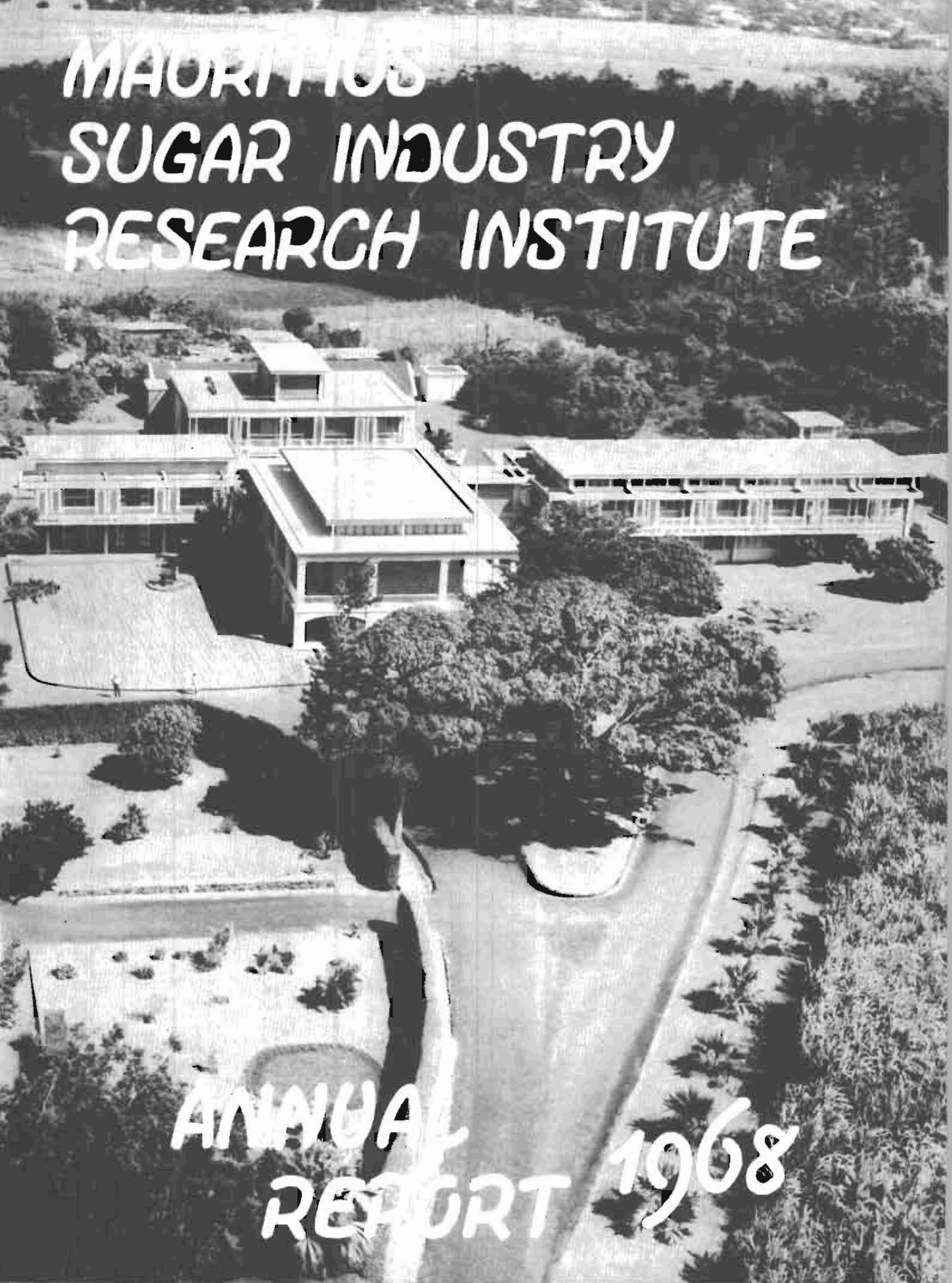
MAURITIUS
SUGAR INDUSTRY
RESEARCH INSTITUTE
ANNUAL
REPORT 1968

MAURITIUS SUGAR INDUSTRY

RESEARCH INSTITUTE

ANNUAL REPORT 1968

Printed by
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Port Louis — Mauritius
1969

CORRIGENDA

Mauritius Sugar Industry Research Institute

Annual Report 1968

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p. 48, Table 12, line 29 *should read :*

iii) Ct^2 is approximately equal to

$\frac{1}{4}(Cb^2 + Cm^2 + 2\,Cbm)$

p. 51, **Discarded Varieties:** *Varieties resistant to gumming disease ; poor performance :*

After M.134/57 *read* M.136/57 instead of M.36/57

Statistical Tables

p. XI Table XIV, Column A, Virgin,

read 36.7 instead of 33.0

p. XXIII Table XXI, Pentachlorophenol,

read 392 instead of 783,
224 instead of 447,
405 instead of 810

CONTENTS

STATISTICAL TABLES

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* *Cover photograph : Headquarters of the Mauritius Sugar Industry Research Institute, Réduit. (Photograph by G. B. Mc Caffery).*

MEMBERS EXECUTIVE BOARD

Mr. J. Espitalier-Noël, *Chairman, representing the Chamber of Agriculture*

Dr. A. Darné, *representing Government, January to August*

Mr. A Mulder, *representing Government, September to December*

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Mr. Y. Rouillard
Mr. J. G. Ducray
} *representing factory owners*

Mr. L. Desvaux de Marigny, *representing large planters*

Mr. G. Beeharry
Mr. R. Googoolye
} *representing small planters*

MEMBERS RESEARCH ADVISORY COMMITTEE

Dr. P. O. Wiehe, C.B.E., *Chairman, January to October*

Mr. R. Antoine, ,, *from November*

Dr. A. Darné, *representing the Department of Agriculture, January to August*

Mr. A. Mulder, *representing the Department of Agriculture, September to December*

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

Mr. A. Harel, *representing the Chamber of Agriculture*

Mr. R. Noël
Mr. L. Lincoln
} *representing the Société de Technologie Agricole et Sucrière*

and the senior staff of the Research Institute.

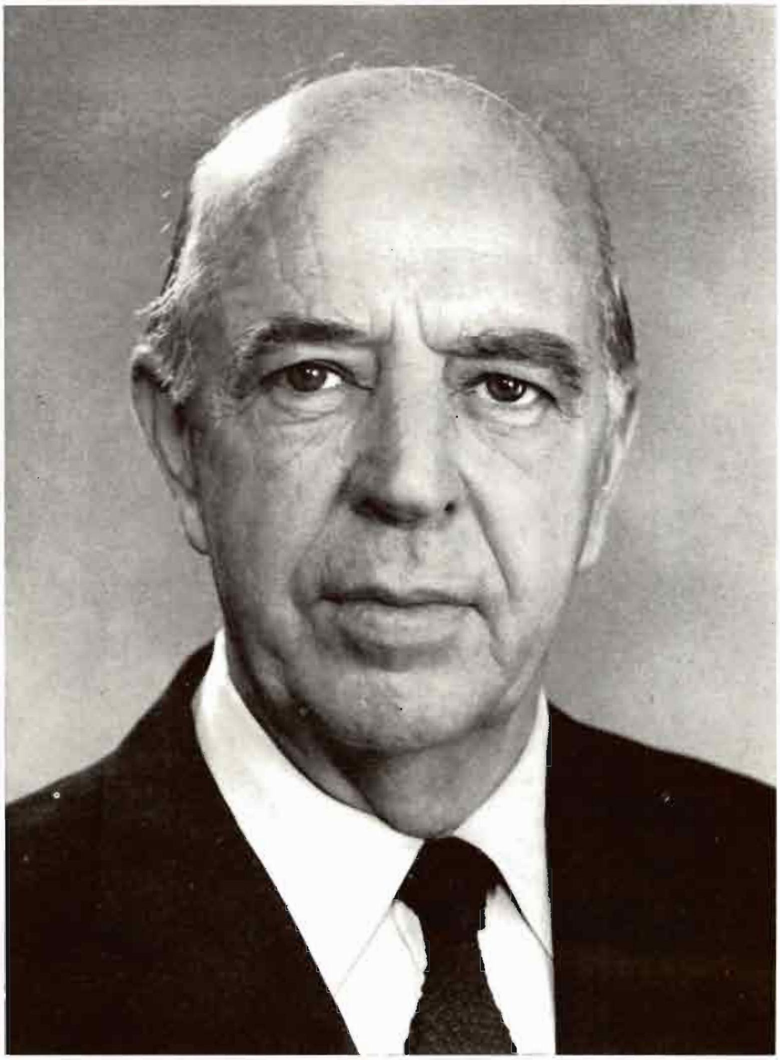
STAFF LIST (as at 31st December 1968)

Director	P. O. Wiehe, C.B.E., D.Sc. (Lond.), A.R.C.S., resigned 31.10.68 *Consultant* as from 1.11.68
	R. Antoine, B.Sc. (Lond.), A.R.C.S., Dip. Agr. Sc. (Cantab.) as from 1.11.68
Asst. Director & Chief Sug. Technologist ...	J. D. de R. de Saint Antoine, B.S. (L.S.U.), Dip. Agr. (Maur.) as from 1.11.68
Chemist	E. C. Vignes, M.Sc. (Lond.), A.R.I.C., Dip. Agr. (Maur.)
Associate Sugar Technologist ...	E. Piat, B.Sc. (Glasgow), Dip. Agr. (Maur.)
Instrument Engineer	F. Le Guen, M.Sc. (Lond.), D.N.C.L., resigned 30.9.68
Senior Asst. Sug. Technologist ...	M. Randabel, Dip. Agr. (Maur.)
Assistant Sugar Technologist ...	S. Marie-Jeanne, Dip. Agr. (Maur.), resigned 1.4.68
Laboratory Assistants ...	L. Le Guen
	M. Abel
Temporary Sugar Technologist ...	A. Bérenger, Dip. Agr. (Maur.)
Chief Agriculturist	G. Rouillard, Dip. Agr. (Maur.)
Senior Field Officers	G. Mazery, Dip. Agr. (Maur.)
	F. Mayer, Dip. Agr. (Maur.)
	M. Hardy, Dip. Agr. (Maur.), *i/c Réduit Expt. Stn & Irrigation.*
	R. Béchet, Dip. Agr. (Maur.), *i/c Belle Rive Expt. Stn* resigned 31.5.68
Field Officers	R. Ng Ying Sheung, Dip. Agr. (Maur.), *i/c Union Park Expt. Stn*
	L. Thatcher, Dip. Agr. (Maur.), *i/c Belle Rive Expt. Stn*
	G. Mc. Intyre, Dip. Agr. (Maur.)
	H. Dove, Dip. Agr. (Maur.), *i/c Pamplemousses Expt. Stn*
Consulting Agronomist ...	P. Halais, Dip. Agr. (Maur.)
Chemist	Y. Wong You Cheong, Ph.D. (Q.U.B.), A.R.I.C.
Assistant Chemists	L. Ross, Dip. Agr. (Maur.)
	P. Y. Chan, B.Sc. (Lond.)
	L. C. Figon
Laboratory Assistants ...	C. Cavalot
	H. Maurice
Chief Entomologist	J. R. Williams, M.Sc. (Bristol), D.I.C., M.I. Biol.
Laboratory Assistant	M. A. Rajabalee
Technical Officer, Food Crops ...	R. Mamet, Dip. Agr. (Maur.), F.R.E.S.

Chief Plant Pathologist	...	R. Antoine, B.Sc. (Lond.), A.R.C.S., Dip. Agr. Sc. (Cantab.), *i/c Plant Breeding & Pathology Divisions.*
Plant Pathologist ...	...	C. Ricaud, Ph.D. (Lond.), D.I.C.
Laboratory Assistant ...	...	S. Sullivan
Field Assistant ...	...	P. Ferré
Biometrician	...	J. A. Lalouette, Dip. Agr. (Maur.)
Plant Breeder ...	...	L. P. Noël, Dip. Agr. (Maur.)
Associate Plant Breeder	...	P. R. Hermelin, Dip. Agr. (Maur.)
Assistant Plant Breeder	...	H. R. Julien, B.Sc. (Reading)
Field Assistant ...	...	S. de Villecourt
Plant Physiologist ...	...	C. Mongelard, M.Sc., Ph. D. (Lond.), D.I.C., M.I. Biol.
Laboratory Assistant ...	...	J. Pitchen
Secretary Accountant ...	...	P. G. du Mée
Asst. Secretary Accountant	...	J. Desjardins
Librarian	...	Miss M. Ly-Tio-Fane, B.A. (Lond.)
Draughtsman-Photographer	...	L. S. de Réland, Grad. N.Y.I.P.
Clerks	...	Mrs. A Baissac
		Mrs. M. T. Rae
		Mrs. J. R. Williams
		Mrs. M. Le Guen, resigned 30.9.68
		Miss P. Julien, appointed 1.12.68

THE MAURITIUS HERBARIUM

Curator	...	R. E. Vaughan, O.B.E., D.Sc. (Lond.). F.R.I.C.
Herbarium Assistant ...	...	J. Guého



P. O. WIEHE C.B.E. D.Sc.

Director 1953 - 1968

REPORT OF THE CHAIRMAN

EXECUTIVE BOARD 1968

IT is my duty in these first lines of my report to pay tribute to Dr. P. O. Wiehe, C.B.E., D.Sc., who resigned as Director on the 31st October to take up his new appointment as Vice-Chancellor of the University of Mauritius.

In 1953, Dr. Wiehe was serving as Plant Pathologist in the Colonial Agricultural Service, Nyasaland, when he agreed to come back to Mauritius and set up the Sugar Research Institute.

Dr. Wiehe's achievements are well known. From a Sugar Cane Research Station almost at a skeletal stage, he created the M.S.I.R.I., an institution which, under his leadership, was soon to occupy a prominent place in the world of sugar research. His international prestige is given recognition in 1959 when he is elected Chairman of the I.S.S.C.T. in Hawaii and the XIth Congress is held in Mauritius three years later.

In the professional field, he is the author of several valuable publications in plant pathology and ecology. He is awarded the D.Sc. by the University of London in 1967 and it pleases Her Majesty the Queen to appoint him Commander of the Most Excellent Order of the British Empire in 1958.

Dr. Wiehe, once more, has taken up a challenge, but this time in the academic field. The task confronting him, at the head of the University of Mauritius, is an arduous one. It is my sincere wish and that of all associated with the Research Institute that Dr. Wiehe will make the University worthy of its motto : *Scientia salus patriae.*

The changes on the Board for 1968 were the replacement of Messrs. L. H. Garthwaite, S. Gaya and S. Bunjun by Messrs. J. G. Ducray, G. Beeharry and R. Googoolye. Dr. Darné was replaced in September by Mr. A. Mulder, the newly appointed Chief Agricultural Officer in the Ministry of Agriculture.

The Board held 13 meetings during the year.

ESTABLISHMENT

As a result of the resignation of Dr. P. O. Wiehe, Mr. R. Antoine, Chief Plant Pathologist, was appointed Director and Mr. J. D. de R. de Saint Antoine, Chief Sugar Technologist, took up the newly created post of Assistant Director, while remaining in charge of the Sugar Technology Division. Both appointments were made to take effect as from 1st November, 1968.

We regret to record the resignation of four other members of the staff in 1968:

Mr. R. Béchet, Senior Field Officer, left for the Republic of South Africa and is now employed in the same capacity by the Experiment Station of the South African Sugar Association.

Mr. S. Marie-Jeanne, Assistant Sugar Technologist, took up employment as Process Superintendent, Chemelil Sugar Factory, Kenya.

Mr. F. Le Guen, Instrument Engineer, left to pursue higher studies in the United Kingdom, so that we also lost Mrs. Le Guen, Clerk-Typist.

As a result of these resignations, Mr. H. Dove was appointed Field Officer in July; Mr. J. Tursan d'Espaignet will assume duty as Instrument Engineer in March 1969, and the other vacancy in the Sugar Technology Division has not yet been filled. Miss P. Julien was appointed Clerk-Typist in December and Mr. P. Ferré, Field Assistant in the Pathology Division in June.

The Board has much pleasure in congratulating Mr. C. Mongelard who has been awarded a Ph.D. by the University of London, Imperial College of Science and Technology.

FINANCE

I have, once again, to lay stress on the inadequate income derived by the Research Institute from the statutory levy on sugar exports, a question which has been raised repeatedly by my predecessors and myself for the last eight years and which is of vital importance to the future of sugar research in Mauritius.

The situation has now reached a critical stage. In the first place, the Institute has never been in a position to build up strategic reserves in a country where the vagaries of climate can and do affect, at times to a considerable extent, the size of the crop with, as a consequence, an inevitable reduction in revenue. Also, with the unavoidable increases in expenditure during the last few years, the Institute has had to restrain the programme of work and thus postpone, through lack of funds, valuable if not essential research projects. Furthermore, the breaking point has now been reached when part of the already insufficient revenue has to be used to pay interests on bank overdrafts which, in 1968, amounted to the substantial sum of Rs. 66,500.

The fact that the Research Institute has been unable during the last few years to secure or retain, in certain fields, the services of technicians of the right calibre to work competently and efficiently, is becoming disheartening.

It should be, once more, pointed out that the Institute has never received the accepted reasonable percentage (1%) of the value of sugar produced which should be invested in research to maintain efficiency in an industry which has to face a highly competitive market. Other comparable Research Institutes derive 1.2% or even 1.5% of that value, whereas the M.S.I.R.I. receives only 0.7%.

The inescapable conclusion to be drawn is that the financial resources of the Institute are grossly inadequate and that the annual levy should be raised to a level commensurate with our present needs.

It would appear that Government is prepared to make a first step in altering, with effect as from 1968, the Ordinance governing the Institute, so that the statutory levy would bear on the total tonnage of sugar produced in any calendar year, instead of the amount of sugar exported, as is the case at present.

Such a measure would lighten the burden to some slight extent, in that an increase in revenue, equivalent to 0.05% of the value of the crop will thus be obtained.

AIME DE SORNAY SCHOLARSHIP

The scholarship was awarded in 1968 to Mr. J.C.L.V.Y. Li Sui Fong who came out third, with 77.7% of the marks, at the entrance examinations of the University of Mauritius, in April.

Mr. K. D. C. Ruhee, who had been awarded the scholarship in 1967 accepted a Government scholarship and, in accordance with the regulations of the University, relinquished the Aimé de Sornay scholarship.

GENERAL

The news of the death of Mr. Adrien Wiehe came as a sad blow to the Research Institute. Mr. Wiehe had been Consulting Sugar Technologist and a member of the Research Advisory Committee for several years. His charming, quiet personality and sound counsels will be sadly missed by all at the Institute.

A Food Crop Research Unit was created during the year and Mr. R. Mamet, formerly Entomologist of the Ministry of Agriculture and, later, of the Ministry of Health, was appointed Technical Officer together with two temporary Field Assistants. The expenses are met by a contribution from the Chamber of Agriculture.

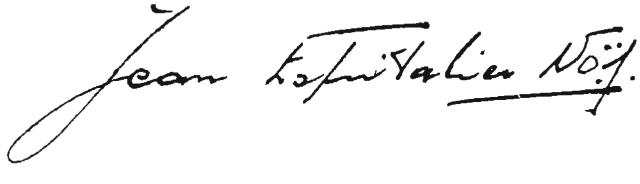
Under the French Technical Assistance Scheme, Mr. A. Heitz has been attached as *Co-opérateur Technique* to the Chemistry Division for a period of two years. Dr. E. Z. Arlidge, Soil Physicist, has been seconded by the F.A.O. to set up a permanent Soil Physics Laboratory at the M.S.I.R.I. I should like to express my gratitude to the French Government and the F.A.O. for their valuable assistance.

PERSONALIA

During 1968, the Institute had the honour of welcoming the following distinguished visitors : Messrs. Frank Judd and John H. Osborne, members of the House of Commons; Professor Robert Debré, *Membre de l'Institut*; M. N. Champion, *Administrateur Civil des Finances*, Paris; Sir Normal Alexander, Adviser to the University of Mauritius; Messrs. Oliver Elliott and David Pritchard of the British Council, and Dr. Matic of the Sugar Milling Research Institute.

ACKNOWLEDGEMENTS

I wish to express my grateful thanks to my Colleagues of the Board who have extended to me their invaluable help and support throughout the year. I would like to thank also our Director, his predecessor, and all the members of his staff for their devotion to duty and the excellent work they have performed during the year under review.



Chairman

28th February 1969

REVENUE AND EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1968

Running & Administrative Expenses ...	1,973,852.03	Cess on Sugar Exported	2,086,024.32
Herbarium Expenses	14,305.49	Miscellaneous Receipts	58,396.36
Interest Paid	66,971.59	Excess of Expenditure over Revenue ...	240,874.48
Leave and Missions Fund	211,025.39		
Depreciation	119,140.66		
Rs.	2,385,295.16	Rs.	2,385,295.16

BALANCE SHEET

AS AT 31st DECEMBER, 1968

ACCUMULATED FUNDS	885,184.22	FIXED ASSETS (at cost less depreciation and amounts written off)		
REVENUE FUNDS	102,500.—	Land & Buildings ...	1,296,955.87	
		Equipment	34,973.87	
AIMÉ DE SORNAY FOUNDATION ...	25,000.—	Agricultural Machinery and Vehicles	37,718.—	
GOVERNMENT OF MAURITIUS (Purchase of Buildings)	76,631.70			1,369,647.74
		CURRENT ASSETS		
SUNDRY CREDITORS	11,733.34	Sundry Debtors ...	240,243.79	
BANK OVERDRAFT	572,231.60	Aimé de Sornay Foundation Account	25,000.—	
		Cash at Bank & in hand ...	38,389.33	
				303,633.12
Rs.	1,673,280.86	Rs.		1,673,280.86

(sd) JEAN ESPITALIER-NOEL } *Board Members*
(sd) G. BEEHARRY }
(sd) R. ANTOINE *Director*

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December 1968, 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 1968, 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.C.A.
DE CHAZAL DU MÉE & Co.
Chartered Accountants

Port Louis
Mauritius,
25th February, 1969.

INTRODUCTION

THE 1968 SUGAR CROP

IN 1968, climatic conditions have, once more, been unfavourable to sugar production in many respects, and are analysed hereunder.

During the vegetative period, November 1967 to June 1968, the sum of monthly rainfall deficits amounted to 16.5 inches, a figure close to the normal value (15.0). The mean temperature, March to June, was 23.0°C compared to the normal value of 23.3°C.

Wind speeds which could affect the standing crop occurred, as can be seen below :

Highest wind speed during one hour in miles

	West	North	East	South	Centre
Cyclone *Ida* (February)	33	30	20	25	28
Cyclone *Monica* (March)	24	17	31	31	20

The threshold value of 30 miles was exceeded in the West in February during the passage of cyclone *Ida*, and also slightly exceeded in the East and South in March during the cyclone *Monica*. The latter cyclone, contrary to those which had reached the vicinity of Mauritius during the last twenty years, curved at some 150 miles from the East Coast, causing a rapid change in the wind direction which has probably affected the standing cane in this particular sector more than is usually expected with a highest wind speed of 31 miles during one hour.

Yields of cane per arpent reaped on estate land in 1967 and 1968 are compared hereunder :

	Island	West	North	East	South	Centre
1967	35.3	40.3	37.7	36.0	33.2	34.7
1968	31.1	37.0	34.1	29.5	30.2	30.0
Reduction	4.2	3.3	3.6	6.5	3.0	4.7

The differences in cane yields can be accounted for by the following factors :

(a) The sum of monthly rainfall deficits, November to June 1967, was more favourable (11.1 in.) than that observed during the same period in 1968 (16.5).

(b) Temperatures during the months March to June were lower in 1968, 23.0°C as compared to 23.5°C in 1967.

(c) Cyclone *Gilberte* (January 1967) occurred earlier in the season than *Ida* (February 1968) and *Monica* (March 1968).

(d) The 1967 sugar campaign was one of the longest on record, specially in the Eastern sector, and consequently was bound to affect adversely the following crop.

The above negative factors have led to a reduction in cane yield in 1968 varying from 3.0 tons per arpent in the South to 6.5 tons in the East, as compared to the 1967 results.

During the maturation period the sum of monthly rainfall excesses amounted to 2.1 inches, a figure close to the normal of 2.5 inches; average minimum temperatures, mean daily range and temperature ratio were also very close to normal values. It follows therefore that, although, on the whole, sugar manufactured % cane was normal, cane yields being affected by the adverse factors mentioned above, the sugar production fell short of expectancy.

The more important data concerning the 1968 campaign compared to the 1967 results are as follows :

	1968	*1967*
Area cultivated, arpents	203,000	204,000
Area harvested, ,,		
Estates	99,500	100,500
Planters	90,500	91,000
Total	190,000	191,500
Weight of canes, metric tons	5,152,240	5,814,468
Tons cane per arpent :		
Estates	31.1	35.3
Planters	22.7	24.9
Average, Island ...	27.1	30.3
Commercial sugar recovered % cane	11.58*	10.98**
Tons sugar per arpent :		
Estates	3.60	3.88
Planters	2.63	2.73
Island	3.14	3.33
Duration of harvest, days	129	168
Tons cane per hour ...	101.9	101.9
Tons cane crushed weekly	278,700	242,600
Sucrose % cane ...	13.10	12.46
Fibre % cane... ...	13.52	13.13
Molasses % cane ...	2.68	2.66
Filter cake % cane ...	3.31	3.09
Purity mixed juice ...	88.3	87.5
Reduced mill extraction	96.1	96.1
Pol % bagasse ...	2.04	1.89
Reduced boiling house recovery	88.3	88.5
Reduced overall recovery	84.8	85.0
Total sucrose losses % cane	1.67	1.62
Tons sugar 98.8 pol, metric tons ...	596,579	638,300
Rainfall deficits Nov.-June (av. 15″)	16.5	11.1
Rainfall excesses July-Nov. (av. 2.5″)	2.1	10.8

Essential information concerning climatic factors, cane and sugar yields, sucrose content, and varietal replacement is given in figs. 1 - 7.

SUGAR CROP FORECAST

In the light of the new International and Commonwealth Sugar Agreements, and considering the real need for agricultural diversification, it is important to have a reasonable assessment of the size of the sugar crop for the years ahead.

The acreage harvested, after increasing until 1962, stabilized itself around 195,000 arpents from 1963 to 1966, followed by a decrease of 3% over 1967 and 1968.

As it is impossible to say whether such trend will continue, it will be assumed that the acreage harvested annually for the next six years will be in the neighbourhood of 190,000 arpents.

Between 1961 and 1968, the only year which came nearest to a "normal" one is 1963, and during that year the sugar made per arpent was 3.53 tons. It follows therefore, taking into account the reshuffle of cane varieties which took place after the epidemic of gumming disease broke out in 1964, that the normal sugar production at the moment should be taken as 3.55.

A critical analysis of crop figures for the last few years shows that the major factor affecting production is governed by climatic conditions prevailing during the growing season of the cane plant. Therefore crop forecasts should be based on what can be termed :

a normal year, correction factor ...	100
a wet year, ,, ,, ...	103
a dry year, ,, ,, ...	94
a cyclonic year, ,, ,, ...	78.5

During the last 56 years, the incidence of such years has been :

normal years	23
wet ,, ...	7
dry ,, ...	9
cyclonic ,, ...	17
Total ...	56

* Equivalent to 8.6 tons of cane per ton of sugar.

** Equivalent to 9.1 tons of cane per ton of sugar.

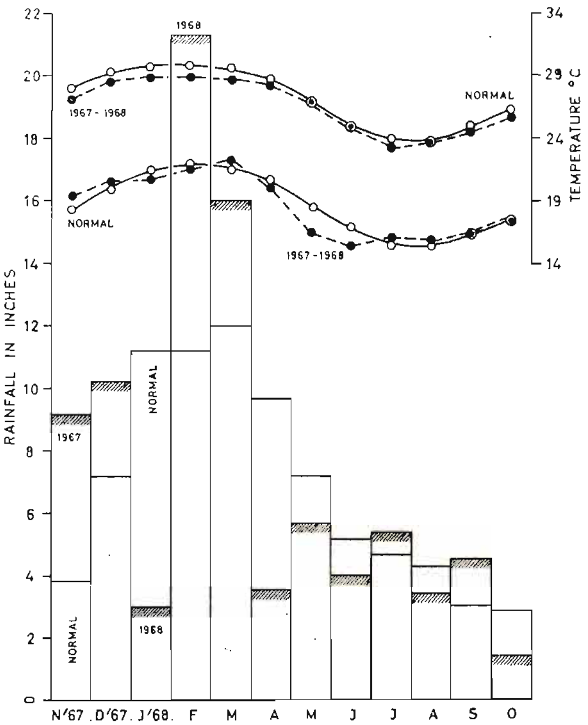


Fig. 1. Average rainfall, maximum and minimum temperatures over the cane area of Mauritius in 1968, compared to normal.

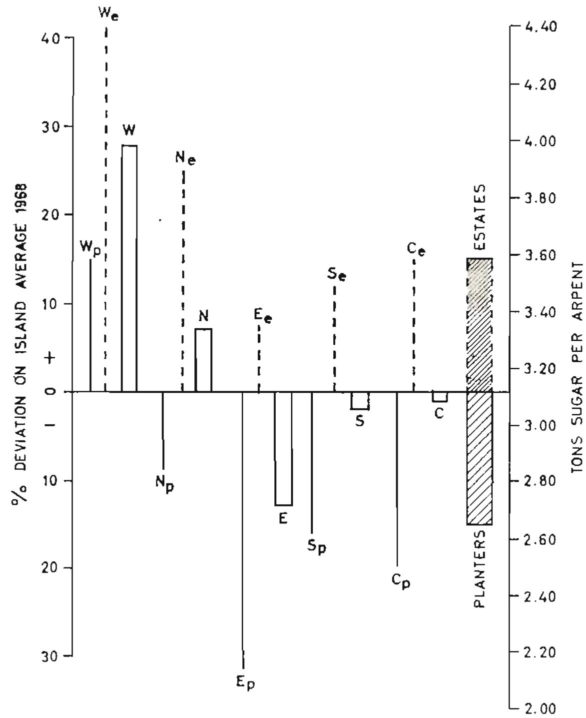


Fig. 2. Relative yields of sugar per arpent in different sectors. Average island yield 3.12 m. tons of 98.8 pol. sugar per arpent. Plain line : planters ; broken line : estates ; columns : sector average.

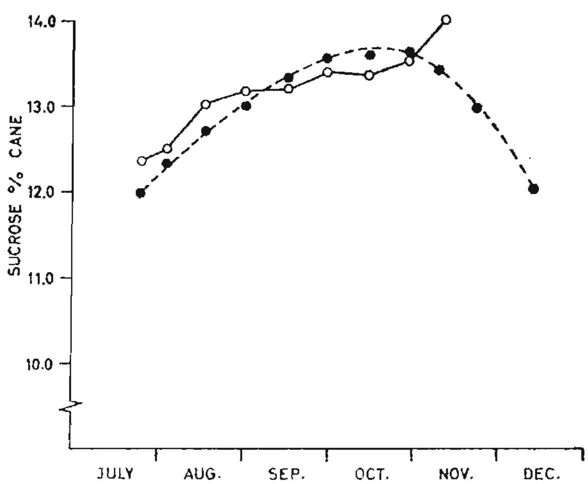


Fig. 3. Variation in sucrose % cane during the harvest season of 1968 (plain line) compared to the 1963-1967 average (broken line).

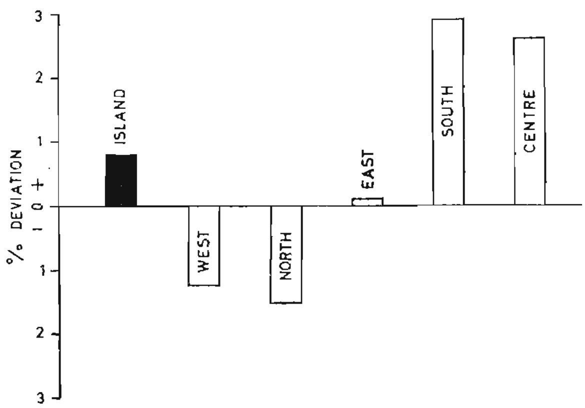


Fig. 4. Sugar manufactured % cane in 1968 for the various sectors, expressed as % deviations from the 1963-1967 averages.

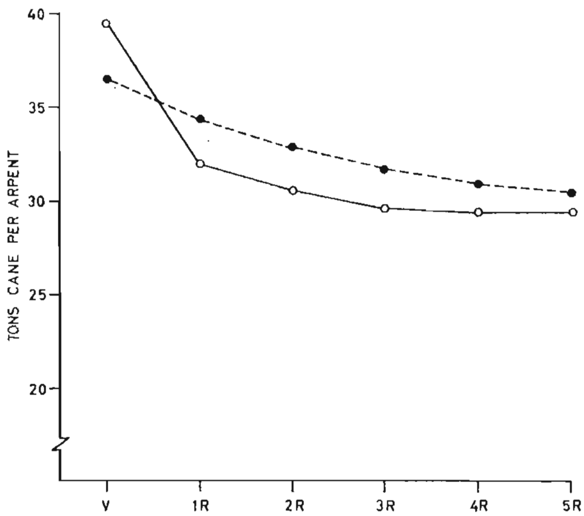


Fig. 5. Cane yields in virgins and ratoons in 1968 (plain line) compared to the 1963-1967 average (broken line).

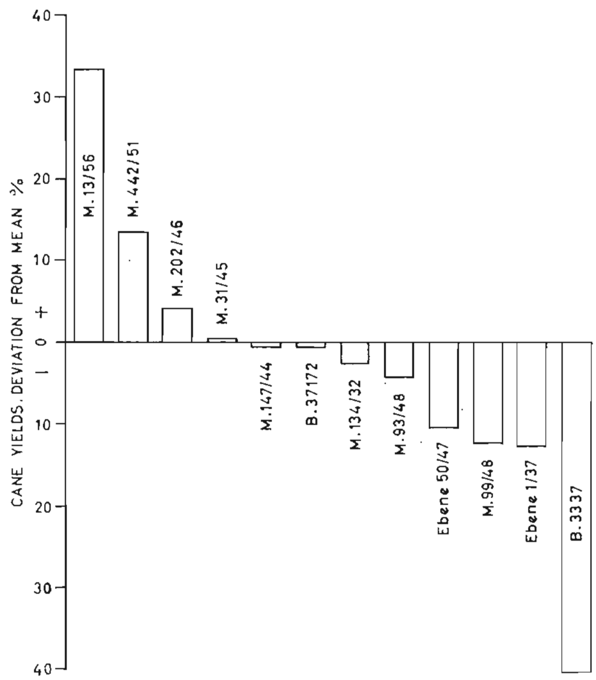


Fig. 6. Yields of different cane varieties on estates in 1968 expressed as % deviation from mean (31.2 TCA).

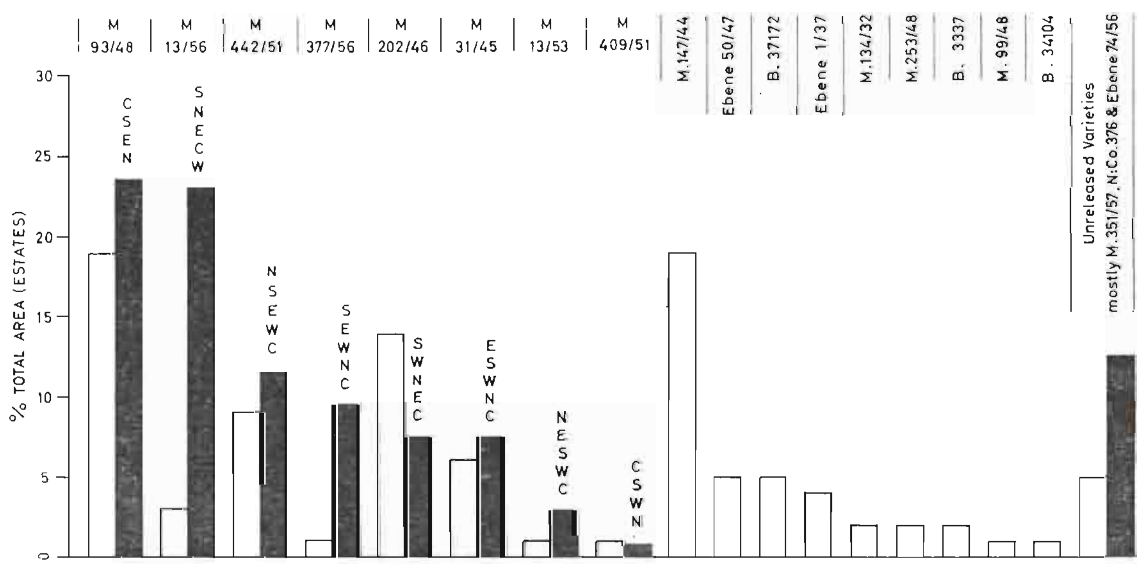


Fig. 7. Varietal trend in 1968 as illustrated by area under cultivation (plain column) and area planted during the year (black column). Letters denote sectors arranged in descending order of magnitude of plantations.

Working therefore on the assumed basis of a harvested acreage of 190,000 arpents and a sugar production of 3.55 tons/arpent, the following crop estimate is arrived at :

normal year	...	675,000 T
wet year ...	...	695,000 T
dry year ...	...	635,000 T
cyclonic year	...	530,000 T

The weighted average based over data collected over the last 56 years is 627,000 tons (actual average production, 1962-1968 = 597,000 tons), in other words, the average annual production taking into account a "normal" incidence of both favourable and unfavourable factors (correction over 56 years) is 627,000 tons.

Although the epidemic of gumming disease which broke out in 1964 was a set-back in the breeding and selection programme, it is a fact that at least two resistant varieties with higher potential have just been released for commercial plantings, and that at least another one will be released in 1969. Also, considering the long ratooning cycle practised in Mauritius, it is reasonable to assume an increase of 0.02 in sugar made per arpent annually. Consequently, again taking into account the vagaries of climate, sugar production for the next six years can be estimated as shown below:

Year		*Sugar made per arpent*	*Sugar production (tons)*
1969 ...	...	3.55	627,000
1970 ...	...	3.57	630,000
1971 ...	...	3.59	634,000
1972 ...	...	3.61	638,000
1973 ...	...	3.63	641,000
1974 ...	...	3.65	645,000

in other words, an average annual production of 636,000 tons for the next 6. years.

It should however be mentioned that if climatic conditions were to be optimal during both growing and maturation periods in any one year, a yield of at least 720,000 tons could be expected.

It follows, therefore, that in the light of the new Commonwealth and International Sugar Agreements it would be unrealistic to start contemplating the uprooting of sugar cane to plant other crops. On the other hand, it is not recommended to put any more land under cane. Diversification should be achieved through :

(a) Planting of new land under other crops,
  (i) tea in the wetter areas;
  (ii) other crops, where and when irrigation facilities are made available.

(b) Converting marginal cane land in super-humid areas (while bearing in mind the higher potential that can be obtained through application of calcium silicate) to tea, while planting an area, to give the same cane production, under cane where irrigation facilities are made available.

(c) Releasing a proportional area of cane land to other crops when the availability of irrigation boosts cane yields;

(d) Making full use of rotational cane land.

(e) Intensive inter-row cultivation in both plant and ratoon canes.

CANE VARIETIES

Among the varieties released since 1964, those that are mostly in favour are : M.442/51, M.13/53, M.13/56 and M.377/56.

M.442/51 is a useful late maturer for the sub-humid zone where it now occupies about 25% of the area cultivated and has thus almost reached saturation point. It is susceptible to chlorotic streak, and for that reason should not be grown in regions of high rainfall, or on soils with impeded drainage. M.13/53 performs well in the coastal irrigated belt only, while the ecological range of M.13/56 covers the humid and sub-humid localities. In the latter zone it was planted over 50% of the area in 1968, and is advantageously replacing M.147/44 as an early maturer. Only one year after its release, M.377/56 was planted on 1,300 arpents in 1968. There are good indications that it is a late maturing variety with a wide range of adaptation.

Considering that the epidemic of gumming disease broke out in 1964, at a time when

M.147/44, the most susceptible variety, was occupying 31% of the total area under cane, almost exclusively in the drier localities, fig. 8 gives a picture of the varietal change, a good expression of the rapid re-orientation which took place in the Northern Sector of the island where the variety was the most popular at the time.

The unreleased varieties of interest are : M.356/53, a rich cane still under study for the super-humid zone; M.351/57, a high yielder that might be useful on the eroded slopes of the super-humid zone but with a sucrose content rather on the low side. S.17 is a very rich variety and a fair yielder. It is now under experimentation in 28 trials representing all the ecological conditions of the island.

Detailed notes on the performance of promising varieties are given in the *Cane Breeding* section of this report.

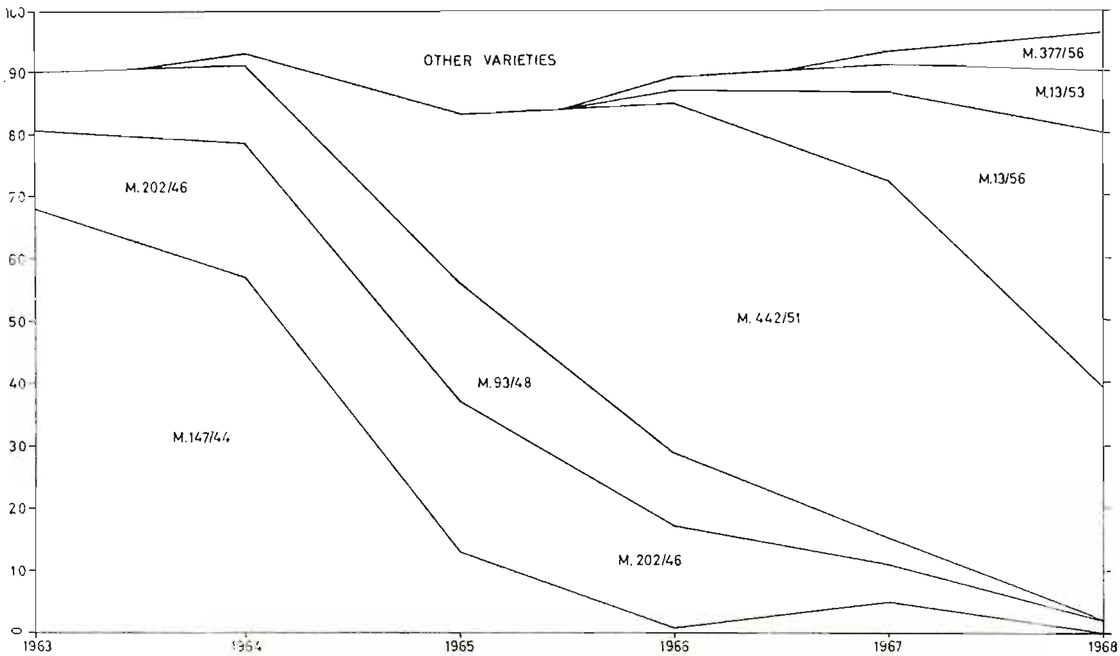


Fig. 8. Varietal trend, 1963-1968, for the Northern Sector expressed as % area planted (Estates).

CANE BREEDING AND SELECTION

The Biometry Section during the year analysed the relevant data pertaining to all stages of the selection process, including for the first time the First Selection Trials.

With the installation of an electronic calculator and an additional punch early in 1968, the Biometry Section had to be moved from the cramped space in the Biology Wing to better accommodation in the Exhibition Building which had to be partly modified for the purpose. It is fitting to mention here, with gratitude, the assistance given by "Esso Ltd." which generously provided the air-conditioning of the machine room.

Flowering was exceptionally heavy in 1968. A few varieties, such as Kassoer and 51 N.G. 142 among others, which had never tasselled until then did so. A record number of crosses was therefore attempted comprising some unpredicted ones.

Germination, however, was very low for the second year running. This problem, which is becoming a cause of concern, is under investigation.

On the whole, 1,301 crosses were carried out involving 209 combinations. A total of

137 different parents was used, comprising 69 clones as females, 60 as males, and 8 as both male and female. Crosses for breeding purposes numbered 170.

Selection work started with the brixing of Bunch Selection Plots at the end of June. The bulk of the work had to be carried out in First Selection Trials, in which 32 varieties were selected from the second ratoons. These were sent to Multiplication Plots for plantation of variety trials in 1969. The work proceeded smoothly until the end of September when selection was completed in the Propagation Plots.

The number of seedlings and varieties now in course of selection is as follows :

(a) Seedlings planted in March 1968 :
 (i) Commercial crosses 14,476
 (ii) Nobilization crosses 2,080
(b) Varieties in Bunch Selection Plots :
 (1966 series) ... 20,353
(c) Varieties in Propagation Plots :
 (1963-1964 series) ... 2,826
(d) Varieties in First Selection Trials :
 (1959-1963 series) ... 569
(e) Varieties in Multiplication Plots :
 (1959-1961 series) ... 32
(f) Varieties in Trials on Estates : 129

Investigations on the physiology of flowering. A number of experiments were laid down in 1968 to investigate more fully certain aspects of the physiology of flowering. The main conclusions derived from these experiments are summarized hereunder :

(i) Studies on the anatomy of the vegetative apex showed that it may be divided into a number of zones, and that at the onset of initiation, this pattern of zonation changes. It was also observed that, under local conditions, initiation takes place at different times for different varieties.

(ii) Leaf cutting experiments with *S. spontaneum* variety Mandalay and M.81/52 confirmed earlier results that flowering seems to be controlled by a balance between flowering inhibitors and promoters. However, it was also observed that varietal differences exist in this respect. Removal of the outer, partly unfolded spindle leaf, and all other leaves during the four weeks preceding initiation resulted in complete inhibition of flowering in variety N:Co.376. It seems therefore that the youngest spindle leaves are not able to perceive the flowering stimulus. Defoliation treatments carried out on variety U.S.48-34, after initiation revealed that presence of the spindle was essential during the initiation of inflorescence branch primordia on the inflorescence primordium, whereas the older leaves do not seem to induce the process.

(iii) A photoperiodic experiment showed that a daylength of 12 hrs 45 mins was optimum for induction of flowering in variety U.S.48-34. The number of cycles, as well as the optimum daylength for induction, appear to be different for varieties used in this experiment.

(iv) When night interruptions were given during three consecutive weeks at a time to variety Mandalay, it was observed that with the treatment applied just after initiation, the result was an almost complete inhibition of emergence. However, when the treatment was started three weeks after initiation, emergence was delayed by five to six weeks with a relatively small reduction in the intensity of emergence. It follows therefore that it may thus be possible to delay flowering in varieties which usually flower shyly.

(v) Further investigations confirmed earlier results that there is no real future in the use of CCC, Phosfon, IAA and cobalt chloride for the control of flowering in sugar cane. On the other hand, Gibcrellic acid (GA_3) appears to play an important rôle in the induction of flowering. Evidence was obtained to support the view that GA_3 is inhibitory to induction in plants with only spindle and first leaf left, whereas in intact plants the older leaves produce an unknown GA_3 inhibitor which counteracts this inhibitory effect. There are also grounds to believe that there are two metabolic pathways for the action of GA_3 : one for growth, and the other for floral initiation.

CANE DISEASES

Gumming disease. Only one resistance trial was carried out in 1968, involving the first-stage testing with the new strain of the pathogen. Infection level in the trial was rather low. Out of 274 varieties, 216 local and 58 foreign, only 7% were rated highly susceptible and 10% susceptible, 15% were slightly susceptible and 68% resistant.

The variety M.377/56 which had been re-included in the trial as a result of its erratic behaviour, having shown susceptibility in the field after being rated resistant in two previous trials, this time revealed susceptibility to foliar infection. Cases of systemic infection, with chlorosis in young plant canes, were also seen in three nurseries; yet, despite thorough surveys, systemic infection developing from foliar infection has not been observed in mature canes. The few systemic symptoms seen in this variety are therefore attributed to infection by contaminated knives during the preparation of cuttings. However, owing to this confirmed susceptibility, at least to foliar infection, fairly intense at times, planters are advised to take special precautions in the cultivation of M.377/56 in that (i) it should not be cultivated for the time being under environmental conditions where gumming can be severe, particularly in the vicinity of infected M.147/44; and (ii) proper sanitation should be followed in nurseries. Systemic infection, with heavy exudation of gum from cut stalks at harvest, was also observed in variety trials, in M.409/51 which had so far been rated resistant. There again, knife infection is believed to have been the cause, as foliar striping was in general mild.

It is now confirmed that, contrary to what was generally accepted in the past, some varieties may not contract infection in resistance trials and yet show susceptibility later on. It is therefore essential that testing for resistance should be conducted under different environmental conditions, both in location and in time. This year the new second-stage testing was replicated in three trials, one with the old strain and two with the new strain. Of the last two, one is conducted under spray irrigation, in a field of dark magnesium clay soil where the disease has always been severe. Thirty-five varieties coming out of First Selection Trials have been included in these 3 trials, and 13 others have been re-included to verify previous results. In the new trial established for first-stage testing with the new strain, 102 varieties were included.

Another series of crosses was carried out in order to continue studies on the reaction to the pathogen of progenies from different combinations involving susceptible and resistant parents.

Studies were initiated in order to determine whether the bacterium can be transmitted by the true seed.

Leaf scald. The leaf scald trial established in 1967 was re-inoculated. Interesting results were obtained in the assessment of resistance by following the development and disappearance of symptoms in inoculated and non-inoculated rows of varieties under test, based on the percentage of infected shoots. The varieties could thereby be classed into various groups of different orders of susceptibility and compared to those of known reaction. The high susceptibility of two promising varieties, M.260/55 and M.130/57, was confirmed.

Chlorotic streak. A trial established in 1966 to compare the effect of organic (scums and molasses) and inorganic fertilizers on two varieties, one highly susceptible to chlorotic streak (M.442/51) and the other only slightly susceptible (M.93/48), was harvested in first ratoon. No differences in yield and millable stalk count resulting from the application of different combinations of organic and inorganic fertilizers were detected, in agreement with previous findings. The build-up of chlorotic streak symptoms in the two varieties was followed and, as expected, was greater in M.442/51. The slight differences observed in the rate of re-infection under the different fertilizer treatments need confirmation. The trial is being continued to study the effect in successive ratoons.

Ratoon stunting disease. The experimental electrically-heated hot-water tank of the Institute built in 1956 at Réduit, was modified and is now heated by hot water circulating in closed coils. The temperature control obtained is excellent.

All the planting material used by the Central Nursery, 157 tons, was treated in the tank of the Institute and 46 arpents of A nurseries were established. The Nursery supplied 1,732 tons of cuttings to estates to establish about 525 arpents of B nurseries (2,325 tons in 1967) and also 1,007 tons to large and small planters for commercial plantations.

The epidemic of gumming disease which led to a reshuffle of varieties was, to a large extent, a set-back in the campaign against ratoon stunting. Thus only 22% of the total area planted on estates was made with disease-free material in 1967, and again in 1968. A real effort in the control of the disease will have to be made as all varieties released for commercial plantings are now available at the Central Nursery.

The resistance trial established in 1967 was harvested, and no effect of the disease was detected in plant canes. Two new trials were established, one in the super-humid zone and the other in the sub-humid, to assess the effect of the disease on eleven varieties.

Studies were initiated on symptom development in young shoots in the variety C.P.44-101, used elsewhere as an indicator plant, as compared to D.109, the variety used for this purpose in Mauritius.

Inflorescence rot. Flowering, as reported earlier, was heavy during the year and, with the dry season, inflorescence rot (*Fusarium moniliforme* associated) was commonly encountered particularly in sub-humid areas. A thorough survey of all fields on an estate of the variety most affected, M.202/46, revealed an average of 20-30% infected stalks.

Investigations were carried out to find out whether emergency harvesting of affected fields was necessary in order to avoid any possible sucrose loss. The results indicated that the sucrose content of infected stalks was comparable to that of arrowed, healthy ones. It is therefore not recommended to reap affected fields of M.202/46 before they are due for harvest, especially since early harvesting promotes heavier flowering the following year.

Yellow spot. A correct assessment of the reaction of promising varieties under selection to yellow spot has become imperative. It has therefore been decided to include all varieties coming out of First Selection Trials in an observation plot in which a high inoculum of the pathogen is provided by rows of the highly susceptible B.3337.

As the onset of the disease seems to depend on climatic conditions prevailing during a restricted period of the year, a trial has been implanted to determine also the effect of different dates of harvest on disease intensity and yield.

Miscellaneous. Wilt was again severe in 1968. The effect of the disease complex on the ratooning of canes in the super-humid zone is causing concern. Although affected patches are usually of restricted size and the overall effect on yield is usually minor, the disease definitely renders the cultivation of certain varieties more difficult, due to emergency harvesting which has to be resorted to in many cases, as well as recruiting after harvest. Observations are being pursued in an attempt to elucidate the real factors at the root of the problem and isolation and identification of pathogens associated with the disease are continuing.

Forty-two of the varieties imported in 1966 were released from quarantine during the year. No new imports of cane varieties were made and the Pathology Division is at present helping with the quarantining of new varieties of potatoes and rice.

Agreement was reached in October at the meeting of the *Comité de Collaboration Agricole, Maurice-Réunion-Madagascar* held in Mauritius, to proceed with the plans for building an insect-proof greenhouse in Tananarive for testing resistance to Fiji disease. It is contemplated that construction will start in March and routine testing may operate as from the end of 1969. The recent observations of Fiji leaf galls in the variety Pindar, hitherto the resistant control in the resistance trials conducted on the east coast of Madagascar, confirms the importance of an early launching of the project.

CANE PESTS

The breeding of the moth-borer parasite *Diatraeophaga striatalis* Tns. at the Pamplemousses Sugar Experiment Station and its release in various localities of the island were terminated in June. This parasite, a Tachinid that is a natural parasite of *Chilo sacchariphagus* (Boj.) in Java, was first obtained by the Institute for study and trial as far back as 1961, but it was only in 1966 that it became possible to breed it on a comparatively large scale for release in the field. From February 1966 to June 1968, twenty-five generations were reared and the total number of parasites released was nearly 62,000, half of which were females that had been mated beforehand and retained for a few days after mating to ensure that they would be fertile after release.

The work of breeding *Diatraeophaga* in quantity has been laborious and exacting, much attention to detail being required to minimize mortality at the various stages of the breeding technique. During the whole period, nearly 200,000 well-grown spotted borers (*C. sacchariphagus* larvae) were collected and "inoculated" with the parasite's larvae and, on an average, 43 adult parasites were obtained for each 100 borers inoculated. In terms of mated female parasites released, the average was 15 per 100 borers inoculated. Fig. 9 shows the average results of the successive stages of laboratory rearing over 25 generations.

Releases were made in 16 different localities, the two main sites being Le Vallon and Belle Vue where about 12,000 and 7,000 mated females, respectively, were liberated. There were four localities where the numbers released were between one and four thousand, while the other places received smaller numbers.

Attempts are now being made to determine if the parasite has established itself in the field. This involves search for the adults and collection of borer larvae which are then retained in the laboratory for emergence of parasites. About 8,000 borers were collected between June and December, but none proved to be parasitized by *Diatraeophaga*. It is thought that the parasite, if established, should already have been recovered and the fact that it has not been is discouraging and may indicate that local conditions have in some way proved unsuitable for its survival.

Investigations on the scale insect, *Aulacaspis tegalensis* (Zehnt.) were continued. Although this pest has several natural enemies that are extremely important in reducing its population, it is hoped that others can be introduced shortly to increase the existing degree of biological control. In this connection, it is necessary to identify the species already present and to obtain a better understanding of their activities. This applies particularly to the hymenopterous parasites that are associated with the scale insect and which are now known to comprise at least four species. The host relations of these are being studied and it is believed that only two of them are primary parasites, the others being secondary and therefore harmful.

Two systemic insecticides that have a persistent action when applied to the soil in granular form were tested against the scale insect, but proved inefficacious. Other work on

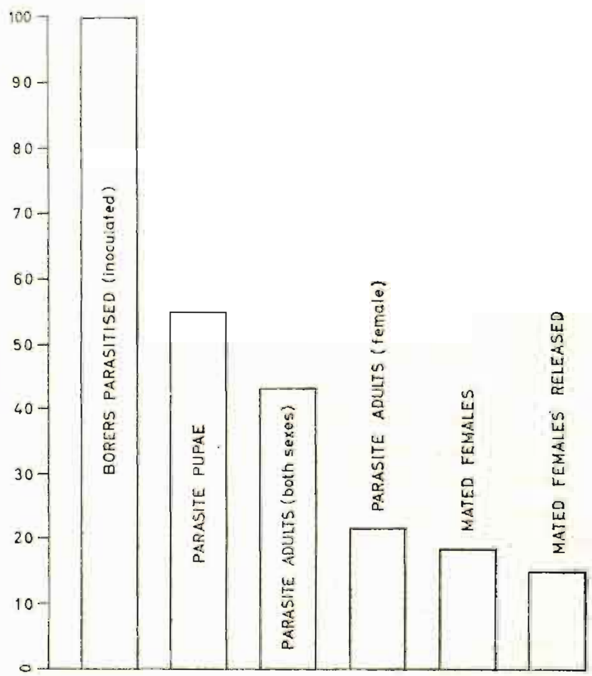


Fig. 9. Average results, over 25 generations, of successive stages in the breeding of *Diatraeophaga striatalis* Tns.

the scale insect included study of its development and reproduction at different times of the year, and its method of feeding on its host-plant.

The thrips, *Fulmekiola serrata* (Kob.), often causes chlorosis and desiccation of cane foliage, particularly during early growth, and it accentuates the effect of drought. However, apart from some earlier work on varietal susceptibility, the insect has never been studied and the effect it has on cane growth is unknown. A preliminary experiment laid down during the year is providing useful information, if only as a guide to the difficulties that will be encountered in field experimentation with the insect. One interesting result that has emerged from the experiment is that granular Phorate applied in the furrow at planting protected shoots from thrips attack for at least the first three months of growth.

Advisory circulars on pests of interline crops, and on pesticides recommended for use in sugar plantations, were issued during the year.

NUTRITION AND SOILS

Nitrogen. Although it is known that the response to nitrogen is greater under dry than under wet conditions, field trials with the "slow release" nitrogen fertilizer, urea-formaldehyde, were carried out under conditions where leaching of nitrogen is intense. Results for two crops show that although a response to nitrogen has been obtained in some cases, urea-formaldehyde is not superior to sulphate of ammonia.

Preliminary results of leaching losses in lysimeter plots which had received either sulphate of ammonia or calcium ammonium nitrate, indicate the rather surprising fact that more nitrogen is leached from sulphate of ammonia than from calcium ammonium nitrate. The lysimeters were irrigated to saturation of the plots.

