial colonies.	Very few bacteria.
9.8.63	...	Bacterial colonies.	Bacterial colonies.
10.8.63	...	Bacterial colonies.	Bacterial colonies.

In the second experiment the massecuite was sampled from the crystallizer at three factories. At a fourth factory the sample was taken from the massecuite as it was being discharged from the vacuum-pan, in the crystallizer and at the point of entry in the centrifugal.

Table 77 shows that the highest number of yeast colonies per gram of massecuite, although a fairly low figure, was recorded at factory C.

Table 77. Massecuite — Micro-organism count on osmophilic agar (with lactic acid)

Factory	*Origin of massecuite*	*No. of yeast colonies/gm*
A	Crystallizer	5
B	Crystallizer	0
C	Crystallizer	85*
D	From vacuum pan	0
D	Crystallizer	0
D	Entering centrifugals	0

It was decided to repeat the first experiment at that factory and to have three treatments (a) crystallizer washed, (b) crystallizer washed and then sprayed with Iosan (a detergent compound containing Iodine), 3 gallons of 75 ppm available iodine solution applied by means of a knapsack sprayer, and (c) crystallizer unwashed (control).

The results given in Table 78 do not indicate a build-up of the yeast population in the crystallizer.

Table 78. Massecuite — Micro-organism plate count on osmophilic agar (with lactic acid), with and without treatment of crystallizer (Factory C)

Date		*Crystallizer No. 17 (washed)*	*Crystallizer No. 18 (washed Iosan)*	*Crystallizer No. 19 (control)*
			(Number of yeast colonies/gm)	
11.11.63	...	—	—	85
12.11.63	...	1	496	195
13.11.63	...	0	39	Aspergillus
14.11.63	...	0	0	63
16.11.63	...	0	20	3

* Sugar sample from centrifugal did not reveal presence of yeasts.

The fourth experiment was conducted in order to determine whether the procedure for sampling the massecuite, upon discharge from the crystallizer should be standardized. Samples were taken at intervals during discharge of the masse cuite and plated. The results of two experiments are given in Table 79.

Table 79. Massecuite — Micro-organism plate count on osmophilic agar (with lactic acid) — samples taken at intervals while crystallizer was being discharged (Factory C)

EXPERIMENT I (18.11.63) *Time*	*No. yeast colonies/gm*	*EXPERIMENT II* (26.11.63) *Time*	*No. yeast colonies/gm*
11.30 a.m. ...	10	10.10 a.m. .	0
11.45 ,, ...	30	10.20 ,, ..	0
12 noon ..	18	10.28 ,,	0
12.20 p.m. ...	22	10 50 ,, ..	0
12.45 ,, ...	28	10.58 ,, ..	1
1.15 ,, ...	28	11.10 ,,	1
1.45 ,, ...	25	11.15 ,, ..	11
2.30 ,, ...	120	11.26 ,,	12
2.40 ,, ...	140	11.35 ,,	24
		11.45 ,, ...	62

It appears that the yeast population of the massecuite is lowest in the first samples taken and increases gradually to the highest figures in the last samples.

(b) Raw Sugar.

Plate examination of raw sugars, sampled from the docks, on osmophilic agar (without lactic acid) revealed in 8 samples out of 9 the presence of *Aspergillus* (Table 80). In one sample only a yeast population of 190 colonies per gram of sugar was recorded.

A second series of experiments was initiated in order to determine the yeast content of raw sugars at the various factories and then follow the population level of some of the selected sugars during storage at the docks. The experiment was conducted during the period August to November, and the results given in Table 81.

Table 80. Sugar Sample from Docks — Micro-organism plate count on osmophilic agar (without lactic acid)

Date	*Factory*	*Dock*	*No. yeast colonies/gm*
20.2.63	E	A	Aspergillus
20.2.63	F	B	Aspergillus
27.2.63	E	A	Aspergillus
27.2.63	F	B	Aspergillus
20.3.63	E	A	190
23.4.63	E	A	Aspergillus
17.5.63	E	A	Aspergillus
20.6.63	E	A	Aspergillus
22.7.63	E	A	Aspergillus

Table 81. Sugar sample from factory followed in docks — Micro-organism plate count on osmophilic agar (with lactic acid)

Date		*Factory*	*Dock*	*No. of yeast colonies/gm* *Sample 1*	*Sample 2*	*Average*
14.8.63	...	G	—	112	175	143
31.10.63	...	G	—	65	90	78
14.8.63	...	D	—	67	90	78
21.8.63	...	D	—	287	190	238
3.9.63	...	D	B	8	20	14
24.9.63	...	D	B	0	0	0
23.10.63	...	D	B	Aspergillus	Aspergillus	Aspergillus
12.11.63	...	D	B	Aspergillus	Aspergillus	Aspergillus
16.8.63	...	H	—	80	95	88
24.10.63	...	H	—	23	15	19
5.11.63	..	H	—	17	30	23
16.8.63	...	A	—	40	35	37
5.11.63	...	A	—	195	225	210
21.8.63	...	I	—	24	48	36
3.9.63	...	I	B	Aspergillus	Aspergillus	Aspergillus
24.9.63	...	I	B	0	0	0
23.10.63	...	I	B	Aspergillus	Aspergillus	Aspergillus
12.11.63	...	I	B	Aspergillus	Aspergillus	Aspergillus
21.11.63	...	I	B	1	0	1
22.8.63	...	J	—	472	525	498
10.9.63	...	J	A	0	0	0
2.10.63	...	J	A	0	0	0
23.10.63	...	J	A	Aspergillus	Aspergillus	Aspergillus
24.10.63	...	J	—(1)	0	0	0
13.11.63	...	J	A	Aspergillus	Aspergillus	Aspergillus
24.8.63	...	K	—	3	9	6
10.9.63	...	K	A	Aspergillus	Aspergillus	Aspergillus
2.10.63	...	K	A	0	0	0
23.10.63	...	K	A	5	10	8
6.11.63	...	K	A	5	5	5
13.11.63	...	K	A	Aspergillus	Aspergillus	Aspergillus
24.10.63	...	L	—	430	410	420
25.10.63	...	M	—	1,385	1,625	1,500
25.10.63	...	N	—	1,932	2,545	2,238
31.10.63	..	F	—	3	7	5
31.10.63	...	B	—	715,000	715,000	715,000
9.11.63	...	B	—(2)	20	—	20
31.10.63	...	O	—	907	1,115	1,010
31.10.63	...	P	—	3	5	4
5.11.63	...	E	—	360	360	360
6.11.63	...	Q	—	227	265	246
6.11.63	...	R	—	753	765	759
6.11.63	...	S	—	5	5	5
16.11.63	...	T	—	320	—	320
21.11.63	...	U	—	1	4	3
21.11.63	...	V	—	12	15	13

(1) From sugar carrier under centrifugals.
(2) From sugar bin.

Two factories with a fairly high yeast population in the sugar (D and J) and two with a low yeast content (I and K) were selected for a study of the fluctuations in the yeast contents of the sugar during storage at the docks.

All plate counts were made on osmophilic agar with lactic acid.

The results show that there has been a considerable decrease or total disappearance of the yeasts during three months' storage at the docks. A few samples showed that the sugar had been contamined by *Aspergillus*.

Examination of sugars, sampled at the various factories from August to November, indicated that, although there are considerable fluctuations from factory to factory, the highest yeast populations are encountered late in the season. Excellent agreement was obtained between plate counts made at two dilutions (samples 1 and 2), each sample figure being the average of three replications.

6. CHEMICAL CONTROL NOTES

(a) THE INFLUENCE OF GLUCOSE AND FRUCTOSE ON THE DIFFERENCE BETWEEN APPARENT AND GRAVITY PURITIES OF JUICES AND MOLASSES

E. C. VIGNES & M. RANDABEL

In recent years it has been noticed that the gravity purity of juices often lies very close to, and sometimes even exceeds, the apparent purity. This fact has been observed especially since the variety Ebène 1/37 was released for commercial cultivation. At first sight such occurrence may appear abnormal. However, the Sugar Technology division has claimed from the start that this supposed anomaly is due to the different amounts of glucose and fructose contained in juices from different cane varieties. In order to elucidate this point, the Chemistry Division was entrusted with the task of carrying out comparative analyses of sugar cane juices, particularly with regard to their sucrose, glucose and fructose content, but owing to various practical difficulties the project never came to fruition, and there matters rested until last year.

Some time in the course of the 1963 campaign the difference between the gravity and apparent purities of the final molasses from one factory, which until then had been of the order of 3 degrees, unexpectedly jumped overnight, to nearly three times that figure. The case was brought to the notice of the M.S.I.R.I., and the Sugar Technology division, still believing that the situation could best be explained by differences in glucose:fructose ratio, set about to study the problem.

Nine samples of molasses from six different sugar factories were collected and analysed. Sucrose, glucose, and fructose were determined by the method of Jackson, Matthews and Chase as described by BROWNE and ZERBAN (1948). In this method, sucrose is determined directly with invertase. Then glucose and fructose are determined by a combination of the Lane and Eynon volumetric and the modified Nijns method.

Assuming that molasses contain a mixture of sucrose, glucose, and fructose, and no other optically active substance, the theoretical values of the gravity and apparent purities of each sample were calculated by taking into account the percentages of the three sugars present and their respective rotatory powers. The differences between the two purities involved were worked out and compared with the actual differences found by saccharimetry. The results obtained are shown in Table 82.

Table 82. Calculated and Actual Differences between Gravity and Apparent Purities in Final Molasses

Sample		*Sucrose %*	*Glucose %*	*Fructose %*	*Calculated Gravity Purity — Apparent Purity*	*Actual Gravity Purity — Apparent Purity*
1	...	32.57	6.65	7.90	6.0	7.6
2	...	30.88	7.17	8.18	6.2	8.6
3	...	32.77	6.23	8.18	6.7	7.2
4	...	31.95	7.70	5.70	2.0	3.9
5	...	33.60	6.00	8.50	7.6	9.1
6	...	35.50	4.06	2.68	0.5	2.1
7	...	37.48	3.94	3.44	1.7	3.5
8	...	36.32	4.76	6.41	5.4	7.3
9	...	31.76	4.22	6.72	6.8	7.8

It will be observed that although the calculated and actual differences give figures of the same order of magnitude, actual differences are always greater than calculated ones. This, no doubt, is due, amongst other things, to the complex nature of the molasses constituents and to the presence of optically active substances other than sucrose, glucose, and fructose. Nevertheless, it is clear from the above results that, as had been forecast, the differences between gravity and apparent purities in molasses, and by inference in juices as well, are directly linked with the nature and relative amounts of reducing sugars present.

Furthermore, the results of the investigation should guard against a practice occasionally followed by certain chemists when they discard the gravity purity figure obtained by the Jackson and Gillis method on the ground that the difference between it and the apparent purity is abnormally large or small, and use instead a figure obtained by applying the previous day average to the actual apparent purity found. It is now clear why alleged abnormal figures should not be set aside so easily. Whilst the practice could possibly be excused at the time when virtually only one variety of cane was cultivated, it should not be followed nowadays since marked differences may exist between the apparent and gravity purities of juices as the following figures clearly indicate (Table 83.)

Table 83. Effect of Glucose and Fructose on the Difference between Gravity and Apparent Purities in Juices

Sample	*Juice*	*Sucrose %*	*Glucose %*	*Fructose %*	*Calculated Gravity Purity (A)*	*Calculated Apparent Purity (B)*	*(A) – (B)*
1	1st expressed	18.22	0.30	0.28	87.5	86.7	0.8
2	1st expressed	15.54	0.12	0.08	90.7	90.4	0.3
3	1st expressed	16.95	0.15	0.09	90.0	89.8	0.2
4	Mixed	14.06	0.32	0.28	85.6	84.6	1.0
5	Mixed	13.72	0.15	0.17	85.4	84.6	0.8
6	Mixed	15.39	0.13	0.10	90.2	89.8	0.4

More accurate methods for the determination of mixtures of sugars are being studied at present, and results will be published at a later date.

REFERENCE

BROWNE, C. A. *and* ZERBAN, F. W. (1948). Physical and Chemical Methods of Sugar Analysis. John Wiley & Sons, New York p. 993.

(b) THE USE OF BASIC LEAD ACETATE FOR JUICE PRESERVATION

J. D. de R. de SAINT ANTOINE & M. M. ABEL

Sub-acetate of lead is one of the best chemicals available for the preservation of composited sugar juices prior to analysis, and has found widespread use in sugar factory laboratories. The amount of salt to use is governed by three main factors :

a. Juice temperature during storage.
b. Duration of storage period.
c. Addition or not of another preservative such as mercuric iodide.

The different conditions and practices prevailing in various countries with regard to these factors have resulted in different recommendations being made as to the amount of lead sub-acetate to use for proper juice preservation. In Mauritius, the *Société de Technologie Agricole et Sucrière* has recommended (1948) the use of about 20 grams per litre of juice, for a storage period of 12 hours, plus 0.5 ml of mercuric iodide solution. In its revised (1963) manual, the *Société* recommends that every laboratory be equipped with a refrigerator for storing the composite juice samples over a period of 24 hours in the presence of 0.5 ml mercuric iodide solution and 10 grams lead sub-acetate per litre of juice. This recommendation results from the well-known fact that lead sub-acetate affects the rotation of sucrose. Thus BATES and BLAKE (1907) have shown that the polarisation of pure sugar is depressed by the addition of lead unless a large excess is used when the polarisation is actually increased. These authors have found that an excess of 0.5 ml of lead sub-acetate solution causes a diminution of pol of 0.10 S; 1 ml, 0.12°S; 3 ml, 0.09 S, and that the rotation returns to its initial value when 6 ml have been added but then continues to increase linearly with the amount of lead solution added. GASKIN (1958) repeated the work of these authors and obtained the general shape of their curve, but observed smaller depressions of polarisation below 100°S, with a minimum at 0.2—0.3 ml, a return to 100 at 2.0 ml and a steady rise thereafter.

It is therefore obvious that the minimum amount of lead compatible with good preservation and clarification should be used when analysing any sucrose-containing product. From experiments carried out on juices from two different factories during the 1963 crop, it was found that if composite juice samples stored in a refrigerator overnight are preserved with 20 grams of Horne's lead sub-acetate their sucrose content, as determined by Jackson & Gillis method No. 4, is about 0.10 lower than when only 10 grams of the salt are used. Detailed figures are shown in Table 84.

Table 84. Influence of amount of lead sub-acetate on sucrose determination of mixed juice

Factory	*Sample No.*	*Sucrose % g mixed juice* 10 g lead subacetate per litre	20 g lead subacetate per litre
Beau Plan	1	13.94	13.78
	2	14.14	13.99
	3	14.17	13.96
	4	14.16	13.94
	5	14.17	14.18
	6	14.24	14.10
	7	14.15	14.09
	8	14.53	14.52
	9	14.34	14.29
	10	14.14	14.08
	Average	14.20	14.09
Mon Désert*	1	13.02	12.87
	2	13.38	13.28
	3	13.56	13.42
	4	13.53	13.42
	5	13.41	13.37
	6	13.05	13.00
	7	13.50	13.44
	8	13.74	13.64
	9	13.54	13.42
	10	13.47	13.40
	11	13.47	13.39
	12	13.39	13.35
	Average	13.42	13.33

* Figures kindly submitted by the Chemist, Mon Désert-Alma.

