MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE

ANNUAL REPORT 1969

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RESEARCH INSTITUTE

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CORRIGENDA

Mauritius Sugar Industry Research Institute

Annual Report 1968

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

NUTRITION AND SOILS

CLIMATE AND CULTIVATION

WEED CONTROL

FOOD CROPS

SUGAR MANUFACTURE

APPENDIX

STATISTICAL TABLES

* *Cover photograph : Potato cultivation in inter-rows of virgin canes.*

MEMBERS EXECUTIVE BOARD

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

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Mr. S. D. de R. de St. Antoine } *representing factory owners*

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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, *January to September*
Mr. F. North-Coombes, *September to December* } *representing the Société de Technologie Agricole et Sucrière*

and the senior staff of the Research Institute.

STAFF LIST (as at 31st December 1969)

Director	R. Antoine, B.Sc. (Lond.), A.R.C.S., Dip. Ag. Sci. (Cantab.)
Asst. Director & Chief Sug. Technologist ...	J. D. de R. de Saint Antoine, B.S. (L.S.U.), Dip. Agr. (Maur.)
Chemist	E. C. Vignes, M.Sc. (Lond.), F.R.I.C., Dip. Agr. (Maur.)
Associate Sugar Technologist ...	E. Piat, B.Sc. (Glasgow), Dip. Agr. (Maur.), resigned 30.6.69
Instrument Engineer	J. T. d'Espaignet, B.Sc. (Glasgow), A.R.C.S.T., Dip. Agr. (Maur.)
Senior Asst. Sug. Technologist ...	M. Randabel, Dip. Agr. (Maur.)
Assistant Sugar Technologist ...	
Laboratory Assistants	L. Le Guen
	M. Abel
Temporary Sugar Technologist ...	A. Bérenger, Dip. Agr. (Maur.)
Chief Agriculturist	G. Rouillard, Dip. Agr. (Maur.)
Associate Agriculturists ...	G. Mazery, Dip. Agr. (Maur.)
	M. Hardy, Dip. Agr. (Maur.), *i/c Réduit Expt. Stn & Irrigation.*
Senior Field Officers	F. Mayer, Dip. Agr. (Maur.)
	R. Ng Ying Sheung, Dip. Agr. (Maur.), *i/c Union Park Expt. Stn*
Field Officers	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.)
Technical Officer, Food Crops ...	R. Mamet, Dip. Agr. (Maur.), F.R.E.S.
Chemist	Y. Wong You Cheong, Ph.D. (Q.U.B.), A.R.I.C.
Senior Assistant Chemists ...	L. Ross, Dip. Agr. (Maur.)
	P. Y. Chan, B.Sc. (Lond.)
Assistant Chemist	L. C. Figon
Laboratory Assistants	C. Cavalot
	H. Maurice
Chief Entomologist	J. R. Williams, M.Sc. (Bristol), D.I.C., F.I. Biol.
Assistant Entomologist	M. A. Rajabalee
Plant Pathologist	C. Ricaud, Ph.D. (Lond.), D.I.C.
Laboratory Assistants	S. Sullivan
	P. Ferré

Biometrician	... J. A. Lalouette, Dip. Agr. (Maur.)
Plant Breeder	... L. P. Noël, Dip. Agr. (Maur.)
Geneticist	... H. R. Julien, B.Sc. (Reading)
Associate Plant Breeder ...	... P. R. Hermelin, Dip. Agr. (Maur.)
Field Assistant ...	... S. de Villecourt
Plant Physiologist ...	... C. Mongelard, M.Sc., Ph.D. (Lond.), D.I.C., M.I. Biol. resigned 30.11.69
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.
Asst. Draughtsman-Photographer	... J. Forget
Clerks	... Mrs. A. Baissac
	Mrs. M. T. Rae
	Mrs. J. R. Williams
	Miss P. Julien

THE MAURITIUS HERBARIUM

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

REPORT OF THE CHAIRMAN
EXECUTIVE BOARD 1969

THE changes on the Board for 1969 were the replacement of Messrs. J. G. Ducray, R. Googoolye and F. North Coombes by Messrs. H. Kœnig, S. Bunjun and S. D. de R. de Saint Antoine. Mr. B. D. Roy replaced for one Board meeting Mr. A. Mulder who was absent from Mauritius in September.

The Board held 10 meetings during the year.

ESTABLISHMENT

Two more members of the Staff resigned during 1969.

Mr. Eric Piat, Associate Sugar Technologist, took up employment in July with Médine and F.U.E.L. Sugar Estates as Technical Adviser.

Dr. Cyril Mongelard, Plant Physiologist, left for Hawaii in November and is now employed in the same capacity by the Experiment Station of the Hawaiian Sugar Planters' Association.

Mr. L. Ross is pursuing his studies leading to the Graduateship of the Royal Institute of Chemistry at the Medway and Maidstone College of Technology, England.

Mr. P. Y. Chan who obtained an FAO scholarship, left in September to follow a one-year post-graduate course in Soil Physics at Cambridge University.

The Board has much pleasure in congratulating Mr. E. C. Vignes who has been made a Fellow of the Royal Institute of Chemistry.

FINANCE

Ordinance No. 9 of 1953 governing the Research Institute was modified during the year so as to apply the statutory levy on sugar produced, instead of sugar exported, during the calendar year. The cess was therefore paid to the Institute by the Mauritius Sugar Syndicate and not by the Customs Department.

The result was an increase in revenue of about Rs. 110,000 for the year under review. At the same time, as the Institute's revenue, being payable on sugar exported, was always treated on a cash basis, the balance of the previous campaign, Rs. 367,447, and almost the total amount due on the present campaign, i.e. Rs. 2,275,000, were received during this financial year. Thus, the surplus of Rs. 319,344 shown in the 1969 accounts is misleading, and would normally, in spite of the fact that the cess was receivable on the whole of the sugar produced, have been a deficit if only the moneys received in respect of the 1969 crop had been taken into account. When it is realized that the 1969 crop produced 668,000 tons of sugar, which is the second highest in the history of Mauritius, it shows that the financial position from 1970 onwards will not be bright.

It follows, therefore, that the financial resources of the Institute are still grossly inadequate, and far from the reasonable percentage of the value of sugar produced which should be invested in research. Unless drastic measures are urgently taken to increase the statutory levy, it is difficult to conceive how research will continue to be able to help maintain efficiency in an industry which has to face a highly competitive market. It should be said once more that it is disheartening to realize that during the last few years the Institute has been unable to secure, or retain, in certain fields, the services of technicians of the right calibre. Such a state of things is bound to deteriorate further, unless the annual levy is raised to a level commensurate with the present needs of the Institute.

Government has agreed to finance for five years a food crop research division and, although experimentation on the cultivation of food crops in sugar cane interline and rotational cane land started two years ago, active steps are being taken to set up an independent division which will start to operate in January 1970. The research programme has been prepared, the staff is being recruited, and the building programme is under way.

AIME DE SORNAY SCHOLARSHIP

The scholarship was awarded in 1969 to Mr. K. F. Lam Chow Wing who came out fifth, with 74.4% of the marks, at the entrance examinations of the University of Mauritius held in May.

The 1968 scholar, Mr. Li Sui Fong, came out first at the first-year examination with 78.2% of the marks.

PERSONALIA

During 1969, the Institute had the honour of entertaining the Prime Minister, the Ministers for Finance, for Agriculture and Natural Resources, and for Health, who visited the various divisions and showed a keen interest in the work being carried out. The other distinguished visitors who were welcomed at the Research Institute are: The Ambassadors for France, for the Federal Republic of Germany, for the Malagasy Republic, and for Israel; Sir Norman Alexander, Adviser to the University of Mauritius and Lady Alexander; Dr. Albert Viton, of the FAO, Rome; Mr. J. Hunter, President, Louisiana State University, and Mr. Anson Lloyd, Chairman, South African Sugar Association. Professor Mangenot and M. P. Rœderer, of ORSTOM, came to discuss the preparation of a Flora of the Mascarene Islands. Also, two missions from Taïwan (one in April and the other in October), a French Aid Mission (in March) and two delegations from Cuba (in November and December) visited the Institute.

ACKNOWLEDGEMENTS

It is with a feeling of deep regret that I shall have to retire as a member of the Board in a near future.

Since I was appointed to serve as representative of the Mauritius Chamber of Agriculture in 1966, I have had during these four years the privilege and great honour to be Chairman of

the Executive Board. I wish to place on record my very sincere and deep appreciation of the most valuable assistance given to me by my colleagues past and present, on the Board, and of the loyal and friendly co-operation of every member of the Staff.

To our Director I should like to add, once again, a special word of gratitude for the remarkable work he has accomplished during the year.

Chairman

28th February, 1970

REVENUE AND EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1969

Running & Administrative Expenses ...	2,103,670.20	CESS ON SUGAR		
Herbarium Expenses	726.66	Produced in 1968 and Exported in 1969	367,446.78	
Interest Paid	90,069.13	Produced in 1969	2,275,000.—	
Leave and Missions Expenses ...	134,864.91			2,642,446.78
Depreciation	111,599.68			
Excess of Income over Expenditure ...	319,344.19	MISCELLANEOUS RECEIPTS ...		117,827.99
Rs.	2,760,274.77	Rs.		2,760,274.77

BALANCE SHEET

AS AT 31st DECEMBER, 1969

ACCUMULATED FUNDS	1,204,528.41	FIXED ASSETS (at cost less depreciation and amounts written off)		
REVENUE FUNDS	95,400.—	Land & Buildings ...	1,272,154.64	
AIMÉ DE SORNAY FOUNDATION ...	25,000.—	Equipment	26,844.51	
		Agricultural Machinery and Vehicles	45,372.—	
GOVERNMENT OF MAURITIUS (Purchase of Buildings)	63,859.75			1,344,371.15
		CURRENT ASSETS		
SUNDRY CREDITORS ...	—	Sundry Debtors	256,354.34	
BANK OVERDRAFT	262,417.54	Aimé de Sornay Foundation Account	25,000.—	
		Cash at Banks & in hand ...	25,480.21	
				306,834.55
Rs.	1,651,205.70	Rs.		1,651,205.70

(sd) JEAN ESPITALIER-NOEL } *Board Members*
(sd) A. MULDER
(sd) R. ANTOINE *Director*

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December 1969, 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 1969, 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,
27th February, 1970.

INTRODUCTION

THE 1969 SUGAR CROP

IN spite of the alarmingly low sucrose content of the cane at the beginning of the 1969 crop season, the weather that followed was such that sugar production would have been the highest ever had it not been for an appreciable reduction in acreage harvested compared to the record year, 1963. Prevailing climatic conditions during the growth and maturation periods are analysed hereunder.

A drought occurred during the first part of the vegetative season (November to February), the sum of monthly rainfall deficits being almost twice the normal value (14.2 inches against 7.8). The second part of the season (March to July), however, showed a deficit of only 7.2 inches, which is the normal value. The mean temperature for the second part of the vegetative season exceeded the normal figure by 0.9°C. and this resulted in very rapid cane growth, compensating the bad effects of the early drought. Data for the record year (1963), the year under review and the preceding year are given below :

Vegetative Period*

Crop Year	*I (Nov. - Feb.)* Cyclonic Winds (max. speed for one hour in miles)	*I* Air Temp. (mean °C)	*I* Sum of monthly rainfall deficits (inches)	*II (March - July)* Cyclonic Winds (max. speed for one hour in miles)	*II* Air Temp. (mean °C)	*II* Sum of monthly rainfall deficits (inches)
Normals	—	*25.0*	*7.8*		*23.5*	*7.2*
1963	—	24.6 (—0.4)	4.5	—	23.4 (—0.1)	9.4
1968	—	24.7 (—0.3)	8.0	*Monica in March (31 mph East)*	23.1 (—0.4)	8.5
1969	—	25.1 (+ 0.1)	14.2	—	24.4 (+ 0.9)	7.2

The crop started on the 15th of July, the canes having a very low sucrose content as a result of the high temperatures which had prevailed in May, June and July. However, sugar made % cane increased by a spectacular two units by the end of the harvest as a result of a drought in August, September and October. Data for the maturation period for the same years are as follows:

Maturation Period*

Crop Year	*I (May - July)* Air Temp. (mean minim. °C)	*I* Total Rainfall (inches)	*II (Aug. - Oct.)* Air Temp. (mean minim. °C)	*II* Total Rainfall (inches)
Normals	*18.1*	*16.5*	*17.6*	*9.9*
1963	18.1 (0.0)	15.6	16.7 (—0.9)	6.1
1968	17.5 (—0.6)	14.6	17.5 (—0.1)	9.1
1969	19.2 (+ 1.1)	15.8	18.3 (+ 0.7)	6.6

* Rainfall data are averages for the sugar plantations of the Island. Temperature records are for Plaisance Air port, a key station for this part of the Indian Ocean.

Wind velocities are measured in the five sugar sectors (W, N, E, S, and C)

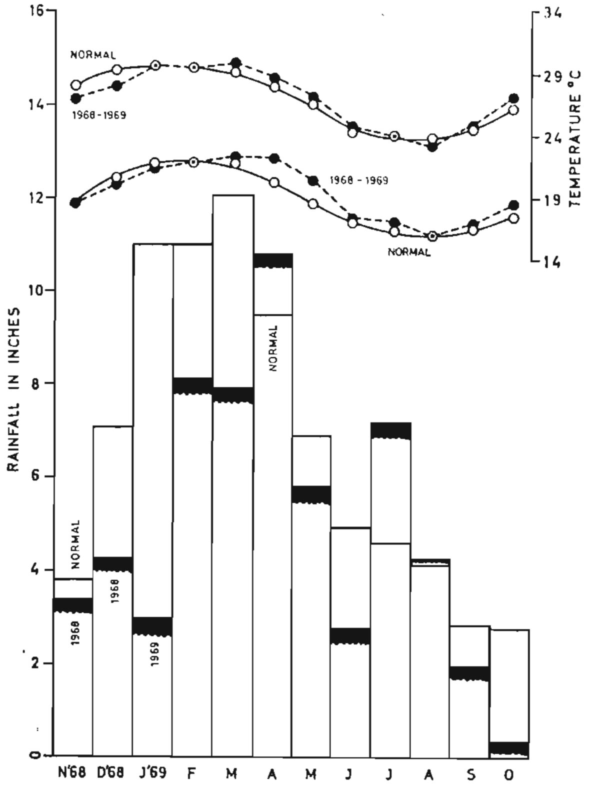

Fig. 1. Average rainfall, maximum and minimum temperatures over the cane area of Mauritius in 1969, compared to normal.

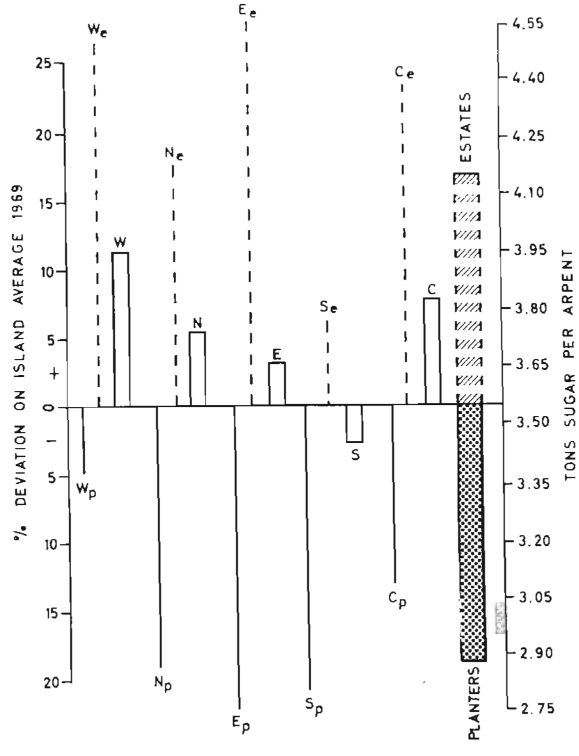

Fig. 2. Relative yields of sugar per arpent in different sectors. Average island yield 3.55 m. tons of 98.8 pol. sugar per arpent.
Plain line : planters; broken line : estates; columns : sector average.

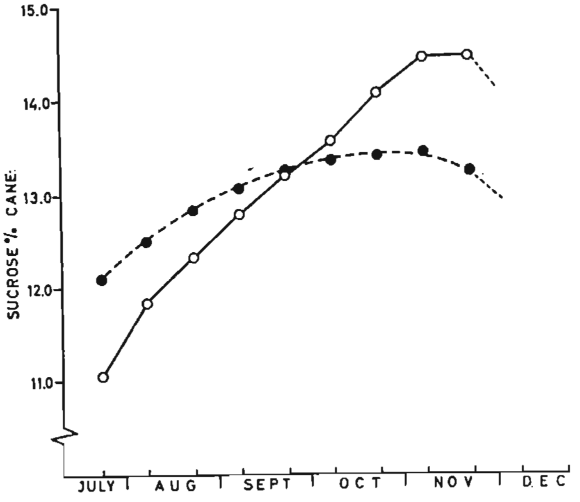

Fig. 3. Variation in sucrose % cane during the harvest season of 1969 (plain line) compared to the 1964-1968 average (broken line).