Phosphorus. Work in progress has shown that the modified Truog extractant which is currently used to predict the phosphate requirements of local soils may not be suitable in very acid soils. As the majority of local soils are acid, and very often very acid from the continual use of sulphate of ammonia, other soil phosphate extractants which may prove more useful in these very acid soils are being studied.

Evidence has been obtained from the study of phosphate esters that silicon promotes phosphorylation in the sugar cane plant, both in the tops and in the roots. Aluminium has an opposite effect.

Potassium. There is a tendency to neglect the maintenance of adequate levels of this major element in our sugar cane lands. Deficiency of potassium, as shown by foliar diagnosis, is now appearing in greater frequency, and it is time that an effort should be made to prevent the depletion of this element in our soils.

In the permanent trial set up at Réduit in 1936, and now running for 32 years, deficiency of potassium has had a much more drastic effect on sugar cane yield than deficiency of phosphate. The average yields are given below (mean of 5 varieties and 31 crops) :

TCA/Arpent

Control (NPK)		—K
34.3	28.0	20.7

Silicon. The results obtained from the seven trials laid down with calcium silicate and coral sand have shown that areas which were previously considered to be unsuitable for cane can now be expected to provide reasonable yields, if adequately supplied with calcium silicate.

In fact, yield increases from the application of calcium silicate were spectacular and were much greater than those obtained from the application of coral sand.

However, these trials were carried out under extreme conditions, from the point of view of both soil and climate, so that new trials will have to be laid down in less acid soils.

At present, the calcium silicate has to be imported from Japan at great expense but, if a nearer source is available, it may well be that the routine application of calcium silicate could revolutionize the cultivation of sugar cane and other *Gramineae* in the upland areas.

Foliar diagnosis. Sheath analysis will be discontinued as from 1969, as a good correlation has been obtained between leaf lamina and sheath levels of Si, Ca, Mn, which were previously determined in the sheath. Foliar diagnosis will thus be simplified.

Also, the spindle will be used instead of the 4 - 5 internode to assess the moisture content of the plant.

Soil physics. A soil physics section is being set up. Information will therefore be available on the different physical properties of local soils, and these data should be useful for the proper planning of irrigation.

Soil analysis. Chemists from 15 sugar estates worked in the Chemistry laboratories and carried out a total of about 1,000 analyses for soil pH and available phosphate.

PLANT-SOIL-WATER RELATIONS

Comparative methods for the estimation of leaf-water status. The leaf-water status in this study was obtained by indirect measurements of leaf-water potential by liquid and vapour pressure equilibration, and by measurements of relative turgidity and water deficit values.

The various techniques for measuring leaf-water potential are briefly described in the technical part of this report.

The investigations were conducted in order to find out whether or not there was any correspondence between the leaf-water potential as measured by three different techniques, and also to study the relation between leaf-water deficit and leaf-water potential measured with the osmometer.

Fairly good correspondence of leaf-water potential as determined by the three methods was noted.

There was also a good correspondence between the leaf-water deficit and the leaf-water potential. Since the water status can be more easily estimated by measuring the water deficit, it is believed that estimates of water deficits will prove useful, provided the relation between water potential and water deficits of leaves of different physiological ages is established in the first place.

Optimum water requirements for cane growth as dictated by leaf-water status. Preliminary investigations are outlined here. In the early stages of growth, up to about 2 - 3 months after germination, one of the useful methods for determining irrigation requirements is by measuring soil-water suction at various depths in the soil profile. However, when the root system ramifies into the deeper soil layers where humidity is higher than in the top soil layers, the situation changes and correlation between soil - water suction at any depth and growth rate of the plant changes with the development of the root system. The measurement of the leaf-water deficits becomes the reliable criterion for determining the optimum irrigation frequency. The amount of water to be applied can be estimated from meteorological attributes, or by measurements of soil humidity. In a preliminary experiment at Pamplemousses, the effects of two levels of leaf-water deficits on growth when the canes were eight months old were compared. The difference in response was of importance. Further experiments are required to assess the effect of different leaf-water deficits on final yield, and the economics of the different treatments will have to be evaluated.

WEED CONTROL

Evaluation of new herbicides. The following herbicides were included in a log-screening trial in the super-humid zone at Belle Rive : Ametryne, BAS 2103H, BAS 2440H, Planavin, HP149, Ordram, Vernam, Tillam. These herbicides were tested in pre-emergence of canes and weeds and were compared to DCMU at dosage rates varying from 5 lb a. i. to 0.8 lb a.i. Weed assessment and cane damage were evaluated 94 days after treatment.

Ametryne and BAS 2440H were comparable in their effects on weed control, but were slighty inferior to DCMU. BAS 2103H. Planavin and HP149 gave satisfactory results whereas Ordram, Vernam and Tillam were disappointing as far as pre-emergence control of weeds is concerned.

Cane toxicity, as determined by growth and germination, was noted at the high dosage rates with Ametryne and BAS 2440H.

Post-emergence trial in ratoons. Six herbicides were compared at two dosage rates of 3 and 4 lb a.i. per arpent. They were Ametryne, C15935, BAS 2440H, Daxtron, C6989 and NPH 1357 (Actril-X). The cane variety M.93/48 was three months old at the time of spraying and each plot size was 400 sq. ft.

Two months after spraying, the best weed control was obtained with Daxtron at both dosage rates and C15935 at 4 lb a.i. per arpent. Cane damage, amounting to about 25% kill of plants in the Daxtron plots, points to the very high toxicity of this chemical. C15935, however, had no effect on cane. Fairly good weed control was also obtained with Ametryne at 4 lb a.i., a dosage which does not seem to affect the crop at this stage of growth.

The other herbicides could not be classified in the same category as the above-mentioned ones regarding post-emergence weed control properties.

Post-emergence trial in plant canes. The canes were 2 months old and weed growth at an advanced stage when spraying was made. The herbicides used were C15935, Ametryne, Actril-D, BAS 2440H at 3 and 4 lb a.i. per arpent, and a mixture of DCMU 3 lb + ActrilD 1 lb active material per arpent. The mixture was by far the best treatment in this particular trial.

On the basis of results obtained in several other trials, there are strong indications that semi post-emergent sprays, made up of mixtures of Actril-D and long residual herbicides at reduced rates, would give excellent weed control with economic advantages. The use of home-made cocktails on sugar estates should be avoided, as this entails unnecessary additional expenditure.

Special weed problems. These studies were made on *Cyperus rotundus* and *Heliotropium amplexicaule.*

Several herbicides were used to study their effects in pre-emergence and post-emergence of *Cyperus rotundus.* Only Daxtron gave indications of a pre-emergent effect on this weed, but the high toxicity of this chemical at 3 and 4 lb a.i. per arpent precludes its use in sugar cane plantations at these high rates.

In post-emergent sprays, Actril-D (with no effect on cane) and Daxtron gave the best results with a weed kill exceeding 95% of the total *Cyperus* population. 2,4-D was slow acting in its effect and 80% kill was noted when 3 weeks had elapsed after application.

Gramoxone was efficient in killing 80-90% of the existing weed population and the control lasted for 3-4 weeks depending on rainfall conditions. Moderate to severe scorching of the cane leaves following spraying was no longer apparent three weeks after the herbicide application.

The other herbicides tested were of no avail in the control of *Cyperus rotundus.*

Heliotropium amplexicaule, a troublesome weed in the North, is receiving attention since it is rapidly spreading in spite of standard herbicidal treatments. Experiments were started to study the effects of Tordon, C15935, Actril-X and Actril -D on their own, and in mixtures, on checking spread of this weed in sugar cane fields. Encouraging results were obtained with mixtures of Tordon and Actril-D or Actril-X, and fairly good results were obtained with mixtures of C15935 and Actril-D. Stimulation of growth of secondary buds obtained with the latter treatment makes it inferior to the control obtained with Tordon which is a slow-acting translocated herbicide.

FIELD EXPERIMENTATION

The programme of Field Experimentation covering the various disciplines of the Institute was pursued satisfactorily in spite of a shorter cropping season and the ever-increasing attention being paid to food crops. A total of 140 field experiments were harvested, involving the weighing and sampling of 4939 plots. 65 new trials were laid down in 1968. A summary of field trials studied during the year is tabulated below :

	Estates	Stations
Variety		
Variety trials	52	—
Final variety trials ...	23	—
Special variety trials (with Estate Agronomists) ...	4	—
Ratooning capacity ...	—	4
Fertilization and amendments		
Nitrogen	22	—
Phosphate	14	—
Calcium and phosphate ...	2	—
Potassium, calcium and magnesium	3	—
Basalt	5	—
Method of fertilizer application	3	—
Calcium silicate ...	7	1
Organic and mineral fertilization	—	4
Permanent fertilizer ... demonstration plots ...	—	4
Cultural practices		
Spacing	10	—
Burning	3	—
Method of planting ...	5	—
Selective harvesting ...	5	—
Food Crops		
Sunflower in cane interline	9	—
Maize in cane interline ...	14	—
Groundnuts variety trials (in pure stand) ...	8	—
Potato, test for wilt ...	—	1
Pests		
Thrips	1	—
Diseases		
Gumming	4	1
Leaf scald	—	2
Chlorotic streak... ...	—	1
Ratoon stunting disease ...	—	3
Yellow spot	1	1
Inflorescence rot .	1	—
Pineapple disease ...	—	2
Plant Physiology		
Drought resistance ...		2
Herbicides	18	3
Total ...	214	29

The final variety trials laid down in 1966 were harvested in first ratoons. M.13/56 proved to be an outstanding early-maturer. The 1968 series of twelve trials was planted with material derived from the Central Cane Nursery to include, as usual, six varieties and two controls.

Ten spacing experiments were harvested in 4th ratoons and will be concluded in 1969. Experimentation also covered method of planting on hydromorphic soils and in the super-humid zone, and burning at harvest, further trials being laid down in the sub-humid area.

A mechanical fertilizer distributor was devised for commercial plantations and it is expected that this machine, operated by one labourer, will, under local conditions, bring an appreciable improvement in fertilizer distribution on a field scale, and thereby improve the general efficiency of fertilizer usage.

Close contact was maintained as usual between the Institute and sugar estates and planters, 1,376 visits being made by members of the staff. The co-operation received from sugar estates and the Central Cane Nursery, as well as the valuable assistance received from Estate Agronomists, are gratefully acknowledged.

FOODCROP CULTIVATION

A contribution from the Chamber of Agriculture has allowed the Institute to employ, as from the beginning of 1968, a technical officer whose main duties are connected with food crop production. The objective will be a study of the inter-and alternate cropping of sugar cane in a rational way. Two temporary assistants have also been employed to help the Field Officers of the Institute.

This assistance has allowed the Institute to advise on potato cultivation on sugar estates throughout the island, and on the control of blight and of the tuber moth, the two main problems encountered. Experimentation on storage was also started with not much success.

Nine trials established to study the effect of inter-row cultivation of the sunflower on the yield of ratoon canes were harvested in 1968. The yields of sunflower seeds had already been assessed in 1967 and had proved disappointing.* Plots in which double lines of sunflower had been planted on every interline of cane produced an average yield of just under 100 kg of oil per arpent, but reductions as high as 900 kg. of sugar per arpent resulted.

In order to become familiar with the crop, the majority of sugar estates had planted several acres of sunflower in ratoon interlines in 1967, and some of them tried again in 1968. The results were on the whole very disappointing : out of a planned programme of 1000 arpents, 530 were harvested, producing an average of 61.5 kg of oil per arpent in 1967. The results obtained in 1968 were even more disappointing as most of the plantations were destroyed by rats and birds at the germination stage. It now appears that there is little hope of establishing the sunflower industry in Mauritius if the crop plant is to be cultivated in cane interlines.

Fourteen trials were established in the different climatic zones of the island in order to study the effect of growing maize in ratoon cane interlines, at two planting distances, on cane yields. The other object of the experiment is to assess the performance of the white variety Hybrid 632 from Kenya compared to the "local" yellow maize. The results will be available in 1969.

Eight trials were laid down in December to compare the performance of seven imported varieties of groundnuts with that of the local "cabri" variety. The two trials situated in the sub-humid zone are being severely affected by the persistent drought. Results will be obtained in May 1969.

SUGAR MANUFACTURE

Raw sugar filterability. During a period of three years, from 1965 to 1967, priority was given in the research activities of the Sugar Technology Division to investigations relating to raw sugar filterability. The quality of Mauritius raws had gradually deteriorated and it was of vital importance that the situation should be quickly and fully redressed. This goal has been achieved within a short period of three years as a result of the sustained efforts of the technicians of the industry. A review of the measures which have led to this result was made by the Chief Sugar Technologist in a paper presented to the XIIIth Congress of the International Society of Sugar Cane Technologists held in Taiwan in 1968. Let it only be mentioned here that these measures include, amongst others :

(a) The adoption of the enzymatic process of starch removal from juice.

(b) The replacement of cold or hot liming by boiling juice liming.

(c) The replacement in several factories of a 3-boiling by a 2-boiling system.

(d) The reduction of the amount of B-sugar in factories following 3-boiling systems.

(e) The remelting of C-sugar instead of using it as a footing for A and B-strikes.

(f) The production of smaller crystals.

* *Vide Rep. Maurit. Sug. Ind. Res. Inst.* **15** (1967) : 108-109.

(g) The removal of dark lumps from shipment sugars.

(h) The adoption of strict quality control on all the raws produced.

These procedures were followed also in 1968 and, as a result, average filterability for the crop was as good as it had been in 1967.

Exhaustibility of final molasses. The sugar quality problem having been solved, priority was given in 1968 to studies relating to final molasses exhaustibility. Mauritius is apparently the cane sugar producing country where milling losses are the lowest; although total sugar losses are also low, yet most of the lead taken at the mills disappears during processing, losses in final molasses being higher than those prevailing in a few other countries — Australia and Taiwan, for example—and account for the major part of the losses in Mauritius factories. Hence the efforts of the industry should be directed towards curtailing these losses, as any investment made towards this goal is likely to pay dividends faster than it would in any other department of the factory. But before trying to cut down on these losses, it is first necessary not only to assess them correctly, but also to know to what extent it is possible to cut them down economically. In other words, it is necessary to determine an expected or target purity, and to compare it with the actual purity. With this objective in mind the following steps were taken :

(a) A large number of average crop samples of final molasses from previous years were analysed and a formula was worked out so as to enable the calculation of the expected purity.

(b) Average 1968 monthly samples from the 23 factories of the island were analysed in the laboratories of the Sugar Technology Division.

(c) The results of the analyses and calculations were circularized to the industry as soon as available.

The Process Managers of all factories were thus able to follow, from month to month, the differences between the actual and expected purities of their samples. They are thus now in a position to judge to what extent their losses in final molasses are in excess of what they could be; and this will no doubt render it easier for them to calculate the profitability of investments they might contemplate to make with the object of reducing these losses. Further, the publication and distribution of monthly results is bound to bring a spirit of competition between factories.

In spite of the large volume of analytical work involved, many of the analyses being carried out in duplicate by two independent analysts, the work will be carried out along the same lines in 1969 and, it is hoped, for several more years. This work should contribute greatly to reducing losses in final molasses in the sugar factories of Mauritius.

Mill sanitation. Any losses that may take place in the milling train through inversion of sucrose are not accounted for in the chemical control since the amount of sucrose coming in with the cane is obtained indirectly from that contained in the mixed juice and in the bagasse. As a result of the fact that these losses are not actually measured, they are more difficult to control.

Although in Mauritius inversion losses in milling tandems are presumably small, as a result of the good sanitation conditions generally prevailing, yet they are larger in certain factories than in others. It would therefore be important to assess them correctly, particularly in those factories where they are apparently larger. Further, the use of expensive bactericides can only be warranted if it will lead to a net gain in cash, but this gain cannot be assessed unless the losses can be accurately measured.

The problem was studied during the crop and it became evident that the methods used to try and assess these losses in sugar factories in Mauritius are unreliable. Studies have therefore been initiated to find out whether the difference in dextran content between first expressed and mixed juice could be used to measure inversion losses in milling trains, or at least those losses resulting from the proliferation of certain species of micro-organisms.

Juice liming. With the adoption, by many factories, of liming practices in which the lime is added just ahead of the clarifier, for instance in the pipe leading from the flash tank to the clarifier, it was necessary to study the rate of reaction of lime and juice at near-boiling temperature in order to determine whether the reaction is complete in a time interval shorter than that corresponding to the travel time of the juice from the liming tank to the clarifier. The result of these studies ,which were carried out at various temperatures, shows that near the boiling point the rate of reaction is complete in only a few seconds so that the juice sample which is sent to the electrodes of the pH controller has reached its final pH by the time it gets there.

Syrup filtration. Experiments were conducted to study the influence of syrup filtration on sugar filterability. A pilot "Hercules" leaf filter was obtained on loan from the Herfilco Company and used to filter syrup of about 40°Bx. bled between the 3rd and 4th effects of a quadruple effect evaporator. The temperature of filtration, which during the first trials dropped by 10-15°C during the tests, was later maintained at predetermined levels (60°C and 80°C) following a modification made to the piping system.

The following conclusions were arrived at :

(*a*) The Hercules filter is inadequate for the filtration of cane syrup because of its low capacity and short cycle time.

(*b*) In the limited number of comparisons made, no significant difference was observed in the filterabilities of sugars produced from filtered and unfiltered syrups.

Quality of slurry used for pan seeding. A survey was made of the pan seeding methods used in Mauritius, particularly with reference to the following :

(*a*) Type of ball mill used.

(*b*) Efficiency of ball mill.

(*c*) Quality of slurry produced.

(*d*) Quality of slurry of a given average crystal size used per ton of massecuite.

(*e*) Comparison of quantity actually used with that necessary for obtaining true pan seeding.

The survey has brought to light two important aspects of pan boiling in Mauritius, namely :

(*a*) The quality of the slurry prepared in many factories is poor.

(*b*) The quantity of slurry used is in most cases insufficient for true pan seeding.

The results of the survey will shortly be published in the form of a Technical Circular.

pH measurement of syrups and molasses. In Mauritius the procedure followed for the pH determination of syrups and molasses varies greatly from factory to factory. In some cases colorimeters are still used although in the majority of others pH meters are employed. But even in the latter cases the samples are diluted to different concentrations before the measurement is made.

Results of experiments carried out during the crop show that the pH of a diluted sample is always higher than that of an undiluted one, the difference being + 0.2 to + 0.3 for a fifty per cent by weight dilution.

Since, with the equipment available nowadays, there is no difficulty in measuring the pH of undiluted samples, it is recommended that the practice of diluting the sample prior to pH measurement be abandoned. Greater uniformity in reporting factory data will result and the Process Manager will know more accurately the pH value of the concentrated sugar products of his factory.

Miscellaneous. The activities of the Sugar Technology Division also comprised the analyses of about 5,500 cane samples from the experimental plots of the Institute. The advice of the Division was sought by individual factories and corporate bodies on a number of problems, and various reports were written at their request. The Instrumentation Section of the Division undertook the testing, repairs and calibration of a number of instruments including 180 gauges, 18 thermometers, 9 saccharimeters, 8 pH-controllers, 5 laboratory pH-meters, 4 balances, 2 temperature controllers and 1 refractometer.

LIBRARY AND PUBLICATIONS

New accessions numbered 559 volumes in 1968, and the periodicals and reports received went up to 430 titles; the shelving consequently had to be increased by 98 feet.

It was possible to review the position concerning the Institute's serials and periodicals holdings thanks to additional help received in the library during the earlier part of the year, and still more in September, when a full-time assistant was employed. The result is that it was possible to circulate to some 120 libraries in the world the *Offers List* no. 6 and *Requests List* no. 5 of the Institute and the response received has been quite encouraging. Special mention should be made of the Institut für Zuckerindustrie in Berlin, the Library of the Experiment Station of the H.S.P.A. and the Institute for Agricultural Research, Ahmadu Bello University, for their continued support and help in the building up of the collections.

New contacts were also made and exchange arrangements established between the *Direction départementale d'Agriculture de la Réunion* and the Library of Congress Field Office in Nairobi, whose Directors visited the Library recently.

The Library was enriched by a collection from the personal library of the late Pierre de Sornay, Officier de la Légion d'Honneur, Commandeur de l'Ordre du Mérite Agricole. Warmest thanks are expressed to the British Council for donations of reference books to the Library; to the British High Commission; to the American Embassy in Port-Louis; and to the Department for Co-operative Relations, U.S.D.A., for presentation of various publications needed.

The Library has recently enlarged its range of collections by including publications on the production of food crops. It has also contributed to the preliminary programme of the University Library, its Librarian serving on the Library Committee of the University of Mauritius.

Publications released in 1968 were :

Annual Report 1967. 151, xxviii p., 41 figs., 8 pl. French summary in *Revue agric. sucr. Ile Maurice* **47** (2) 1968 : 80-107.

Technical Circulars (mineographed)

No. 31 WIEHE, P.O. Sugar research and its application in Mauritius. 31p., 9 figs. (Summary of a case study presented at an international seminar on *Change in Agriculture* at Reading University, September 1968).

No. 32 SAINT ANTOINE, J. D. de R. de. A simplified method of calculating Pol of Cane harvested from experimental plots. 11 p.

No. 33 MAMET, R. La culture de la pomme de terre dans les entrelignes de cannes. 29 p.

Private Circulation Report (mineographed)

No. 22 SAINT ANTOINE, J. D. de R. de. Calculation of amount of sugar accruing to a planter in Mauritius. 9 p.

No. 23 NG YING SHEUNG, R. Mushroom production in Taiwan. 25 p.

Contrôle Mutuel Hebdomadaire. 21 issues.

Bulletin Hebdomadaire. Evolution Campagne Sucrière. 20 issues.

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

HALAIS, P. L'Agronomie de la canne à sucre en marge du XIIIe Congrès International de Taiwan. **47** (3): 205-211.

HARDY, M. L'arroseuse par aspersion "Target Master". **47** (4) : 291-293.

LE GUEN, F. The selection and sizing of control valves. **47** (1): 33-36.

LE GUEN F. Divers aspects de l'instrumentation à Maurice. **47** (4): 279-290.

RICAUD, C. Recherches dans la lutte contre une épiphytie bactérienne de la canne à sucre à l'Ile Maurice. **47** (2): 108-119.

ROUILLARD, G. Histoire des domaines sucriers de l'Ile Maurice — III. Flacq. **47** (1): 11-25.

(*Note*. Propriétaires des domaines de Pamplemousses et de Rivière du Rempart, des origines à nos jours. Publication privée parue en 1968. 48 p.)

SAINT ANTOINE, J.D. de R. de. Comparaison de l'efficacité de nos sucreries à celle des pays visités. Procédés de fabrication et qualités des sucres. **47** (3): 212-223.

WIEHE, P.O. Notes on the XIIIth Congress of the I.S.S.C.T. Taiwan. **47** (3): 148-156.

WIEHE, P.O. Visit to the International Rice Research Institute in the Philippines and general observations on rice cultivation in Mauritius. **47** (3): 160-169.

Contribution to Foreign Publications.

HALAIS, P. Normes du diagnostic foliaire pour les repousses de canne à sucre récoltables annuellement en régions tropicales. *Comptes Rendus, Colloque sur la Fertilité des Sols Tropicaux*, Tananarive, 19-25 novembre 1967. Tome I, 1968 : 169.

Thesis

MONGELARD, J. C. Studies on the soil-plant-water relations of 'drought-susceptible' and 'drought-resistant' sugar cane varieties. Ph. D. Thesis, University of London. 1968.

GENERAL

The Research Advisory Committee held one meeting in February to review the current research programme of the Institute.

Lectures given at the Bonâme Hall are listed below.

6th February — J. QUINTERO (Engineer, Fischer & Porter Inc.) Sur l'application des instruments de contrôle en sucrerie. (1)

12th February — L. LINCOLN. La fabrique de panneaux ligneux (Bagapan) des Sucreries de Bourbon, La Mare, à la Réunion. (1)

16th February — P. O. WIEHE. Revue des travaux du M.S.I.R.I. en 1967.

19th February — G. ROUILLARD. L'histoire des domaines sucriers de Flacq. (2)

19th March — Y. WONG. La fertilisation de la canne. (3)

30th April — G. ROUILLARD. Les résultats préliminaires obtenus dans les expériences faites sur la culture du tournesol en entre-lignes de canne à sucre. (3)

21st May — R. JULIEN. Résultats d'expériences sur le contrôle de la floraison. (3)

23rd May — P. O. WIEHE. XIII^e^ Congrès de l'I.S.S.C.T. tenu en mars à Formose.

29th May — P. O. WIEHE. Voyage dans le sud-est asiatique. (4)

20th June — *Société de Technologie Agricole et Sucrière de Maurice.* En marge du XIII^e^ Congrès de l'I.S.S.C.T. à Taiwan. Compte-rendu des participants.

16th July — F. LE GUEN. Différents aspects de l'instrumentation dans les sucreries de Maurice. (3)

1st August — G. NICKSON (Mill gear lubrication expert). Sugar mill gear lubrication. ([1])

29th July — F. BOYER DE LA GIRODAY (Directeur des Affaires Monétaires des Communautés Européennes). Vue d'ensemble des activités et des structures de la Communauté Economique Européenne.([5])

20th August — P. HALAIS. Nutrition de la canne à sucre, en marge du XIII[e] Congrès de l'I.S.S.C.T., Taiwan.([3])

26th November — R. ANTOINE. Les variétés de canne à sucre.([3])

5th December — R. NG. YING SHEUNG. La culture du champignon à Taiwan; en marge du XIII[e] Congrès de l'I.S.S.C.T., Taiwan.([1])

Staff Movements. Nine officers of the Institute, Dr. C. Mongelard and Messrs. J. Desjardins, L. P. Noël, R. Ng Ying Sheung, J. D. de R. de St. Antoine, E. Piat, J. A. Lalouette, G. Rouillard and P. R. Hermelin, went on overseas leave during the year, and according to the established policy, attended scientific congresses, visited research institutions, and established or renewed useful scientific contacts.

Dr. P. O. Wiehe and Messrs. P. Halais, J. D. de R. de St. Antoine, L. P. Noël and R. Ng Ying Sheung attended the XIIIth Congress of the I.S.S.C.T. held in Taiwan in March. Dr. Wiehe also visited the Philippines and Burma; attended a seminar at the University of Reading on *Change in Agriculture* in September, and presented a paper. Mr. Ng Ying Sheung visited Burma, Mr. Noël, Australia and South Africa, and Mr. de St. Antoine, the Philippines, Australia and South Africa. Mr Piat visited South Africa and France; Mr. Lalouette, South Africa, he also spent some time studying at International Computers Ltd. and Rothamsted Experiment Station. Mr. Rouillard went to South Africa and Mr. Hermelin to the United Kingdom and Canada.

Under the auspices of the *Comité de Collaboration Agricole*, Dr. C. Ricaud visited Madagascar in April to see and discuss Fiji disease control work. Dr. Wong went to discuss research in soil science in Madagascar in September; he was followed by Dr. Arlidge and Mr. Chan in December. Mr. Mazery studied also in December various aspects of rice cultivation in Madagascar

Mr. Ross left in August to read for his G.R.I.C. at the Medway and Maidstone College of Technology, England.

Dr. Ricaud visited Sena S.E., Mozambique, to advise on the yellow wilt problem of the sugar cane and initiate relevant research work. Dr. Mongelard visited research centres in Switzerland, Germany, Holland, France and England. He also attended, in June, an international Symposium on *Photosynthesis in Sugar Cane* sponsored by the Imperial College of Science and Technology, London, and Tate and Lyle Limited.

Mr. R. Antoine attended the International Congress of Plant Pathology, held at the Imperial College of Science and Technology, London, in July and presented a paper on the hot-water treatment of cuttings. Mr. Williams

1. Meeting under the auspices of the *Société de Technologie Agricole et Sucrière de Maurice.*
2. Meeting under the auspices of the *Société de Technologie Agricole et Sucrière de Maurice* and *Société de l'Histoire de l'Ile Maurice.*
3. Talks specially prepared for Extension Officers of the Department of Agriculture and for the Field Staff of the Sugar Estates.
4. Meeting under the auspices of the Royal Society of Arts and Sciences of Mauritius.
5. Meeting under the auspices of the Mauritius Chamber of Agriculture.

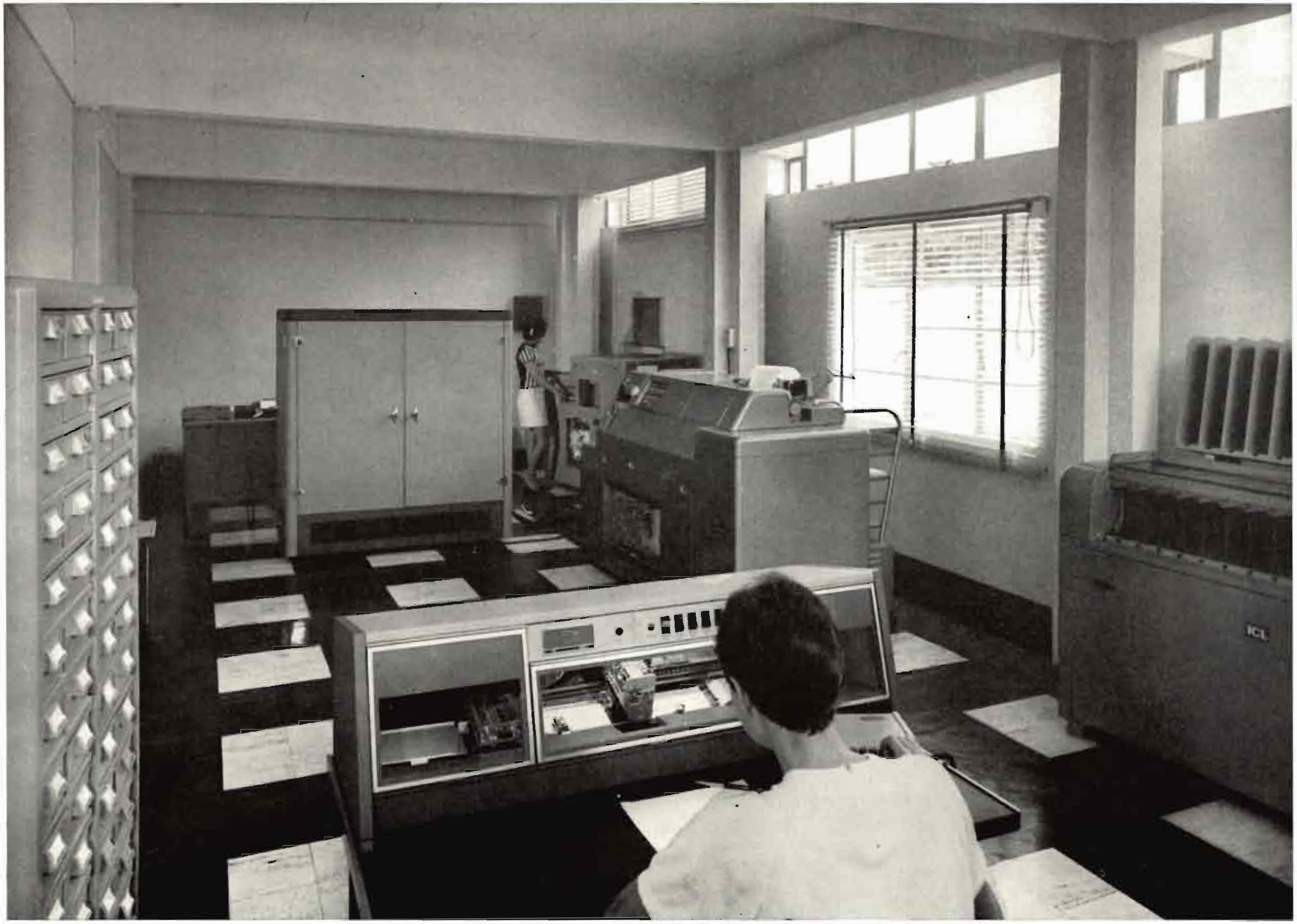
after attending the Caribbean symposium on nematodes of tropical crops, visited the West Indies, the U.S.A. and the United Kingdom.

The XVIIth meeting of the *Comité de Collaboration Agricole* was held in Mauritius from the 22nd to the 29th October, the Institute being represented by Dr. Wiehe, Chairman of the Committee, Messrs. Robert Antoine and P. du Mée.

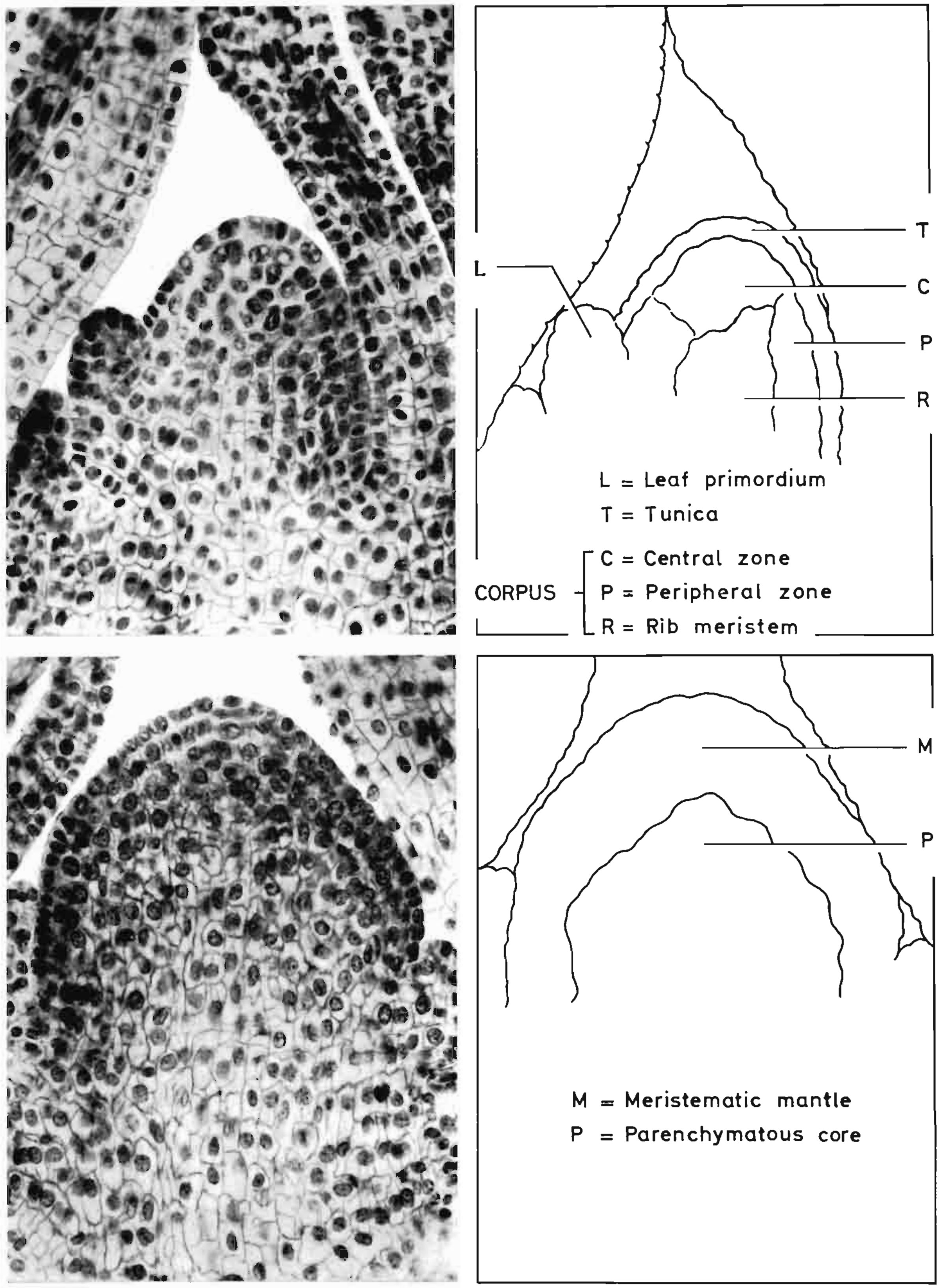
I should like to express, in the name of the former Director and in my own, our gratitude to estate managers and their personnel for their kind co-operation and the many facilities granted to the Institute for the conduct of experimental work and the collection of data. We would also like to thank the Director of Agriculture and his staff for their collaboration. Finally, it is a pleasure to record our appreciation of the loyal support given by the staff of the Institute during the year.

Director

25th February, 1969



Biometry Room



Histological changes during the transition of a vegetative apex to an inflorescence primordium.

Top : L. S. of a vegetative apex (X300)

Bottom : L. S. of a young inflorescence primordium (X300)

CANE BREEDING AND VARIETIES

1. INVESTIGATIONS ON THE PHYSIOLOGY OF FLOWERING

R. JULIEN

Development of floral buds

Investigations on the anatomy and morphology of vegetative and floral apices continued during the year. The transition from the vegetative to the floral state was studied in the following varieties: N:Co.376, N:Co.382, N.50-211, 47R.4066, Uba and *S. spontaneum* var. Krakatau. The anatomy of the vegetative apex was in general similar in all varieties studied. The vegetative apex may be divided into the following zones : the tunica, the central zone, the peripheral zone and the rib meristem; this is illustrated for variety 47R.4066 in Pl. II, a. The transition of the apex from the vegetative to the floral state is accompanied by a change in cellular organization of the corpus. The zones of the corpus lose their identity and are replaced by a mass of meristematic cells (Pl. II, b). Subsequent changes during growth and development of the primordium were similar to those described earlier for variety U.S.48-34. (JULIEN, 1968).

The development of the spikelets and florets were studied in varieties M.202/59 and *S. spontaneum* var. Krakatau. It was apparent that although the lowest branch primordia were initiated first on the axis of the inflorescence primordium, development of the spikelets was relatively slower on these branches compared to those on branches initiated later. It is tentatively suggested that a development hormone is synthesized at the tip of the inflorescence axis, so that the amount of hormone reaching the lowest inflorescence branches is relatively low, resulting in a slower development of spikelets on the lowest branches.

The role of leaves

(*i*) *Prior to initiation*

Plants of variety N:Co.376 were given various defoliation treatments at weekly intervals during the month of February. Initiation occurred in this variety during the first week of March. The time and percentage emergence were recorded for each treatment, and are presented in Table 1. Leaf numbering is illustrated in fig. 10

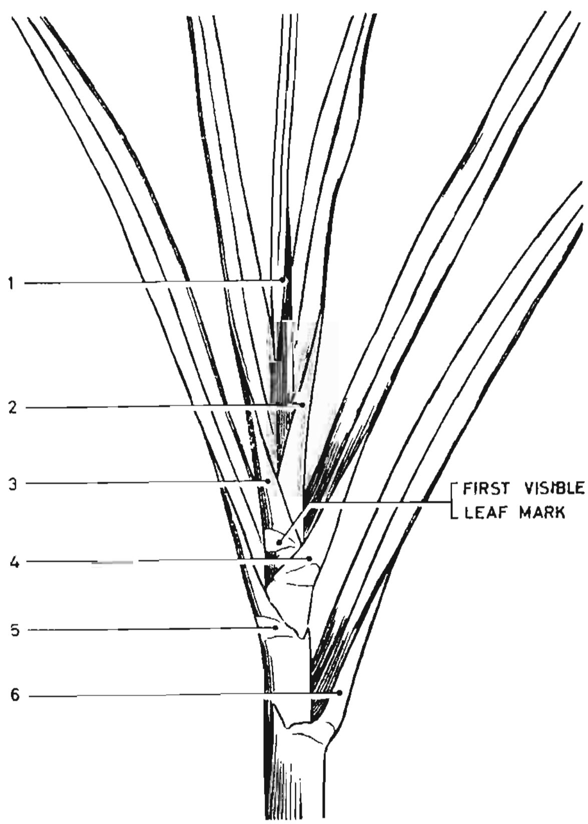


Fig. 10. Illustration of leaf numbering in variety N:Co. 376.

Table 1. **Effect of leaf-cutting treatments on mean no. of days to emergence* and % emergence.**

Treatment (Leaves left on plant)	*Mean no. of days to emergence**	*% Emergence*
1 only	∞	0
1 & 2	∞	0
1 to 3	∞	0
1 to 4	19.6	46
1 to 5	19.4	63
1 to 6	19.4	53
1 to 7	15.8	65
1 to 8	14.5	70
1 to 9	19.4	60
1 to 10	13.9	66
1 to 11	17.4	61
1 to 12	16.5	68

* Reckoned from 1st of May

The inhibition of initiation which resulted when only the very young leaves were left on the plant suggests that these leaves are not able to perceive the flowering stimulus. However, as the leaf area was considerably reduced in these treatments, inhibition may also have been due to insufficient amounts of carbohydrates reaching the apex. Further experiments have been set up in an attempt to elucidate this point.

(*ii*) *After initiation*

Plants of variety U.S.48-34 received various defoliation treatments at roughly weekly intervals during the month of March. The time taken for flower emergence for each stalk was recorded as number of days to emergence reckoned from 1st of April. A mean and its S.E. were calculated for each treatment and are illustrated in fig. 11.

Earlier studies on the growth and development of the inflorescence in variety U.S.48-34 have shown that infloreseence branches start initiating on the inflorescence primordium on the 10/3 and this process is completed by the 18/3 (Julien, 1968). Thus it appears that the presence of the young leaves is essential during the initiation of the inflorescence branches on the primordium as their removal delays emergence. The presence of older leaves is not required then, During subsequent stages of development of the inflorescence all the leaves appear to be necessary as all defoliation treatments delay emergence compared to control.

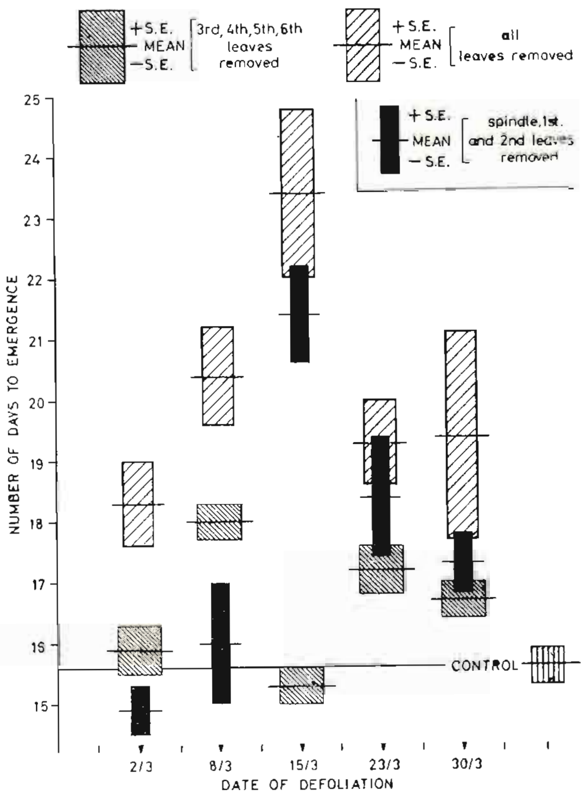


Fig. 11. Effect of defoliation treatments on time taken for emergence in variety U.S. 48-34, expressed as number of days from 1st April.

Daylength and Flowering

Plants of varieties U.S.48-34, N:Co.376 and M.12/49 were subjected to four cycles of three daylengths, 12h. 31 min. 12 h. 45 min. and 12 h. 53 min., as illustrated in fig. 12. Varieties N:Co. 376 and M.12/49 failed to flower even when given 20 cycles of any one of the three daylengths used. Control plots emerged on the 15th of May and the intensity of emergence was around 50%. It thus appears that either 20 cycles were not sufficient to induce flowering in these varieties, or that none of the daylengths used was optimum for flowering. On the other hand, 20 cycles of daylengths 12 h. 31 min. and 12 h. 45 min. induced flowering in variety U.S.48-34, but 20 cycles of daylength 12 h. 53 min. failed to do so. Further, plants of U.S.48-34 flowered when given 15 cycles of daylength 12 h. 45 min. but did not flower when given 15 cycles of daylength 12 h.

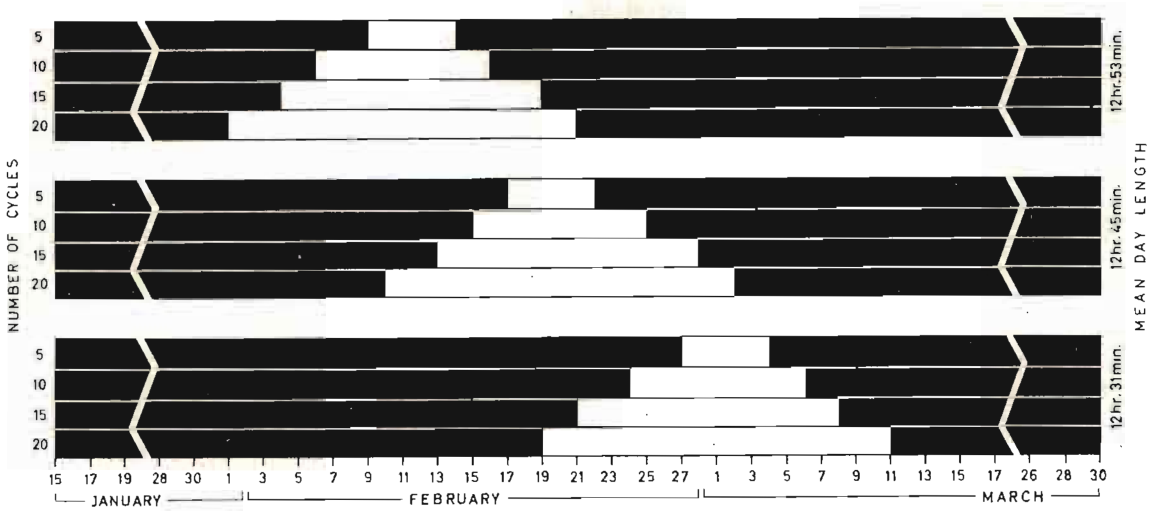


Fig. 12. Four different cycles of three photo-periodic treatments : mean day length of 12 hr. 31 min, 12 hr. 45 min. and 12 hr. 53 min. ■: 8 hour daylength; □: natural daylength.

53 min. It may be concluded that 12 h. 45 min. is the optimum daylength for flower induction in that variety. It also appears that the number of cycles required for photo-induction as well as the optimum daylength are not the same for the varieties used in this experiment.

The Role of Light

Effect of night break and defoliation treatments on flowering of S. spontaneum *var. Mandalay.*

Night interruptions and defoliation treatments were applied to plants of *S. spontaneum* var. Mandalay. The scheme adopted is described below.

(a) Defoliation treatments. These consisted in removing selected leaves from the plant during the following four different stages of the flowering cycle :

(i) Prior to initiation (3/2 — 26/2)
(ii) During initiation* of inflorescence primordium and inflorescence branches (26/2 — 20/3)
(iii) During initiation and development of spikelets and florets primordia (20/3 — 10/4)
(iv) Prior to emergence (10/4 — 30/4)

The defoliation treatments were :

Control — no defoliation
S — only spindle left on plant
S 1 — ,, ,, & 1st leaf left on plant
S 1 2 — only spindle & 1st & 2nd leaves left on plant
3 — only 3rd leaf left on plant
4 — ,, 4th ,, ,, ,,
3 + 4 — ,, 3rd & 4th leaves left on plant
NIL — complete defoliation

(b) Night interruptions. Half of the plots, after receiving the various defoliation treatments, were illuminated from 10 p.m. to 2 a.m. with 100 w Philips incandescent bulbs, during the different stages of flowering.

Results

(a) Defoliation Treatments without Night Breaks.

Removal of either young or old leaves, or complete defoliation, during the three weeks preceding initiation and emergence did neither promote nor delay flowering. However, when these treatments were applied during initiation of the inflorescence primordium and inflorescence branches, removal of older leaves resulted in earlier emergence compared to the control, and removal of young leaves resulted in delay and inhibition of emergence. Removal of the young leaves during the development of the spikelets

* Initiation started on or about the 24th of February in this variety.

delayed flowering by about 10 days, removal of older leaves during this stage did not result in earlier flowering (fig. 13).

(b) Simultaneous defoliation and Night Break Treatments.

Night interruption given just prior to initiation delayed emergence by 2 to 40 days depending on the type of defoliation treatment the plants had received. Removal of all leaves on the plant resulted in the greatest delay; however, this was accompanied by a marked reduction in percentage emergence (fig. 13).

Night interruptions given during the initiation of the inflorescence and of the inflorescence branches resulted in a delay of about 70 days in plants having either the spindle only, or the 3rd and 4th leaves. However, the intensity of emergence was very low (3.5%). Flowers did not emerge from plants having received other defoliation treatments. Dissection of the apices at the end of the experiment showed that initiation had taken place in most stalks (90%), but the primordia had either reverted to the vegetative stage and produced a "bunch top", or had not grown at all. In a few stalks, the inflorescences were fully differentiated but had stopped growing.

Night interruptions applied during the development of the spikelets delayed emergence by 30 to 45 days. In plots where only the

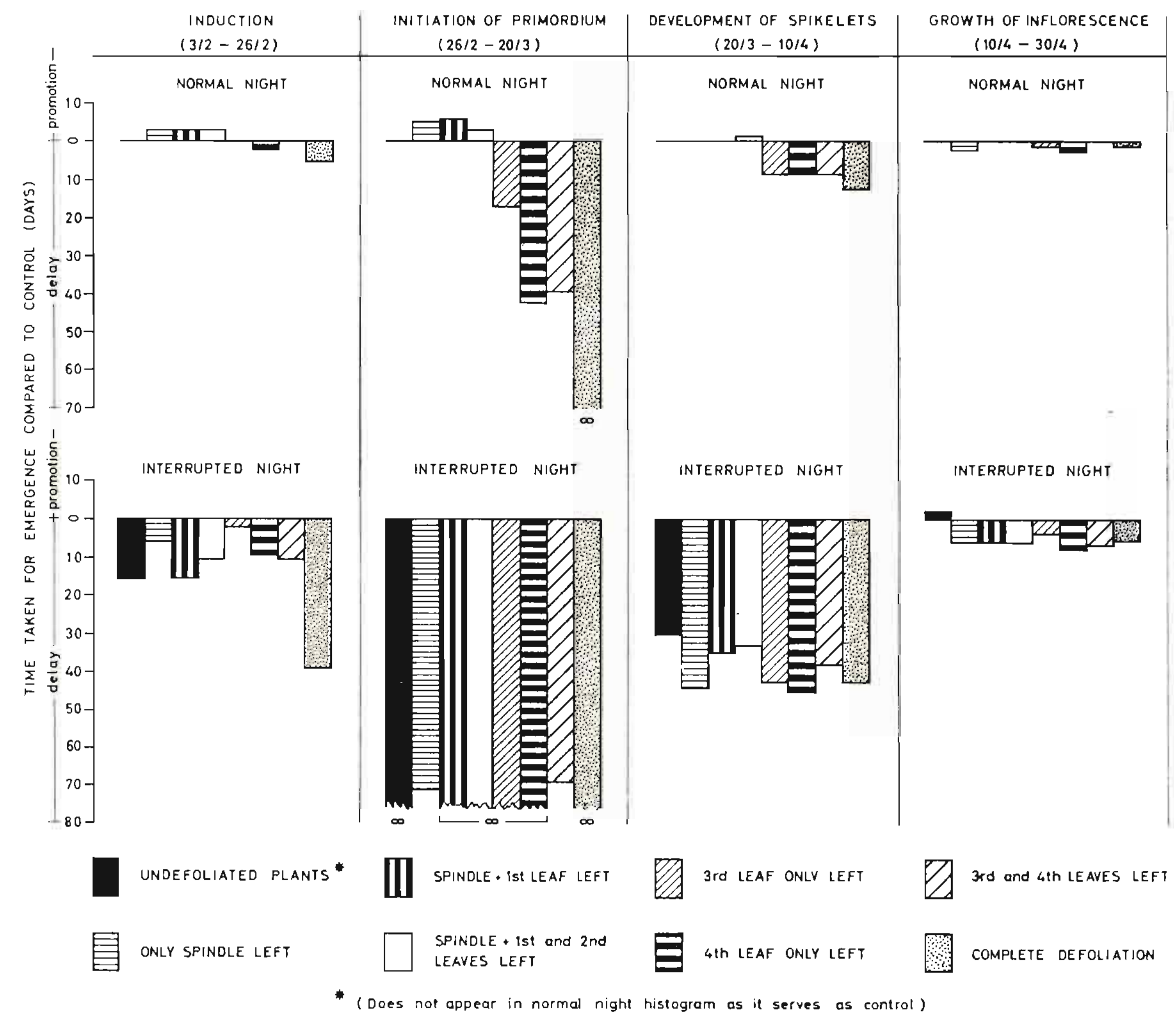


Fig. 13. Effect of defoliation and nightbreak treatments on time taken for emergence, compared to control, in *S. spontaneum* var. Mandalay.

spindle was left on the plants, delay was of the order of 45 days (fig. 13) and the reduction in intensity emergence was as low as 8%. This treatment will be of great value in delaying flowering in varieties which usually flower shyly, as it results in considerable delay and an insignificant reduction in intensity of emergence. It is hoped that by varying the intensities of light used for night-breaks and the number of days during which the treatments are given a gradual delay in flowering will be achieved and this should prove an important asset in the crossing programme.

The Use of Chemicals

(*i*) *CCC.* This chemical was applied at concentrations of 0, 1, 2 and 4 % to plants of variety N:Co.376 during three stages of flowering. These treatments had no effect on time of emergence but affected the intensity of emergence. Thus, when this chemical was applied at a concentration of 1% during development of the inflorescence primordium, it promoted emergence to a small extent, and when applied at a concentration of 4% prior to initiation it reduced emergence. However, flowering was neither promoted, nor delayed at a significant level.

(*ii*) *Phosfon.* Phosfon was applied at the rates 0, 25, 50 and 100 gm of 50% active chemical per cubic foot of soil to plants of variety Co.1186 and U.S.48-34. Although these treatments reduced growth in both varieties, neither the intensity of initiation and emergence, nor the time of emergence was affected.

(iii) *Cobaltous ion.* Cobalt chloride was sprayed at concentrations of 0, 0.5 and 1% on intact and defoliated plants of varieties P.R.980 and N.52-219, during two stages of flowering, just prior to initiation, and during the early stages of development of the primordium. Cobalt chloride applied during the early stages of development of the primordium to defoliated plants of N.52-219 delayed emergence by about 10 days. When applied to intact plants prior to initiation, or during the early stages of growth of the primordium, delay in emergence did reach a significant level in this variety. Cobalt chloride applied prior to initiation or during development of the primordium to intact or defoliated plants of P.R.980 delayed flowering by about 10-15 days. It must also be noted that the removal of lower leaves of variety P.R.980 during the early stages of development of the primordium resulted in a delay of 5-6 weeks, and there was also a marked reduction in the intensity emergence. Variety N.52-219 was not affected by the defoliation treatment.

(iv) *Indole*-3-*yl-acetic acid* (*IAA*). IAA was applied at concentrations of 0, 10 and 100 mg/litre to intact and defoliated plants of varieties N:Co.376 and M.81/52. The leaf cutting and auxin treatments were given at weekly intervals during the month of February. Plants treated with IAA emerged later than the control ,but differences did not reach the 5% significance level. Removal of lower leaves had no effect on time of emergence of variety N:Co.376, but resulted in earlier emergence in variety M.81/52. This is further evidence for the production of flowering inhibitors by lower leaves; however, as varietal differences are apparent, further investigations will be undertaken to elucidate this point.

IAA applied at concentrations of 10 and 100 mg/litre during growth and development of the inflorescence primordium did not promote or delay flowering.

(v) *Giberellic acid* (GA_3). GA_3 was applied at concentrations of 10 and 100 p.p.m. to intact and defoliated (only spindle and first leaf left) plants of varieties Beau-Bois, Rose-Bambou and N :Co.376 at weekly intervals during the four weeks preceding initiation. Intact and defoliated plants treated with GA_3 showed a marked increase in height compared to the control (Table 2).

Table 2. Effect of treatments on height (cm.) of variety N:Co. 376.

	Concentration of GA_3 in p.p.m. 0	10	100
Intact plant ...	151	162	204**
Defoliated ...	130	162	199***

L.S.D. at { P 0.01 = 41; P 0.001 = 55

Defoliation had no effect on time and intensity of emergence of varieties N:Co.376 and Rose-Bambou. Applications of GA_3 to

Table 3. Effect of treatments on intensity of emergence (Arc Sin $\sqrt{\%}$ Emergence) of variety N:Co.376.

	Concentration of GA_3 in p.p.m.		
	0	10	100
Intact plant ...	90	80	53***
Defoliated ...	81	45***	0***

L.S.D. at P 0.001 = 34

intact plants delayed and reduced to some extent the intensity of emergence.

However, when GA_3 was applied to defoliated plants flowering was more severely delayed and reduced at the low concentration and inhibited at the high (Table 3). The interaction between application of GA_3 and defoliation was highly significant. It must be noted that this interaction was not significant for increase in height. It is tentatively suggested that the lower older leaves produce an inhibitor which prevents the full inhibitory action of GA_3 on floral initiation; this inhibitor appears not to interfere with the promotive effect of GA_3 on growth. It is therefore also suggested that there are two metabolic pathways for the action of GA_3, one for growth, and the other for floral initiation. More critical experiments have been laid down to verify this point.

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2. THE BREEDING POLICY

J. A. LALOUETTE

General

The work started in 1967 on Selection Criteria was completed in 1968. Thus the four main selection stages have all been analysed according to predetermined criteria. It is hoped that uniformity in the selection pressure has been achieved.

A new feature of the Crossing Programme is the utilization of inflorescences from several seedlings of given families of early nobilisations as parents. This has been made necessary as it is impossible to maintain a sufficient number of representatives of early nobilisations in Breeding Plots. In such cases, the parents utilized in the cross were given the combination number from which they were obtained prefixed by the letters M.C. This system should enable rapid and accurate reference.

Three years have now elapsed since the new system of numbering M varieties by the year of sowing instead of the year of crossing was started. Such a procedure was necessary after adopting the practice of cold storage of fuzz, in order to facilitate and obtain a better control of field work. It is interesting to compare the results from these three series, M/66, M/67 and M/68. Relevant data are presented in Table 4.

Crossing

The policy followed during the period under review can be summarized as follows :-

(a) A reasonable number of combinations should be transplanted each year; the number is estimated to vary around 120.

(b) A reasonable number of locations should be allocated to each combination, so as to provide a fair chance of obtaining superior varieties and also of assessing the value of the parents involved; this number is estimated to be 150 ideally. The 150 locations when planted with bunches of 3 provide room for 450 seedlings/combination.