It is therefore most important that composite juice samples stored in a refrigerator overnight be preserved with 10 grams of lead sub-acetate per litre, instead of the usual amount of 20 grams, as otherwise the sucrose value will be depressed. In the case of mixed juice, an error of —0.10 will affect the calculation of sucrose per cent cane by an equivalent amount and will have a detrimental influence on the accuracy of recovery figures and profit and loss accounts.

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(c) THE DIRECT DETERMINATION OF FIBRE IN CANE

J. D. de R. de SAINT ANTOINE & R. de FROBERVILLE

The method used in Mauritius for the determination of the sucrose content of planters' canes has been described elsewhere (ST. ANTOINE, 1960). In this method cane sticks are sampled by hand from the cane carrier, shredded in a Queensland fibrator (Cutex) and fibre per cent cane determined as a sub-sample of the fibrated material after lixiviation in cold running water for 24 hours. However the sampling technique followed, fibrator used and analytical procedures adopted for fibre determination, are all open to criticism for the following reasons, mainly :

(a) By picking 90 sticks at random from the cane carrier, it is impossible to obtain a sample representative of the 10-30 tons of cane crushed during the test.

(b) When the cane is shredded in the fibrator, a certain amount of juice is sprayed into fine droplets. Some of these droplets are forced out of the machine and entrained by the current of air displaced by the moving rotor whilst the greater part of them are splashed on the hood of the fibrator and fall back dropwise on the shredded material, but only in localized spots where the shredded material becomes soaked with the juice. With these localized spots of high juice content, it is impossible in practice to homogenize the shredded material before taking a sub-sample for fibre determination.

(c) The fibrator shreds the cane into a mixture of long fibres and pith tissue. This mixture is also very difficult to homogenize prior to sub-sampling.

(d) The fibrator can shred only clean canes free from trash so that the sample used for fibre determination is not truly representative of the material fed to the mills.

(e) The shredded material from the fibrator is not sufficiently finely divided to ensure full removal of the Brix from all the cells especially when cold lixiviation during 24 hours is restored to.

Until recently there was not much that could be done by the Central Board to improve the accuracy of the fibre determination as no reliable machine was available to replace the Cutex. In fact, the Central Board followed the procedure recommended by the *Société de Techologie Agricole et Sucrière* as published in its 1948 manual. Recently however, a new machine called the Jeffco cutter grinder has been successfully used in Australia for the same purpose, and it was decided to test it under local conditions to find out whether it could advantageously replace the Cutex. The study was not limited to a choice between two machines as it was decided to investigate at the same time the possibility of :

(a) Replacing the cold lixiviation method by a more accurate one.

(b) Sub-sampling the raw material after the cane knives or shredder, i.e. as fed to the mills.

The first series of experiments were conducted with the object of determining the reproducibility of fibre determination with three different analytical methods. Two machines were used in these trials, the Cutex and a model 265 Jeffco cutter grinder. The latter is essentially a vertical hammer mill on the central spindle of which are fixed two heavy cutters which rotate at 3,000 rpm at a clearance of 15—20 thousandths of an inch from fixed anvil bars forming part of the head section enclosing the top half of the disintegrating zone. The degree of fineness of the material leaving the machine is to some extent governed by the size of the openings in the perforated plate located beneath the rotating hammers. The plate used during the test had $\frac{3}{4}$ inch perforations, as it was found that when plates with smaller perforations were used, the temperature of the mass of cane built up too much and caused evaporation losses. A large air tight receiving bin is fitted to the machine to reduce to a minimum the loss of moisture during or after grinding.

Table 85. Reproducibility of Various Methods for the Direct Determination of Fibre % Cane.

Run No.	*CUTTER GRINDER* *Cold* Fibre % Cane	Diff. between Duplicates	*Hot* Fibre % Cane	Diff. between Duplicates	*Rietz* Fibre % Cane	Diff. between Duplicates	*CUTEX* *Cold* Fibre % Cane	Diff. between Duplicates	*Hot* Fibre % Cane	Diff. between Duplicates	*Rietz* Fibre % Cane	Diff. between Duplicates
1A	12.56	0.16	11.76	0.04	12.28	0.12	11.96	1.20	15.08	1.72	13.04	0.24
	12.40		11.80		12.16		13.16		13.36		13.28	
1B	12.60	0.16	12.36	0.20	12.32	0.16	13.44	0.04	11.84	0.96	11.64	0.60
	12.76		12.16		12.48		11.40		12.80		12.24	
1C	13.16	0.28	12.52	0.04	12.36	0.16	11.60	0.28	10.80	0.04	11.72	0.04
	12.88		12.48		12.52		11.32		10.84		11.68	
2A	14.24	1.16	13.68	0.08	13.68	0.04	15.56	0.40	14.20	0.92	14.20	0.80
	15.40		13.60		13.64		15.96		13.28		13.40	
2B	14.04	1.68	13.16	0.24	13.68	0.04	14.88	1.28	11.64	2.20	14.40	1.00
	15.72		13.40		13.72		16.16		13.84		13.40	
2C	14.48	1.24	13.16	0.12	13.60	0.20	13.76	1.96	14.40	0.40	13.20	0.40
	15.72		13.04		13.40		15.72		14.00		13.60	
3A	12.16	0.12	11.28	0.20	12.12	0.08	11.52	0.36	11.24	0.16	12.20	0.28
	12.28		11.48		12.20		11.16		11.08		11.92	
3B	12.40	—	11.96	0.32	12.40	0.08	12.12	0.12	11.64	0.60	12.44	0.12
	12.40		11.64		12.48		12.00		11.04		12.32	
3C	12.40	0.72	11.40	0.28	11.60	0.28	12.32	0.72	11.36	0.24	11.76	0.04
	13.12		11.12		11.88		11.60		11.60		11.80	
4A	13.04	0.04	12.44	0.04	12.96	0.12	12.36	0.28	12.48	0.60	12.80	0.20
	13.00		12.48		13.12		12.64		11.88		13.00	
4B	12.72	0.08	12.12	0.28	12.57	0.23	13.08	0.12	12.08	1.08	13.48	0.60
	12.80		11.84		12.80		12.96		11.00		12.88	
4C	12.76	0.16	12.28	0.12	12.76	0.04	11.88	0.52	12.00	0.04	12.40	0.68
	12.92		12.40		12.72		12.40		12.04		13.08	
Average	13.25	0.48	12.32	0.16	12.73	0.13	12.96	0.61	12.31	0.75	12.74	0.42
Max. Diff. between Duplicates	—	1.68	—	0.32	—	0.28	—	1.96	—	2.20	—	1.00
Standard Deviation	—	0.73	—	0.19	—	0.15		0.83	—	0.99	—	0.51

For the first series of experiments, 4 lots of 30 whole canes were sub-sampled into thirds following the procedure already described elsewhere (St Antoine *and* Le Guen, 1960) and 12 sub-samples thus obtained. Each sub-sample was fed to the Cutex in such a way that only half of each portion of cane was shredded, the remaining half being set aside for disintegration in the cutter grinder. The shredded material from the Cutex was mixed up, and six sub-samples taken for the determination of fibre : two by cold lixiviation, two by hot lixiviation and two by the Rietz disintegrator method developed in Hawaii and followed at this Institute since several years. Six sub-samples of disintegrated cane were also taken from the cutter grinder and fibre determined on them in duplicate by the three above-mentioned methods.

In the cold lixiviation method 250 grams of the shredded material were tied up in a piece of calico cloth, placed under a tap of cold water, squeezed by hand several times and immersed in cold running water for 24 hours. After further pressing to eliminate surplus water, the cloth and its contents were dried to constant weight in an oven at 105°C.

The same procedure was employed for the hot lixiviation method, except that the cloth and its contents were first immersed in cold running water and squeezed by hand at intervals during one hour, then immersed in boiling water for another hour during which it was squeezed four times.

In the Rietz disintegrator method, 250 grams of shredded cane were placed in the bowl with two and a half litres of water and the machine allowed to run for 10 minutes. The contents of the bowl were then washed into a tared copper cylindrical container, about 6 inches in diameter and 2.5 inches high, the bottom of which is made up of a 150-mesh screen. Four gallons of cold water were then allowed to shower through the fibre and the container placed in an oven at 105°C for drying to constant weight.

The results of this first series of experiments are given in Table 85.

The following conclusions may be drawn from an analysis of these data :

(1) Best reproducibility is obtained with the Rietz disintegrator method on cutter grinder samples, average and maximum differences between duplicates amounting to only 0.13 and 0.28, comparative figures for Cutex samples being 0.42 and 1.00.

(2) Good reproducibility is also obtained with the hot digestion method on cutter grinder samples whereas the reproducibility is bad when the same method is applied to the Cutex samples.

(3) The cold lixiviation method is of very poor reproducibility, especially on Cutex samples for which average and maximum differences between duplicates amount to 0.61 and 1.96, respectively.

It will further be observed that :

(1) The cold lixiviation method yields higher fibre values than the two other methods. Although with this method one would have expected lower values on samples from the cutter grinder than on those from the Cutex, as the former is known to disintegrate the cane more fully than the latter, the results show that cold lixiviation does not remove fully the soluble non-solids.

(2) The hot lixiviation method yields lower fibre results than both the cold lixiviation and the Rietz disintegrator methods. This may be explained by the fact that boiling water may, to some extent, convert pentosan and pectins, which are constituents of the fibre, into soluble products.

(3) As a result of the similar average fibre values obtained on samples from both machines, the results of this first series of experiments only show that much greater reproducibility is obtained when analysing duplicate cutter grinder samples by the hot lixiviation or Rietz disintegrator methods, as compared to that obtained with Cutex samples when using the same analytical procedures.

In the light of these results, it was decided to use the hot lixiviation method in the following series of tests carried out at Mon Désert-Alma and Médine factories, as Rietz disintegrators were unfortunately not available.

Twenty-nine tests were carried out at Mon Désert where the following procedure was adopted. All the runs were made to coincide with tests carried out by the Central Board. In each run cane was sampled after the knives, in the chute to the first mill, during the whole time interval taken by the Central Board Chemist to sample cane from the cane carrier. The latter sample was sub-sampled by the Central Board Test Chemist into 30 thirds of cane, and half of each portion shredded in a Cutex. Three sub-samples of the shredded material were taken one for analysis by the Central Board using the cold lixiviation method, the two remaining duplicate samples being analysed by the hot lixiviation method. The half portions of cane remaining from the Central Board sample were disintegrated in the cutter grinder and duplicate sub-samples taken for fibre determination by hot lixiviation. Two sub-samples were also taken, after disintegration in the cutter grinder of the sample of knifed cane collected during the run, and analysed for fibre by the hot lixiviation method. A summary of the results obtained is given in Table 86 below.

Table 86. Determination of Fibre in Cane — Mon Désert-Alma

	Cutter Grinder				*Cutex*		
	After knives (Hot)		*On Central Board sample (Hot)*		*Central Board sub-samples (Hot)*		*(Cold)*
	Fibre % Cane	*Av. Diff. between Duplicates*	*Fibre % Cane*	*Av. Diff. between Duplicates*	*Fibre % Cane*	*Av. Diff. between Duplicates*	*Fibre % Cane*
	13.06	0.48	12.19	0.30	12.88	0.56	13.12
Max. Diff. between Duplicates ...	—	1.60	—	0.80	—	2.40	—
Root mean square Deviation ...	—	0.62	—	0.37	—	0.83	—

A similar series of 29 tests was carried out at Médine factory using the same procedure as that outlined for Mon Désert-Alma. The only difference between the two series lies in the fact that Médine factory is equipped with a shredder, and that samples of the raw material fed to the mills were taken after the shredder. The results obtained are summarized in Table 87.

Table 87. Determination of Fibre in Cane — Médine

	Cutter Grinder				*Cutex*		
	After Shredder (Hot)		*On Central Board sample (Hot)*		*Central Board Sub-Samples (Hot)*		*(Cold)*
	Fibre % Cane	*Av. Diff. between Duplicates*	*Fibre % Cane*	*Av. Diff. between Duplicates*	*Fibre % Cane*	*Av. Diff. between Duplicates*	*Fibre % Cane*
	14.67	0.30	13.49	0.24	14.17	0.39	14.31
Max. Diff. between Duplicates ..	—	1.00	—	0.68	—	1.76	—
Root mean square Deviation .	—	0.39	—	0.29	—	0.55	—

An analysis of the results obtained at Mon Désert-Alma and Médine leads to the following conclusions :

(1) At both factories, fibre of Cutex samples yielded lower results (—0.24 and —0.14) when determined by hot as compared to cold lixiviation. As already mentioned, this may be attributed to the action of boiling water on pentosan and pectins.

(2) At both factories when the half portions of cane remaining from the Central Board samples were disintegrated in the Cutter Grinder and analysed by the hot lixiviation method average fibre values smaller by 0.68 were obtained as compared to equivalent samples shredded in the Cutex and analysed by hot lixiviation. This implies that the shredding action of the Cutex is incomplete, that a number of cells are not broken, and that all the Brix cannot be removed by the water during lixiviation.

(3) By sampling the cane as fed to the mills, higher fibre values are obtained, as would be expected, as compared to sampling cane from the cane carrier. If, for the sake of comparison, the Cutter Grinder values only are considered, the differences found at Mon Désert-Alma and Médine amount to + 0.87 and + 1.18 respectively.

Conclusions and Recommendations

The obvious conclusions that may be drawn from the present study are as follows :

(1) The cold lixiviation method should be replaced by the Rietz disintegrator method which yields more reproducible results, is simple, and less time consuming.

(2) The Cutex shredder should be replaced by the Jeffco Cutter Grinder which disintegrate the cane much more fully than the Cutex does, and thus increases the accuracy of direct fibre determination. It should be pointed out that this machine has been already adopted in Queensland.

(3) It would be much preferable to determine fibre on the raw material as fed to the mills than on cane sampled from the cane carrier. Whereas this is a fairly easy proposition where the cane is shredded before being sent to the mills, it should be stressed that it is not always easy, and often very difficult, to sample knifed cane correctly and representatively. The conditions prevailing in each mill have to be studied and the sampling technique adapted accordingly. Until such time as these studies have been completed, it will still be necessary, when calculating the fibre of planters' canes, to relate this fibre to the average factory figure by working out fibre balances, as practised by the Central Board.

Finally, it should be mentioned that, if all factory laboratories were equipped with Jeffco Cutter Grinders and Rietz disintegrators, the factory chemist would have useful tools for a number of other determinations, in particular for calculating the sucrose content of cane from various fields or sectors of the estate.

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BY-PRODUCTS

1. THE USE OF PROTEIN IN CANE JUICE AS AN ANIMAL FEED

D. H. PARISH

As the proteins of high biological value, such as are contained in meat, eggs, milk and fish are expensive, the bulk of the population of Mauritius rely on seed proteins (rice and pulse grains) for their dietary needs, and even these low biological value proteins are consumed at low levels, so that dietary protein deficiency is very common.