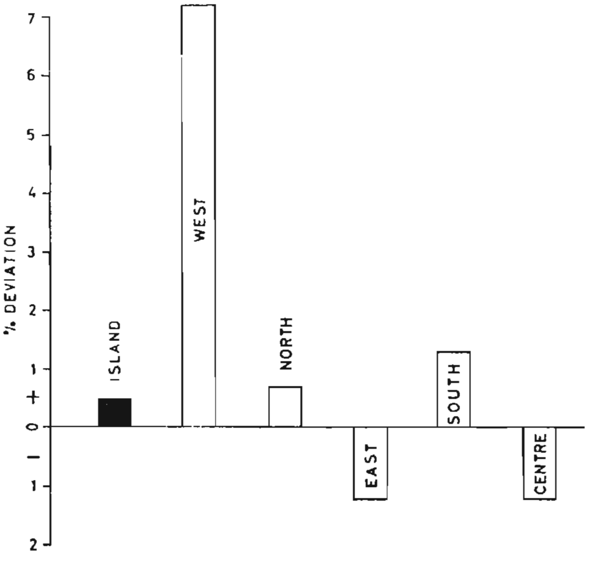

Fig. 4. Sugar manufactured % cane in 1969 for the various sectors, expressed as % deviations from the 1964-1968 averages.

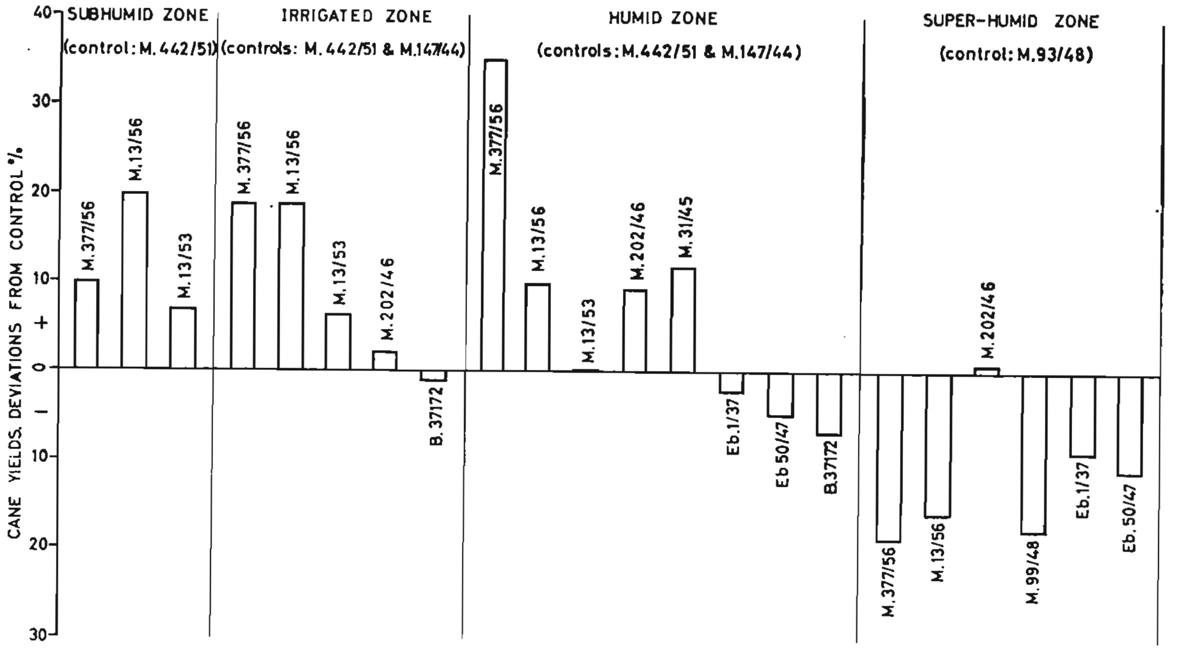

Fig. 5. Yields of cane varieties on estates in 1969, expressed as % deviation from standard varieties in the same categories in the four climatic zones.

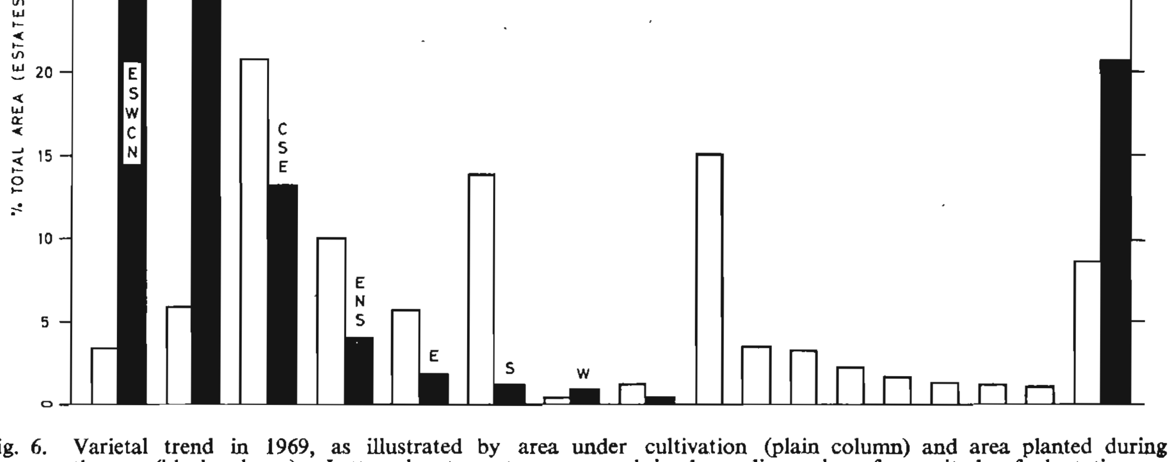

Fig. 6. Varietal trend in 1969, as illustrated by area under cultivation (plain column) and area planted during the year (black column). Letters denote sectors arranged in descending order of magnitude of plantations.

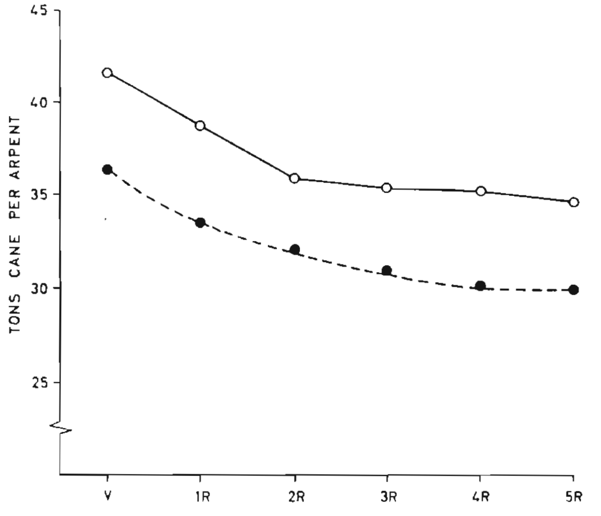

Fig. 7. Cane yields in virgins and ratoons in 1969 (plain line) compared to the 1964-1968 average (broken line).

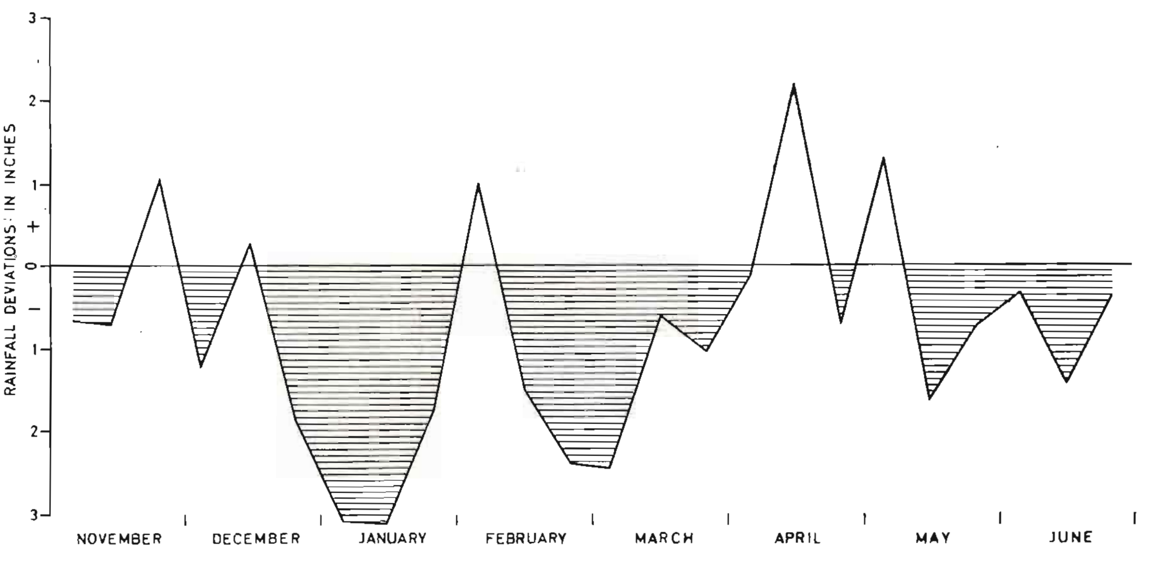

Fig. 8. Rainfall deficits (average for all sugar cane sectors) during the growing season, 1968-1969.

A comparison between sugar production at the beginning of the season and for the whole crop is given below :

Sugar production at the beginning and for the whole crop

Crop Year	*T.C.A.*		*Sugar made % cane*		*Sugar made/arpent (Tons)*		*Diff. in sugar made/arpent*
	1/8/69	*Final*	*1/8/69*	*Final*	*1/8/69*	*Final*	*(Final — 1/8/69)*
1963	30.6	29.6	10.4	11.9	3.18	3.52	+ 0.34
1968	28.4	27.2	10.7	11.6	3.04	3.16	+ 0.12
1969	30.6	30.9	9.5	11.5	2.91	3.55	+ 0.64

Sugar made per unit area was slightly better in 1969 than in 1963. However, the area harvested was 5,600 arpents less, and sugar production was 668,700 metric tons, second best to the record of 685,500 metric tons in 1963. The final production figures for 1963 and 1969 are as follows :

Final Sugar Production

Crop Year	*Area harvested (arpents × 1000)*	*T.C.A.*	*Sugar made % cane*	*Sugar made/arp. (Tons)*	*Profitable Sugar*	*Sugar made (m. tons × 1000)*
1963	194.1	29.6	11.9	3.52	2.34	685.5
1969	188.5	30.9	11.5	3.55	2.32	668.7

The more important data for the 1969, compared to the 1968, campaign are :

	*1969**	*1968*
Area cultivated, arpents	203,000	203,000
Area harvested :		
Estates	99,000	99,300
Planters	89,500	89,700
Total	188,500	189,000
Weight of canes, metric tons	5,824,243	5,152,240
Tons cane per arpent :		
Estates	36.1	31.2
Planters	25.2	22.8
Average, Island ...	30.9	27.2
Commercial sugar recovered % cane	11.48**	11.58***

	*1969**	*1968*
Tons sugar per arpent :		
Estates	4.14	3.61
Planters	2.89	2.64
Island	3.55	3.15
Duration of harvest, days	137	129
Sucrose % cane ...	13.01	13.10
Fibre % cane... ...	12.85	13.52
Tons sugar 98.8° pol, metric tons ...	668,700	596,579
Rainfall deficits Nov.-June (av. 15″)	21.6	16.5
Rainfall excesses July-Nov. (av. 2.5″)	2.7	2.1

Essential information concerning climatic factors, cane and sugar yields, sucrose content and varietal replacement is given in figs. 1-8.

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* Provisional figures.

** Equivalent to 8.7 tons of cane per ton of sugar.

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

CANE VARIETIES

An analysis of yields of estate-grown canes has confirmed the very good performance of the newly released varieties, M.377/56 and M.13/56 in the sub-humid, irrigated and humid zones (fig 5).

Results obtained from the Final Variety Trials of the 1966 series have shown that M.13/56 is the best early maturer, and that M.442/51 is a useful late maturer in localities receiving less than 100″ of rain annually; M.13/53 performs well only under irrigation, and M.93/48 is still unequalled in the super-humid zone, above 1000 feet.

In trials carried out in co-operation with Estate Agronomists, M.377/56 is confirmed as a very promising late maturer for all localities, except the upper part of the super-humid zone, where it should be propagated with caution until more information is available. The same series of trials have confirmed the hardiness of M.351/57; however, its low sugar content should limit its cultivation to the eroded slopes of the super-humid zone. M.356/53 has performed well as an early maturer in the super-humid zone and M.144/56 is also promising for the same locality. These two varieties are still under study.

Variety trials planted in 1965 were in 3rd ratoons in 1969. However, the majority of the 59 varieties planted in this series gave disappointing results in 1st and 2nd ratoons, and it was decided not to harvest in 3rd ratoons. The eight varieties which have shown some promise will be multiplied for re-testing.

Results in trials planted in 1966 are more interesting and will be reported fully next year. Data from one series of four trials over three years (virgin, 1st and 2nd ratoons) led to the decision to recommend variety S.17 for release in 1970.

An analysis of data collected in trials planted in 1963 was completed as a final assessment of the varieties concerned. M.351/57 emerged as a variety that can be recommended for release. However, the cultivation of this variety — it is stressed once more — should be restricted to the shallow soils of the eroded slopes of the super-humid zone, where M.93/48 performs rather poorly.

The replacement of variety M.147/44, highly susceptible to gummosis in the Northern Sector of the island, where it was extensively cultivated, is progressing satisfactorily as indicated by fig. 9 (a, b).

Detailed notes on the performance of varieties are given in the Cane Breeding Section of this report.

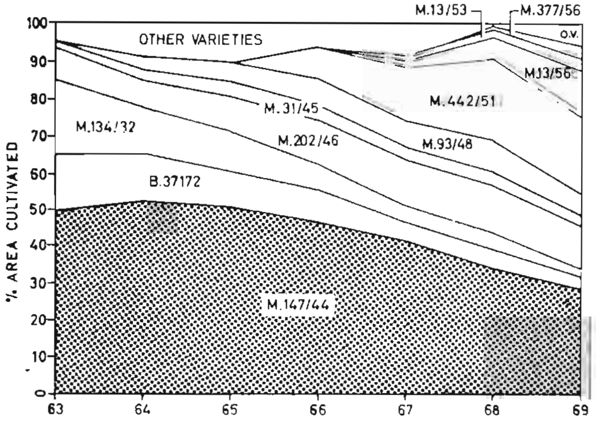


Fig. 9. (a) Varietal trend, 1963-1969, for the Northern Sector, expressed as % area cultivated (Estates).

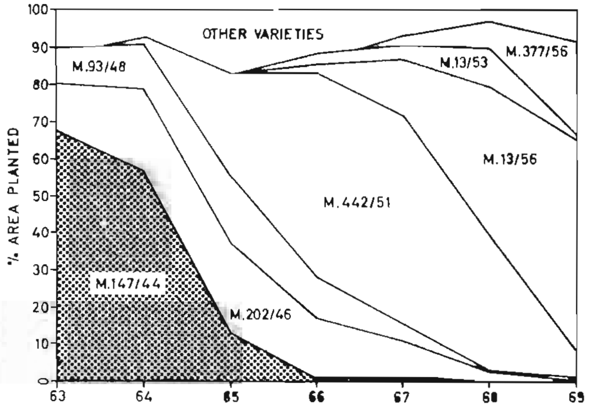


Fig. 9. (b) Varietal trend, 1963-1969, for the Northern Sector, expressed as % area planted (Estates).

CANE BREEDING AND SELECTION

The Biometry Section, created towards the end of 1966, evolved into a separate division at the beginning of 1969. The bulk of the work of the division is devoted to breeding and selection, but advice on various aspects of experimental design and analysis is given to all divisions, whenever required. The Food Crop Unit, working mainly on groundnuts and potatoes, took advantage of this service during the year under review.

An automatic verifier was received in September and immediately put into operation. The pressure of work having increased considerably during 1969, two extra junior technicians were appointed in December. Two stages in the selection process, Bunch Selection Plot and Variety Trial were re-examined during the year.

Flowering was average in 1969. A total of 726 crosses were made involving 140 combinations and 100 different parents, comprising 32 clones as males, 53 as females, and 15 as both males and females. Crosses for breeding purposes numbered 144.

Poor germination of fuzz, which had caused concern during the last two years, was found to be unrelated to the keeping quality of the preservative solution but resulted when inadequate time was allowed for ventilation of the soil after methyl bromide treatment. Germination was not impaired when the fuzz was sown eight days or more after treatment. This finding together with better control of the entire crossing work led to very good seed germination in 1969.

Selection work started, as usual, with the brixing of Bunch Selection Plots in the first days of July. It continued with selections effected in First Selection Trials in 1st ratoon and virgin stages, and ended with selections in Propagation Plots in 1st ratoons and finally in virgins. 24 varieties were selected and sent to Multiplication Plots for plantation of Variety Trials in 1970.

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

(a) Seedlings planted end February 1969 :
- (i) (1968 series) Commercial crosses 25,569
- (ii) Nobilization crosses 337

(b) Varieties in Bunch Selection Plots :
- (i) ratoons (1966 series) 6,014
- (ii) virgins (1967 series) 10,688

(c) Varieties in Propagation Plots : (1964 and 1966 series) 3,414

(d) Varieties in First Selection Trials : (1961-1964 series & foreign varieties) 463

(e) Varieties in Multiplication Plots : (1959-1962 series & foreign varieties) 26

(f) Varieties in Trials on Estates : 102

Investigations on the physiology of flowering. A knowledge of the basic mechanism controlling flowering in *Saccharum* species appears to be essential to regulate flowering in various clones. A number of experiments were laid down in 1969 to study aspects of the physiology of flowering in *S. spontaneum*. The main conclusions derived from them are :

(i) The daylengths required to promote flowering are different during the induction and developmental stages of the inflorescence primordium. In *S. spontaneum* var. Mandalay and 51N.G.2, an intermediate daylength of 12.5 hours is required during the 14 days preceding and following the first anatomical change in the apex marking the transition from the vegetative to the floral stage. During the initiation of inflorescence branch primordia, a short day of about 12 hours is required, while during the initiation of spikelet primordia and growth of the inflorescence, the critical daylength is 9 hours or less.