(c) In order to explore as wide a spectrum of parents and combinations as possible, combinations having already produced a reasonable number of seedlings, 1,000 or more, should not normally be repeated for the time being;

instead, their selected progeny should be used as parents in further combinations.

(d) Combinations of known low fertility should be repeated as often as necessary until a sufficient quantity of seedlings is obtained for the desired number of locations at transplanting. Further, an effort should be made to raise an increasing number of seedlings from this type of combination, for a period of years, in order to assess whether the preliminary indication that combinations of low fertility yield the most valuable seedlings proves true.

(e) The number of locations transplanted each year should not exceed 20,000, including special nobilisation combinations, this number being the absolute upper limit which can be handled with facilities available at present.

An examination of Table 4 will show that, on the whole, the figures are in agreement with the policy. Two features need be emphasized however. First and foremost, the number of seedlings transplanted per germinated cross has dropped from 115 in the M/66 Series to 53 and 50 respectively in the subsequent series.

Table 4. Analysis of seedling production for industrial cultivation

	M/66 Series	*M/67 Series*	*M/68 Series*	Total
1. *Combinations*				
No. Sown	216	91	174	
No. Germinated	188	78	128	
% Success	87.0	85.7	73.6	
2. *Parents involved in Combinations sown*				
No. of females	63	27	62	
No. of males	22	39	51	
No. both females & males	9	4	7	
Total parents ...	94	70	120	
3. *Crosses*				
No. sown	923	441	1,118	
No. germinated	689	271	516	
% Success	74.6	61.5	46.2	
4. *Germinated Combinations*				
Combs. yielding 8 sdlgs. and less % total germ. ...	22	31	30	
Combs. yielding 9 to 450 sdlgs. % total germ. ...	59	55	55	
Combs. yielding 450 & more sdlgs. % total germ. ...	19	14	15	
Crosses sown	843	382	917	
Crosses germinated	689	271	516	
% Success	81.7	70.9	56.3	
5. *Seedlings transplanted to the fields*				
Locations planted : Singles	—	10,204	9,684	
Bunches of 3	6,680	1,424	5,295	
3 Bunches of 3	6,594	—	—	
Total locations	13,274	11,628	14,979	
Total seedlings	79,386	14,476	25,569	
6. *Transplanted Seedlings/Cross*				
a) Total combinations sown :				
All crosses	86	33	23	
Germinated crosses	115	53	50	
b) Combinations germinated :				
All crosses	94	38	28	
Germinated crosses Combs. with 8 sdlgs. & less	2	3	2	
Combs. with 9 to 450 sdlgs.	40	25	19	
Combs. with more than 450 sdlgs.	343	174	140	
7. *Distribution of combinations sown*				
Different combinations	204	83	165	452
M/66 series repeated in M/67 series	5	5	—	5
M/66 series repeated in M/68 series	6	—	6	6
M/67 series repeated in M/68 series	—	2	2	2
M/66 series repeated in M/67 & M/68 series ...	1	1	1	1
Total different combinations for the 3 series ...	—	—	—	466
Totals sown	216	91	174	481

This tendency is even clearer when the number of transplanted seedlings per germinated cross is considered within the three categories of combinations defined. However, as the 481 combinations transplanted from the three series involve no less than 466 different ones, it is not possible at this stage to decide whether the crossing technique is deteriorating. It may well be that the urgency of the problems encountered in the selection process has diverted attention from the no less important aspect of the work : crossing. Investigations will therefore have to be started during the coming year.

The other point worth mentioning is that the drop in the number of seedlings produced has been partially neutralised by adapting the transplanting policy to the needs of the moment. Thus, the number of locations transplanted in each of the three series has remained reasonably constant within the limits defined above.

Propagation Plots

The new system having been in operation for two years it is possible to take a very preliminary glance at the figures obtainable. Table 5 gives information on control plots and Table 6 depicts the distribution of selections within categories of crop cycles.

Table 5. Analysis of control plots in propagation plots (character Brix x Weight)

Propagation plots selected in 1967
Locality — Minissy — Humid
Control varieties : M.147/44 & M.93/48

	Dates	*Age (Wks.)*	*Crop Cycle*	*Mean no. plots per sub-trial*	*Mean Cv/plot %*	*Cv Range %*
Planted	Oct. 1965					
Harvested V	Sept. 1966	45	V	76	23	20-29
Harvested 1R	Sept. 1967	52	1R	76	20	17-23
			V + 1R	76	18	15-20

Propagation plots selected in 1968
Locality — Minissy — Humid
Control Varieties : M.147/44 & M.442/51

	Dates	*Age (Wks.)*	*Crop Cycle*	*Mean no. plots per sub-trial*	*Mean Cv/plot %*	*Cv Range %*
Planted	Aug. 1966					
Harvested V.	Sept. 1967	55	V	30	16	12-21
Harvested 1R	Sept. 1968	52	1R	30	17	13-31
			V + 1R	30	15	11-27

Table 6. Distribution of selections within categories of crop cycles

Selection Criterion : Weight x Brix in the upper 75% tail area of the distribution on the results of either Virgin, or 1st Ratoon, or Virgin and 1st ratoon.

Locality : Minissy — Humid

Categories	*Selections % Plantations* — *1965 Plantations Selected in 1967*	*Selections % Plantations* — *1966 Plantations Selected in 1968*
V	7.09%	2.82%
1R	0.70	1.34
V + 1R = Cumulative	0.12	0.20
V & 1R	0.04	—
V & Cumulative	1.40	0.84
1R & Cumulative	0.55	1.19
V & 1R & Cumulative	1.99	1.39
TOTAL	11.89	7.77
Total excluding Virgins	4.80	4.95
Total diff. vties. planted	2566	2020

It is too early yet to comment fully on these figures. However, it is perhaps interesting to point out that the highest % selection in both years is in plant canes only. Varieties selected on the basis of plant cane results only are not planted in the following selection stages. Therefore if this tendency is confirmed, it may indicate that elimination of bad ratooners is operative at this selection stage and would support the case for recording plant cane results in variety trials as well.

1st Selection Trials

First Selection Trials were completely analysed for refractometric Brix, Weight and Brix x Weight for the 1st time in 1968.

The design, at this stage, consists of randomized blocks with 3 replicates, and a plot size involving 2 lines x 1.5 gaulettes (i.e. approximately 15 ft./line)

Cœfficients of Variability for this stage are presented in Table 7.

Table 7. Cœfficients of variability % per plot

	Dates	*Age (Wks.)*	*Crop Cycle*	*Brix* Cv Mean	*Brix* Cv Range	*Weight* Cv Mean	*Weight* Cv Range	*Bx × Wgt* Cv Mean	*Bx × Wgt* Cv Range
Planted ...	Nov. 1965								
Harvested V	Sept. 1966	41							
Harvested 1R	Aug. 1967	47	1R	4	3-5	14	11-19	14	11-20
Harvested 2R	Aug. 1968	54	2R	3	2-4	14	10-18	14	10-18
			1R + 2R	3	2-4	11	7-15	12	8-15

The distribution of selections within categories of crop cycles is depicted in Table 8.

The character under selection is Brix x Weight and the selection pressure is at the 85% probability level in the upper tail area.

Table 8. Distribution of selections within categories of crop cycles

Categories	*Selection % Plantations*
1R	1.49%
2R	2.98
1R & 2R	—
1R + 2R = Cumulative	0.30
1R & Cumulative	1.19
2R & Cumulative	2.98
1R & 2R & Cumulative	3.57
TOTAL ...	*12.5 %*

In all, 336 different varieties were planted in 1965 for selection at the completion of the 2nd ratoon in 1968. Of these, 36 varieties were planted simultaneously in two environments, namely humid and super-humid.

Varieties reaching the mark on cumulative results were selected to be planted in Variety Trials in 1969; these numbered 27, i.e. a selection rate of 8.04%. Three additional varieties were selected on the basis of their relatively high Brix, and a Kilo-Brix very near the required level. None of the 36 varieties planted in two environments, was selected in both of them and only 6 were selected at all; of these 5 reached the mark in the super-humid region and 1 in the humid region.

3. CROSSING AND SELECTION

L. P. NOEL, P. R. HERMELIN, & R. JULIEN

Crossing

Flowering was exceptionally heavy in 1968, a good number of varieties, among which 51 N.G. 142 and Kassœr, which had never flowered before did so.

It was thus possible to make some interesting combinations. Furthermore, a record number of crosses were attempted.

On the whole 1,301 crosses were made, involving 209 combinations with 137 parents, of which 69 were females, 60 males, and 8 male and female. 170 crosses were attempted for breeding purposes. A summary of the crossing work is given in Table 9.

Table 9. Crossing work in 1968

Station	*No. of crosses made* *Greenhouse Bi-parental*	*Fields Bi-parental*	*Total*
Réduit	1179	—	1179
Pamplemousses	—	122	122
	1179	122	1301

However, germination was on the low side for the 2nd year running. Incompatibility of parents may account partly for the poor results in that crosses giving only a small number of seedlings are being repeated. The problem, however, which is a cause for concern, is being closely investigated. A summary of the sowing done in 1968 is given in Table 10.

Table 10. Sowing in 1968

Crosses	*Year of crossing*	*No. of crosses* *not germinated*	*germinated*	*No. of sdlgs obtained*	*No. of combinations*
Involving nobilizations	1968	49	47	337	26
Commercials	1965 1966 1967 1968	381	513	25,569	125

The Breeding Plot at Union Park was replanted during the year and now includes 39 varieties.

The 42 varieties, imported from various sources, and planted in quarantine in 1966 were released and transplanted in the field at the end of September.

As only a small number of seedlings (15,488) was obtained in 1967, most of them were planted as singles. They will be selected in 1969.

Selection

Seedlings. The 82,986 seedlings planted in February-March 1967 were selected in March-April 1968 and 20,353 stalks were planted in Bunch Selection Plots in 4 environments : Pamplemousses, F.U.E.L., Réduit and Minissy.

Bunch Selection Plot. Selection started at the end of June with the brixing of controls in B.S.P. Out of the 23,406 varieties planted in 1966 only 13,242 had been selected in 1967 in virgins. The 10,164 varieties left over were selected in 1st ratoons in 1968, yielding 1,534 selections, all of the 1964 series. The varieties were planted at Minissy and replicated at Belle-Rive and Union Park.

Propagation Plots (Ratoons). As no replications had been established in the super-humid zone, the 2,020 varieties at Minissy only (humid zone) were brixed and weighed, and 102 varieties selected and planted in First Selection Trials at Réduit and Pamplemousses.

Propagation Plots (Virgins). 1,292 varieties in virgins in the two climatic zones were also brixed and weighed. Selection is to be carried out in 1969 in 1st ratoons.

First Selection Trials. The bulk of the work was conducted in the First Selection Trials. 803 varieties were brixed and weighed, and out of the 336 varieties present in 2nd ratoons, 28 were selected and sent to the Multiplication Plot. One variety from the 1st ratoon stage which had repeatedly shown adaptation to super-humid conditions was, exceptionally, sent to the Multiplication Plot stage. Three other varieties which had been temporarily discarded, having shown a certain degree of susceptibility to gumming in 1966, were re-included in the 1968 Multiplication Plot, bringing the total number of varieties to be planted in variety trials in 1969 to 32.

The electronic calculator was used for the first time in 1968, for selecting First Selection Trials, all stages of the selective process being now thus analysed. The same criterion, Kilo-Brix, used in 1967 for selection in Propagation Plots, was again used and is now standard practice in the selection scheme wherever possible.

The remaining varieties in virgins and 1st ratoons were brixed and weighed and data-processed. These data will be used for selection in 2nd ratoons.

A summary of selection work in 1968 is given in Table 11.

Table 11. Selection work in 1968

Station	*Stalks planted in B.S.P.*	*Varieties Planted in Prop. Plots*	*Varieties Planted in 1st Sel. Tr.*	*Selection made in 1st Sel. Tr.*
Réduit ...	962	—	63	1
Pamplemousses	8,572	—	39	6
Belle Rive ...	—	775	—	16
Union Park ...	—	759	—	2
FUEL-Union ...	6,014	—	—	—
Mon Désert-Minissy	4,805	1,534	—	7
	20,353	3,068*	102	32**

* This figure represents in reality 1,534 different varieties replicated in 2 climatic zones.

** Of this number, 29 varieties are 1968 selections, 2 other varieties were selected in 1966 and 1 in 1965, but had not yet been planted in variety trials.

4. VARIETY TRIALS

I. BORDER EFFECT IN VARIETY TRIALS

J. A. LALOUETTE & G. J. S. ROSS*

During the period 1963 to 1966, Variety Trials have always been laid out to accommodate twelve varieties including controls; the layout was either rectangular lattices, or randomized blocks with three replicates in each case; the plot size was 4 lines of 3 gaulettes that is approximately 30 ft and only the 2 middle lines have been weighed and sampled for determination of sucrose content.

During the 1967 crop, it was decided to investigate whether the possible gain in precision due to elimination of border effects compensated for the loss in precision due to smaller plot size. The border lines in eight experiments were therefore weighed separately, and the results for border lines, middle lines and total plot analysed. % standard errors per plot, i.e. cœfficients of variability, are presented below.

Crop cycles were as follows :

Trials planted in 1963, indicated as P.B. — /63 : 3rd ratoon

Trials planted in 1964, indicated as P.B. — /64 : 2nd ratoon

Trials planted in 1965, indicated as P.B. — /65 : 1st ratoon

* Rothamsted Experimental Station, Harpenden, Herts, England.

Table 12. Percentage Standard error per plot and correlation cœfficients for border and middle rows in Variety Trials

Character : Weight of plot

	% Standard error/plot			Correl. Cœff.
Lattices (13 degrees freedom)	*Border*	*Middle*	*Total*	*Bor./Middle*
Trial P.B. 26/63	12.3	13.7	11.5	+ 0.59
Trial P.B. 36/63	16.4	10.9	10.0	+ 0.01
Trial P.B. 22/64	6.7	8.7	3.2	— 0.69
Trial P.B. 29/64	10.5	8.5	6.9	+ 0.05
Trial P.B. 30/64	8.9	10.5	6.9	0.00
Randomized Blocks (22 degrees freedom)				
Trial P.B. 26/63	17.7	14.2	13.9	+ 0.49
Trial P.B. 36/63	16.4	12.1	11.3	+ 0.22
Trial P.B. 22/64	14.8	8.7	8.6	+ 0.02
Trial P.B. 29/64	9.6	9.1	6.3	— 0.09
Trial P.B. 30/64	9.4	11.3	7.8	+ 0.12
Trial P.B. 11/65	21.9	18.9	17.1	+ 0.40
Trial P.B. 17/65	12.2	11.5	7.5	— 0.19
Trial P.B. 29/65	15.7	6.9	9.0	+ 0.15

If cœfficients of Variability are thus defined :

Cb = Cœfficient of Variatiliby for border lines $= \frac{Sb \times 100}{Mb}$

Cm = Cœfficient of Variability for middle lines $= \frac{Sm \times 100}{Mm}$

Ct = Cœfficient of Variability for border + middle lines $= \frac{St \times 100}{Mt}$

Where Sb = Residual standard deviation for border lines;
Mb = Mean value for border lines;

and Sm, Mm, St, Mt, apply *mutatis mutandis* to middle lines and to the total of border and middle lines; and, if it is assumed that the mean of border lines (Mb) is approximately equal to that of middle lines, (Mm).

then :
(i) Mt is approximated equal to 2Mb and to 2Mm,
(ii) $St^2 = Sb^2 + Sm^2 + 2$ Co-Variance (b, m),
(iii) Ct^2 is approximately equal to $\frac{1}{4}$ ($Cb^2 + Cm^2$ 2 + Cbm).

Where Cbm is the residual co-variance expressed as a percentage of the product of border and middle means.

If errors of border and middle lines are uncorrelated, then Ct^2 is approximately equal to $\frac{1}{4}$ ($Cb^2 + Cm^2$) and in oder to gain accuracy from inclusion of border lines, i.e. in order that Ct be equal to or smaller than Cm, Cb must be less than $\sqrt{3} \times$ Cm.

If Cb is greater than $\sqrt{3} \times$ Cm, there is definitely no advantage in combining the lines.

If errors of border and middle lines are correlated, negative correlation will ensure greater benefit than expected and positive correlation will ensure less benefit than expected when combining the lines.

Correlation cœfficients between border and middle lines have been calculated and are presented in Table 12.

Conclusions

From this table it can be seen that combining border and middle lines generally improves slightly the precision of the experiments by lowering the cœfficient of variability of total plot compared to middle lines. This lowering of the cœfficient of variability is on average about 27% for lattices and 12% for randomized blocks. This is equivalent to the effect of an increase in the number of plots of 88% for lattices and 29% for randomized blocks, i.e. more than that of adding two extra replications in the first case and about one replication in the second. In one case, however, (P.B. 29/65), the border lines have a cœfficient which is more than twice that of the middle lines. This causes an increase in the C.V. of the total plot due to inclusion of border lines amounting to 30% of its value. If facilities were available, it might be possible to weigh border lines separately for every trial, and then depending on conditions decide on the advisability of adding border and middle lines together; however, this would entail exactly twice the amount of work in the fields and cannot be envisaged under prevailing conditions. Further, it is known that the retention of edge lines will give biased estimates of the treatment differences due to trespassing and competition effects of the treatments on the edge lines (COOMBS 1934). It is therefore considered reasonable to continue the current practice of rejection of border lines.

Thanks are due to Field Officers who took charge of the extra weighings and to the Statistics Department, Rothamsted Experimental Station, Harpenden, Herts, England, for analysis of data on their computer.

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II. SUMMARY OF RESULTS FROM TRIALS PLANTED IN 1964

J. A. LALOUETTE, L. P. NOEL & G. ROUILLARD

No Variety Trials were laid out in 1968. The number of varieties undergoing screening at this stage of selection is given in Table 13.

Table 13. Varieties planted in Variety Trials

	1965	1966	1967	*Totals*
M/54 Series	4	—	—	4
M/55 Series	17	—	—	17
M/56 Series	7	—	—	7
M/57 Series	18	1	1	20
M/58 Series	8	6	—	14
M/59 Series	—	16	22	38
M/60 Series	—	—	20	20
Sub total	54	23	43	120
Ebène Varieties ...	5	—	—	5
Foreign Varieties ...	—	4	—	4
Total	59	27	43	129
No. of Series ...	5	3	3	

Trials planted in 1964 were harvested in 3rd ratoons in 1968; the four basic characters have been analysed for every crop cycle available and for their cumulative values. Mean cœfficients of variability are presented in Table 14.

Of the fifty-six varieties planted in 1964 for selection after the 3rd ratoon crop in 1968, two are already released, namely M.442/51 and M.377/56, leaving fifty-four.

Of these fifty-four varieties, forty had to be rejected for the following reasons :

Rejected Varieties

Highly Susceptible to gumming disease ...	11
Susceptible to gumming disease ...	4
Slightly Susceptible to gumming disease, poor performance	7
Resistant to gumming disease. poor performance	17
No information on gumming disease. poor performance	1
Total ...	40

Varieties which should be re-tested

Of the fourteen varieties left, the performance of which is discussed below, ten are resistant, one moderately resistant and three are slightly susceptible to gumming disease.

The three varieties slightly susceptible to gumming disease are :- M.359/53, M.146/55, M.144/56.

It should be mentioned here that it is only since 1966 that all varieties in Variety Trials are being tested simultaneously in the four main climatic zones. It follows therefore that inform-

Table 14. Variety Trials planted in 1964 : mean cœfficients of Variability % plot

Crop Cycle	*No. of trials*	*Sub-Humid Characters* W.	*I.*	*S.*	*P.*	*No. of trials*	*Irrigated Characters* W.	*I.*	*S.*	*P.*	*No. of trials*	*Humid Characters* W.	*I.*	*S.*	*P.*	*No. of trials*	*Super-Humid Characters* W.	*I.*	*S.*	*P.*
1R (1966) ...	4	14	4	14	15	5	10	4	12	14	4	15	4	16	17	5	13	5	14	16
2R (1967) ...	4	12	4	12	13	5	12	5	17	15	5	12	5	13	15	5	12	5	14	16
3R (1968) ...	3	21	5	21	24	3	11	5	13	15	3	15	5	15	17	3	11	4	12	12
1R + 2R ...	4	9	3	9	10	5	9	4	11	12	4	10	3	12	12	5	11	4	12	13
1R + 2R + 3R	3	11	3	11	12	3	9	4	10	11	2	10	3	11	11	3	10	3	11	11

Characters W = Weight of Plot (Kgs)

I = I.R.S.C.

S = Sucrose per plot (Kgs) $= \frac{W \times I}{100}$

P = Profitable sucrose per plot (Kgs)

$= \frac{W \times (I - 4)}{100}$

ation derived in earlier trials on the performance, under certain environmental conditions, of some varieties is lacking.

Furthermore, considering the outbreak of the new epidemic of gummosis, it has been decided that resistant varieties, comparable to the controls, should be re-tested before a decision is taken as to their future. This is a precautionary measure, in case the resistance to gummosis of one or more of the canes released for commercial planting may break down.

Varieties		*Parents*		
M.359/53	:	E.1/37 x Co.290	—	Is a reasonable yielder compared to the controls in the super-humid zone.
M.146/55	:	E.1/37 x Co.419	—	Is a rich cane with yields on the low side; it can be discarded for the super-humid area.
M.144/56	:	M.241/40 x M.147/44	—	Is comparable to the controls in the four climatic zones; there is a slight indication that it might prefer the super-humid and humid zones.

The situation regarding the eleven varieties resistant to gumming disease is as follows :-

Varieties		*Parents*		
B.49119	:	B.35218 x B.4098	—	Is a high yielder with low sucrose content and appears adapted to the super-humid regions only. It is possible that its sucrose content might improve if harvested late.
M.428/51	:	M.377/41 x M.213/40	—	Rich cane, yields comparable to control in the humid and irrigated areas, and rather lower in the sub-humid area.
M.356/53	:	E.1/37 x Co.290	—	Information is available only in the irrigated area where it appears to be rich.
M.361/53	:	E.1/37 x Co.290	—	A rich cane, with yields on the low side; it appears adapted to the humid and super-humid areas.
M.346/54	:	B.37161 x M.423/41	—	Poor performance in irrigated area, but comparable to control in super-humid area.
M.357/54	:	E.1/37 x Co.419	—	Poor performance in irrigated area. Rich cane in super-humid area.
M.461/54	:	B.34104 x M.63/39	—	This variety is comparable to controls in the sub-humid zone only.
M.16/57	:	N : Co.310x M.147/44	—	Rich cane in the sub-humid and super-humid areas.
M.361/57	:	P.O.J.2878 x M.147/44	—	Comparable to controls in the four zones.
M.379/57	:	E.1/37 x M.202/46	—	Comparable to controls in sub-humid area only.
M.64/58	:	Co.421 x M.147/44	—	Comparable to control in sub-humid, irrigated and humid areas.

Discarded varieties

Varieties highly susceptible to gumming disease :
M.260/54, M.314/54, M.518/54, M.270/56, M.356/56, M.387/56, M.6/57, M.55/57, M.81/57, M.142/57, M.183/57

Varieties susceptible to gumming disease :
Q.68, Q.70, M.151/57, M.180/58

Varieties slightly susceptible to gumming disease ; poor performance :
C.B.45-6, M.197/55, M.202/56, M.35/57, M.96/57, M.125/57, M.115/58

Varieties resistant to gumming disease ; poor performance:
H.39-7028, H.44-3098, M.193/54, M.323/54, M.377/54, M.221/55, M.265/56, M.352/56, M.357/56, M.358/56, M.385/56, M.30/57, M.133/57, M.134/57, M.36/57, M.137/57, M.412/57

Varieties of poor performance, no information on gumming disease reaction :
M.252/53

New open Pathology greenhouse

Stem galls observed in M.31/45

CANE DISEASES

1. GUMMING DISEASE

CLAUDE RICAUD

Disease situation and varietal replacement

The distribution of gumming disease (*Xanthomonas vasculorum*) in commercial plantations during the year under review was, as in 1967, restricted to a few foci principally in M.147/44. The disease was, on the whole, of moderate intensity, restricted mainly to foliar infection, except, as usual, in canes growing in dark magnesium clay soils under spray irrigation, where the incidence of systemic infection was high.

The replacement of highly susceptible and condemned varieties is progressing on estates and large planters' land where the percentage area cultivated under such varieties has dropped from 39 to 22 during the four years following the outbreak of the new epidemic (fig. 14). With the release of varieties which have confirmed their resistance, at least to systemic infection, and their superior performance, it appears that the replacement of M.147/44 in such plantations should be completed before the date line, i.e. the end of 1973.

The picture in small planters' land is not so bright. A recent report from the Extension Service of the Ministry of Agriculture showed that at the end of 1967, 26,830 arpents were still under highly susceptible varieties, mainly M.147/44, representing 42.8% of the total cane land belonging to those planters. As they usually replant an average of only about 4% of the area in the sub-humid zone annually, it is difficult to foresee the complete removal of M.147/44 from small planters' fields by the end of 1973, unless special and vigorous steps are taken.

Three varieties are now available for the replacement of M.147/44, namely : M.442/51, M.13/56 and M.377/56. The excellent yields obtained in 1968 with M.13/56 in sub-humid areas and the fact that this variety has a good sucrose content at the beginning of the crop season make it an ideal replacement for M.147/44 for early harvesting and a good complement to M.442/51, a late maturer.

The case of M.377/56 deserves special consideration. This variety had been rated resistant in two resistance trials but had shown susceptibility in the field in 1967. Re-included

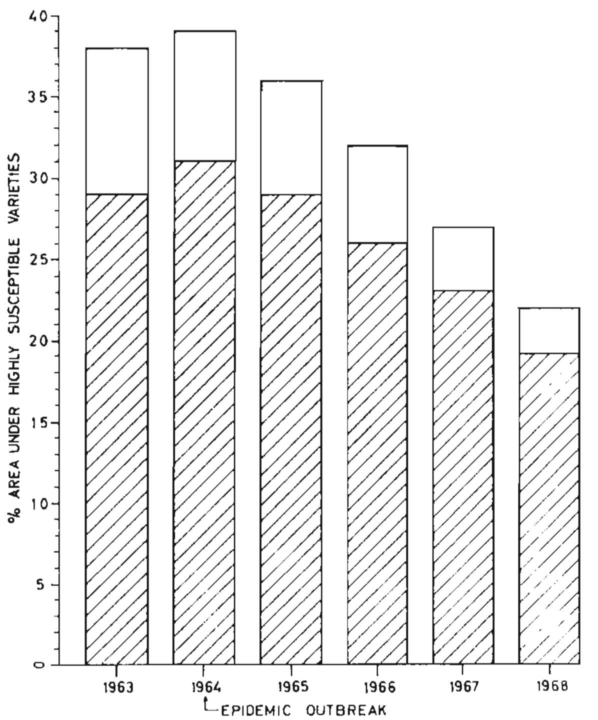


Fig. 14. Trend in the replacement of highly susceptible and condemned varieties on estates and large planters' land. Plain : B. 3337 & B. 34104 ; Shaded : M. 147/44.

in the 1968 trial, susceptibility to foliar infection has this time been noted. Furthermore, cases of systemic infection, with chlorosis of leaves, have been observed in 2-3 months' old plant canes in three nurseries, and two fields in first ratoon, just after harvest. Yet, despite intensive surveys throughout the island, no cases of systemic infection developing from natural secondary foliar infection in mature canes have been observed. The systemic symptoms observed so far are therefore attributed to direct infection by contaminated knives at harvest and during preparation of cuttings.

In the light of these observations, special precautions should be taken in the cultivation of this variety :

(i) It should not be cultivated in the vicinity of M.147/44 under conditions where the spread and intensity of the disease is severe, and priority should be given to M.13/56 for the replacement of M.147/44 in those regions.

(ii) Nurseries should be surveyed frequently, and stools showing chlorosis rogued so as to reduce the sources of contamination by knives.

(iii) Knife sterilization should be rigidly followed when cutting nursery canes and preparing cuttings.

It should be stressed that the behaviour of this variety in future will depend greatly on the rate of replacement of M.147/44 which, up to now, constitutes the main source of infection in the island. Unless this replacement is hastened, the gumming epidemic which started in M.147/44 may well be carried over in M.377/56.

Systemic infection with heavy gum exudation from cut stalks at harvest was observed in two variety trials on M.409/51 which had so far been rated resistant. Foliar infection was by no means heavy in both cases and, there again, systemic infection must have developed from knife contamination. The behaviour of M.409/51 supports the view that a variety may be moderately susceptible to foliar infection but highly susceptible to systemic infection, and confirms previous findings that contamination by knives may maintain a high level of systemic infection in a field where foliar infection may be low. As M.409/51 has shown an erratic performance so far, the cultivation of this variety is no longer recommended.

Resistance trials

Only one resistance trial involving the first stage testing with the new strain of the pathogen was conducted in 1968. Included were 274 varieties : 58 foreign and 216 local, of which 7 were being re-tested.

The level of infection in the trial was rather low, the majority of M.147/44 control plots showed moderate susceptibility. The proportion of resistant and susceptible varieties are shown in Table 15.

Table 15. Reaction of varieties to the new strain in the 1968, first stage, gumming resistance trial

*Rating**			*No. of Varieties*	*% of total tested*
Resistant		1 ...	25	9.1
		2 ...	161	58.8
Susceptible		3 ...	67	24.4
Highly Susceptible	Foliar infection	4 ...	18	6.6
	Systemic infection	5 ...	1	0.4
		6 ...	2	0.7
		7 ...	0	0

* Numbers correspond to the following ratings :
1. Absence of leaf stripes.
2. Few short stripes on old leaves.
3. Long stripes on old leaves, short stripes on young leaves.
4. Heavy striping.
5. Heavy striping and chlorosis.
6. Gum exudation from stalk after sweating test.
7. Death of stalks.

Of the Mauritian varieties re-tested : M.144/56 and M.145/56 were slightly susceptible; M.260/55, M.130/57 and M.393/57 susceptible, while Ebène 74/56 and M.377/56 showed high susceptibility to foliar infection.

Foreign varieties which showed susceptibility were the following :

Moderately Susceptible :	I.216, Q.61, 58 B 38, B.50112, B.51129, B.52298, 51 R.124, Mol.5843, Cl.41-223, PR.1048.
Highly Susceptible :	B.46364, B.47135, B.5336, Co.527, D.141-46, H.382915, 51 N.G. 56, PR999 & PR1016.

The behaviour of M.409/51 and M.377/56 has confirmed that, contrary to observations in other countries in the past, some varieties may escape infection in resistance trials and show susceptibility later and that it is therefore essential that testing for resistance should be replicated both in environment and in time. This year, the new second stage testing has been replicated in three trials, one with the old strain and two with the new strain. Of the last two, one is conducted in a field of dark magnesium clay soil under spray irrigation, where the disease has always been severe. Replication in different localities is preferable to replication of plots in a single trial. Thirty-five varieties coming out of first selection trials have been included in these three trials, together with 13 others which are being re-tested.

In the new trial established for the first stage testing, with the new strain, 100 varieties have been planted.

Other investigations

Studies, conducted in order to assess the reactions of progenies from different combinations involving susceptible and resistant parents, reported last year, were continued. Another series of crosses were carried out and the seedlings will be planted early in 1969.

A request for fuzz from some African countries has prompted research on the possible transmission of certain vascular diseases by the true seed. Studies were initiated this year in order to determine whether gumming disease may be transmitted by the true seed. Several stalks of some varieties which are potential females and also known to be highly susceptible to the disease, were inoculated by various methods with bacterial suspension, some of them just prior to flower emergence. Flowers from these stalks were crossed with those of M.147/44 by the usual methods. Naturally infected stalks of M.147/44 showing positive signs of systemic infection were also selfed.

An enrichment culture in peptone broth was prepared with the fuzz from these crosses, after surface-sterilization by various methods. This was later inoculated in young stools of M.147/44.

The experiment failed to reveal any seed-borne infection. As the success of such an experiment may be influenced by many variables, e.g. method and success of inoculation of flowering stalks, method of surface sterilization of seeds, the studies will be repeated in 1969 with more refined techniques.

2. LEAF SCALD

An improvement in the method of assessing resistance

Methods employed so far in various cane sugar producing countries for testing resistance to leaf scald have not proved quite satisfactory. Assessment based solely on symptom expression in stools inoculated with a maceration prepared from chopped-up diseased stalks does not always give a reliable estimate of reaction to infection under natural conditions. Although inoculation by knives is known to play an important part in the spread of the disease in the field, the level of inoculum under such natural conditions may be very low compared to artificial inoculation. Also, transmission no doubt occurs in the field through other agencies which, though suspected, have not yet been elucidated.

For these reasons, the method adopted by this Institute consists in observing the behaviour of both inoculated and non-inoculated stools growing in adjacent rows.

The susceptibility of a cane variety to leaf scald depends on :

(i) its ability to contract infection easily;
(ii) the persistence of infection in infected stalks and development of infection in secondary tillers;
(iii) the development in infected stools of a sufficient amount of inoculum so that the disease may be spread by natural means and by knives.

Based on these assumptions, the development of symptoms in inoculated and non-inoculated rows of test varieties were followed in the resistance trial in an attempt to obtain more precise information on the reactions of varieties under test. Results obtained this year have been encouraging.

The trial, planted in 1966, included 24 varieties and two controls : M.202/46, highly susceptible and M.31/45, resistant. Each variety was represented by a plot of 4 rows x 15 feet, the plots being bordered or separated from one another by a contaminating row made up of a mixture of susceptible varieties. The trial was inoculated in first ratoon early in 1967, three months after harvest, according to the method devised in 1960* with the aluminium cap modification of Hawaii. The two middle rows of each plot of test variety, as well as the contaminating rows were inoculated, so that the non-inoculated external rows in each plot were flanked on both sides by infected cane. The shoots in these external rows were only cut back above their growing point, without inoculation.

No symptoms were observed in the test plots in 1967 and only very few in the contaminating rows. The trial was cut at the end of that year without knife sterilization in order to spread any latent infection from inoculated rows to the non-inoculated canes. A few symptoms then developed in both inoculated and non-inoculated rows of M.202/46, M.130/57, M.260/55 and M.124/59.

The trial was re-inoculated in February 1968, three months after harvest, following the usual procedure, except that, this time, knives were sterilized in between plots when cutting the non-inoculated rows.

Table 16. Mean percentage of infected shoots for 6 surveys during 7 months in leaf scald resistance trial

Group	*Variety*	*% Infected shoots* *Inoculated*	*Not inoculated*	*Mean*
I. (0-5%)	M.31/45**	3.3 (0)*	1.7 (0)	2.4
	M.442/51	4.5 (0.1)	4.2 (0.2)	4.4
	M.13/53	5.6 (0.3)	2.2 (0.1)	3.9
	M.13/56	2.4 (0.1)	3.4 (0.2)	2.9
	Eb.74/56	6.2 (0)	2.7 (0)	4.4
	Eb.88/56	3.5 (0)	5.0 (0)	4.3
	B.51129	2.3 (0.2)	1.8 (0)	2.1
	B.52107	6.9 (0)	1.8 (0)	4.3
	N : Co.376	1.4 (0)	2.5 (0.1)	1.9
II. (5-10%)	M.99/48	7.0 (0.1)	3.6 (0)	5.3
	M.484/51	5.4 (0)	5.9 (0.4)	5.7
	M.359/53	10.3 (0.2)	7.9 (0.7)	9.1
	M.351/57	6.9 (0)	4.8 (0.3)	5.9
	M.579/59	11.4 (1.2)	8.3 (0.8)	9.8
III. (10-15%)	M.409/51	19.2 (2.6)	7.2 (0.4)	13.2
	M.356/53	15.8 (0.4)	8.9 (0.2)	12.4
	M.361/53	12.9 (1.9)	7.4 (1.2)	10.1
	M.220/56	12.2 (0.6)	8.5 (1.1)	10.3
	M.84/57	8.6 (0.1)	12.2 (0.5)	10.4
	M.124/59	14.6 (1.9)	10.3 (0.8)	12.5
IV. (15-20%)	M.377/56	18.1 (1.9)	14.2 (3.3)	16.5
	M.1007/59	16.0 (0.8)	19.2 (3.2)	17.6
	S.17	19.8 (4.1)	14.1 (2.8)	17.0
V. (20-25%)	M.202/46***	23.4 (4.8)	21.7 (8.1)	22.2
	M.260/55	24.5 (3.4)	19.2 (3.6)	21.9
VI.	M.130/57	25.5 (8.1)	24.9 (8.6)	25.2

* Figures in brackets denote % shoots showing scalding or systemic choloris
** Resistant control
*** Highly susceptible control

* *Vide Rep. Maurit. Sug. Ind. Res. Inst.* **9** (1961) : 55-56

Symptoms developed soon after in both inoculated and non-inoculated rows in all varieties. The percentage of total infected stalks including those with only positive leaf stripes, and those with systemic chlorosis or scalding, were determined 2 months after inoculation in both inoculated and non-inoculated rows and subsequently at intervals of 1 to 2 months throughout 1968.

On the basis of the mean percentage infection in inoculated and non-inoculated rows throughout the period of observations, the varieties could be classified into arbitrary groups of varying orders of susceptibility and compared to the controls (Table 16).

The development of infection in the control varieties and a few others, showing different degrees of susceptibility, is presented in fig. 15.

Although disease development in the non-inoculated rows was not due solely to natural infection, normal conditions of spread of the disease have been reasonably reproduced, i.e. a combination of natural infection and spread by knives from canes with latent infection. Attention should be drawn to the effect of cutting back the young shoots above the growing point upon symptom expression in these non-inoculated rows.

The varieties in Group I showed a fairly high resistance in both inoculated and non-inoculated rows. The results with M.442/51, M.13/53, M.13/56 and N:Co.376 confirm observations on their behaviour on a plantation scale, whereas those of Ebène 88/56 are not in agreement with field observations, this variety having shown a high level of infection in certain plantations.

At the other end of the scale, M.260/55 and M.130/57 are rated highly susceptible; a high level of infection had already been observed in the latter cane in variety trials.

Among varieties in the intermediate groups, some were highly susceptible to inoculation but rapidly recovered from infection.

Attention should be drawn to the moderate susceptibility of M.377/56 and S.17 varieties in which a few cases of leaf scald have also been found in variety trials and nurseries. The recommendations made earlier in this report, in connection with the control of gummosis in M.377/56, apply here as well i.e. rogueing in nurseries and sterilization of knives during preparation of cuttings.

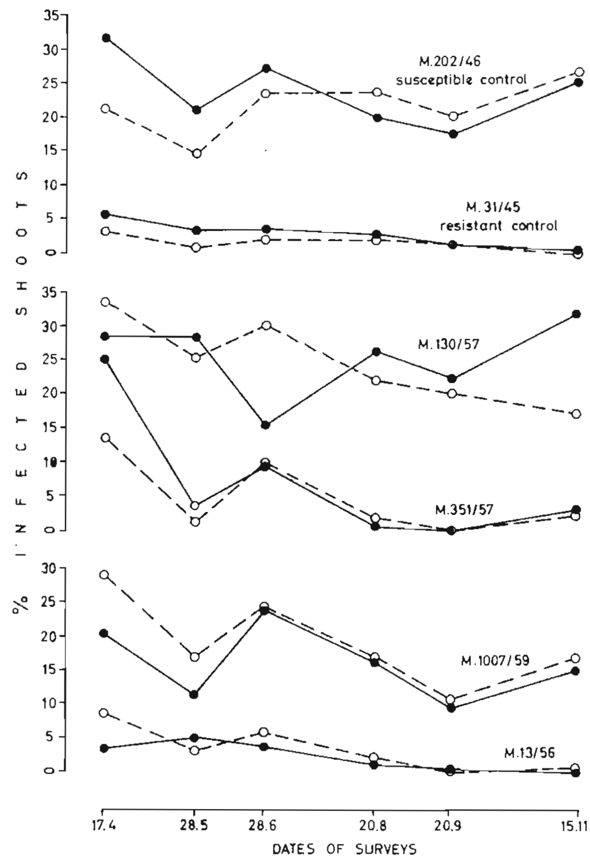


Fig. 15. Development of infection in control and certain test varieties in the leaf scald trial.
(Plain line : inoculated rows ; broken line : non-inoculated rows.)

3. CHLOROTIC STREAK

Although the short hot-water treatment of cuttings (52°C/20 mins) against chlorotic streak ensures uniform stand in plantation and is effective in the plant crop, it does not give complete control of the disease. As a result, re-infection may be very rapid and can be appreciable even in the virgin crop and generally attains maximum level in first ratoon. Until resistant varieties are produced, more efficient control of the disease should depend on cultural methods that would slow-down the rate of re-infection. While investigations are being pursued on the nature and mode of transmission of the pathogen, a first attempt in disease control was made along the lines mentioned.

Previous studies on the transmission of the disease have indicated that such transmission is more rapid in water culture and sterilized basalt sand culture than in soil, even when a high level of soil moisture is maintained. Similar results have been obtained elsewhere and, furthermore, it has been found that disease transmission is more easily obtained in sterilized than in unsterilized soil. Such differences could very well be due to antibiosis in soil.

In view of the fact that scums and molasses may have an effect on soil microflora and antibiosis, it was decided to compare the effects of such organic fertilizers to those of inorganic ones on the rate of re-infection by chlorotic streak.

Investigations carried out by the agronomy division in the past have shown that scums and molasses provide no additional benefit to the cane plant apart from their supply of P and K. The present studies were therefore conducted solely in an attempt to detect whether there was any differential response to infection in two varieties — one highly susceptible to chlorotic streak : M.442/51, and the other only slightly susceptible : M.93/48 — when supplied with organic as compared to inorganic fertilizers.

A 4 x 2 factorial field experiment was set up in 1966 with the following treatments :

- (i) Scums + molasses
- (ii) Scums + muriate of potash
- (iii) Triple superphosphate + molasses
- (iv) Triple superphosphate + muriate of potash

The two factory residues were applied at the rate of 5 tons/arpent and the mineral fertilizers at proportional rates to give equal amounts of P and K in all plots. A top dressing of sulphate of ammonia was applied throughout. Individual stools were planted separately along rows to facilitate surveys. All cuttings were treated at 52°C/20 mins.

The experiment was not weighed in virgin as the canes were too small and infection in the trial was still very low. The same fertilizer applications were given after harvest.

The results in 1st ratoon, in 1968, showed no significant differences in yield or millable stalk count between various treatments, or any interaction between variety and treatment, in agreement with previous findings on the relative value of the organic and mineral fertilizers concerned. The experiment will be continued in higher ratoons, with the same fertilizer treatments applied annually, in an attempt to detect whether ratooning capacity may be eventually affected.

Surveys on symptom expression have revealed a much greater build up of infection in M.442/51 than in M.93/48, as was to be expected. Differences in rate of re-infection in M.442/51 in plots receiving inorganic fertilizers only compared to those receiving any of the organic amendments, have been detected. These results will have to be confirmed.

In greenhouse experiments on disease transmission, under reasonably insect-proof conditions, healthy and diseased plants were grown in sterilized basalt sand culture and in water culture. Unfiltered as well as filtered soil extracts from diseased and disease-free areas were later added to the pots containing diseased plants, in an attempt to introduce a probable soil-borne vector in some and not in others. After some time, leachates from diseased plants were transferred to healthy ones.

Disease transmission occurred in both basalt sand culture and water culture, irrespective of the type of soil extracts previously added to the diseased plants. The preliminary inference that can be drawn from the few experiments conducted so far is that, either the plants under study were accidentally contaminated with the vector of chlorotic streak, or the chlorotic streak pathogen needs no vector.

4. THE EFFECT OF INFLORESCENCE ROT ON SUGAR YIELD IN M.202/46

Flowering was heavy during 1968 the highest intensity on record for many years, due partly to the early onset of the cool season. With extremely dry conditions prevailing at the beginning of the maturing season, especially in May, at the time when newly initiated flower primordia are about to develop, a high incidence of inflorescence rot (*Fusarium moniliforme* associated) occurred, particularly in sub-humid areas. Several varieties were affected but, as in 1966, the variety M.202/46 was found to be the most susceptible. The new promising cane S.17 also proved to be vulnerable.

On one estate in particular, the problem which is in general of minor importance, appeared alarming in M.202/46, well before harvest time. As in 1966, when inflorescence rot was severe on that estate, fields harvested late in the season gave disastrous yields with poor sucrose content, it was decided to cut infected fields at the beginning of harvest well before the due date. However, as it is known that early harvesting in M.202/46 may result in a higher incidence of flowering the following year, if climatic conditions are again conducive, a survey was carried out in fields of M.202/46 over the whole estate in order to assess the degree of infection and establish a priority list for emergency harvesting.

The survey was carried out by the assistant chemist of the estate on the recommendation of the Institute. The total number of healthy non-flowered, flowered, and infected stalks from several plots, each consisting of one cane row, 10 ft long, were counted. The plots were taken at random from different parts of the fields in which varying degrees of infection had been noted. The number of plots taken from each field varied according to the apparent heterogeneity of distribution of infection and the percentage of infected stalk for each field was taken as the average of all plots sampled.

The distribution of the incidence of infection in M.202/46 over the whole estate is shown in Table 17.

Table 17. Distribution of incidence of inflorescence rot in M.202/46 on an estate in the sub-humid zone

% Infected Stalks		*No. of fields*	*Acreage (Arp.)*	*% of total area under M.202/46*
Nil	...	2	14.00	3.9
0-10	...	7	54.03	15.0
10-20	...	17	99.27	27.5
20-30	...	13	97.81	27.1
30-40	...	5	50.88	14.1
40-50	...	4	33.55	9.3
50-60	...	1	8.68	2.4
60-70	...	1	2.40	0.7

The survey gave a fairly good picture of the incidence of infection and helped to establish a certain priority for harvesting but was subject to some degree of error. As infection was usually more concentrated in patches, it was not easy to assess the extent of distribution of such patches in the field. Aerial observation coupled with the ground survey would have given a more precise evaluation of the distribution of disease incidence.

The necessity for early harvesting of infected fields of M.202/46 was also investigated. Four fields were selected and, at two weeks' intervals, random samples of equal numbers of healthy non-flowered, flowered and infected stalks were collected from each field, weighed and analysed for sucrose content over a period of 14 weeks from 19th June to 24th September.

The results are presented in fig. 16. The theoretical sugar yield at each sampling date was calculated from the average number of stalks of each category revealed by the survey.

Contrary to expectation, the sucrose content of infected stalks was, on an average, only slightly lower than that of normally flowered stalks and followed the same rising trend for most of the time the investigations lasted.

Of great interest was the spectacular loss of weight in flowered and infected stalks throughout the survey and also in healthy non-flowered stalks in later stages. There again, flowered and infected stalks followed the same trend except for the first 2-3 dates of sampling. This is due to the fact that infected stalks side-shooted earlier and, as the canes were sampled in the normal way, the upper parts with side shoots were cut off. After the first 2-3 samplings the flowered stalks had side-shooted too.

Gain in weight and sucrose from healthy non-flowered stalks as the season advanced, compensated any loss, due mainly to drop in weight, from flowered and infected stalks. In fields where the total percentage of flowered and infected stalks was low (30%) there was an appreciable net theoretical gain in TSA, whereas in those where incidence of arrowing and infection was high (about 50%) there was only a slight net loss in TSA.

At the end of the experiment, the fields were harvested and a mill test was conducted with the bulk of cane from all four fields. None of the fields yielded less than the estate average for M.202/46 that year although they were harvested much later than the majority of other fields of this variety. The mill test did not indicate any abnormal sucrose or purity. It should be mentioned that fairly dry conditions prevailed throughout harvest and it cannot be concluded that the same results would have been obtained if the weather had been wet.

In conclusion, fields affected by inflorescence rot should be treated as normally flowered ones and need not be harvested before the due date. Early harvesting may cause unnecessary loss and furthermore, in some varieties such as M.202/46, may result in a heavier flowering the following year.

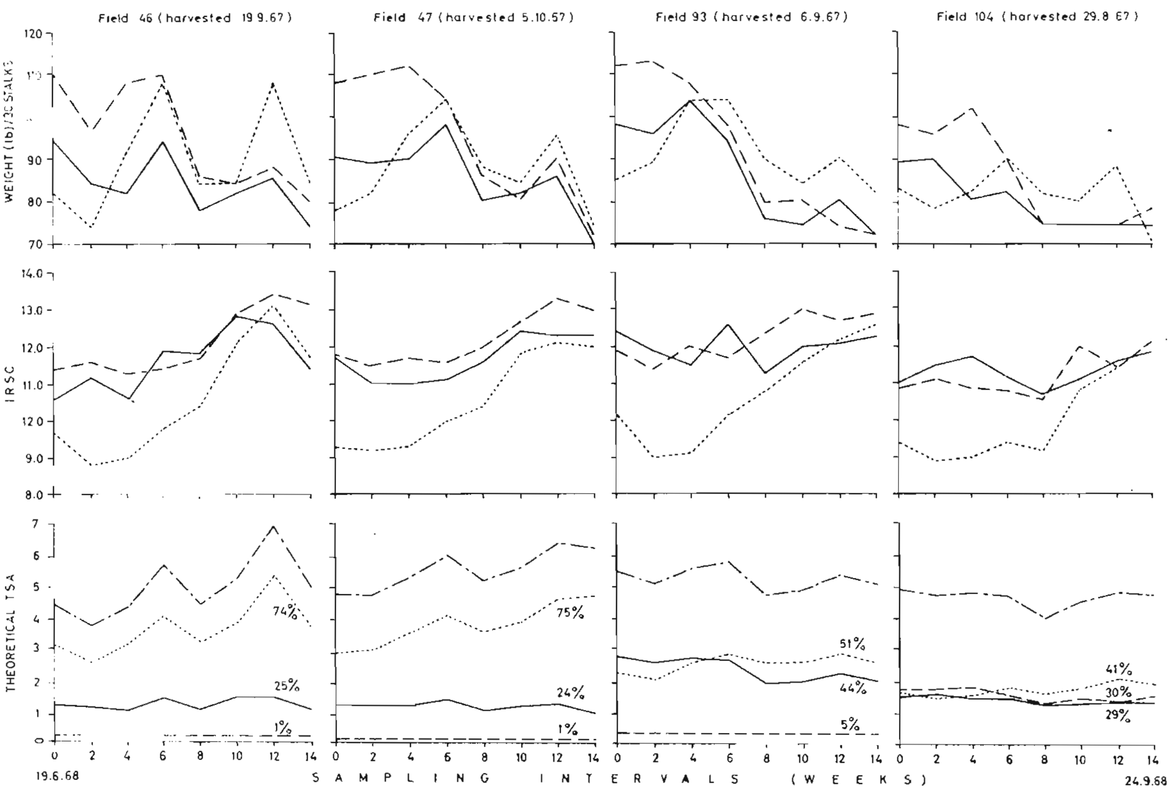


Fig. 16. Changes in stalk weight, sucrose content and theoretical sugar yield in different types of stalks in 4 fields of M. (202/46) infected with inflorescence rot. (Plain line : infected stalks ; broken line : normally flowered stalks ; dotted line : healthy non-flowered stalks ; dashes and dots : total yield).

5. MISCELLANEOUS DISEASES AND INVESTIGATIONS

Ratoon stunting disease

The experimental electrically-heated hot-water treatment tank of the Institute built in 1956 has been modified and is now heated by hot water circulating in closed coils. Temperature control is effected by an electrical thermostat which operates a solenoid valve regulating water flow in the coils. Initial heating is rather slow but excellent control is obtained during treatment, as was the case before. To reduce time lag between immersion of cuttings and temperature stabilization at 50°C, the temperature in the tank is raised to 52°C just before immersion and stabilization is thereby achieved in 5 minutes.

All the planting material for the Central Nursery was treated in the tank of the Institute this year. A total of 157 tons of cuttings was used to establish 46 arpents of A nurseries. The nursery supplied 1,732 tons of cuttings to estates (2,325 tons in 1957) for establishing 525 arpents of B nurseries and also 1,007 tons to large and small planters for commercial plantations.

The trial established in 1967 to study the effect of the disease on some newly released and promising varieties was harvested and no differences between inoculated and healthy plots were observed in the virgin crop. Two new trials were planted, one in the super-humid zone and the other in the sub-humid. The following varieties are under investigation in the three trials : M.99/48, M.305/51, M.409/51, M.428/51, M.442/51, M.13/53, M.356/53, M.359/53, M.13/56 M.377/56, M.351/57, N:Co.376 and S.17.

In an attempt to obtain a better diagnosis of the disease, studies were initiated on symptom development in young shoots of the variety C.P. 44-101, claimed elsewhere to be a good indicator plant, compared to D.109 which gives the best symptoms in Mauritius. The symptoms observed so far in inoculated, previously hot-water treated C.P. 44-101, are faint and less convincing than those seen in diseased D.109. Interesting observations are being made on symptom development in young shoots.

Wilt

Wilt, which is caused by a complex of adverse soil factors and infection by *F. moniliforme*, was again severe this year on M.202/46. The variety N:Co.376 was also affected in a few fields. The effect of the disease complex on the ratooning of canes in the super-humid zone is causing some concern. On one estate the total area of M.202/46 which had to be recruited in 1967 amounted to as much as 75 arpents.

Although affected patches are usually of restricted size and the overall effect on yield is usually small, the disease certainly renders the cultivation of certain varieties more difficult, due to emergency harvesting often necessary and also to frequent recruiting. Observations are being pursued in order to confirm assumptions on the causal factors involved while isolation and identification of pathogens associated are continuing.

Symptoms of a basal stem and root rot resembling in some aspects the problem discussed above, were found this year in two fields of N:Co.376, in virgins, situated on hill slopes, on an estate in the super-humid zone. Extremely dry conditions which prevailed shortly after planting are believed to have favoured infection which gained entry in the basal tissues of the stalk through roots and root primordia. The pathogens involved are under study.

Yellow spot

Reduced yields in the variety B.3337 in recent years, due mainly to its high susceptibility to yellow spot, indicate that this disease can now be reckoned as one of the important problems of the super-humid zone. The susceptibility of certain newly released varieties, such as M.377/56 and M.99/48, may seriously limit their cultivation in the wet areas. The correct assessment of the reaction to yellow spot of promising varieties under selection for the super-humid zone has therefore become imperative. It has been decided to include all varieties coming out of first selection trials in an observation plot in the super-humid zone in which a high inoculum of the pathogen is provided by rows of naturally infected B.3337. The reaction of the new varieties will be compared to those of known susceptibility and a scheme is being devised to index susceptibility according to the degree of foliar infection.

As the onset of the disease and its duration seem to depend on climatic conditions prevailing during a restricted period in the year, a trial has been set up to determine the effect of time of harvest on disease intensity and subsequent yield.

Ring spot

Ring spot caused by *Leptosphaeria sacchari*, which is usually encountered on old varieties in the cane collection, or on varieties under selection, is of rather rare occurrence in commer cial plantations in Mauritius at present. This year, as an exception, the disease was widely distributed in commercial plantations throughout the island from the time of harvest onwards; in some cases the intensity observed was high. Several commercial varieties were found infected. In a field of M.202/46 the spots were found to be very variable in appearance. Two distinct types of spots could be distinguished, typical ellipsoidal ones with necrotic centres and very narrow atypical ones without necrotic centres, 1mm. wide by 3-6mm. long. Some were intermediate, i.e. filiform but with necrotic centres. The different types of spot were usually on separate leaves but could be on the same plant. Occasionally they were found on the same leaf. When affected leaves were kept in a moist chamber, the narrow spots did not develop necrotic centres. These variations could be due to the presence or absence of the secondary fungus *Phyllosticta sacchari* often isolated from ring spot.

The disease must have been favoured by the exceptionally dry season which prevailed, an observation not reported before. It could be that water-stress conditions have favoured infection by restricting the uptake of one or certain essential nutrients.

Leaf freckling in M.13/56

The variety M.13/56 has always shown an inherent tendency to develop leaf freckles. These are characterized by minute reddish-brown spots on the under surface of leaves. On the older leaves and when the condition is severe, the spots which are at first isolated, coalesce and give a uniform rusty appearance. Affected leaves dry out prematurely from the margins.

The condition varies in intensity in different fields and within a field. Increased intensity in patches over underlying bed-rock indicates that the problem is aggravated by water-stress.

This effect of water-stress was confirmed this year when the condition was generalised in several fields of the variety. In some cases the problem was so severe that heavy leaf drying occurred. M.13/56 appears particularly susceptible to the condition and other commercial varieties growing in adjacent rows near affected canes do not show any symptom. The rôle of trace element deficiency is under investigation.

A survey in the cane collection has shown that the following imported varieties show the same freckling : Co. 740, CP. 48-103, and Q.58.

Stem galls

Stem galls were observed in M.31/45 growing in a dry locality. Well developed buds were present on the galls (Pl. IV) and on germination gave rise to normal plants. Cross sections of affected tissues showed that the galls developed through a proliferation of the epidermal cells of the rind.

Fiji disease in Madagascar

Agreement was reached in October at the meeting of the *Comité de Collaboration Agricole Maurice-Réunion-Madagascar* held in Mauritius, to go ahead with the plans to erect an insect-proof greenhouse in Tananarive for testing resistance according to the new Australian method. It is contemplated that construction of the greenhouse will begin next March and testing may start as from the end of 1969. The recent observation of symptoms, for the first time, in the variety Pindar which had shown resistance in the trials on the East Coast of Madagascar for several years but which is rated as susceptible in Fiji, proves that the launching of this project is timely.

The varieties B.46364, B.49119, Cl.41223 and Q.58 can now be added to the list of resistant varieties.

M.409/51, in first ratoon during the year, has not yet contracted infection.