This problem of protein shortage is not peculiar to Mauritius but is widespread throughout the tropical world. Carbohydrates such as sugar and starch are in plentiful supply, whilst fats, the alternative source of metabolic energy, can be fed without any ill effects over a wide range of levels, depending on their availability. Diets poor in vitamins can be supplemented with small quantities of high vitamin food, or the now cheap compounds themselves, and mineral supplementation of any diet is cheap and simple.

Protein, however, remains the centre of dietary requirements; it must be fed at fairly high levels and it must have a balanced amino-acid composition to meet the body's need for all the essential amino-acids.

It is important, therefore, that any local source of protein for dietary use should be exploited to the full, the more so that a rapid increase in population is taking place without concurrent increase in national wealth.

This means in effect that production of higher quality protein must be increased and that the efficiency of utilization of protein already available must be improved.

Fibrous leafy materials, which contain proteins of high biological value, are not directly utilisable by human beings but must be fed first to ruminant animals reducing immediately, in terms of human needs, the efficiency of their utilization by more than three-quarters.

Pirie (1942), conscious of this inefficiency, has been the motivating force behind much of the work in progress on the separation of leaf protein from the fibre, with the final aim of preparing a material suitable for direct human consumption.

The only crop of importance in Mauritius is sugar cane, the green tops of which are very low in protein (about 5% on a dry matter basis), and very high in fibre, making extraction of the protein a difficult matter although Pirie (1960) is convinced that it is possible.

The protein in the sugar cane itself is, however, extracted during milling and, although it is present in only small amounts, because of the large quantities of cane crushed, about 6000 tons of this protein are precipitated and filtered off during juice clarification.

Parish (1960) drew attention to the large quantities of protein being dumped in the fields with the scums, and has suggested that attempts could be made to recover this protein in a form suitable for direct human consumption, or for use in poultry rations — high laying hens convert about two-fifths of their dietary protein into animal protein. Following this, Staub and Darné (1962) have said that the best way of utilizing the protein present in cane juice would be to dry the filter muds and feed them directly to animals, a proposition first made in Mauritius by Boname (1897).

PARISH (1962), from the analytical data then available, studied the whole project of using scums in animal rations and concluded that as all scums are fairly low in protein, which is the main point of nutritional interest, and fairly high in fibre, the simplest use of scums is as a direct feed for cattle, for which low energy and large bulk are of little importance, but that the efficiency of utilization of the protein in terms of human interest is low.

This opinion, as has been pointed out, was based on the analytical data available at that time, but STAUB and DARNÉ, although they gave no actual figures, considered scums as a valuable feeding stuff for all animals.

The following is a translated abstract from their article : «When dried scums are substituted at a 20 % level in rations, the ration is readily accepted by the animals. In the case of young pigs and rabbits, the weight gains of the animals on the scums rations are more rapid than the controls. With laying hens, the number of eggs laid remains unchanged, and with chickens, it has been observed that the addition of the dried scums to the standard concentrate improves their condition ».

More recently the following remarks on the use of dried scums in rations have been published (ANON, 1963).

«A trial to assess the value of scums, a by-product of sugar manufacture, as part of stock rations was undertaken using milch cattle, pigs and rabbits. In the trial, cow feed was replaced by scums to the extent of 20 per cent of the ration with the following results :

(a) No difference in milk production was found between the control and test groups.

(b) All other factors being equal, the cost of production per litre was lower in the test group.

(c) A digestibility trial revealed that ruminants are capable of digesting 70 per cent of the wax component of both scums and fodder.

(d) Rabbits are selective feeders and definitely rejected the scum part of the ration.

(e) In pigs, the trial revealed that 7.8 lbs of pig starter containing 20 per cent scum was required to yield an increase of 1 lb liveweight compared with 4.15 lbs of pig starter without scums. It was apparent that the scums part of the ration was not well utilized in this class of animal.»

These newer data show that for pigs, scums not only are indigestible, but that when added to a normal ration, seriously depress its digestibility and confirm the opinion expressed by PARISH, *loc. cit.*, that scums can be considered as being of potential value for ruminants only.

Accepting that dried scums can be usefully included in ruminant feeds and that cane-tops and molasses are readily available in Mauritius, it seemed that a useful cheap ration for sheep and cattle could be produced on a very large scale locally.

Digestibility trials were therefore carried out using two wether sheep of around 30 Kgs liveweight, using dried cane-tops, scums, and molasses.

The results of these first trials (PARISH, 1963) showed that although dried scums were readily eaten by sheep, the digestibility of the protein they contained was very low, particularly when the scums were oven dried.

In a second series of experiments, it was decided to compare lucerne meal (16% protein) with scums, when both were added at the same level to a basic dried-cane-top — molasses ration.

The results for the nitrogen digestibility obtained from these trials are given in Table 88.

The results presented in this table show that the content of digestible crude protein of a ration in which scums, which had been carefully dried at a temperature not exceeding 80 C, when compared with the content of digestible crude protein of a ration in which a poorish quality lucerne (16% C.P.) was substituted for the scums, is less than one half of the lucerne ration even though the level of protein fed was identical.

The fact that the scums-containing ration and the lucerne-containing ration were identical in their contents of cane-tops and molasses, and the crude protein contents were 11.26% and

Table 88. Digestibility of the Crude Protein of three different rations prepared from dried cane-tops, molasses, oven dried scums (80°C), and lucerne meal. (Figures are N x 6.25)

RATION I

Dried cane-tops – Lucerne meal – Molasses (giving 44.89, 44.52 and 10.59 % of the D.M. fed respectively).

Crude Protein content of ration 11.26%. Dig. C.P. = 5.27%

Sheep A	fed 715.3 gms	Excreted in faeces	384.7 gms.	Digested 46.2%
,, B	,, 683.3 ,,	,, ,,	359.5 ,,	,, 47.4%

RATION II

Dried cane-tops – Oven dried scums – Molasses (giving 44.52, 44.97 and 10.51% of the D.M. fed respectively).

Crude Protein content of ration 11.10%. Dig. C.P. = 2.57%

Sheep A	fed 825.9 gms	Execreted in faeces	655.7 gms	Digested 20.6%
,, B	,, 813.7 ,,	,, ,, ,,	601.4 ,,	,, 26.1%

RATION III

Dried cane-tops – Molasses (giving 89.44% and 10.56% of the D.M. of the ration respectively).

Crude Protein content of ration 5.75%. Dig. C.P. = 1.89%.

Sheep A	fed 405.6 gms	Excreted in faeces	282.4 gms	Digested 30.4%
,, B	,, 401.7 ,,	,, ,, ,,	258.5 ,,	,, 35.6%

11.10% respectively, means that the large differences in the nitrogen digestibility of the two rations is due entirely to the effect of the low digestibility of the scums.

This shows that scums cannot be considered as a normal feeding stuff and that the amount of crude-protein they contain, (*vide* Table 89), is misleading as an indication of their value as an animal feed.

If the digestibility data for ration III are used to estimate the digestibility coefficient of the crude protein in the scums and lucerne (for an absolute comparison this ration should have contained 21% of molasses, but the effect of the small amount of nitrogen contained in the molasses can be ignored), the following figures are obtained :-

Digestibility coefficient of crude protein in scums 0.193

Digestibility coefficient of crude protein in lucerne meal 0.566

The results for the lucerne meal are the same as the published figures for this material and the results can therefore be accepted with confidence.

Table 89. The average crude protein content of dried filter muds produced during the 1963 crushing season.

Factory	*Type of Filter*	*Crude Protein % D M*
F.U.E.L.	Rotary (cloth)	14.9
Médine	Rotary (cloth)	14.6
Mon Trésor	Rotary (normal)	11.7
Highlands	Filter press	16.7
Rose Belle	Filter press	15.2

No feeding stuff containing up to 18% of crude protein, as dried scums do, has such a low content of digestible crude protein, and therefore, although from the point of view of total protein content scums would be equated to a good quality dried grass, from the point of view of animal feeding they are the equivalent of only a poor quality hay.

The possible causes for the low digestibility of scums protein are :

(a) precipitation of the protein from a strong solution of sucrose and reducing sugars at a temperature of 100°C and under slightly alkaline conditions, resulting in serious denaturation of the protein.

(b) The coating of the protein particles with wax which could prevent enzymic degradation of the protein.

(c) The effect of the temperature used in drying the scums. Air-drying has been shown by PARISH (1962) to improve the digestibility of the scums protein, but this is a difficult method of drying on an industrial scale, and in any case the digestibility of the protein is still fairly low, being only around 30%.

(d) The composition of the basic ration to which the scums are added may possibly affect the digestibility of the protein they contain.

Research into the cause of the low digestibility of scums-protein is in progress, but it does seem that some treatment of the dried scums will be necessary before the full nutritional potentiality of the protein they contain can be exploited. Should it prove possible to dry the scums carefully, and if dewaxing improves the digestibility, then this material may play a valuable role in ruminant livestock production in Mauritius; in the meantime, as a protection against possible financial loss, it is desirable that they be considered only as the equivalent of a poor quality meadow hay.

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2. THE AMINO-ACID COMPOSITION OF THE HOT-WATER INSOLUBLE NITROGEN FRACTION OF CANE LEAVES, CANE JUICE AND FACTORY FILTER-MUDS

D. H. PARISH

There is little reason to suppose that marked differences in the amino-acid composition of leaf-protein will occur between different plants and between the same plants grown under differing conditions of fertility; this has been generally supported by the analytic results available (MORRISON and PIRIE, 1961).

As the protein recovered in the scums is from the stalks of the cane plant and not from the leaves, it was of interest to compare the amino-acid composition of acid hydrolysates of the hot-water-insoluble nitrogen fraction of cane leaves, dried factory filter-muds and a coagulate from cane juice made by heating the juice to 80 C.

The cane leaves used contained about 1% of nitrogen, the dried scums 2.5% nitrogen, and the laboratory prepared coagulate 10% of nitrogen.

Hydrolysis was carried out using the method described by DUSTIN, CZAJKOWSKA, MOORE and BIGWOOD (1953), and the amino-acids were determined by the method of MOORE and STEIN (1951), using the modified ninhydrin reagent described by these authors (MOORE *et al*, 1954). Various mixtures of pure amino-acids were also analysed to ensure correct identification of the peaks (BENDER, PALGRAVE and DOELL, 1959).

As the three hydrolysates were treated in an identical way, it is valid to compare the materials between themselves, even though recovery of such substances as methionine, and particularly tryptophan, is poor.

The results of the analyses presented graphically in figs. 36, 37 and 38, show that for all the amino-acids, little or no differences in levels occur.

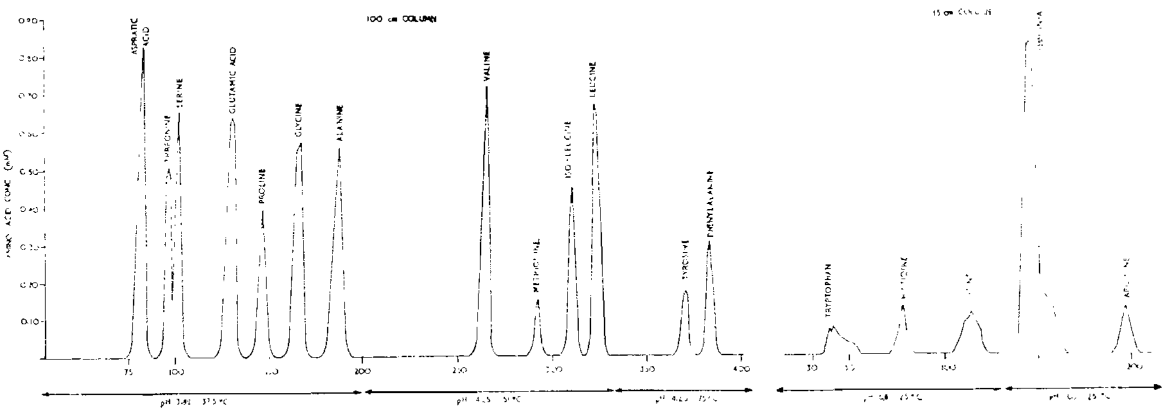

Fig. 36. Amino acid composition of the hydrolised 80% alcohol (v/v) insoluble nitrogen of cane leaves.

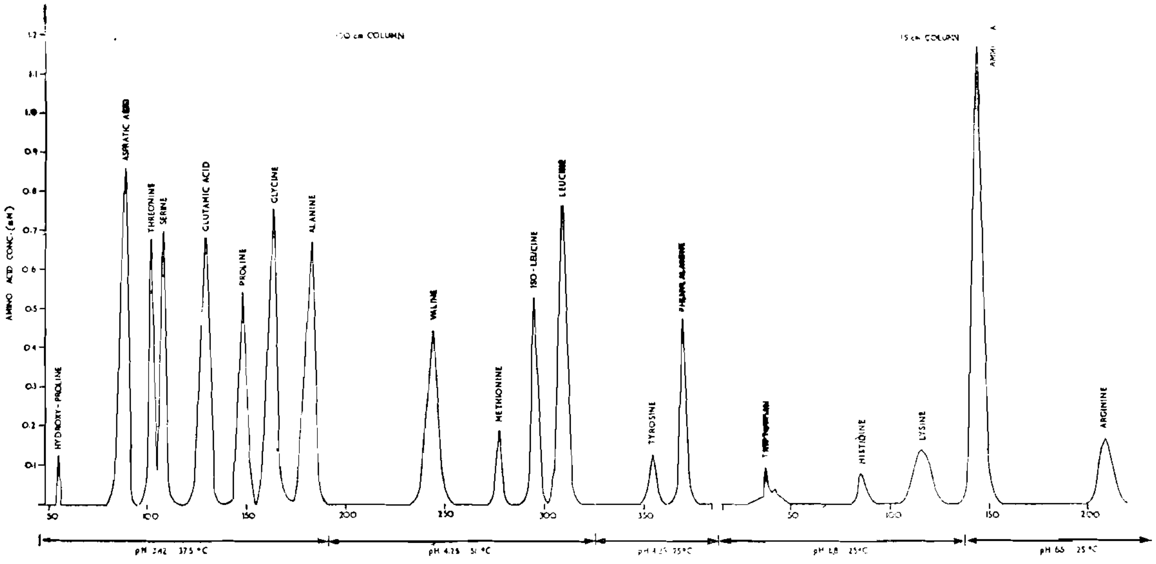

Fig. 37. Amino acid composition of hydrolised factory filter-muds.

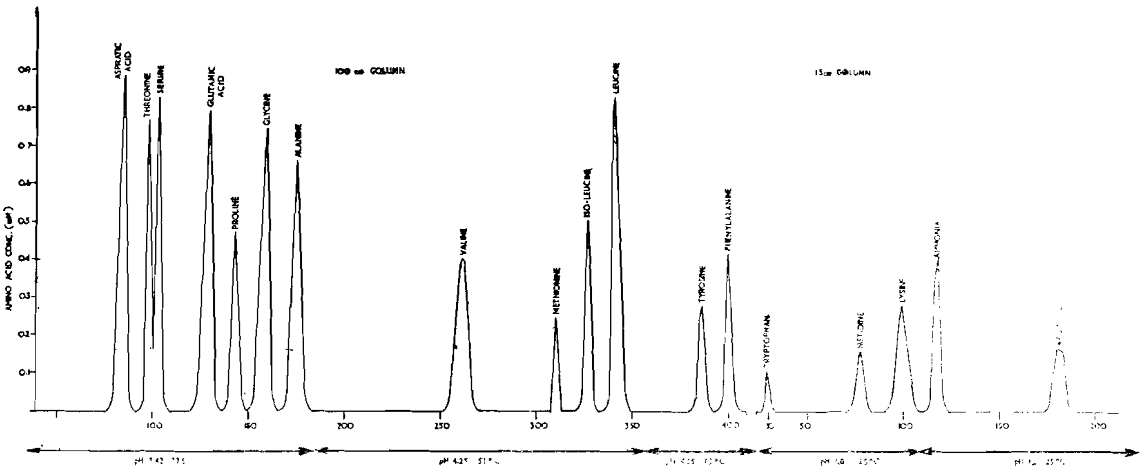

Fig. 38. Amino acid composition of hydrolised heat coagulate from cane juice.