(ii) Inhibition of flowering by night interruptions with incandescent light is most effective in Mandalay and 51N.G.2 when the interruptions are during the initiation of inflorescence branch primordia. The fact that there is a short day requirement during this stage is therefore of significance. 2,400 f.c. minutes or more completely inhibits flowering in variety 51N.G.2 when given during this stage, whereas 1,400 f.c. minutes or less, retards and reduces flowering but is not completely inhibitory. Night interruptions with light of different wavelengths showed that Blue, Green, Red and Far Red are all inhibitory during the initiation of inflorescence branch primordia, but during subsequent stages Blue and Far Red have only a slight delaying effect, Green and Red being still highly inhibitory. Of these two colours, Red is slightly more inhibitory. For practical purposes, night interruptions with incandescent or green light given during the initiation of spikelet primordia are the most useful treatments for delaying flowering, up to six to eight weeks, with only a slight reduction in intensity of emergence.

(iii) Removal of the young leaves during the differentiation period prevents and delays flowering, particularly when defoliation is just prior to the initiation of inflorescence branch primordia. Removal of the young leaves during the initiation of spikelet primordia is less inhibitory but delays flowering for 4-5 weeks. Removal of the old leaves just prior to the initiation of spikelet primordia hastens flowering. Hence, it appears that the old leaves may produce inhibitors which influence the rate of initiation of spikelets.

These conclusions and their relation to current theories on the mechanism of flowering in sugar cane and in other plants are discussed in another section of this report.

CANE DISEASES

The incidence of cane diseases was influenced by a severe drought early in the growing season and another near the end of harvest. Leaf infection by gumming disease in plantations of susceptible varieties was at the beginning of the year the lowest since the epidemic outbreak of 1964 but it increased rapidly with late rains and, as a result of the second drought, systemic infection was frequent after harvest. A recrudescence of leaf scald was also observed after harvest.

The later drought period favoured cane deterioration caused by sour rot (rind disease), with a consequent drop in purity in several fields harvested late in the Northern Sector. It also caused several cases of top rot and rind disease in plant canes.

Eye spot reappeared in some fields of M.377/56.

Gumming disease. Four trials were carried out during the year. In the first-stage tests, five out of 100 varieties were rated as highly susceptible, 27 susceptible and 68 resistant. For the first time since testing at two stages of selection began, varieties that had previously been screened reached the second stage. After assessing the reaction of the 36 varieties in the three second-stage trials, and taking into consideration their behaviour at first-stage testing, three were rated highly susceptible, six susceptible and twenty-seven resistant.

Four new trials were set up for assessing resistance in 1970, and one for testing 720 seedlings from eight different crosses.

Ratoon stunting disease. The reactions of 13 newly released and promising varieties to this disease are being studied in three trials, two in the super-humid zone and one in the sub-humid. The effects of the disease were not evident in the two trials in the super-humid zone, but striking reductions in yield occurred in some of the varieties in the trial in the sub-humid zone, indicating that the disease may be severe in this region and emphasizing the damaging effects of the disease under drought conditions, even in plant canes. The most severely affected varieties were M.377/56, M.305/51 and M.442/51, yields of inoculated plants being 11.7%, 7.5% and 7.1%, respectively, lower than the control. In the highly susceptible variety M.134/32, reduction was only 6.7%.

As a result of difficulties encountered at the Central Nursery run by the Sugar Planters' Rehabilitation Fund Committee, the major one being the scale insect problem, steps are being taken by the Mauritius Sugar Producers' Association to set up regional A nurseries for supplying R.S.D.-free material to estates. Pending the implementation of this new scheme, 168 tons of cuttings were treated during the year in the small tank of the Research Institute for establishing nearly 40 arpents of nurseries with newly released varieties.

Yellow spot. The relative susceptibility of varieties coming from First Selection trials was assessed in an observation plot in the super-humid zone. Rows of the highly susceptible B.3337 served as a source of natural infection. Of 36 varieties tested, eight could be classed "highly resistant," seventeen "resistant to slightly susceptible", and eleven "susceptible to highly susceptible".

Preliminary experiments were made on fungicidal control of the disease using the systemic fungicide Benlate. In a large field trial, the efficacy of one, two and three sprayings was tested at three concentrations. The fungicide was found effective, especially at the two higher concentrations, 4 and 6 oz. a.i./100 gallons/arpent, but protection did not last more than 6-7 weeks. Further experimentation, particularly on timing of the applications and on assessment of costs, is contemplated.

Chlorotic streak. Field trials are in progress on the influence of cultural practices on the rate of infection of plants grown from treated cuttings. Application of scums and/or molasses, as compared to inorganic fertilizers was apparently associated with greater incidence of disease. The validity of this finding is being tested in a new experiment, and if confirmed, may indicate the nature of the causal agent or its vector.

A trial was set up in the super-humid zone to compare the effect of ridge v/s furrow planting on rate of reinfection and development of disease.

Efforts are continuing to elucidate the nature of the causal agent of the disease and its vector. Diseased material was sent to Dr. I. Mac Farlane of Rothamsted Experiment Station, United Kingdom, for electron microscope investigations.

Leaf scald. A resistance trial was set up with several important foreign and local varieties to compare their reactions in Mauritius to those in other countries, in an attempt to clarify the problem of strain variation of the causal bacterium.

Quarantine and exchange of varieties. To assist the national effort for increased production of food crops, the new cane quarantine cycle which was due to start in 1968 was postponed for one year and the quarantine greenhouse used for the introduction of 23 new varieties of rice. Funds and technical assistance normally available for cane quarantine, which is run by the Institute, were diverted towards this project.

A new cane quarantine cycle was started in September with 28 varieties imported from ten countries.

Forty-two varieties were shipped during the year to the following countries : Ceylon (4); Indonesia (4) ; Kenya, E A A F R O, (19) ; Réunion (13) ; United States, Beltsville, (2).

CANE PESTS

Most work on cane pests during the year was devoted to the introduction of parasites and predators of the scale insect and of moth-borers in an effort to increase the existing degree of natural control of these insects.

Three species were introduced from East Africa against the scale insect, *Aulacaspis tegalensis*, all being obtained through the Uganda Station of the Commonwealth Institute of Biological Control, which has for some time been investigating the ecology of the scale insect in East Africa at the request of the M.S.I.R.I. Two of the species were Coccinellid predators, *Chilocorus discoideus* and *C. distigma*, and about 6700 adults of the former and 1500 of the latter were imported and released directly in the field between January and July. Both species were observed to be breeding in the field after their release, but they disappeared later in the year when the fields in which they were present were cut. It is hoped that they will survive the summer months when the scale insect is scarce. Proof of their establishment will be their reappearance in 1970. The third species was a minute Hymenopterous parasite, *Physcus* sp., which from June onwards was cultured in the insectary. Difficulties in breeding the parasite were encountered at first but eventually overcome, and from November onwards large numbers were regularly released.

Reelases were continuing at the end of the year. Evidence that the parasite is reproducing in the field was also obtained and the chances of its becoming established seem good.

A pupal parasite of moth-borers was also introduced from East Africa through the Commonwealth Institute of Biological Control. It is *Pediobius furvum*, which may prove useful against the spotted borer (*Chilo sacchariphagus*) and pink borer (*Sesamia calamistis*). Some 250,000 were bred in the insectary and released in ten different localities between January and May. No attempt was made during the year to determine if the insect had become established : this will involve the particularly difficult task of collecting borer pupae in the field.

Work with *Pediobius* necessitated the collecting of thousands of pink borers and then retaining them until they transformed to pupae. This, incidentally, provided data on the frequency of parasitism by *Apanteles sesamiae*, that tend to support the belief that the importance of the pink borer has diminished since the parasite became widespread following its introduction from Kenya in 1952. Thus, 60% of all pink borers collected proved to be parasitized and, of course, died as a result. Such mortality hindered laboratory breeding of *Pediobius* but was nevertheless welcome as proof of a successful introduction.

Trichospilus diatraeae, a parasite introduced from India in 1963-64, was recovered from a pupa of the spotted borer for the first time in April. After such a lapse of time it can be assumed that it is firmly established but, as it is a pupal parasite, it will be difficult to ascertain the extent of its beneficial action.

A study on the importance and control of rats in cane fields was started. Appreciable sums of money are spent annually on rat control and although the measures employed, as recommended by the M.S.I.R.I., are basically sound, they are derived from experience abroad and it is desirable to supplement this by local observations and experimentation.

NUTRITION AND SOILS

The general nutrient status of estate canes in 1969 was very satisfactory. Leaf sampling for foliar diagnosis was carried out under optimum conditions and it is encouraging to note that there was no serious nutritional stress despite the widely different soils and climates in Mauritius.

Nitrogen. As there is a tendency to apply nitrogen in liberal amounts, deficiency of nitrogen in permanent sampling units is now uncommon, except on gravelly soils in dry areas where deficiency results from lack of water and is therefore temporary.

Nitrogen deficiency in canes has also resulted from water-logging in the hydromorphic soils of some permanent sampling units and can be corrected by proper drainage.

The two nitrogen fertilizers now being tested (urea-formaldehyde and calcium ammonium nitrate) have proved to be useful sources of nitrogen. Results of field experimentation conducted over three years have shown that urea-formaldehyde is equal to sulphate of ammonia in efficacy. In virgin canes, calcium ammonium nitrate has been found to be as good as sulphate of ammonia.

Phosphorus. The continued application of adequate amounts of guano phosphate in the furrow at planting has raised soil phosphorus reserves to satisfactory levels. Foliar diagnosis has pointed out only isolated cases of phosphorus deficiency.

Many estates have stopped applying phosphate in ratoons because no response is obtained after application of adequate amounts at planting.

Potassium. Estates are now using potassium in greater amounts with generally beneficial results.

Potassium uptake by sugar cane in Mauritian soils presents no problem, except in the Dark Magnesium Clays of the western region where the element is fixed by montmorillonite. Apart from the application of gypsum, there is, as yet, no simple way of counteracting this fixation.

Silicon. The better yields in virgin cane in 1968 after application of silicon were also evident this year in first ratoons. Although the increases were less than those in the virgin cane, they confirmed that applications of calcium silicate in low-silicon soils would greatly increase yields.

A series of trials were laid down in order to compare the efficacy of a single dose of calcium silicate at planting against smaller annual applications.

The help of Estate Agronomists is acknowledged for the setting up of additional calcium silicate trials on a semi-industrial scale.

Calcium silicate from several sources is now available on the market at a much lower price than in 1968.

Foliar diagnosis. Favourable weather conditions during the sampling period enabled the full programme of foliar diagnosis to be carried out.

As a result of the greater attention now being paid by Estate Agronomists and Chemists to correct leaf sampling procedure, many of the discrepancies previously observed no longer occur.

Soil Physics. Infiltration rates of water in the Low Humic Latosols and the Latosolic Reddish Prairies were measured.

Soil Analysis. Chemists from 15 estates worked in the Chemistry laboratories and carried out 4,981 analyses of pH, and available phosphate and silicon.

WEED CONTROL

Evaluation of new herbicides. Two logarithmic trials were laid down, one in November, 1968, and the other in April, 1969, at Belle Rive Experimental Station. In the November trial, three herbicides, namely C15935, Daxtron and R.P. 17623, were tested in pre-emergence of both canes and weeds at dosage rates ranging from 5lb a.i. to 1.25lb a.i. / arpent. Weed assessment and cane measurement were made 86 days after planting. Daxtron caused much toxicity to cane at rates above 2 lb a.i./arpent and C15935 produced severe leaf chlorosis at high dosage rates. R.P. 17623 did not affect cane growth and good weed control was obtained at rates higher than 2lb a.i./arpent.

In the April trial, the herbicides used included : Igran 50, Saminol 1089, GS 14254, GS 13529, GS 14259, R.P. 17623, C 15935, Lasso and PP 493, and DCMU as control. The dosage rates were the same as those mentioned above. This experiment lasted 111 days. R.P. 17623, GS 14254 and GS 14259 compared favourably to DCMU, whilst Lasso and PP 493 were disappointing. The other herbicides need further testing.

Pre-emergence trials in plant canes. Two experiments were laid down, one in the humid and the other in the super-humid zones. In the humid zone, eight herbicides at various dosage rates were compared to Atrazine at 4lb a.i./arpent. Four months after planting (variety M.377/56), R.P. 17623 was by far the best chemical giving spectacular control of all weeds except *Cyperus rotundus*. Complete control of noxious weeds, such as the *Oxalis* spp., was obtained with this chemical at 3 and 4 lb a.i./arpent.

In the super-humid zone the same herbicides were compared to DCMU at 4lb a.i./arpent and the cane variety was M.202/46. The experiment lasted only 74 days owing to high rainfall (39 inches) in the final six weeks. C 15935 and Planavin at 4 lb a.i./arpent affected germination and cane growth, while the toxicity of Daxtron was so high that it is not to be considered further as a herbicide for sugar cane plantations. R.P. 17623, DCMU, C 15935 at 4 lb a.i./arpent gave good results, as did a mixture of DCMU + Sinbar (2 + ¾) lb, but the latter chemical affected cane growth.

Pre-emergence trials in ratoon canes. Two experiments were laid down, one in the humid zone where 15 herbicidal treatments were compared to Atrazine at 4lb a.i./arpent, and the other in the super-humid zone where the same treatments were compared to DCMU at 3lb a.i./arpent.

In the humid zone, the best results were obtained with R.P. 17623, Atrazine and C 6313. No ill-effect on the canes (variety M.147/44) was noted.

In the super-humid zone, R.P. 17623 and mixtures of R.P. 17623 + DCMU gave promising results, but R.P. 17623 caused leaf burn of the young ratoon shoots still standing after harvest.

Post-emergence trials in plant canes. *Humid zone.* Several herbicides, alone or in combination with Actril-D, were applied in post-emergence seven weeks after planting and were compared to a pre-emergence application of Atrazine at 4lb a.i./arpent a few days after planting. All the herbicides in mixture with Actril-D gave satisfactory results and were far better than the pre-emergence treatment of Atrazine, even 3½ months after planting.

Super-humid zone. The experiment described above was also laid down in the super-humid zone with a pre-emergence application of DCMU at 4lb a.i./arpent just after planting as control. The results showed that adequate weed control was obtained with a mixture of Actril-D and a reduced dosage rate of a long residual herbicide. The use of such a mixture seems to be more profitable in the winter months and during the dry season when weed growth is slow.

Post-emergence trials in ratoon canes. *Humid zone.* No data could be obtained, the experimental plots having been accidentally hand-weeded prior to post-emergence spraying.

Super-humid zone. The results obtained in plant canes were confirmed ; mixtures of Actril-D with a long residual herbicide, particularly Diuron, gave good weed control without affecting the canes (variety M.351/57). Severe scorching effects on the crop were again noted with C 6989 and R.P. 17623, confirming that their use is not advisable on standing canes.

In field practice three varieties, M.377/56, S.17 and M.99/48, in the young stages of growth have shown some susceptibility to the use of mixtures of a long residual herbicide with Actril-D applied in post-emergence.

In conclusion, it can be said that a pre-emergence treatment of cane fields is to be preferred to a post-emergence treatment, because the latter, although more economic, is not always practicable on a large scale.

Post-emergence spraying should be carried out when weed growth is at a fairly early stage. This practice cannot be contemplated for a whole estate as a large proportion of the cane fields may become highly infested with weeds if favourable climatic conditions prevail.

It is advisable to experiment with post-emergence spraying on a fairly small scale and on as many varieties as possible, in order to obtain the maximum information before valid conclusions can be drawn.

FIELD EXPERIMENTATION

The usual programme of field experiments covering the various activities of the Institute was pursued during the year. It included variety testing, fertilization, cultural operations, use of herbicides, control of pests and diseases, and trials on food crops.

Work on breeding and selection of cane varieties was carried out on the stations and on land graciously made available to the Institute by estates.

A total of 159 sugar cane field trials were harvested by the Institute, and 37 by Estate Agronomists. Twenty six new trials were planted in 1969. In addition, eight variety trials were carried out on groundnuts, and ten on potato in full stand.

A summary of field trials conducted during the year is tabulated here :

Variety	*Estates*	*Stations*
Variety trials ...	34	—
Final variety trials ...	23	—
Special trials (with Estate Agronomists) ...	49	—
Ratooning capacity ...	—	4
Fertilization and amendments		
Nitrogen	10	—
Phosphate	7	—
Potassium, calcium and magnesium ...	2	—
Basalt	3	—
Methods of fertilizer application	2	—
Calcium silicate ...	20	1
Organic & mineral fertilization	4	—
Permanent fertilizer demonstration plots ...	4	—

	Estates	Stations
Cultural practices		
Spacing	10	—
Burning	3	—
Method of planting ...	4	—
Selective harvesting ...	5	—
Food Crops		
Groundnuts, variety trials	8	—
Potatoes, variety trials ...	9	1
Maize in cane interlines ...	12	—
Diseases		
Gumming	7	2
Leaf scald	—	2
Chlorotic steak ...	1	2
Ratoon stunting ...	—	4
Yellow spot	2	3
Inflorescence rot ...	1	—
Plant physiology		
DA5	4	—
Flowering of Sugar cane ...	—	6
Herbicides	16	2
Total ...	240	27

Cane yield results in spacing experiments with interrows 3,4,5 and 6 feet wide respectively, were slightly in favour of interrows of 4 feet. Lowest yields were obtained at 6 feet spacing, irrespective of variety and climate. Sucrose content as expected was not affected. A new series of experiments, including various combinations, will be laid down in an attempt to determine a cane spacing which will accommodate an intercrop, at least in one interline out of two, without affecting sugar yield.