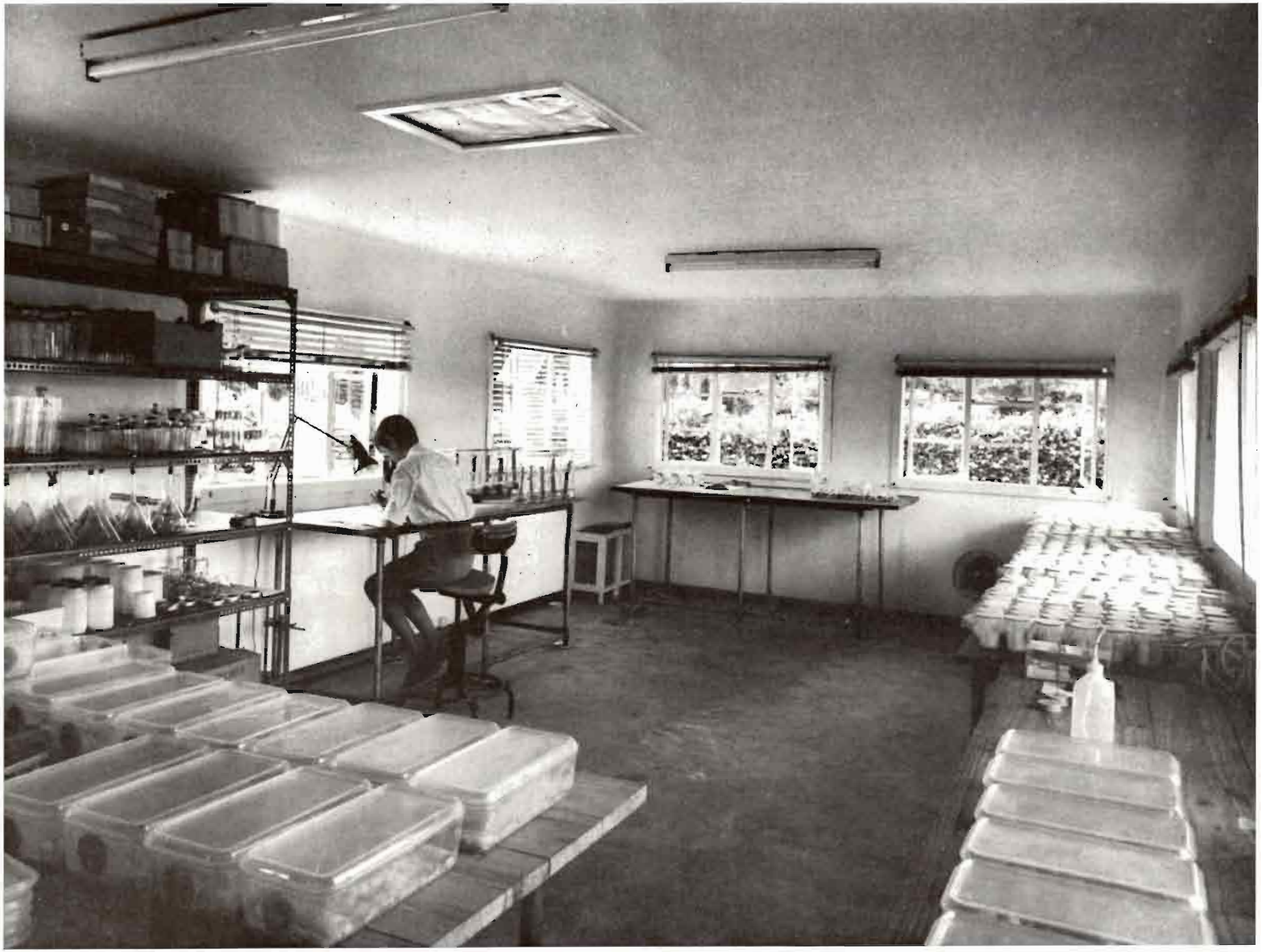
The following Mauritian varieties included in the 1968 trial have already shown disease symptoms : M.39/49, M.658/51, M.13/53 and M.212/56. Seven new varieties were sent to Madagascar this year for testing after the usual quarantine period : M.305/51, M.428/51, M.356/53, M.75/55, M.260/55, M.144/56 and M.145/56.

Quarantine

Of the 43 varieties received in quarantine in 1966, one had to be destroyed while the others have been released this year. They are now well established in the field.

No new import of cane varieties was made during the year and the pathology division is, at present, helping with the quarantining of new varieties of potatoes and rice.

Insectary, exterior



Insectary, interior

CANE PESTS

J. R. WILLIAMS

1. LIBERATION OF THE MOTH-BORER PARASITE, *DIATRAEOPHAGA STRIATALIS*

ACCOUNTS of the breeding and release of *Diatraeophaga striatalis* Tns., the Tachinid parasite of the spotted cane borer, *Chilo sacchariphagus* (Boj.), have appeared in the two preceding Annual Reports. In brief, intensive breeding of this parasite, which originates from Java, was begun in February 1966 at the Pamplemousses Sugar Experiment Station with the object of establishing it in the island. The scale of breeding was as large as facilities permitted, in order to release as many parasites as possible at all seasons and in various climatic regions.

In June, breeding was terminated as it was judged that sufficient numbers of the insect had been released to establish it in the field if it was at all adaptable to local environments.

Table 18 summarizes the entire work of breeding *Diatraeophaga* from February 1966 to June 1968 and gives the results of each stage of the breeding technique* for every generation reared. It is seen that 25 generations were reared and, in round figures, a total of 200,000 borers inoculated yielded 85,500 adult parasites : half the parasites were females and 30,000 of them were mated before their release. This last figure represents 15 mated females released for every 100 field-collected borers inoculated.

Table 19 gives details of liberations made in 1968, while Table 20 summarizes the liberations made during the entire period February 1966 — June 1968.

As from June, *Chilo* larvae were collected at or near various liberation sites in an effort to recover the parasite and determine if it has become established. The 7,980 larvae collected were kept in the laboratory for emergence of parasites but none proved to have been attacked by *Diatraeophaga*. Also, adult *Diatraeophaga* have not been seen in the field. There is, therefore, no evidence that the parasite has become established and although a final conclusion cannot yet be reached, it is feared that its introduction has not been successful.

2. THE SCALE INSECT, *AULACASPIS TEGALENSIS*

Natural enemies

Natural enemies of the sugar cane scale insect include predacious Coleoptera and parasitic Hymenoptera. They are important in suppressing the scale insect although their combined action is evidently insufficient to prevent frequent infestations in some regions of the island. Studies on these natural enemies were started to obtain a better understanding of their action and as an adjunct to the proposed introduction of additional parasites and predators.

The following is a complete list of the natural enemies now known to be associated with *A. tegalensis* in Mauritius :

Hymenoptera

Encyrtidae
- *Adelencyrtus femoralis* Comp. & Annecke

Eulophidae
- *Tetrastichus* sp.

Aphelinidae
- *Marietta carnesi* (How.)
- *Aspidiotiphagus fuscus* Comp.

Coleoptera

Coccinellidae
- *Lindorus lophanthae* Blais.
- *Chilocorus politus* Muls.
- *Chilocorus nigritus* Muls.

Nitidulidae
- *Cybocephalus mollis* End.-Younga.

* Vide *Rep. Maurit. Sug. Ind. Res. Inst.* 14 (1966) : 61-64

Table 18. Laboratory-rearing of *Diatraeophaga striatalis*, February 1966 - June 1968

Generation	*Date*	*Borers inoculated*	*Pupae obtained*		*Adults obtained*		*Females obtained*		*Females mated*		*Mated females released*		*Efficiency Index: (Mated females released × 100/ borers inoculated)*
			No.	*As % borers inoculated*	*No.*	*As % pupae*	*No.*	*As % adults*	*No.*	*As % females*	*No.*	*As % females mated*	
1	Feb-Ap. '66	4,205	1,345	32.0	1,165	86.6	600	51.5	495	82.5	361	72.9	8.6
2	March-May '66	6,760	3,501	51.8	3,118	89.0	1,517	48.7	1,252	82.5	1,042	83.2	15.4
3	Ap.-June '66	8,224	5,893	71.7	5,081	86.2	2,612	51.4	1,688	64.6	1,519	90.0	18.5
4	May-July '66	3,488	2,603	74.6	2,195	84.3	1,137	51.8	997	87.7	904	90.7	25.9
5	July-Aug. '66	3,152	2,122	67.3	1,692	79.7	822	48.6	769	93.6	672	84.7	21.3
6	Aug.-Sept. '66	3,107	1,952	62.8	1,691	86.6	837	49.5	749	89.5	571	76.2	18.4
7	Sept.-Nov. '66	6,754	3,612	53.5	2,884	79.8	1,425	49.4	1,314	92.2	1,039	79.1	15.4
8	Oct.-Dec. '66	11,324	5,226	46.2	4,365	83.4	2,274	52.1	2,061	90.6	1,757	85.2	15.5
9	Nov.-Jan '67	8,567	6,100	71.2	5,108	83.7	2,578	50.5	2,192	85.0	1,877	85.6	21.9
10	Dec.-Feb. '67	8,226	5,422	65.9	4,366	80.5	2,202	50.4	1,927	87.5	1,580	82.0	19.2
11	Jan.-Feb. '67	15,210	7,284	47.9	5,364	73.6	2,674	49.9	2,292	85.6	1,925	84.0	12.7
12	Feb.-March '67	10,191	6,983	68.5	5,949	85.2	3,062	51.5	2,551	83.3	2,355	92.3	23.1
13	March-Ap. '67	10,371	5,265	50.8	4,587	87.3	2,330	50.8	1,972	84.6	1,679	85.1	16.2
14	Ap.-June '67	9,548	4,508	47.2	3,539	78.5	1,842	52.0	1,662	90.2	1,472	88.6	15.4
15	May-July '67	11,766	6,546	55.6	4,679	71.5	2,411	51.5	2,058	85.4	1,509	73.3	12.8
16	July-Aug. '67	7,185	3,005	41.7	2,212	73.6	1,083	49.0	920	84.9	494	53.7	6.9
17	Aug.-Oct. '67	5,462	1,524	27.9	1,172	76.9	600	51.2	527	87.8	348	66.0	6.4
18	Oct.-Nov. '67	3,059	1,934	63.2	1,477	76.4	714	48.3	656	91.9	393	59.9	6.0
19	Nov.-Dec. '67	7,843	5,465	69.7	4,212	77.1	2,126	50.5	1,327	62.4	1,219	91.9	15.5
20	Dec.-Jan. '68	7,026	3,624	51.6	2,904	80.1	1,420	48.9	1,300	91.6	1,067	82.1	15.2
21	Jan.-Feb. '68	8,416	3,149	37.4	1,795	57.0	846	47.1	769	90.6	536	69.1	6.4
22	Feb.-March '68	9,378	5,269	56.2	4,224	80.2	2,030	48.0	1,811	89.2	1,498	82.7	16.0
23	March-Ap. '68	10,625	4,340	40.8	2,996	69.0	1,432	47.8	1,258	87.8	1,001	79.6	9.4
24	Ap.-May '68	8,001	4,710	58.9	3,742	79.4	1,769	47.3	1,596	90.2	1,366	85.6	17.1
25	May-June '68	10,372	6,540	63.0	4,977	76.1	2,415	48.5	2,075	85.9	1,912	92.1	18.4
Total		198,260	107,922	54.5	85,449	79.1	42,758	50.0	36,218	84.7	30,096	82.9	15.1

Table 19. Liberations of *Diatraeophaga* in 1968

Date	*Mated females*						*Total mated females*	*Others (mostly males)*	*Grand totals*	*Locality*
	Days after mating									
	0	*1*	*2*	*3*	*4*	*5+*				
1/1/68		135	180	132			447	300	747	**Joli Bois**
5/1/68		49	38	27	55		169	250	419	
8/1/68		83	74	46			203	220	423	
11/1/68		24	47	58			129	160	289	
15/1/68	5	12	32	34	20		103	225	328	
30/1/68		25	52	51			128	170	298	
2/2/68		50	52	54			156	155	311	
5/2/68		10	10	20		17	57	132	189	
Totals	5	388	485	422	75	17	1392	1612	3004	
9/2/68		30	41	62	27	27	187	225	412	**Riche Bois**
1/3/68		44	46	11	4		105	150	255	
4/3/68	100	61	37	41			239	200	439	
7/3/68		120	113	46			279	400	679	
11/3/68	154	163	115	106	66	3	607	400	1007	
Totals	254	418	352	266	97	30	1417	1375	2792	
15/3/68	7	18	72	124	22	1	244	425	669	**Valetta**
19/3/68						8	8	0	8	
1/4/68			52	63	39	24	178	256	434	
4/4/68		142	183	97			422	500	92	
8/4/68		17	58	87	141	19	322	350	672	
10/4/68			25			9	34	65	99	
11-16/4/68						45	45	0	45	
29/4/68		34	6	73	19		132	154	286	
2/5/68		15	19	6			40	100	140	
5/5/68			19	19			38	205	243	
9/5/68			43	40	45	68	196	125	321	
13/5/68				138	58	76	272	608	880	
15/5/68		87	159	120	178	2	546	270	816	
20/5/68				16	44	52	112	145	257	
Totals	7	313	636	783	546	304	2589	3203	5792	
6/6/68		82	168	73			323	420	743	**Pte aux Sables**
14/6/68		14	54	108	88		264	300	564	
17/6/68		51	73	84			208	290	498	
25/6/68		74	63	30	39		206	360	566	
29/6/68	10		26	42	67		145	200	345	
Totals	10	221	384	337	194		1146	1570	2716	
3/6/68	100	36	4				140	0	140	**Beau Vallon**
10/6/68		102	93	52	55		302	235	537	**Riche en Eau**
22/6/68			93	72	84	75	324	375	699	
20/1/68										
25/5/68						70	70	100	170	**Pamplemousses**
Totals	100	138	190	124	139	145	836	710	1546	
Grand Totals	376	1478	2047	1932	1051	496	7380	8470	15850	

Table 20. Summary of *Diatraeophaga* liberations February 1966 - June 1968

Year	*Locality*	*Mated females*	*Others (Mostly males)*	*Total*
1966-67	Belle Vue	6,751	9,590	16,341
1966-67	Le Vallon	11,763	11,934	23,697
1967	Piton	608	—	608
1967-68	Valetta	3,709	3,438	7,147
1967-68	Joli Bois	2,386	2,968	5,354
1968	Riche Bois	1,417	1,375	2,792
1968	Pamplemousses	70	100	170
1968	Beau Vallon	140	—	140
1968	Pointe aux Sables	1,146	1,570	2,716
1968	Riche en Eau	626	610	1,236
1967	Various	1,480	230	1,710
	Totals ...	30,096	31,814	61,911

Adelencyrtus femoralis has been previously recorded as *Homalotylus* sp. Laboratory rearing has shown that it is a primary parasite. Other data on its biology have been acquired and field surveys indicate that it is the most important parasite present.

Tetrastichus sp., which has also been previously recorded, appears, from initial experiments, to be hyperparasitic on *Adelencyrtus* and therefore harmful.

Marietta carnesi and *Aspidiotiphagus fuscus* from *A. tegalensis* are both new records. The former may be hyperparasitic but the latter is considered to be primary although the biology of neither has yet been studied.

Of the four hymenoptera, *Adelencyrtus* and *Tetrastichus* have been the commonest in parasitized scale insects collected from various localities.

Lindorus lophanthae is the only Coccinellid predator that is constantly associated with *A. tegalensis.* The Nitidulid *Cybocephalus mollis* is likewise a frequent predator.

Investigation of natural enemies of *A. tegalensis* in East Africa were made by Dr. D. J. Greathead of the Commonwealth Institute of Biological Control at the request of the M.S.I.R.I. As a result, it appears that two Coccinellids *Chilocorus discoideus* Crotch and *C. distigma* Klug, and a hymenopteran, *Physcus* sp., may be suitable introductions. It is hoped that one or more can be introduced in 1969.

Insecticide tests

Scale insects of the family Diaspididae are notoriously difficult to control with insecticides and this is particularly so with *A. tegalensis* because of problems of insecticide application. Experiments were made during the year with Phorate and Temik, largely because both these insecticides when applied to the soil in granular form have a prolonged systemic action against certain insects and this method of application could be practicable for treatment of cane against *A. tegalensis.*

All experiments were made at the Central Cane Nursery. Plot size was 8 rows × 5 gaulettes (1/20th arpent) and there were 3 plots, side by side, in each experiment, one treated with Phorate, one with Temik, and an untreated plot in the middle. High doses were used, namely 10% Phorate granules at 40 lb/arp. and 10% Temik granules at 60 lb/arp., the granules being sprinkled along the rows around the bases of the shoots. There were 8 experiments, with different cane varieties, some being virgins and others 1st or 2nd ratoons. All treatments were made at the end of January and the experimental plots overhead irrigated.

At the time of treatment, the canes in the experimental plots had, with one exception, begun to form stems, but scale insects were absent in 6 of the 8 experiments. Five weeks later, scale insects were absent in only one experiment and there was no discernable difference in the degree of infestation between the plots of any experiment.

Spot treatments of infested canes in a field of 2nd ratoon M.93/48 were made to supplement the above experiments. Five-foot lengths of row were treated by sprinkling granules around the shoot bases at rates equivalent to 40 lb and 80 lb/arp. for Phorate and 60 lb and 120 lb/arp. for Temik. The canes received overhead irrigation immediately after application of the insecticides. Examined two weeks later, the scale insects were still alive on all treated canes.

It was concluded that neither Phorate nor Temik, when applied to the soil surface as granules, even at high, uneconomic rates, can prevent the development of infestation or eradicate an existing infestation.

Biology

Various aspects of the biology of *A. tegalensis*, such as duration of development, fecundity, longevity and method of feeding, were studied. This work is still continuing.

3. THE THRIPS, *FULMEKIOLA SERRATA* (KOB.)

A preliminary experiment designed to study the effect of insecticide treatments and cane varieties on thrips populations was laid down in June in the north of the island. It was also hoped that the experiment would provide data on the effect of thrips attack on cane growth. A split-plot design was used, with 3 treatments and 3 varieties. The experiment is continuing and it would be premature to describe in detail the data and experience of field work that has so far been gained on this insect. However, fig. 17 illustrates the control of thrips obtained by application of 10% Phorate granules at the rate of 30 lb/arp. in the open furrow at planting, which was carried out in mid-June. It is seen that the insecticide was giving virtually complete protection to young shoots after 2½ months and was still efficacious, though much less so, after 4 months. The general decrease in thrips abundance in November coincided with severe desiccation of foliage because of drought. The slight upward trend of the lower graph in November may be the result of a supplementary side-dressing of granules applied at the beginning of that month.

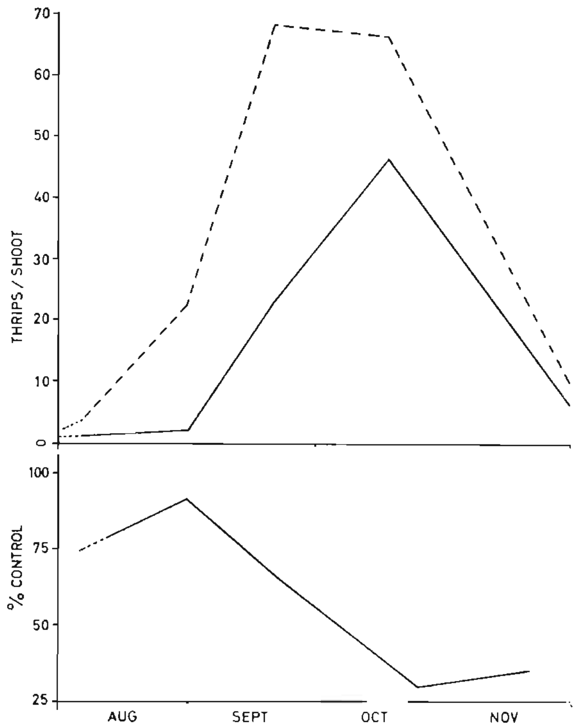


Fig. 17. The efficacy of an application of 10% Phorate granules in the open furrow at planting against the thrips, *Fulmekiola serrata*. Planting date — June 14th. (Plain line : treated; broken line : untreated).

4. THE INCIDENCE OF *XIPHINEMA* SPECIES IN CANE FIELDS

Soil sampling to determine the species of *Xiphinema* and their incidence about sugar cane roots was mentioned in the Annual Report for 1967. Further sampling could not be carried out in 1968 but the identity of the species found was ascertained as far as taxonomic data on the genus permits. The following summarizes the conclusions concerning the identity and incidence of *Xiphinema* spp. around cane roots that have resulted from the 90 soil samples taken.

X. elongatum Sch. Stek. & Teun. is the commonest species and is very prevalent in all regions except in the central plateau where annual rainfall exceeds 100 inches.

X. sp. probably *X. ensiculiferum* (Cobb) replaces *X. elongatum* in the higher rainfall areas as the common species about cane roots. The distribution of the two species overlaps little, if at all.

X. vulgare Tarjan is abundant in the few cane fields on sandy soil in the north of the island. It could not be found in other soils nearby or anywhere else in the island. No other species occurred in this sandy soil.

Two species, which appear to be *X. insigne* Loos and *X. brevicolle* Lordello, were found in only a few soil samples and the latter appears to be rare in cane fields. Both were found too infrequently for any conclusion as to their habitat preferences.

In general, 54% of all samples contained *Xiphinema* of one species or another but more than one species was obtained only once from a sample indicating, on the one hand, the ubiquity of nematodes of this genus in cane soils and, on the other, the limitations imposed on particular species by environmental factors.

5. MISCELLANEOUS

(a) Concentrations of hoppers of the Red Locust, *Nomadacris septemfasciata*, occurred in a few fields of young cane in January. Defoliation was not extensive and spraying with dieldrin gave satisfactory control.

(b) A shipment of *Tytthus mundulus* Bredd. (Miridae), a predator of leafhopper eggs, was sent to the Sugar Experiment Station, Mount Edgecombe, South Africa, in February. The insect was required for work on biological control of *Numicia viridis*.

(c) With the development of interline cultivation of food and other crops in sugar cane fields, observations on pests that attack these crops were made and control measures recommended when necessary. Advice on pests likely to be encountered and on useful insecticides against pests on sugar plantations was circularized.

Calcium silicate experiments. Canes from control plots (left), and calcium silicate-treated plots (right).

NUTRITION AND SOILS

1. THE EFFECT OF CALCIUM SILICATE SLAG AND CORAL SAND ON SUGAR CANE YIELDS IN FIELD TRIALS

Y. WONG YOU CHEONG & P. HALAIS

AFTER preliminary pot experiments with sorghum (CHAN *et al*, 1967) had shown that yield responses could be obtained from the application of calcium silicate to some of the soils of Mauritius, six field trials with sugar cane were laid down between May and October 1967 to assess the value of calcium silicate slag, as compared to coral sand, as a soil amendment.

The calcium silicate slag was a finely-ground product of low Mn content imported from Japan and the coral sand was relatively pure calcium carbonate found locally.

In order to obtain maximum responses, experimental sites were chosen from the Humic Ferruginous Latosols, which are acid soils known to be the most deficient in silicon as revealed by analysis of 3-6 cane sheaths of ratoon crops sampled at the boom stage from 1963 to 1966 (HALAIS, 1967). Soil extractable silicon, obtained by extraction with an ammonium acetate solution (pH 4.8), of the six localities chosen varied between 20 and 50 ppm Si. The six experimental sites were all on the windward side of the island with super-humid climates, ArB_4/B_3a' according to Thornthwaite's world classification. These were : Plaine Sophie — Réunion S.E, Rioux — Britannia S.E., Cascade — Rose-Belle S.E., Valetta — Mon Désert-Alma S.E., Sans-Souci — FUEL, and Metheline — Riche-en-Eau S.E.

These sites occur in "growth failure" areas, with very low soil fertility and marginal climatic conditions. Sugar cane growing in these upland areas shows typical symptoms of "leaf freckling", particularly in winter. Efforts to increase cane yields, such as the use of large amounts of nitrogen, phosphate and potash, have proved unrewarding. In the same way, correction of soil acidity with coral sand has been of limited benefit only. However, massive applications of finely crushed basalt have shown an unequivocal increase in sugar production (d'HOTMAN, 1947).

In the present trials, both amendments were intimately mixed in with the surface soil

Table 21. Cane yields in tons per arpent (mean of 6 trials on virgins, 1968 season)

Treatment	*Eb. 1/37*	*M.93/48*	*Mean of two varieties*
Control	17.9	16.0	17.0
3 tons calcium silicate/arpent	26.6**	26.9**	26.8
6 tons ,, ,, ,, ...	29.6**	28.1**	28.9
4 tons coral sand/arpent	21.3*	20.3*	20.7
LSD (P = 0.05)	3.1	3.6	
,, (P = 0.01)	4.3	5.0	

before planting with cane setts of two well-adapted varieties : Ebène 1/37 and M.93/48.

Results of the six field trials are shown in Table 21. The virgin canes, between 10 and 16 months, were reaped at an average age of 12.4 months during the 1968 crop.

The yield responses obtained from the application of calcium silicate can be considered to be "spectacular". The calcium silicate slag treatment produced a yield increase of about 3 times that obtained from the comparative coral sand treatment. Calcium silicate, applied at the rate of 6 tons/arpent, produced about 2 tons of cane more than when applied at 3 tons/arpent; however, from the economic point of view, the higher rate of silicate application is probably questionable at this early stage of experimentation. Yield responses in ratoons will also have to be examined for as many years as possible.

The beneficial effects of calcium silicate over calcium carbonate, apart from alleviating soil acidity to a comparable extent, are reflected in better tillering, larger girth of stalk, heavier leaves and sheaths and absence of leaf freckling symptoms.

As far as the rôle played by calcium silicate in sugar nutrition is concerned, it appears that calcium silicate slag fulfils the functions of coral sand as a soil amendment and in addition provides silicon for the sugar cane plant. Consequently, the experimental data obtained indicate that calcium silicate is going to supersede coral sand in the near future as the best soil amendment for the conditions prevailing in the "growth failure" areas of Mauritius.

Future developments

A fuller analysis of this first series of field trials with virgin canes is given elsewhere (Wong You Cheong & Halais, 1969). It would seem that the tentative threshold value of extractable soil silicon, 50 ppm Si, (Ayres, 1966) below which sugar yield responses to calcium silicate would be expected, is too low for local conditions and could safely be doubled. This is also apparently true for the 3-6 leaf sheath (sampled at 6 months) threshold value of 1.5% SiO_2 (Clements, 1965), which appears to be too low in view of the responses observed locally in this first series of field trials with virgin canes.

If such interpretation is correct, nearly all the Humic Ferruginous Latosols, Mountain Slope Complexes, and most of the Humic Latosols of Mauritius would respond favourably to calcium silicate treatment. Consequently, it is estimated, at this stage, that 30,000 arpents would benefit from applications of calcium silicate.

It appears that the dressings of calcium silicate at planting time would vary, according to locations, between 1 and 3 tons per arpent. The calcium silicate slag used up to now in the trials has been imported from Japan at about Rs. 300 per ton CIF, Port Louis. Assuming a mean annual cane yield response to an application at planting of 3 tons of calcium silicate per arpent, to be in the neighbourhood of 10 tons of cane, this initial heavy expenditure would be recovered after three years. As, in all probability, the beneficial action of calcium silicate on cane growth will last over several years, such applications appear to be economically justified. However, if the raw materials were available, the manufacture of calcium silicate could be carried out locally and the cost of the calcium silicate could thus be reduced. There is no shortage of calcium carbonate (coral sand) in Mauritius, but as no silica sand is available, it must be imported from a nearby country (Madagascar, for example). Bagasse ash and trachyte can also be used as sources of Si but the manufacture of calcium silicate from these materials needs careful study.

Si survey

It is advisable for estates to start determining the Si content of their soils likely to benefit from calcium silicate applications. No additional soil sampling is required as the extractable Si can be determined in the same HSPA Truog extract (Fox *et al*, 1967) used for the determination of available P. With the exception of the Latosolic Brown Forest soils, a highly significant correlation ($r = 0.989^{***}$) has been obtained between the silicon levels extracted by ammonium acetate (pH 4.8) and the modified Truog extractant (pH 2.0) for all the soil groups of Mauritius.

The regression equation is : $Y = 2.93\ X - 15$

where Y = extractable Si as determined by the HSPA Truog extractant

and X = extractable Si as determined by ammonium acetate.

It has also recently been found that the silicon contents of the 3-6 sheaths and of the 3rd leaf lamina are closely correlated. Therefore, it has been decided to simplify the foliar diagnosis procedure by carrying out the analysis of the six elements presently needed, namely N, P, K, Si, Ca and Mn on the same 3rd leaf blade samples.

It is hoped that the concurrent use of both soil and leaf analysis will help to solve the problem of rational application of calcium silicate to sugar cane fields under local conditions.

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2. FERTILIZER CONSUMPTION AND USAGE IN MAURITIUS

Y. WONG YOU CHEONG

There has been no marked increase in fertilizer imports during the last years (*Statistical Table* XX). Annual nitrogen imports have remained at about 9,000 tons N and phosphate imports at slightly over 5,000 tons P_2O_5. Potash imports, however, are still increasing and in 1968, 8,000 tons K_2O were imported into this country.

As fertilizers are used not only on sugar cane but also on tea and other crops, it is difficult to calculate the "average" rate of fertilizer application to sugar cane in Mauritius. Even if this figure is obtainable, it may not have much meaning on account of the wide differences in the amounts and nature of fertilizers applied by "small" and "large" planters. As a rule, small planters tend to overfertilize with N and underfertilize with phosphate and potash. The greater use of complex granulated fertilizers containing N, P and K in the right proportion would certainly help towards a more rational fertilizer programme for small planters.

Use of complex fertilizers

Figs. 18-20 show that since 1962, there has been an important increase in imports of complex fertilizers containing the three major nutrients. In itself, the trend is not surprising as the majority of cane lands are under ratoons for which complex fertilizers are well suited. In 1968, 63 % of the total nitrogen, 49 % of the total phosphate and 68 % of the total potash imported were in the form of complex mixtures.

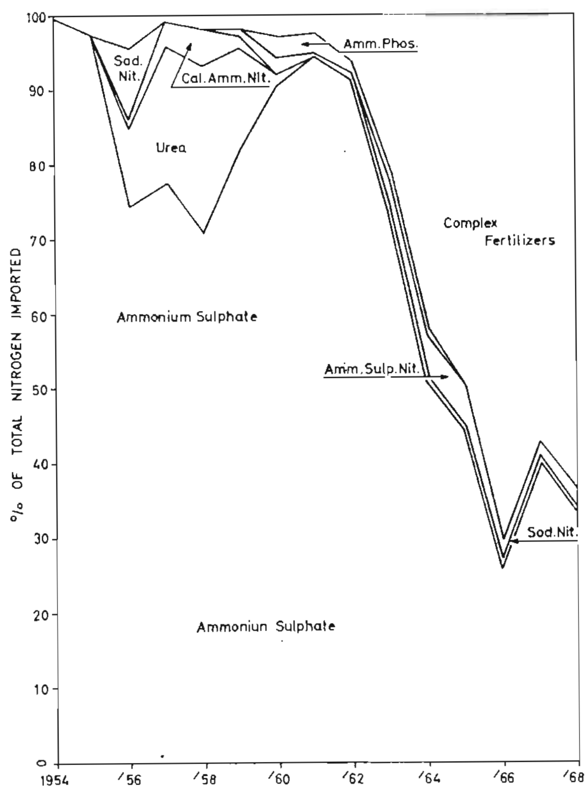


Fig. 18. The nature and relative proportion of nitrogenous fertilizer imports.

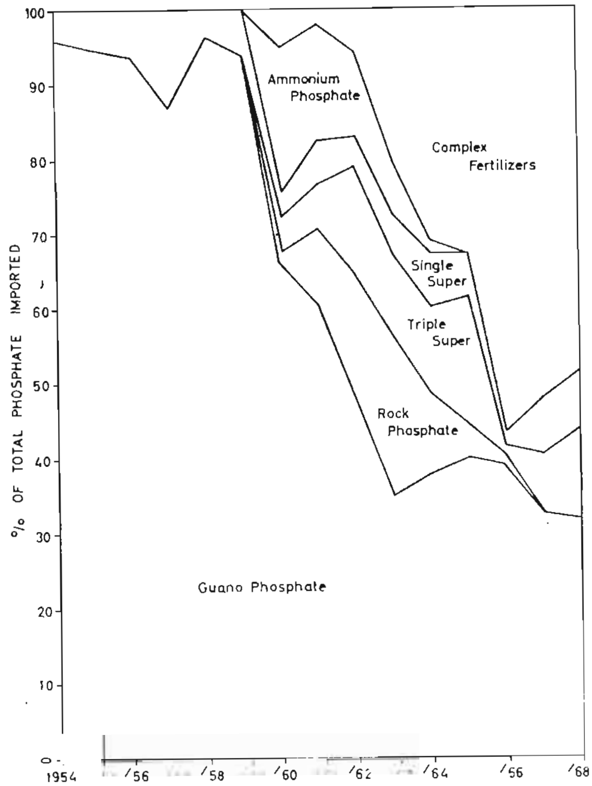


Fig. 19. The nature and relative proportion of phosphate fertilizer imports.

Straight fertilizers are mainly used in virgins. In ratoons, however, granulated complex mixtures, provided the nutrients are in the right ratio, can be used to advantage. They are more concentrated, easier to handle and in fact, complex fertilizers are comparable in price with straight fertilizers.

The most popular complex fertilizers on the market have the following ratio of nutrients : 1 : 1 : 1, 1 : 0 : 1, 2 : 1 : 1, 2 : 1 : 2 and 2 : 1 : 3. It is hoped, however, that in view of the more frequent detection of potassium deficiencies, greater use would be made of a mixture with the nutrients in the proportion 2 : 1 : 3 or 2 : 0 :3 Also, phosphate deficiencies are now less common and phosphate applications may even be reduced in young ratoons, whenever phosphate levels are known to be adequate.

Nitrogen

Nitrogen fertilizers

Sulphate of ammonia is the only important straight nitrogenous fertilizer. In 1961, it represented about 95% of the total nitrogen imported but since then the percentage has steadily fallen to about 34% in 1968 and now appears to have levelled off. There has been not only an increasing use of complex fertilizers but also an actual decrease in tonnage of sulphate of ammonia imported.

Only insignificant amounts of straight N fertilizers in nitrate form are used but many of the complex fertilizers contain nitrate nitrogen.

Considering that the efficiency of nitrogen is low and that adequate amounts are applied anyway, the basis on which to assess a complex fertilizer containing nitrogen either in the ammonium or nitrate form is the cost per unit

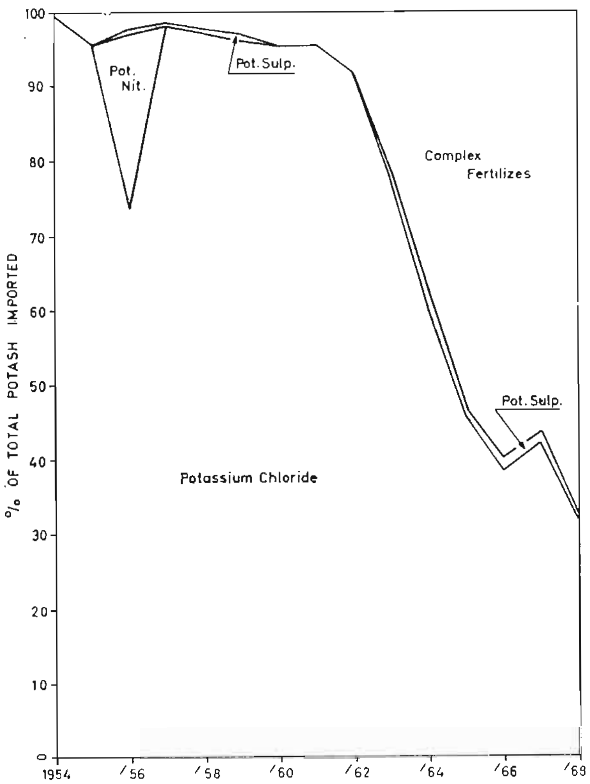


Fig. 20. The nature and relative proportion of potassium fertilizer imports.

nutrient. As a rule, the cheapest complex fertilizer (per unit nutrient) should be purchased.

Present nitrogen status of cane lands

Foliar diagnosis results indicate that the nitrogen status of cane lands is generally good, particularly in humid and super-humid regions. It is a characteristic of soils in these upland areas to be fairly rich in nitrogen and responses to this element are not easy to obtain in such soils.

As the optimum level of N in the third leaf, at the boom stage of vegetation, is 1.90 N% d.m., it may be concluded that nitrogen applications in the upland areas have been sufficient. Under such wet conditions, nitrogen applications can even be reduced in some places. The amount of N applied in fertilizers is small compared to the total amount present in these soils in organic form; the soil moisture being always high, organic N seems to be easily available to sugar cane.

Nitrogen deficiencies have been noted in gravelly soils, and occasionally also in free soils in lower areas. These deficiencies may not be absolute deficiencies but may be temporary deficiencies caused by low soil moisture. Provided soil moisture is sufficient, these low leaf N levels would probably disappear. However, leaching of nitrogen in these soils cannot be disregarded but it cannot be held to be the only factor responsible for low plant levels of nitrogen.

Some planters in the drier North and West prefer to wait until the rainy season before they apply their fertilizers. It is stressed here that this practice should be avoided and that nitrogen should be applied as early as possible, about one month after the harvest. In no circumstances should nitrogen be applied after December.

As a rule, between 40 and 50 kgs. of nitrogen are applied per arpent per year. Nitrogen is still applied on the basis of expected yield of canes and there is no reason to discontinue this sound practice. It is uneconomic to increase the levels of nitrogen applied in fields of low yield potential, just as it is bad management to try to keep nitrogen applications to a minimum in fields of high yield potential.

Phosphate

Phosphate fertilizers

Since 1962, phosphate imports have remained more or less at a steady 5,000 tons P_2O_5 per annum but there has been an important change in the nature of the phosphate fertilizers imported. Between the years 1954-1959, tricalcium phosphate was practically the only phosphatic fertilizer used (90% of total phosphate imports) but soluble phosphate, in the form of complex fertilizers, now occupies a greater share of the import market (50%). However, there will always be a demand for tricalcium phosphate (guano phosphaté) as a basic dressing at planting because the majority of local soils are acid; but, in neutral or alkaline soils, soluble forms of phosphate should be used. All scums are returned to the fields and are a useful source of phosphate.

Present phosphate status of cane lands

The net export of phosphate from the fields is low as filter muds are all returned to the fields. There has therefore, been a steady build-up of phosphate levels in local soils, and it is becoming increasingly difficult to obtain a yield response to phosphate application.

It is probably with this nutrient that an improvement can be made in the fertility of small planters' lands. As they do not have recourse to soil analysis or foliar diagnosis, small planters are not in a position to know the phosphate status of their soils and therefore have most certainly not made the necessary effort to build it up. Foliar diagnosis results from fields originally managed by small planters invariably show a serious deficiency of phosphate.

With heavy applications of tricalcium phosphate at planting, yield responses to phosphorus may not be obtained in young ratoons; these responses, when obtained in plant canes, tend to diminish and even disappear in ratoons. Consequently, where a serious deficiency of some other nutrient, notably potassium, is occurring, it is better to reduce phosphate application in ratoons and use the money thus saved in making the necessary effort to boost up the application of that other nutrient. However, the correct approach is to aim for maximum economic production and not simply to reduce expenditure on fertilizers.

Some cases of phosphate deficiency occur in the potentially more productive lower and drier regions than in less productive higher and wetter regions. This is due to higher rates of application of phosphate to soils in the uplands which had previously been thought to more strongly "fix" phosphate than the less acid soils found in the lower regions, with the result that the phosphate content of sugar cane growing in the higher regions is largely adequate.

Soils in lower areas (LRP,LHL) having a more or less neutral pH, the reason for the deficiency in phosphate occurring there can also be due to the lower availability of P in guano phosphate when such a fertilizer is applied to these soils. Soluble phosphate should be used in these soils. Soil analysis with the Truog extractant is meaningless in neutral soils which have received guano phosphate, as the acid extract will dissolve unreacted and unavailable guano phosphate and yield an abnoımally high extractable phosphate value.

Potassium

Potassium fertilizers

As with nitrogen and phosphate, there has been a major switch from the use of straight to complex fertilizers. However, potassium chloride remains the only straight fertilizer used in sugar cane. Before 1961, 95% of the total potassium imported was in the form of potassium chloride but now potassium in complex fertilizers makes up about 68% of the total imported.

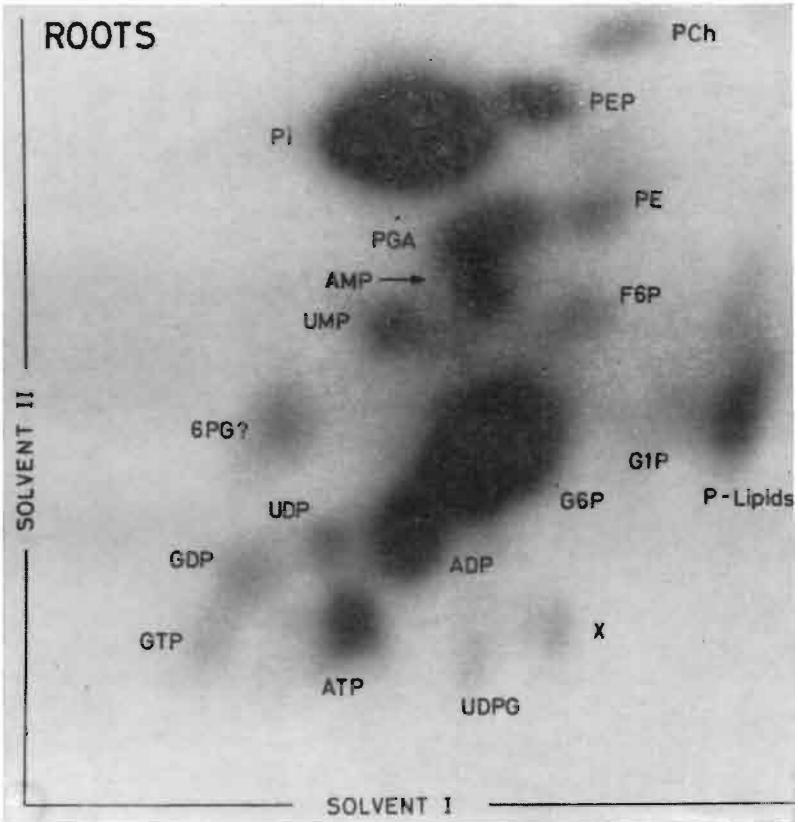
Popular mixtures contain the nutrients in the ratio 2:1:1 or 2:1:2, so that the highest rates of application of potassium do not exceed 40 kgs K_2O per arpent per year.

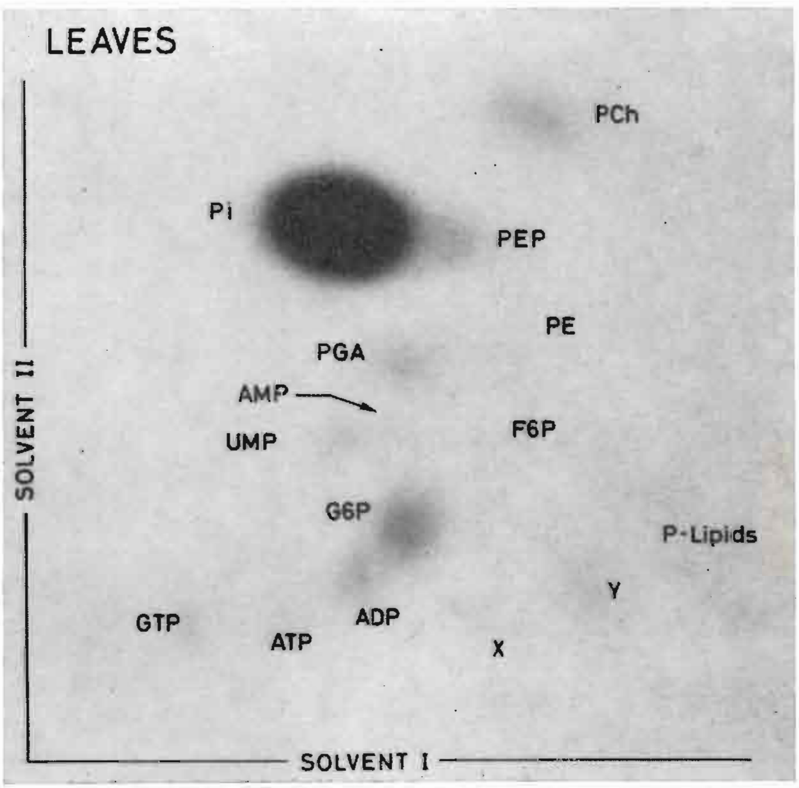
Part of molasses produced each year is returned to the fields as a source of potassium but, in the last few years, this practice has been curtailed on account of the good export price obtained for this by-product.

Present potassium status of cane lands.

It is a paradox that potassium deficiency is rare on estate lands in the super humid areas where leaching of potassium would be considered to be a problem. In fact, foliar diagnosis shows that leaf levels are maintaining themselves in spite of the fairly low rates of applications. An explanation lies perhaps in the fact that field exports of K are low on account of the lower yields obtained in these regions and also that leaching of potassium is not as important as it was thought to be.

On the other hand, leaf levels of potassium are decreasing with alarming frequency in soils occurring in drier areas. In some cases, leaf deficiency symptoms have even appeared. Potassium is the nutrient which has been the most neglected by planters. Although sugar cane has been cropped for a great number of years it is only recently that potassium fertilizer applications have received any consideration. Around 1950, the average rate of application of potash





p 32 Phosphorylated compounds in MCW extracts of roots and leaves of sugar cane incubated in radioactive phosphate solution.

was 15 kgs K_2O per arpent. The depletion of potash which has now become apparent is not easy to make up. Large single applications of potash are not recommended and the policy is to spread over a number of years the extra potash that should be applied. Immediate increases in leaf levels will perhaps not be obtained, although yield responses may occur.

Potassium uptake is influenced by the activity of calcium and magnesium ions and as soils in the super-humid areas are low in both calcium and magnesium there is a greater plant uptake of potassium from soils in these areas than in the drier areas for the same amount of potassium applied.

Any deficiency of potassium can easily be corrected as this nutrient is cheap and its uptake by plants does not present any problem. Where a deficiency has been diagnosed, a minimum of 60 kgs K_2O per arpent per year should be applied until foliar diagnosis shows that optimum leaf levels are once more being obtained.

3. PHOSPHATE ESTERS IN THE SUGAR CANE PLANT

Y. WONG YOU CHEONG & P. Y. CHAN

Phosphate esters, in one form or another, are involved in the metabolism of active tissues and therefore play a vital role in the syntheses of carbohydrates. It has been shown that the distribution of the different phosphate esters in tissues gives a measure of their metabolism.

Owing to the very low levels of phosphate esters present in tissues, their identification and quantitative determination present analytical difficulties. In the work briefly described below, the incorporation of P^{32} into metabolites was studied in both the roots and leaves of sugar cane (var. M.147/44), as well as the effect of Al and Si on phosphorylation.

Distribution of P^{32} esters in the roots and leaves of intact plant

The P^{32} esters in the roots and leaves of the intact plant are shown in Plate VIII In both cases, the distribution pattern was similar to the one obtained with other plants.

The absence of certain phosphate metabolites in the leaves and the fact that a much higher proportion of the labelled phosphate absorbed remained as inorganic P in the leaves imply a higher degree of phosphorylation taking place in the roots. Too low activity in the leaves was responsible for the fewer metabolites shown; in fact, when the activity was increased, all the metabolited present in the roots also appeared in the leaves.

Effect of Al and Si on phosphorylation in excised roots

In this preliminary investigation, excised roots were pretreated with either $Al_2(SO_4)_3$ or Na_2SiO_3 before incubation with labelled phosphate.

The % distribution of the absorbed P^{32} is given in Table 22.

The table shows that although Al pre-treatment increased absorption of labelled phosphate, no effect was observed on phosphorylation. The increased absorption of phosphate was quite striking.

Silicon pre-treatment, on the other hand, increased phosphorylation without affecting phosphate absorption. The nucleotide fraction was greatly increased, suggesting that silicon improved the energy metabolism as well as the synthesis of sugars.

Table 22. Incorporation of P^{32} into phosphorylated compounds in root segments (activities given as counts/sec./gm. fresh weight)

		% Activity			
	Activity	*P. inorg.*	*Nucleotides*	*Sugar phosphates*	*Other esters*
Control	7,960	86.0	4.4	5.4	4.0
Al pre-treatment ...	16,500	86.5	3.6	6.5	3.3
Si pre-treatment ...	7,900	72.0	10.6	8.6	9.0

4. MANUAL METHODS OF CANE LEAF ANALYSIS FOR N,P,K,Ca,Si and Mn

By P. HALAIS, C. L. FIGON & H. MAURICE

In the absence of expensive and automated apparatus, the Foliar Diagnosis Laboratory has been constantly trying to improve existing methods of leaf analysis.

In this report, a detailed account is given of the different steps involved in the analysis of the common elements present in sugar cane leaf lamina. Information on the preparation of reagents can be obtained in the original papers referred to in the text.

Leaf sampling and preparation

As analytical errors are relatively small, the greatest attention should be paid to proper leaf sampling and preparation (Halais, 1968). It is therefore important to recall the critical stages.

The cane fields chosen for foliar diagnosis should be fairly large, about 50 arpents in area, and contain ratoon canes of an approved variety, so that varietal corrections can be applied. The leaves, from primary stalks, should be sampled only during the summer boom stage. No factor, whether of physical, climatic, pathological or entomological origin, should be limiting growth except those associated with the plant nutrients under investigation. Two, or preferably three samplings, of the same field unit carried out at not less than four weeks intervals, are advocated and each sample should consist of sixty 3rd leaf blades collected over the whole unit.

Under local conditions, the common perturbing factors are :

(a) moisture stress during droughts

(b) wind damage during cyclones

(a) Leaf sampling should be carried only if there has been no moisture stress during the fortnight preceding the sampling, as shown by 4-5 internode moisture levels above 90% (Tanimoto, 1962) or more conveniently by spindle moisture levels above 78% (Evans 1965).

(b) Where wind damage has resulted in shredding of leaves, a period of six weeks should elapse before the sampling. It is only under exceptional circumstances that foliar diagnosis is completely invalidated by cyclone damage to canes.

Leaves should be collected in the early morning before 8 a.m. Up to now, two tissues have been selected for foliar diagnosis:

(i) The central lamina of the 3rd leaf for the determination of NPK status. Fertilizer recommendations are based on these data.

(ii) The 3-6 leaf sheaths for the determination of Ca, Si and Mn status. Recommendations for the application of soil amendments such as calcium carbonate and calcium silicate depend on these data.

Research carried out at the Institute during 1968 has shown that a single tissue, viz. the 3rd leaf lamina, can be used for the determination of the status of all the six elements listed above. This leads to a simplification in the sampling technique and enables a greater number of leaf samplings to be carried out per year, with a consequent reduction in sampling errors.

The sample consisting of the sixty 3rd leaf blades should be quickly processed. As the selection of an exact middle portion of the leaf, 20 cm in length, is critical, the extreme tip and the base of each leaf are brought together to obtain the true centre of the leaf. The leaf is cut at 10 cm of either side of the centre to give the required 20 cm portion. The mid-rib is then removed. All the leaf laminae thus obtained are immediately placed in a large mesh cloth bag and dried to constant weight in a well-ventilated oven already brought to 80-90° C. Rapid drying is necessary to prevent losses of organic matter and nitrogen, and also growth of moulds which subsequently is likely to occur during conservation of samples prior to analysis. A composite sample is obtained, on an equal dry weight basis, from the different batches of leaves from the same sampling unit. After drying, the leaf tissue is cut by means of stainless steel shears into lengths not exceeding 5 mm, which are then carefully mixed.

(i) About 5 g of dried tissue is crushed in a micro Wiley mill fitted with a 0.5 mm sieve. The fine powder is then kept in small specimen tubes fitted with polythene caps. This sample is normally used for determinations of N and of other special elements such as S, if needed.

(ii) About 10 g of dried tissue is placed in a clean and tared aluminium dish (75 × 20 mm) which is then kept in an oven maintained at 105°C for at least 2 hours for dry matter determination. Afterwards, the dish is placed in an electric muffle furnace and the temperature raised to 300°C. This temperature is maintained for 1 hour, after which it is again raised to 450°C and maintained thus for 6 hours.

The dish is allowed to cool in a desiccator and weighed. The ash sample is stored in a small specimen tube with polythene cap.

Aluminium dishes used for ashing cost very little and may be used for months if they are properly handled, care being taken to avoid scratching, and heating above 500°C. The ashing procedure is derived from *Methods of Leaf Analysis* by J. A. Varley and Poon Yew Chin of the Oil Palm Research Station, Barunting, Selangor, Malaysia.

Nitrogen (Ward, G.M. and Johnston, F.B., 1960)

100 mg of the fine leaf powder, dried at 105°C for 2 hours in the specimen tube without the polythene cap is introduced into a pyrex test tube, 200 × 25mm. Two ml of the digesting reagent, consisting of sulphuric acid, phosphoric acid and Cu and Se catalysts is added. The wet combustion is completed in only 12 minutes after insertion of the test tube into an aluminium block heated to 370°C.

On cooling of the tube, 50 ml of distilled water is added to the clear digest. 10 ml of this first dilution is pipetted to 50 ml of distilled water in a test tube, mixed and allowed to settle for at least one hour. 5 ml of this second dilution is placed into 50 ml beakers, followed by 10 ml of diluted Rochelle salt solution and 2 ml of a special Nessler reagent.

The colour intensity is read immediately by means of a photoelectric colorimeter fitted with the 490mμ filter. The colorimeter is adjusted to zero with distilled water.

A standard is prepared by evaporating 2 ml of a 0.5N H_2SO_4 solution containing 2 mg N in a digestion tube; for the blank, the pure acid is used. Both standard and blank are then run through the whole procedure.

The blank reading is subtracted from the sample and standard readings. The 2ml of the standard solution used corresponds to 2.00 N % dry matter.

This Kjeldahl digestion, followed by Nesslerisation, is the most rapid and reliable method yet available for total N determination in plant tissue.

Ash solution for P, K, Ca and Mn (BRADFIELD, E. G., 1964)

50 mg of well mixed ash, dried at 105°C for 2 hours, is placed into a 50 ml conical flask to which 10 ml of 0.5N KCl and 1 ml of freshly prepared 1% sodium nitrate solution are added. A special funnel condenser is put over the neck of the flask which is heated on an asbestos mat over a hot plate. Steady boiling is maintained for 10 minutes.

After cooling all the contents are transferred to a 50 ml graduated tube and brought to the mark with distilled water. The solution is filtered over a dry filter paper, and the paper is not washed at the end of the filtration.

Preparation of standards and blank

A stock synthetic ash solution is used for calibration. It contains per litre of 0.5N HCl

200 mg of P	corresponding to	4.00 P % ash
1500 mg of K	,,	30.00 K % ash
300 mg of Ca	,,	6.00 Ca % ash
10 mg of Mn	,,	2,000 ppm Mn

The blank consists of 0.5N HCl only.

10 ml of the stock synthetic ash solution for the working standards and 10 ml of pure 0.5N HCl for the blank are pipetted into 50 ml conical flasks, 1 ml of 1% sodium nitrite is added and the whole boiled for 10 minutes. After cooling the contents are made up to 50 ml in a marked tube.

The following aliquots of the sample filtrate, standard and blank are taken

2 ml for P & K	determination
20 ml for Ca	,,
4 ml for Mn	,,

Phosphorus (VAN SCHOUWENBURG, J. Ch. and WALINGA, I., 1967)

2 ml aliquot of the ash solution is added to 100 ml of distilled water contained in a large test tube. Ten ml of this diluted solution is placed in a dry test tube followed by 2 ml of a freshly prepared molybdic reagent and mixed immediately.

After 45 minutes, the blue colour developed is read at 650 mμ in a photoelectric colorimeter.

2 ml of the standard solution corresponding to 4.00 P% ash and 2 ml of the blank is used for calibration after following the above procedure. The blank serves to adjust the colorimeter to zero.

P% leaf dry matter is given as :

$$\frac{\text{P\% ash} \times \text{ash \% leaf dry matter}}{100}$$

The mixed molybdic reagent used is derived from four solutions including potassium antimonyl tartrate, which acts as a catalyst and avoids the necessity of heating the solution for colour development. Its use is therefore an improvement over the molybdic reagent with only ascorbic acid as the reducing agent.

Potassium (Flame photometry)

The same diluted solution as for P (consisting of 2 ml aliquot of ash solution plus 100 ml of distilled water) is used. The flame photometer is adjusted to 100 by using the same standard solution as for P; this corresponds to 30.00 K% ash. The same blank is used to adjust the flame photometer to zero.

K% leaf dry matter is given as :

$$\frac{\text{K\% ash} \times \text{ash\% leaf dry matter}}{100}$$

Calcium (Flame photometry)

To a 20 ml aliquot of the ash solution placed in a 50 ml conical flask are added 2 drops of a brom cresol green indicator and the contents titrated against 1:3 ammonia solution to just green-blue end-point. One drop of 1:3 HCl is then added to bring the colour back to yellow, followed by one ml of a 1% zirconyl oxychloride solution and one drop 1:3 ammonia. A green-blue colour is obtained. The liquid is allowed to stand for 5 minutes before being brought to 50 ml with distilled water. The solution is filtered over a dry filter paper which is not washed afterwards.

The filtrate is used for Ca determination on the flame photometer fitted with a special filter.

20 ml of the standard solution and 20 ml of the blank solution are used for calibration following exactly the procedure described above. The standard solution corresponding to 6.00Ca % ash is used to set the flame photometer reading to 100 and the blank solution to adjust the flame photometer to zero.

Ca % leaf dıy matter is given as :

$$\frac{\text{Ca \% ash} \times \text{ash \% leaf dry matter}}{100}$$

The critical feature of this method is neutralization, which is made in three steps. The method has been used for more than five years and gives very reproducible results with plant tissue which is low in calcium, such as sugar cane leaves.

Manganese (VAN SCHOUWENBURG, S. Ch., 1966)

A 4 ml aliquot of the ash solution is placed in a test tube followed by 1 ml of metol sulphite solution and 5 ml of alkaline potassium cyanide solution and allowed to stand for 15 minutes.

Four drops of formaldoxime solution are then added and the solution allowed to stand for 30 minutes before it is read at 490 mμ in a photocolorimeter.

4 ml of the standard solution and 4 ml of the blank solution Mn are used for calibration after following the above procedure. The standard will correspond finally to 2,000 ppm Mn in the ash.

The blank serves to set the colorimeter at zero.

Mn ppm dry leaf is given as :

$$\frac{\text{Mn ppm ash} \times \text{ash \% leaf dry matter}}{100}$$

Silicon (KILNER, V. J., 1965)

10 ml of a 15% w/w NaOH solution is placed into a nickel crucible, size 50 × 50 mm and evaporated to dryness over a hot plate regulated at 150-200°C. To this is added 50 mg of well mixed ash, dried at 105°C for 2 hours in the specimen tube without the cap. Fusion is carried out for 5 to 10 minutes by placing the nickel crucible into a muffle furnace regulated at 450° C. Allow to cool and add 50 ml of distilled water and let stand overnight.