The levels of the nutritionally important amino-acids commonly deficient in plant proteins, but occurring in leaf protein preparations, are given by MORRISON and PIRIE, *loc. cit.*, as lysine 5.3 — 7.1 %, methionine 1.3 — 2.7 % and tryptophan 1.0 — 2.0 %. The levels of these amino-acids occurring in the coagulate from juice are : lysine 5.3 %, methionine 1.0 % and tryptophan 0.4 % respectively, which confirms that the material is similar to leaf proteins for if the contents were corrected for losses during analysis, they would fall into the ranges cited.

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APPENDIX*

I. Description of cane sectors

II. Area under sugar cane, 1956 - 1963

III. Sugar production, 1956 - 1963

IV. Yield of Cane, 1956 - 1963

V. Sugar manufactured % cane 1956 - 1963

VI. Sugar manufactured per arpent, 1956 - 1963

VII. Rainfall excesses and deficits, 1947 - 1963

VIII. Wind velocity, 1949 - 1963

IX. Wind velocity, cyclone years

X. Variety trend, 1950 - 1963

XI. Varietal composition of plantations, 1959 - 1963

XII. Relative production of virgin and ratoon canes, 1950 - 1963

XIII. Yield of virgin and ratoon canes, 1963

XIV. Evolution of 1963 sugar crop

XV. Evolution of cane quality, 1963

XVI. Duration of harvest and weekly crushing rates, 1948 - 1963

XVII. Summary of chemical control data, 1963 crop
(i) Cane crushed and sugar produced
(ii) Cane, bagasse, and juices
(iii) Filter cake, syrup, pH, final molasses and sugar
(iv) Massecuites
(v) Milling work, sucrose losses and balance recoveries

XVIII. Molasses production and utilization, 1948 - 1963

XIX. Importation of fertilizers, 1950 - 1963

XX. Sale of herbicides, 1962 - 1963

XXI. Importation of herbicides, 1953 - 1963

XXII. List of 1962 crosses planted in 1963

XXII a. List of crosses made and planted in 1963

XXIII. List of Approved Cane Varieties

* *Grateful acknowledgment is made to the Secretary, Mauritius Chamber of Agriculture, for providing the necessary data to compile Tables II to VI.*

Table I. General description of sugar cane sectors of Mauritius

SECTORS	WEST	NORTH	EAST	SOUTH	CENTRE
DISTRICT	Black River	Pamplemousses & Rivière du Rempart	Flacq	Grand Port & Savanne	Plaines Wilhems & Moka
ORIENTATION	Leeward	—	Windward	Windward	—
PHYSIOGRAPHY	Lowlands and Slopes	Lowlands	Lowlands and Slopes	Lowlands and Slopes	Plateau
GEOLOGY	Late lava — Pleistocene.				
PETROLOGY	Compact or vesicular doleritic basalts and subordinate tuffs.				
ALTITUDE	Sea level - 900 ft.	Sea level - 600 ft.	Sea level - 1,200 ft.	Sea level - 1,200 ft.	900 - 1,800 ft.
HUMIDITY PROVINCE	Sub-humid	Sub-humid to humid	Humid to super-humid		
ANNUAL RAINFALL, inches. Range and mean	(30 - 60) 44	(40 - 75) 55	(60 - 125) 94	(60 - 125) 90	(60 - 150) 90
MONTHS RECEIVING LESS THAN TWO INCHES RAIN	June to October	September to October	None		
AVERAGE TEMPERATURE °C — JAN.	27.0°	26.5°	25.5°	25.0°	23.5°
AVERAGE TEMPERATURE °C — JUL.	21.0°	20.5°	19.5°	19.0°	17.5°
CYCLONIC WINDS, greater than 30m.p.h. during 1 hour	December to May				
PEDOLOGY Great Soil Groups	Soil Families				
Low Humic Latosol	« Richelieu »	« Richelieu » « Réduit »	« Réduit » « Bonne Mère »	« Réduit »	« Réduit » « Ebène »
Humic Latosol	—	« Rosalie »		« Riche Bois »	« Riche Bois »
Humic Ferruginous Latosol	—	—	« Sans Souci »	« Belle Rive » « Sans Souci » « Midlands » « Chamarel »	« Belle Rive » « Sans Souci » « Midlands »
Latosolic Reddish Prairie	« Médine »	« Labourdonnais » « Mont Choisy »	« Mont Choisy »	« Labourdonnais » « Mont Choisy »	« Médine »
Latosolic Brown forest	—	—	« Rose Belle »	« Rose Belle » « Bois Chéri »	« Rose Belle » « Bois Chéri »
Dark Magnesium Clay	« Lauzun » « Magenta »	« Lauzun »	—	—	—
Grey Hydromorphic	« Balaclava »	« Balaclava » « St. André »	« Balaclava »	—	—
Low Humic Gley	—	—	« Valetta »	—	« Valetta » « Petrin »
Lithosol	—	« Melleville »	« Pl. des Roches » « Melleville »	« Melleville »	—
IRRIGATION	Common	Some	Rare		
APPROXIMATE AREA 1000 arpents — Sector	56	91	72	160	63
APPROXIMATE AREA 1000 arpents — Cane	12	54	47	65	27
CANE PRODUCTION 1000 metric tons (1963)	373	1,421	1,259	1,922	769
SUGAR PRODUCTION 1000 metric tons (1963)	47	176	144	220	95
SUGAR FACTORIES Production in 1000 metric tons (1963)	Médine 47	Belle Vue 37 Mon Loisir 36 Solitude 27 St Antoine 26 Beau Plan 26 The Mount 24	Union Flacq 81 Beau Champ 35 Constance 28	Savannah 33 Mon Trésor 30 Riche en Eau 26 Rose Belle 25 Union 23 Britannia 21 Bel Ombre 18 St. Félix 15 Ferney 15 Benares 14	Mon Desert 43 Highlands 27 Réunion 25

Table V. Average sugar manufactured % cane(1), 1956 - 1963

Crop Year	Island	West	North	East	South	Centre
1956	12.95	13.17	13.59	12.84	12.47	12.89
1957	12.94	13.07	13.86	12.64	12.49	12.88
1958	12.14	12.36	12.95	12.22	11.53	12.12
1959	12.24	12.48	13.08	12.22	11.64	12.27
1960	9.84	10.94	10.34	9.73	9.29	9.56
1961	11.19	11.40	11.76	10.94	10.78	11.47
1962	11.52	12.07	11.90	11.38	11.12	11.76
1963(2)	11.93	12.66	12.36	11.54	11.54	12.39

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, 1956 - 1963

	Island	West	North	East	South	Centre
1956	3.41	3.56	3.47	3.07	3.53	3.49
1957	3.31	4.02	2.92	2.89	3.66	3.68
1958	2.98	3.46	2.79	2.74	3.16	3.14
1959	3.17	3.66	2.81	3.03	3.33	3.57
1960	1.26	1.96	1.49	1.19	1.20	0.84
1961	2.95	3.16	2.76	2.67	3.05	3.54
1962	2.75	3.16	2.94	2.56	2.84	2.27
1963(1)	3.56	4.28	3.42	3.35	3.58	3.79

NOTE: (1) *Provisional figures*

Table VII. Monthly rainfall in inches, 1947 - 1963. Average over whole sugar cane area of Mauritius

Crop year	GROWTH PERIOD (deficient months in italics)								NOV-JUNE (sum of monthly deficits)	MATURATION PERIOD (excess months in italics)				JULY-OCT. (sum of monthly excesses)
	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 to date	0.52 13.18	1.74 44.81	2.69 32.46	2.59 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 8.06	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
1958	*2.09*	10.26	13.49	13.28	29.54	13.29	*4.95*	*2.20*	6.40	*8.22*	*4.51*	1.50	2.47	3.99
1959	*1.18*	*3.06*	13.64	*9.48*	13.93	4.81	*3.04*	*1.80*	19.91	3.07	*6.01*	2.67	*6.53*	5.59
1960	11.43	*6.58*	23.46	18.29	16.97	*1.73*	*3.23*	5.06	11.96	3.57	2.29	*8.06*	1.49	5.16
1961	*2.48*	*3.13*	*4.31*	*2.59*	*7.96*	*7.58*	*4.70*	7.13	28.71	*7.84*	*5.65*	2.05	2.26	4.75
1962	3.89	44.81	11.17	15.42	14.47	*5.12*	*5.62*	5.49	5.67	2.89	3.50	*3.79*	*5.28*	3.36
1963	4.68	*5.26*	*8.41*	11.46	*5.02*	*9.49*	*5.41*	*4.09*	13.91	*6.13*	0.82	1.76	*3.50*	2.23

NOTE: To convert into millimetres, multiply by 25.4

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	1958	1959	1960	1961	1962	1963
November	—	21	17	24	18	18	14	16	12	13	13	19	16	18	15
December	18	16	24	21	15	16	15	17	13	13	14	15	15	*43*(2)	24
January	27	26	21	22	18	28	13	20	20	14	17	*53*(2)	16	20	26
February	20	24	20	25	15	15	*34*(2)	16	19	18	17	*74*(2)	13	*59*(2)	16
March	20	17	18	25	15	15	29	19	18	*33*(2)	18	15	13	18	17
April	18	21	17	22	20	16	16	17	16	28	17	15	12	21	16
May	20	19	20	24	22	22	19	18	15	14	16	17	13	20	20
June	24	20	23	25	23	20	22	17	13	14	17	17	19	17	18
July	21	23	21	20	24	16	17	15	12	11	16	15	19	19	17
August	18	19	24	25	24	23	20	14	17	20	18	16	20	22	15
September	20	21	21	21	20	19	19	17	17	17	17	20	21	18	17
October	18	19	20	20	19	20	14	18	15	17	18	18	19	22	16

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. Highest wind speed during one hour in miles in different sectors. Cyclone years

	West	North	East	South	Centre
February 1955	—	30	—	37	35
March 1958	34	29	22	35	31
January 1960 *Alix*	60	48	43	60	—
February 1960 *Carol*	83	82	78	74	55
December 1961 *Beryl*	49	45	33	51	40
February 1962 *Jenny*	64	74	49	58	54

Table X. Variety trend in Mauritius, 1950 - 1963

% Area cultivated (Estate lands)

	M. 134/32	M. 112/34	M. 147/44	M. 31/45	M. 202/46	M. 93/48	M. 253/48	Other M. seedlings	Ebène 1/37	Ebène 50/47	B. 3337	B. 34104	B. 37161	B. 37172	Others
1950	91	2	—	—	—	—	—	5	1	—	—	—	—	—	1
1951	92	2	—	—	—	—	—	4	2	—	—	—	—	—	—
1952	90	2	—	—	—	—	—	3	4	—	—	—	—	—	1
1953	86	2	—	—	—	—	—	3	8	—	—	—	—	—	1
1954	83	2	—	—	—	—	—	3	9	—	1	—	1	—	1
1955	74	2	—	—	—	—	—	2	15	—	3	—	2	1	1
1956	66	2	1	1	—	—	—	3	17	—	4	—	3	2	1
1957	55	2	6	3	—	—	—	1	21	—	4	1	3	3	1
1958	43	2	10	4	—	—	—	2	24	—	5	1	3	5	1
1959	33	2	15	5	—	—	—	1	25	—	5	2	3	8	1
1960	25	2	19	5	—	—	—	1	26	—	6	2	3	10	1
1961	19	1	23	5	2	1	1	—	24	1	7	2	2	11	1
1962	13	1	26	4	4	3	1	—	21	3	7	3	2	11	1
1963	9	—	29	4	6	5	2	—	18	4	6	3	2	11	1

Table XI. Percentage annual plantations under different cane varieties on sugar estates, 1959 to 1963

Years / Varieties	Island					West					North					East					South					Centre				
	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963	1959	1960	1961	1962	1963
M.134/32	1.2	2.8	1.0	1.7	—	—	—	—	—	—	2.7	11.3	5.0	8.0	0.6	0.2	0.4	—	—	...	1.5	1.2	0.4	1.0	—	0.4	0.3	0.1	—	—
M.147/44	32.7	30.0	30.1	28.9	31.0	20.5	17.8	17.8	44.1	55.1	50.4	49.4	55.4	53.3	68.1	39.0	27.8	34.4	32.5	30.9	31.2	27.9	27.9	23.6	23.1	8.0	16.4	8.9	3.6	1.0
M.31/45	3.8	2.6	0.8	1.2	1.7	4.8	7.4	—	—	—	4.9	6.7	3.3	1.9	1.0	5.7	3.8	1.0	2.7	6.1	2.4	0.3	0.2	0.8	1.0	3.3	—	—	1.0	—
M.202/46	—	7.7	12.6	16.1	14.8	—	9.2	18.3	15.6	23.9	—	6.2	11.2	12.1	12.4	—	4.9	15.3	26.3	19.3	—	10.4	11.5	15.7	15.8	—	5.0	10.8	8.1	7.8
M.93/48	—	2.9	11.6	20.4	24.4	—	1.5	—	3.3	1.8	—	0.9	2.9	3.1	9.3	—	1.8	12.8	28.6	16.4	—	5.3	18.7	24.0	28.7	—	0.4	5.5	27.4	45.6
M.253/48	—	2.1	3.6	3.7	1.7	—	20.2	12.8	7.4	2.4	—	0.2	3.1	3.7	3.3	—	3.6	4.0	3.3	1.3	—	0.6	2.2	3.1	1.9	—	0.7	3.4	3.6	—
Ebène 1/37	24.3	14.5	12.7	3.0	4.5	—	—	—	—	—	7.2	3.2	3.3	—	—	25.2	17.8	11.7	—	4.1	30.2	14.5	12.3	1.2	3.6	35.2	—	30.3	16.4	13.5
Ebène 50/47	—	—	7.3	12.6	9.7	—	—	3.1	2.9	0.7	—	—	0.5	6.3	4.0	—	—	6.4	4.4	3.5	—	—	3.9	12.5	9.2	—	—	26.3	35.5	26.0
B.3337	6.9	10.3	6.0	2.4	5.8	—	—	—	—	—	—	—	—	—	—	6.4	10.2	5.7	0.1	14.8	8.3	15.2	6.9	5.4	7.6	14.7	—	12.9	1.7	—
B.34104	2.8	2.5	4.0	3.5	1.2	29.6	15.9	26.7	24.5	9.0	2.9	2.1	0.6	2.2	—	—	0.3	1.5	0.9	—	2.1	2.9	4.3	2.5	1.9	1.2	—	0.6	0.6	—
B.37161	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
B.37172	21.0	16.5	8.7	5.4	2.4	30.9	26.4	18.7	1.3	4.9	25.7	19.6	14.0	8.6	—	15.9	17.4	6.1	0.6	—	19.8	18.6	9.2	9.4	5.1	23.0	0.5	0.6	0.2	—
Other varieties	6.8	8.1	1.6	1.1	2.8	14.2	—	2.6	0.9	2.2	5.1	0.4	0.7	0.8	0.7	7.0	12.0	1.2	0.6	3.6	4.2	3.1	2.5	0.8	2.1	14.1	—	0.6	2.9	5.1
Total area arpents	13203	14321	15451	13406	12290	512	729	1042	1203	531	2579	2796	2559	2251	2445	2 20	2834	3071	2800	2274	5565	6058	6318	5225	4902	1927	1905	2461	2077	2127