The self-loading device designed and tested in 1955 at the M.S.I.R.I., although now generally adopted for the transport of sugar cane in Mauritius, presents some mechanical defects. A new self-loading and tipping device for the haulage of sugar cane and other material has been developed, so that the strain on the winch and other parts of the vehicle is reduced to a minimum, with the result that it is possible to use the self-loading device for much heavier loads, while reducing considerably the wear and tear of the vehicle. The prototype hauled quite satisfactorily a total of about 4,000 tons of canes during the 1969 crop.

Experiments were carried out with a ripening agent, coded as DA5, at four sites during the year. The varieties included in the experiments were M.93/48, M.442/51, and M.351/57. Results, which were encouraging, have indicated possible interactions between variety, time of application, and rate of application.

Experiments on evapotranspiration were continued in 1969 but, due to a severe drought, water was not available for adequate irrigation of the experimental plot throughout the year. The trial had to be concluded at the end of the previous crop and therefore covers one plant and three ratoon crops. The results appear elsewhere in this report. During the grand period of growth which extends from November to May, evapotranspiration varied between 7 and 5 inches per month (mean of the four years). An interesting feature is that by maintaining a proper water regime at Palmyre (7/8 atm. tension) cane yields of over 60 tons per acre were obtained throughout the trial period, sugar yields fluctuating around 6 tons/acre.

Close contact was maintained, as usual, between the Institute, estates, and planters, visits made by members of the staff numbering well over 1000. The valuable assistance received from Estate Agronomists, whose services are now available to 13 estates, and the close co-operation received from estates are, once more, gratefully acknowledged.

FOOD CROPS

A financial contribution from the Sugar Millers, the same as in 1968, has allowed the Institute to experiment for the second year running, on cultivation of food crops in sugar cane lands. The aim is production of food crops by intensive inter- and alternate-cropping with sugar cane without affecting sugar production. As a result of discussions between Government and the Institute, a Food Crop Division will be formed as an integral part of the M.S.I.R.I. in 1970, with the financial assistance of Government and the private sector.

Potatoes. Two series of trials were carried out in May and August in order to assess the performance of several varieties under different environmental conditions, and also to select one or two varieties to be used as controls in future experiments. The following varieties were tested : King George, Up-to-Date, Cedara, B.P.1., Van der Plank, Maris Peer (all kindly supplied by the South African Potato Board, through the Mauritius Marketing Board), Delaware (from Australia) and Noorin No. 1, Wheeler and Unzen (from Japan). Results have shown that Up-to-Date outyielded all other varieties in all localities.

No results were obtained in two series of trials established in March in the humid zone. One was accidentally damaged by herbicides and the other suffered a severe attack of bacterial wilt. However, in the latter trial, there are indications that variety Unzen may show some tolerance to the disease.

Groundnuts. Preliminary conclusions from results of trials conducted in late 1968 – early 1969, with nine varieties of groundnuts in the four climatic zones of the island are the following :

(*a*) *Varieties for oil production.* Manipintar, SA156 and B_1, are superior under all climatic conditions to the local variety "Cabri" as well as to the other varieties under test. However B_1 should not be cultivated on account of its high susceptibility to bacterial wilt and *Cercospora* leaf spot.

(*b*) *Large-seeded "table" varieties.* Among the varieties tested, Virginia Bunch, Florigiant and Beit Dagan, appear to be better yielders than NC_2. Beit Dagan seems to be more adapted to the humid zone, whereas Virginia Bunch and Florigiant can be grown under all climatic conditions, but more particularly in the sub-humid and humid zones.

(*c*) *Small-seeded varieties.* Varieties such as the local "Cabri" and Natal Common would perhaps be suitable for confectionery. Their oil content is rather low. It should be noted that "Cabri", which has been grown for many years in Mauritius, produces a tasty nut, shows some tolerence to bacterial wilt and readily finds a market locally.

Maize. Results from experiments on the intercropping of sugar cane and maize have shown that cane yields are reduced to an extent that is not compensated by the value of the maize crop reaped.

SUGAR MANUFACTURE

The activities of the Sugar Technology Division were handicapped in 1969 owing to shortage of staff. The post left vacant by the resignation in October 1968 of Mr. F. Le Guen, was filled only in March 1969 with the appointment of Mr. J. Tursan d'Espaignet. Mr. Eric Piat, Associate Sugar Technologist, resigned in July and his post remained vacant throughout the crop and up to the end of the year. The Chief Sugar Technologist, Mr. J.D. de R. de Saint Antoine, had to devote part of his time to administrative matters in his capacity of Assistant Director.

Raw sugar filterability. Raw sugar filterability in 1969, as measured by the CSR test on the affined samples, was excellent, averaging ten points more than in both 1968 and 1967 when the same average figure was recorded. This praiseworthy achievement resulted from the sustained effort of the industry during the recent years to produce good filtering sugars by adopting a number of measures that have been fully discussed in previous reports. Although the favourable weather and the quality of the juice processed in 1969 may have made things easier, yet the adoption of saccharate liming in several factories has without doubt contributed appreciably to better clarification and the production of better filtering raws.

Starch content of raws. For those refineries using the carbonatation process, starch is one of the most undesirable non-sugars in the raws. Hence many refiners are of opinion that the starch content of good raws should not exceed 150-200 p.p.m. In Mauritius, the enzymatic process of starch removal, using the natural juice enzymes, has been adopted by most factories with excellent results, elimination of about eighty per cent being obtained under the best conditions.

As from the 1970 crop, all the factories will have adopted the enzymatic process. Simultaneously a bonus/penalty system based on starch content and on CSR filterability index will be operative, and any factory producing raws below standard will be penalized. Although the enzymatic process of starch removal, using natural enzymes, works well under Mauritian conditions, as pointed out above, it was felt that an alternative method should be made available wherever it is not possible, for some reason or other, to eliminate sufficient starch from the juice in order to avoid the penalty. With this end in view, experiments were carried out with a bacterial amylase received just prior to the end of the campaign. The results obtained are presented and discussed in the Sugar Technology section of this report, and from these it will be observed that under certain conditions fairly high percentage elimination of starch may be obtained with the bacterial amylase used.

Sucrose losses in milling tandems. Most of the methods used for measuring the efficiency of mill sanitation are either unreliable, or industrially impracticable. During the 1968 crop, an attempt was made to investigate the possibility of using some other yardstick to estimate sucrose losses during milling. It will be recalled that the determination of the increase in dextran from first expressed to mixed juice was envisaged as a simple means of measuring the major part of sucrose losses in the milling train. As pointed out in the Annual Report for 1968, it was only at the very end of the crop that it was possible to obtain results under industrial conditions. It was therefore decided to study the problem further and investigations were resumed during the 1969 crop.

In the first place it was necessary to ascertain whether an increase in the dextran % Brix figures occurred in the juices expressed at each successive unit of the mill tandem when the mills were clean and could be assumed free of micro-organisms. To this end, experiments were carried out in two factories. The tests were made during the first 15-20 minutes of crushing when the factories resumed work after the week-end shutdown. The mill tandems had been thoroughly cleaned and could be considered free from micro-organisms. Juice from each mill was sampled and dextran % Brix determined. In every case a substantial increase was obtained in the juices sampled from the first to the last mill of the tandem. A typical case is illustrated in fig. 10. The dextran % Brix figures obtained for the different mill units were found to be respectively 0.021, 0.023, 0.034, 0.068.

Under these circumstances, it is evident that this method cannot be relied upon to assess the efficiency of mill sanitation. It would appear that the only reliable method is the determination of the amount of sucrose which is consumed per unit time by a given number

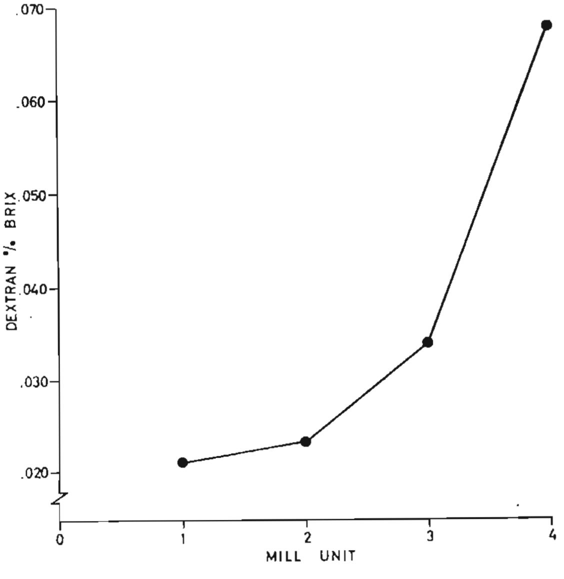


Fig. 10. Increase in dextran % Brix along milling tandem

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. Unfortunately this method is time-consuming and calls for culture techniques with which the factory Chemist is generally not familiar.

Entrainment losses in evaporators. Further work was carried out during the crop on quantitative measurement of entrainment from the last body of multiple effect evaporators and calculation of catch-all efficiency.

The method consisted in direct sampling of vapour, upstream and downstream of the catch-all, with the help of a slanting ½″ diameter pipe extending to the centre of the vapour pipe and connected to a condenser and receiving flask. The latter was placed in an ice-cold water bath and was connected to a laboratory high-vacuum pump. The sucrose content of the condensed vapour was determined by the citric acid method of ANDO and KIUCHI.

Tests were carried out at Constance, Mon Désert-Alma and Highlands. In the case of Constance the catch-all being fitted in the vapour space, it was not possible to sample vapour upstream of it, and hence to calculate its efficiency. However the amount of sucrose present in the vapour leaving the catch-all amounted to 22 ppm which is a fairly low figure.

At Mon Désert-Alma the baffle-type catch-all showed an efficiency of 87 per cent, vapour upstream and downstream of the catch-all containing 134 and 18 ppm sucrose. Corresponding figures for Highlands, where a simple Vortex catch-all is used, are 97% efficiency, the vapour containing 419 and 11 ppm of sucrose.

It has further been established that undetermined losses, which are calculated to the second decimal place, are not influenced by entrainment when the amount of sucrose present in the condensed vapour is as low as in the tests reported here.

Slurry preparation and pan seeding. A few factories in Mauritius still use icing sugar for seeding vacuum pans although the majority have resorted to slurry. The object of using the latter is primarily to avoid shock and practise true pan seeding. However this condition will be met only if the slurry used is sufficiently fine and if the quantity used is sufficiently large. In order to determine whether true pan seeding is actually taking place in those factories using slurry, it was decided to carry out a survey of the pan seeding methods used, particularly with reference to the following :

(a) Type of ball mill used.

(b) Efficiency of ball mill.

(c) Quality of slurry produced.

(d) Quantity 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.

In spite of difficulties encountered in calculating the average crystal sizes of slurries, the results obtained indicate that none of the fifteen factories using slurry is practising true pan seeding.

Spindle Brix of final molasses. The advice of the Sugar Technology Division having been sought on spindle Brix determination of final molasses intended for export, the matter was investigated during the crop. In the analysis clause that buyers proposed to insert in future contracts, it was stipulated that the Brix should be determined using a Brix hydrometer which should be allowed to stand in the solution for 20 minutes at 20°C.

The 20°C limit cannot be recommended since no factory laboratory is equipped with a constant temperature room.

Concerning the time limit of 20 minutes, it was necessary to determine whether, within this short period, all the occluded air could escape and all the suspended solid impurities could settle down, as both may be important sources of error.

The results of the tests carried out, which are reported in detail elsewhere in this report, show that a settling time of 20 minutes is definitely too short. Most of the samples analysed had to be allowed to stand for about three hours before relatively constant spindle

Brix figures could be obtained. But even when the solutions were allowed to stand for six hours, the spindle Brix figures were higher than those of the centrifuged solutions, indicating that lighter solid particles take a long time to settle, or even cannot settle by gravity only.

Final molasses analysis. The heaviest sucrose losses sustained by the factories are those occurring in final molasses. Hence efforts made towards curtailing these losses should be directed to the boiling house. However, when comparing different types of equipment or different boiling house processes, conclusions that may be drawn will depend largely on the analysis of final molasses, particularly on the determination of Gravity Purity. It is therefore most important that the precision of the determination be known as a small difference in the average values of two sets of figures will not necessarily mean that the results obtained in one case are better than those obtained in the other.

Further, when analyses are carried out by two different analysts, it is necessary to know the permissible error in order to decide whether the values obtained by each, even if slightly different, are correct. This problem arose during the last campaign when monthly samples of final molasses from all the factories were analysed both by the factory Chemist and by a member of the Sugar Technology Division.

The results of preliminary investigations carried out indicate that although the precision of the analyses is high, yet a number of factors still have to be investigated before results from different individuals or laboratories can be safely compared.

Chemical Control Manual. At the request of the *Société de Technologie Agricole et Sucrière de Maurice*, and in collaboration with the factory chemists, the revision of the Society's Chemical Control Manual entitled *Official Methods of Control and Analysis for Mauritius Sugar Factories* was completed and will be available for next crop.

Miscellaneous. The activities of the Sugar Technology Division also included the analysis of 6,400 samples of cane from the experimental plots of the Institute, the usual duties of the Instrumentation Section and various studies in connection with advisory work for a number of factories.

LIBRARY AND PUBLICATIONS

The library was enriched by 723 volumes in the course of 1969, and the number of periodicals and reports received increased to 434 titles. As a result of the appointment of a Library Assistant, the Librarian could give more time to the preparation of the catalogue and to bibliographical surveys. On mission abroad, the Librarian visited the main libraries of Paris, the Berlin *Institut für Zuckerindustrie*, the Harvard group of Libraries, the Hunt Botanical Library in Pittsburgh, the Library of Congress, and established contact with the librarians of the American Sugar Associations in New York and of the International Sugar Research Foundation in Bethesda, Maryland. These visits were intended to facilitate acquisition of information and documentation in the agricultural sciences and to extend the exchange of publications with the Institute. Discussions were held with the technical and marketing branches of publishing houses in England, concerning the printing and the distribution of publications of the Institute.

Warmest thanks are expressed to the individuals and organizations which made presentations to the library, and to those libraries which, through the circulation of duplicate material, have helped to complete the collections of scientific periodical literature.

The Library has in the course of the year acquired a few items dedicated to the history of sugar. One publication of note during 1968 was the French translation by Mlle Andrée Mansuy of André Joao ANTONIL's *Cultura e Opulencia do Brasil por suas Drogas e Minas*, based on the 1711 edition which in its time had an eventful and adventurous fate. The publication was sponsored by *Institut des*

Hautes Etudes de l'Amérique Latine, Paris, (*Travaux et Mémoires de l'Institut des Hautes Etudes de l'Amérique Latine, Université de Paris,* no. 21, 1968, 627 p.). The title of the original text, which is self-explanatory, is paraphrased in the French edition : "*De l'exploitation des richesses du Brésil en drogues et en mines contenant diverses informations curieuses sur la façon de faire le sucre, de planter et de traiter le tabac, d'extraire l'or des mines, et de découvrir les mines d'argent; et des grandes ressources que cette conquête de l'Amérique méridionale procure au Royaume de Portugal grâce à ces produits et à d'autres encore, et grâce aux Fermes royales.*"

Photostat copies were also made of the parts interesting the production of sugar in Cayenne from PREFONTAINE's influential treatise: *Maison rustique à l'usage des habitants de la partie de la France équinoxiale connue sous le nom de Cayenne.* Paris, 1763.

The *Institut für Zuckerindustrie*, Berlin, has offered a copy of the very rare edition (now in course of reprinting) of Edmund O. von LIPPMANN's *Geschichte des Zuckers seit den ältesten Zeiten bis zum Beginn der Rübenzucker-Fabrikation,* (Berlin 1929), and its two supplements published in *Zeitschrift des Vereins der Deutschen Zucker-Industrie* (part 84, 1934) and *Zeitschrift der Wirtschaftsgruppe Zuckerindustrie* (part 88, 1938) ; it has also presented a copy of the magnificent edition by Jakob BAXA and Guntwin BRUHNS of *Zucker im Leben der Völker ; eine Kultur-und Wirtschaftsgeschichte* (Berlin, Verlag Dr. Albert Bartens, 1967, 402 p.). Also to be noted is Dr. Auguste TOUSSAINT's *Le Domaine de Bénarès et les débuts du sucre à l'Ile Maurice* in *Annales de l'Université de Madagascar,* (*Série Lettres & Sciences Humaines*) **6** (1967) : 35-89.

Three publications of special interest to the sugar industry of Mauritius appeared during the year :

Pests of sugar cane (Elsevier, Amsterdam, 1969. 568 p.) published under the auspices of the International Society of Sugar Cane Technologists and edited by M.S.I.R.I.'s Chief Entomologist, J.R. WILLIAMS, in co-operation with J.R. METCALFE of the Sugar Manufacturers' Association (of Jamaica) Ltd., R.W. MUNGOMERY of the Bureau of Sugar Experiment Stations, Brisbane, and R. MATHES of U.S.D.A. Entomology Research Division, Houma, La. In the first chapter, C.E. Pemberton and J.R. Williams review the distribution, origins and spread of sugar cane insect pests, and in chapter 24, J.R. Williams reviews the question of "Nematodes as pests of the sugar cane".

By-products of the cane sugar industry; an introduction to their industrial utilization, by J. Maurice PATURAU (Elsevier, Amsterdam, 1969, 274 p.). The author recalls in the Preface that "the idea of this book originated with a report written in 1961 by a Committee, under the chairmanship of the author, set up by the M.S.I.R.I. (*Technical Circular* no. 18, private circulation)."