Transfer the whole of the contents of the crucible into a beaker containing 200 ml of distilled water and 20 ml. of 6N HCl. Dilute to exactly 500 ml. Pipette 5 ml of the solution into a 100 ml graduated flask, add 5 ml of distilled water, followed by 1 ml of molybdate solution. Mix and allow to stand for 10 minutes. Next add 4 ml of tartaric solution and 1 ml of the sulfonic reducing solution, mixing after each addition. Bring the final volume to 100 ml with distilled water. Allow to stand for 30 minutes before reading at 650 mμ in the photocolorimeter.

The calibration is effected with 20 mg of purified quartz (SiO_2) . A blank is also run to set the instrument to zero. The standard used corresponds to 40.00 SiO_2 % ash.

SiO_2 % leaf dry matter is given as :

$$\frac{SiO_2 \text{ \% ash} \times \text{ash \% leaf dry matter}}{100}$$

A quick determination of silica in cane leaves is now available as a result of work carried out at the Institute during 1968.

The SiO_2 content of cane leaf blade can be determined indirectly if ash % leaf dry matter and K % leaf dry matter are known. The equation found experimentally on 22 pairs of data covering a wide range of varieties and leaf composition (ash varying from 4.90 to 8.56%, K from 1.02 to 1.40% and SiO_2 from 1.18 to 5.32%) is :

$$SiO_2 = 1.184 \text{ ash} - 2.895 \text{ K} - 1.457$$

The maximum difference between SiO_2 derived from actual analysis and calculated from the equation has been found to be - 0.23 on a leaf dry matter basis. This variation is small when compared to the wide range of Si contents of cane leaf lamina.

Therefore, as ash and potassium contents are available in routine work, this indirect method of leaf silicon determination will be used for that purpose.

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Illustrating uniformity in growth of sugar cane plants prior to starting an experiment on effects of leaf water potential on growth rate

PLANT-SOIL-WATER RELATIONSHIP

C. MONGELARD

1. COMPARATIVE METHODS FOR THE ESTIMATION OF LEAF-WATER STATUS

THE plant water status can be obtained by measuring the plant water content, the plant water deficit or the plant water potential.

The water content in the plant can be expressed per unit fresh weight or dry weight. Both methods have drawbacks since the fresh weight varies with the degree of hydration of the plant organs and the dry weight is not a constant value. An expression which involves the turgid weight or the water content at saturation as denominator appears more acceptable. The values of W and RT (relative turgidity)

$$\text{where } W = \frac{\text{Turgid wt} - \text{Sample wt}}{\text{Turgid wt}} \times 100$$

$$\text{and } RT = \frac{\text{Sample wt} - \text{Dry wt}}{\text{Turgid wt} - \text{Dry wt}} \times 100$$

have therefore been measured during the experiments.

These measurements however give only a rough idea of the physical state of the water which is essentially thermodynamic. But when these measurements are related to the water suction (∅) of the plant, studies on the water relationships between soil, plant and atmosphere become more valuable.

The measurement of ∅ gives a measure of the tendency for water movement and can be expressed in pressure units. It is therefore comparable to measurements of total soil moisture stress.

Three techniques for the measurement of ∅ of leaf tissues were compared, two of them following liquid equilibration and the third one after establishing vapour pressure equilibration.

Liquid equilibration

The two methods used consisted of

(1) the density column technique of SCHARDAKOW ;

(2) the refractometric method of ASHBY and WOLF (1947).

The density column technique consists in measuring a change in the density of a graded series of sucrose solutions of known osmotic pressure (O.P.) in which leaf pieces have been immersed for a two-hour period. Absorption of water by the leaves from the solutions or by the solutions from the leaves was detected by measuring any change in the density of the prepared solutions. The change in density was tested by using glass pipettes with long narrow jets to introduce a drop of sucrose solution coloured with methylene blue into a sample of the corresponding concentration in a 0.5 cm diameter tube. When no change in density of the prepared solution had occurred, the coloured drop introduced neither rose to the surface of the sample solution nor fell to the bottom of the tube. The concentration at which no change in density would have occurred was normally found by interpolation, the precision of the results depending on the number of graded series of solutions prepared between any two concentrations. The O.P. of the sucrose solution where no change in concentration would have taken place gave an estimate of ∅ leaf.

Similarly the O.P. of the sucrose solution with no change in refractive index after immersion of the leaf tissues for two hours in the solution was taken to correspond with ∅ leaf.

Vapour-pressure equilibration

WEATHERLEY's micro-osmometer (1960) as modified by MONGELARD (1965) was used to estimate ∅ leaf by vapour pressure equilibration. The detailed techniques have been described elsewhere (WEATHERLEY, *loc. cit.*, MONGELARD, *loc. cit.*). It will suffice here to say that the technique consists of measurements after equilibration of the rate of evaporation of a drop of water in a small hermetically closed capsule containing a leaf segment. The rate of evaporation was assumed to be directly related to the difference in vapour pressure between the drop and the leaf tissue. The ∅ leaf was read off from a calibration curve relating the amount of evaporation obtained with sodium chloride solutions of known O.P. Theoretically, the relation between O.P. and the evaporation rate (itself determined by the relative vapour pressure P/Po) is logarithmic since OP varies as — log P/Po; but the relation between P/Po and its logarithm is near enough linear for values of P/Po from 1 to 0.97. Stomatal resistance, when leaf tissues are used, has been calculated (MONGELARD, *loc. cit.*) as negligible when compared with the resistance of air, the ∅ leaf being underestimated by less than 2% as long as the stomata remain open.

The investigations were carried out to find

(i) Whether or not there was any correspondence between the ∅ leaf as measured with the osmometer (∅ osm) and the ∅ leaf determined by the Schardalow density column technique (∅ s) and by the refractive index method (∅ r).

(ii) The relation, if any, between W and ∅ osm.

Comparison between the values of ∅ osm, ∅ s and ∅ r

Six single-bud cuttings of each of the two varieties Ebène 1/37 and M.147/44 were planted in the greenhouse in a 40-gallon drum filled with low humic latosol soil. The soil was watered to capacity on the date of planting and subsequently each time when the soil water tension, as measured by irrometers placed at 15 cm depth, reached 0.25 atm. Three months after planting, the canes had sufficiently grown to provide enough leaf tissues for the investigations to proceed.

Leaf samples were taken from one plant and determinations of ∅ osm, ∅ s and ∅ r were carried out when the soil was saturated. After the first sample had been taken, the soil was allowed to dry to different levels of water suction, and at each pre-determined degree of soil water stress (measured by Bouyoucos blocks for suction greater than 0.7 atm), samples were taken from a different plant of each variety, following each time the same sampling procedure.

Fairly good correspondence of ∅ leaf measurements by the 3 methods was noted as can be seen from the results which are presented in Table 23.

Table 23. Comparison of ∅ osm leaf, ∅ sleaf, and ∅ r leaf of the varieties Ebène 1/37 and M.147/44 at different levels of water tension

Soil suction atm at 15 cm depth	*Ebene 1/37*				*M.147/44*			
	∅ osm leaf atm		*∅ s leaf atm*	*∅ r leaf atm*	*∅ osm leaf atm*		*∅ s leaf atm*	*∅ r leaf atm*
	1	*2*			*1*	*2*		
0	2.2	2.0	< 2.0	1.5 — 2.7	1.8	2.2	< 2.0	1.5 — 2.7
0.25	2.0	2.4	< 2.0	1.5 — 2.7	2.0	2.0	< 2.0	1.5 — 2.7
0.47	4.5	4.7	4.6 — 5.2	3.9 — 5.2	2.3	3.2	2.7 — 3.3	2.7 — 3.9
0.63	4.4	4.5	4.6 — 5.2	3.9 — 5.2	4.0	3.6	3.9 — 4.6	3.9 — 5.2
3—3.5	8.7	—	> 9.0	7.7 — 9.0	7.2	6.6	?	6.4 — 7.7
9—10	10.0	10.7	< 11.6	11.6 — 13.0	10.3	8.6	< 11.6	11.6 — 13.0

Relation between W and ∅ osm

Leaf samples without midrib were taken from the 3rd leaf of 3 months' old canes of the varieties Ebène 1/37 and M.147/44 for estimations of W and ∅ osm. From leaf strips about 6 cm long cut out from the plant, a portion about 1/2 cm long was severed and introduced in the osmometers for ∅ osm determinations. The remaining portion was immediately weighed and then immersed in water overnight. The next morning, the leaf strip was blotted dry and the turgid weight determined. No great importance was attached to photosynthetic and respiratory activities because the water content of the young leaf tissue is so high that small differences in the dry weight could be considered negligible. The estimation of ∅ osm at different values of W is graphically represented in fig. 21.

Discussion

The refractive index method was found to be the least accurate for ∅ leaf estimations since differences in refractometric readings between solutions of different osmotic concentrations of about 1.3 atm were not large. The Schardakow technique is more sensitive than the refractive index method, but it has a few technical drawbacks which need not be described here. Both methods could prove useful for field determinations of ∅ leaf for irrigation purposes in practice, provided the level of ∅ leaf which affects growth is known; otherwise the amount of work involved would be time consuming. The ∅ osm determination is essentially a laboratory method and can be used for accurate estimations of ∅ leaf at which growth is affected.

No difference in ∅ osm between the varieties Ebène 1/37 and M.147/44 at equal W was noted. There was a good correspondence between W and ∅ osm for leaves of the same physiological age. Since the water status can be more easily measured by the W method than by the refractive index method or the Schardakow technique, it is believed that estimates of W as a guide for irrigation in field application would prove useful.

Such a technique, used during the course of a field trial, is described in the next chapter.

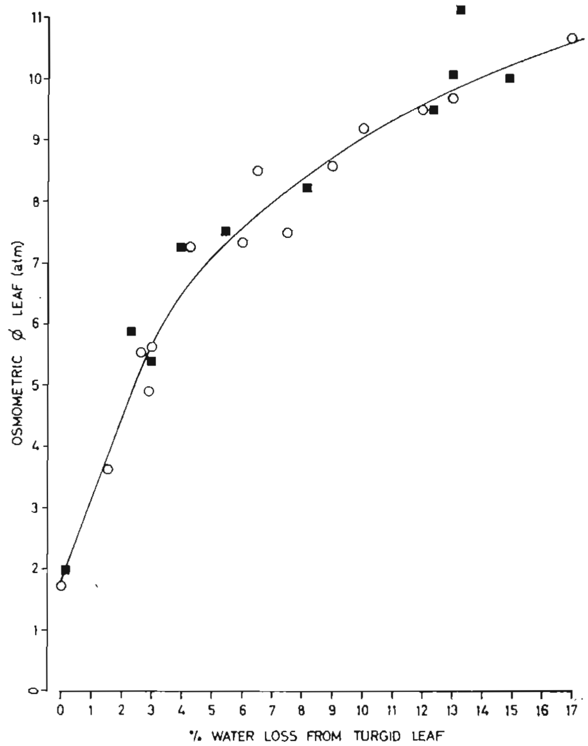

Fig. 21. Relation between W leaf and ∅ osm leaf.

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WEATHERLEY, P. E. (1960). A new micro-osmometer. *J. Exp. Bot.* **11** (32) : 258-269.

2. PRELIMINARY INVESTIGATIONS ON OPTIMUM WATER REQUIREMENTS FOR CANE GROWTH AS INDICATED BY THE LEAF-WATER STATUS

Evidence has been given and presented in Table 23 that with an increase in ∅ soil, ∅ leaf also increases, but it appeared that at the same ∅ soil, ∅ leaf in the variety M.147/44 was sensibly less than that of Ebène 1/37, especially at ∅ soil = 0.47, 0.63 and 3-3.5 atm. The differences in ∅ leaf between the two varieties at equal ∅ soil could have been due to either a higher shoot/root ratio in Ebène 1/37 which resulted in a greater resistance to water flow and a concomitant increase in ∅ leaf, or to a more superficial root system in Ebène 1/37 where the effective soil suction around the roots is likely to be higher. Detailed observations on the root systems of both varieties (MONGELARD 1967) support both assumptions. It has also been shown that successive drying cycles, if any pre-determined ∅ soil at any one depth is the criterion of measurement for soil humidity before the soil is watered again, do not have similar effects on growth. Further, the level of ∅ soil (at any one depth) that affects growth increases as the root system develops in depth. It follows that there will be different optimum ∅ soil at a fixed depth at different stages of growth for different varieties if maximum yields are to be obtained.

It is evident that during the germination and early growth phases, soil moisture measurements should indicate the irrigation requirement. But whenever leaf tissues are available, more attention should be devoted to relate the leaf water status to growth rate and yield.

Preliminary investigations were carried out on 8 months' old canes sampled in a trial started last year and the results have been reported. (MONGELARD *loc. cit.*)

Values of W (which have been shown in the preceding chapter to be related to ∅ leaf) were measured in four randomized replicate plots and the mean of the four measurements was allowed to reach 2% and 5% before irrigating the plots, thus constituting two different treatments. Measurements of stem height were carried out at weekly intervals on ten tagged plants in each plot. The mean percent increases of initial height for each variety and for each treatment are shown in figs. 22 and 23.

It is evident that there is a differential growth rate at the two different levels of W. Ignoring precipitation, three irrigations were required to keep W at a value lower than 2% during the duration of the experiment which lasted six weeks, whereas only one irrigation was required to keep W at the 5% level. But the differences in percent increase of initial height of plants between the two treatments and in both varieties were appreciable. A difference of about 20% in the variety M.147/44 was recorded and in Ebène 1/37, the difference was about 16%.

The differences in growth rate between varieties under the same treatment could be due to different growth patterns caused by factors inherent to the varieties.

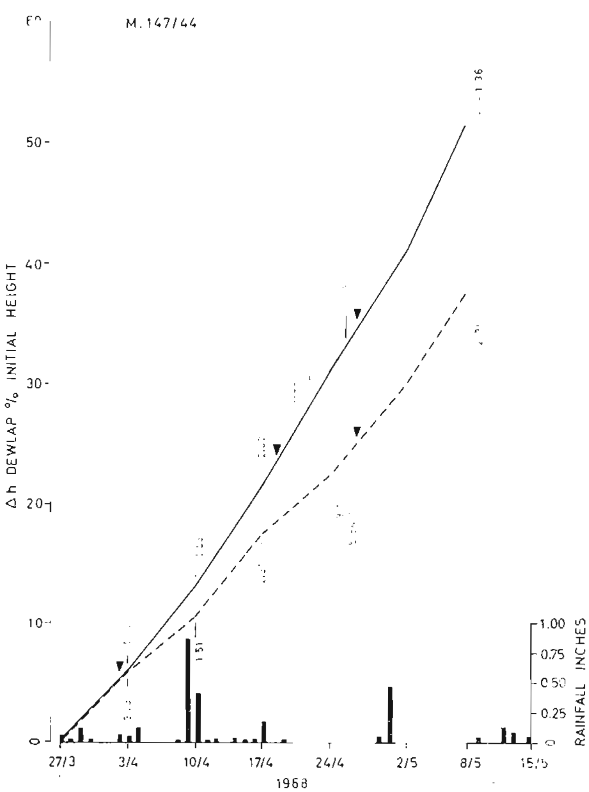

Fig. 22. Growth response of the cane variety M147/44 as influenced by two different levels of leaf water deficits.
▼ - Irrigation.

These preliminary observations support the view that measurements of W ought to give an indication of irrigation requirements. Future experiments should compare growth rate and yield obtained when irrigation is made whenever values of W reach various pre-determined levels. The increase in yield obtained at any W value should be an economic proposition in regards to the expenses incurred for irrigation purposes; in other words the W value for optimum economic yield should be determined.

Regarding the amount of water to be applied, one would have to rely on a knowledge of soil structure and on calculations made from (i) soil humidity measurements, or (ii) ∅ soil if this is measured at different depths and the relation between soil moisture content and ∅ soil has been determined, or (iii) evaporation rates actually measured or calculated from physical attributes and corrected to take into account the plant factors.

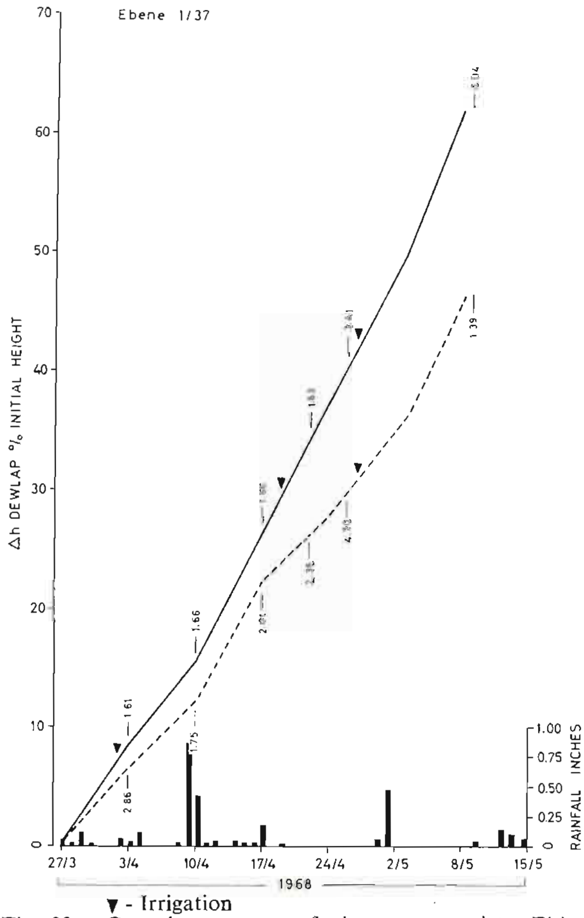

Fig. 23. Growth response of the cane variety Ebène 1/37 as influenced by two different levels of leaf water deficits.

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3. FURTHER NOTES ON THE USE OF SINBAR FOR THE SELECTION OF DROUGHT-RESISTANT SUGAR CANE VARIETIES

Further observations were carried out in an experiment laid out in 1967 to study the effect of Sinbar on drought-resistant and drought-susceptible sugar cane varieties. The experimental set-up and preliminary observations have been recorded (MONGELARD 1967). It will be recalled here that eight cane varieties were included in this experiment. Three of them are known to be drought-resistant — M.147/44, M.351/57 and M.442/51; three of them are drought-susceptible — Ebène 1/37, B.3337 and M.93/48; and the two others are adapted to humid regions — M.31/45 and M.99/48. After planting, the plots were sprayed with Sinbar at concentrations varying from 3 lb a.i. to 0.8 lb a.i. per arpent. Ten weeks after planting, a quantitative estimate of green pigment extracts from leaves, at different dosage rates, was carried out.

Analytical methods

The 50-foot long strip of each plot which received the logarithmic spray of the herbicide was divided into eight 5-foot long sub-plots starting from the beginning of the strip. The last two sub-plots were not considered. The concentration of the chemical spray in these eight sub-plots was in lb active ingredient per arpent in the following dosage groups : 3-2.6, 2.6-2.2, 2.2-1.89, 1.89-1.62, 1.62-1.40, 1.40-1.19, 1.19-1.03, 1.03-0.87.

In the middle of each sub-plot, the third leaf (counting the spindle as number 1) from 5 different plants in each concentration group was sampled. The laminae of these leaves were cut in rectangles about 6 cm long, immersed in water in test tubes and brought to the laboratory. On any one day, leaves from only two of the varieties were sampled and the work was completed in 4 days.

The green pigments from a sub-sample of exactly 2 gm turgid weight were extracted with methanol at 60°C for 10 minutes. The optical densities of the green pigments extracted quantitatively from the samples were read off a lumetron colorimeter using a 530 u filter.

Results

The results are expressed in fig. 24, in % transmission of methanol extracts against concentrations of Sinbar which had been previously sprayed on the sampled plants. It must be emphasized that the amount of green pigments extracted from unit turgid weight of untreated leaf tissue varies with the variety and no comparison between varieties is possible. Regression lines, fitted by the method of least squares, for each variety give a good estimate of the degree of chlorosis caused by different concentrations of Sinbar. The slopes of the regression lines give an indication of the tolerance or susceptibility of the cane varieties to Sinbar, the smaller the cosine of the angle which the regression line makes with the ordinate, the more tolerant the variety. It is interesting to note that the drought resistant varieties M.351/57, M.147/44 and M.442/51, have regression slopes whose cosines with the ordinate are nearly equal to zero. Of the five other varieties, the drought-susceptible M.93/48, Ebène 1/37 and B.3337 have shown the least tolerance to Sinbar.

Discussion

The use of Sinbar for a broad and rapid classification of drought-resistant and drought-susceptible varieties into their respective categories has been demonstrated. In preliminary trials laid down to evaluate the tolerance of different cane vaiieties to Sinbar in humid localities, no chlorotic symptoms were observed on the leaves of the drought-tolerant varieties. In drought-susceptible varieties, leaf chlorosis was apparent 2 months after the herbicidal spray with the most striking chlorotic symptoms being observed one month later.

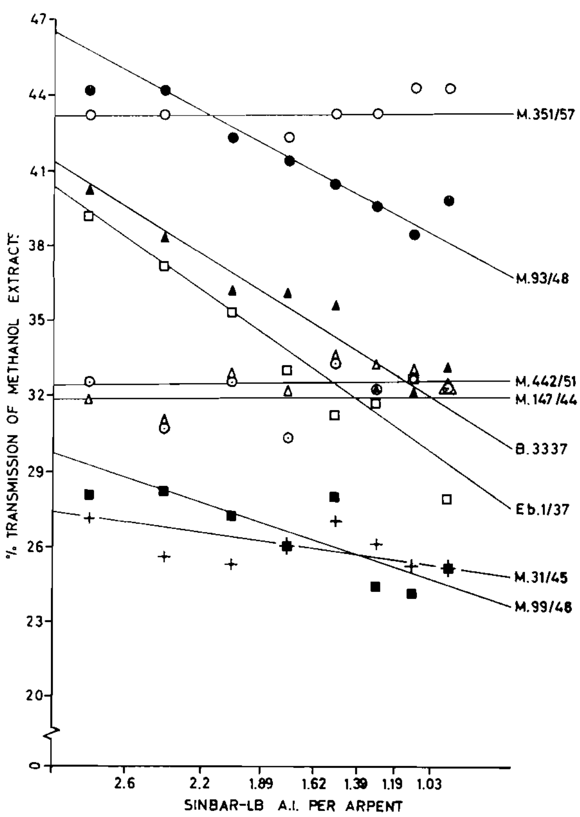

Fig. 24. Methanol extracts of green leaf pigments of different varieties at varying dosage rates of Sinbar.

The experiment just described was conducted in a superhumid zone and attention must be drawn to the fact that on the 3rd day after the herbicide application, 80 mm of rain were recorded. The first chlorotic symptoms were noted 6 weeks later, but the expected increase in leaf chlorosis up to 3 months did not take place. When the leaf sampling was made 10 weeks after spraying, the yellow colour of the leaves was almost turning back to green. It is possible that if the sampling had been made 2 weeks earlier, better results would have been obtained. Another observation which is of interest was the slight chlorotic symptoms observed in M.442/51 and M.147/44 at the highest dosage rate, a reaction never recorded in previous trials in humid localities.

It would seem therefore that the amount of rainfall which follows Sinbar application affects to some extent its toxicity. This is quite understandable when the root system development of the varieties concerned is taken into consideration. It is clear from root studies of M.147/44 and Ebène 1/37* that drought-tolerant varieties have deeper root systems than drought-susceptible ones. When Sinbar application is not followed by heavy rain, the chemical is not leached down to the deeper soil layers; it therefore is available to the roots in the superficial soil layers. Since it appears that drought — susceptible varieties, two months after planting, have a greater concentration of roots in the upper soil layers, absorption of the chemical will soon reach a toxic level in the plant and chlorotic symptoms will appear. The drought-resistant varieties which have a better distribution of roots show tolerance to Sinbar because absorption of water takes place in a higher soil volume and the amount of chemical absorbed from the upper soil layers is thus probably "diluted" and the concentration of the chemical in the plant does not reach toxicity level. However, when rainfall is abundant after the herbicidal spray, the chemical is probably leached down to a greater depth in the soil and absorbed by the deeper roots as well; this would explain the slight leaf chlorosis observed in the varieties M.442/51 and M.147/44.

It goes without saying that the physical structure of the soil is of importance since root system development of the same variety shows great variation in different soil types (Hudson 1964, Mongelard 1962). It therefore follows that assessment of tolerance of cane varieties to Sinbar should be made in humid localities in soils where normal root development is not impeded either by soil compaction or otherwise, if the object in view is to correlate the results obtained with varietal drought-resistance.

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* *Rep. Maurit. Sug. Ind. Res. Inst.* **15** (1967) : 92-97

4. THE EXPOSED SPINDLE, AN EFFICIENT AND CONVENIENT TISSUE FOR ASSESSING THE MOISTURE STATUS OF THE CANE

P. HALAIS & M. HARDY

There is a *consensus* of opinion among agronomists on the need for some specific and simple method of assessing moisture stress within the cane growing under field conditions.

The first tissue to fulfil the need of specificity has been the 4-5 joint proposed by TANIMOTO (1962), HALAIS and HARDY (1964) were able to confirm this under Mauritius conditions.

More recently EVANS (1965) has proposed another tissue, the tightly rolled exposed spindle cut off at the level of the top visible dewlap, as offering both advantages of specificity and convenience of sampling.

Tests were carried out in Mauritius between the 27th of March and the 8th of July 1968 on six final nitrogen/variety trials, on 1st ratoons, each comprising eight varieties, three doses of nitrogen and three dates of harvest in 1967. The number of determinations of moisture % exposed spindle exceeded one hundred.

Apart from the rapidity and convenience of the sampling which are evident, the exposed spindle has proved to be a very useful tissue for testing moisture status.

Varietal differences for the same field conditions are negligible in the absence of moisture stress, i.e. above 78% moisture. At a moderate stress, however, differences were observed, the extreme cases being 73.9% moisture for M.147/44 and 76.3% for M.409/51. The differences observed between zero-N plots and those getting the high dose of 60 kg N/arpent were 74.4 and 75.2 respectively. The ratoons aged 6, 8 and 10 months have respectively shown the following spindle moisture contents: 75.2, 74.8 and 74.4. This corresponds to a fall of 0.2% moisture per month, the same rate as the one observed previously for the 4-5 joint.

The general conclusion is that any ratoon crop aged 6 months showing a spindle moisture superior to 78% is under no moisture stress from the practical point of view. The extremes observed up to now have been 80% after saturating rains and 65% during the peak of a drought.

The spindle moisture test is therefore convenient for checking from an early stage of growth the efficiency of irrigation practices. In addition, its regular use as a prelude to valid cane leaf sampling for foliar diagnosis is also useful. No leaf sample should be taken unless the spindle test shows values equal to, or superior to 78%, during the fortnight preceding the sampling.

Description of the spindle test

It is imperative that spindle test should be made early in the morning before 8 o'clock (SINGH, 1966).

At least twenty fully representative spindles should be taken for each test on primary cane stalks.

With the help of a pair of shears each top to be sampled is sectioned at the level of the highest visible dewlap.

The tightly rolled spindles, after removal of any leaf which has started to unfold, are put as soon as collected, one at a time, inside a clean, tared polythene bag 50 cm long and 10 cm wide. After collection of the twenty spindles, the bag is tightly closed with a rubber ring to prevent any loss of moisture.

On arrival at the laboratory, the bag containing the spindles is weighed in order to obtain the fresh green weight of the collected spindles. These are removed, without any loss, and placed inside a well ventilated electric oven regulated at 80-90°C. A constant dry weight is usually obtained after 12 to 24 hours according to the type of oven used.

Moisture % fresh weight is then calculated.

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CLIMATE AND CULTIVATION

1. WEATHER CONDITIONS AND SUGAR PRODUCTION IN 1968

P. HALAIS

THE four graphs (figs. 25-28) reproduced in this note illustrate data, expressed as average values for the sugar zone of Mauritius, covering the vegetative period from November, 1967, to June, 1968, and for the maturation period from July to November, 1968.

Fig. 25 shows the monthly air temperature deviations from normal values for the vegetative period and average minimum temperature values for the maturation period.

Fig. 26 shows rainfall deviations from ten days median values for both periods.

Fig. 27 shows the highest monthly hourly wind speed deviations from median values for both periods.

Fig. 28 shows monthly relative insolation deviations from normals for both periods.

In addition, each figure shows the comparative values for the two previous sugar campaigns, 1965-1966 and 1966-1967.

Vegetative period (November-June).

The favourable and unfavourable factors which influence cane production are as follows :

Critical data	*Favourable*	*Unfavourable*
(i) Sum of monthly rainfall deficits	low	high
(ii) Highest hourly wind speed ...	low	high
(iii) March-June mean temperature ...	high	low
(iv) Relative insolation	high	low
(v) Length of growing season		
(a) mid-harvest date previous campaign ...	early	late
(b) mid-harvest date actual campaign	late	early

Comparative data for the five factors together with cane yields per arpent are given in Table 24.

Table 24. Variations in critical meteorological elements for vegetative periods and cane production, 1966-1968

	Normals	*1968*	*1967*	*1966*	*Extremes since 1950*
(i) Inches	*15.0*	16.5	11.1	23.7	5.7 (1962) — 28.7 (1961)
(ii) Miles/hour	*26.0*	27 (Feb)	39 (Jan)	45 (Jan)	18 (1959) — 74 (1960)
(iii) °C	*23.3*	23.0	23.5	23.1	22.6 (1965) — 24.6 (1961)
(iv) %	*58*	58	63	65	53 (1963) — 66 (1961)
(v) a) Day/month...	*18/9*	23/9	26/9	24/9	23/9/67 — 15/9/64
b) Day/month...	*19/8*	2/9	23/9	16/9	2/9/68 — 24/9/65
Tons cane per arpent	*31.0*	27.1	30.3	24.7	12.7 (1960) — 30.6 (1965)

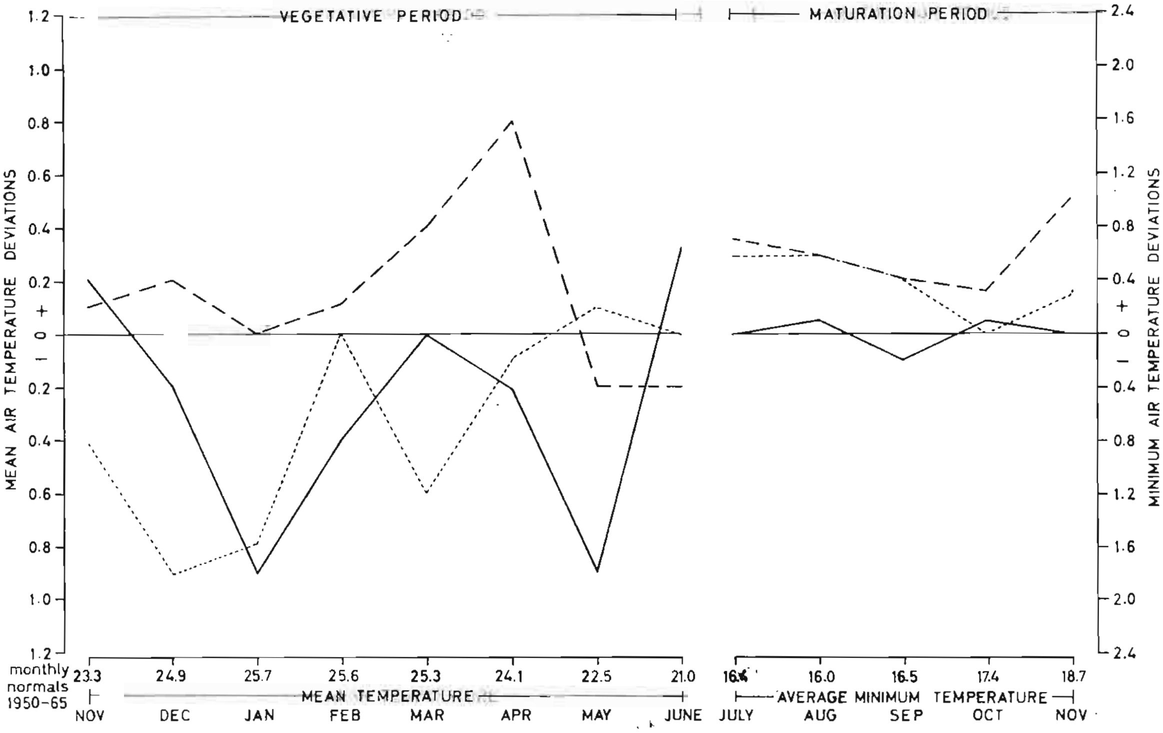


Fig. 25. Air temperature; deviations from monthly normal values. Average mean temperature for vegetative period; Average minimum temperature for maturation period : dotted lines : 1965-66; broken line : 1965-1966; plain line : 1967-68. Scale used for vegetative period is double that for maturation period.

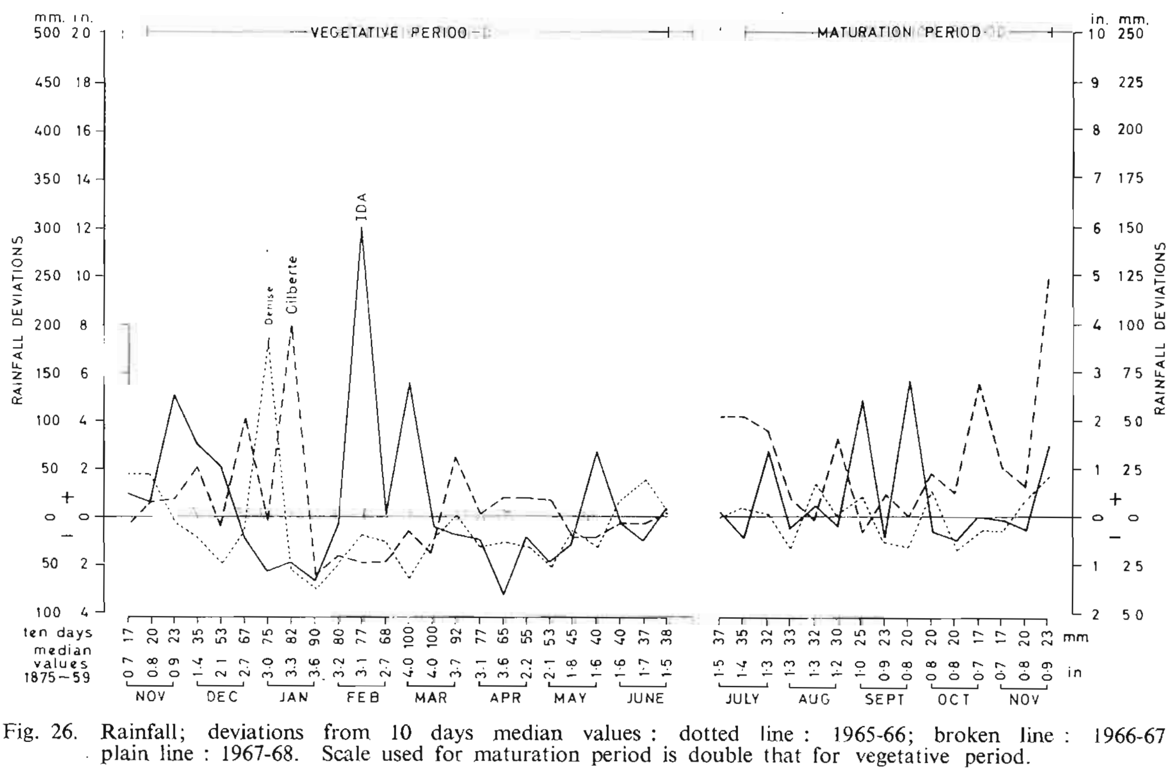


Fig. 26. Rainfall; deviations from 10 days median values : dotted line : 1965-66; broken line : 1966-67 ; plain line : 1967-68. Scale used for maturation period is double that for vegetative period.

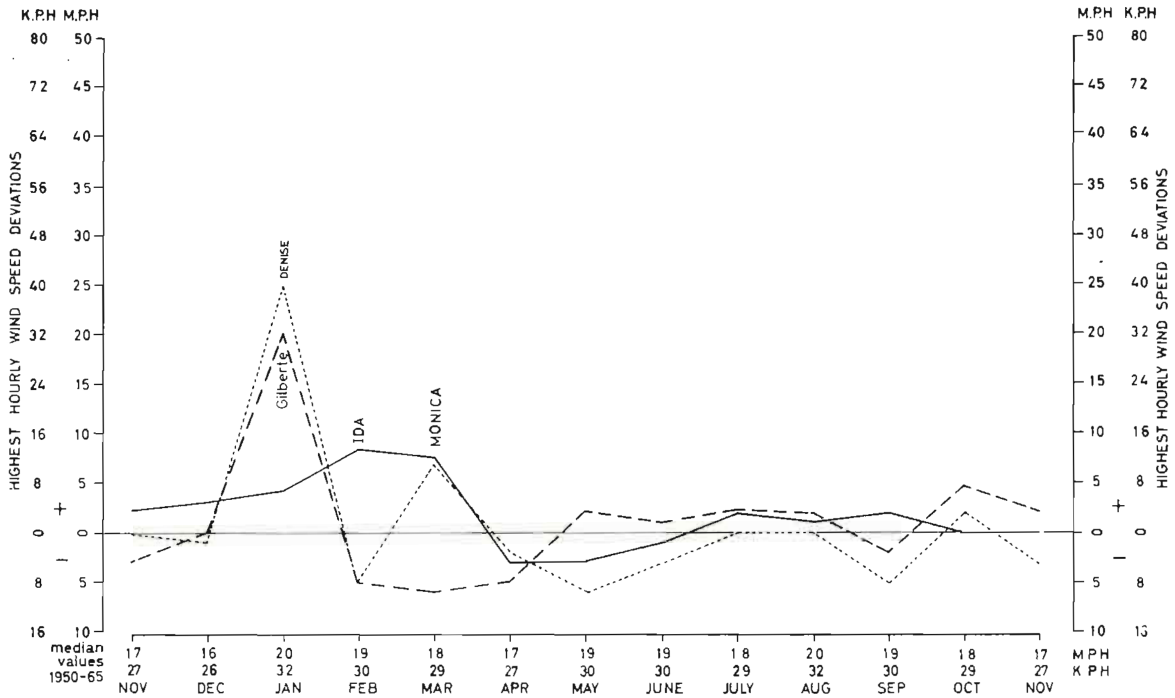


Fig. 27. Highest hourly wind speed; deviations from corresponding median values; dotted line : 1965-1966 ; broken line : 1966-67; plain line : 1967-1968.

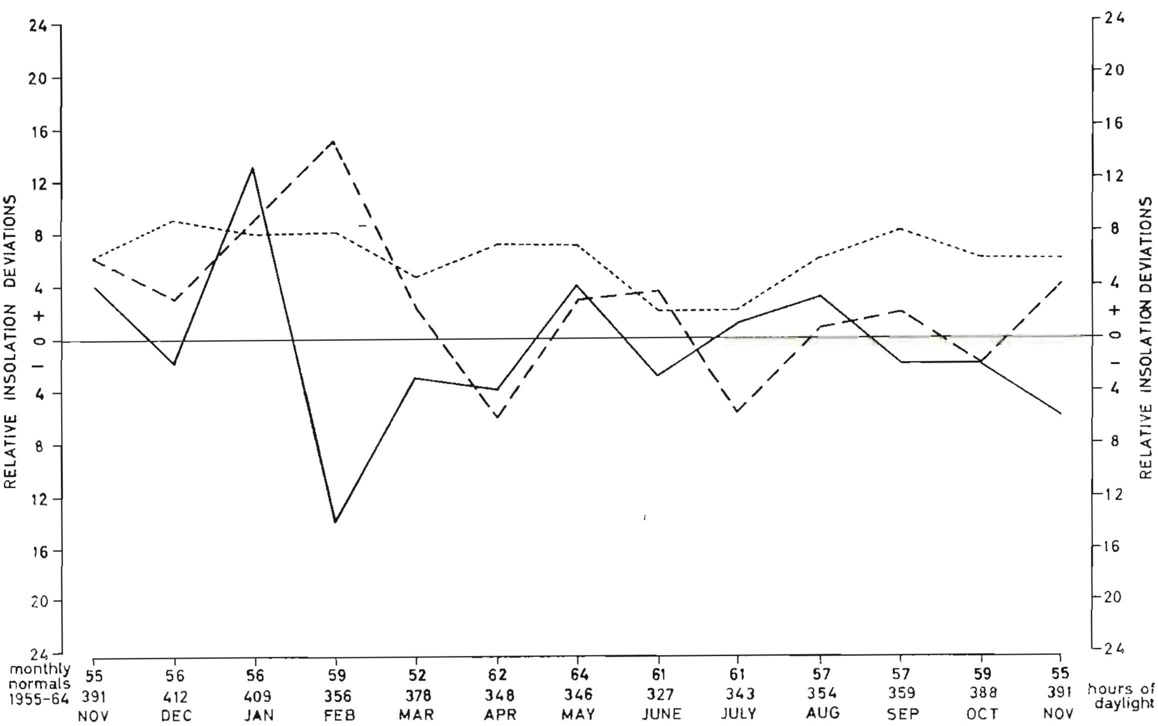


Fig. 28. Relative insolation; deviations from monthly normals : dotted line : 1965-66 ; broken line : 1966-67; plain line : 1967-68.

It follows that the various factors have not had a more favourable influence compared to normal values, during the vegetative period, November 1967 to June 1968.

Two cyclones, *Ida* in February and *Monica* in March, approached the island. Cyclone *Monica*, in addition to its lateness in the season, followed an unusual course. It curved sharply before reaching the east coast of Mauritius and affected the eastern sugar sector much more than is usually the case with cyclones in general.

Pre-harvest weighing of standing cane crops made by the Institute with the co-operation of the three sugar estates of the eastern sector, gave the following results in 1967 and 1968:

Eastern Sector *Date of pre-harvest test*	*Tons cane per arpent — in brackets tons tops/arpent* *15th April*		*15th May*		*15th June*		*15th July*		*Final (TCA)*
1967	30.6	(13.2)	31.6	(9.9)	31.2	(8.7)	33.3	(7.8)	*36.0*
1968	23.6	(7.3)	25.3	(7.7)	27.0	(7.1)	27.7	(7.2)	*29.5*
Difference 1968-1967 ...	— 7.0	(— 5.9)	— 6.3	(— 5.9)	— 4.2	(— 1.6)	— 5.6	(— 0.6)	— 6.5

The above figures of the pre-harvest test show that cyclone *Monica* has considerably affected cane growth and reduced the size of tops, which are the vital organ of growing canes. It must be mentioned in this connection that, during the passage of cyclone *Monica* in the vicinity of the eastern sector, the anemometer readings observed locally reached the highest wind speed, during one hour, of 31 miles only.

It is evident that under exceptional circumstances, although the threshold of 30 miles is accepted as the lower limit for cyclone damage to sugar cane crops, such damage may be more important than expected, the more so when it is considered that cyclone Monica occurred late in the season.

The cane yield per arpent for the island and for the five sugar sectors is given below for the last two campaigns, and is compared to normal values adjusted to-date:

	Tons cane per arpent *West*	*North*	*East*	*South*	*Centre*	*Island*
Normals	*36.5*	*28.5*	*30.2*	*31.3*	*31.4*	*31.0*
1967	35.0	29.3	29.5	30.7	30.2	30.3
1968	33.5	27.8	24.2	27.6	26.3	27.1
Difference 1968 from normal	— 3.0	— 0.7	— 6.0	— 3.7	— 5.1	— 3.9
Difference 1968 from 1967	— 1.5	— 1.5	— 5.3	— 3.1	— 3.9	— 3.2

The climatic conditions associated with so called "normal" vegetative periods are : sum of monthly rainfall deficits in the range of 10-20 inches, that is, excluding wet or dry seasons, and absence of damaging cyclones.

Maturation period (July to October).

The favourable and unfavourable factors which influence sucrose content of the cane at harvest are as follows :

Critical Data	*Favourable*	*Unfavourable*
(i) Sum of monthly rainfall deficits	low	high
(ii) Mean daily range of temperature	high	low
(iii) Average minimum temperature	low	high
(iv) Temperature ratio	high	low
(v) Relative insolation	high	low
(vi) Mean of highest hourly wind speed	low	high
(vii) Duration of harvest	short	long

The comparative figures for the seven factors together with sugar made per cent cane for the last three years are given in Table 25.

Table 25. Factors affecting sucrose content for the years 1966-1968

	Normal	*68*	*67*	*66*	*Extremes since 1950*	
(i) Inches	*2.5*	2.1	10.8	0.0	0.0 — (1956-1966)	14.1 (1965)
(ii) °C	*8.2*	7.9	7.3	7.9	6.7 (1965)	9.3 (1956)
(iii) °C	*16.5*	16.6	17.1	16.9	15.7 — (1963)	17.6 (1961-1965)
(iv) °C	*0.98*	0.95	0.85	0.93	0.77 — (1965)	1.15 (1956)
(v) %	*58*	59	57	64	51 — (1963)	65 (1956)
(vi) Miles/hour	*18*	20	21	18	15 — (1957)	22 (1953)
(vii) Days	*142*	126	168	139	113 — (1960)	168 (1967)
Sugar made % cane	*11.5*	11.6	11.0	11.6	—	—

Six out of the seven critical factors were normal during 1968 maturation period. However, the duration of harvest was much shorter than normal, consequently favourable *per se.*

Sugar made % cane for the five sugar sectors and for the island for the last two campaigns are given below, and are compared to normal values adjusted to-date.

Sugar made % cane

	West	*North*	*East*	*South*	*Centre*	*Isalnd*
Normals	*12.2*	*11.7*	*11.4*	*11.2*	*11.8*	*11.5*
1967	11.7	10.8	10.7	10.9	11.4	11.0
1968	11.9	11.5	11.3	11.6	12.0	11.6
Difference 1968 from normal	— 0.3	— 0.2	— 0.1	+ 0.4	+ 0.2	+ 0.1
Difference 1968 from 1967	+ 0.2	+ 0.7	+ 0.6	+ 0.7	+ 0.6	+ 0.6

A "normal" season as regards maturation is one showing a sum of monthly rainfall excesses in the neighbourhood of 2.5 inches and temperature ratio of approximately 1.00. Absence of strong cyclonic winds during the vegetative period is also a pre-requisite in this respect.

Sugar made per arpent for the five sugar sectors and for the island for the last two campaigns, are given below and are compared to normal values adjusted to-date :

Tons sugar made per arpent reaped

	West	*North*	*East*	*South*	*Centre*	*Island*
Normals	*4.45*	*3.33*	*3.44*	*3.51*	*3.71*	*3.57*
1967	4.09	3.18	3.16	3.36	3.39	3.33
1968	3.99	3.19	2.74	3.20	3.15	3.14
Difference 1968 from normals	— 0.46	— 0.14	— 0.70	— 0.31	— 0.56	— 0.43
Difference 1968 from 1967	— 0.10	+ 0.01	— 0.42	— 0.16	— 0.24	— 0.19

In the figures given below, the profitable sugar indices : 0.01 TCA (SM-4). are compared :

Tons profitable sugar made per arpent

	West	*North*	*East*	*South*	*Centre*	*Island*
Normals	*2.99*	*2.19*	*2.23*	*2.25*	*2.45*	*2.33*
1967	2.70	1.99	1.98	2.13	2.20	2.12
1968	2.65	2.09	1.77	2.10	2.10	2.06
Difference 1968 from normals	— 0.34	— 0.10	— 0.46	— 0.15	— 0.35	— 0.27
Difference 1968 from 1967	— 0.05	+ 0.10	— 0.21	— 0.03	— 0.10	— 0.06

The more important data relevant to this note are given below :

Sugar production of the island for the years 1966-68

	Normals	*1968*	*1967*	*1966*	*Extremes since 1950*		
Area harvested, th. arp.	*190*	190	192	196	151 (1950)	—	196 (1966)
Duration of harvest, (days)	*142*	126	168	137	113 (1960)	—	168 (1967)
Sugar made % cane	*11.5*	11.6	11.0	11.6	—		—
Tons sugar made arpent	*3.57*	3.14	3.33	2.86	1.26 (1960)	—	3.53 (1963)
Tons profitable sugar made/arpent 0.01 TCA (SM-4)	*2.33*	2.06	2.12	1.88	0.74 (1960)	—	2.35 (1956-1963)
Total sugar production, th. tons	*680*	597	638	562	254 (1960)	—	686 (1963)

2. THE EFFECT ON SUGAR CANE YIELD OF DIFFERENT METHODS OF FERTILIZER APPLICATION IN RATOON CROPS

Y. WONG YOU CHEONG & C. FIGON

Although sugar cane is grown under climates with rainfall varying from 40″ to over 160″ per annum, fertilizers are usually applied in the same manner throughout the island. Also, soil families range from the very gravelly Latosolic Reddish Prairies to fairly deep and free Humic Ferruginous Latosols. It would appear, therefore, that under such widely-differing soil and climatic conditions, the method of fertilizer application would have some bearing on the efficiency of utilization of the fertilizers.

Nitrogen and potassium are considered to be mobile in the soil but the uptake of these elements may depend on the rooting pattern, which is itself influenced by soil conditions and also by agricultural practice. Particularly in the dry areas, the practice of piling up trash in the interrow to reduce soil-water evaporation encourages roots to develop below the trash, and therefore influences nutrient uptake.

As burying of fertilizers requires an additional operation, surface application of complex fertilizers is usually carried out but is of limited value as far as the immediate availability to plant roots of the phosphate in the complex fertilizers is concerned. This positional unavailability is probably not so important when fertilizers are directly placed on the cane stool because the developing roots of the new tillers may be able to reach this source of phosphate.

Another problem that arises in the dry areas is fertilizer burn. Placement of fertilizer on the cane stool frequently results in fertilizer granules being caught between the spindle and the leaves. As periods of drought or very light rain are quite frequent during that time of the year, quite serious leaf burns may occur.

Normal estate practice in the application of fertilizers varies between broadcasting along the cane rows and direct placement on cane stools.

Five treatments are considered below :

(1) No fertilization
(2) Broadcasting along cane row
(3) Broadcasting on trash
(4) Burying along cane row
(5) Dropping vertically on cane stool.

Three experimental sites were chosen : two (Mount and Constance) under an annual rainfall of about 50″ per annum, and the third (Plaine Magnien) under a much higher rainfall (100″ per annum).

Fertilizers were applied annually as ammonium sulphate at the rate of 250 kg/arpent and as muriate of potash at the rate of 100 kg/arpent. The canes were ratoons and the results were obtained over 4 years. Cane yield data are given in Table 26.

Table 26. (a) Cane yield data

	MOUNT Cane yields (TCA)					*CONSTANCE* Cane yields (TCA)					*PLAINE MAGNIEN* Cane yields (TCA)				
Treatment	*1965*	*1966*	*1967*	*1968*	*Mean*	*1965*	*1966*	*1967*	*1968*	*Mean*	*1965*	*1966*	*1967*	*1968*	*Mean*
No fertilization	24.6	19.9	25.3	23.8	23.4	35.0	28.5	39.5	31.9	33.7	33.3	26.6	29.3	21.3	27.5
Broadcasting along row	31.2	36.4	43.1	41.1	37.9	38.0	34.2	43.5	32.4	37.0	32.7	29.5	28.2	23.8	28.5
Broadcasting on trash	32.9	37.0	43.9	42.2	39.0	37.5	33.7	42.9	38.9	38.2	35.0	30.2	29.7	25.3	30.6
Burying along cane row	41.0	36.0	44.4	42.6	41.0	40.2	34.5	52.6	35.1	40.6	33.4	30.2	29.1	24.2	29.2
Dropping vertically on cane stool	32.9	31.2	47.8	41.7	38.4	41.7	32.5	48.2	33.9	39.1	33.5	28.8	26.8	22.7	28.9

Table 26. (b) Cane yield data

MOUNT & CONSTANCE

	Mean cane yield (TCA)
Broadcasting along row	37.5
Broadcasting on trash	38.6
Burying along cane row	40.8*
Dropping vertically on cane stool	38.7
LSD (P = 0.05)	2.7

Significant yield responses were obtained from fertilizer applications in Mount and Constance trials. However, there was no significant response in the Plaine Magnien trial.

Table 26 (b) shows that burying of fertilizers along cane row gave a significant increase in yield over the other methods of fertilizer application. This is in accordance with results obtained by Parish *et al* (1965) who showed that utilization of nitrogen fertilizers (urea and sulphate of ammonia) was more efficient when these fertilizers were buried.

In these trials, the main object of study was the effect of fertilizer burn on cane yield.

The yield data in Table 26 (b) show that there was no adverse effect on cane yield when the fertilizers were directly dropped on the cane spindle but it is better to avoid this procedure.

The three trials were carried out on free soils and it would appear therefore that burying or covering of fertilizers in the dry areas is to be recommended, particularly as this operation entails only an insignificant expenditure.

REFERENCE

PARISH, D. H., ROSS, L., FIGON, C. and CAVALOT, C. (1966). Nitrogen studies. *Rep. Maurit. Sug. Ind. Res. Inst.* **13** : 41-42.

3. UNIFORMITY IN FERTILIZER DISTRIBUTION

G. MAZERY

In most sugar producing countries artificials are applied to the plantations by mechanical means. However, in Mauritius and a few other places, land topography and labour facilities have not favoured the mechanization of this operation and manual labour is still employed for the purpose.

In Mauritius, prior to the use of crawler tractors, sugar cane was planted in holes dug by hand and, when applying fertilizers, the labourers used small metal containers of appropriate size for measuring out the amount of fertilizer required for each hole, at planting, or, at a later stage, for each stool.

At that time there was no problem for applying artificials uniformly in commercial fields or in experimental fields, where the plots consisted of rows of equal lengths which always comprised an equal number of holes or stools.

After the last war, when furrowing by means of crawler tractors became the general practice, canes were planted in almost continuous lines and it became impossible to measure out the amount of artificials for each stool. The artificials were consequently weighed in bulk for each field, the actual uniformity of distribution in the field being left to the judgement of the labourers working under the supervision of a field overseer.

In the case of experimental fields which consisted of small plots, it became general practice to weigh or measure an amount of artificials corresponding to the size of the plot, its distribution inside the plot being left to the judgement of the operator.

In the course of an investigation carried out by the author, in 1964, it became evident that, amongst other factors, the very irregular distribution of fertilizers, inherent to the method of application in current practice, could account to a great extent for the rather high experimental errors observed in field trials (Plate XI bottom). A detailed report was submitted accordingly with specific recommendations and a new method was developed which solved the problem as far as experimental plots were concerned.

However, the tests carried out during this investigation and subsequently on eight different estates in industrial plantations, showed that there was room for substantial improvement in this field.

The tests consisted in weighing the artificials being carried by each operator before and after application to a section varying from 50 to 300 ft in length in a regular cane row of a commercial field, and the corresponding rate of application per arpent calculated therefrom. The figures given in Table 27 and illustrated in fig. 29 may be summarized as follows :

Out of 207 observations only 30 corresponded to the theoretical rate desired, while 92 were lower and 85 higher, the range of distribution varying from 20% to over 250%

Fertilizer Application

Top: Middle rows: left, by machine; right, by hand.

Bottom: Uneven distribution when applied by hand

Table 27. Pattern of fertilizer distribution — Hand application

Test No.	Type of Fertilizer	Desired Rate Kgs./Arp.	No. of obser-vations	*FERTILIZER DRESSING EXPRESSED AS PERCENTAGE OF DESIRED RATE*												
				18-32	*33-47*	*48-62*	*63-77*	*78-92*	*Desired Rate* 200 ± 7	*108-122*	*123-137*	*138-152*	*153-167*	*168-182*	*183-197*	*Above 197*
1	Sulphate of Ammonia ...	150	10	—	—	—	3	1	2	1	3	—	—	—	—	—
2	Granulated 18 : 9 :18 ...	200	27	2	1	2	6	5	1	3	3	2	—	2	—	—
3	,, 20 :10 :10 ...	200	24	—	—	1	2	6	2	5	5	—	2	1	—	—
4	Muriate of Potash ...	50	19	—	—	—	1	8	0	4	1	—	3	2	—	—
5	Granulated 20 :10 :10 ...	200	36	—	1	2	1	3	4	3	4	5	4	4	4	1
6	,, ,, ...	200	59	1	5	11	15	5	14	4	1	1	—	1	1	—
7	Sulphate of Ammonia ...	100	12	—	—	1	—	2	2	1	—	1	2	—	—	3
8	Granulated 20 : 0 :20 ...	50	20	—	—	—	2	5	5	3	2	1	2	—	—	—
	TOTAL		207	3	7	17	30	35	30	24	19	10	13	10	5	4
	% TOTAL ...			1	3	8	14	17	14	12	9	5	6	5	2	2

Table 28. Pattern of fertilizer distribution by new machine

Test No.		*Type of Soil*	*Doser No.*	*Type of fertilizer*	*Weight of fertilizer (Kg)*	*Length of line to which applied (French feet)*	*Rate of application (Kg/Arp.)*
1	...	Rocky	1	Granulated 18 : 9 : 18	11	769	114
2	...	,,	1	,, ,,	11	763	114
3	...	,,	1	,, ,,	11	755	117
4	...	,,	1	,, ,,	11	772	114
5	...	Free	1	,, 20 : 0 : 20	4	280	114
6	...	,,	1	,, ,,	4	275	116
7	...	,,	1	,, ,,	4	282	113
8	...	,,	1	,, ,,	4	285	112
9	...	Rocky	2	,, 18 : 9 : 18	5	266	150
10	...	,,	2	,, ,,	5	256	156
11	...	,,	2	,, ,,	5	251	159
12	...	,,	2	,, ,,	5	272	147
13	...	Free	2	,, ,,	5	272	147
14	...	,,	2	,, ,,	5	251	159
15	...	,,	2	Sulphate of Ammonia	5	216	185
16	...	,,	2	,, ,,	5	226	177
17	...	,,	2	,, ,,	5	230	174
18	...	,,	2	,, ,,	11	484	182
19	...	,,	2	,, ,,	11	464	190
20	...	,,	3	,, ,,	8	235	272
21	...	,,	3	,, ,,	8	238	269
22	...	,,	3	,, ,,	8	230	278
23	...	,,	3	,, ,,	8	230	278

of the desired rate.

With a view to improving this lack of efficiency in fertilizer use, due consideration being given to the local conditions with regard to land topography and labour facilities, a mechanical distributor handled by one operator has been developed.

This machine* which is light and handy, has given very encouraging results (Plate XI top) the rate of application obtained in the field varying by less than 10% and the labour efficiency being possibly increased (Table 28).

Moreover, the use of such mechanical distributors might bring about new techniques on an industrial scale and justify the establishment of units, similar to those existing for chemical weeding, which would be responsible for all fertilizer applications on estates.

Such a development would certainly bring about a better control and an increased efficiency of fertilizer use, especially on large estates.