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

Year	Island	West	North	East	South	Centre
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
1958	82.9	77.9	86.3	77.5	83.1	85.5
1959	86.1	87.8	85.9	82.1	87.2	87.8
1960	81.9	82.2	82.7	78.3	75.2	84.8
1961	85.4	78.5	84.4	85.1	86.3	86.7
1962	82.9	72.8	83.3	82.1	84.6	82.1
1963	86.2	77.8	86.2	84.6	88.3	85.8

NOTE: The weight of cane produced on estates in 1963 was: virgins 486,594 tons; ratoons 3,028,906

Table XIII. Average yields of virgin and ratoon canes on estates
Tons per arpent. A : 1957 - 1962(1) B : 1963

	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	35.3	40.9	41.6	45.7	34.9	41.1	38.8	45.6	33.8	39.7	33.7	39.8
1st Ratoon	33.2	37.6	35.7	39.1	31.8	39.0	34.2	39.3	32.5	35.1	32.7	39.4
2nd ,,	31.7	34.9	33.5	37.5	31.2	34.6	32.7	37.6	31.1	33.3	32.2	35.4
3rd ,,	30.7	33.8	32.2	34.1	29.7	32.6	31.4	37.2	30.4	32.7	31.6	33.3
4th ,,	29.7	33.6	30.3	33.1	28.7	33.8	29.5	35.5	27.3	32.1	30.7	35.0
5th ,,	28.6	33.6	30.7	31.4	27.7	33.6	27.5	35.8	28.6	32.5	30.2	35.0
6th ,,	28.4	33.1	31.0	32.7	27.6	32.2	27.5	35.3	28.9	31.6	29.3	35.9

NOTE: (1) 1960 excluded

Table XIV. Evolution of 1963 crop — Production data at weekly intervals

	Island	West	North	East	South	Centre	*Island*	West	North	East	South	Centre	*Island*	West	North	East	South	Centre	*Island*	West	North	East	South	Centre
	6th July						*13th July*						*20th July*						*27th July*					
Cane crushed (1000 m. tons)	253	—	—	94	145	14	451	16	10	145	240	40	719	32	65	204	338	80	1,023	50	148	265	440	120
Sugar manufactured % cane	9.77	—	—	9.89	9.64	10.32	10.04	11.3	10.42	10.06	9.83	10.72	10.21	11.31	10.23	10.16	9.97	10.89	10.37	11.44	10.38	10.31	10.11	11.04
Sugar manufactured (1000 m. tons)	24.7	—	—	9.3	14.0	1.4	45.3	1.8	1.1	14.6	23.6	4.2	73.5	3.6	6.6	20.8	33.7	8.8	106.0	5.7	15.3	27.3	44.4	13.3
	3rd August						*10th August*						*17th August*						*24th August*					
Cane crushed (1000 m. tons)	1,283	65	220	316	527	155	1,595	85	306	374	633	197	1,851	100	377	424	719	231	2,158	120	464	480	822	272
Sugar manufactured % cane	10.52	11.62	10.51	10.45	10.24	11.17	10.67	11.85	10.67	10.57	10.41	11.33	10.80	11.96	10.79	10.67	10.51	11.46	10.94	12.09	10.96	10.81	10.63	11.58
Sugar manufactured (1000 m. tons)	134.9	7.6	23.0	33.0	54.0	17.3	170.2	10.1	32.5	39.5	65.8	22.3	199.9	12.0	40.7	45.2	75.5	26.5	236.1	14.5	50.8	52.0	87.3	31.5
	31st August						*7th September*						*14th September*						*21st September*					
Cane crushed (1000 m. tons)	2,444	138	536	538	921	313	2,749	156	626	597	1,016	354	3,053	175	715	654	1,114	395	3,347	194	801	709	1,208	435
Sugar manufactured % cane	11.08	12.21	11.11	10.94	10.76	11.70	11.2	12.31	11.27	11.06	10.85	11.82	11.33	12.39	11.46	11.18	10.97	11.93	11.46	12.47	11.62	11.28	11.07	12.04
Sugar manufactured (1000 m. tons)	270.9	16.8	59.5	58.9	99.1	36.6	307.9	19.3	70.5	66.0	110.2	41.9	346.0	21.7	81.9	73.1	122.2	47.1	383.4	24.1	93.1	80.0	133.8	52.4
	28th September						*5th October*						*12th October*						*19th October*					
Cane crushed (1000 m. tons)	3,639	211	885	765	1,302	476	3,927	229	967	819	1,395	517	4,206	246	1,051	869	1,484	556	4,453	262	1,123	915	1,562	591
Sugar manufactured % cane	11.56	12.54	11.76	11.39	11.18	12.12	11.67	12.59	11.90	11.46	11.27	12.18	11.75	12.64	12.02	11.54	11.35	12.25	11.82	12.70	12.13	11.61	11.40	12.31
Sugar manufactured (1000 m. tons)	420.9	26.5	104.1	87.1	145.5	57.7	458.1	28.8	115.1	93.9	157.3	63.0	494.2	31.0	126.4	100.3	168.4	68.1	526.3	33.3	136.1	106.2	178.0	72.7
	26th October						*2nd November*						*9th November*						*16th November*					
Cane crushed (1000 m. tons)	4,660	274	1,184	955	1,626	621	4,889	290	1,252	999	1,694	654	5,135	306	1,318	1,048	1,771	692	5,342	320	1,383	1,086	1,829	724
Sugar manufactured % cane	11.88	12.73	12.20	11.64	11.49	12.35	11.92	12.76	12.27	11.66	11.51	12.38	11.94	12.78	12.31	11.67	11.53	12.40	11.96	12.77	12.33	11.67	11.55	12.41
Sugar manufactured (1000 m. tons)	553.8	34.9	144.4	111.1	186.7	76.7	582.7	36.9	153.7	116.5	194.6	81.0	613.2	39.0	162.1	122.2	204.1	85.8	639.0	40.8	170.4	126.7	211.4	89.7
	23rd November						*30th November*						*7th December*						*Total crop production (preliminary figs.)*					
Cane crushed (1000 m. tons)	5,542	338	1,420	1,131	1,888	765	5,634	357	1,420	1,171	1,917	769	5,697	374	1,421	1,210	1,923	769	5,747	374	1,421	1,260	1,923	769
Sugar manufactured % cane	11.96	12.72	12.33	11.66	11.55	12.39	11.95	12.68	12.35	11.61	11.54	12.39	11.95	12.66	12.36	11.60	11.54	12.39	11.93	12.66	12.36	11.54	11.54	12.39
Sugar manufactured (1000 m. tons)	662.8	43.0	175.0	131.9	218.1	94.8	673.3	45.2	175.4	136.1	221.3	95.3	680.8	47.3	175.7	140.5	221.9	95.4	685.6	47.3	175.7	145.3	221.9	95.4

Table XV. Evolution of cane quality during 1963 sugar crop

Week Ending	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
6th July	11.67	9.88	—	—	—	—	11.60	9.86	11.67	9.82	11.92	10.32
13th ,,	11.97	10.36	13.29	11.30	11.98	—	11.75	10.17	11.76	10.01	12.42	10.94
20th ,,	12.21	10.50	13.43	11.31	12.06	10.21	11.90	10.42	12.10	10.35	12.59	11.06
27th ,,	12.42	10.74	13.52	11.68	12.15	10.48	12.24	10.82	12.24	10.54	12.82	11.33
3rd August	12.70	11.12	13.89	12.19	12.38	10.80	12.51	11.12	12.70	11.04	13.13	12.64
10th ,,	12.80	11.36	13.94	12.60	12.62	11.12	12.60	11.25	12.64	11.15	13.26	11.85
17th ,,	13.01	11.54	14.01	12.60	12.81	11.30	12.77	11.46	12.85	11.30	13.61	12.22
24th ,,	13.23	11.78	14.29	12.78	13.08	10.67	12.97	11.71	13.12	11.53	13.70	12.35
31st ,,	13.50	12.07	14.45	12.96	13.52	12.00	13.22	11.97	13.38	11.75	13.92	12.52
7th September	13.74	12.33	14.60	13.01	13.86	12.32	13.45	12.23	13.48	11.82	14.07	12.66
14th ,,	13.97	12.56	14.48	13.13	14.36	12.83	13.72	12.42	13.84	12.21	14.22	12.89
21st ,,	14.20	12.68	14.73	13.14	14.49	12.89	13.79	12.19	13.97	13.37	14.40	12.97
28th ,,	14.33	12.82	14.96	13.33	14.78	13.13	13.99	12.66	13.96	12.43	14.33	12.98
5th October	14.46	12.91	14.81	13.25	15.02	13.35	14.11	12.69	14.16	12.50	14.38	13.06
12th ,,	14.55	12.96	14.75	13.38	15.20	13.48	14.06	12.65	14.61	12.50	14.46	13.11
19th ,,	14.54	13.02	14.82	13.49	15.33	13.65	14.00	12.61	14.13	12.50	14.46	13.21
26th ,,	14.51	12.94	14.86	13.38	15.33	13.62	13.80	12.37	14.12	12.45	14.49	13 19
2nd November	14.39	12.81	14.85	13.35	15.17	13.51	13.66	12.14	14.04	12.38	14.30	12.91
9th ,,	14.14	12.53	14.57	13.10	14.98	13.23	13.31	11.72	13.88	12.23	14.20	12.82
16th ,,	13.96	12.43	14.30	12.59	14.76	13.18	13.92	11.56	13.77	12.07	13.83	12.48
23rd ,,	13.58	12.01	13.59	11.84	14.35	12.75	12.58	11.21	13.61	11.78	13.97	12.58
30th ,,	12.74	11.24	13.64	11.99	—	—	12.02	10.67	13.16	11.26	14.17	12.66
7th December	12.50	11.02	13.84	12.33	—	—	12.00	10.52	—	—	—	—

NOTE: *A* = *Sucrose % cane*

B = *Sugar manufactured % cane*

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, 1948 - 1963

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
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
1958	131	232.2	131	13.7	109	68.2	142	42.9	142	76.4	135	30.9
1959	134	248.4	127	15.5	106	71.8	152	46.7	148	79.4	136	35.1
1960	113	148.3	110	10.5	116	43.9	123	29.5	118	46.2	81	18.2
1961	150	230.2	147	13.6	126	66.2	160	44.6	165	72.2	154	33.6
1962	140	231.4	158	12.9	136	66.9	159	42.2	141	78.8	111	30.6
1963	153	263.3	160	16.3	132	75.4	174	50.6	156	86.0	154	34.9

Table XVII. Summary of chemical control data 1963

(i) CANE CRUSHED AND SUGAR PRODUCED

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney
CRUSHING PERIOD	From	5/7	12/7	19/7	6/7	11/7	12/7	20/7	26/6	24/6	19/6	26/6
	To	9/12	23/11	29/11	21/11	19/11	5/11	23/11	22/11	19/12	13/12	6/12
	No. of crushing days	130	109	108	113	106	95	105	124	150	149	138
	No. of crushing hours per day	20.88	22.44	23.15	21.04	21.63	22.72	21.32	20.10	21.03	21.10	17.84
	Hours stoppage per day	1.37	1.02	0.78	0.54	1.08	0.66	0.72	0.52	1.58	0.58	0.60
	Overall time Efficiency	93.8	95.7	96.8	97.5	95.3	97.1	96.7	97.4	93.0	97.3	96.7
CANE CRUSHED (Metric Tons)	Factory	189,285	52,510	66,414	125,076	128,784	73,397	170,306	99,622	448,473	211,592	78,319
	Planters	184,347	172,013	144,439	67,388	155,621	147,159	118,236	145,407	251,677	102,839	63,983
	Total	373,632	224,523	210,853	192,464	284,405	220,556	288,542	245,029	700,150	314,431	142,302
	Factory % Total	50.7	23.4	31.5	65.0	45.3	33.5	59.0	40.7	64.1	67.3	55.0
	Per day	2,874	2,060	1,952	1,703	2,683	2,322	2,748	1,976	4,668	2,110	1,031
	Per hour actual crushing	137.8	91.8	84.3	81.0	124.1	105.3	128.9	98.3	221.9	100.8	57.8
VARIETIES CRUSHED (Factory)	M.134/32 per cent	11.5	16.9	22.8	11.9	43.3	1.8	22.4	6.1	3.7	2.0	0.8
	M. 147/44 per cent	27.9	37.5	44.3	37.6	34.4	53.7	56.2	59.4	24.5	32.7	36.2
	M. 202/46 per cent	9.8	16.5	6.8	6.1	1.0	4.5	0.3	8.5	8.7	6.4	5.3
	M. 93/48 per cent	0.9	3.3	0.6	—	1.4	0.4	0.4	0.2	9.6	2.9	3.9
	Ebène 1/37 per cent	—	0.7	2.0	8.6	0.7	—	0.9	5.7	29.3	16.8	12.2
	Ebène 50/47 per cent	1.5	—	0.3	4.5	0.6	—	0.5	0.3	4.1	1.4	2.3
	B. 3337 per cent	—	—	—	—	—	—	—	—	5.7	1.9	8.0
	B. 37172 per cent	12.9	19.5	7.7	15.4	10.1	33.6	14.0	13.4	5.3	21.0	11.7
	Other varieties	35.5	5.6	15.5	15.9	8.5	6.0	5.3	6.4	9.1	14.9	19.7
SUGAR PRODUCED (Metric tons)	Raw Sugar	47,340	27,167	26,589	23,658	36,238	19,903	35,686	28,487	81,335	35,494	7,773
	White Sugar	—	—	—	—	—	6,344	—	—	—	—	7,438
	Total Sugar	47,340	27,167	26,589	23,658	36,238	26,247	35,686	28,487	81,335	35,494	15,211
	Tons Sugar 96° Pol.	48,593	28,001	27,307	24,309	37,249	27,093	36,636	29,308	83,436	36,529	15,711

		Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CRUSHING PERIOD	From	20/6	17/6	28/6	29/6	17/6	28/6	1/7	1/7	28/6	12/6	6/7	1/7	—
	To	22/11	28/11	20/11	16/11	30/11	27/11	27/11	29/11	3/12	26/11	27/11	25/11	—
	No. of crushing days	129	138	121	117	114	127	125	127	129	114	120	122	123
	No. of crushing hours per day	19.95	17.57	21.47	20.56	21.13	16.89	19.11	21.12	18.83	21.50	22.67	22.55	20.82
	Hours stoppage per day	0.35	0.58	0.37	0.57	0.56	0.18	0.42	0.66	3.11	0.73	0.29	1.04	0.88
	Overall time Efficiency	99.2	94.5	98.3	97.3	97.3	99.0	97.8	97.0	87.0	96.7	98.7	95.6	95.9
CANE CRUSHED (Metric Tons)	Factory	204,625	203,565	201,405	142,177	161,515	124,344	201,011	53,852	82,398	128,058	134,837	235,640	3,517,205
	Planters	33,825	44,725	69,416	68,912	27,196	2,006	173	80,359	78,787	84,015	75,109	111,837	2,229,469
	Total	238,450	248,290	270,821	211,089	188,711	126,350	201,184	134,211	161,185	212,073	209,946	347,477	5,746,674
	Factory % Total	85.8	82.0	74.4	67.4	85.6	98.4	99.9	40.1	51.1	60.4	64.2	67.8	61.2
	Per day	1,848	1,799	2,238	1,804	1,655	995	1,609	1,057	1,249	1,860	1,750	2,848	2,036
	Per hour actual crushing	95.0	102.4	104.3	87.8	78.3	58.9	84.2	50.0	66.4	86.6	77.2	126.3	97.8
VARIETIES CRUSHED (Factory)	M.134/32 per cent	0.7	8.1	22.4	0.3	1.9	7.8	19.8	3.6	20.2	4.2	—	1.8	9.3
	M. 147/44 per cent	41.7	24.6	25.6	6.4	22.0	20.2	22.0	40.4	34.0	22.7	2.4	15.9	28.9
	M. 202/46 per cent	3.7	4.9	3.5	8.2	3.4	4.2	10.6	5.1	6.4	7.2	1.7	4.1	5.9
	M. 93/48 per cent	2.3	2.5	4.2	16.4	17.1	3.6	2.5	2.5	3.8	5.4	3.8	5.0	4.7
	Ebène 1/37 per cent	16.2	21.6	15.2	38.5	25.6	5.7	16.2	10.7	4.8	27.7	41.7	55.6	19.1
	Ebène 50/47 per cent	1.2	4.9	2.6	1.0	1.6	2.5	4.8	1.9	1.0	4.7	36.3	12.5	4.4
	B. 3337 per cent	12.4	1.4	2.5	24.8	22.2	1.2	5.3	4.9	1.8	15.0	9.2	3.6	5.6
	B. 37172 per cent	16.9	9.2	16.8	0.3	—	40.8	4.6	19.0	17.1	3.2	-	—	11.0
	Other varieties	4.9	22.8	7.2	4.1	6.2	14.0	14.2	11.9	10.9	9.9	4.9	1.5	11.1
SUGAR PRODUCED (Metric tons)	Raw Sugar	26,110	30,280	32,390	24,860	21,380	8,235	23,123	15,444	18,541	25,300	26,894	43,155	665,382
	White Sugar	.		—	—	—	6,359	—	-	—	-	—	—	20,141
	Total Sugar	26,110	30,280	32,390	24,860	21,380	14,594	23,123	15,444	18,541	25,300	26,894	43,155	685,523
	Tons Sugar 96° Pol.	26,891	31,079	33,241	25,546	21,995	15,071	23,757	15,906	19,046	26,049	27,636	44,339	704,728

Table XVII. Summary of chemical control data 1963

(ii) CANE, BAGASSE, AND JUICES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Felix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE/SUGAR RATIO	Tons cane per ton sugar made	7.9	8.3	7.9	8.1	7.9	8.4	8.1	8.6	8.6	8.9	9.4	9.1	8.2	8.4	8.5	8.8	8.7	8.7	8.6	8.7	8.4	7.8	8.1	8.4
	,, ,, ,, ,, ,, of 96° Pol	7.7	8.0	7.7	7.9	7.6	8.1	7.9	8.4	8.4	8.5	9.1	8.8	8.4	8.1	8.3	8.6	8.4	8.5	8.4	8.5	8.1	7.6	8.0	8.2
CANE	Sucrose per cent	14.26	13.94	14.15	13.66	14.34	13.88	13.81	13.10	12.86	12.87	12.78	12.62	13.81	13.51	13.19	12.69	13.32	12.96	13.44	13.37	13.41	14.21	13.78	13.47
	Fibre per cent	13.76	13.65	14.08	12.64	12.76	15.08	13.69	14.17	13.05	13.02	13.86	14.15	12.06	13.61	12.88	13.32	13.27	11.88	12.92	12.61	12.47	11.04	11.65	13.11
BAGASSE	Pol per cent	2.50	2.30	2.31	1.91	2.28	1.94	1.79	2.28	1.86	1.61	2.30	1.59	2.21	2.24	2.58	2.05	2.09	1.85	2.41	2.03	2.10	2.21	2.01	2.08
	Moisture per cent	49.40	48.25	45.37	46.85	48.13	50.28	47.81	46.40	50.20	46.90	46.00	47.77	48.49	47.50	49.58	47.40	46.01	49.11	46.90	48.60	51.25	50.10	48.25	48.38
	Fibre per cent	47.16	48.63	51.33	50.36	48.69	47.13	49.82	50.51	47.20	50.76	50.83	50.20	48.45	49.60	47.12	49.71	51.12	48.12	49.98	48.60	45.94	46.88	49.05	48.76
	Weight per cent cane	29.2	28.1	27.4	25.1	26.2	32.0	27.5	28.1	27.7	25.7	27.3	28.2	24.9	27.5	27.3	26.8	26.0	24.7	25.9	25.9	27.2	23.6	23.8	26.9
1st EXPRESSED JUICE	Brix (B_1)	20.30	20.39	20.33	19.24	20.41	20.51	19.59	19.15	18.59	18.70	18.35	18.12	19.46	18.99	18.23	17.63	18.59	18.09	17.17	18.21	18.87	19.10	18.66	18.99
	Gravity Purity	88.2	88.3	88.0	90.2	89.1	89.7	88.7	88.1	86.4	87.7	87.0	88.4	88.2	88.6	89.9	89.9	89.0	88.7	87.3	87.9	89.6	91.1	89.7	88.7
	Reducing sugar/sucrose ratio	2.6	3.8	3.3	3.3	2.4	2.6	2.8	4.7	3.1	2.9	3.6	3.1	2.8	3.3	2.5	4.0	2.4	3.4	2.5	2.7	1.9	2.4	2.3	3.0
LAST EXPRESSED JUICE	Brix	3.12	4.19	3.12	1.91	2.39	3.86	3.18	3.13	4.30	2.83	4.07	3.72	3.57	2.95	3.79	2.37	3.36	1.85	2.76	2.79	2.74	1.98	2.63	3.07
	Apparent Purity	72.6	73.7	70.0	68.4	72.3	74.9	75.5	74.4	71.6	67.0	73.7	76.9	72.7	75.9	78.1	70.9	73.4	67.5	75.7	72.8	74.6	75.2	74.5	73.1
MIXED JUICE	Brix	15.55	16.41	15.33	14.86	14.80	15.42	15.00	13.89	15.24	14.03	13.31	14.31	14.96	14.12	14.11	12.96	13.52	13.90	14.33	13.95	14.57	15.10	14.69	14.65
	Gravity Purity	86.2	85.4	85.4	87.1	86.1	86.5	86.8	85.5	85.0	85.2	84.6	86.0	86.5	86.7	88.4	87.3	86.8	86.4	85.6	85.7	87.4	88.6	87.9	86.3
	Reducing sugar/sucrose ratio	3.1	4.3	4.0	3.7	2.8	3.2	3.5	5.6	3.7	3.4	4.3	3.8	3.3	4.3	3.1	4.1	2.7	4.2	2.8	3.4	2.3	2.7	2.7	3.5
	Gty. Pty. drop from 1st expressed juice	2.0	2.9	2.6	3.1	3.0	3.2	1.9	2.6	1.4	2.5	2.6	2.4	1.7	1.8	1.5	2.6	2.3	2.3	1.7	2.2	1.9	2.5	1.8	2.4
ABSOLUTE JUICE	Brix (B_A)	19.36	19.02	19.47	18.13	19.26	19.02	18.54	17.98	17.55	17.51	17.66	17.16	18.29	18.15	17.23	16.95	17.84	17.20	18.13	17.97	17.65	18.15	17.85	18.10
	B_A/B_1	0.954	0.933	0.958	0.943	0.944	0.947	0.946	0.940	0.944	0.936	0.960	0.947	0.940	0.956	0.950	0.961	0.959	0.951	—	0.987	0.935	0.950	0.957	0.953
	Gravity Purity	85.4	84.8	84.6	86.3	85.4	85.9	86.3	84.9	84.3	84.4	84.0	85.6	85.9	86.1	87.8	86.4	86.1	85.5	85.1	85.1	86.8	88.0	87.4	85.7
CLARIFIED JUICE	Brix	15.18	15.77	14.54	14.60	14.64	14.70	14.91	13.62	14.68	13.69	13.22	13.77	14.61	14.45	13.96	13.54	13.62	13.93	14.26	14.59	14.58	14.84	14.29	14.35
	Gravity Purity	—	—	85.1	87.3	87.0	86.7	—	86.2	85.4	85.5	85.0	87.2	86.8	86.9	—	87.7	86.5	—	85.8	86.4	88.4	89.0	88.0	86.7
	Reducing sugar/sucrose ratio	3.2	4.2	4.4	3.7	2.9	3.2	—	5.5	3.7	3.4	4.3	3.5	2.9	4.1	3.3	5.0	2.6	3.8	2.7	3.0	2.2	3.1	2.7	3.5

Table XVII. Summary of chemical control data 1963

(iii) FILTER CAKE, SYRUP, pH, FINAL MOLASSES, SUGAR

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney
FILTER CAKE	Sucrose per cent	1.20	1.62	1.74	1.74	1.85	1.57	1.40	1.70	0.63	1.40	7.30
	Weight per cent cane	3.0	3.0	4.4	3.0	3.3	4.2	3.2	3.3	3.3	3.4	1.9
SYRUP	Brix	61.5	60.6	56.4	63.1	61.7	67.2	59.2	60.7	60.3	55.2	57.9
	Gravity Purity	—	—	85.6	86.7	86.5	—	—	85.8	85.2	85.7	84.6
	Reducing sugar/sucrose ratio	3.3	3.9	4.3	4.2	3.2	2.7	—	4.5	3.3	3.5	4.4
pH VALUES	Limed juice	7.8	—	7.8	8.1	7.9	-	—	8.3	8.5	8.0	8.0
	Clarified juice	6.9	7.0	6.9	6.8	7.1	—	7.1	6.8	7.0	7.0	6.9
	Filter Press juice	—	—	8.8	—	7.5	—	—	6.7	7.7	8.2	—
	Syrup	—	—	6.5	6.4	6.6	—	—	6.5	6.8	6.8	6.8
FINAL MOLASSES	Brix	99.6	98.9	97.3	96.1	98.2	94.7	96.2	94.8	97.2	95.4	95.4
	Sucrose per cent	34.5	34.3	33.1	34.2	35.1	35.3	33.9	30.7	34.3	34.5	32.6
	Reducing sugar per cent	15.1	16.7	17.7	15.6	13.2	9.9	16.8	20.0	12.4	15.1	16.7
	Total sugars	49.6	51.0	50.8	49.8	48.3	47.7	50.7	50.7	46.7	49.6	49.3
	Gravity Purity	34.7	34.7	34.0	35.6	35.7	37.2	35.3	32.4	35.4	36.2	34.1
	Reducing sugar/sucrose ratio	43.7	48.7	53.4	45.6	37.5	28.0	49.4	65.1	36.2	43.6	51.3
	Weight per cent cane at 95° Brix	2.68	3.30	3.06	2.37	2.62	3.09	2.80	2.67	2.50	2.94	3.02
SUGAR MADE	White sugar recovered per cent cane	—	—	—	—		2.88	—	—	—	—	5.23
	Raw ,, ,, ,, ,,	12.67	12.10	12.61	12.29	12.74	9.02	12.37	11.63	11.62	11.29	5.46
	Total ,, ,, ,, ,,	12.67	12.10	12.61	12.29	12.74	11.90	12.37	11.63	11.62	11.29	10.69
	Average Pol. of sugars	98.54	98.95	98.59	98.64	98.68	99.07	98.56	98.77	98.48	98.80	99.16
	Total sucrose recovered per cent cane	12.49	11.97	12.43	12.13	12.57	11.79	12.19	11.48	—	11.15	10.69
	Moisture content of raw sugar per cent	0.28	0.28	0.36	0.40	0.37	—	0.37	0.28	0.35	0.30	0.28
	Dilution indicator	23.7	36.4	34.3	41.6	38.9	—	34.5	29.3	29.9	33.3	26.7

		Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Sucrose per cent	0.91	2.45	2.89	7.94	2.94	1.19	2.13	7.68	8.20	8.50	5.22	2.27	2.28
	Weight per cent cane	4.4	3.8	2.2	1.5	2.9	3.0	2.3	2.0	2.4	2.0	1.7	4.0	3.1
SYRUP	Brix	58.0	64.2	58.9	71.6	65.6	58.9	58.6	58.5	59.8	58.9	60.8	65.2	61.4
	Gravity Purity	87.1	86.8	87.0	—	87.6	86.3	—	85.9	86.4	88.2	88.9	87.9	86.6
	Reducing sugar/sucrose ratio	3.6	2.8	2.6	2.7	5.3	2.4	3.7	2.3	2.8	2.3	3.2	2.9	3.4
pH VALUES	Limed juice	8.3	8.1	8.0	7.6	8.0	8.2	7.6	—	7.5	8.4	8.0	7.5	8.0
	Clarified juice	7.0	7.2	7.0	7.0	7.1	6.9	7.0	6.8	6.9	7.3	7.0	6.9	7.0
	Filter Press juice	8.7	7.8	6.7	7.0	—	6.8	6.6	—	—	8.3	7.9	8.0	7.6
	Syrup	6.8	6.8	6.7	—	7.0	6.3	6.7	—	6.9	7.1	6.6	6.8	6.7
FINAL MOLASSES	Brix	95.0	95.3	96.4	95.7	93.7	99.3	94.0	94.0	95.4	97.5	94.2	94.7	96.7
	Sucrose per cent	34.5	32.0	34.2	33.6	33.6	36.7	35.9	34.4	35.9	34.6	34.1	35.1	34.2
	Reducing sugar per cent	12.2	15.8	13.2	14.6	18.7	12.2	13.1	13.1	12.1	11.8	15.0	14.1	14.5
	Total sugars	46.7	47.8	47.4	48.2	52.3	48.9	48.9	47.5	47.9	46.5	49.1	49.2	48.7
	Gravity Purity	36.3	33.6	35.5	35.1	35.9	37.0	38.1	36.6	37.6	37.1	36.2	37.0	35.3
	Reducing sugar/sucrose ratio	35.3	49.5	38.6	43.5	55.6	30.9	30.4	38.0	33.6	34.1	43.9	40.2	42.4
	Weight per cent cane at 95° Brix	2.81	2.48	2.53	2.00	2.41	2.77	2.47	2.74	2.79	2.13	2.31	2.43	2.72
SUGAR MADE	White sugar recovered per cent cane	—	—	—			5.03	—	-	—	—		—	0.35
	Raw ,, ,, ,, ,,	10.95	12.20	11.96	11.78	11.33	6.52	11.49	11.50	11.50	11.93	12.81	12.42	11.58
	Total ,, ,, ,, ,,	10.95	12.20	11.96	11.78	11.33	11.55	11.49	11.50	11.50	11.93	12.81	12.42	11.93
	Average Pol. of sugars	98.87	98.53	98.52	98.65	98.76	99.14	98.63	98.87	98.61	98.84	98.65	98.63	98.69
	Total sucrose recovered per cent cane	10.83	12.02	11.78	11.62	11.19	11.45	11.34	11.37	11.34	11.79	12.64	12.25	11.77
	Moisture content of raw sugar per cent	0.32	0.37	0.25	0.32	0.33	0.35	0.40	0.22	0.42	0.32	0.36	0.37	0.35
	Dilution indicator	39.3	33.5	20.5	30.6	36.3	38.3	41.7	24.1	43.2	37.4	36.5	37.0	36.5