The *Proceedings of the XIIIth Congress of the I.S.S.C.T.,* held in Taiwan, March 2-17, 1968, edited by LIU KAN-CHIH (Elsevier, Amsterdam, 1969, 2015 p.). The Staff of the Institute contributed ten articles which have been already mentioned in the Annual Report for 1967.

Interesting comments on the problems of editing the proceedings have been published by the editor in *Taiwan Sug.* **14** (5) 1969 : 6-15. These should be most useful to the future editors of this essential tool of sugar research.

An interesting book on agricultural insurance schemes has just appeared in the series *Marchés et Structures Agricoles,* ed. by Luc Fauvel : *Les calamités agricoles : étude des risques et leurs modes de couverture en France et à l'étranger,* by Roger Henri MILLOT, docteur-ès-sciences économiques. It includes a chapter on the Cyclone and Drought Insurance, entitled : *Un exemple de garantie en zone tropicale. L'assurance des cannes à sucre contre les cyclones et la sécheresse dans l'Ile Maurice.*

Publications by the Institute Staff in 1969 were :

Annual Report 1968. 138, XXX p., 33 figs, XI pl. French summary in *Revue agric. sucr. Ile Maurice* **48** (2) : 66-94.

Occasional Paper

No. 23. HALAIS, Pierre and DAVY, E. G. Notes on the 1 :100,000 agro-climatic map of Mauritius, comp.

by the M.S.I.R.I. and the Mauritius Meteorological services. 27 p. 3 figs. ; 6 maps.

Revue d'information Technique (mimeographed)

No. 1. HALAIS, Pierre. Détermination du degré de maturité des cannes avant la récolte en utilisant le réfractomètre de poche. 10 p.; 5 figs.

Contrôle Mutuel Hebdomadaire. 24 issues.

Bulletin Hebdomadaire. Evolution Campagne Sucrière. 23 issues.

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

KŒNIG, H., MAMET, R. & LAGESSE, A. Le développement des cultures vivrières dans les terres à canne à sucre. **48** (3) : 181-189.

WIEHE, A., NARAIN, T., OWADALLY, L., LINCOLN, L. & MAZERY, G. Projet de culture du riz à Maurice. **48** (3): 173-180.

MAZERY, G. Chargement et transport de la canne à sucre. **48** (3) : 307-310 *et seq.*

Articles contributed to Journals published abroad & Symposia :

SAINT ANTOINE, J. D. de R. Measures adopted in Mauritius to improve raw sugar filterability. *Int. Sug. J.* **71** (1969): 40-44; 72-75 (Proceedings XIIIth Congress, I.S.S.C.T., Taiwan 1968).

WILLIAMS, J. R. Nematodes attacking sugar cane. *Tech. Commun. Commonw. Bur. Helminth.*, No. 40, 1969. (Proceedings Caribbean Symposium on Nematodes of Tropical Crops, 1968).

GENERAL

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

Lectures and meetings held in the Bonâme Hall are listed below :

30th January — Y. WONG. Echantillonnage et la préparation des feuilles pour le diagnostic foliaire. [1]

20th February — M. MILLIKEN. (Economist with the U.N.D.P. Land & Water Resources Survey, Mauritius). Population growth, income change, demand for food in Mauritius. [2]

18th March — R. ANTOINE. Revue des travaux du M.S.I.R.I. en 1968.

20th March — Film show: (i) Precise measurements. (ii) Engineers in Communications. [3]

23rd April — Dr. HESCH. (Siempel Kamp). The use of bagasse in the manufacture of particle board. [2]

19th-23rd May — Société de Technologie Agricole et Sucrière, Congrès 1969.

11th June — L. LINCOLN. Regards sur les peuples du monde. [4] Projection de diapositives et commentaires.

24th June — R. MAMET. Conseils sur la culture de la pomme de terre. [1]

R. ANTOINE. Résultats des premières expériences sur la culture de la pistache à Maurice. [1]

16th July — D. R. STODDART, F. R. G. S. (Leader of the Royal Society of London's Aldabra Research Committee). Work of the Aldabra Research Committee sponsored by the Royal Society of London. [4]

22nd July	— M. Hardy. Résultats des expériences à Palmyre sur l'évapotranspiration. [1]
23rd July-1st Aug.	Meeting of the F.A.O. Sub-Committee on Tea.
19th August	— C. Mongelard. Les résultats des essais avec de nouveaux herbicides. [1]
23rd September	— P. Halais. La carte agro-climatique. [1]
3rd October	— F. M. Chapman. (Consulting Sugar Technologist, Vancouver, Canada). Molasses exhaustibility. [2]
15th October	— A. Rowland-Jones. (Administrative Consultant, University of Mauritius). The academic and physical planning of a new university. [4]
17th October.	— A. Fejer (Chairman, Dept. of Mechanical and Aerospace Engineering, Illinois Institute of Technology). Technology in the future. [3]
21st October	— C. Ricaud. L'emploi de boutures saines à la plantation. [1]
5th November	— E. Lim Fat (Professor, University of Mauritius). Free industrial zones in Taiwan and Puerto Rico.
20th November	— G. Mazery. (i) Un nouveau système de "self-loader". (ii) Un attelage pour train de remorques semi-portées. (Démonstrations à Médine). [1]
20th November	— Film show : Apollo XI.
25th November	— J. R. Williams. Losses caused by the sugar cane scale insect and methods of control. [1]
9th December	— R. Antoine. Les variétés de canne à sucre. [1]

Staff Movements. Seven officers of the Institute, Miss M. Ly-Tio-Fane, Dr. C. Ricaud, Messrs. M. A. Rajabalee, M. Abel, L. Thatcher, G. Rouillard and L. C. Figon went on overseas leave during the year, and as usual devoted some of their time visiting scientific research institutions. Mr. Abel went to England, Kenya and Uganda; Mr. Rajabalee to India, Pakistan and England; Mr. Figon to England; Mr. Thatcher to Australia; Mr. Rouillard to the Republic of South Africa; Dr. Ricaud to Australia, Taiwan, Hawaii, the U.S.A., England and France; and Miss Ly-Tio-Fane to the Federal Republic of Germany, France, England, the U.S.A. and Italy.

Dr. Y. Wong You Cheong attended the XIth Meeting of the East African Specialists Committee on "Soil Fertility and Crop Nutrition" held in Kampala, Uganda, in March.

Mr. J. R. Williams took part in a meeting convened by the International Union of Biological Sciences in Amsterdam in November, to finalize plans for the proposed new "International Organization for Biological Control."

The Director attended the Vth Rehovot Conference on "Science and Education" in

1. Talks specially prepared for Extension Officers of the Department of Agriculture and for the Field Staff of the Sugar Estates.

2. Meeting under the auspices of the *Société de Technologie Agricole et Sucrière de Maurice.*

3. Meeting under the auspices of the *Société de Technologie Agricole et Sucrière de Maurice* and *Association des Ingénieurs.*

4. Meeting under the auspices of the Royal Society of Arts & Sciences of Mauritius.

August. After the conference he visited agricultural research centres and various factories connected with the storage and processing of agricultural products in Israel. He then went to England and France where discussions centered mainly on food crop production and marketing; on the return journey he visited the F.A.O. Headquarters in Rome.

Mr. J. Guého visited Rodrigues in December, on a plant collecting expedition which proved very fruitful.

Mr. P. Y. Chan, who obtained an F.A.O. scholarship, left in September to follow a one year post-graduate course in Soil Physics at Cambridge University.

Mr. L. Ross is pursuing his studies leading to the graduateship of the Royal Institute of Chemistry at the Medway and Maidstone College of Technology, England.

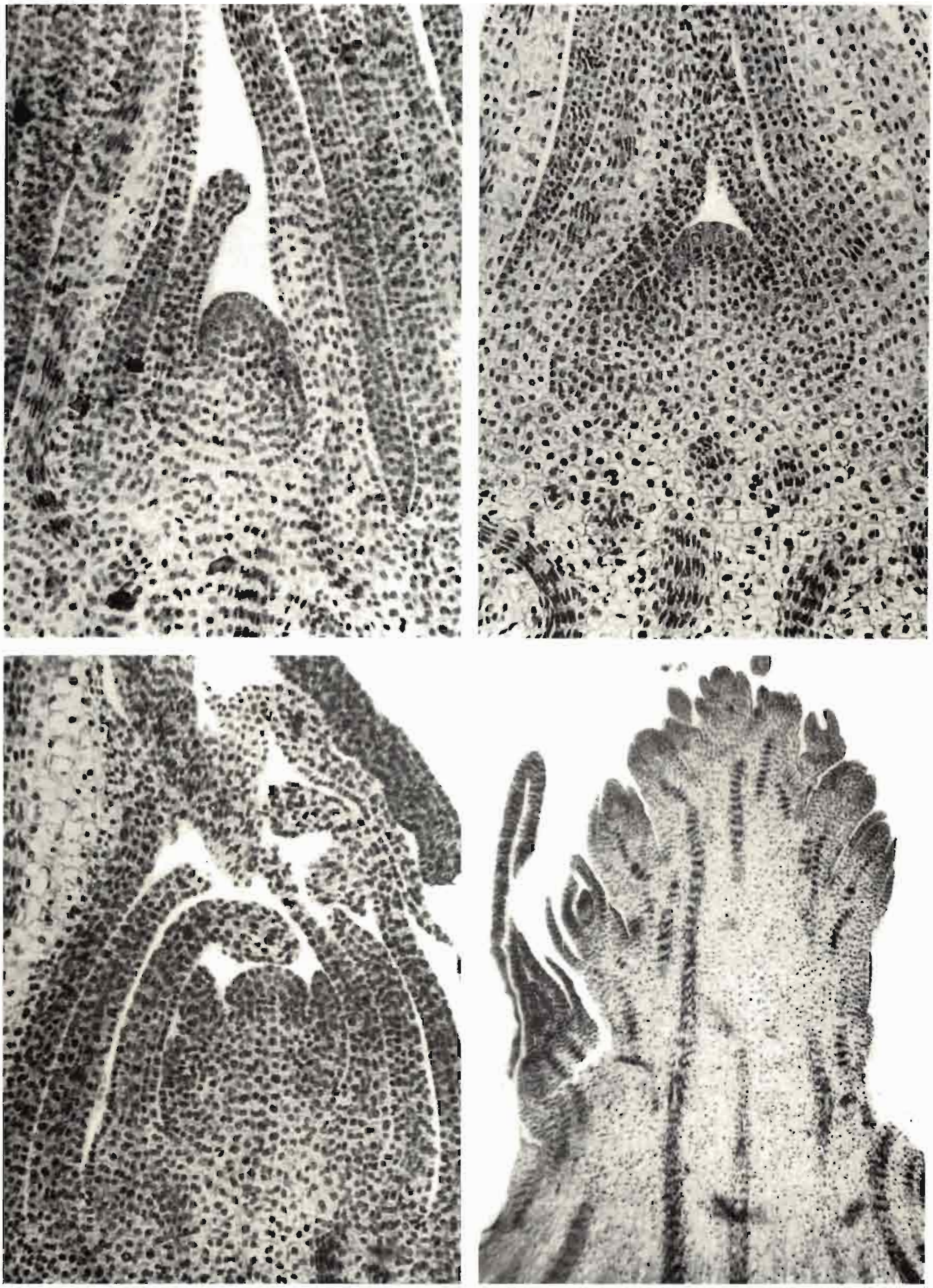
Under the auspices of the *Comité de Collaboration Agricole,* Mr. J. R. Williams went to Réunion in May, in connection with the biological control of the sugar cane scale insect, and the Director visited Madagascar in early August to see and discuss Fiji disease control work.

The XVIIIth meeting of the *Comité de Collaboration Agricole* was held in Madagascar from the 21st to the 28th October, the Institute being represented by Mr. R. Antoine, Chairman of the Committee for Mauritius, and Mr. P. du Mée.

I should like to conclude in expressing my gratitude to Estate Managers and their personnel for their valuable assistance and to the Chief Agricultural Officer, Agricultural Services, Ministry of Agriculture, and his staff for their co-operation. I should also like to record my warmest thanks to the Chairman and Members of the Executive Board for their judicious advice and, finally, it is a pleasure to express my appreciation of the loyal and unstinted support I have received from the staff of the Institute during the year.

Director

28th February, 1970.



Abnormal apices in variety Mandalay

Top left : Vegetative apex (x 130) ; *top right :* Abnormal apex (x 130)
Bottom left : Embryonic bunch-top (x 130) ; *bottom right :* Reverted inflorescence primordium (x 40)

Control 9 11 13 15 17
HOURS
28–14 Days prior to initiation

Control 9 11 13 15 17
HOURS
14–0 Days prior to initiation

Control 9 11 13 15 17
HOURS
Initiation of inflorescence branch primordia

Control 9 11 13 15 17
HOURS
Initiation of spikelet primordia

Control V B G R FR
Effect of night breaks with light of different spectral composition.
V = Ultra Violet B = Blue G = Green
R = Red FR = Far Red

Cont. 18–25 25–4 4–11 11–18 18–25 25 1 1 8
FEB MARCH APRIL
Effect of night-breaks with incandescent light applied at different stages of flowering

Plots from experiments on the effect of daylength (*top & middle*) and night-breaks (*bottom*) on flowering of variety Mandalay

CANE BREEDING AND VARIETIES

1. INVESTIGATIONS ON THE PHYSIOLOGY OF FLOWERING

R. JULIEN

Effect of daylength

Introduction

ALLARD (1938) classified sugar cane as an intermediate day plant requiring a daylength of 12-14 hours for flowering. SARTORIS (1939) working with the same variety as ALLARD, namely *S. spontaneum* var. 28 N.G. 292, reported that this clone did not flower on 12- or 14-hour days, but required a daylength of 12h. 30 mins. for optimum flowering. The specific requirement of an intermediate day for optimum flowering in sugar cane has been confirmed by BRANDES and MATZ (1939). COLEMAN (1969) in a recent review of literature concludes that sugar cane is generally an intermediate day plant although there are a few exceptions, particularly among *S. spontaneum* clones. CHILTON and MORELAND (1954) induced flowering in a number of clones by subjecting them to a photoperiod of 12h. 44 mins, and then gradually shortening the day. They therefore concluded that fixed daylengths were unsuccessful in promoting flowering, and what was important was the gradual shortening of the day. However, when they tried this inducing method on several *S. officinarum* clones, only one clone 28 N.G. 72-514 was induced to flower. This gradual shortening of the day, required for optimum flowering in certain clones, appears to indicate that different photoperiods are required during the induction and development stages of flowering. Furthermore, failure to flower may be attributed to several resaons, namely :

(i) The transition from the vegetative to the floral organization does not take place in the apex;

(ii) The young primordium fails to develop and the apex reverts to the vegetative stage ; if this occurs very early during the differentiation process, zig-zag nodes are produced and are a symptom of early reversion (CLEMENTS and AWADA, 1967) ; reversion may also take place during later stages of differentiation and this results in abnormal apices (Pl. I) and bunch tops (ENGARD and LARSEN, 1949) ;

(iii) The author has observed that in a large number of stalks taken at random among several varieties, a fully differentiated inflorescence was present, but for unknown reasons had failed to reach its maximum size and therefore had not emerged; there are also instances when mature inflorescences fail to emerge because the leaf sheath acts as a mechanical barrier, as shown by CHILTON and PALIATSEAS (1956) who were able to promote emergence by dissecting the leaf sheath.

Hence, it is desirable to investigate the effect of daylength on different stages of flowering from induction to emergence, as it has been shown that post-initiation stages are as important as the induction stage for flowering to occur.

Material and Methods

S. spontaneum varieties Mandalay and 51 N.G. 2 were used in the experiments, the results obtained with these two varieties being similar, this report will be devoted solely to the work on variety Mandalay.

One-eye cuttings of this variety were raised in $6'' \times 6''$ plastic pots and later transplanted to 22″ diameter plastic pots. A randomized block design was used, consisting of three replicates of 42 plots, one large pot with about 15 canes representing a plot. The treatments were in 6 × 7 factorial structure and consisted of six daylengths : 9, 11, 13, 15 and 17 hours, natural daylength being included as control. These daylength treatments were given during seven consecutive, but different, periods of 14 days, the periods being planned so as to correspond to different stages of flowering, as given in Table 1.

Table 1. Periods of treatment and corresponding stages of flowering

Date *Started*	*Ended*	*Stage of Flowering*
13/1	27/1	42 to 28 days prior to onset of initiation*
27/1	10/2	28 to 14 days prior to onset of initiation
10/2	24/2	14 to 0 days prior to onset of initiation
24/2	10/3	Initiation and growth of inflorescence axis
10/3	24/3	Initiation and growth of inflorescence branch promordia
24/3	7/4	Initiation of spikelet primordia
7/4	21/4	Growth of the inflorescence

* The onset of initiation is marked by histological changes in the apex (JULIEN, 1968, 1969).

As the treatments were applied during different periods, climatic factors which are known to influence flowering were taken into account. The mean minimum temperatures for the different periods were always above the threshold level of 18.3°C and ranged from 19.6°C to 21.2°C. The mean maximum temperatures were always below 31.0°C, and ranged from 27.9°C to 29.1°C. Precipitation was extremely variable; however, the pots were watered to field capacity whenever required. This reduced the variation to a very low level. No significant differences in the percentage sunshine, as recorded by a Campbell-Stokes sunshine recorder, could be detected. It seems, therefore, unlikely that photoperiodic treatment effects could be confounded with effects due to variation in climatic factors.

Results and Discussion

The intensity of initiation as estimated by per cent value was considered for treatments applied up to the start of the process, these results are illustrated in Table 2.