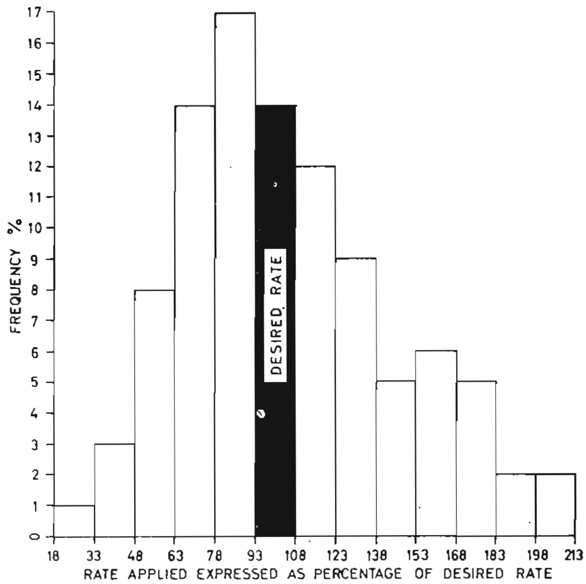


Fig. 29. Variation in amount of fertilizer applied by hand.

4. NOTES ON SUNFLOWER CULTIVATION IN RATOON CANE INTERLINES

G. ROUILLARD & G. MAZERY

Survey of results obtained on estates in 1967 and 1968

In order to become familiar with the crop, the majority of sugar estates, at the request of the Chamber of Agriculture, planted several acres of sunflower in ratoon interlines in 1967, and some of them tried again in 1968.

The results obtained in 1967, which were on the whole very disappointing, are given in Table 29. The data were obtained from a total harvested area of 530 arpents out of a planned programme of 1,000 arpents. It will be seen that, on an average, only 61.5 kg of oil were obtained per arpent, when interplanted with ratoon cane. The results obtained in 1968 were even more disappointing as most of the plantations were destroyed by rats and birds at the germination stage. It now appears that there is little hope of establishing a sunflower industry in Mauritius if the crop is to be cultivated in cane interlines.

Spacing trials and effects on cane yields

While estates were becoming familiar with the sunflower crop through observations in plantations on a fairly large scale, the Institute laid down field experiments in order to study the performance of sunflower when planted in inter-rows of ratoon cane at different spacings, and also its effect on cane yields.

Two series of trials were harvested :

(a) four in the humid and super-humid zones;

(b) five in the sub-humid zone, with and without irrigation.

The various treatments and corresponding results are given in Table 30.

* Patent applied for by the author.

Table 29. **Results on sunflower cultivation in cane interlines on sugar estates in 1967**

DATE PLANTED	SUB-HUMID ZONE (Without irrig.)		SUB-HUMID ZONE (Irrigated)		HUMID ZONE (Rainfall = 50" — 75")		HUMID ZONE (Rainfall=75"—100")		SUPER-HUMID ZONE (Rainfall > 100")		TOTALS & AVERAGES	
	Area Harvested Arp	*Seeds Obtd. Kg/Arp*	*Area Harvested Arp*	*Seeds Obtd. Kg/Arp*	*Area Harvested Arp*	*Seeds Obtd. Kg/Arp*	*Area Harvested Arp*	*Seeds Obtd. Kg/Arp*	*Area Harvested Arp*	*Seeds Obtd. Kg/Arp*	*Area Harvested Arp*	*Yield Kg/Arp*
15.7 to 20.8 ...	19	145	88	198	133	143	29	120	43(47)	104	312	151
21.8 to 20.9 ...	28	89	8	65	59(69)	166	16(54)	65	42(57)	98	153	117
21.9 to 20.10 ...	2 (9)	108	4(13)	54	26	179	8	27	23(39)	88	63	148
Total area harvested (Arp.)	49		100		218		53		108		528	
Seeds aver . yields (Kg/Arp.)		111		182		154		89		98		137
Seeds (Max & Min. Kg/Arp.)		310 — 60		379 — 54		473 — 65		294 — 21		340 — 12		473 — 12
Oil % seeds		47.6		48.3		44.8		38.1		40.6		44.8
Oil aver. Kg/Arp. ...		52.3		87.9		69.0		33.9		39.8		61.5

N.B. Figures in brackets indicate the areas actually planted

Table 30. **Yields of sunflower harvested in 1967 and of corresponding cane plots harvested in 1968**

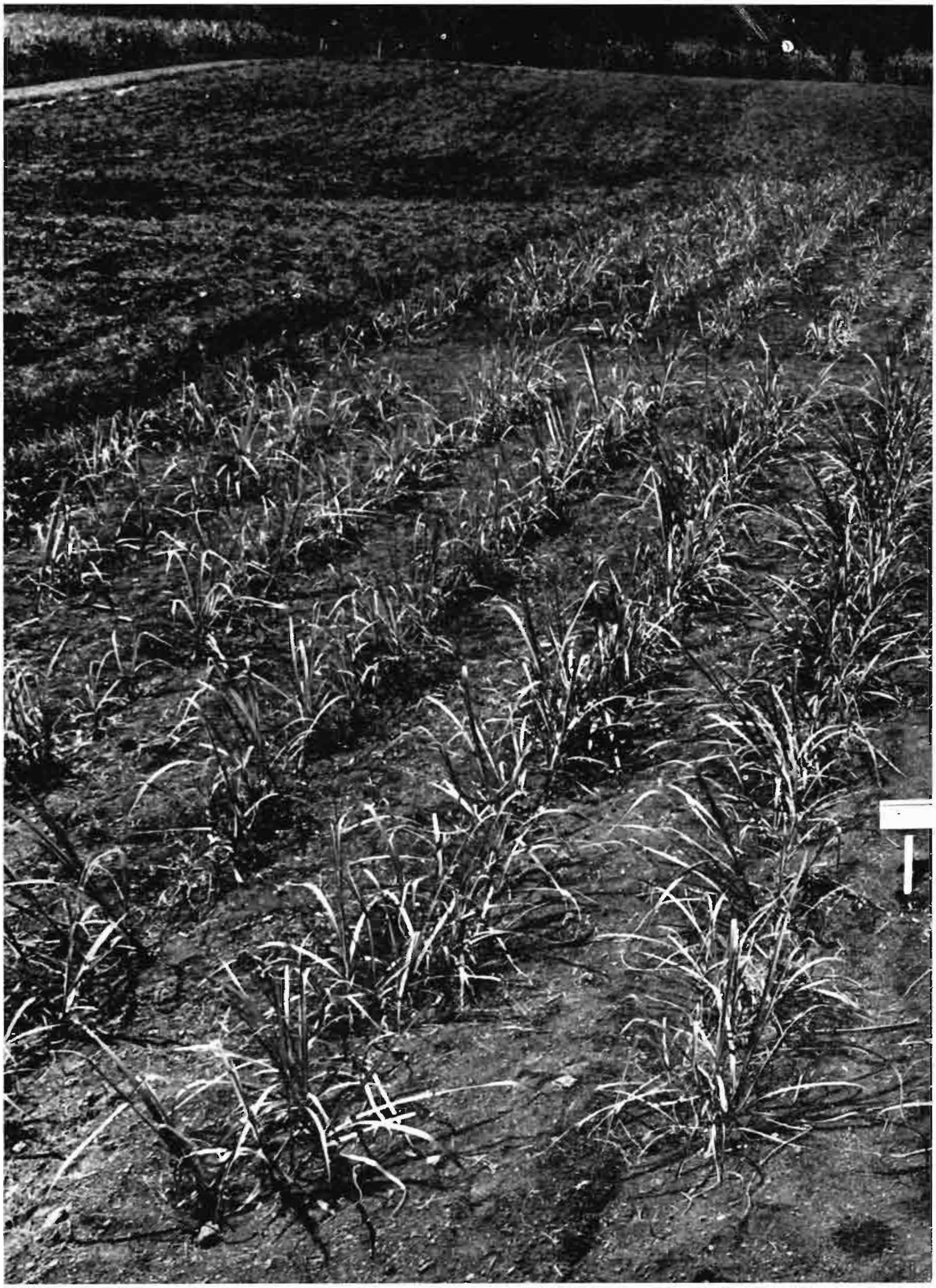
	Sub-humid zone — Irrigated & non-irrigated					*Super-humid and humid zones*				
	Tons Commercial Sugar/Arp.		*Sunflower oil Kg/Arp Cane*			*Tons Commercial Sugar/Arp.*		*Sunflower oil Kg/Arp. Cane*		
	Aver.	*Negative difference from control (Average)*	*Aver.*	*Max.*	*Min.*	*Aver.*	*Negative difference from control (Average)*	*Aver.*	*Max.*	*Min.*
1. Trash on alternate interlines — No sunflower ...	3.27					2.85				
2. Trash on alternate interlines — 1 line sunflower on clean interlines	3.28	0.18	19.3	31.2	12.5	2.67	0.18	19.2	41.0	6.8
3. Trash on alternate interlines — 2 lines sunflower on clean interlines	3.03	0.43	38.0	51.9	21.0	2.56	0.29	58.9	118.7	31.5
4. All interlines without trash — no sunflower	3.40					2.72				
5. All interlines without trash — 1 line of sunflower on all interlines	3.21	0.25	56.3	75.1	39.4	2.20	0.65	63.5	97.3	42.5
6. All interlines without trash — 2 lines of sunflower on all interlines	2.77	0.69	90.4	130.0	50.3	1.77	1.08	101.9	193.4	57.9
7. Trash on all interlines — no sunflower	3.46									

It will be seen from the data that, whereas the oil production was very low, the depressing effect of the sunflower crop on cane yield has been marked. It follows therefore that with the present market values of oil and sugar respectively, the growing of sunflower in ratoon interlines is not economical.

As may be seen from the figures obtained both in large-scale plantations and in experimental plots, there has been a great variation in yield in all climatic regions, so that no reliable conclusions can be drawn with regard to the suitability of any of these regions for sunflower cultivation. In some cases yields were so poor that the fields were not harvested.

However, oil content has been rather uniform, as could be expected, due to the fact that only one variety (received from Gunson Seeds South Africa Pty Ltd) was planted.

Finally, the plant, being a member of the *Compositae*, is severely affected by conventional herbicides and therefore sets an important limiting factor to chemical weeding in cane fields, and its cultivation in cane interline would be a serious handicap to efficient weed control in humid and super-humid zones.



Log-sprayed plots showing damage to canes at the high dosage rates with a new herbicide on test

WEED CONTROL

C. MONGELARD & G. Mc. INTYRE

1. EVALUATION OF NEW HERBICIDES

THE screening of new herbicides with the Chesterford logarithmic spraying machine was carried out in the super-humid zone at Belle Rive experimental station and in the humid zone at Olivia. No observation could be recorded at Olivia, because a drought period, following the herbicide application, was not conducive to weed growth even in the control plots.

At Belle Rive, eight herbicides were compared to DCMU at rates ranging from 5 lb a.i. to 1.25 lb a.i. in pre-emergence application in plant canes of the variety M.93/48. They were Ametryne, BAS 2103H, BAS 2440H, Planavin, HP 149, Ordram, Vernam and Tillam. The experiment lasted 94 days and a total rainfall of 24.86 inches (63 mm.) were recorded during 79 days of precipitation.

A weed assessment, germination counts and cane height measurements were carried out at the close of the experiment.

The main weed species in order of frequency-abundance and percent cover in the control plots were the following : *Ageratum conyzoides*, *Bidens pilosa*, *Hydrocotyle bonariensis*, *Oxalis* spp., *Youngia japonica*, *Kyllinga polyphylla*, *Paspalum conjugatum* and *Sisyrinchium chinense*. Twelve other weed species of minor importance were also recorded.

In the three replicated control plots, the percent weed cover was 86, 97 and 92 respectively. The degree of chemical control obtained with the different herbicides at the different dosage rates is given in terms of frequency of occurrence and total weed cover in percent of the control in Table 31.

Table 31. Weed assessment

Herbicides		*DOSAGE RATE OF HERBICIDES (lb a.i. per arpent)* 5.0 - 3.8	3.8 - 2.85	2.85 - 2.15	2.15 - 1.65	1.65 - 1.25
DCMU ...	A	10.5	11.0	12.0	12.5	15.0
	B	18.0	18.0	19.1	23.5	35.0
Ametryne ...	A	10.5	11.0	11.0	12.0	15.0
	B	33.9	29.0	27.9	32.2	39.9
BAS 2103H	A	15.0	17.0	17.0	22.0	22.5
	B	30.0	35.0	40.4	56.8	61.2
BAS 2440H	A	13.5	13.0	14.0	14.0	17.5
	B	26.8	24.6	27.9	30.6	36.1
H.P. 149 ...	A	18.0	17.0	18.5	23.5	17.5
	B	45.4	43.7	49.2	52.5	55.7
Ordram ...	A	25.0	27.0	27.0	27.0	27.0
	B	100.0	100.0	100.0	100.0	100.0
Tillam ...	A	27.0	25.0	26.0	29.0	25.0
	B	71.0	87.4	85.2	89.6	75.4
Vernam ...	A	31.0	32.0	32.0	32.0	36.0
	B	96.2	97.3	100.0	100.0	100.0
Planavin ...	A	19.0	22.5	23.0	21.5	21.0
	B	42.1	44.8	45.4	42.1	44.8

A = Frequency-abundance total
B = Weed cover % control

The effects of chemical treatment on germination and shoot height in percentage of the control are shown in Table 32.

Table 32. Effects of herbicides on germination and growth of cane 94 days after application

Herbicides		*DOSAGE RATE OF HERBICIDES (lb a.i. per arpent)* 5.0 - 3.8	3.8 - 2.85	2.85 - 2.15	2.15 - 1.65	1.65 - 1.25
DCMU	A	103	133	106	103	117
	B	110	125	106	114	115
Ametryne	A	104	98	99	113	123
	B	89	92	100	116	124
BAS 2103H ...	A	126	112	89	102	105
	B	118	105	85	102	108
BAS 2440H ...	A	85	92	102	105	100
	B	75	75	98	106	98
H.P. 149	A	93	123	104	126	131
	B	84	115	99	134	134
Ordram	A	100	94	85	112	109
	B	88	86	95	119	106
Tillam	A	104	105	102	101	107
	B	92	100	96	110	118
Vernam	A	107	112	101	117	124
	B	104	118	111	132	134
Planavin	A	81	95	114	88	104
	B	75	89	110	89	104

A = Germination % control.
B Stem height % control.

Ametryne was as effective as DCMU regarding the frequency of occurrence of weed species, but the tolerance of *Hydrocotyle bonariensis* and *Oxalis* spp. to Ametryne resulted in a relatively fairly high percent weed cover. More weed species were present in the BAS 2440H plots, but weed growth was reasonably checked by this herbicide mixture even at fairly low concentrations. BAS 2103H, Planavin and HP 149 gave fair weed control, and on an active ingredient basis proved inferior to DCMU Ametryne and BAS 2440H. Tillam, Vernam and Ordram were disappointing.

An indication of cane toxicity was noted after application of several of these herbicides at the high dosage rates. Germination was affected by BAS 2440H and Planavin. Effects on cane growth were evident at the high dosage rates with Planavin and BAS 2440H. Ametryne, HP 149 and Ordram possibly affected growth at the highest rates.

2. I. POST-EMERGENCE TRIAL IN PLANT CANES

The trial was conducted at Belle Rive (super-humid zone) in post-emergence of weeds and canes. The variety was N : Co.376 and had been planted 2 months prior to herbicide application. The plot size for each treatment was 400 sq. ft.

The treatments, which were replicated, consisted of the following herbicide applications at the rate of 3 and 4 lb active material per arpent : Ametryne, BAS 2440H, C15935, Actril-D. A further treatment consisted of a mixture of 3 lb a.i. DCMU with Actril-D at 1 lb a.c./arpent.

The weeds, at the time of spraying, were in an advanced stage of growth and were highly competing with the crop. The weed population comprised the following species which were the most abundant in the plots : *Digitaria timorensis, Ageratum conyzoides, Hemarthria altissima Paspalum paniculatum, Kyllinga polyphylla* and *Cyperus rotundus.*

The observations were made 2, 5 and 7 weeks after spraying.

at 2 weeks

Ametryne	4 lb a.i. —	good weed control except *Paspalum* sp. and *Kyllinga* sp.
,,	3 lb a.i. —	fairly good control except *Paspalum* sp. and *Kyllinga* sp.
Actril-D	4 lb a.e. —	good weed control — regrowth of *Digitaria* sp. has started.
Actril-D	3 lb a.e. —	less effective than above

BAS 2440H at both rates did not show any post-emergence effect.

C.15935	4 lb a.i. —	fairly good check of weeds present.
C.15935	3 lb a.i. —	less effective than at 4 lb.

DCMU 3 lb + Actril-D 1 lb — very good weed control obtained.

at 5 weeks

Breakdown of weed control occurred in the following treatments :

Ametryne 3 lb, BAS 2440H, C.15935 and Actril-D at both rates. In the Actril-D plots however, no regrowth of *Ageratum* sp. and *Gnaphalium* sp. was noted.

Ametryne at 4 lb a.i. was still checking growth and the weed cover then consisted of *Hemarthria* sp. (15%), *Digitaria* sp. (15%), *Kyllinga* sp. (5%) and *Pycreus* sp. (3%).

The best treatment was by far the mixture of DCMU 3 lb + Actril-D 1 lb, where control of all weeds was still holding good with the exception of *Paspalum paniculatum.*

at 7 weeks

There was a complete breakdown of weed control with the exception of the treatment DCMU + Actril-D, where apart from *Paspalum* sp., the mean percent weed cover was mainly due to *Digitaria timorensis* 12% and *Kyllinga polyphylla* 3%.

2. II. POST-EMERGENCE TRIAL IN RATOON CANES

The canes were 3 months' old ratoons of the variety M.93/48. All the plots were severely infested with the following weed species : *Nothoscordum inodorum, Setaria pallide-fusca, Oxalis* spp., *Digitaria horizontalis, Cyperus rotundus, Kyllinga polyphylla, Paspalum paniculatum* and *Panicum glabrescens.*

Six herbicides at two dosage rates 3 and 4 lb a.i. per arpent were compared and they were Ametryne, C.15935, BAS 2440H, Daxtron, C.6989 and NPH 1357. The plot size for each treatment was 400 sq. ft.

Two weeks after spraying, the best weed control was obtained with Daxtron at both rates and C.15935 at 4 lb a.i. Ametryne at 4 lb a.i. was comparable to C.15935 at 3 lb a.i.; NPH 1357, BAS 2440H and C.6989 at both rates showed much inferior post-emergence weed control properties.

Two months after spraying, the best treatments were still Daxtron at both rates and C.15935 at 4 lb a.i. Fairly good weed control was obtained with Ametryne at 4 lb a.i.

With regards to cane toxicity, Daxtron provoked severe chlorosis at both concentrations and two months after spraying, 25% kill of the canes was noted at the high concentration. C6989 caused moderate scorching of the cane leaves which was still apparent at the final survey.

3. SPECIAL WEED PROBLEMS

Cyperus rotundus

Three trials were laid down to compare the effectiveness of several herbicides on the control of *Cyperus rotundus*. One in the humid zone in ratoon canes two months after harvest, and the other two in the super-humid region in plant canes about 3 months old.

Trial I. Trianon (humid zone — ratoon canes).

The field where the experiment was carried out was heavily infested with *Cyperus rotundus* and an estimate of weed cover in each plot, 200 sq. ft. in size, was made before spraying with the following herbicides at 3 and 4 lb a.i. plus Gramoxone at 1/4 lb a.e. per arpent : Ametryne, C15935, BAS 2440H, Asulam, Daxtron, Actril-D, C6989.

Weed control two weeks after spraying was comparable in all plots, where complete desiccation of the top growth had occurred. This was evidently due to the gramoxone effect. Four weeks after spraying, regrowth in all plots was noted, except where Actril-D was applied. Only 10% regrowth was observed in the Actril-D plots 8 weeks after herbicide application in contrast to very poor control obtained in all the other treatments.

Trial II. Deux-Bras (super-humid zone — plant canes).

The *Cyperus rotundus* population was estimated prior to spraying and expressed as percentage weed cover per plot, the size of which was 200 sq. ft.

The following herbicides were used at 3 and 4 lb a.i. plus Gramoxone at 1/4 lb a.e. per arpent : Ametryne, Daxtron, BAS 2440H, Actril-D, C15935, C6989, Asulam.

Tordon 101 was used in combination with Gramoxone 1/4 lb a.e. at the rates of 1,2 and 4 lb a.e. per arpent. Gramoxone (1/4 lb a.e.) was also applied alone.

Observations made two weeks after spraying showed that all the canes were fairly heavily scorched by Gramoxone. As regards weed control, the best treatments were Actril-D and Daxtron which gave equally good results at both rates (90-95% weed kill). Severe scorching of the *Cyperus* plants in all plots at thi stage was a result of Gramoxone application.

Five weeks after spraying, there was about 10% regrowth of *Cyperus rotundus* in the Actril-D plots at both rates and about 20% in the Daxtron plots. Complete regrowth of the *Cyperus* population in all the other treatments indicated complete tolerance of the weed to the herbicides used in "post-emergence" sprays.

Daxtron, at both rates, was highly toxic to the canes inducing severe chlorosis that culminated in the death of 50 to 75% of the cane stalks.

Trial III. Deux-Bras (super-humid zone — plant canes).

Again in this trial the *Cyperus* population was estimated prior to spraying. Half of each experimental plot was cleaned by hand in order to study the efficacy of the following herbicides in pre- and post-emergence applications :

> Daxtron 1 lb + Actril-D 1 lb a.i. per arpent, 2,4-D ester 2 lb a.e. per arpent and Daxtron, Actril-D, NPH 1330, RP17623, C15935, BAS 2440H at the rates of 2 and 3 lb active material per arpent respectively.

Two weeks after spraying, the best control was again obtained with Actril-D and Daxtron at both rates of application, 100% weed kill by Actril-D and 90% weed kill by Daxtron. The mixture Actril-D 1 lb + Daxtron 1 lb was also highly effective. 20% kill and slight chlorosis of the remaining weeds were obtained with the 2,4-D ester.

It was too early to evaluate at this stage, the effects of the herbicides in pre-emergence application.

Moderate to severe chlorosis of the cane leaves was recorded where Daxtron had been applied, the extent of damage depending on the rates of application.

One month after spraying, regrowth in the Daxtron plots in pre-emergence and post-emergence application was about 40% at 2 lb and 15% at 3 lb rate.

Weed control in the Actril-D plots had broken down, indicating poor activity of this herbicide in pre-emergence application at both dosage rates.

In the plots sprayed with the mixture Actril-D 1 lb + Daxtron 1 lb, there was a regrowth of 50%.

80% weed kill in post-emergence was obtained with 2,4-D ester which however had no effect in pre-emergence sprays.

With Actril-D, a complete kill of the overground population soon after application probably stimulates regrowth of the underground nuts, which depends on rainfall conditions. Repeated applications of Actril-D at reduced rates every 6-8 weeks may be required to keep *Cyperus rotundus* under control. No stimulation for regrowth was noted when 2,4-D ester was used, thus indicating that a potential is being held in store for renewed activity, should adequate environmental conditions prevail.

The other herbicides were of no avail for the control of *Cyperus rotundus* in both pre-emergence and post-emergence applications.

Extensive damage to the crop resulted from the application of Daxtron, and severe scorching of the cane leaves was observed in plots sprayed with the herbicide RP 17623.

Heliotropium amplexicaule (Herbe bleue).

This weed is causing concern in the northern parts of the island. It is very resistant to chemical control. Hand weeding, which is the method used to keep this weed under control, is not satisfactory. A trial was laid down at Nouvelle Industrie in an attempt to solve this problem which, if left unattended, would soon become known as "the big problem of the north".

The following treatments with replicates were applied in 3 months' old virgin canes where the rows and interrows were heavily infested with weeds 1 to 2 feet high. Herbicide activity was evaluated 4 and 7 weeks after application and estimates of % kill at each of these two dates are tabulated below :

	Herbicides	*Dose lb active material per arpent*	*% Kill-Mean of 2 replicates* at 4 weeks	*7 weeks*
1	Actril-D	4	80	80
2	Actril-X	4	72	72
3	C.15935	4	65	65
4	Tordon 101 + Actril-X	3 + 1	95	95
5	Tordon 101 + Actril-X	4 + 1	95	95
6	Tordon 101 + Actril-D	2 + 2	90	85
7	Tordon 101 + Actril-D	3 + 1	98	98
8	Tordon 101 + Actril-D	4 + 1	90	98
9	C.15935 + Actril-D	3 + 2	80	80

The mixture Tordon 101 and Actril-D gave the best results. Seven weeks after application, the control of this weed was still highly satisfactory. Good results can be expected with a mixture of Tordon 101 at 2 lb + Actril-D at 1 lb, provided spraying is made at an earlier stage of growth than under the conditions of the experiment. In the plots sprayed with C15935 alone or in combination with Actril-D, severe scorching of the weed was noted but the observed regrowth of secondary buds is liable to cause reinfestation which is not desirable. The translocated herbicide Tordon 101 which is highly effective, though expensive, is to be preferred. Actril-D helps to give a rapid knockdown of the established weeds. Mixed with Tordon 101 which is slow-acting but very noxious to the weed, excellent results can be obtained. No effect on cane was noted in any of the treatments.

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1968

J. D. de R. de SAINT ANTOINE

A SYNOPSIS of the chemical control figures of the twenty-three factories of the island is given in *Statistical Table* XVIII, *i-v*.

Cane and Sugar Production

Sugar production in 1968 amounted to only 596.6 thousand metric tons, showing a reduction of 6.5 per cent over the 1967 crop of 638.3 thousand tons. If compared to the record crop of 685.5 thousand metric tons, the reduction amounts to almost 13 per cent. Table 33 gives the area harvested, cane crushed and sugar produced during the past five years.

Table 33. Area barvested (thousand arpents), cane crushed and sugar produced (thousand metric tons) 1964 - 1968

	1964	*1965*	*1966*	*1967*	*1968*
Area harvested	195.4	194.1	195.7	191.7	190.0
Cane crushed	4375	5985	4843	5814	5152
Sugar produced	519.0	664.5	561.8	638.3	596.5

The largest average percentage reduction was registered in the eastern sector of the island with a figure of 14 per cent. The central sector was also badly hit with a reduction of about 11 per cent. The largest individual reduction, 23.5 per cent, was obtained at Rose-Belle whilst in the cases of St. Félix, The Mount Beau Plan, Bénarès and St. Antoine factory areas, the 1968 sugar production exceeded that of 1967 by about 5 per cent.

The various factors that have caused the 1968 sugar production to fall short of expectancy are discussed in the introduction to this report and need therefore not be considered again here.

Cane Quality

The climatic conditions that prevailed during the maturation period were very close to normal, and sucrose % cane averaged 13.10. It will be remembered that in 1966, when climatic conditions were generally favourable to maturity, sucrose % cane averaged only 13.20. It may therefore be said that, with the varietal position as it stands now, it is realistic to assume that, under normal climatic conditions, average sucrose % cane will be about 13.10. However, as pointed out in the Annual Report for 1967, it is anticipated that the gradual replacement of M.147/44 by richer varieties like the M.409/51, M.13/56, M.377/56, and with the advent of several promising varieties like S/17, average sucrose per cent cane in Mauritius will soon take an upward trend.

Fibre per cent cane averaged 13.52, a figure which shows no marked difference from that obtained in 1966 and 1967.

Milling

Milling figures for the period 1964-68 are given in Table 34.

Table 34. Milling results, 1964-1968

	1964	*1965*	*1966*	*1967*	*1968*
No. of crushing days	100	128	111	130	106
No. of net crushing hours/day	19.96	20.28	19.57	19.07	20.67
Hours of stoppages/day*	0.83	0.92	0.62	0.65	0.63
Factory running efficiency	96.0	96.6	96.9	96.7	97.0
Tons cane/hour	95.4	100.6	97.3	101.9	101.9
Tons fibre/hour	13.21	13.00	13.10	13.39	13.72
Imbibition % fibre	228	220	230	223	224
Pol % bagasse	2.03	1.93	2.05	1.89	2.04
Moisture % bagasse	48.5	48.9	48.7	48.6	48.6
Reduced mill extraction	96.2	96.0	96.1	96.1	96.1
Extraction ratio	31.0	31.7	31.9	31.2	31.8

* Exclusive of stoppages due to shortage of cane

Milling work in 1968 was very similar to that which was achieved the previous crop; thus the average tonnage of cane ground per hour and the reduced mill extraction figures are identical to those of 1967. However, the number of net crushing hours per day increased by 1.6 from 19.07 to 20.67. As a result of this, and of the reduced tonnage of cane harvested in 1968, the duration of the crop was considerably reduced, the average number of crushing days having amounted to only 106 as compared to 130 in 1967.

Specific feed rates for all the factories are given in Table 35 which calls for little comment, its figures being very similar to those published last year. Attention should however again be drawn to dilution ratio values. As pointed out in the Annual Report for 1966, in many cases it would be profitable to pay more attention to factors that may influence its magnitude, particularly the first mill extraction and the extent to which imbibition liquid and residual juice mix at the various mills. If, for example, the case of Beau Champ factory is considered, it will be seen that its dilution ratio has decreased from 77 in 1966 to 71 in 1967 and 64 in 1968; since its specific feed rate has not varied much during the same period, corresponding figures being 55, 56 and 52, the marked drop in reduced mill extraction — 96.9 in 1966, 96.5 in 1967 and 96.0 in 1968 — may be attributed mostly to the deterioration of the dilution ratio.

Clarification & Filtration

Mixed juice Gravity Purity was quite high in 1968 (88.3 v/s 87.5 in 1967) and no clarification difficulties were encountered. The pH of clarified juice averaged 7.1 as compared to 7.2 the previous year. Filtration results were comparable to those obtained in previous years, as shown in Table 36.

Boiling House Work

The gradual trend of replacing the 3-boiling by the 2-boiling system has persisted. In addition to The Mount, Solitude and FUEL where a 2-boiling system was followed throughout the crop, Mon Désert and Rose-Belle have used it during most of the season. And it should be pointed out that, although mixed juice Gravity Purity at Rose-Belle was high, averaging 90.3 the 2-boiling system could be advantageously used there. The system offers a

Table 35. Comparative milling results, 1968 crop

Factory	*Set of knives*	*Shredder*	*No. of rolls*	*Specific feed rate*	*Imbibition % fibre*	*Dilution ratio*	*Extraction ratio*	*Reduced mill extraction*
Belle Vue ...	1 x 62 1 x 72	—	12	72	228	76	28.4	96.6
F.U.E.L. ...	1 x 60 1 x 80	—	21	71	197	74	32.2	96.0
Médine ...	1 x 40 1 x 100	1	18	71	193	77	29.9	96.3
St. Antoine ...	1 x 36 1 x 44	—	15	66	228	71	35.8	95.7
Mon Loisir ...	2 x 35	1	15	64	225	70	32.8	96.0
Mon Désert ...	1 x 34 1 x 92	—	15	61	224	74	29.9	96.2
Rose Belle ...	1 x 24 1 x 42	—	12	61	233	69	35.9	95.5
St. Félix ...	1 x 12 1 x 32	1	12	60	250	69	33.0	95.9
Savannah ...	1 x 28 1 x 48 1 x 92	—	12	60	234	68	37.2	95.4
Constance ...	1 x 24 1 x 32	1	15	58	194	69	30.2	96.3
Solitude ...	1 x 42 1 x 84	—	14	58	187	72	34.6	95.8
Bel Ombre ...	1 x 16	1	12	56	264	72	34.9	95.8
Réunion ...	1 x 30	1	15	56	215	73	34.5	95.7
Riche en Eau	1 x 40 1 x 52	—	15	56	261	77	29.5	96.4
Beau Champ	1 x 42 1 x 72	—	15	52	261	64	32.0	96.0
Ferney ...	1 x 84 1 x 64	—	12	51	266	72	36.0	95.6
Britannia ...	1 x 32 1 x 60	—	14	46	243	65	34.8	95.7
Mon Trésor ...	1 x 40 1 x 80	—	12	46	245	69	36.1	95.5
Beau Plan ...	1 x 42 1 x 100	—	14	45	223	78	24.6	97.0
Bénarès ...	1 x 62 1 x 124	—	14	43	184	59	38.1	95.3
The Mount ...	1 x 34 1 x 88	—	15	39	208	76	26.8	96.7
Union St. Aubin	1 x 28 1 x 32	—	15	39	260	72	30.5	96.2
Highlands ...	1 x 32 1 x 64	—	15	32	241	85	21.4	97.3

Table 36. Filtration Results, 1964-1968

	1964	*1965*	*1966*	*1967*	*1968*
Pol % cake	1.98	2.13	1.80	1.73	1.69
Cake % cane	3.4	2.9	3.4	3.1	3.3
Pol in cake % cane	0.07	0.06	0.06	0.05	0.06

number of advantages over 3-boiling, and the Process Managers of those factories where it is not used would be well advised to study the possibility of doing so.

Whilst a battery of six new Broadbent centrifugals, comprising three fully automatic 48" × 30" × 1500 RPM machines for the A and B massecuites, and three semi-automatic 48" × 30" × 1800 RPM units for C-massecuites were installed at Beau Plan, three new continuous centrifugals were installed at Médine (Broadbent), St. Antoine (Saltzgitter) and Solitude (BMA) on C-massecuites. Each of these machines was equipped with a resistance heater.

Boiling house figures for the past five years are given in Table 37, but it should be mentioned that refractometer Brix has been used throughout the industry since 1965, so that purity figures for 1964 are not strictly comparable with those for the following years.

Table 37. Syrup, Massecuites and Molasses 1964-1968

	1964	*1965*	*1966*	*1967*	*1968*
Syrup Gravity Purity	87.0	88.0	88.0	87.5	88.5
A-Mcte App. Purity	82.8	84.9	86.0	85.2	85.2
Purity drop : A-mcte	20.7	20.3	18.4	19.4	19.5
B-mcte	20.7	21.0	20.0	20.2	20.0
C-mcte	23.6	25.1	25.2	26.1	25.6
Crystal % Brix in C-mcte	35.5	38.6	39.3	39.9	39.1
Magma Purity	83.4	86.7	87.0	86.4	85.9
Final Molasses : Gravity Purity	36.1	38.3	39.1	38.0	38.6
Red sugars % Brix	12.8	15.5	14.9	17.0	16.3
Total sugars % Brix ...	48.9	53.8	54.0	55.0	54.6
Wt. % cane at 85° Brix ...	2.85	2.64	2.88	2.76	2.68

It will be observed from this table that the purity of final molasses was slightly higher in 1968 than in 1967, namely 38.6 v/s 38.0. However reducing sugars % Brix were 16.3 against 17.0 the previous crop, and since molasses production was slightly smaller in 1968 losses in molasses were lower than in 1967. Yet it is in the final molasses that the heaviest losses are sustained, and since milling efficiency is already high in Mauritius, every effort should be directed towards curtailing losses in the boiling house. This topic is dealt with later in this report in an article entitled *Further Notes on the Exhaustibility of Final Molasses.*

Losses and recovery figures for the past five years are given in Table 38.

Table 38. Losses and Recoveries, 1964-1968

	1964	*1965*	*1966*	*1967*	*1968*
Sucrose lost in bagasse % sucrose in cane ...	4.30	4.10	4.30	4.07	4.32
Sucrose lost in filter cake % sucrose in cane ...	0.50	0.49	0.46	0.43	0.43
Sucrose lost in final molasses % sucrose in cane ...	6.76	6.87	7.23	7.15	6.70
Undetermined losses % sucrose in cane ...	1.31	0.92	1.13	1.33	1.28
Industrial losses % sucrose in cane	8.57	8.29	8.82	8.91	8.41
Total losses % sucrose in cane	12.87	12.39	13.13	12.98	12.73
Overall Recovery	87.13	87.61	86.87	87.02	87.27
Reduced Overall Recovery	86.5	85.3	85.0	85.0	84.8

It will be observed from this table that total losses % sucrose in cane were smaller, amounting to 12.73 as compared to 12.98 in 1967, but it should be pointed out that sucrose % cane was higher this crop, namely 13.10 as against only 12.46 in 1967, which was the lowest figure recorded (1960 excepted) since the publication of reliable chemical control figures in 1926.

As may be observed from Statistical Table XVIII (v), the smallest total sucrose losses were registered at Highlands factory with a figure of 9.77, but the highest Reduced Recoveries were obtained at Beau Plan where the Overall Reduced Recovery amounted to 88.7.

2. EFFECT OF TEMPERATURE ON RATE OF REACTION DURING LIMING

E. C. VIGNES

The control of pH in industry is influenced by the nature of the materials processed. In the liming of cane juices, the addition of milk of lime to the raw juice is essentially a neutralization process. The reaction rate depends on a number of variables, such as the buffering capacity of the juice and the liming temperature, among other things.

During the neutralization of a strong acid or alkali the reaction rate is high and the change in pH is characterized by the typical S-shaped titration curve. In contrast, due to its buffering capacity the titration curve of cane juice is as shown in fig. 30. This curve demonstrates that, for all practical purposes, at pH values where control is necessary the rate-response of the process to incremental additions of reagent follows a linear relationship. In other words, the addition of milk of lime to cane juice lends itself to automatic regulation (WILES and BROOKS, 1968). The deleterious effects of poor liming control when using manual methods are too well-known to be mentioned here.

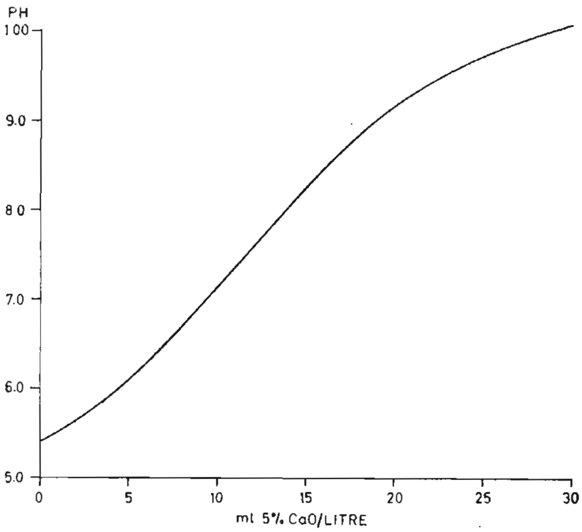


Fig. 30. Titration curve of cane juice.

The adoption, in recent years in Mauritius, of automatic control of pH during liming has been of great advantage to the sugar industry. At all events, it has considerably simplified the problem of chemical control.

Until 1966, when it became necessary to improve the clarification procedure, the practice in local factories consisted in either straight cold liming or liming at about 60°C. A number of factories then proceeded to lime at a boiling temperature, a technique which had given good results in Queensland (de St. ANTOINE, 1967), but is not as easy to control as the so-called cold liming process. In certain cases difficulties were experienced to obtain the correct pH in clarified juice and other products.

During the automatic liming of cane juice two problems are encountered. First, lime must be added at such a rate that the desired pH is maintained, and secondly sufficient time must be allowed after addition for the juice to reach equilibrium before the limed juice reaches the electrode assembly.

The aim of pH control in clarification is the production of a clear juice with a final reaction close to neutrality at the outlet of the clarifier. What happens in the juice during clarification is not very clear since the physico-chemical reactions of the various constituents which take place are extremely complex (PAYNE 1953). If the temperature of liming is increased the various reactions are accelerated.

In practice, addition of lime results in a rapid initial rise of pH followed by a far slower drop which takes place mainly in the clarifier. In a well controlled process, sufficient time must be allowed to ensure that the pH has attained its maximum before the limed juice reaches the electrodes. Otherwise, the measured pH will be low, increased lime will be allowed by the controller, and the excess will react after the point of control causing an unwarranted high pH with detrimental consequences.

The present study was initiated to ascertain the minimum time of contact required between lime and juice under practical conditions; in other words, to determine how far from the liming station should the sample sent to the electrodes be taken when liming at different temperatures.

The procedure employed was as follows. Factory mixed juice was used for all determinations. Samples were kept in a beaker provided with an asbestos lid to minimize evaporation. The beaker was placed in a thermostatically-controlled constant temperature bath. Spaces were provided in the lid for stirrer, thermometer and for the electrodes at the time of measuring pH. The instrument used was an EIL pHmeter connected to a Honeywell recorder. A remote liquid junction was fitted to the reference calomel electrode and the glass electrode could be used for temperatures up to 140°C. For temperatures lower than room temperature ice was used to bring the temperature down. Values of pH at the boiling point of mixed juice were obtained with the help of a hot plate.

Two series of experiments were carried out. In the first series the rates of change of pH in cane juice during clarification with lime, magnesium oxide and with a mixture of lime and magnesium oxide were compared. The lime/magnesium oxide employed was in the ratio of three parts CaO to one part MgO. Liming was carried out at three temperatures, namely: 25°, 60°, and 90°C. The clarifying agent, in a 5% suspension in water, was added from a pipette to the well stirred juice and the pH recorded. At each temperature, the juice studied gave after boiling, cooling and decanting the same final pH. The results obtained are represented in graphical from in fig. 31.

It will be observed that as MgO reacts more slowly than CaO, the rate of rise with that agent is much slower at all temperatures. At 25°C when limed with the CaO/MgO mixture the juice takes one minute to reach equilibrium, for all practical purposes. Under the same conditions of liming with CaO the reaction time is only thirty seconds, i.e. by substituting 25% of CaO by MgO the time of reaction has been doubled. As the curves show with liming at 100% MgO the residence time before equilibrium is reached needs to be considerably increased. This point must be considered in controlling pH when MgO is used for clarifying purposes.

For the second series of experiments, the clarifying agent was exclusively lime. Investigations, were carried out at temperatures ranging from 3°C to 101°C, the boiling point of mixed juice under conditions prevailing at the time. Preliminary titrations led to the determination of the exact amount of lime needed to give a clarified juice of neutral reaction at room temperature after boiling and subsidation. The technique was considerably simplified when it

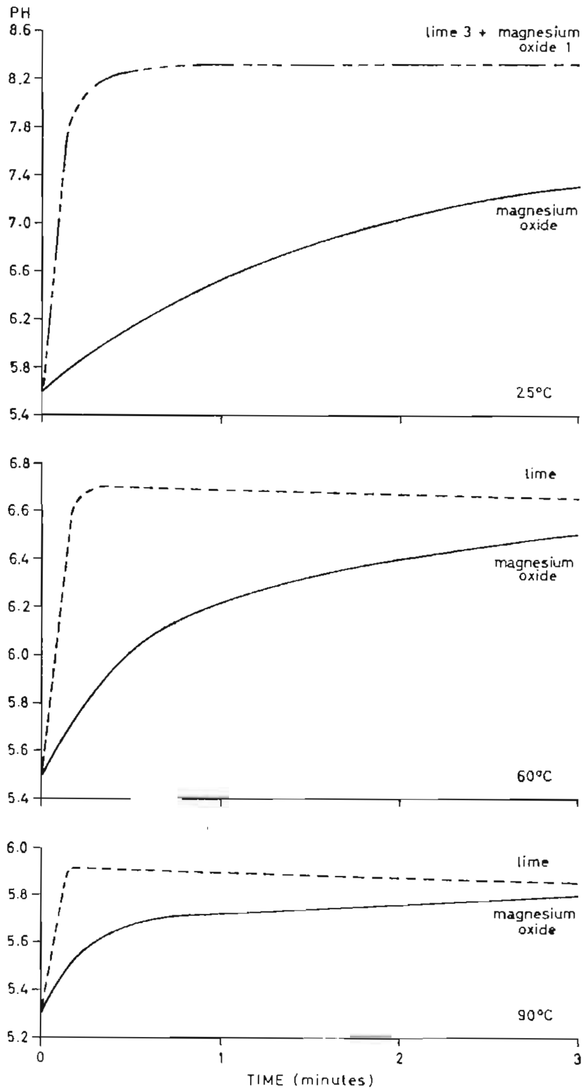


Fig 31. Rate of change of pH during clarification with lime, magnesium oxide and lime/magnesium oxide mixture.

emerged that the same amount of lime gave the same pH in the clarified juice, at whatever temperature liming was carried out. The required amount of milk of lime was then measured out in a beaker and quickly transferred to the intensely-stirred juice.

The curves of fig. 32, which show the change of pH during liming at different temperatures were obtained with the same sample of mixed juice. As mentioned earlier there is a rapid rise of pH in the juice on liming, the higher the liming temperature the more rapid the rise.

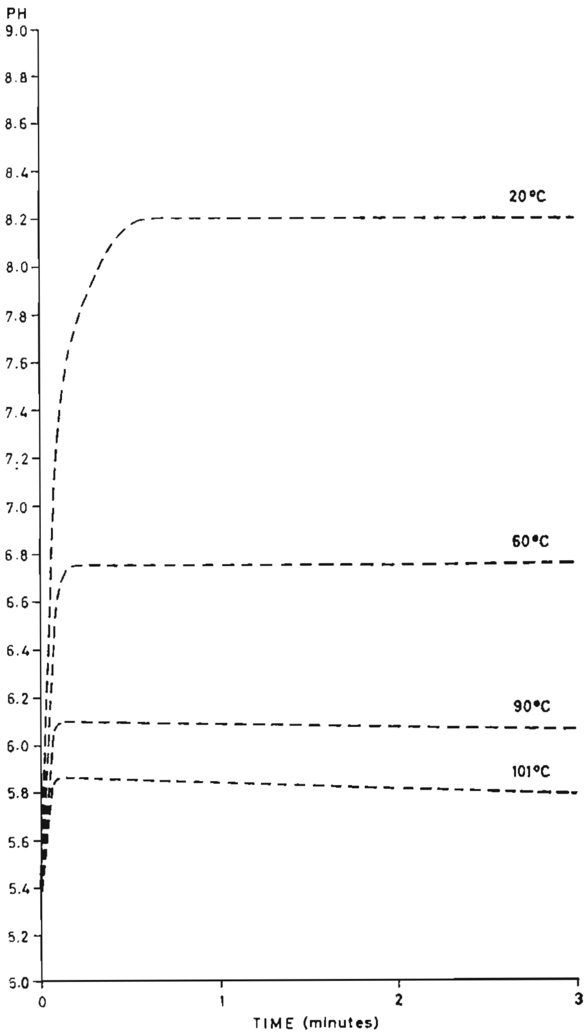


Fig. 32. Change of pH of cane juice during liming at different temperatures.

Fig. 33 reveals that all values of time required to reach maximum pH, even with different juices, fall on a smooth curve, an exponential relationship existing between minimum time of contact and liming temperature. This type of curve has an obvious practical value in the design of pH control stations for liming in cane juice processing.

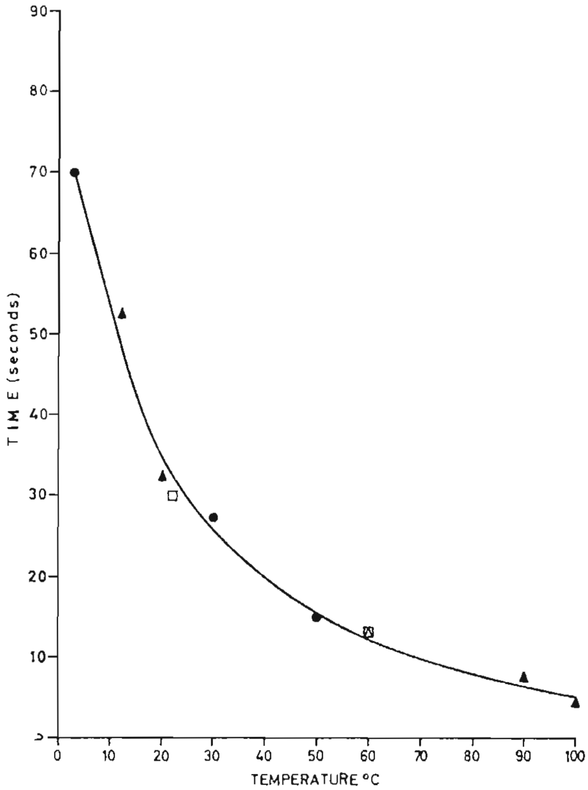


Fig. 33. Time required to reach maximum pH at different temperatures

The conclusions to be derived from the present study are fourfold. In the first place, cold liming whether with CaO or MgO cannot be carried out inside a tube along which juice is flowing to the clarifier. Hot liming with CaO is feasible in the pipe leading the juice to either the flash tank or the clarifier provided adequate mixing is achieved inside the pipe. If a mixture of 75% CaO and 25% MgO is used, the distance between the point of liming and the electrodes has to be double that obtaining in the previous case. Finally hot liming with 100% MgO cannot be carried out as described in the case of CaO.

The present work only aims at establishing the minimum time interval to be allowed between addition of the liming agent and measurement of the pH by the electrodes of the controller. What the maximum holding time should be is still an "unanswered question", according to MARCHES (1956). In his extensive studies of liming techniques, this author mention liming tanks ranging from 200 litres (15 seconds' residence time) to 15,000 litres (more than 15 minutes' residence time). In practice, the maximum holding time will depend on the conditions prevailing in the factory, particularly on the juice temperature at the time of liming. Hence the results published in this paper should be useful in the design of liming stations and pH control installations.

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3. CHEMICAL CONTROL NOTES

I. A SIMPLIFIED METHOD OF CALCULATING POL OF CANE HARVESTED FROM EXPERIMENTAL PLOTS

J. D. de R. de SAINT ANTOINE

The method followed at the Sugar Industry Research Institute for the analysis of cane harvested from experimental plots may be briefly described as follows : the cane sample is finely chipped in a cane chipper, the chipped material is thoroughly mixed and a sub-sample transferred to a Rietz disintegrator in the presence of water and a few ml of sodium carbonate solution for extraction of the juice; part of the juice is clarified and its Brix and pol values determined; the fibre left in the disintegrator is transferred to a tared copper cylindrical container, the bottom of which is fitted with a 150-mesh screen; four gallons of cold water are allowed to shower through the fibre and the container placed in an oven for drying to constant weight.

Until a few years ago, a sub-sample of 300 grams of chipped cane was used for disintegration in the presence of one litre of water and 10 ml of 5% sodium carbonate solution. Pol % cane was calculated as shown in *Appendix I*, on the assumption that cane contains 25 per cent Brix-free water on fibre.

The number of cane samples sent to the Sugar Technology laboratory every crop having considerably increased during the past few years, — they now amount to 125-150 daily during the peak of the harvesting season — it became necessary to simplify the calculations and to cut down on the time taken for the analyses. To achieve this goal the following steps have been taken :

(a) Fibre per cent cane is determined only on those samples for which a fibre value is requested by the Head of the Division from which the sample originates. As a result, the number of fibre determinations has been cut down by about 80 per cent.

(b) Although Brix is measured in each case, juice purity is calculated only for a limited number of samples upon request.

(c) The weight of chipped cane used has been calculated in such a way that the pol reading of the clarified diluted juice gives directly pol % cane. By eliminating all the calculations required to arrive at pol % cane, not only has much time been saved, but the risk of calculation errors has also disappeared.

Simplified Calculation

In order that the pol reading of the diluted juice may be equal to pol % cane, certain assumptions have to be made. They are :

(a) that all the cane samples analysed contain 12 per cent fibre;

(b) that Brix-free water amounts to 25 per cent on fibre.

On these assumptions, the amount of chipped cane which should be weighed is 329 grams when one litre of water, containing 10 mls of 5% sodium carbonate solution, is used for extraction. In *Appendix II*, it is shown why, under these conditions, the pol reading gives directly pol % cane.

Accuracy of Simplified Method

Since the simplified method of calculation is based on the assumption that all the cane samples analysed contain 25 per cent Brix-free water and 12 per cent fibre, the influence on pol % cane of variations in each of these figures should be assessed.

Brix-free water is known to vary somewhat from one cane variety to another, but average values quoted (DOUWES DEKKER, 1956) for Natal and Java are 25 and 23 per cent respectively. Its determination is delicate, time-consuming, and still not very accurate; hence it cannot be envisaged for refining the calculation of pol in cane, the more so since even a large difference between the assumed and actual values has only a small influence on pol % cane, as shown in Table 39.

Table 39. Influence of amount of Brix-free water on pol % cane

Brix-free water % fibre	*Pol % cane* Fibre 10.2%	Fibre 15.1%
15	14.40	14.67
25	14.37	14.62
35	14.34	14.57

The influence of varying percentages of fibre on the accuracy of the pol calculation is shown in Table 40.

Table 40. Influence of fibre content on pol calculation

Fibre % cane	*Direct pol (= pol reading)*	*Calculated Pol*	*Difference*
9	14.00	14.14	-0.14
10	14.00	14.09	-0.09
11	14.00	14.05	-0.05
12	14.00	14.01	-0.01
13	14.00	13.96	+0.04
14	14.00	13.91	+0.09
15	14.00	13.86	+0.14

It will be observed from Table 40 that the error introduced in the pol figure is small even if the actual fibre value is several points higher or lower than the assumed value of 12 per cent. In fact, it is much smaller than that due to sampling of cane in experimental plots.

It will also be observed that the method followed introduces a slight bias in favour of more fibrous varieties. It is preferable that it should be so for selecting new cane varieties in a country like Mauritius where cyclonic conditions prevail so often.

Conclusion

In the simplified method followed at the Sugar Industry Research Institute for the determination of pol % cane it is not necessary to determine Brix and fibre, and the pol reading gives directly pol % cane. The method is sufficiently accurate for agronomic purposes, is rapid, and necessitates no calculations.

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Appendix I

Given :

Wt of chipped cane, g	300
Wt of added water and sodium carbonate solution, g	1010
Wt of dry fibre	30.6
Pol reading of diluted juice	13.2
Ref. Brix of diluted juice	3.63
Pol % g of diluted juice	3.39

Then :

Wt of absolute juice $= 300 - (30.6 + \frac{25 \times 30.6}{100})$

$= 261.8$

Wt of diluted juice $= 1010 + 261.8$

$= 1271.8$

Wt of pol in diluted juice $= 1271.8 \times 3.39/100$

$= 43.11$

Pol % cane $= 43.11 \times 100/300$

$= 14.37$

Appendix II

$$\text{Pol \% cane} = \text{Pol \% g dil. juice} \times \frac{\text{grams dil. juice}}{100}$$

$$= \frac{\text{Pol \% ml dil. juice}}{\text{App. Dty dil. juice}} \times \frac{\text{grams dil. juice}}{100}$$

$$= \text{Pol reading} \times \frac{\text{normal wt}}{100} \times \frac{1}{\text{App. Dty. dil. juice}} \times \frac{\text{grams dil. juice}}{100}$$

$$= \text{Pol Reading} \times \frac{0.26}{\text{App. Dty. dil. juice}} \times \frac{\text{grams dil. juice}}{100}$$

In practice, the Brix values of the diluted juices vary little and in most cases lie between 3.5 and 4.0, corresponding to apparent densities of 1.0108 and 1.0128 which yield values of 0.2572 and 0.2568 in the above equation. It is therefore reasonable to adopt an average factor of 0.257 and the equation now reads :

$$\text{Pol \% cane} = \text{Pol reading} \times 0.257 \times \frac{\text{grams dil. juice}}{100}$$

Now wt of undiluted juice % g cane $= 100 - 12 - \frac{25 \times 12}{100}$

$= 85$ g

And wt of water added % g cane $= 1000 \times 100/329$

$= 304$ g

∴ Wt of diluted juice % g cane $= 304 + 85$

$= 389$ g

$$\text{Hence Pol \% cane} = \text{Pol reading} \times 0.257 \times \frac{389}{100}$$

$$= \text{Pol reading} \times 1.0$$

$$= \text{Pol reading}$$

II. NOTES ON THE MEASUREMENT OF SUCROSE LOSSES IN MILLING TANDEMS

E. C. VIGNES & M. RANDABEL

The yardstick generally used in Mauritius to measure the efficiency of mill sanitation is the difference in reducing sugars/sucrose ratio between first expressed and mixed juices. In a survey of these figures carried out at the beginning of 1968, it appeared that for the 1967 crop this difference ranged from 0.3 to 0.9 and showed a marked trend to increase towards the end of the crop. Following discussions on the cause of this increase, which is attributed to the higher temperatures prevailing during the latter part of the crop, it was decided to study the relative distribution of reducing sugars and sucrose in various parts of the cane stalk. If, as presumed, the first mill of the tandem extracts a greater proportion of juice from the soft parts of the cane, i.e. the parenchymatous internodes, whilst the last mills, with closer settings and higher pressures, express relatively more rind and node juice, then an uneven distribution of reducing sugars and sucrose in the stalk would invalidate the use of the ratio for assessing mill sanitation.

In the course of the study, the following experiments were carried out :

(i) A number of cane stalks were chipped in a cane chipper used for routine analysis of cane harvested from experimental plots; the chipped material was well mixed and placed in a hydraulic press. Pressure was applied very gradually by hand and a sample of the juice flowing out under minimum pressure was collected. More pressure was then applied and the juice flowing out was collected into several 500 ml beakers until the last portion of juice that could be extracted using maximum pressure was obtained. The samples extracted under minimum and maximum pressures were analysed. The experiment was repeated and the following figures obtained. (Table 41).

Table 41. Analysis of juice extracted under minimum (a) and maximum (b) pressures

	I		*II*	
	(*a*)	(*b*)	(*a*)	(*b*)
Brix %	19.36	18.96	19.93	19.65
Sucrose %	18.04	17.63	18.41	18.15
Reducing sugars %	0.17	0.17	0.47	0.47
Gravity purity	93.2	93.0	92.4	92.4
R.S./sucrose ratio	0.94	0.96	2.55	2.59

As may be seen from the above table, the juice flowing under minimum and maximum pressures showed very little difference in analysis. This similarity was attributed to the following factors :

(a) Cane preparation by the chipper, in which transverse chips about 1/8 in. thick are obtained, is much finer than that of a cane sugar factory, with the result that the chipped material is much more homogeneous than factory prepared cane.

(b) The maximum pressure applied by hand in the press was much smaller than that prevailing in a last mill unit.

The following experiment was then carried out. A circular saw was used to subdivide a number of cane stalks into nodes and internodes. The internodes were then peeled and two samples obtained : (a) peeled internodes, (b) rind and nodes. Both samples were shredded in a Jeffco Cutter Grinder and juice extracted from each in the hydraulic press under maximum pressure that could be applied by hand. The experiment was repeated twice and the following results obtained (Table 42).

Table 42. Analysis of juice extracted from peeled internodes (a) and rind and nodes (b)

	I		*II*		*III*	
	(a)	*(b)*	*(a)*	*(b)*	*(a)*	*(b)*
Brix %	21.35	19.41	22.43	20.50	21.64	19.45
Sucrose %	20.13	17.17	21.39	18.21	20.61	17.19
Reducing sugars % ...	0.14	0.20	0.06	0.10	0.08	0.10
Gravity purity	94.7	88.5	95.4	88.8	95.2	88.4
R.S./sucrose ratio	0.70	1.16	0.28	0.55	0.39	0.58

It will be observed from Table 42 that in the three experiments carried out, the reducing sugars ratios in the rind and nodes were respectively 1.2, 2.0 and 1.5 times greater than that in the peeled internodes.