Table XVII. Summary of chemical control data 1963

(iv) MASSECUITES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MAGMA	Apparent Purity	78.6	88.3	85.3	81.2	–	82.9	82.2	78.6	80.1	81.2	88.5	83.3	85.1	90.5	76.9	82.2	80.9	81.2	83.8	—	80.8	83.5	–	82.8
A—MASSECUITE	Brix	94.3	94.8	94.8	93.0	95.1	93.3	95.1	94.9	94.4	94.6	92.9	94.1	95.4	93.1	93.6	95.0	94.0	93.7	94.0	94.3	95.0	93.9	94.1	94.3
	Apparent Purity	83.9	83.0	83.6	84.8	83.2	82.8	80.4	79.3	81.4	82.6	84.0	85.6	84.1	81.8	86.9	83.2	85.9	86.3	84.8	83.1	81.8	85.6	81.6	83.0
	,, ,, of A—Molasses	68.6	62.4	64.1	64.3	63.2	62.2	58.6	57.0	64.0	56.3	63.9	64.0	60.5	62.8	64.6	58.0	69.7	68.6	63.0	61.7	63.7	61.4	60.3	62.7
	Drop in Purity	15.3	20.6	19.5	20.5	20.0	20.6	21.8	22.3	17.4	26.3	20.1	21.6	23.6	19.0	22.3	25.2	16.2	17.7	21.8	21.4	18.1	24.2	21.3	20.3
	Crystal per cent Brix in massecuite	48.7	54.8	54.3	57.4	54.3	54.5	52.7	51.9	48.3	60.2	–	60.0	59.7	51.1	63.0	60.0	53.3	56.4	58.9	55.9	49.9	62.7	53.7	54.4
	Cubic feet per ton Brix in Mixed Juice	30.4	26.1	25.4	25.3	29.9	34.3	33.5	30.2	32.7	24.0	27.8	22.8	25.6	31.3	30.3	25.6	31.8	26.0	21.1	27.0	27.3	22.6	33.1	28.6
	A—Massecuite per cent total massecuite	59.3	53.8	57.6	50.3	66.4	64.5	64.4	61.4	68.2	49.3	45.8	48.8	58.4	58.6	58.2	55.2	53.0	50.4	45.9	56.2	65.0	53.1	67.1	58.8
B—MASSECUITE	Brix	96.5	96.0	96.1	95.7	98.8	96.2	95.9	96.5	96.0	96.1	94.5	95.8	97.2	94.7	94.5	96.5	96.0	95.3	94.6	96.7	96.7	95.1	95.1	95.9
	Apparent Purity	72.1	70.3	70.8	74.8	69.4	72.1	71.2	69.5	70.2	69.7	72.3	74.1	69.8	73.1	73.1	67.3	76.3	75.5	74.2	73.2	72.5	72.9	73.7	72.0
	,, ,, of B—Molasses	51.2	50.5	46.7	49.1	46.9	49.8	49.2	46.8	49.8	44.6	55.8	49.7	43.4	53.6	50.1	42.1	58.8	53.8	51.5	53.6	49.4	48.2	51.9	49.8
	Drop in purity	20.9	19.8	24.1	25.7	22.5	22.3	22.0	22.7	20.4	25.1	16.5	24.4	26.4	19.5	23.0	25.2	17.4	21.7	22.7	19.6	23.1	24.7	21.8	22.2
	Crystal per cent Brix in massecuite	42.8	40.0	45.2	50.5	42.4	44.4	43.4	42.7	40.6	45.3	—	45.8	46.6	42.0	46.1	43.5	42.3	47.0	46.8	42.3	45.7	47.7	45.3	44.2
	Cubic feet per ton Brix in Mixed Juice	12.8	11.8	11.0	16.0	7.6	10.0	10.2	11.7	8.6	12.5	19.7	14.3	10.9	12.8	12.5	13.8	15.5	17.1	15.2	12.3	8.4	12.0	9.7	11.7
	B—Massecuite per cent total Massecuite	24.8	24.3	24.8	31.9	16.9	18.8	19.6	23.9	17.9	25.8	32.6	30.5	24.8	24.0	24.1	29.7	25.8	33.2	33.1	25.5	20.0	28.1	19.6	24.0
	Kgs. Sugar per cubic foot of A & B Massecuite	18.7	20.5	21.9	22.6	21.2	17.5	18.0	19.1	19.4	21.1	15.7	20.8	21.7	18.2	19.5	20.7	16.6	18.4	21.5	19.6	22.8	24.0	19.2	19.8
C—MASSECUITE	Brix	98.9	100.7	100.3	98.9	101.5	98.7	99.8	99.6	99.2	99.3	99.9	98.5	100.5	100.1	98.6	99.0	100.6	99.8	98.0	98.2	100.0	98.3	100.5	99.5
	Apparent Purity	56.5	56.3	53.5	54.6	57.7	58.3	55.7	54.1	54.9	55.5	57.7	56.6	55.5	57.9	56.1	51.3	61.7	56.6	58.5	58.9	56.4	60.5	57.1	56.6
	,, ,, of final Molasses	34.7	31.6	27.8	32.8	32.4	35.8	33.1	28.9	32.8	31.4	31.1	33.5	28.0	29.9	30.2	35.9	33.2	35.0	32.9	35.1	34.8	30.9	32.6	32.3
	Drop in Purity	21.8	24.7	25.7	21.8	25.3	22.5	22.7	25.2	22.1	24.1	26.6	23.1	27.5	28.0	25.9	15.4	28.6	21.6	25.6	23.8	21.6	29.6	24.5	24.3
	Crystal per cent Brix in massecuite	33.4	36.1	35.6	32.4	37.4	35.0	33.9	35.4	33.9	35.1	—	34.7	38.2	39.9	37.1	56.9	42.7	33.2	38.2	36.7	33.1	42.8	36.4	35.9
	Cubic feet per ton Brix in Mixed Juice	8.1	10.7	7.7	9.0	7.5	8.9	8.4	7.0	6.7	12.1	13.3	9.7	7.4	9.3	9.2	7.0	12.7	8.5	9.6	8.8	6.3	8.0	6.6	8.4
	C—Massecuite per cent total massecuite	15.9	21.9	17.6	17.8	16.7	16.7	16.0	14.6	13.9	24.9	21.6	20.7	16.8	17.4	17.7	15.1	21.2	16.4	21.0	18.3	15.0	18.8	13.3	17.3
TOTAL MASSECUITE	Cubic feet per ton Brix in Mixed Juice	51.3	48.6	44.1	50.3	45.1	54.0	52.1	48.9	47.9	48.6	60.8	46.7	43.9	50.2	52.0	46.3	59.9	51.6	45.9	48.0	41.9	42.5	49.3	48.7
	,, ,, ,, ,, sugar made	63.6	62.5	55.3	53.9	56.5	69.6	64.5	61.3	60.0	63.0	81.7	60.3	55.1	66.4	62.3	56.9	76.5	65.1	59.7	62.6	51.6	51.3	60.1	61.1

Table XVII. Summary of chemical control data 1963

(v) MILLING WORK, SUCROSE LOSSES AND BALANCE RECOVERIES

		Medine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Benarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MILLING WORK	Imbibition water % cane	30.1	22.8	30.6	27.0	34.1	31.4	29.8	32.9	23.1	29.8	35.2	27.0	27.3	32.8	27.4	34.2	34.9	28.9	30.4	33.3	27.9	25.9	26.7	29.0
	,, ,, % fibre	219	167	217	213	267	208	218	232	177	229	254	191	226	241	213	257	263	243	234	264	224	234	230	221
	Extraction ratio	37.1	34.0	31.8	27.7	32.8	29.8	26.0	34.6	30.6	24.7	35.4	25.2	33.3	33.8	41.5	32.3	30.6	29.6	36.3	30.9	33.7	33.2	29.8	31.7
	Mill extraction	94.9	95.4	95.5	96.5	95.8	95.5	96.4	95.1	96.0	96.8	95.1	96.4	96.0	95.4	94.7	95.7	95.9	96.5	95.3	96.1	95.8	96.3	96.5	95.8
	Reduced mill extraction	95.4	95.8	96.1	96.5	95.9	96.4	96.8	95.8	96.2	96.9	95.6	96.9	95.8	95.8	94.8	96.0	96.2	96.3	95.5	96.1	95.8	95.8	96.2	96.0
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.73	0.65	0.63	0.48	0.60	0.62	0.49	0.64	0.51	0.42	0.63	0.45	0.55	0.62	0.71	0.55	0.54	0.46	0.63	0.53	0.57	0.52	0.48	0.56
	,, ,, in filter cake % cane	0.04	0.05	0.08	0.05	0.06	0.07	0.05	0.06	0.02	0.05	0.14	0.04	0.09	0.06	0.12	0.09	0.04	0.05	0.15	0.20	0.17	0.09	0.09	0.07
	,, ,, in molasses % cane	0.88	1.09	0.99	0.80	0.89	1.09	0.94	0.82	0.84	1.01	0.98	0.97	0.79	0.85	0.67	0.82	0.97	0.90	0.95	1.00	0.75	0.79	0.86	0.89
	Undetermined losses % cane	0.12	0.18	0.02	0.21	0.22	0.31	0.14	0.09	0.05	0.24	0.43	0.33	0.36	0.20	0.07	0.04	0.32	0.21	0.34	0.30	0.13	0.17	0.10	0.18
	Industrial losses % cane	1.04	1.32	1.09	1.06	1.17	1.47	1.13	0.97	0.91	1.30	1.55	1.34	1.24	1.11	0.86	0.95	1.33	1.16	1.44	1.50	1.05	1.05	1.05	1.14
	Total losses % cane	1.77	1.96	1.72	1.54	1.77	2.09	1.62	1.61	1.42	1.72	2.18	1.79	1.79	1.73	1.57	1.50	1.87	1.62	2.07	2.03	1.62	1.57	1.53	1.70
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	5.11	4.64	4.48	3.51	4.16	4.47	3.56	4.88	3.99	3.26	4.90	3.57	3.98	4.59	5.35	4.33	4.06	3.52	4.69	3.96	4.24	3.66	3.47	4.16
	,, ,, filter cake % sucrose in cane	0.28	0.36	0.54	0.37	0.42	0.50	0.33	0.46	0.16	0.39	1.09	0.31	0.66	0.45	0.92	0.71	0.27	0.39	1.11	1.50	1.24	0.63	0.66	0.52
	,, ,, molasses % sucrose in cane	6.17	7.82	7.00	5.86	6.18	7.85	6.79	6.26	6.52	7.85	7.67	7.69	5.72	6.29	5.08	6.46	7.30	6.91	7.07	7.48	5.62	5.56	6.21	6.60
	Undetermined losses % sucrose in cane	0.84	1.26	0.12	1.54	1.58	2.24	1.07	0.69	0.39	1.86	3.40	2.63	2.61	1.48	0.54	0.32	2.42	1.62	2.53	2.24	0.93	1.20	0.75	1.33
	Industrial losses % sucrose in cane	7.29	9.44	7.66	7.76	8.18	10.59	8.19	7.40	7.07	10.10	12.16	10.63	8.99	8.22	6.54	7.49	9.99	8.92	10.71	11.22	7.79	7.34	7.62	8.45
	Total losses % sucrose in cane	12.40	14.08	12.14	11.27	12.34	15.06	11.75	12.29	11.06	13.36	17.06	14.20	12.97	12.81	11.89	11.82	14.04	12.44	15.40	15.18	12.03	11.05	11.09	12.61
RECOVERIES	Boiling house recovery	92.3	90.1	92.0	92.0	91.5	88.9	91.5	92.2	92.6	89.6	87.2	89.0	90.7	91.4	93.1	92.2	89.6	90.6	88.7	88.3	91.9	92.3	92.1	91.2
	Reduced boiling house recovery (Pty M.J.85)	91.1	89.8	91.7	90.5	90.7	87.5	90.2	91.9	92.6	89.4	88.1	88.0	89.4	90.1	90.8	90.5	88.0	89.7	88.1	87.6	89.9	89.4	89.9	90.2
	Overall recovery	87.6	85.9	87.9	88.7	87.7	84.9	88.3	87.7	89.0	86.6	82.9	85.8	87.0	87.2	88.1	88.2	86.0	87.5	84.6	84.8	88.0	88.9	88.9	87.4
	Reduced overall recovery (Pty M.J.85 , F % C 12.5)	86.9	86.0	88.1	87.3	87.0	84.4	87.3	88.0	89.1	86.6	84.2	85.3	85.7	86.3	86.1	86.9	84.6	86.4	84.1	84.2	86.1	85.7	86.5	86.6
	Boiling house efficiency	100.3	98.6	100.4	99.6	99.9	97.4	99.2	99.9	101.9	98.8	87.2	97.4	97.8	99.3	99.6	100.0	98.7	99.7	97.6	97.3	99.9	99.0	99.6	99.3

Table XVIII. Production and utilisation of molasses, 1948 - 1963

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_2O_5	K_2O
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
1957	110,471	72,539	7,796	30,136	157	75	1,549
1958	113,811	59,158	8,435	46,218	240	116	2,376
1959	118,056	59,985	9,632	48,439	252	121	2,490
1960	72,991	45,180	8,871	18,940	98	47	970
1961	139,234	64,633	7,357	67,244	350	168	3,456
1962	122,890	76,800	7,750	38,340	199	96	1,955
1963(1)	149,586	108,740	8,192	32,171(2)	167	80	1,640

(1) *Provisional figures*

(2) *483 tons used in the preparation of animal foodstuff have been deducted*

Table XIX. Importation of inorganic fertilizers, in metric tons, 1950 - 1963

	N	P_2O_5	K_2O
1950	3,990	870	1,930
1951	5,710	1,020	4,080
1952	5,800	1,140	2,960
1953	5,080	560	2,380
1954	4,170	1,110	3,340
1955	5,620	570	3,110
1956	8,870	2,170	3,940
1957	6,900	2,770	4,390
1958	6,210	3,020	4,690
1959	8,500	2,740	5,310
1960	8,170	4,382	5,765
1961	7,462	4,769	4,569
1962	9,467	5,377	6,373
1963	9,762	5,079	6,952