Table 2. Effect of daylength treatment on percentage initiation expressed as arc sin $\sqrt{\%}$ Initiation

Stage of Flowering	*9*	*11*	*13* (*Daylength*)	*15*	*17*	*Control*
14 to 0 days prior to initiation	90	71*	84	63**	69**	90

* Significant at P.0.05 = 15
** ,, ,, P.0.01 = 21

For treatments applied after the onset of initiation, the intensity was considered as being similar to that of control plots, which was 96%. The intensity of emergence as estimated by per cent value is illustrated in fig 11. The per cent emergence was transformed into angles where the angle = arc sin $\sqrt{\%}$ Emergence, significance levels are given for this derived variate. The time of emergence was recorded for each stalk in a plot, being measured as number of days to emergence, the 1st of April being taken as 0 day. In computing the means, one extreme value in a given treatment may lead to erroneous results; hence, the median on the emerging population for each treatment was also calculated, and these are shown in Table 3.

Table 3. (a) Time taken in days for half of the emerging population to flower †

Stage of Flowering	*Daylength (hr.)* 9	11	13	15	17	Natural
42 to 28 days prior to onset of initiation	33	32	36	33	32	34
28 to 14 days prior to onset of initiation	35	32	35	35	36	34
Initiation of spikelet primordia	31*	35	56***	66***	65***	34
Growth of inflorescence	29**	34	40***	51***	47***	34

† Part of experiment which could be analysed "en bloc".
* Significantly different from control at P. 0.05
** ,, ,, ,, P. 0.01
*** ,, ,, ,, P. 0.001

Table 3 (b). Time taken in days for half of the emerging population to flower ††

Stage of flowering	*Daylength (hr.)* 9	11	13	15	17	Natural
14 to 0 days prior to initiation	55	70	41	44	52	34
Initiation of inflorescence axis	49	72	64	∞	∞	34
Initiation of inflorescence branch primordia	35	39	44	64	70	34

†† Part of experiment which could not be analysed because plots of one or more replicates did not flower.

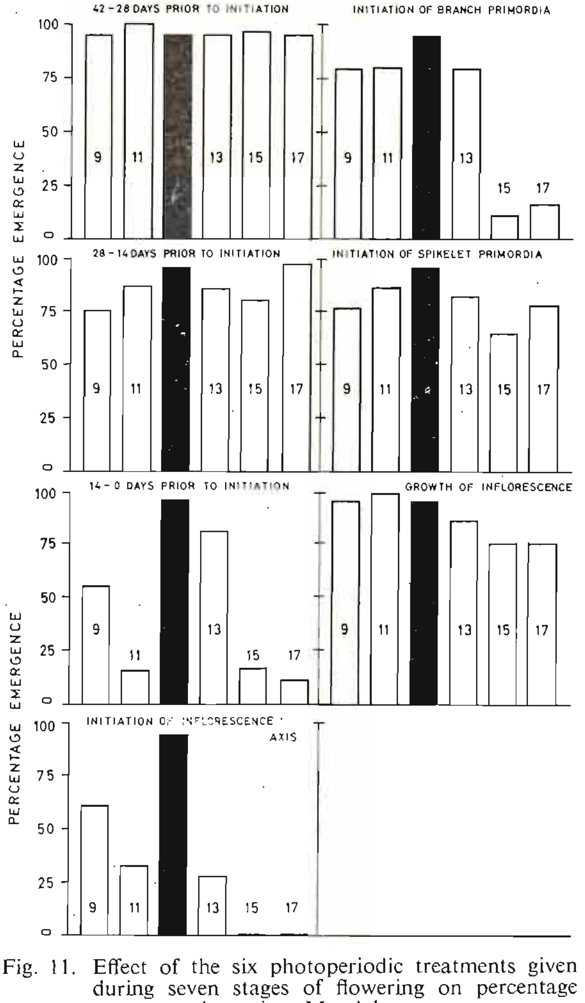


Fig. 11. Effect of the six photoperiodic treatments given during seven stages of flowering on percentage emergence in variety Mandalay.

Black columns = control; numbers in columns represent daylength in hours.

Histograms of cumulative % emergence against number of days were drawn for the last two stages of flowering (fig 12), in which the intensity of emergence is not significantly different from control.

From 42 to 14 days prior to the initiation of the inflorescence primordium, the percentage and time of emergence for the daylength treatments were not significantly different from control, (Table 3 a, and fig 11). It may, therefore, be concluded that the plants are not photoperiodically sensitive during this period.

From 14 to 0 days prior to initiation, daylength of 9, 11, 15 and 17 hours, reduced significantly the % emergence and retarded emergence; on the other hand, the % emergence for the 13 hour-day treatment was not significantly different from control, but the time taken for emergence is most probably significantly different from control. Thus, there is a requirement for an intermediate daylength of more than 11 hours, but just less than 13 hours, for full flowering response. It is worth noting that the 9 hour-day is significantly less inhibitory than the 11-hour one; this observed fact is difficult to explain, and further experiments will be set up in an attempt to throw light on this point.

During the next stage of flowering, initiation and growth of inflorescence axis, daylength treatments of 9, 11 and 13 hours reduced and retarded emergence significantly as compared to control, 15- and 17-hour days inhibited completely flowering. A progressive inhibitory trend from 9 to 17 is apparent, the difference between % emergence for the 9- and 11-hour day treatments does not reach significance level, but when time of emergence is considered, 9-hour has a less retarding effect than 11-hour (Table 3b, and fig 11).

The initiation of branch primordia on the inflorescence axis requires days shorter than 15 hours for maximum emergence, and shorter than 13 for normal time of emergence. A typical short-day response appears to characterize this stage of flowering, the critical day for intensity of emergence lying between 13-15 hrs. (fig. 11), and for time of emergence between 11-13 hrs. (Table 3b).

Intensity of emergence is not much affected by daylength treatments during the two subsequent stages of flowering, a slight reducing effect due to 15- and 17-hour days is worth noting, although only the 15-hour day treatment reaches significant level during the initiation of spikelet primordia (fig. 11). On the other hand, time of emergence is dependent on daylength treatment given; thus during initiation of spikelet primordia, days of 13 hours and longer retard flowering, a progressive trend being evident, although maximum effect occurs at 15- hour, 17-hour days having similar effect to 15-hour ones (fig. 12).

Although a number of points remain to be elucidated, the preliminary conclusions which may be derived from these experiments are as follows :

(a) Intermediate-day requirement.

The requirement of an intermediate day of about 12 hr. 30 min. for floral induction is confirmed in this experiment. However, there is an indication that this is not the clear cut answer to the problem, because the 9-hour day treatment is less inhibitory than the 11-hour day, and as it has not been clearly established whether days shorter than 9 hours would inhibit flowering. Hence, further experiments using daylengths of less than 9 hours will have to be undertaken to clarify this point. The same problem arises with the requirements of the next stage of flowering : 9-hour, instead of being more inhibitory, is less than the 11-hour treatment.

(b) Short-day requirement.

The three subsequent stages of flowering, initiation of inflorescence branch primordia, initiation of spikelet primordia and growth of the inflorescence are characterized by a typical short-day response; however, the critical daylength is not constant. Thus, during the initiation of inflorescence branch primordia, a critical daylength of either 9 hours, or natural daylength, appears to be required. The mean natural daylength during this stage is 12hr. 18min. As the 11-hour day resulted in a very small delay as compared to 9-hour and natural daylength, it appears that the general more inhibitory effect of 11-hour, as compared to 9-hour, is still present, but very much less marked. Finally, during the initiation of spikelet primordia and growth of the inflorescence, 9-hour days promoted earlier flowering as compared to natural daylength, or 11-hour day (Table 3a); hence, the critical daylength is 9-hour, or may even be less. Further experimentation is required to conclude on this point.

The concept of floral induction as generally understood for other plants (ZEEWART, 1962) appears to be a relatively simple mechanism compared to the processes which lead to optimum flowering response in sugar cane. Such response may be defined as total and earliest emergence for a given population. It has now been established for the two clones of *S. spontaneum* studied that the right daylength is not only necessary for the induction, but also important during subsequent differentiation stages and during the growth of the fully differentiated inflorescence.

Effect of night interruptions

Introduction

BURR (1950) reported that an interruption given after midnight with 2 f.c. of incandescent light was sufficient to inhibit flowering in variety H.37-1933. COLEMAN (1963) elaborated on this and showed that under Hawaiian conditions, if all nights from the 1st of August to the 15th of October were interrupted, flowering was completely inhibited. In a further paper, COLEMAN (1965) showed that the photo-inductive period for variety H.37-1933 occurred from the

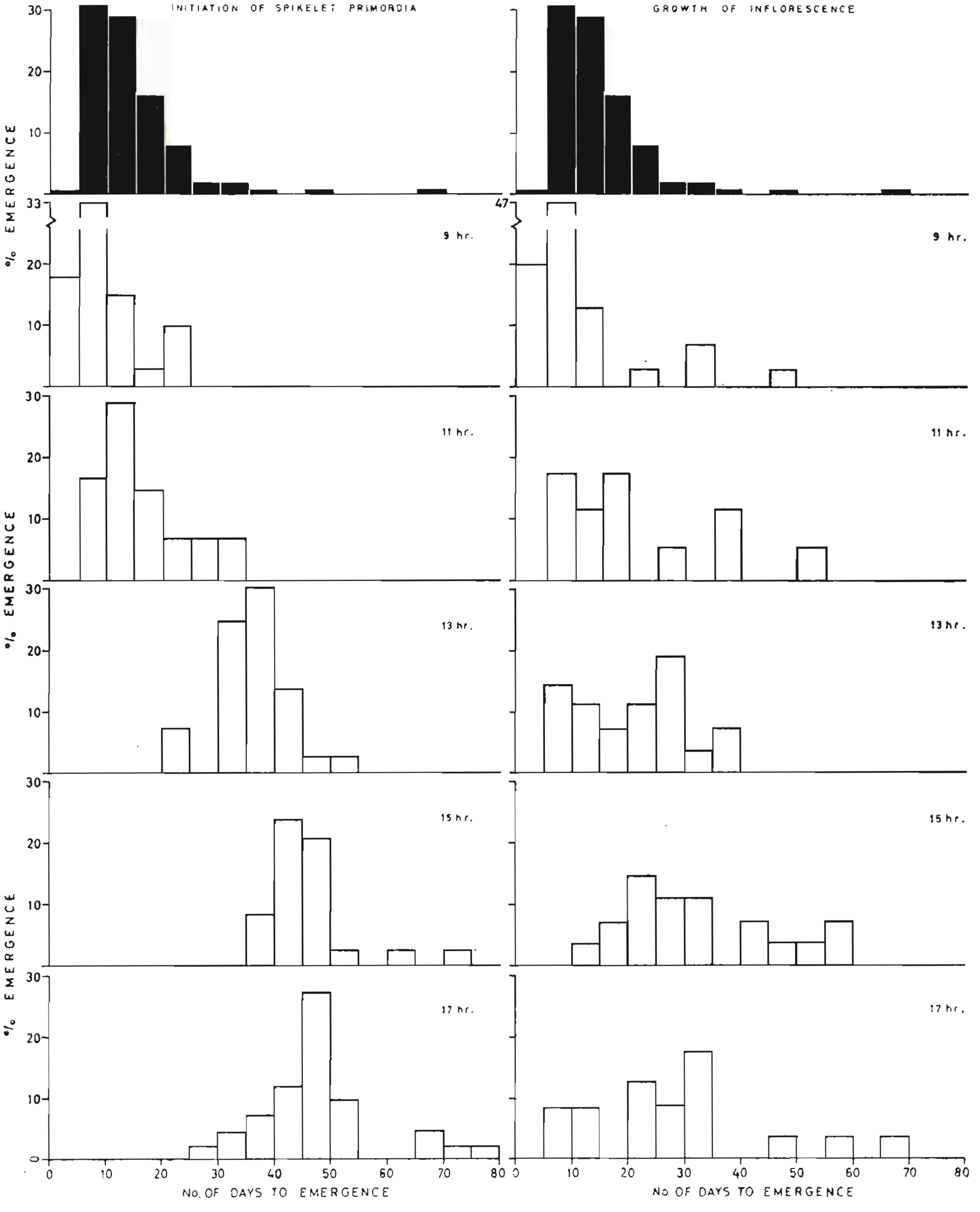


Fig. 12. Effect of the six photoperiodic treatments given during two stages of flowering on the distribution of emergence in time in variety Mandalay.

Black columns = control.

1st to the 20th of September, and night interruptions given during this period were inhibitory to flowering. GEORGE and LALOUETTE (1963) showed that 'long-day treatments', (i.e interrupting the night from 11 p.m. to 3 a.m. with incandescent light obtained from a 100 W, 240 V tungsten lamp,) given to variety C.P. 36-13 during the induction of flowering resulted in delay and reduction in intensity of emergence; the treatments had also an effect on the time at which the inflorescence was first formed. The author working with *S. spontaneum* var. Mandalay has shown that night interruptions had a relatively small inhibitory effect when given during the 'induction time', that is during the three weeks preceding the onset of the first histological changes in the apex marking the transition from the vegetative to the floral stage. On the other hand, when given during the three weeks following the first histological changes in the apex, the treatment almost completely inhibited flowering (JULIEN, 1969). This period corresponds to the time when the young primordium enlarges and inflorescence branch primordia are initiated on it (JULIEN, 1968).

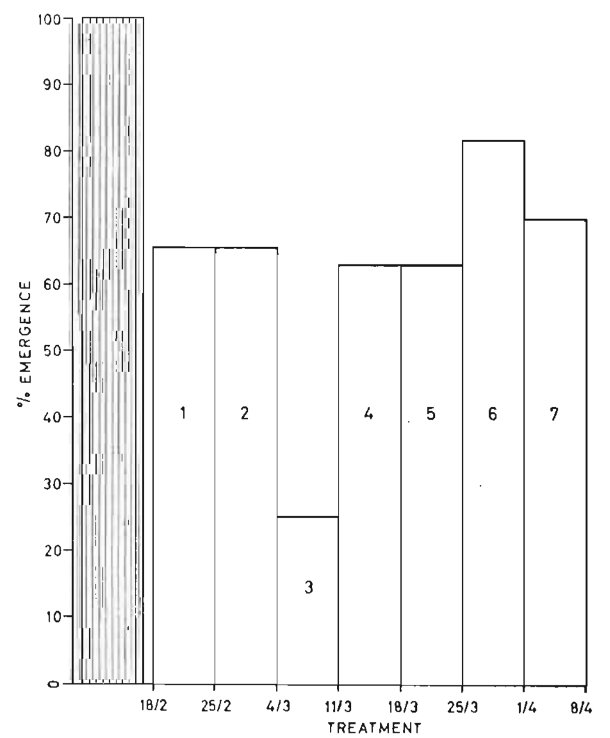


Fig. 13. Effect of night interruptions given during seven different stages of development of the inflorescence on percentage emergence in variety Mandalay.

Striped column = Control

Column 1 = 6-0 days prior to initiation.
Column 2 = 0-7 days after initiation
Column 3 = Initiation of inflorescence branch primordia (early)
Column 4 = Initiation of inflorescence branch primordia (late)
Column 5 = Initiation of spikelet primordia (early)
Column 6 = Initiation of spikelet primordia (late)
Column 7 = Growth of inflorescence (early)

In order to elucidate whether the 'dark reaction' in sugar cane is dependent on the inter-conversion of the pigment phytochrome, as described for other plants (ZEEWART, 1962), some preliminary work has already been conducted. Thus COLEMAN (1969) reported that both incandescent and fluorescent light affect the dark inhibition; however, light from mercury lamps and far-red light have no effect. The author working with variety U.S. 48-34 has shown that red light was most inhibitory to flowering compared to blue, green and red + far-red. (JULIEN 1968). However, COLEMAN (1963), reported that far-red light did not reverse the inhibitory effect of red light. In order to elaborate on these preliminary findings, studies were conducted to evaluate the relative effect of light of different wavelengths used for night interruptions.

Experimental.

(a) Night interruptions with incandescent light of same intensities.

S. spontaneum var. Mandalay was used in this experiment. The planting procedure was similar to that described above. A randomized block design was used, each replicate consisting of eight plots, one pot with 15 canes being taken as a plot. The treatments consisted in giving night interruptions during seven consecutive but different periods of 8 days. These periods were planned so as to correspond to different stages of flowering.

A bank of four 100 W 240 V tungsten frosted 'Philips' bulbs were used to illuminate the canes every night from 10 p.m. to 2 a.m. The mean light intensity at the leaf canopy was 12 f.c.

(b) Night interruptions with incandescent light of different intensities.

S. spontaneum var. 51 N.G. 2 was used in this experiment. One-eye cuttings were raised in 6″ × 6″ plastic pots and later transplanted to metal pots 18″ high and 8″ in diameter. A randomized block design was used, each consisting of 42 plots, one pot with about 15 canes representing a plot. The treatments were in a 6 × 7 factorial structure and consisted in (i) giving night interruptions from 10 p.m. to 2 a.m. every night with incandescent light of 5 different intensities : 4, 6, 10, 14 and 35 f.c.; these different intensities were obtained by using 240 V 'Philips' tungsten frosted bulbs of 15, 25, 40, 60 and 100 W, respectively ; (ii) these night interruption treatments were given during seven different but consecutive periods of 10 days. The periods were planned so as to correspond to different stages of flowering.

(c) Night interruptions with light of different wavelengths.

S. spontaneum var. 51 N.G. 2 was used for this experiment ; planting and experimental design were similar to those described in the previous experiment. The treatments consisted in giving night interruptions from 10 p.m. to 2 a.m. every night with light of different colours. The type of lamp, filters and wavelength transmitted are shown in Table 4.