After these experiments in the laboratory, the following investigations were carried out in two sugar factories : juice from each mill unit was sampled during 15-20 minutes and the R.S./sucrose ratio determined. The tests were carried out during the first 15-20 minutes of crushing when the factories resumed crushing after the week-end shutdown. The mills had been thoroughly cleaned and could be considered free of micro-organisms responsible for inversion. Juice imbibition was not applied during the tests but it was found necessary to apply water on the last two mills. The results obtained are given in Table 43.

Table 43. Analysis of juice from successive units of a mill tandem

Mill No.	*Brix %*	*Sucrose %*	*Reducing sugars %*	*Gravity Purity*	*R.S./sucrose ratio*	*R.S. % Brix*
Test 1 — Factory A						
1	17.77	15.91	0.42	89.5	2.6	2.4
2	16.69	14.45	0.44	86.6	3.0	2.6
3	16.63	14.07	0.50	84.6	3.6	3.0
4	10.62	8.62	0.38	81.2	4.4	3.6
5	3.86	2.99	0.15	77.5	5.0	3.9
Test 2 — Factory B						
1	18.51	16.65	0.30	90.0	1.8	1.6
2	17.90	15.37	0.36	85.9	2.3	2.0
3	17.30	14.31	0.44	82.7	3.1	2.5
4	17.15	13.94	0.50	81.3	3.6	2.9
5	3.12	2.36	0.09	75.6	3.8	2.9
Test 3 — Factory A						
1	18.83	17.32	0.25	92.0	1.4	1.3
2	17.21	15.34	0.28	89.1	1.8	1.6
3	17.26	14.92	0.39	86.4	2.6	2.3
4	9.82	8.31	0.20	84.6	2.4	2.0
5	2.57	2.12	0.06	82.5	2.8	2.3

As may be seen from Table 43, there is an increase in the R.S./sucrose ratio in the juices expressed at each successive unit even when the mills are clean and may be assumed to be unaffected by inversion-causing microorganisms. Hence the practice of assessing mill sanitation by measuring the increase in R.S./sucrose ratio from first expressed to mixed juices cannot be of great value.

Various other methods have been used for measuring inversion losses in milling trains, and their merits will be reviewed briefly. They are :

(i) Difference in purity between first expressed and mixed juices. This method cannot be recommanded because the difference is small and is influenced by a number of factors other than sucrose decomposition. A standard difference has first to be assumed and figures higher than the standard are supposed to indicate inversion losses. But the so-called standard difference will be influenced by the condition of the cane and by the extraction of the first mill. Further, Brix determination is influenced by percentage of suspended solids which is not necessarily the same in the first expressed and mixed juices.

(ii) Increase in acidity of juices through the milling train, expressed as acidity per cent Brix. However it has been shown by KING (1930) that, due to the varying quality of cane milled, this method cannot be used to measure inversion losses.

(iii) The methylene blue test which is commonly used in the determination of bacterial concentration in raw milk. Following a suggestion by OWEN (1949), SHUKLA & KAPOOR (1956) recommend the use of this test for the routine check of mill sanitation and for assessing the efficiency of disinfectants. Unfortunately the test is time-consuming and calls for special equipment and know-how.

(iv) The drop in sucrose concentration of samples of juice kept in the laboratory at a given temperature during a given period of time may be used to determine the rate at which inversion takes place. If the retention time and sucrose concentration of the juice are known, the total loss may then be calculated and compared with that taking place when a new bactericide is used, for instance. This method however, is not very accurate, because it is difficult to reproduce in the lab the conditions prevailing at the mills. Further, the differences measured are small and the retention time of the juice is very short.

(v) The determination of the amount of sucrose which is converted in a fixed time by a given number of cells for each of the species of micro-organisms found to any appreciable extent in the juice. From the results of plate counts it is then possible to calculate the total sucrose loss incurred in the milling train. The major disadvantages of this method are that it is time-consuming and calls for culture techniques with which the factory chemist is generally not familiar.

Since the methods described above are either unreliable or unpractical, it was decided to investigate the possibility of using some other yardstick to estimate inversion losses in milling tandems. If it is assumed that under normal conditions the concentration of micro-organisms in cane juices are of no great economic importance except for the presence of dextran forming bacteria (OWEN, 1949) then a simple way of determining the major part of sucrose losses during milling would be the measurement of the rise in dextran content from first expressed to mixed juice. If found practical, the method could also be used to determine the loss incurred in mixed juice from the time it is pumped to the weighing scales until it reaches the clarifier. It should not be forgotten that, as pointed out by BRUIJN (1959), whereas the retention time in the mill is too short to result in serious loss, yet the contaminated juice from the mills is kept for a relatively long time before it is heated. Hence sucrose loss in the mills is much smaller than between the mills and the heaters.

The determination of dextran is simple and the procedure has been described by NICHOLSON & HORSLEY (1959). It depends on the fact that any dextran in a sample of juice from which protein has been removed will develop a haze on the addition of an equal volume of alcohol. It is possible to measure this haze quantitatively in a spectrophotometer. In the preliminary investigations made this crop, it was necessary to prepare dextran from the local strains of

Leuconostoc in order to obtain a calibration curve. This dextran was prepared according to the method employed by the above mentioned authors except that, in the present work, the material was dried under vacuum at room temperature. Optical densities were measured at 900 mμ so as to minimise errors due to colour.

Unfortunately it was only at the end of the crop that it was possible to obtain results under industrial conditions. Three factories were chosen : Factory A practised cold liming while Factory B limed at 70°C and Factory C at the flash tank. Only Factory C made use of bactericide for the control of micro-organisms.

Samples of first expressed juice, mixed juice and limed juice at the entrance to the clarifier were collected over half-hour periods, the different time-lags for the same juice to reach the different sampling points being taken into account. The dextran content of the various samples were the following :

Table 44. Dextran content of mill juices.

Factory	*Liming temperature*	*Mode of sanitation*	*Dextran % Brix*			
			First expressed juice	*Mixed juice*	*Limed juice*	*Total increase*
A	Cold	Hot water	0.05	0.07	0.15	0.10
B	70°C	Hot water	0.08	0.15	0.15	0.07
C	Boiling	Bactericide	0.04	0.04	0.07	0.03

It is interesting to note that Factory C where a bactericide was used showed the least increase in dextran; there was moreover no increase during miling, both first expressed and mixed juices showing the same percentage of dextran. Although the figures reveal a logical trend, it is obvious that no conclusion can be based solely on the results of single tests in three factories.

The data from Factory B seem to be abnormal. It appears from the figures that all sucrose losses occurred at the mills, and none between the mills and the clarifier, whereas according to Bruijn (1959) the contrary should have been the case. Nevertheless, assuming that the data reflect what took place in the factory and that Factory C was working satisfactorily, then the least increase of dextran to be expected would have been 0.03% on Brix. Factory A then, was producing dextran at the rate of 0.07% which could be curtailed. If, as it has been shown, when *Leuconostoc* ferment sucrose, 25% of the sucrose is turned into dextran (Evans & Hibbert, 1947), Factory A was losing sucrose at the rate of 0.28% on Brix unnecessarily. In other words, the purity of the mixed juice was lower by 0.28 than what it should have been. This involves a loss of 0.071 tons of sugar on every 100 tons of cane. For a factory crushing 200,000 tons of cane annually the total loss amounts to Rs.60,000. It thus seems that there is a case for studying the problem further. It is intended to continue investigations during 1969.

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2. EFFECT OF TEMPERATURE ON RATE OF REACTION DURING LIMING

E. C. VIGNES

The control of pH in industry is influenced by the nature of the materials processed. In the liming of cane juices, the addition of milk of lime to the raw juice is essentially a neutralization process. The reaction rate depends on a number of variables, such as the buffering capacity of the juice and the liming temperature, among other things.

During the neutralization of a strong acid or alkali the reaction rate is high and the change in pH is characterized by the typical S-shaped titration curve. In contrast, due to its buffering capacity the titration curve of cane juice is as shown in fig. 30. This curve demons-

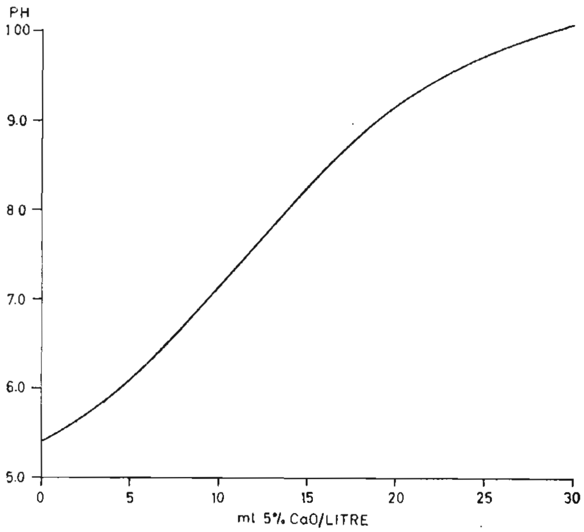

Fig. 30. Titration curve of cane juice.

trates that, for all practical purposes, at pH values where control is necessary the rate-response of the process to incremental additions of reagent follows a linear relationship. In other words, the addition of milk of lime to cane juice lends itself to automatic regulation (Wiles and Brooks, 1968). The deleterious effects of poor liming control when using manual methods are too well-known to be mentioned here.

The adoption, in recent years in Mauritius, of automatic control of pH during liming has been of great advantage to the sugar industry. At all events, it has considerably simplified the problem of chemical control.

Until 1966, when it became necessary to improve the clarification procedure, the practice in local factories consisted in either straight cold liming or liming at about 60°C. A number of factories then proceeded to lime at a boiling temperature, a technique which had given good results in Queensland (de St. Antoine, 1967), but is not as easy to control as the so-called cold liming process. In certain cases difficulties were experienced to obtain the correct pH in clarified juice and other products.

During the automatic liming of cane juice two problems are encountered. First, lime must be added at such a rate that the desired pH is maintained, and secondly sufficient time must be allowed after addition for the juice to reach equilibrium before the limed juice reaches the electrode assembly.

The aim of pH control in clarification is the production of a clear juice with a final reaction close to neutrality at the outlet of the clarifier. What happens in the juice during clarification is not very clear since the physico-chemical reactions of the various constituents which take place are extremely complex (Payne 1953). If the temperature of liming is increased the various reactions are accelerated.

In practice, addition of lime results in a rapid initial rise of pH followed by a far slower drop which takes place mainly in the clarifier. In a well controlled process, sufficient time must be allowed to ensure that the pH has attained its maximum before the limed juice reaches the electrodes. Otherwise, the measured pH will be low, increased lime will be allowed by the controller, and the excess will react after the point of control causing an unwarranted high pH with detrimental consequences.

The present study was initiated to ascertain the minimum time of contact required between

Table 45. Effect of dilution on the potentiometric pH of syrups and molasses

Factory	*Product*	*pH value* Undiluted	*1 : 1 dilution*	*1 : 5 dilution*	*1 : 6 dilution*
A	Syrup	6.2	6.5	6.9	—
		6.7	7.0	7.2	—
	Final molasses	5.7	5.8	—	6.2
		5.7	5.9	—	6.3
B	Syrup	6.7	—	7.0	—
		6.7	—	7.1	—
		6.6	—	6.9	—
		6.5	—	6.8	—
	Final molasses	—	5.5	—	5.8
		—	5.8	—	5.7
		—	5.5	—	5.8
		—	5.5	—	5.7
C	Syrup	6.8	7.0	7.2	—
		6.7	7.0	7.1	—
		6.8	6.9	7.0	—
		6.6	6.9	7.2	—
		6.6	6.8	7.0	—
		6.6	6.8	7.0	—
	A-molasses	6.2	6.5	—	6.7
		6.2	6.3	—	6.6
		6.1	6.3	—	6.6
	B-molasses	6.2	6.3	—	6.5
		6.1	6.2	—	6.4
		6.0	6.2	—	6.4
		5.8	6.0	—	6.3
		6.1	6.2	—	6.5
		5.9	6.1	—	6.4
	Final molasses	5.6	6.0	—	6.2
		5.7	6.0	—	6.3
		5.6	6.0	—	6.2
		5.6	6.0	—	6.2
		5.6	6.0	—	6.2
		5.6	5.9	—	6.2

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IV. FURTHER NOTES ON THE EXHAUSTIBILITY OF FINAL MOLASSES

J. D. de R. de SAINT ANTOINE & E. C. VIGNES

Analytical and Statistical Results

During 1967 the Sugar Technology Division carried out a study of the exhaustibility of Mauritius final molasses aimed at calculating formulae for obtaining (a) dry matter from refractometric Brix and (b) expected true purity in local molasses (VIGNES *et al.* 1967). It will be recollected that two formulae, amongst others, capable of easy application in industrial practice, were calculated, namely :

Dry matter 0.834 Refractometric Brix + 8.42 ....(1)

Expected True Purity = 43.4 — 2 × Reducing Sugars/Ash ....(2)

The necessary data were obtained from the analysis of average 1966 crop samples from 21 defecation factories.

As those equations are actual statistical regressions, it was felt that more results of molasses analyses would give formulae applicable more closely to Mauritius conditions. Consequently, average crop samples of final molasses from the same defecation factories were again collected during 1967 and analysed. The combined results for two years are given in Table 46.

A statistical analysis of the relevant figures indicated a linear relationship, significant at 0.1% level, between dry matter and refractometric Brix, the regression formula reading as follows :

Dry matter = 0.821 Refractometric Brix + 9.65 ....(3)

The values for dry matter calculated from this expression are given in Table 47 from which it will be observed that in all cases, except one, deviations from the Gardiner oven dry matter are less than unity and that the maximum deviations are — 1.21 and + 0.84.

As the determination of dry matter is too delicate and time consuming to be included in the routine chemical control of sugar factories, the values obtained by calculation can be used with confidence to work out the actual true purity of final molasses for comparison with the expected true purity.

It will be observed from column 5 of Table 47 that the Karl Fischer method provides an alternate way of arriving at dry matter in molasses. Except in two cases, the method gives values somewhat lower but nevertheless consistent with those obtained by the long and tedious oven drying method. The Karl Fischer method is quick, gives reproducible results but is more expensive than other methods and requires more skill and care with reagents (RASPER and SVOBODA, 1962). For these reasons, unfortunately, it cannot be recommended for routine control, for the time being at any rate.

As mentioned earlier, the second step in the study was the calculation of an equation for determining expected true purity in terms of the reducing sugars/ash ratio. The formula obtained was the following :

$$\text{Expected True Purity} = 44.6 - 4 \times \text{Reducing Sugars/Ash} \quad \ldots\ldots\ldots\ldots(4)$$

In Table 48 actual true purities are compared to purities calculated from equation (4). This equation, being a statistical regression formula obtained from actual practical values, will give purities sometimes greater and sometimes lower than actual true purities as will be noticed from column 3 of Table 48. However the fact that the actual purity is lower than the expected purity does not mean that a still lower purity could not have been obtained in practice.

Table 46. Composition of average Mauritius final molasses

Sample No.		*Sucrose %*	*Dry Matter % (Gard. Oven)*	*True Purity*	*Ref. Brix %*	*Reducing Sugars %*	*Sulphated Ash %*
1	...	33.87	82.93	40.8	88.44	15.02	16.17
2	...	34.82	83.12	41.9	88.77	12.48	16.47
3	...	32.64	83.33	39.2	89.54	16.93	15.83
4	...	33.06	82.32	40.2	88.71	14.68	16.44
5	...	34.94	82.31	42.4	89.07	10.96	17.31
6	...	34.94	82.59	42.3	89.13	12.73	17.02
7	...	34.66	83.50	41.5	89.73	15.19	15.79
8	...	33.25	80.87	41.1	86.61	15.77	14.35
9	...	35.18	81.25	43.3	87.18	14.56	14.27
10	...	34.84	82.33	42.3	88.20	15.55	15.22
11	...	33.51	83.11	40.3	89.67	13.10	17.55
12	...	33.33	82.18	40.6	88.65	13.23	17.80
13	...	34.23	82.21	41.6	88.95	13.10	16.79
14	...	36.07	84.24	42.8	90.51	14.03	15.63
15	...	32.36	79.59	40.7	85.59	15.72	13.59
16	...	35.42	82.40	43.0	88.17	13.62	17.39
17	...	34.23	82.46	41.5	89.25	14.37	15.93
18	...	34.15	81.81	41.7	88.65	12.83	17.66
19	...	34.79	82.18	42.3	88.92	12.62	16.01
20	...	34.60	80.49	43.0	86.46	12.62	16.06
21	...	34.83	81.97	42.5	88.14	12.49	16.36
22	...	33.32	83.61	40.1	89.33	16.33	16.43
23	...	34.47	81.93	41.9	87.84	13.10	16.72
24	...	31.50	83.92	37.6	90.14	17.63	17.01
25	...	30.01	80.04	37.4	85.95	17.54	16.12
26	...	33.44	82.84	40.1	89.25	13.28	17.64
27	...	34.92	83.22	42.0	89.28	13.77	16.86
28	...	33.23	83.53	39.8	89.43	17.78	15.94
29	...	32.19	79.86	40.3	85.44	17.89	14.04
30	...	33.81	82.51	40.5	88.31	17.60	13.89
31	...	33.81	82.85	40.5	88.53	17.02	15.05
32	...	32.18	80.98	39.8	87.36	13.93	16.32
33	...	32.04	81.98	37.8	87.90	15.75	16.29
34	...	33.12	82.05	40.5	88.58	16.60	15.43
35	...	33.26	82.31	40.4	88.14	15.53	14.58
36	...	32.72	80.86	39.7	86.87	16.43	13.71
37	...	34.26	82.90	41.2	88.20	14.31	17.18
38	...	33.01	82.26	40.0	88.26	15.67	15.65
39	...	32.74	80.51	40.3	86.04	14.44	16.37
40	...	36.11	82.72	42.7	90.48	13.70	15.71
41	...	33.58	80.87	41.3	87.63	14.26	15.79
42	...	33.47	80.93	41.7	87.03	13.00	15.36

Table 47. Dry matter by Gardiner oven, Regression Formula and Karl Fischer Method

Sample			*A* *Dry Matter%* *(Gard. Oven)*	*B* *Dry Matter%* *(Reg. Form)*	*A — B*	*C* *Dry Matter%* *(K. F. Method)*	*A — C*
1	...	...	82.93	82.26	+ 0.67	—	—
2	...	...	83.12	82.53	+ 0.59	—	—
3	...	...	83.33	83.16	+ 0.17	—	—
4	...	...	82.32	82.48	— 0.16	—	—
5	...	...	82.31	82.78	— 0.47	—	—
6	...	...	82.59	82.83	— 0.24	—	—
7	...	...	83.50	83.32	+ 0.18	—	—
8	...	...	80.87	80.76	+ 0.11	—	—
9	...	...	81.25	81.22	+ 0.03	—	—
10	...	...	82.33	82.06	+ 0.27	—	—
11	...	...	83.11	83.27	— 0.16	—	—
12	...	...	82.18	82.43	— 0.25	—	—
13	...	...	82.21	82.68	— 0.47	—	—
14	...	...	84.24	83.94	+ 0.30	—	—
15	...	...	79.59	79.92	— 0.33	—	—
16	...	...	82.40	82.04	+ 0.36	—	—
17	...	...	82.46	82.92	— 0.46	—	—*
18	...	...	81.81	82.43	— 0.62	—	—
19	...	...	82.18	82.65	— 0.47	—	—
20	...	...	80.49	80.63	— 0.14	—	—
21	...	...	81.97	82.01	— 0.04	—	—
22	...	...	83.61	82.99	+ 0.62	83.30	+ 0.31
23	...	...	81.93	81.77	+ 0.16	81.25	+ 0.68
24	...	...	83.92	83.65	+ 0.27	82.61	+ 1.31
25	...	...	80.04	80.21	— 0.17	79.25	+ 0.79
26	...	...	82.84	82.92	— 0.08	82.42	+ 0.42
27	...	...	83.22	82.95	+ 0.27	82.22	+ 1.00
28	...	...	83.53	83.07	+ 0.46	83.02	+ 0.51
29	...	...	79.56	79.80	— 0.24	79.83	— 0.27
30	...	...	82.51	82.15	+ 0.36	82.23	+ 0.28
31	...	...	82.85	82.33	+ 0.52	82.56	+ 0.29
32	...	...	80.98	81.37	— 0.39	80.82	+ 0.16
33	...	...	81.98	81.82	+ 0.16	81.68	+ 0.30
34	...	...	82.05	82.37	— 0.32	81.79	+ 0.26
35	...	...	82.31	82.01	+ 0.30	81.99	+ 0.32
36	...	...	80.86	80.97	— 0.11	80.88	— 0.02
37	...	...	82.90	82.06	+ 0.84	82.60	+ 0.30
38	...	...	82.26	82.11	+ 0.15	81.49	+ 0.67
39	...	...	80.51	80.29	+ 0.22	79.99	+ 0.52
40	...	...	82.72	83.93	— 1.21	82.49	+ 0.23
41	...	...	80.89	81.59	+ 0.30	80.73	+ 0.16
42	...	...	80.93	81.10	— 0.17	80.64	+ 0.29

Table 48. Comparison of actual and expected true purities

Sample No.			*Actual True Purity (a)*	*Expected True Purity (b)*	*Difference (a — b)*
1	...	...	40.8	41.0	— 0.2
2	...	...	41.9	41.4	+ 0.5
3	...	...	39.2	40.2	— 1.0
4	...	...	40.2	41.0	— 0.8
5	...	...	42.4	42.2	+ 0.2
6	...	...	42.3	41.8	+ 0.5
7	...	...	41.5	40.6	+ 0.9
8	...	...	41.1	40.2	+ 0.9
9	...	...	43.3	40.6	+ 2.7
10	...	...	42.3	40.6	+ 1.7
11	...	...	40.3	41.8	— 1.5
12	...	...	40.6	41.8	— 1.2
13	...	...	41.6	41.4	+ 0.2
14	...	...	42.8	41.0	+ 1.8
15	...	...	40.7	39.8	+ 0.9
16	...	...	43.0	41.4	+ 1.6
17	...	...	41.5	41.0	+ 0.5
18	...	...	41.7	41.8	— 0.1
19	...	...	42.3	41.4	+ 0.9
20	...	...	43.0	41.4	+ 1.6
21	...	...	42.5	41.4	+ 1.1
22	...	...	40.1	40.6	— 0.5
23	...	...	41.9	41.4	+ 0.5
24	...	...	37.6	40.6	— 3.0
25	...	...	37.4	40.2	— 2.8
26	...	...	40.1	41.4	— 1.3
27	...	...	42.0	41.4	+ 0.6
28	...	...	39.8	40.2	— 0.4
29	...	...	40.3	39.4	+ 0.9
30	...	...	40.5	39.4	+ 1.1
31	...	...	40.5	40.2	+ 0.3
32	...	...	39.8	41.0	— 1.2
33	...	...	37.8	40.6	— 2.8
34	...	...	40.5	40.2	+ 0.3
35	...	...	40.4	40.2	+ 0.2
36	...	...	39.7	39.8	— 0.1
37	...	...	41.2	41.4	— 0.2
38	...	...	40.0	40.6	— 0.6
39	...	...	40.3	41.0	— 0.7
40	...	...	42.7	41.0	+ 1.7
41	...	...	41.3	41.0	+ 0.3
42	...	...	41.7	41.4	+ 0.3

Table 49. Difference between expected and actual true purities of monthly final molasses samples

Factory Number			*Difference in True Purity*				
			July	*August*	*September*	*October*	*November*
1	...	...	4.5	4.4	3.7	3.7	5.5
2	...	...	3.8	4.2	4.2	4.2	4.4
3	...	...	2.9	1.3	0.8	1.2	1.1
4	...	...	0.6	0.5	— 0.2	0.0	0.8
5	...	...	2.1	2.1	2.1	2.9	4.5
6	...	...	1.7	2.6	2.8	2.5	2.6
7	...	...	2.4	2.1	2.8	1.9	3.6
8	...	...	4.9	3.2	3.7	3.3	—
9	...	...	4.9	4.9	4.0	3.5	—
10	...	...	3.7	4.3	4.7	3.3	—
11	...	...	1.7	3.0	2.3	4.4	—
12	...	...	1.0	1.4	0.9	1.9	2.3
13	...	...	2.5	3.7	3.9	3.6	3.8
14	...	...	2.4	2.1	2.9	2.3	—
15	...	...	4.8	3.5	3.7	2.6	—
16	...	...	4.1	3.3	4.1	5.0	5.4
17	...	...	3.2	1.8	2.9	3.0	4.3
18	...	...	3.4	2.5	1.8	1.4	2.4
19	...	...	3.5	4.1	5.8	5.8	—
20	...	...	4.8	4.0	3.5	3.9	—
21	...	...	4.3	4.7	4.9	4.3	—

Industrial Application

Mauritius is apparently the cane sugar producing country where milling efficiency is on the average the highest. Although total losses are also low, yet most of the lead taken at the mills disappears during processing, losses in final molasses being higher than those prevailing in a few other countries, Australia and Taiwan for example, and account for the major part of the total losses in Mauritius factories. Hence the efforts of the industry should be directed towards curtailing these losses as any investment made towards this goal is likely to pay dividends faster than it would in any other department of the factory.

It was therefore decided to collect average monthly samples of final molasses from the 21 defecation factories of the island, to analyse them in the laboratories of the Sugar Technology Division, to calculate the expected purities and to circularize the results to the industry as soon as available. This called for a rather considerable amount of analytical work. It was first necessary to measure the reproducibility and accuracy of each of the determinations involved. This work was carried out by two analysts who, for the same samples, made all the analyses in duplicate. The results obtained revealed that whereas the accuracy and reproducibility of reducing sugars and sulphated ash determinations are high, such is not the case for refractometer Brix and sucrose. Consequently it was decided that all the determinations of Brix and of sucrose on the monthly composite samples would be carried out by two independent analysts and that the results obtained by them would be averaged unless the difference in purity exceeded 0.7, in which case the determinations would be made by a third analyst.

It was also decided to reduce arbitrarily the constant of formula (4) from 44.6 to 41.6 so as to avoid that the actual purity should be lower than the expected purity. As already pointed out, this is bound to happen if the deduction is not made since formula (4) is based on the analyses of average crop samples.

The results obtained, expressed in terms of difference between expected and actual true purities, are given in Table 49. It will be observed that these differences vary sometimes considerably from one factory to the other. But it should immediately be stressed that it would be futile to compare the results obtained in one factory with those of another. It should be remembered that these results were calculated from an equation derived from the analysis of 42 average samples collected during two consecutive crops and is therefore a function of the average equipment available and boiling house technique followed during these two crops. Further, the equation does not account directly for viscosity, a factor which has an important impact on exhaustibility and which may vary considerably from one factory to another.

However, in spite of its limitations, the formula should prove most useful in helping to curtail losses in final molasses as it will enable Process Managers to follow, from month to month and from crop to crop, the difference between actual and expected purities and, other conditions remaining unchanged, will make it easier for them to interpret any improvement or deterioration in boiling house work. They should also be in a position to calculate more accurately any investment they might contemplate to make with the object of reducing losses in final molasses.

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APPENDIX

THE MAURITIUS HERBARIUM

R. E. VAUGHAN

Accessions. The most significant feature of the material acquired during the year has been the very welcome increase in specimens from the island of Réunion. The duplicate set of plants collected by Sir Colville Barclay Bt. during his visit to Réunion and Mauritius in November 1967 has now been incorporated in the Herbarium. Of the flowering plants, 72 species have been named by Mr. W. Marais, The Herbarium, Royal Botanic Gardens, Kew, and his determinations form a valuable check-list and cross reference to material already possessed by the Herbarium. These specimens are rich in the shrubby species of *Helichrysum*, *Senecio*, *Psiadia* and *Philippia* which dominate the upland scrublands of Réunion and include some new additions to the Herbarium.

In February a collection of plants made in Réunion by Mr. Philippe Morat and Dr. P.O. Wiehe in November 1967 was received from Mr. Morat, Botanist, O.R.S.T.O.M., Tananarive. This collection contained a male inflorescence of an endemic species of *Pandanus* and also species in the genera *Polyscias*, *Phyllanthus* and *Isachne*. Mr. Morat presented the Herbarium with some Madagascar grasses for comparison with similar species found in Mauritius.

Mr. T. Cadet, *Assistant Agrégé au Centre d'Enseignement Superieur Scientifique de la Réunion*, Saint Denis, actively continued his field studies of Réunion vegetation, and in October sent to the Herbarium twenty species of plants accompanied by field notes and useful ecological information.

Altogether 251 sheets of Réunion plants were added to the Herbarium collections during the year under review.

Field-work. The search has continued for new or rare palms with encouraging results though their ultimate preservation in the field will be difficult. It is hoped that in due course their propagation will be possible in botanic gardens and elsewhere. In the meanwhile good herbarium material is coming to hand and a series of photographs including colour slides has been obtained. Pollen material of these palms has been sent to Professor Dr. G. Erdtman, Director of the Palynological Laboratory, Stockholm, Sweden, for examination.

About fifty young specimens of the rare endemic Réunion palm *Hyophorbe indica* have been planted in an avenue at the Royal Botanic Gardens, Pamplemousses, and when these come to maturity, a continued supply of viable seed should be ensured.

Special emphasis is given in field-work in developing the orchid section of the Herbarium which of recent years has grown considerably. This expansion is aided by the facilities available for growing living material in an orchid house near the Herbarium. Rare or unidentifiable orchids found in the flowerless state in remote areas difficult of access may be brought to the Orchid House where they can usually be induced to flower; the inflorescence is then preserved as an herbarium specimen.

Grateful thanks are expressed here to voluntary helpers and naturalists who have continued to give valuable help to our institution by combing upland river gorges and plateaux in search of new or little known plants, thus contributing in a substantial way to our knowledge of Mascarene vegetation.

Visitors. On many occasions throughout the year we had the pleasure of welcoming visitors from overseas. Early in January Dr. Luciano Bernardi, Curator, *Conservatoire et Jardin Botaniques, Genève*, spent a few days in Mauritius on his way to Australia. His main interest was in the families *Araliaceae and Cunoniaceae* which he had been studying in Madagascar & Réunion. In Mauritius he was able to find some of the rare species in *Polyscias* and allied genera. He also made a general collection of plants for the Herbarium in Geneva.

In February Mr. R. Capuron, *Chef de la Division de Botanique*, *Centre Technique Forestier Tropical*, Tananarive, came to Mauritius and was able to study in the field, species of the family *Sapotaceae* in which he has a special interest. Mr. Capuron, who has an unrivalled knowledge of Malagasy indigenous forest trees, had also recently visited Réunion, and later was able to send the Herbarium a critical collection of Réunion plants belonging to the *Sapotaceae*. It was clear from a study of this material and from discussions we had with Mr. Capuron that much confusion exists in the naming and identity of the Mascarene species, and that further field-work and research will be necessary in order to unravel the very involved situation which has arisen.

Dr. Benjamin C. Stone, Lecturer at the University of Malaya and Curator, University Herbarium, was able to spend some weeks in Mauritius and Réunion in furtherance of his researches on the family *Pandanaceae*. He made extensive collections of both living and herbarium material of more than half the endemic Mauritius species and also preserved specimens for future study of their leaf anatomy and cytology.

On his return journey from the Kerguelen Islands in April, Mr. R. Delépine, Marine Biologist at the *Faculté des Sciences*, *Université de Paris*, paid a short visit to the Herbarium to examine special genera of marine algae. He was much impressed by the richness and variety of our marine flora and hopes to undertake field studies here in the near future.

In November, Dr. Christopher N. Page, Dept. of Botany, University of Newcastle on Tyne, stopped off at Mauritius on his way to Australia where he has been awarded a two-year post-doctoral fellowship at the University of Queensland. Dr. Page is engaged on a research project concerning the cyto-taxonomy of certain groups of ferns; in particular, a comparative study of those from the Mascarenes with ferns from other oceanic Islands and areas where comparable work has been done. He made a collection of over seventy species of living plants. These were sent off by air freight and arrived in good condition at the University of Newcastle.

Towards the end of the year Sir Colville Barclay returned to Mauritius and had the opportunity of making further collections in Réunion. He has kindly presented the Herbarium with a duplicate set of his material.

Determinations and Distribution to Overseas Institutions. Collections made by visiting botanists are usually retained by the Herbarium for the necessary processing, (drying, poisoning and so on) and after a schedule of determinations has been prepared, the material is despatched to the collector or institution. During the past year some hundreds of specimens have been handled and despatched by the Herbarium in this way. It is also necessary to meet, as far as our resources allow, the requirements of correspondents overseas wishing to borrow Herbarium specimens on loan, or who need fresh material of some special Mascarene group of plants for taxonomic study or research.

There are still in the Herbarium many species awaiting the attention of experts which can only be accurately determined by workers in the large National Herbaria overseas. We are grateful to the following specialists who have named specimens in the course of the year. Mr. J.P.M.Brenan, cultivated and naturalized species of *Albizia*; Mr. A.W.Exell, cultivated species of *Combretum*; Dr. A. Fernandez, naturalized species of *Osbeckia*; Dr. Norman K. Robson, two species of *Hibiscus* and some troublesome weeds belonging to the genus *Abutilon*. Our thanks are due to the Director, Royal Botanic Gardens, Kew, for the determination of Réunion grasses and for some cultivated plants in the Royal Botanic Gardens, Pamplemousses.

Viable seed of species of Réunion Hibiscus were sent to Mr. Ross H. Gast in connection with the Hibiscus project referred to in our Annual Report for 1967. Indigenous species of this genus have also been propagated by grafting for further study.

Vegetation of St. Brandon. In November 1964 the assistant Curator, Mr. J. Guého visited the Cargados Carajos Archipelago (St. Brandon) with the object of making a study of the vegetation concerning which previous knowledge was very meagre. A plant survey of the different islets was made and observations on the ecology and distribution of the plants recorded. The results of this expedition have been published recently in the *Proceedings of the Royal Society of Arts & Sciences of Mauritius*. In November 1968 a second visit was made. On this occasion the main objective was the study of the marine algae. Judging by the specimens collected, particularly of polymorphic species in the genera *Halimeda* and *Caulerpa*, it seems that there is a closer relation to forms found in the Chagos Archipelago, a thousand miles to the north-north-east, rather than to those of the Mascarene islands. Significant also was the absence of *Sargassum* spp. which is such a familiar genus in the lagoons of Mauritius.

Weed flora. Some specimens of species intended for inclusion in the *Weed Flora* were examined at the Kew Herbarium. It seems that the common weed, formerly known as *Paederia fœtida L.* (Liane lingue), is in fact *P. tomentosa* Blume var. *glabra* Kurz. This is a frequent weed in Asian countries, but it is scarce in Africa. The widely distributed African weed *P. fœtida L.* may occur in Mauritius, but authentic material has not been seen. The weed known in Mauritius as *Ageratum conyzoides L.* (Herbe Bouc) has also been the cause of much confusion. In addition to the typical *A. conyzoides L.*, a related cultivated species *A. houstonianum Mill.*, has become naturalized. Variants also are common in *A. conyzoides L.* in the colour and structure of the florets, some of the forms coming close to an American weed *A. latifolium Cav.*

The Director, Botanic Gardens, Singapore, has kindly confirmed the identity of the common riverine "Songe blanc" as a form of *Colocasia esculentum* Schott. This is a troublesome plant in streams and irrigation canals, and it is to be included in the *Weed Flora* in the near future.

Poisonous Plants. Material suspected of being involved in cases of poisoning has been sent to the Herbarium by the Central Laboratory, Victoria Hospital, for identification on several occasions. The plants responsible were *Euphorbia tirucalli L.* (Kalli), *Datura metel L.* (Herbe diable) and seeds of *Jatropha curcas L.* (Pignon d'Inde).

Maps and Publications. A list of publications concerning the Mascarene islands, received by the Herbarium Library during the year under review is given below :-

BRENAN, J.P.M. (1968). Notes on *Mimosoïdeae :* XI. A new species of Albizia from Mauritius. *Kew Bull.* **21** : 3, 482-483.

CADET, Th. (1968). *Le Cryptomeria japonica.* Espèce de Reboisement à la Réunion. *Bull. Inf. Cen. depl. Documn. pedag. Réun.* No. 3, 2-7, March 1968.

FISHER, R.L., JOHNSON, G.L. & HEEZEN B.C. (1967). Mascarene Plateau, Western Indian Ocean. *Bull. geol. Soc. Am.* : **78**: 1247-1266, 7 figs., 6 pls.

HOCHREUTINER, B. P. G. (1900). Revision du Genre Hibiscus. *Annu. Conserv. Jard. bot. Genève* : **4** : 23-191.

JONES, E. W. (1968). African Hepatics. XIX. The Lejeunea complex. *Trans. Br. bryol. Soc.* **5** : 3, 548-562, 5 figs.

LEROY, J. F. (1968). A propos d'un Caféier endemique à l'Ile Maurice : *Coffea vaughanii. J. Agric. trop. Bot. appl.* **15** : 195-198, 3 plates.

MALLERET, L. (1967). Commémoration du bi-centenaire de l'arrivée de Poivre à L'Ile Maurice II. Pierre Poivre, l'Abbé Galloys et l'introduction d'espèces botaniques et d'oiseaux de Chine à l'Ile Maurice. *Proc. R. Soc. Arts Sci. Maurit.* **3** : 1, 117-130, 1968.

RIVALS, P. (1968). Conservation of vegetation in Africa South of the Sahara, Madagascar and the Mascarenes : La Réunion. *Acta phytogeogr. Suec.* **54 :** 272-275.

SAUER JONATHAN, D. (1967). Plants and man on the Seychelles Coast. Technical Report No. 49 : Coastal studies Institute, Louisiana State University, Baton Rouge, Louisiana.

STAUB, F. & GUEHO, J. (1968). The Cargados Carajos Shoals or St. Brandon : Resources, Avi-fauna and Vegetation. *Proc. R. Soc. Arts Sci. Maurit.* : 3,1, 7-46, 5pl., 1 text fig.

VAUGHAN, R.E. (1968). Conservation of vegetation in Africa South of the Sahara. Madagascar and the Mascarenes Mauritius and Rodriguez. *Acta phytogeogr. Suec.* **54 :** 265-272, text figs. 1-5.

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* *Grateful acknowledgment is made to the Secretary, Mauritius Chamber of Agriculture, for providing the necessary data to compile Tables II to VI.*

Table 1. 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°
	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
	Cane	12	54	47	65	27
CANE PRODUCTION 1000 metric tons (1968)		415	1406	1039	1657	634
SUGAR PRODUCTION 1000 metric tons (1968)		50	162	118	192	76
SUGAR FACTORIES production in 1000 metric tons 1966-1968		Médine 49	Belle Vue 30 Mon Loisir 29 St. Antoine 25 Solitude 23 Beau Plan 22 The Mount 21	Union Flacq 69 Beau Champ 31 Constance 28	Savannah 30 Mon Tresor 27 Riche en Eau 23 Rose Belle 22 Union 19 Bel Ombre 18 Britannia 18 St Félix 14 Bénarès 13 Ferney 13	Mon Désert 34 Réunion 21 Highlands 20

Table II. Area under sugar cane in thousand arpents (1), 1960 - 1968

Year	Area under cane Island	Area reaped					
		Island	West	North	East	South	Centre
1960	201.61	188.36	10.22	51.50	42.15	60.34	24.14
1961	201.17	187.29	10.33	50.71	41.98	60.29	23.98
1962	204.97	193.77	11.07	52.60	42.61	62.41	25.08
1963	204.20	194.08	11.63	51.17	43.61	62.67	25.00
1964	206.94	195.41	11.79	52.70	42.23	62.45	25.24
1965	205.56	194.92	12.02	51.80	43.08	62.74	25.28
1966	207.55	195.87	12.36	51.44	43.96	62.90	25.21
1967	205.31	192.17	12.30	50.25	43.43	61.54	24.65
1968(2)	203.08	190.08	12.40	50.55	42.96	60.03	24.14

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

Table III. Sugar production in thousand metric tons(1), 1960 - 1968

Crop Year	No. of factories operating	Av. Pol.	Island	West	North	East	South	Centre
1960	23	98.0	235.8	18.1	75.2	50.0	72.2	20.3
1961	23	98.8	553.3	32.6	140.1	111.9	183.8	84.9
1962	23	98.6	532.7	35.1	154.6	109.3	176.8	56.9
1963	23	98.8	685.5	47.3	175.2	145.5	222.0	95.5
1964	23	98.9	519.0	40.5	148.7	108.9	161.4	59.5
1965	23	98.8	664.4	53.9	158.0	148.6	212.5	91.4
1966	23	98.9	561.8	48.4	130.0	125.8	191.7	65.9
1967	23	98.8	638.3	50.4	159.3	137.3	206.2	85.1
1968(2)	23	98.7	596.5	49.5	161.4	117.8	192.0	75.8

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

Table IV. Yield of cane metric tons per arpent(1), 1960 - 1968

SECTORS	1960	1961	1962	1963	1964	1965	1966	1967	1968(2)
ISLAND									
Millers ...	15.3	32.2	28.0	35.1	26.2	35.7	29.5	35.3	31.1
Planters ...	10.2	20.5	19.5	23.7	18.5	25.3	19.5	24.7	22.7
Average ...	12.7	26.4	23.9	29.6	22.4	30.7	24.7	30.3	27.1
WEST									
Millers ...	21.3	35.3	31.8	37.8	32.3	43.5	35.9	40.3	37.0
Planters ...	13.5	23.4	22.7	27.8	25.0	34.7	28.5	29.8	30.0
Average ...	16.2	27.8	26.2	32.1	28.1	38.9	32.1	35.0	33.5
NORTH									
Millers ...	19.2	29.2	31.1	35.0	29.0	35.5	28.6	37.7	34.1
Planters ...	11.4	20.6	21.4	24.0	19.2	24.4	17.8	24.6	24.4
Average ...	14.1	23.5	24.7	27.8	22.5	28.2	21.5	29.3	27.8
EAST									
Millers ...	16.3	32.7	29.0	37.6	28.0	39.0	31.1	36.0	29.4
Planters ...	9.3	17.9	17.1	21.3	16.0	23.5	18.8	23.0	18.9
Average ...	12.2	24.4	22.5	28.9	21.5	30.9	24.8	29.5	24.2
SOUTH									
Millers ...	14.6	31.7	27.8	33.4	24.5	33.2	29.3	33.3	30.2
Planters ...	9.4	20.8	20.1	24.6	18.7	25.7	21.0	25.2	22.6
Average ...	12.9	28.3	25.5	30.7	22.7	30.9	26.6	30.7	27.6
CENTRE									
Millers ...	9.7	36.7	22.1	36.2	23.3	35.7	26.4	34.7	30.2
Planters ...	7.6	23.7	15.8	24.1	16.9	25.5	18.6	24.3	21.0
Average ...	8.8	30.8	19.3	30.8	20.5	31.2	23.0	30.2	26.3

NOTE: (1) *To convert in metric tons/acre, multiply by 0.959*
„ „ „ long tons/acre, „ „ 0.945
„ „ „ short tons/acre, „ „ 1.058
„ „ „ metric tons/hectares, „ „ 2.370

(2) *Provisional figures*

Table V. Average sugar manufactured % cane(1). 1959 - 1968

Crop Year	Island	West	North	East	South	Centre
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	11.93	12.66	12.32	11.54	11.54	12.40
1964	11.85	12.22	12.52	11.70	11.39	11.50
1965	11.10	11.52	10.82	11.15	10.98	11.61
1966	11.60	12.20	11.76	11.54	11.46	11.38
1967	10.98	11.70	10.84	10.71	10.92	11.43
1968(2)	11.58	11.91	11.48	11.33	11.58	11.96

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, 1959 - 1968

Crop Year	Island	West	North	East	South	Centre
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	3.53	4.06	3.42	3.34	3.51	3.82
1964	2.66	3.43	2.82	2.52	2.58	2.35
1965	3.41	4.48	3.05	3.45	3.39	3.62
1966	2.87	3.92	2.53	2.86	3.05	2.62
1967	3.33	4.10	3.18	3.16	3.35	3.45
1968(1)	3.14	3.99	3.19	2.74	3.20	3.15

NOTE: (1) Provisional figures

Table VII. Monthly rainfall in inches, 1953 - 1968. 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 14.12
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	12.87	*6.44*	*5.04*	*4.11*	1.53	3.95
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*	19.92	3.07	*6.01*	2.67	*6.53*	5.58
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
1964	7.43	*2.24*	22.12	*9.75*	*10.58*	*8.28*	*6.42*	*4.05*	10.29	3.71	2.07	*4.05*	*4.54*	2.88
1965	*1.08*	*5.27*	11.13	*6.85*	*10.70*	16.19	*4.66*	*3.23*	14.09	*9.01*	*9.45*	*6.67*	*3.46*	14.14
1966	5.74	*2.87*	11.99	*5.34*	*8.60*	*4.34*	*1.78*	7.44	23.72	4.47	3.85	1.85	1.82	0.00
1967	*3.28*	12.37	15.07	*3.83*	12.21	*9.17*	*4.62*	*4.19*	11.11	*9.17*	*5.69*	2.85	*6.53*	9.84
1968	8.95	10.14	*3.07*	20.92	15.97	*3.43*	*5.43*	*3.95*	16.53	*5.22*	3.38	*4.35*	1.41	2.08

NOTE: To convert into millimetres, multiply by 25.4

Table VIII. Monthly maximum and minimum air temperatures, 1953 - 1968. Average over whole sugar cane area of Mauritius

YEAR	NOV.		DEC.		JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT .	
	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m
Normals 1950-65	27.9	18.7	29.2	20.6	29.7	21.7	29.4	21.8	29.1	21.5	27.9	20.2	26.4	18.6	24.8	17.1	24.0	16.4	23.8	16.0	24.8	16.5	26.1	17.4
1953	27.7	18.6	28.7	19.7	29.2	21.5	29.6	21.5	30.4	21.2	28.6	20.2	27.1	19.9	26.0	19.1	24.1	17.2	23.7	16.1	24.7	16.6	25.9	17.5
1954	28.1	19.0	28.8	21.1	29.8	21.7	30.4	22.3	29.8	21.4	27.9	21.0	26.6	20.0	24.9	17.3	24.1	17.4	24.2	17.0	24.6	17.4	26.5	17.3
1955	27.4	19.2	29.1	20.2	30.9	21.6	29.4	21.3	29.1	22.1	28.1	20.4	26.6	18.9	24.7	17.6	24.0	16.8	23.4	15.9	24.9	16.4	25.8	16.5
1956	28.4	18.7	28.4	20.4	29.4	21.7	28.4	21.6	28.6	21.3	27.5	19.4	26.2	19.2	24.5	16.4	24.0	15.0	24.7	15.5	25.8	16.6	27.2	17.6
1957	29.2	17.8	29.8	20.3	30.4	21.6	28.8	21.1	29.4	21.3	27.4	19.2	26.7	18.4	24.6	16.7	24.9	16.2	24.4	16.0	25.6	16.5	27.6	17.4
1958	29.2	17.8	30.5	21.3	29.9	21.9	29.6	21.8	29.6	22.4	28.8	22.1	26.0	17.7	24.4	16.3	24.2	15.6	24.4	16.7	25.9	16.2	26.1	17.3
1959	28.4	17.9	30.1	19.9	30.1	21.1	29.8	21.7	28.7	22.5	28.1	20.0	26.6	17.6	25.0	15.8	23.5	15.6	23.7	15.9	24.8	16.2	25.8	17.8
1960	27.3	20.5	28.9	20.9	28.8	22.0	29.1	22.4	28.7	21.5	27.8	19.1	26.8	18.6	24.7	17.7	23.4	16.2	24.0	17.0	24.3	17.5	25.7	17.5
1961	26.6	18.6	29.2	20.6	29.8	21.9	30.8	21.2	29.8	21.8	29.4	21.1	28.3	19.6	26.4	18.3	25.5	18.4	24.3	16.8	25.4	16.5	26.7	18.0
1962	28.3	19.9	28.6	22.1	29.2	21.7	29.5	22.2	29.5	22.1	27.6	19.3	25.8	18.0	24.7	16.0	24.0	15.1	23.6	15.7	25.1	17.0	25.7	17.8
1963	27.3	18.4	29.1	20.8	29.1	21.3	29.3	21.6	28.7	20.7	28.6	20.8	25.8	17.8	25.2	17.4	23.8	16.3	23.6	14.4	24.3	15.4	25.9	16.7
1964	27.1	18.9	29.0	20.0	29.2	21.1	29.1	23.1	28.9	22.7	26.1	19.8	24.8	18.1	24.1	16.5	22.7	14.9	22.9	15.4	23.7	15.9	25.2	16.9
1965	27.3	18.2	28.8	20.4	28.3	21.4	29.2	21.8	28.0	20.5	27.1	20.8	25.2	18.7	24.4	16.1	24.1	17.5	22.9	16.6	24.2	17.3	25.3	18.1
1966	26.8	19.1	28.2	19.9	28.5	21.3	29.2	22.1	27.9	21.5	27.8	20.3	27.2	18.1	24.7	17.4	23.9	17.0	23.7	16.5	25.4	16.9	26.0	17.2
1967	27.8	19.0	28.9	21.3	29.3	22.2	29.6	21.8	29.4	22.0	28.9	20.8	25.8	18.8	24.5	17.1	23.3	17.1	23.3	16.6	24.4	16.9	25.4	17.7
1968	27.2	19.7	28.6	20.8	28.6	21.0	28.4	22.0	28.3	22.3	27.9	19.8	26.3	16.8	24.7	15.8	23.6	16.4	23.9	16.1	24.7	16.3	25.7	17.5

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

Crop Year	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
November	18	14	16	12	13	13	19	16	18	15	17	15	17	14	19
December	16	15	17	13	13	14	15	15	*43*(2)	24	18	17	15	16	19
January	28	13	20	20	14	17	*53*(2)	16	20	26	*60*(2)	19	*45*(2)	*39*(2)	24
February	15	*34*(2)	16	19	18	17	*74*(2)	13	*59*(2)	16	*34*(2)	15	14	14	27
March	15	29	19	18	*33*(2)	18	15	13	18	17	24	21	25	12	25
April	16	16	17	16	28	17	15	12	21	16	18	21	15	12	14
May	22	19	18	15	14	16	17	13	20	20	22	24	13	21	16
June	20	22	17	13	14	17	17	19	17	18	20	17	16	20	18
July	16	17	15	12	11	16	15	19	19	17	20	20	18	20	20
August	23	20	14	17	20	18	16	20	22	15	20	18	20	22	21
September	19	19	17	17	17	17	20	21	18	17	20	17	14	17	21
October	20	14	18	15	17	18	18	19	22	16	17	18	20	23	18

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*

X. Highest wind speed during one hour in miles in different sectors. Cyclone years

Cyclone Years	West	North	East	South	Centre
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
January 1964 *Danielle*	48	61	55	81	53
February 1964 *Gisele*	37	33	26	42	32
January 1966 *Denise*	53	52	35	44	40
January 1967 *Gilberte*	33	38	41	45	37
February 1968 *Ida*	33	30	20	25	28
March 1968 *Monica*	24	17	31	31	20

Table XI. Cane Varieties, 1955 - 1968

%Area cultivated (Estate lands)

	M.134/32 (1937)	Ebène 1/37 (1951)	B.3337 (1953)	B.37161 (1953)	B.37172 (1953)	B.34104 (1956)	M.147/44 (1956)	M.31/45 (1956)	M.202/46 (1960)	M.93/48 (1960)	M.253/48 (1962)	Ebène 50/47 (1962)	M.442/51 (1964)	M.99/48 (1965)	M.409/51 (1966)	M.13/53 (1966)	M.13/56 (1966)	M.377/56 (1967)
1955	74	15	3	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—
1956	66	17	4	3	2	—	1	1	—	—	—	—	—	—	—	—	—	—
1957	55	21	4	3	3	1	6	3	—	—	—	—	—	—	—	—	—	—
1958	43	24	5	3	5	1	10	4	—	—	—	—	—	—	—	—	—	—
1959	33	25	5	3	8	2	15	5	—	—	—	—	—	—	—	—	—	—
1960	25	26	6	3	10	2	19	5	—	—	—	—	—	—	—	—	—	—
1961	19	24	7	2	11	2	23	5	2	1	1	1	—	—	—	—	—	—
1962	13	21	7	2	11	3	26	4	4	3	1	3	—	—	—	—	—	—
1963	9	18	6	2	11	3	29	4	6	5	2	4	—	—	—	—	—	—
1964	6	15	6	—	11	2	31	3	8	9	2	5	—	—	—	—	—	—
1965	5	11	5	—	9	2	29	4	11	12	2	6	2	—	—	—	—	—
1966	3	9	4	—	8	2	26	4	13	16	2	6	5	—	—	—	—	—
1967	2	6	3	—	6	1	23	5	14	17	2	6	7	1	—	—	—	—
1968	2	4	2	—	5	1	19	6	14	19	2	5	9	1	1	1	3	1

NOTE: Year of release shown in brackets

Table XII. Percentage annual plantations under different cane varieties on sugar estates, 1964 to 1968

Years / Varieties	Island					West					North				
	1964	1965	1966	1967	1968	1964	1965	1966	1967	1968	1964	1965	1966	1967	1968
M.134/32 ...	0.6	1.3	—	—	—	0.9	1.4	—	—	—	1.8	3.2	—	—	—
M.147/44 ...	22.5	3.6	2.5	2.9	0.1	40.1	13.1	10.3	16.8	0.3	56.8	13.4	0.7	5.8	0.4
M.31/45 ...	6.2	9.4	9.4	6.3	7.4	1.3	6.2	11.6	3.0	7.5	2.4	7.5	3.6	1.6	0.3
M.202/46 ...	21.3	21.1	16.2	8.6	7.7	28.4	29.2	30.9	30.0	18.3	22.0	23.7	15.9	4.8	1.7
M.93/48 ...	25.5	26.3	22.7	20.2	23.7	—	0.9	—	1.2	—	12.3	18.8	12.7	4.6	0.7
M.99/48 ...	0.4	3.4	3.6	3.1	0.1	0.2	1.1	4.8	2.4	0.9	—	0.6	—	0.3	—
M.253/48 ...	1.4	2.7	0.5	0.3	—	10.9	20.6	0.3	0.5	—	0.3	1.6	0.3	—	—
M.409/51 ...	0.1	0.9	5.9	4.9	0.9	—	—	1.5	7.3	2.1	—	0.8	1.5	1.7	0.3
M.442/51 ...	4.2	18.8	24.1	24.4	11.7	7.0	23.8	29.2	17.6	13.2	1.8	26.6	55.3	56.8	36.8
M.13/53 ...	—	—	2.5	3.7	3.0	—	—	6.3	4.9	3.1	—	—	5.3	8.4	9.9
M.13/56 ...	—	—	1.1	7.9	22.9	—	—	3.0	4.3	9.2	—	—	1.9	14.6	41.4
M.377/56 ...	—	—	—	0.8	9.8	—	—	—	2.3	31.5	—	—	—	0.6	6.4
Ebène 1/37 ...	1.7	1.7	3.4	0.2	0.1	—	—	—	—	—	—	—	—	—	—
Ebène 50/47...	7.6	4.4	2.1	0.4	—	—	—	—	—	—	2.1	1.4	1.2	—	—
N : Co.376 ...	—	—	—	0.8	1.9	—	—	—	—	1.1	—	—	—	—	0.1
Other varieties	8.5	6.4	6.0	15.5	10.7	11.2	3.7	2.1	9.7	12.8	0.5	2.4	1.6	0.8	2.0
Total area arpents	13,755	13,400	11,021	12,020	12,986	741	1,045	804	777	774	2,176	2,255	2,212	2,355	2,298

Years / Varieties	East					South					Centre				
	1964	1965	1966	1967	1968	1964	1965	1966	1967	1968	1964	1965	1966	1967	1968
M.134/32 ...	0.5	1.2	—	—	—	0.4	1.0	—	—	—	—	—	—	—	—
M.147/44 ...	22.0	1.6	6.1	2.8	—	14.9	—	0.8	0.3	0.1	0.4	—	—	—	—
M.31/45 ...	14.9	22.3	12.6	10.8	23.5	5.5	7.9	13.1	9.4	5.4	—	0.6	2.1	0.5	0.1
M.202/46 ...	23.0	23.3	13.8	8.8	1.3	25.1	24.8	19.8	9.8	14.0	4.0	0.6	3.7	1.6	0.9
M.93/48 ...	20.6	19.1	32.2	24.3	27.8	23.4	22.9	16.0	18.4	17.1	62.7	67.9	50.5	45.2	74.0
M.99/48 ...	0.6	5.7	4.9	5.8	—	0.5	4.4	4.8	1.7	—	0.2	1.8	3.1	5.9	—
M.253/48 ...	1.3	0.9	0.7	0.8	—	1.2	1.5	0.8	0.2	—	—	—	0.2	—	—
M.409/51 ...	—	—	6.7	5.3	—	—	—	9.8	7.1	0.8	—	—	3.4	2.3	2.7
M.442/51 ...	5.0	18.4	19.1	27.7	10.3	5.4	20.9	17.9	17.1	5.1	1.0	1.8	1.3	1.0	1.7
M.13/53 ...	—	—	1.0	3.5	3.7	—	—	1.9	2.5	0.8	—	—	0.2	0.3	0.1
M.13/56 ...	—	—	0.1	2.9	16.6	—	—	1.3	10.8	24.4	—	—	0.2	1.7	10.3
M.377/56 ...	—	—	—	0.7	10.1	—	—	—	0.9	9.8	—	—	—	0.2	4.8
Ebène 1/37 ...	—	—	—	—	—	3.6	3.4	3.9	0.6	0.3	1.3	1.5	13.3	1.0	—
Ebène 50/47...	3.5	2.4	1.5	—	—	8.6	7.1	3.8	0.6	—	20.4	5.5	1.0	—	—
N : Co.376 ...	—	—	—	—	—	—	—	—	2.0	4.1	—	—	—	—	0.6
Other varieties	8.6	5.1	1.3	6.6	6.7	11.4	6.1	6.1	18.6	18.1	10.0	20.3	21.0	40.3	4.8
Total area arpents	3,164	2,554	2,281	2,520	2,531	5,696	5,593	4,090	4,396	5,452	1,978	1,953	1,634	1,975	1,931