Table XX. Sales of Herbicides, 1962 - 1963

HERBICIDES	1962			1963		
	Quantity		Sales in Rupees	Quantity		Sales in Rupees
	Imperial gallons	Kgs.		Imperial gallons	Kgs.	
MCPA — Metallic Salt	14,897	—	198,187	9,626	—	123,838
2, 4- D Amines	25,118	—	440,647	26,813	—	409,860
2, 4 - D Esters	14,492	—	444,008	9,386	—	312,788
Pentachlorophenol	1,010	—	16,077	969	—	14,523
Sodium Chlorate	—	272,937	349,715	—	276,502	357,866
Sodium Trichloroacetate (TCA)	—	335,595	1,034,933	—	339,981	970,747
Sodium 2,2 dichloro-propionate (Dalapon Basfapon, Unipon)	—	21,933	226,810	—	5,070	48,906
Substituted Ureas DCMU	—	38,279	1,185,000	—	39,915	1,197,315
Substituted Triazines						
Simazine	—	21,432	303,191	—	26,833	388,777
Atrazine	—	—	—	—	2,377	40,144
Unclassified	—	1,000	6,600	339	250	11,287
			4,205,168			3,876,051

Table XXI. Importation of Major Herbicides, 1953 - 1963

YEAR	Inorganic Chemicals		Hormone type		Aliphatic Acid Derivatives		Substituted phenols	Substituted ureas	Substituted Triazines	
	Sodium Chlorate Kgs.	Sodium Arsenite Kgs.	2,4-D; 2,4,5-T M C P A Imp. Gall.	2,4-D; 2,4,5-T M C P A Kgs.	T C A Kgs.	Dalapon Kgs.	P. C. P. Imp. Gall.	D.C.M.U. Kgs.	Simazine Kgs.	Atrazine Kgs.
1953	55,605	—	50,041	2,550	12,488	—	—	—	—	—
1954	66,365	310	49,265	5,600	149,316	—	2,563	—	—	—
1955	81,494	124	49,706	6,125	254,300	—	3,448	—	—	—
1956	92,780	80	48,333	645	181,700	—	3,460	—	—	—
1957	107,961	4,000	36,142	565	163,278	—	1,824	—	—	—
1958	128,835	—	43,150	72	167,096	—	3,528	—	—	—
1959	173,383	7,050	60,261	—	264,389	—	1,534	—	—	—
1960	304,851	6,000	76,629	—	377,063	400	2,641	12 500	568	—
1961	214,301	8,000	59 272	—	363,716	9,553	1,403	30,000	1,812	—
1962	272,937	—	54,507	—	335,595	21,933	1,010	38,279	21,432	—
1963	276,502	—	45,825	—	339,981	5,070	969	39,915	26,833	2,377

Table XXII. Crosses made in 1962 and stored in deep freeze at — 5°C
Sown in November 1963

CROSS		Greenhouse		Field		TOTAL	
		No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
B.37172	x P.T. 43-52	—	—	1	123	1	123
Ebène 1/37	x M.202/46	—	—	3	2559	3	2559
„	x M.92/53	—	—	1	660	1	660
„	x M.99/53	—	—	1	1968	1	1968
„	x 47 R2777	—	—	1	27	1	27
M.134/32	x M.490/54	—	—	1	240	1	240
M.93/48	x M.63/39	—	—	1	495	1	495
M.99/48	x M.202/46	—	—	1	69	1	69
M.305/49	x M. 213/40	1	102	—	—	1	102
M.716/51	x E.1/37	—	—	1	6	1	6
M.232/52	x M.147/44	—	—	1	30	1	30
M.272/52	x M.147/44	—	—	2	279	2	279
M.97/53	x M.147/44	—	—	1	9	1	9
M.98/53	x M.213/40	—	—	1	135	1	135
„	x M.147/44	—	—	1	249	1	249
M.262/54	x M.403/54	1	60	—	—	1	60
M.323/54	x Ebène 1/37	—	—	1	159	1	159
M.376/54	x M.147/44	—	—	1	795	1	795
M.107/55	x M.213/40	2	9	—	—	2	9
M.332/56	x M. 241/40	1	9	—	—	1	9
M.L. 3-18	x M.202/46	—	—	1	60	1	60
P.R. 1000	x 47 R4066	—	—	1	1185	1	1185
Q. 56	x M.147/44	2	51	—	—	2	51
Total ...		7	231	21	9048	28	9279
Not germinated		6	—	2	—	8	—
Discarded		5	17	12	53	17	70
Grand Total ...		18	248	35	9101	53	9349

Table XXIIa. List of 1963 Crosses — Sown in November 1963
Bi-parental crosses

CROSS		Greenhouse		Field		TOTAL	
		No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
B.34104	x M.92/53	—	—	1	270	1	270
B.52298	x M.47/38	1	1368	—	—	1	1368
,,	x M.189/56	1	1248	—	—	1	1248
C.B.41-35	x unknown	1	21	—	—	1	21
Chalain	x 57NG208	—	—	1	2580	1	2580
Co. 281	x M.423/41	—	—	2	129	2	129
,,	x M.41/55	2	999	—	—	2	999
C.P. 48-103	x M.84/35	1	69	—	—	1	69
C.P. 53-18	x B.34104	1	90	—	—	1	90
D.109	x unknown	1	324	—	—	1	324
Ebène 1/37	x B.3337	—	—	1	159	1	159
,,	x M.196/31	—	—	1	420	1	420
Ebène 50/47	x C.T.B.	2	87	—	—	2	87
Ebène 88/56	x M.43/51	2	189	—	—	2	189
,,	x P.T. 43-52	2	441	—	—	2	441
,,	x 47R2777	2	75	—	—	2	75
H. 109	x 57NG208	—	—	1	79	1	79
M.55/1182	x 57NG208	2	318	—	—	2	318
M.33/19	x 57NG208	2	117	—	—	2	117
M.109/26	x 57NG208	3	1299	—	—	3	1299
M.134/32	x C.B. 41-35	2	249	—	—	2	249
,,	x M.92/53	—	—	2	933	2	933
,,	x M.201/59	1	15	—	—	1	15
,,	x P.T. 43-52	—	—	1	135	—	135

CROSS		Greenhouse		Field		TOTAL	
		No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
M.134/32	x Q 58	—	—	1	99	1	99
,,	x 47R4066	2	840	1	108	3	948
,,	x 40SN5819	—	—	1	231	1	231
M.2/33	x P.T. 43-52	1	210	—	—	1	210
M.47/38	x 28NG101	1	51	—	—	1	51
M.213/40	x M. 403/54	1	438	—	—	1	438
M.213/40	x M.490/54	1	360	—	—	1	360
,,	x M.202/59	1	420	—	—	1	420
M.241/40	x M.202/46	—	—	2	780	2	780
,,	x P.T. 43-52	—	—	1	1665	1	1665
,,	x Vesta	—	—	2	3675	2	3675
M.311/41	x M.423/41	—	—	2	192	2	192
,,	x M.81/52	—	—	1	111	1	111
M.147/44	x 47R2777	2	1161	—	—	2	1161
,,	x S.C.12/4	1	129	—	—	1	129
M.31/45	x M.189/56	2	198	—	—	2	198
M.93/48	x Ebène 1/37	—	—	1	387	—	387
,,	x S.C.12/4	—	—	1	24	1	24
M.716/51	x M.213/40	—	—	2	903	2	903
M.127/52	x M.361/56	1	390	—	—	1	390
,,	x 27MQ1124	—	—	1	60	1	60
M.272/52	x Ebène 50/47	1	231	—	—	1	231
,,	x M.92/53	—	—	1	192	1	192
,,	x M. 69/56	2	90	—	—	2	90

CROSS		Greenhouse		Field		TOTAL	
		No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
M.272/52	x M.189/56	2	900	—	—	2	900
M.322/52	x 47R4066	—	—	2	585	2	585
M.85/53	x M.189/56	1	750	—	—	1	750
„	x M.P. 87	1	510	—	—	1	510
M.97/53	x M. 69/56	1	780	—	—	1	780
M.98/53	x C B. 41-35	2	66	—	—	2	66
M.194/54	x M.99/48	2	81	—	—	2	81
„	x M.P. 87	2	150	—	—	2	150
„	x P.T. 43-52	1	1842	—	—	1	1842
„	x 47R2777	1	3150	—	—	1	3150
„	x Senneville	1	60	—	—	1	60
„	x 40SN5819	2	105	—	—	2	105
M.376/54	x C.B. 41-35	1	474	—	—	1	474
„	x D.109	1	120	—	—	1	120
„	x P.T. 43-52	1	390	—	—	1	390
M.518/54	x Ebène 1/37	1	453	—	—	1	453
M.17,55	x M.147/44	1	399	—	—	1	399
„	x M.41/55	2	405	—	—	2	405
M.107/55	x M.490/54	2	351	—	—	2	351
M.117/55	x Ebène 50/47	—	—	2	978	2	978
„	x M.377/41	—	—	1	498	1	498
„	x 47R2777	1	270	—	—	1	270
„	x Vesta	—	—	2	5034	2	5034
M.296/55	x M.43/51	1	432	—	—	1	432

CROSS		Greenhouse		Field		TOTAL	
		No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
M.296/55	x 40 SN 5819	1	231	—	—	1	231
M.340/55	x M.147/44	1	600	—	—	1	600
M.349/55	x P.O.J. 3016	1	684	—	—	1	684
M.351/55	x M.43/51	1	150	—	—	1	150
,,	x M.289/59	1	420	—	—	1	420
M.402/55	x M.147/44	1	51	—	—	1	51
M.212/56	x Ebène 50/47	1	150	—	—	1	150
,,	x M.31/45	2	315	—	—	2	315
M.361/56	x B.34104	1	441	—	—	1	441
,,	x Ebène 50/47	3	1992	—	—	3	1992
,,	x 27MQ1124	1	78	—	—	1	78
M.6/57	x Ebène 1/37	1	780	—	—	1	780
,,	x Ebène 50/47	1	246	—	—	1	246
,,	x M.P. 87	1	735	—	—	1	735
,,	x S.C. 12/4	2	12	—	—	2	12
M.158/57	x M.92/53	1	24	—	—	1	24
M.394/57	x M. 147/44	2	276	—	—	2	276
,,	x M.55/55	1	1080		—	1	1080
,,	x P.T. 43-52	1	165	—	—	1	165
,,	x 47R2777	1	1323	—	—	1	1323
M.563/59	x M.147/44	1	360	—	—	1	360
M.576/59	x C.B.41-35	1	9	—	—	1	9
M.336	x M.213/40	—	—	1	441	1	441
M.L. 3-18	x Ebène 3/48	—	—	1	15	1	15

CROSS	Greenhouse		Field		TOTAL	
	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.	No. Crosses	No. Seedl.
39 MQ 832 x M.213/40	1	621	—	—	1	621
,, x M.55/55	1	615	—	—	1	615
N.50-211 x M.143/41	2	189	—	—	2	189
N.Co.376 x Ebène 1/37	—	—	2	147	2	147
,, x M.423/41	—	—	1	273	1	273
,, x POJ 2878	—	—	1	354	1	354
N.Co.382 x unknown	2	18	—	—	2	18
P.O.J. 2878 x M.69/56	2	1320	—	—	2	1320
Q.50 x M.99/34	2	180	—	—	2	180
,, x M.147/44	1	402	—	—	1	402
Q. 68 x M. 41/55	1	2091	—	—	1	2091
Q. 70 x M.41/55	1	1140	—	—	1	1140
47R2777 x C.B. 45-6	1	30	—	—	1	30
Total ...	110	39843	40	21457	150	61300
Stored in deep freeze for next year	155	—	25	—	180	—
Not germinated	208	—	24	—	232	—
Discarded	128	1551	45	1599	173	3150
Grand Total ...	601	41394	134	23056	735	64450

List of 1963 crosses — Sown in November 1963
Solution crosses*

CROSS			No. of Crosses	No. of Seedlings
B. 52298	x	M.147/44	1	1122
Co. 281	x	C.B. 41-35	2	672
Co. 1208	x	Senneville	1	60
Ebène 1/37	x	C.B. 41-35	1	360
Ebène 3/48	x	Ebène 50/47	1	690
Ebène 50/47	x	M. 147/44	2	390
Eros	x	M. 99/34	2	972
M.112/34	x	C.B. 41-35	2	561
M.241/40	x	C.B. 41-35	3	3384
M.198/51	x	M.147/44	2	1140
M.81/52	x	M.92/53	2	150
M.127/52	x	M. 147/44	1	840
,,	x	47R2777	1	1377
M.272/52	x	Ebène 50/47	1	270
,,	x	M.147/44	1	1728
,,	x	47R2777	1	381
M.382/52	x	M.147/44	1	1602
M.85/53	x	John Bull	1	90
,,	x	M.43/51	1	360
M.97/53	x	M.55/55	1	510
,,	x	P.T. 43-52	2	747
M.194/54	x	John Bull	1	120
M.323/54	x	Ebène 50/47	1	87
M.392/54	x	P.T. 43-52	2	369

* *Parentage of these crosses can be doubtful as some female varieties started giving pollen under the special conditions in the crossing cubicles.*

CROSS			No. of crosses	No. of seedlings
M.516/54	x	M.147/44	1	390
,,	x	M.43/51	1	201
M.518/54	x	Ebène 50/47	1	510
,,	x	M. 92/53	1	480
,,	x	M.376/54	1	210
M.107/55	x	M. 55/55	2	84
M.259/55	x	John Bull	1	51
,,	x	P.T. 43-52	2	1755
M.340/55	x	Ebène 50/47	1	48
M.349/55	x	Ebène 50/47	1	528
M.261/56	x	M.147/44	1	390
M.332/56	x	M.147/44	1	1392
M.361/56	x	M. 99/34	1	735
,,	x	47R2777	1	27
M. 6/57	x	M. 376/54	1	210
,,	x	47R2777	2	2745
M.563/59	x	M 43/51	1	66
M.576/59	x	47R2777	1	210
N.Co.376	x	M. 147/44	1	480
P.O.J. 2878	x	M. 99/34	1	810
Q. 70	x	M.147/44	1	2229
,,	x	M.92/53	2	870
,,	x	P.T. 43-52	1	1215
		Total ...	61	33618
Stored in deep freeze for next year			59	—
Not germinated			83	—
Discarded			95	2269
		Grand Total ...	298	35887

Seedlings produced in 1963

Source	Potted	Discarded	Total
1962 crosses	9279	70	9349
1963 bi-parental crosses ...	61300	3150	64450
1963 solution crosses ...	33618	2269	35887
Total ...	104197	5489	109686

Table XXIII. List of Approved Cane Varieties, 1964

M.134/32
M.134/32 white
M.134/32 striped
*M.112/34
*M.423/41
M.147/44
M.31/45
M.202/46
M.93/48
M.253/48
Ebène 1/37
Ebène 50/47
*B.H.10(12)
B. 3337
B. 34104
B. 37161
B. 37172

* To be uprooted before 31st December, 1969.

10 YEAR TREND IN SUGAR PRODUCTION IN MAURITIUS.