These night-interruption treatments were given during seven consecutive but different periods of twelve days at a time, which corresponded to different stages of flowering, as described in Table 5.

Table 4. Type of lamp, filters and wavelength transmitted for each treatment

Colour	*Type of lamp**	*Filters*	*W** max. mμ*
Blue	Fluorescent "TL" 20 W/18	"Cinemoid" no. 20	450
Green	,, "TL" 20 W/17	"Cinemoid" no. 24	520
Red	,, "TL" 20 W/15	"Cinemoid" no. 6	660
Far Red	Tungsten 100 W	"Plexiglass" no. 501 & 627 + 5 cm. of water	735

* All lamps used were of the trade mark "Philips".

** Wavelength at which maximum transmission occurred.

Table 5. Periods of treatment and corresponding stages of flowering

Date *Started*	*Ended*	*Stage of Flowering*
6/1	18/1	42 to 30 days prior to onset of initiation
19/1	30/1	30 to 18 days prior to onset of initiation
31/1	11/2	18 to 6 days prior to onset of initiation
12/2	24/2	Initiation of inflorescence axis
25/2	10/3	Initiation of branch primordia
11/3	24/3	Initiation of spikelet primordia
25/3	7/4	Growth of the inflorescence

Results

The intensity of emergence as estimated by per cent emergence is illustrated in figs. 13, 14, 15. This primary variate was transformed into angles where the angle = are sin$\sqrt{\%}$ Emergence, significance levels were calculated for this derived variate. The number of days to emergence was recorded for each cane in a plot; from these data, the time taken for half of the emerging population to flower was calculated for each treatment. These results are shown in figs. 16, 17 for the first and second experiments, and in Table 6 for the third one.

Table 6. Time taken in days for half of the emerging population (Variety 51 N.G. 2) to flower*

Stage of Flowering	*Control*	*Blue*	*Green*	*Red*	*Far Red*
40 to 28 days prior to initiation ...	13	14	12	14	15
28 to 16 days prior to initiation ...	13	13	12	14	13
16 to 14 days prior to initiation ...	13	12	13	13	14
Induction & initiation of inflorescence axis	13	15	19	∞	23
Initiation of branch primordia ...	13	52**	∞	∞	50**
Initiation of spikelet primordia ...	13	14	48	64**	14
Growth of inflorescence	13	14	25	32	17

* Plants were subjected to night interruptions with light of different wavelengths.

** Only a few flowers in one of the three replicates emerged.

Discussion

(a) Night interruptions with incandescent light of same intensities.

The night interruption treatment with incandescent light reduced the intensity of emergence and retarded flowering when given to all stages of flowering, starting from a few days prior to onset of initiation up to complete differentiation of the spikelets. These effects were not uniform but reached their maximum when the treatments were applied from 4th to 11th of March (figs. 13, 16) this period corresponds to the onset of initiation of inflorescence branch primordia on the inflorescence axis. This histological change takes place about two weeks after the occurrence of the first histological changes marking the transition from the vegetative to the floral stage. It is also worth mentioning that the night-interruption treatment given from the 12th to the 18th of March, although having a less retarding effect than from the 4th to 11th of March, was significantly more pronounced than at other periods (fig. 16). Initiation of inflorescence branch primordia was completed on the axis of the inflorescence about the 18th of March; hence it appears that maximum inhibiting effect of night breaks occurs during the initiation of inflorescence branch primordia on the inflorescence axis.

(b) Night interruptions with incandescent light of different intensities.

The night interruption studies with light of different intensities on variety 51 N.G. 2 confirms the earlier report that night breaks have their maximum inhibitory effect when given during the initiation of inflorescence branch primordia. An intensity of 10 f.c. given during four hours was sufficient to inhibit completely flowering; lower intensities had a delaying effect on emergence. When treatments were applied during the initiation of the inflorescence axis, at least 14 f.c. were required for complete inhibition of flowering; lower intensities have no retarding effect although they

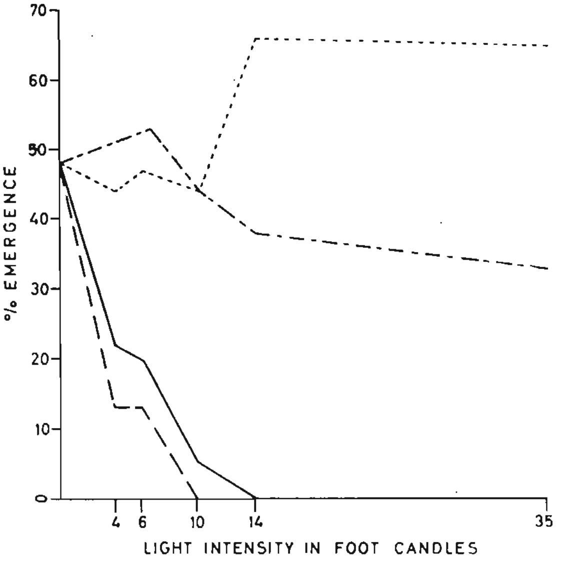


Fig. 14. Effect of night interruptions with different light intensities given during four stages of flowering on percentage emergence in variety 51 N.G.2

Line	=	Initiation of inflorescence axis
Dashes	=	Initiation of inflorescence branches
Dashes & Dots	=	Initiation of inflorescence spikelet primordia
Dots	=	Growth of inflorescence

reduce the intensity of emergence (figs. 14, 17). Interruptions applied during the initiation of spikelet primordia proved to be the most valuable treatment from a practical point of view. Gradual delay in emergence of up to about five weeks could be obtained by varying the intensity of light used for interruptions, and reduction in intensity of emergence was relatively low. BURR (1950) has shown that 50 f.c. minutes were sufficient to inhibit flowering in hybrid variety H. 37-1933 ; the fact that 1440 f.c. minutes were not sufficient to inhibit completely flowering in *S. spontaneum* var. 51 N.G. 2, appears to indicate that the *spontaneums* are less sensitive to night interruptions than hybrid varieties.

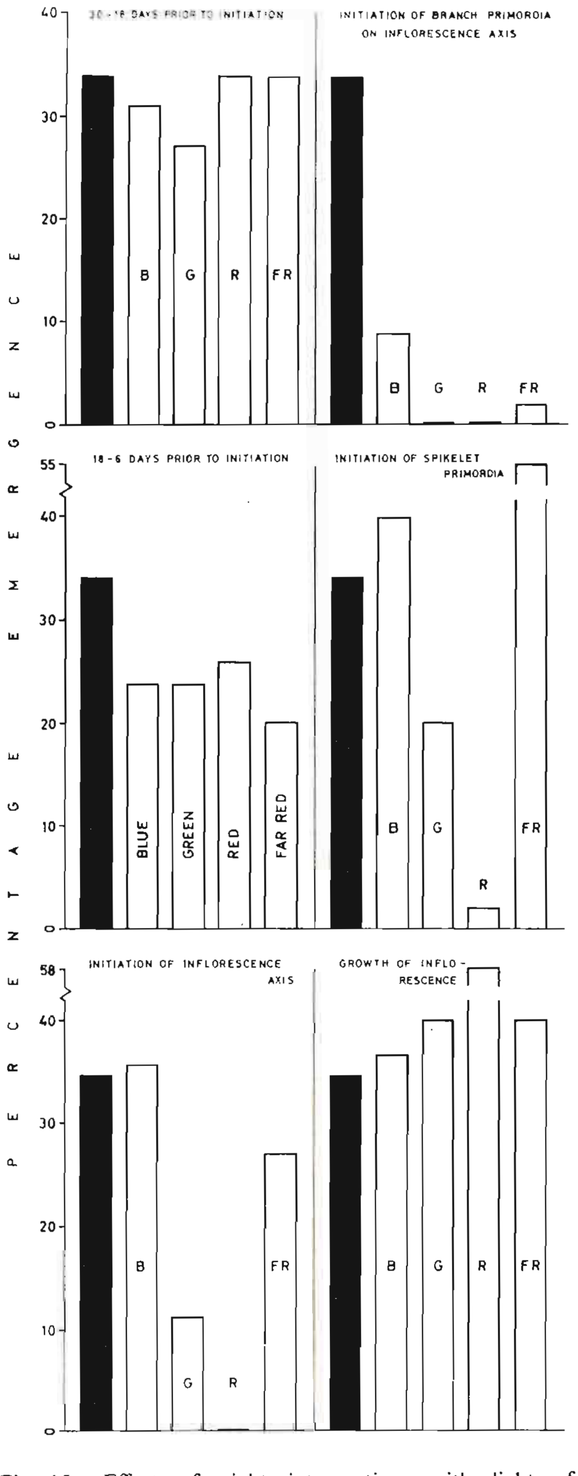


Fig. 15. Effect of night interruptions with light of different wavelengths given during six stages of flowering on percentage emergence in variety 51 N.G.2

Black columns = Control

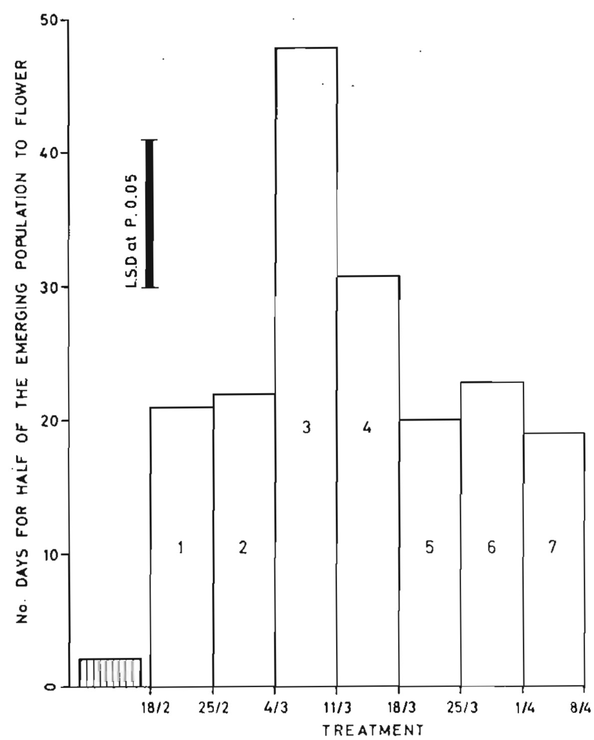


Fig. 16. Effect of night interruptions given during seven different stages of development of the inflorescence on median time to flowering in variety Mandalay.

Striped column = Control
Column 1 = 6-0 days prior to initiation
Column 2 = 0-7 days after initiation
Column 3 = Initiation of inflorescence branch primordia (early)
Column 4 = Initiation of inflorescence branch primordia (late)
Column 5 = Initiation of spikelet primordia (early)
Column 6 = Initiation of spikelet primordia (late)
Column 7 = Growth of inflorescence (early)

(c) Night interruptions with light of different wavelengths.

Irrespective of the wave-length used, night breaks had no effect when applied prior to the 11th of February, the onset of initiation occurring in this variety on, or about, the 18th of February. During the early stages of growth of the inflorescence axis primordium, red light inhibited flowering, green reduced the intensity and delayed emergence. When the night-interruption treatments are given during the initiation of inflorescence branch primordia on the axis of the inflorescence, all wavelengths used were highly inhibitory. The initiation of spikelet primordia and growth of the inflorescence axis are only slightly affected by night interruptions with blue and far-red light. On the other hand, interruptions with red and green lights reduce and delay flowering. (fig. 15).

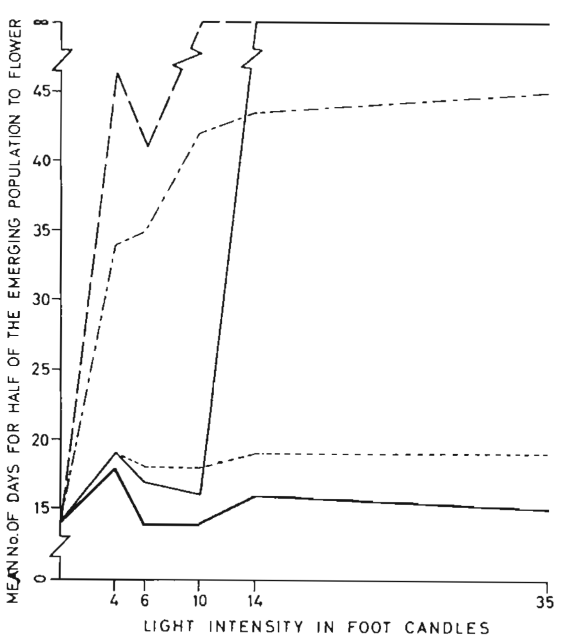


Fig. 17. Effect of night interruptions with light of different intensities given during five stages of flowering on median time to emergence in variety 51 N.G.2.

Thick line		14-0 days prior to initiation
Thin line		Initiation of inflorescence axis
Dashes	=	Initiation of inflorescence branches
Dashes & Dots	=	Initiation of spikelet primordia
Dots	=	Growth of inflorescence

Mechanism of flowering

The mechanism of flowering in sugar cane has been recently discussed in the light of fifty years research (Coleman, 1969). Recent studies conducted in Mauritius have thrown new light on some specific aspects of the mechanism in *S. spontaneum*, and this is discussed in the present article in relation to classical work on the physiology of flowering.

It has been established that in the short day (SD) plant *Xanthium*, the leaves perceive the night length, the flowering stimulus is produced, this is then translocated to the apex. This has been defined as the photo-induction stage of flowering. The first histological changes observed in the apex of *Xanthium* take place four days after the inductive long night is given (Wetmore *et al.*, 1959). Coleman (1969) reports that the photo-inductive period for sugar cane in Hawaii occurs from the 1st to the 20th of September, and during this period a specific night length of 11.5 hours is required, and that the 12.5 hr. day length must also be of high intensity. Burr (1950) and Coleman (1963) have also shown that night interruptions given from the 1st to the 20th September in Hawaii inhibit flowering. It is also established that in *Xanthium* and other SD plants an interruption of the inductive long night inhibits flowering (Zeewart 1962). Coleman (1969) on the above evidence therefore concluded that the mechanism controlling flowering in sugar cane fitted quite well in the general theories established for other plants; but he, however, also pointed out that differences do exist between sugar cane and other plants and stressed the complexity of the mechanism.

Work conducted on some clones of *S. spontaneum* has shown that during the fifteen days preceding the onset of the first histological changes in the apex marking the transition from the vegetative to the floral stage, there is a specific requirement of intermediate days of 12.5 hours; this period would correspond to the photoinductive period in *Xanthium*, which also precedes the onset of initiation. However, it has also been shown that, during this period, night interruptions (3,000 f.c. minutes) hardly inhibit flowering (Julien, 1969).

This may be contrasted with the work on the hybrid variety H.37-1933 which has shown that when inductive intermediate days are required, night interruptions of 50 f.c. minutes are sufficient to inhibit flowering (Burr, 1950, Coleman, 1963). In order to throw some light on this problem, it is worth considering the results obtained by George and Lalouette (1963) with the hybrid variety C.P. 36-13. They intercalated a period of seven natural days in a lengthy period of long days (already described) and showed that optimum flowering response occurred when natural days were given from the 23rd of February to the 2nd of March, (daylength of approximately 12.5 hours). The initiation of an inflorescence primordium occurs from the 4th to the 6th March in this variety; hence, just prior to this an intermediate day of 12.5 hours is required. Furthermore, night interruptions have their maximum inhibitory effect from the 2nd to the 16th of March, and relatively less effect from the 23rd of February to the 2nd March. This in fact agrees quite well with the results obtained with *S. spontaneum*, and supports the view that prior to initiation intermediate days of 12.5 hours are required, and during this period night interruptions are only slightly inhibitory, whilst just after initiation night interruptions are highly inhibitory. Hence H.37-1933, the variety experimented on in Hawaii, appears to behave differently to daylength and night interruptions as compared to *S. spontaneum* clones Mandalay, 51 N.G. 2 and hybrid variety C.P. 36-13. An alternative explanation to this problem is that in Hawaii, the apices of variety H.37-1933 could have already started to change from the vegetative to the floarl stage on the 1st of September.

Sachs (1956) has suggested a model to explain the intermediate-day requirement observed in sugar cane. On the evidence obtained with the long-short-day plant (LSDP) *Cestrum nocturnum*, he postulates that an intermediate-day plant requires both long and short days for floral induction. The critical photoperiods and nyctiperiods for the two reactions involved overlap, and floral initiation could be possible if continuous treatment with the daylength at which the two reactions overlap were given. This hypothesis, to the author's knowledge, has not so far been verified for sugar cane. Flowering is promoted in long-day plants and inhibited in short-day plants by night interruptions, and as it has been shown that night interruptions are neither promotive nor inhibitory when the intermediate day is required in sugar cane, the view of Sachs (1956) is thus supported. However, further experiments have been designed to verify this hypothesis.

The short-day requirement observed during the initiation of the inflorescence branch primordia, of spikelets primordia and growth of the inflorescence axis is confirmed by the fact that night interruptions are inhibitory to flowering during these stages. In SD plant *Xanthium* the pigment phytochrome controls the dark reactions; the question which remains to be answered is whether the same system exists in sugar cane. The initiation of inflorescence branch primordia is very sensitive to night interruptions and all wavelengths used proved to be inhibitory, so that it is not possible to say whether red was the most inhibitory wavelength. However, during the two subsequent stages, red is highly inhibitory compared to blue and far-red; hence, in this respect, sugar cane behaves like *Xanthium*. But there are reports that the red effect cannot be reversed by far-red in sugar cane (Coleman 1963). It is therefore difficult to conclude on this point and further experiments will have to be conducted. The highly inhibitory effect of green light suggests that there is a pigment system other than phytochrome which is involved in the control of the dark reaction, as green light is the best safety light for phytochrome *in vitro* (Siegelman and Butler, 1965).