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

Year	Island	West	North	East	South	Centre
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
1964	88.2	89.9	86.9	88.9	89.3	83.7
1965	86.7	87.2	87.2	85.0	78.5	87.2
1966	86.7	83.6	86.2	88.0	87.5	84.8
1967	89.1	87.9	87.7	89.8	89.8	88.4
1968	86.7	88.3	83.4	88.0	87.9	84.6

NOTE: The weight of cane produced on estates in 1968 was · virgins 414,863 tons; ratoons 698,691

Table XIV. Average yields of virgin and ratoon canes on estates
Tons per arpent. A: 1963 - 1967 B: 1968

Crop Cycle	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	33.0	39.2	44.6	44.1	37.4	46.5	39.5	34.2	34.2	38.5	35.0	35.9
1st Ratoon	34.7	32.0	39.2	34.7	36.3	36.3	36.2	30.5	32.8	30.2	33.5	31.4
2nd ,,	32.9	30.9	37.8	36.9	33.4	33.5	35.3	30.2	31.1	29.2	31.2	30.5
3rd ,,	31.6	29.9	35.4	35.3	32.2	32.6	34.0	28.3	30.0	29.4	30.3	29.1
4th ,,	30.8	29.7	34.3	36.6	31.5	30.9	33.2	28.8	29.0	29.0	29.7	28.9
5th ,,	30.7	29.7	33.8	35.0	31.7	30.7	32.6	30.3	29.1	28.2	29.5	28.5
6th ,,	30.4	29.3	33.0	32.7	31.4	31.8	32.1	26.3	28.8	29.2	30.0	28.9

Table XV. Evolution of 1968 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
	13th July						*20th July*						*27th July*						*3rd August*					
Cane crushed (1000m. tons)	349	44	38	117	104	46	647	67	110	182	204	84	959	89	191	245	307	127	1.276	112	272	311	412	169
Sugar manufactured % cane	10.71	10.79	10.22	10.72	10.49	10.86	10.64	10.80	10.28	10.79	10.48	11.08	10.68	10.88	10.36	10.83	10.52	11.18	10.75	11.00	10.42	10.88	10.60	11.27
Sugar manufactured (1000m tons)	37.2	4.7	3.9	12.6	11.0	5.0	68.9	7.2	11.4	19.6	21.4	9.3	102.4	9.6	19.8	26.5	32.3	14.2	137.2	12.3	28.3	33.9	43.6	19.1
	10th August						*17th August*						*24th August*						*31st August*					
Cane crushed (1000m tons)	1.597	134	354	377	518	214	1.905	156	435	441	619	254	2.205	178	515	504	721	287	2.489	199	591	563	814	322
Sugar manufactured %, cane	10.86	11.07	10.49	10.95	10.75	11.35	10.96	11.15	10.61	11.03	10.89	11.48	11.06	11.22	10.72	11.10	11.02	11.57	11.13	11.30	10.80	11.16	11.12	11.65
Sugar manufactured (1000m. tons)	173.3	14.8	37.1	41.4	55.7	24.3	208.8	17.4	46.2	48.6	67.4	29.2	243.8	19.9	55.2	55.9	79.5	33.3	277.1	22.4	63.9	62.8	90.5	37.5
	7th September						*14th September*						*21st September*						*28th September*					
Cane crushed (1000m. tons)	2,786	219	671	624	910	362	3,061	239	738	683	1,001	400	3,363	260	819	744	1.097	443	3,650	282	894	806	1,186	482
Sugar manufactured %, cane	11.22	11.39	10.88	11.21	11.24	11.74	11.28	11.45	10.94	11.26	11.29	11.80	11.34	11.54	11.03	11.29	11.35	11.85	11.39	11.62	11.08	11.32	11.41	11.90
Sugar manufactured (1000m. tons)	312.6	25.0	72.9	69.9	102.3	42.5	345.1	27.3	80.8	76.8	113.0	47.2	381.4	30.0	90.3	84.0	124.6	52.5	415.7	32.8	99.2	91.3	135.7	57.3
	5th October						*12th October*						*19th October*						*26th October*					
Cane crushed (1000m. tons)	3,930	303	969	863	1.277	518	4.220	325	1.048	922	1,366	559	4,481	346	1,117	977	1,443	598	4,692	364	1,181	1,006	1,511	630
Sugar manufactured % cane	11.42	11.67	11.14	11.34	11.46	11.91	11.46	11.72	11.19	11.34	11.49	11.92	11.48	11.79	11.25	11.34	11.51	11.95	11.51	11.83	11.30	11.34	11.52	11.97
Sugar manufactured (1000m. tons)	448.8	35.3	107.8	97.8	146.2	61.7	483.4	38.0	117.2	104.5	157.0	66.7	514.6	40.8	125.5	110.7	166.2	71.4	540.0	43.1	133.5	114.1	174.0	75.3
	2nd November						*9th November*						*16th November*						*Total crop production (preliminary figs.)*					
Cane crushed (1000m. tons)	4,851	383	1,245	1,026	1,563	634	5,009	405	1,316	1.034	1,620	634	5,112	415	1,385	1,039	1,639	634	5.152	415	1,407	1,039	1.657	634
Sugar manufactured % cane	11.52	11.88	11.35	11.34	11.53	11.96	11.56	11.89	11.41	11.34	11.57	11.96	11.58	11.91	11.47	11.33	11.57	11.96	11.58	11.91	11.48	11.33	11.58	11.96
Sugar manufactured (1000m. tons)	559.1	45.4	141.3	116.3	180.3	75.8	578.8	48.2	150.2	117.3	187.3	75.8	591.6	49.5	158.9	117.7	189.7	75.8	596.5	49.5	161.5	117.7	192.0	75.8

Table XVI. Evolution of cane quality during 1968 sugar crop

Week Ending	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
13th July	12.25	10.54	12.27	10.69	12.07	10.22	12.38	10.72	12.16	10.39	12.46	10.89
20th ,,	12.37	10.65	12.50	10.83	12.07	10.31	12.46	10.91	12.30	10.45	12.80	11.32
27th ,,	12.41	10.78	12.65	11.11	12.11	10.46	12.42	10.94	12.39	10.62	12.86	11.39
3rd August	12.51	10.98	12.93	11.47	12.18	10.58	12.50	11.13	12.48	10.82	12.96	11.54
10th ,,	12.69	11.21	12.93	11.41	12.22	10.72	12.59	11.26	12.88	11.32	13.06	11.68
17th ,,	13.01	11.52	13.16	11.65	12.60	11.18	12.95	11.51	13.14	11.56	13.43	12.11
24th ,,	13.06	11.65	13.28	11.74	12.66	11.22	12.96	11.57	13.26	11.81	13.48	12.23
31st ,,	13.17	11.76	13.50	12.01	11.79	11.33	13.10	11.74	13.33	11.88	13.50	12.28
7th September	13.36	11.93	13.59	12.16	13.03	11.54	13.17	11.75	13.56	12.06	13.71	12.50
14th ,,	13.26	11.80	13.63	12.25	13.01	11.53	13.12	11.67	13.33	11.80	13.55	12.30
21st ,,	13.36	11.99	13.93	12.51	13.01	11.77	13.13	11.74	13.51	11.99	13.72	12.40
28th ,,	13.42	11.91	14.03	12.50	13.28	11.75	13.00	11.61	13.56	12.01	13.61	12.33
5th October	13.29	11.85	13.90	12.76	13.23	11.74	12.81	11.46	13.46	11.94	13.44	12.16
12th ,,	13.37	11.92	14.06	12.49	13.27	11.92	13.00	11.47	13.50	11.96	13.52	12.16
19th ,,	13.46	11.94	14.50	12.87	13.57	12.09	12.89	11.22	13.48	11.93	13.48	12.12
26th ,,	13.59	12.07	14.21	12.51	13.72	12.19	13.22	11.66	13.46	11.92	13.45	12.22
2nd November	13.83	12.20	14.55	12.83	13.71	12.19	13.74	11.74	13.83	12.14	13.06	11.45
9th ,,	14.08	12.28	14.23	12.19	14.17	12.50	13.65	11.70	13.91	12.08	—	—
16th ,,	14.08	12.26	14.42	12.53	14.19	12.45	13.70	11.90	13.65	11.57	—	—

NOTE: A = Sucrose % cane

B = Sugar manufactured % cane

Table XVII. (i) Duration of harvest in days (A) and weekly crushing rates of factories in 1000 metric tons (B) in different sectors of the island, 1950 - 1968

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1950	141	184.6	130	10.1	140	47.9	145	35.1	144	65.0	135	26.5
1951	154	197.8	150	1 0.3	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
1964	121	252.9	119	19.5	115	72.1	127	51.3	130	76.2	107	33.7
1965	156	268.7	178	18.3	145	70.5	164	56.7	155	87.4	154	35.7
1966	139	244.4	159	17.4	123	63.0	155	49.2	148	79.0	113	35.7
1967	168	242.6	166	18.2	160	64.5	183	48.9	169	78.2	159	32.9
1968	129	278.7	140	20.7	135	72.7	125	58.0	128	90.4	121	36.8

Table XVII (ii). Mid - harvest date (A) and average difference in the age of successive crops (B), days, 1955 - 1968

Crop Years	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1955	26/9		25/9		29/9		24/9		23/9		28/9	
1956	19/9	— 7	18/9	— 7	21/9	— 8	20/9	— 4	16/9	— 7	24/9	— 4
1957	23/9	+ 4	21/9	+ 3	20/9	— 1	27/9	+ 7	24/9	+ 8	22/9	— 2
1958	24/9	+ 1	21/9	0	15/9	— 5	2/10	+ 5	26/9	+ 2	26/9	+ 4
1959	16/9	— 8	6/9	—15	12/9	— 3	20/9	—12	17/9	— 9	25/9	— 1
1960	16/9	0	16/9	+10	16/9	+ 4	26/9	+ 6	20/9	+ 3	23/8	—33
1961	24/9	+ 8	15/9	— 1	3/10	+16	20/9	— 6	24/9	+ 4	15/9	+23
1962	19/9	— 5	23/9	+ 8	27/9	— 5	16/9	— 4	17/9	— 7	10/9	— 5
1963	10/9	— 9	19/9	— 4	14/9	—13	11/9	— 5	3/9	—14	12/9	+ 2
1964	15/9	+ 5	12/9	— 7	22/9	+ 8	11/9	0	13/9	+10	7/9	— 5
1965	24/9	+ 9	25/9	+13	3/10	+11	23/9	+ 8	17/9	+ 4	1/10	+24
1966	16/9	— 8	26/9	+ 1	20/9	—13	16/9	— 7	14/9	— 3	8/9	—23
1967	23/9	+ 7	23/9	— 3	30/9	+10	23/9	+ 7	20/9	+ 6	17/9	+ 9
1968	2/9	—21	4/9	—19	10/9	—20	26/8	—28	1/9	—19	30/8	—19
Averages 1955 - 1968	*18/9*	—	*18/9*	—	*22/9*	—	*19/9*	—	*17/9*	—	*15/9*	—

Table XVIII. Summary of chemical control data 1968

(i) CANE CRUSHED AND SUGAR PRODUCED

		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
CRUSHING PERIOD	From	29/6	5/7	19/7	6/7	11/7	5/7	12/7	5/7	27/6	1/7	26/6	5/7	3/7	1/7	12/7	3/7	12/7	12/7	3/7	29/6	5/7	16/7	1/7	
	To	13/11	19/11	18/11	23/11	22/11	20/11	14/11	14/11	23/10	2/11	30/10	26/10	20/11	12/11	17/10	2/11	23/11	9/11	14/11	21/11	31/10	28/10	26/10	
	No. of crushing days	116	114	101	115	112	114	104	112	101	106	106	96	117	114	84	104	112	99	114	122	98	88	98	106
	No. of crushing hours per day	22.37	22.47	23.33	22.06	21.87	22.43	20.39	21.84	21.62	20.37	17.34	19.06	18.86	20.42	21.31	17.99	19.84	18.54	20.24	19.53	18.30	21.10	21.99	20.67
	Hours stoppage per day	0.58	0.59	0.23	0.52	1.06	0.72	1.76	0.53	0.72	0.19	0.36	0.43	0.98	0.17	0.74	0.45	0.31	0.51	0.55	1.38	0.28	0.63	0.44	0.63
	Overall time Efficiency	93.2	93.6	97.2	91.9	91.1	93.5	85.0	91.0	90.1	84.9	72.3	79.4	78.6	85.1	88.8	75.0	82.7	77.3	84.3	81.4	76.3	86.7	91.6	86.1
	Mechanical Efficiency	97.4	97.4	98.2	97.7	95.2	96.9	92.1	95.4	96.8	99.1	98.0	97.7	95.1	99.2	96.7	97.6	98.5	97.3	97.4	93.4	98.5	97.1	98.0	97.0
CANE CRUSHED (Metric Tons)	Factory	229.625	31,077	67,726	139,408	118,276	81.203	151,867	100,987	345.128	183,299	52,256	163.065	182.408	182,530	119,603	130,214	122,103	152,026	49,071	72,037	111,802	110,193	197.254	3,093,698
	Planters	185,781	188,597	123.761	64,693	163.997	174,125	101,815	134,083	196.868	78,602	56,255	27.418	36,802	60,951	44,477	18,847	1,860	8,386	81,010	95,445	65,779	58,393	90,597	2,058,542
	Total	415,406	219,674	191,487	204,101	282.273	255,328	253,682	235,070	541,996	261,901	108,511	191,023	219,210	243,481	164,080	149,061	123,963	160,412	130,081	167,482	177,581	168,586	287,851	5,152,240
	Factory % Total	55.3	14.1	35.4	68.3	41.9	31.8	59.9	43.0	63.7	70.0	48.2	85.7	83.2	75.0	72.9	87.4	98.5	94.8	37.7	43.0	63.0	65.4	69.5	60.0
	Per day	3,581	1,927	1,890	1,775	2,520	2.240	2,439	2,099	5.366	2,471	1,024	1,990	1,874	2,136	1,953	1,433	1,107	1,620	1,141	1,373	1,812	1,916	2,937	2,106
	Per hour actual crushing	160.1	85.7	81.0	80.4	115.2	99.9	119.7	98.5	248.3	121.3	59.0	106.9	99.4	104.6	91.7	79.6	55.8	87.4	56.3	70.3	98.8	90.8	133.5	101.9
VARIETIES CRUSHED (Factory)	M.134/32 per cent	1.4	0.8	2.0		6.4		7.2	-	0.1				0.4	4.7		-	3.8	8.3	1.9	2.2	--	-		1.7
	M.147/44 per cent	29.0	16.3	30.7	20.1	41.9	44.8	43.6	52.9	13.1	26.8	9.6	33.0	23.8	12.5	0.2	8.4	10.4	17.5	27.8	31.1	6.9		2.7	20.8
	M.31/45 per cent	1.1	—	6.5	4.4	1.2	-	3.8	9.3	8.4	15.2	13.0	4.3	6.3	4.7	2.3	5.1	7.5	7.3	12.2	4.5	5.5	-	—	5.3
	M.202/46 per cent	23.7	40.0	21.5	19.4	10.2	8.3	3.9	11.7	18.1	23.6	18.3	13.8	17.0	19.5	35.3	10.9	16.5	10.1	5.7	14.1	14.9	1.0	1.4	15.5
	M.93/48 per cent	1.1	3.9	4.7	24.1	2.3	6.3	5.7	2.0	25.9	11.5	13.3	7.4	9.6	10.2	39.0	45.7	9.6	18.3	8.6	3.3	33.0	21.8	61.4	18.0
	M.253/48 per cent	10.1	5.7	1.1	1.5	2.0	0.5	0.1	1.0	1.0	3.8	—	—	2.2	2.0	0.4	—	2.1	-	3.3	—	—	-		1.8
	M.409/51 per cent	1.0	1.9	0.1	0.5	0.1	1.1	0.2		3.3	0.5	2.9	0.8	2.3	7.1	0.6	0.4	3.3	0.1	0.7	1.1	1.2	1.3	1.0	1.6
	M.442/51 per cent	8.2	14.3	15.0	18.9	18.4	14.5	31.3	15.6	8.9	3.9	16.8	7.7	13.1	6.8	0.8	3.6	6.3	6.4	8.9	14.7	3.6		1.0	9.6
	M.13/53 per cent	1.5	1.9	6.3	2.8	3.5	1.0	1.0	0.5	0.5	0.6	1.9	0.7	0.2	0.6	-	0.2	0.5	-	0.4	4.2	0.3	0.1		1.0
	M.13/56 per cent	0.9	1.5	5.6	0.8	4.1	4.5		0.3	0.3	0.4	2.7	2.6	0.9	2.5	-	1.7	0.9	0.2	1.1	3.7		0.8	0.4	1.2
	Ebène 1/37 per cent	—	--			-	3.9		0.4	2.2				3.6	7.5	10.2	8.4	—	4.8		-		4.8	15.7	3.1
	Ebène 50/47 per cent	0.5	3.9	1.3	3.6	1.6	—	0.1	3.2	1.9	3.3	5.3	3.4	4.7	4.1	3.4	0.4	6.8	13.2	4.9	8.0	5.3	38.6	3.4	4.8
	B.37172 per cent	7.5	9.2	2.0	1.1	5.6	14.1	2.9	2.5	1.4	--	3.4	8.2	4.4	10.7	—	--	28.4	-	--	9.9	—	—	—	4.9
	Other varieties per cent	14.0	0.9	3.2	2.8	2.7	1.0	0.2	0.6	14.9	10.4	12.8	18.1	11.5	7.1	7.8	15.2	3.9	13.8	24.5	3.2	29.3	31.6	13.0	10.7
SUGAR PRODUCED (Metric Tons)	Raw Sugar	49,497	24,752	23,010	23,438	32,930	20,516	29,134	26,481	61,868	29,409	3,911	21,916	27,052	29,306	19,908	17,511	7,557	18,094	14,619	18,456	20,558	21,216	34,054	575,193
	White Sugar	—	—	—	-	--	7,677	-	—	-	--	7,758			-	—	-	5,951	--	-	—	-	--		21,386
	Total Sugar	49,497	24,752	23,010	23,438	32,930	28,193	29,134	26,481	61,868	29,409	11,669	21,916	27,052	29,306	19,908	17,511	13,508	18,094	14,619	18,456	20,558	21,216	34,054	596,579
	Tons Sugar at 96 Pol.	50,858	25,348	23,657	24,135	33,839	29,075	29.958	27.232	63,525	30,245	12.058	22,549	27,801	30.158	20,501	17,991	13,968	18,607	15,035	18,901	21,147	21,821	35,015	613,421

Table XVIII. Summary of chemical control data 1968

(a) 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. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE/SUGAR RATIO	Tons cane per ton sugar made	8.39	8.87	8.32	8.71	8.57	9.06	8.71	8.88	8.76	8.90	9.30	8.72	8.10	8.31	8.24	8.51	9.18	8.87	8.90	9.07	8.60	7.95	8.45	8.64
	,, ,, ,, ,, ,, @ 96° Pol	8.17	8.67	8.09	8.46	8.34	8.78	8.47	8.63	8.53	8.66	9.00	8.47	7.80	8.07	8.00	8.29	8.87	8.62	8.65	8.86	8.40	7.73	8.22	8.40
	Sucrose per cent	13.49	12.88	13.27	12.84	13.22	12.90	12.98	13.02	12.79	12.69	12.54	12.92	13.86	13.64	13.53	13.16	12.93	12.85	12.83	12.62	12.99	13.77	13.22	13.10
	Fibre per cent	13.72	14.04	14.23	13.54	14.85	15.27	13.83	15.09	13.37	11.86	14.46	14.08	13.15	12.90	12.81	12.94	13.20	12.31	13.46	14.57	13.34	11.46	12.08	13.52
BAGASSE	Pol. per cent	1.93	2.11	1.64	1.74	1.88	2.15	2.06	2.02	1.96	2.04	2.12	1.87	2.45	2.45	2.32	2.31	2.47	1.92	2.11	2.11	2.13	1.45	1.93	2.04
	Moisture per cent	49.9	49.9	47.3	47.1	47.4	50.3	48.6	45.9	50.1	46.8	50.2	48.6	48.1	48.6	49.5	47.4	46.4	48.3	47.3	49.4	50.1	48.8	48.6	48.6
	Fibre per cent	47.5	47.3	50.4	50.6	50.2	46.6	48.5	51.4	47.3	50.3	47.0	49.0	48.9	48.4	47.5	49.6	50.3	49.2	49.9	47.9	47.2	49.3	48.9	48.6
	Weight per cent cane	28.9	29.7	28.3	26.8	29.6	32.8	28.5	29.4	28.3	23.6	30.8	28.7	26.9	26.6	27.0	26.1	26.2	25.1	27.0	30.4	28.3	23.3	24.7	27.8
1st EXPRESSED JUICE	Brix (B_I)*	18.84	19.00	19.28	18.06	18.97	19.17	18.44	18.65	17.87	18.33	17.88	18.29	19.13	18.70	18.23	18.10	18.17	17.57	17.40	17.53	18.23	18.10	17.83	18.39
	Gravity Purity	89.3	88.4	89.0	90.8	90.7	88.5	89.7	89.4	90.4	89.3	88.8	90.0	91.4	90.5	91.6	92.5	89.8	90.4	88.9	90.9	91.1	91.7	90.8	90.1
	Reducing sugar/sucrose ratio	3.2	3.1	3.3	3.1	2.3	3.2	3.0	3.6	2.6	3.1	3.4	2.2	2.4	2.5	2.1	2.5	2.8	3.2	2.6	3.0	1.9	2.1	2.4	2.8
LAST EXPRESSED JUICE	Brix*	2.00	3.34	2.81	1.59	3.31	3.35	2.45	2.51	3.80	2.99	2.77	2.54	3.09	3.11	3.05	2.97	4.07	2.91	2.83	2.70	2.29	1.76	2.27	2.80
	Apparent Purity	73.4	73.6	70.3	76.1	77.3	69.6	71.3	74.9	74.7	69.9	74.7	72.6	80.6	80.4	77.0	76.8	75.5	75.9	75.9	78.1	77.7	75.0	75.9	75.1
MIXED JUICE	Brix*	15.02	14.63	14.27	13.88	13.75	13.84	13.75	14.22	14.04	13.05	12.66	13.04	14.04	14.11	13.89	13.15	14.29	13.03	13.09	12.49	13.85	14.29	13.95	13.85
	Gravity Purity	88.3	86.7	86.7	87.9	88.3	86.4	87.9	87.5	89.0	87.1	87.2	88.0	89.3	88.9	90.3	90.6	87.6	88.7	87.7	88.8	89.1	90.1	89.3	88.3
	Reducing sugar/sucrose ratio	3.5	3.6	4.1	3.7	3.1	4.0	3.9	4.7	3.3	3.6	4.1	2.8	2.8	3.1	2.6	2.9	3.9	3.9	2.9	3.7	2.6	2.5	2.8	3.4
	Gty. Pty. drop from 1st expressed juice	1.0	1.7	2.3	2.9	2.4	2.1	1.8	1.9	1.4	2.2	1.6	2.0	2.1	1.6	1.3	1.9	2.2	1.7	1.2	2.1	2.0	1.6	1.5	1.8
	Weight per cent cane	97.6	96.6	103.5	101.4	104.3	102.0	102.6	99.9	98.0	107.4	107.7	108.0	105.3	103.5	102.9	101.4	98.0	107.0	106.7	108.0	100.4	104.3	102.3	102.4
ABSOLUTE JUICE	Brix (B_A)	17.87	17.44	17.99	16.99	17.69	17.86	17.32	17.66	16.74	16.68	16.96	17.19	17.97	17.70	17.32	16.82	17.12	16.63	17.02	16.75	16.94	17.36	16.94	17.28
	B_A/B_I	0.949	0.918	0.933	0.941	0.933	0.932	0.939	0.947	0.937	0.910	0.950	0.940	0.939	0.947	0.950	0.930	0.942	0.946	0.978	0.956	0.929	0.959	0.950	0.940
	Gravity Purity	87.5	85.9	86.0	87.4	87.7	85.2	87.0	86.8	88.2	86.3	86.4	87.5	88.8	88.4	89.6	89.8	87.0	88.1	87.1	88.2	85.5	89.6	88.8	87.6
CLARIFIED JUICE	Brix*	14.90	15.23	13.91	13.70	13.46	13.10	13.14	14.17	14.54	12.93	12.05	12.64	13.99	13.84	13.04	13.03	14.57	12.99	13.16	12.42	13.99	14.08	14.03	14.30
	Gravity Purity	—	87.3	87.1	88.2	88.7	86.4		87.4	88.7	88.5	87.8	89.9	89.5	89.0	—	92.5	87.8	-	88.2	89.2	89.6	90.3	89.9	88.7
	Reducing sugar/sucrose ratio	3.6	3.5	4.2	3.6	2.6	4.2	—	4.3	3.3	3.5	3.9	2.7	2.5	3.1	2.4	3.1	3.1	—	3.1	3.4	2.2	2.7	2.6	3.2

* *All Brix values are Refractometric*

Table XVIII. Summary of chemical control data 1968

(m) 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	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Felix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Pol. per cent	0.90	1.35	1.47	2.16	1.11	0.81	0.85	1.09	0.49	1.40	0.50	0.82	1.92	1.42	2.12	2.01	2.05	1.73	8.24	7.20	7.70	2.82	2.50	1.69
	Weight per cent cane	3.39	3.16	4.40	3.37	4.07	4.36	3.15	2.63	3.46	3.40	3.95	4.69	4.00	2.11	2.10	2.99	2.54	2.38	1.83	2.19	1.91	2.73	4.74	3.31
SYRUP	Brix*	58.3	59.4	59.2	57.6	56.7	61.8	60.6	58.3	60.0	55.1	59.6	65.2	63.2	60.2	66.2	62.9	60.1	58.9	55.4	50.4	58.0	58.7	63.6	59.5
	Gravity Purity	—	86.6	86.9	88.4	89.4	86.7		87.6	88.0	87.5	88.2	87.8	89.9	89.1	-	91.1	87.5	—	87.8	88.9	89.4	90.2	89.9	88.5
	Reducing sugar/sucrose ratio	3.7	4.1	4.2	3.7	3.0	4.3		4.5	3.1	3.7	3.3	2.7	2.6	3.2	2.4	2.8			2.8	3.7	2.5	2.8	2.8	3.3
pH VALUES	Limed juice	8.4	8.1	8.3	7.7	7.3	7.8		7.8	8.4	8.3	8.0	7.9	8.7	7.4	8.0	—	7.3		–	–	8.3	8.3	7.6	8.0
	Clarified juice	7.3	7.1	7.1	7.0	7.0	7.1	7.2	7.1	7.4	7.4	7.0	7.2	7.1	7.0	7.2	—	6.5	7.0	6.9	7.0	7.3	7.2	7.1	7.1
	Filter Press juice	—	—	9.3	—	6.9	8.0	7.0	7.1	9.1	7.2	—	8.7	7.0	6.8	6.5	—	—	6.5		—	6.7	8.5	7.0	7.5
	Syrup	—	—	7.0	6.5	6.7	6.7	6.8	6.7	7.0	6.9	7.1	6.9	6.7	6.5	6.9	—	5.3	6.6	—	6.9	7.0	7.0	7.0	6.7
FINAL MOLASSES	Brix**	89.7	87.7	90.2	85.9	90.2	90.4	90.3	86.5	89.1	89.8	85.8	88.0	88.1	90.7	89.8	86.6	88.2	89.8	88.5	86.7	84.0	86.7	87.6	88.6
	Sucrose per cent	35.3	33.9	31.8	30.5	35.2	34.5	35.0	32.9	35.0	34.8	33.1	33.4	33.1	34.0	34.1	33.6	37.2	36.2	33.0	33.7	33.5	33.7	35.3	34.0
	Reducing sugar per cent	16.8	13.9	17.5	14.8	12.3	14.7	15.6	16.4	14.6	15.5	14.3	11.0	14.6	13.8	14.0	15.8	11.5	12.4	13.7	14.1	11.3	13.7	13.0	14.4
	Total sugars per cent	52.1	47.8	49.3	45.3	47.5	49.2	50.6	49.3	49.6	50.3	47.4	44.4	47.7	47.8	48.1	49.4	48.7	48.6	46.7	47.8	44.8	47.4	48.3	48.4
	Gravity Purity	39.4	38.6	35.3	35.5	39.0	38.2	38.7	38.1	39.3	38.8	38.6	38.0	37.6	37.4	37.9	38.8	42.2	40.3	37.2	38.9	39.9	38.9	40.2	38.6
	Reducing sugar/sucrose ratio	47.5	41.1	54.9	48.5	35.0	42.4	44.7	49.7	41.7	44.4	43.2	33.1	44.2	40.6	41.1	47.0	31.0	34.2	41.5	41.7	33.6	40.5	36.9	42.4
	Weight per cent cane at 85 Brix	2.79	3.38	2.86	2.67	2.67	3.43	2.80	3.00	2.48	2.72	2.73	2.65	2.60	2.57	2.05	2.19	3.24	2.58	2.59	2.56	2.10	2.34	2.40	2.68
SUGAR MADE	White sugar recovered per cent cane	—	—	—	—	—	3.01	...	—	—	—	7.06		-	—	—	—	6.04	—	—	—	—	—	-	0.41
	Raw ,, ,, ,, ,, ,,	11.92	11.27	12.02	11.48	11.67	8.03	11.48	11.26	11.41	11.23	3.69	11.47	12.34	12.04	12.13	11.75	4.85	11.28	11.23	11.02	11.58	12.58	11.83	11.17
	Total ,, ,, ,, ,, ,,	11.92	11.27	12.02	11.48	11.67	11.04	11.48	11.26	11.41	11.23	10.75	11.47	12.34	12.04	12.13	11.75	10.89	11.28	11.23	11.02	11.58	12.58	11.83	11.58
	Average Pol. of sugars	98.641	98.309	98.698	98.855	98.648	99.000	98.715	98.721	98.571	98.729	99.198	98.775	98.657	98.792	98.863	98.633	99.265	98.725	98.732	98.317	98.754	98.737	98.709	98.710
	Total sucrose recovered per cent cane	11.75	11.08	11.86	11.35	11.51	10.93	11.34	11.12	11.25	11.09	10.67	11.33	12.17	11.89	11.99	11.59	10.82	11.14	11.10	10.84	11.43	12.43	11.68	11.43
	Moisture content of raw sugar per cent	0.32	0.39	0.33	0.33	0.33	0.37	0.33	0.35	0.34	0.36	0.40	0.31	0.30	0.25	0.31	0.37	0.22	0.36	0.34	0.33	0.36	0.39	0.32	0.33
	Dilution indicator	31.2	30.0	34.1	39.8	31.9	40.2	34.0	37.6	37.2	39.7	35.7	34.0	28.6	26.0	37.3	37.0	21.3	38.7	36.5	24.6	35.9	44.8	32.8	34.4

* *Refractometric Brix 1 : 5 w/w*
** ,, ,, *1 : 6 w/w*

Table XVIII. Summary of chemical control data 1968

(iv) MASSECUITES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau
MAGMA	Apparent Purity	81.3	85.8	87.7	85.0	90.8	82.7	82.3	83.8	89.1	81.1	82.6	90.8
A-MASSECUITE	Brix	90.4	91.7	91.3	92.1	90.2	91.1	92.6	91.6	93.0	92.3	90.0	91.9
	Apparent Purity	86.7	83.0	85.1	84.3	86.1	84.2	81.4	82.5	81.1	87.5	87.1	89.4
	,, ,, of A-Molasses	73.0	59.9	67.6	60.4	66.5	63.0	59.5	58.3	57.4	66.3	71.1	70.0
	Drop in Purity	13.7	23.1	17.5	23.9	19.6	21.2	21.9	24.2	23.7	21.2	16.0	19.4
	Crystal per cent Brix in massecuite	50.7	57.6	54.0	60.4	58.5	57.3	54.2	58.0	55.6	62.9	55.4	64.7
	Cubic feet per ton Brix in Mixed Juice	32.8	35.7	29.1	33.6	26.5	32.1	31.0	26.7	33.9	27.2	31.0	25.8
	A-Massecuite per cent total massecuite	57.8	74.6	61.1	80.6	61.1	58.7	59.5	58.2	82.7	56.1	48.0	54.6
B-MASSECUITE	Brix	91.4	—	90.8	—	91.5	93.4	91.9	92.7	—	92.8	90.9	93.0
	Apparent Purity	74.8	—	73.7	—	74.0	73.3	73.6	72.7	—	74.2	77.2	78.8
	,, ,, of B-Molasses	58.3	—	53.1	—	52.8	52.0	53.1	52.0	—	51.5	62.9	55.5
	Drop in Purity	16.5	—	20.6	—	21.2	21.3	20.5	20.7	—	22.7	14.3	23.3
	Crystal per cent Brix in massecuite	39.6	—	43.9	—	44.9	44.4	43.8	43.1	—	46.8	38.5	52.3
	Cubic feet per ton Brix in Mixed Juice	15.2	—	11.0	—	8.3	11.8	12.8	11.0	—	12.4	21.0	11.1
	B-Massecuite per cent total Massecuite	26.9	—	23.0	—	19.1	21.6	24.6	23.9	—	25.5	32.6	23.6
	Kg. Sugar per cubic foot of A & B Massecuite	16.9	22.3	20.3	24.3	23.3	17.8	18.7	21.1	24.5	20.3	15.2	22.1
C-MASSECUITE	Brix	93.4	92.6	93.5	93.9	94.9	95.7	93.7	94.3	95.8	94.8	93.7	94.5
	Apparent Purity	60.7	61.3	58.8	60.7	60.4	59.6	58.3	58.9	59.1	57.2	63.4	62.9
	,, ,, of final Molasses	35.5	35.9	31.8	34.0	36.4	35.6	38.3	33.8	34.7	34.7	34.8	34.9
	Drop in Purity	25.2	25.4	27.6	26.7	24.0	24.0	20.0	25.1	24.4	22.5	28.6	28.0
	Crystal per cent Brix in massecuite	39.1	39.6	40.1	40.5	37.7	37.3	32.4	37.9	37.4	34.5	43.9	43.1
	Cubic feet per ton Brix in Mixed Juice	8.7	12.5	7.6	8.1	8.6	10.8	8.3	8.0	7.1	8.9	12.5	14.5
	C-Massecuite per cent total massecuite	15.3	25.9	15.9	19.4	19.7	19.7	15.9	17.9	17.3	18.4	19.4	21.8
TOTAL	Cubic feet per ton Brix in Mixed juice	56.7	48.2	47.7	41.7	43.4	54.7	52.0	45.7	41.0	48.5	64.5	47.2
MASSECUITE	,, ,, ,, ,, sugar made	69.7	60.5	58.6	51.1	53.3	70.0	63.6	57.6	49.4	60.5	81.7	57.9

		Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Felix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MAGMA	Apparent Purity	87.2	95.2	86.5	84.1	—	85.6	84.9	87.6	86.0	84.8	84.5	85.9
A-MASSECUITE	Brix	91.7	92.2	93.0	91.6	89.6	90.5	91.6	91.8	90.2	90.9	91.5	91.6
	Apparent Purity	89.0	84.2	87.5	87.0	87.3	90.0	84.6	85.0	86.0	89.2	84.7	85.2
	,, ,, of A-Molasses	68.1	66.3	63.4	68.3	76.3	76.7	64.8	64.5	70.9	73.1	66.2	65.7
	Drop in Purity	20.9	17.9	24.1	18.7	11.0	13.3	19.8	20.5	15.1	16.1	18.5	19.5
	Crystal per cent Brix in massecuite	65.5	53.1	65.8	59.0	46.4	57.1	56.2	57.7	51.9	59.9	54.7	56.9
	Cubic feet per ton Brix in Mixed Juice	24.5	36.0	36.8	29.0	31.8	42.1	28.4	29.2	27.3	29.5	41.6	31.7
	A-Massecuite per cent total massecuite	53.7	63.2	73.5	62.3	48.7	59.3	55.5	60.6	64.1	60.7	76.6	63.3
B-MASSECUITE	Brix	92.9	92.7	93.1	91.9	90.9	92.0	91.2	92.8	91.1	91.8	92.0	92.0
	Apparent Purity	75.5	75.5	81.8	76.4	80.8	79.9	73.6	75.1	78.3	80.3	74.8	75.8
	,, ,, of B-Molasses	49.0	60.2	53.5	55.5	67.2	58.8	52.7	51.8	58.7	57.4	57.7	55.8
	Drop in Purity	26.5	15.3	28.3	20.9	13.6	21.1	20.9	23.3	19.6	22.9	17.1	20.0
	Crystal per cent Brix in massecuite	52.0	38.4	60.9	47.0	41.4	51.2	44.1	48.3	47.5	53.8	40.4	45.2
	Cubic feet per ton Brix in Mixed Juice	13.3	12.3	4.9	10.3	17.5	19.3	14.1	9.8	9.3	11.3	5.5	9.6
	B-Massecuite per cent total Massecuite	29.2	21.5	9.9	22.2	26.9	27.1	27.5	20.3	21.9	23.3	10.1	19.3
	Kg. Sugar per cubic foot of A & B Massecuite	21.8	17.0	20.4	21.5	15.8	13.2	18.8	20.9	22.7	20.7	18.7	19.7
C-MASSECUITE	Brix	94.0	96.8	93.5	93.1	94.6	95.2	93.6	93.7	93.7	94.2	97.1	94.5
	Apparent Purity	60.3	63.2	63.9	61.7	68.1	63.3	60.6	59.7	61.7	64.3	62.2	61.1
	,, ,, of final Molasses	34.9	34.1	34.3	34.2	39.3	37.7	32.4	38.9	37.7	34.0	37.1	35.5
	Drop in Purity	25.4	29.1	29.6	27.5	28.8	25.6	28.2	20.8	24.0	30.3	25.1	25.6
	Crystal per cent Brix in massecuite	39.0	44.2	45.1	41.8	47.5	41.1	41.7	34.0	38.5	45.9	39.9	39.1
	Cubic feet per ton Brix in Mixed Juice	7.8	8.7	8.3	7.2	15.9	9.7	8.7	9.2	6.0	7.8	7.2	8.7
	C-Massecuite per cent total massecuite	17.1	15.3	16.6	15.5	24.4	13.6	17.0	19.1	14.0	16.0	13.3	17.4
TOTAL	Cubic feet per ton Brix in Mixed juice	45.6	57.0	50.0	46.6	65.2	71.1	51.3	48.2	42.7	48.6	54.3	50.0
MASSECUITE	,, ,, ,, ,, sugar made	54.6	69.3	58.9	55.1	83.9	87.9	63.8	59.1	51.2	57.6	65.5	61.3

Table XVIII. Summary of chemical control data 1968

(v) MILLING WORK, SUCROSE LOSSES AND BALANCE ; RECOVERIES

		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
MILLING WORK	Imbibition water % cane	26.5	26.3	31.8	28.2	33.9	34.8	31.1	29.2	26.3	31.0	38.5	36.7	32.2	30.1	29.9	31.5	24.3	32.0	33.7	38.4	28.7	27.6	27.0	30.2
	,, ,, % fibre	193	187	223	208	228	228	225	194	197	261	266	261	245	234	233	243	184	260	250	264	215	241	224	224
	Extraction ratio	29.9	34.6	24.6	26.8	28.4	35.8	32.8	30.2	32.2	32.0	36.0	29.5	36.1	37.2	35.9	34.8	38.1	30.5	33.0	34.9	34.5	21.4	29.9	31.8
	Mill extraction	95.9	95.1	96.5	96.4	95.8	94.5	95.5	95.4	95.7	96.2	94.8	95.8	95.3	95.2	95.4	95.5	95.0	96.3	95.6	94.9	95.4	97.6	96.4	95.7
	Reduced mill extraction	96.3	95.8	97.0	96.7	96.6	95.7	96.0	96.3	96.0	96.0	95.6	96.4	95.5	95.4	95.5	95.7	95.3	96.2	95.9	95.8	95.7	97.3	96.2	96.1
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.56	0.63	0.46	0.47	0.56	0.70	0.59	0.59	0.55	0.48	0.65	0.54	0.66	0.66	0.62	0.60	0.65	0.48	0.57	0.64	0.60	0.34	0.48	0.57
	,, ,, in filter cake % cane	0.03	0.04	0.06	0.07	0.05	0.04	0.03	0.03	0.02	0.05	0.02	0.04	0.08	0.03	0.04	0.06	0.05	0.04	0.16	0.16	0.15	0.08	0.12	0.06
	,, ,, in molasses % cane	0.93	1.11	0.86	0.81	0.89	1.12	0.92	0.97	0.83	0.89	0.90	0.85	0.83	0.82	0.66	0.73	1.16	0.89	0.82	0.85	0.71	0.78	0.82	0.87
	Undetermined losses % cane	0.22	0.03	0.03	0.14	0.21	0.11	0.11	0.31	0.14	0.18	0.30	0.16	0.12	0.24	0.22	0.18	0.25	0.30	0.19	0.13	0.10	0.14	0.12	0.17
	Industrial losses % cane	1.18	1.18	0.95	1.02	1.15	1.27	1.06	1.31	0.99	1.12	1.22	1.05	1.03	1.09	0.92	0.97	1.46	1.23	1.17	1.14	0.96	1.00	1.06	1.10
	Total losses % cane	1.74	1.81	1.41	1.49	1.71	1.97	1.65	1.90	1.54	1.60	1.87	1.59	1.69	1.75	1.54	1.57	2.11	1.71	1.74	1.78	1.56	1.34	1.54	1.67
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	4.14	4.86	3.50	3.63	4.21	5.45	4.53	4.56	4.33	3.79	5.20	4.16	4.75	4.78	4.62	4.58	5.01	3.75	4.44	5.09	4.63	2.45	3.61	4.32
	,, ,, filter cake % sucrose in cane	0.22	0.33	0.49	0.57	0.34	0.27	0.21	0.22	0.13	0.37	0.16	0.30	0.56	0.22	0.33	0.45	0.41	0.32	1.18	1.26	1.13	0.56	0.90	0.43
	,, ,, molasses % sucrose in cane	6.92	8.60	6.46	6.29	6.75	8.64	7.11	7.46	6.46	7.05	7.18	6.62	6.00	5.99	4.89	5.51	8.96	6.89	6.40	6.71	5.46	5.64	6.21	6.71
	Undetermined losses % sucrose in cane	1.62	0.23	0.19	1.10	1.62	0.89	0.84	2.36	1.12	1.40	2.38	1.21	0.86	1.80	1.53	1.38	1.97	2.36	1.51	1.06	0.77	1.12	0.93	1.27
	Industrial losses % sucrose in cane	8.76	9.16	7.14	7.95	8.72	9.80	8.16	10.04	7.72	8.82	9.72	8.13	7.42	8.01	6.75	7.35	11.34	9.57	9.08	9.03	7.36	7.32	8.04	8.41
	Total losses % sucrose in cane	12.90	14.02	10.64	11.58	12.93	15.25	12.69	14.60	12.04	12.61	14.92	12.29	12.17	12.79	11.37	11.93	16.35	13.32	13.53	14.12	11.99	9.77	11.65	12.73
RECOVERIES	Boiling house recovery	90.9	90.4	92.6	91.8	90.9	89.6	91.5	89.5	91.9	90.8	89.7	91.5	92.2	91.6	92.9	92.3	88.1	90.1	90.5	90.5	92.3	92.5	91.7	91.2
	Reduced boiling house recovery (Pty.M.J.85°)	87.8	89.0	91.5	89.4	87.9	88.4	89.0	86.8	88.4	89.1	87.5	89.1	88.5	88.1	88.2	86.9	85.1	86.3	88.0	86.7	88.9	87.9	87.7	88.3
	Overall recovery	87.1	86.0	89.4	88.4	87.1	84.8	87.3	85.4	88.0	87.4	85.1	87.7	87.8	87.2	88.6	88.1	83.7	86.7	86.5	85.9	88.0	90.2	88.4	87.3
	Reduced overall recovery (Pty. M.J. 85°, F % C 12.5)	84.6	85.2	88.7	86.5	84.9	84.6	85.4	83.6	84.9	85.5	83.7	85.8	84.6	84.0	84.9	84.3	81.1	85.5	84.4	83.0	84.8	85.6	84.4	84.8
	Boiling house efficiency	98.9	99.4	100.5	98.7	98.7	98.6	99.6	97.5	99.2	99.6	98.5	99.2	98.8	98.4	98.9	98.2	97.7	97.7	98.0	97.5	99.8	98.9	99.0	98.9

Table XIX. Production and utilization of molasses, 1949 - 1968

Year	Product-ion M. tons	Exports M. tons	Used for product-ion of alcohol M. tons	Other domestic uses M. tons	Available as fertilizer M. tons	N.P.K. equivalent in molasses available as fertilizer M. tons		
						N	P_2O_5	K^2O
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	149,586	109,770	8,192	483	31,141	162	78	1,588
1964	113,781	96,830	7,172	446	9,333	46	23	476
1965	151,152	105,360	7,824	454	37,514	195	94	1,913
1966	133,262	118,556	6,653	484	7,569	39	20	386
1967	154,612	146,353	7,717	542	—	—	—	—
1968	132,462	125,496	6,400	566	—	—	—	—

Table XX. Importation of inorganic fertilizers, in metric tons, 1953 - 1968

YEAR	N	P_2O_5	K_2O
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
1964	10,095	5,698	8,838
1965	9,520	7,236	6,222
1966	8,070	4,596	7,515
1967	9,249	5,046	9,073
1968	9,092	5,946	8,033

Table XXI. Sales of herbicides, 1966 - 1968

HERBICIDES	1966			1967			1968		
	Quantity		acid equivalent lb	Quantity		acid equivalent lb	Quantity		acid equivalent lb
	Imperial gallons	Kg.		Imperial gallons	Kg.		Imperial gallons	Kg.	
MCPA	9,402		37,608	8,978		35,912	8,738		34,550
2,4-D amines	15,909		83,671	15,760	2,255	82,632	18,201		102,025
2,4-D esters	6,380		38,155	12,017		61,528	6,196		41,107
2,4-D and 2,4-5T esters	6,679		29,795	4,172		21,838	5.355		28,393
Pentachlorophenol	261		783	149		447	270		810
Sodium chlorate		261,774			270,055			292,159	
Sodium trichloroacetate (TCA)		314,625			318,819			284,728	
Sodium 2,2-dichloropro-prionate (Dalapon, Basfa-pon, Unipon)		931			608			1,281	
Substituted ureas (Herban, DCMU, Linuron)		53,611			50,200			47,214	
Substituted triazines (Simazine, Atrazine)		30,495			37,544			40,753	
Unclassified	1,359	874		1,143		2,537	793		

Table XXII. Importation of major herbicides, 1958 - 1968

YEAR	Inorganic chemicals		Hormone type		Aliphatic acids derivatives		Substituted phenols	Substituted ureas	Substituted triazines
	Sodium chlorate Kg.	Sodium arsenite Kg.	2,4-D; 2,4-5T; M C P A		T C A Kg.	Dalapon Kg.	P C P Imp. gall.	Linuron D.C.M.U. Herban Kg.	Simazine Atrazine Kg.
			Imp. gall.	Kg.					
1958	128,835	4,000	43,150	565	167,096	—	3,528	—	—
1959	173,383	—	60,261	72	264,389	—	1,534	—	—
1960	304,851	7,050	76,629	—	377,063	400	2,641	12,500	568
1961	214,301	6,000	59,272	—	363,716	9,553	1,403	30,000	1,812
1962	272,937	8,000	54,507	—	335,595	21,933	1,010	38,279	21,432
1963	276,502	—	45,825	—	339,981	5,070	969	39,915	29,210
1964	398,053	—	48,249	—	389,449	6,670	595	35,312	37,594
1965	272,823	—	45,330	—	309,746	2,261	100	38,922	42,643
1966	261,774	—	38,370	—	314,625	931	261	53,611	30,495
1967	270,055	5,186	36,755	2,255	318,819	608	149	50,200	37,544
1968	292,159	26,844	38,490	—	284,728	1,281	270	47,214	40,753

Table XXIII. List of combinations transplanted in 1969

(i) Early nobilisations of *S. spontaneum*, *S. robustum* and *S. sinense* potted singly

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations trans- planted	No. of non- germinated crosses
5848	Chalain	x	Mol.5843	1	1	4
4861	Korpi	x	Uba Marot	2	1	10
4831	M.26/20	x	B.39246	1	1	1
4614	M.2/33	x	57 N.G. 208	1	10	0
4065	Mapou Perlée	x	M.B. 1/64	1	2	1
4059	Mapou Perlée	x	M.C. 1214/66	1	2	1
4072	Mapou Perlée	x	*S. spont.* Mandalay	1	9	0
4069	Mapou Perlée	x	*S. spont.* Tabongo	2	3	0
4579	51 N.G. 56	x	57 N.G. 208	1	2	1
5889	51 N.G. 140	x	Korpi	2	49	0
5887	57 N.G. 208	x	Korpi	2	9	0
5919	Uba sdlg. Brown	x	John Bull	1	2	0
5917	Uba sdlg. No. 4	x	M.109/26	2	3	0
5343	Uba sdlg. No. 4	x	M.5/38	1	2	7
Total	14			19	96	25

(ii) Further nobilisations of *S. spontaneum*, *S. robustum* and *S. sinense* potted singly

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations trans- planted	No. of non- germinated crosses
5213	Co.213	x	D.109	1	10	1
5215	Co.213	x	John Bull	2	21	1
5218	Co.213	x	M.27/16	2	10	1
5901	Co.213	x	M.Q.27/1124	2	9	0
4684	Korpi	x	M.687/63	2	18	1
4895	M.26/20	x	M.614/63	1	9	2
4517	M.168/33	x	M.679/63	1	4	2
4485	M.409/51	x	58 B. 38	3	35	7
4362	M.351/57	x	58 B. 38	6	5	5
4843	Mapou Perlée	x	M.614/63	2	63	0
4953	Mignonne	x	M.614/63	4	52	2
4378	S.17	x	58 B. 38	2	2	2
Total	12			28	238	24

Table XXIII. List of combinations transplanted in 1969

(iii) (a) Combinations having produced more than 9 seedlings potted 3 seedlings/pot.

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations trans-planted	No. of non-germinated crosses
5199	B.3337	x	M.202/46	6	143	1
5361	B.3337	x	M.69/56	10	428	0
5421	Ebène 88/56	x	M.13/53	6	216	3
4811	M.109/26	x	Vesta	8	198	2
5027	M.305/51	x	M.84/57	9	619	1
5015	M.305/51	x	P.T.43-52	9	819	2
5160	M.305/51	x	R.47/4066	11	171	0
2357	M.409/51	x	B.3337	2	323	0
2334	M.409/51	x	Senneville	2	555	0
5828	M.85/53	x	P.T.43-52	10	351	0
4876	M.13/56	x	P.T.43-52	7	261	2
5902	M.13/56	x	R.47/4066	9	360	0
4661	M.351/57	x	Vesta	7	324	3
5192	M.Q.39/832	x	M.84/57	5	288	1
4019	N : Co.376	x	M.84/57	7	207	2
5583	Mixed*	x			25	
Total	15			108	5288	17

* *Include left overs from the 15 combinations transplanted.*

Table XXIII. List of combinations transplanted in 1969

(iii) (b) Combinations having produced more than 9 seedlings potted singly

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations Trans-planted	No. of non-germinated crosses
5222	B.3337	x	M.108/30	3	27	3
5071	B.3337	x	M.13/53	6	198	1
5351	B.3337	x	P.T.43-52	5	108	5
3455	B.3337	x	R.47/2777	2	106	0
2330	B.4362	x	Senneville	2	18	0
2557	B.34104	x	M.171/30	2	9	0
4136	C.B.38-22	x	B.34104	6	16	2
4125	C.B.38-22	x	M.202/46	5	243	3
4115	C.B.38-22	x	M.220/56	7	189	2
4145	C.B.38-22	x	M.84/57	7	180	2
4467	Co.527	x	P.T.43-52	1	18	7
3344	Co.975	x	Vesta	2	85	0
4650	Co.1186	x	M.220/56	5	36	1
4447	D.3745	x	M.13/53	2	22	8
4457	D.3745	x	P.T.43-52	7	207	1
5110	Ebène 1/37	x	M.13/53	3	287	5
1482	Ebène 1/37	x	M.69/56	4	646	4
5100	Ebène 1/37	x	M.84/57	6	131	2
2054	Ebène 5/40	x	Ebène 50/47	1	18	0
4333	F.150	x	P.T.43-52	3	36	5
3329	H.32-8560	x	R.47/4066	2	525	0
3329	H.32-8560	x	R.47/4066		125	
2336	H.50-7209	x	B.3337	1	32	1
4706	I.216	x	C.B.45-6	9	45	1
3327	M.33/19	x	R.47/4066	1	18	0
2058	M.134/32	x	John Bull	1	36	2
2049	M.134/32	x	M.29/16	1	16	0
2037	M.134/32	x	M.35/17	2	18	5
3152	M.134/32	x	M.72/31	2	32	1
5461	M.134/32	x	M.84/57	2	9	7
5282	M.93/48	x	C.B.41/35	3	45	3
5334	M.93/48	x	M.202/46	2	18	6
5144	M.93/48	x	M.13/53	7	72	3
5242	M.93/48	x	M.69/56	5	214	7
5134	M.93/48	x	M.84/57	5	90	5
5409	M.93/48	x	P.T.43-52	10	338	0
4717	M.99/48	x	F.149	6	17	4
5397	M.305/51	x	M.147/44	10	72	0
5059	M.305/51	x	M.12/49	5	23	3
5037	M.305/51	x	M.13/53	9	837	1
5047	M.305/51	x	M.69/56	10	933	0
4559	M.409/51	x	C.B.41-35	1	71	8
4919	M.409/51	x	M.12/49	3	72	6
5091	M.409/51	x	M.100/55	7	142	1
5801	M.85/53	x	N : Co.310	9	36	1
3191	M.13/54	x	M.213/40	1	18	0
2545	M.107/55	x	M.11/43	2	9	0

(iii) (b) Combinations having produced more than 9 seedlings potted singly

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations Trans-planted	No. of non-germinated crosses
5005	M.13/56	x	M.202/46	3	36	6
5382	M.13/56	x	M.69/56	4	27	5
4739	M.13/56	x	M.84/57	15	288	5
4739	M.13/56	x	M.84/57		60	
4759	M.351/57	x	M.55/55	7	376	0
5838	M.351/57	x	M.220/56	9	107	1
4105	M.351/57	x	M.84/57	6	90	3
4231	M.351/57	x	M.463/59	2	18	8
4185	N : Co.310	x	M.84/57	6	72	2
4767	N : Co.376	x	B.42231	6	45	3
5818	N : Co.376	x	C.P.48-103	6	43	4
4749	N : Co.376	x	M.13/53	3	79	6
4696	N : Co.376	x	M.55/55	7	114	1
4155	N : Co.382	x	B.34104	3	9	7
4165	N : Co.382	x	M.69/56	4	9	3
4175	N : Co.382	x	M.220/56	4	36	4
4500	N : Co.382	x	M.84/57		45	
4500	N : Co.382	x	M.84/57	7	72	0
4085	N : Co.382	x	Q.58	6	59	3
75	P.O.J.2364	x	Co.419	1	18	10
1403	P.O.J.2878	x	M.220/56	5	45	0
2292	P.O.J.2961	x	M.144/36	1	16	0
1411	P.O.J.2961	x	M.69/56	2	144	0
1143	P.O.J.2961	x	M.220/56	1	42	0
3119	P.R.1000	x	M.Q.27/1124	10	279	1
4604	Q.50	x	P.T.43-52	4	35	5
3351	Ragnar	x	M.147/44	5	14	6
4901	Ragnar	x	M.13/53	7	655	3
4789	Ragnar	x	M.69/56	5	140	2
3242	S.17	x	S.N.40-5819	1	45	1
4427	Sabre	x	M.69/56	3	9	3
5581	Mixed*	x			32	
5582	Mixed*	x			27	
Total		75		338	9529	208

*NOTE: * Include left-overs from the 75 combinations transplanted*

Table XXIII. List of combinations transplanted in 1969

(iii) (c) Combinations having produced less than 9 seedlings potted singly

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of locations trans-planted	No. of non-germinated crosses
3064	Co.527	x	M.69/56	3	5	5
4095	Co.1190	x	Q.58	3	7	6
3423	Ebène 1/37	x	M.5/38	1	1	1
5122	Ebène 3/48	x	C.B.45-6	5	6	3
5441	Ebène 88/56	x	B.34104	3	7	5
2062	Gros Genoux	x	B.34104	1	2	1
4911	H.44-101	x	R.47/4066	1	1	7
4729	H.32-8560	x	M.Q.27/1124	1	3	9
2063	M.134/32	x	M.13/18	1	6	0
5451	M.134/32	x	M.13/53	1	3	8
2055	M.112/34	x	Fotiogo	1	4	0
2498	M.36/35	x	R.P.6	2	8	0
2500	M.95/35	x	D.109	1	6	0
2452	M.129/43	x	B.3337	1	6	0
5312	M.93/48	x	B.34104	3	8	4
3192	M.142/49	x	M.213/40	1	2	0
3195	M.142/49	x	M.202/46	1	3	0
5172	M.305/51	x	C.B.45-6	2	4	8
5252	M.305/51	x	M.108/30	2	6	8
3267	M.381/51	x	P.T.43-52	1	8	7
4933	M.409/51	x	R.53/4132	1	1	6
2553	M.107/55	x	M.13/18	1	1	1
2065	Mignonne	x	B.34104	2	8	0
4321	M.Q.36/2717	x	P.T.43-52	4	4	6
1144	P.O.J.2940	x	M.220/56	1	1	8
4407	P.R.1000	x	M.13/53	1	1	9
1526	P.R.1000	x	M.438/59	1	5	1
4943	Q.44	x	M.84/57	2	6	8
4851	Q.44	x	R.47/4066	1	2	9
3057	Q.47	x	M.69/56	2	1	0
4632	Q.70	x	C.B.45-6	4	8	6
4280	S.17	x	M.213/40	2	3	9
3101	S.17	x	M.Q.27/1124	3	6	7
4437	Sabre	x	B.34104	1	5	7
5580	Mixed *	x		6	9	7
Total	35			67	157	156

*NOTE: * Replace one combination mixed completely with one cross of another combination.*

Table XXIV. List of Approved Cane Varieties, 1969

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.99/48
M.253/48
M.409/51
M.442/51
M.13/53
M.13/56
M.377/56
Ebène 1/37
Ebène 50/47
*B.H.10/12
**B.3337
**B.34104
B.37161
B.37172
N : Co. 376

* *To be uprooted before 31st December, 1969*

** *To be uprooted before 31st December, 1970*

*** *To be uprooted before 31st December, 1973*