It is generally accepted that leaves perceive the right daylength and produce the flowering stimulus. Coleman (1967) has shown that in sugar cane the leaf spindle is essential prior to August 29, that is, prior to the photoinductive period. During this period the presence of leaves is required and their removal reduces initiation. A defoliation experiment on *S. spontaneum* var. 51 N.G. 2 has shown that the removal of the spindle* and first two leaves*

* Leaf position and numbering were defined by the author; *vide Rep. Maurit. Sugar Ind. Res. Inst.* **16** (1968) : 37.

during the initiation of inflorescence branch primordia resulted in inhibition of flowering. When the defoliation treatment is given during the two subsequent stages of development, namely initiation of spikelet primordia and growth of inflorescence, the inhibitory effect is still present, though less marked, (Table 7). It therefore appears that the spindle and young leaves play an important role during the development of the inflorescence primordium from the time of initiation of the inflorescence branch primordia to the early stages of growth of the inflorescence. It is of significance that this corresponds to the period of short-day requirements. When intermediate days are required, leaves do not appear to play an important role in promoting flowering (Table 7). This confirms earlier work on variety Mandalay in which it was shown that complete defoliation prior to the first histological changes in the apex resulted in a slight inhibition of flowering only (JULIEN, 1969).

Table 7. Effect of defoliation treatments on time taken in days for half of the emerging population to flower

	Leaves left on plant		
Stage of Flowering	*All Control*	*Spindle + 1st + 2nd*	*3rd 4th + 5th 6th ...*
42 to 30 days prior to initiation	15	15	16
30 to 18 days prior to initiation	15	15	15
18 to 6 days prior to initiation	15	16	15
Initiation of inflorescence axis	15	16	18
Initiation of branch primordia	15	15	34***
Initiation of spikelet primordia	15	13	27**
Growth of inflorescence	15	14	21*

* Significant at P. 0.05
** ,, P. 0.01
*** ,, P. 0.001

These facts emphasize once more the complexity of the mechanisms involved. It is not intended to discuss the different hypotheses which could be put forward to explain these results until additional experimental evidence is obtained.

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2. THE BREEDING POLICY

J. A. LALOUETTE

Biometry Division

With the evolution of the Biometry Section into a separate division in 1969, it may be interesting to review briefly the development of this unit. Towards the end of 1964, it was decided to attempt a large-scale investigation of parental behaviour based on an analysis of the large amount of information available on crossing and selection work accumulated throughout the years. It was then evident that this could only be achieved with the aid of data-processing equipment. As the Institute did not possess such equipment, slow progress was made in 1964 and 1965. In 1966, the creation of the Biometry Section and the installation of an automatic punch, a sorter and a tabulator enabled more rapid progress to be made. However, as information accumulated, it became evident that the lack of carefully defined selection criteria made the whole investigation difficult and possibly hazardous. It was therefore decieed to postpone temporarily the work already started and, early in 1967, investigations on selection criteria were started. Data-processing equipment was completed by the addition, early in 1968, of an electronic calculator and an interpreter punch and of a verifier in 1969. All dara relevant to selection of cane varieties in 1969 have been dealt with by the Biometry Division. This has now become a routine procedure and accounts for the bulk of the work of the division. It will now be possible to resume investigations on parental behaviour.

The Selection Process

Two stages of the selection process namely Bunch Selection Plots and Variety Trials were reconsidered during the year. The modifications brought about are outlined hereunder.

Bunch Selection Plots

This is the stage in the selection process during which new varieties are planted from cuttings for the first time. Each variety is represented by a single stool and a control variety is planted at every tenth location.

Selection is carried out generally in plant cane, early in the season, starting in the last week of June. Refractometric Brix is the criterion at this stage.

During the years 1967 and 1968, control stools were assessed first, data analysed and parameters of selection decided for each trial. The refractometric Brix of varieties undergoing selection was then measured and selection carried out. It is known, however, that at this time of the year Brix increases rapidly. It has therefore been decided that both varieties and control stools should be assessed at the same time. Selection is then based on the results obtained in control stools, as before. The added advantage of this system is that a complete assessment can be made before starting to select, and the selection pressure adjusted, if necessary, to provide the optimal number of varieties to be planted at the next stage. While taking measurements for Brix, varieties are also graded for yield of cane in the following categories :

(i) Dead varieties.
(ii) Very poor varieties which can only provide a few cuttings to plant the next stage 0
(iii) Varieties which can provide cuttings to plant one line of 15 feet at the next stage = 1
(iv) Varieties which can provide cuttings to plant two lines of 15 feet at the next stage = 2
(v) Varieties exceptionally good, i.e. which would provide cuttings for three lines of 15 feet at the next stage = 3

At the next stage of Selection, the Propagation Plot stage, the plot size is one line of 15 feet and each variety is usually planted simultaneously in the humid and super-humid zones. The coding, adopted above, while being a yield grading, also provides a clue, at the time of selection, as to the availability of planting material for each variety.

Selection Criteria : As during the past two years, the truncation point for Brix remained at the 75% probability level in the upper tail area of the distribution. Formerly, however, only those varieties providing sufficient planting material for the two zones were selected. In 1969, varieties making the grade for Brix but providing planting material for one zone only were also selected and planted in the humid zone. In addition, varieties exceptionally good on the above yield grading but reaching only the 75% probability level in the lower tail area of the distribution for Brix were also planted in two zones in Propagation Plots.

Variety Trials

This is the final stage of testing. All varieties selected from First Selection Trials, which follow the Propagation Plot stage, are planted simultaneously on estate lands in the 4 main climatic zones of the island. Two important modifications were implemented during 1969. The first one regards the timing of harvest operations which now extend from the 1st week in September to the last week in October. Virgins are harvested first and the successive ratoons are harvested at 54 weeks intervals. September and October have been chosen because these are generally the two months during which sucrose content is at a maximum. Comparisons of varieties at the same age, during this period, should provide a more accurate assessment of their sugar potential.

The second modification concerns the system of testing varieties at the final stage. It has been the practice, so far, to make the final assessment of varieties after the third ratoon, in variety trials. At this point, the experimenter is faced with three alternatives depending on the merits of the vareities under test :

(i) Varieties which are decidedly inferior to the controls and which can be rejected forthwith.
(ii) Varieties which are just comparable to the controls; the evidence from the trials being insufficient to either reject or release them.
(iii) Varieties which are superior to the controls and which would therefore be considered for release to the planting community.

Varieties falling into the first category present no problem and no further comment is necessary. Varieties falling into either of the remaining two categories however deserve some more consideration. It must be remembered, that at the final stage of testing, a large amount of the funds available for the production and testing of varieties has already been spent. It is not the time, therefore, to reject varieties unless they are really inferior to the available cultivars. Varieties which are assessed as comparable to the controls could prove slightly superior when tested in a more accurate trial or under a more specific environment. On the other hand, it is not desirable to go on harvesting trials which include only a few varieties of interest just in order to obtain additional information on them. Further, it must be pointed out that superior varieties are constantly being released, with the result that comparison of those varieties still under test with the newly released ones is desirable.

It has therefore been decided to adopt a system which includes multiplication plots and two additional series of trials at the final stage so that a proper assessment for the release or rejection of varieties may be made. The system is depicted in the flow chart (fig. 18), the essential features being as follows :

(i) Multiplication Plots

These are not selection stages and serve only to provide top quality planting material. When multiplication plots are planted, it is not possible usually to predict which varieties will be eventually rejected, re-tested or released. It is important, therefore, that all varieties included in Variety Trials should be replanted. Planting material will thus be available for rapid propagation of released varieties, as well as for planting varieties which have to be tested in additional trials.

(ii) Trials by Estate Agronomists

In the normal sequence of operations, trials by Estate Agronomists will include varieties considered the best in variety trials after analysis of one or two years' results. They will provide comparisons of varieties still under test with recently released varieties, whenever necessary, and the additional information available may lead to the earlier discard of variety trials including but a few varieties of interest. Furthermore, as these trials will be supervised by Estate Agronomists, the latter will soon become familiar with the new varieties.

(iii) Final Test Trials

Whenever these have to be planted, they will include all varieties not re-tested in trials by Estate Agronomists on which no decision can be reached from results of Variety Trials. This three-stage testing system has been designed to provide a continuous flow of information about varieties when they are in the final stage of selection and, should therefore, it is hoped, not only supply more precise information but also speed up the release or rejection of new varieties.

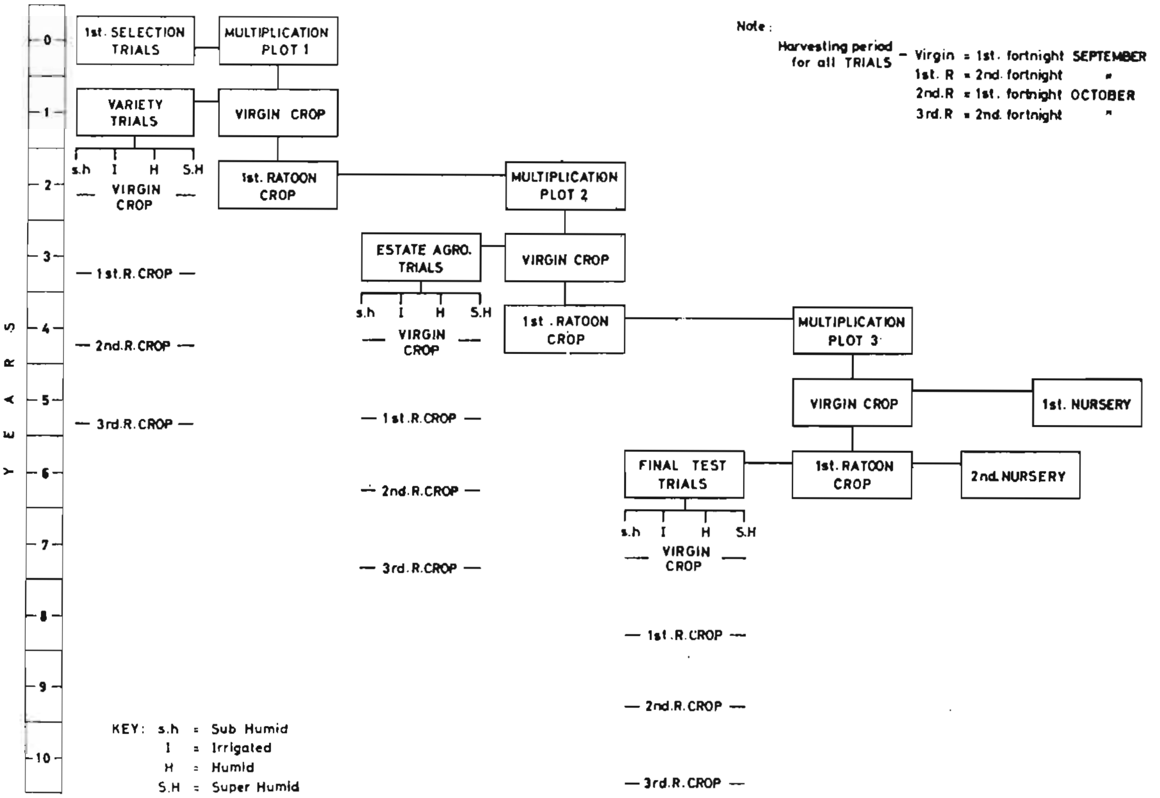


Fig. 18. Flow chart of variety testing at the final stage.

3. CROSSING AND SELECTION

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

Crossing

Flowering was average in 1969. On the whole 726 crosses were made, involving 140 combinations with 100 different parents, of which 53 were females, 32 males, and 15 male and female, 144 crosses were made for breeding purposes. A summary of crossing work is given in Table 8.

Table 8. Crossing work in 1969

Station	*No. of crosses*
Réduit	624
Pamplemousses	102
Total ...	726

As stated in the report for 1968, germination having been on the low side during the two preceding years, a few experiments were carried out to investigate this problem. Preliminary results are discussed in another section of this report.

Moreover, a better control at all stages of the crossing work led to a much better germination than that obtained in 1968. A summary of sowing done in 1969 and transplanting in 1970 is given in Table 9.

The 25,906 seedlings (1968 series) planted in 1969 are to be selected near the end of March 1970.

Three new breeding plots were planted, one comprising 12 selected noble varieties at Médine, another at Réduit (67 varieties), and the third at Pamplemousses (46 varieties).

Table 9. Sowing in 1969 and Transplanting in 1970 (M/69 Series)

	Year of crossing	*No. of combinations*	*Crosses*		*Seedlings*	*transplanted*
			No. sown	*No. potted*	*Locations*	*Seedlings*
Nobles & Nobilizations	1969	31	139	121	7,514	38,285
Commercials	1968 1969	121	640	524	16,171	56,824
Total		152	779	645	23,685	95,109

Selection

Seedlings. The 15,488 seedlings, (1967 series) planted in February-March 1968, mostly as single seedlings, were selected in March-April 1969, and 10,688 stalks were planted in 3 environments : Réduit, Pamplemousses and Minissy.

Bunch Selection Plot. Selection started at the end of June with the brixing of controls and varieties in B.S.P. The total number of varieties standing in B.S.P. in 1969 was 20,353. Selection was carried out in 14,339 varieties only yielding 1,554 canes of the 1966 series, and 8 of the 1964 series with sufficient planting material to plant the 1,562 selections in two localities. A further 318 selections (1966 series) were planted in one locality only through lack of planting material. The 6,014 varieties (1966 series) left will be selected in ratoons in 1970.

Propagation Plots (*Ratoons*). 1,292 varieties (778 of the 1963 series and 514 of the 1964 series) planted at Minissy and replicated at Union Park or Belle-Rive were brixed and weighed. 108 varieties were selected from them and planted in First Selection Trials at Belle-Rive, Union Park, Réduit and Pamplemousses.

Propagation Plots (*Virgins*). 1,534 varieties, all of the 1964 series planted in two climatic zones were brixed and weighed. Final selection in them is to be effected in 1970.

First Selection Trials. The 242 varieties present in the 2nd ratoon stage were brixed and weighed, and 24 varieties were selected and sent to Multiplication Plots. Of these, three varieties were selected in two regions. Two other varieties, coming from 1st selection trials planted in 1965, were added to this list, bringing to 26 the number of varieties to be planted in variety trials in 1970.

The 327 varieties in 1st ratoons and virgins were also brixed and weighed.

A summary of selection work in 1969 is given in Table 10.

Table 10. Section work in 1969

Station	*Stalks planted in B.S.P.*	*Varieties planted in Prop. Plots*	*Varieties planted in 1st Sel. Tr.*	*Selections made in 1st Sel. Tr.*
Réduit ...	3,544	—	40	6
Pamplemousses	5,142	—	44	10
Belle Rive ...	—	1,100	83	3
Union Park ...	—	462	21	8
Mon Désert (Minissy)	2,002	1,880	—	—
	10,688	3,442*	188**	27***

* Of this total 1,562 varieties only were duplicated, 318 varieties being planted at Minissy only.

** 52 varieties (12 Mauritius and 40 Foreign) were planted in two regions, making a total of 136 different varieties.

*** Of this number 3 varieties were selected in two different regions, making a total of 24 different varieties, Also, from these 1st Selection Trials, one variety was selected in two regions in 1968 while in 1st ratoons.

4. VARIETY TRIALS

J. A. LALOUETTE

Plantations

(*a*) *Variety Trials*

Two series of trials including 32 varieties were planted in 1969. As usual, each series consists of 4 trials, one in each of the four main climatic zones of the island. The two series were laid out as 4 × 5 rectangular lattices, with 3 replicates, and each trial comprised 16 varieties and 4 controls. The origin of varieties undergoing screening at this stage of selection is given in Table 11.

Table 11. Varieties plantes in Variety Trials

Varieties	*1966*	*1967*	*1969*	*Totals*
M/57 Series	1	1	—	2
M/58 Series	6	—	—	6
M/59 Series	16	22	7	45
M/60 Series	—	20	19	39
M/61 Series	—	—	6	6
Sub total	23	43	32	98
Foreign Varieties ...	4	—	—	4
Total	27	43	32	102
No. of Series ...	3	3	2	8

(*b*) *Trials by Estate Agronomists*

One series of trials was planted in this new stage of selection. It consists of 4 trials, one in each of the four main climatic zones of the island. The design consists of 4 × 4 balanced lattices in 5 replications and accommodates 13 varieties and 3 controls. The origin of varieties planted in this series is given in Table 12.

(*c*) *Final Test Trials*

A special series of two trials was planted in 1969 in an attempt to find varieties adapted to the super-humid areas and suitable for late harvest. The design consists of 4 × 4 balanced lattices, with 5 replicates, and each trial accommodates 14 varieties and 2 controls. Both trials were planted in late August, one at low and the other at high altitude. The virgin crop will be harvested in the first week of November 1970 and the ratoons will thereafter be harvested at 53 weeks intervals. The origin of varieties being tested in this series is given in Table 13.

Table 12. Varieties planted in trials by Estate Agronomists

Varieties			*1969*
M/51 Series	...	...	2
M/57 Series	...	...	1
M/58 Series	...	...	1
M/59 Series	...	...	8
Sub total	...	...	12
Foreign Varieties		...	1
Total	...	...	13

Table 13. Varieties planted in Final Test Trials

Varieties			*1969*
M/51 Series	...	...	1
M/53 Series	...	...	3
M/54 Series	...	...	2
M/56 Series	...	...	1
M/57 Series	...	...	4
M/61 Series	...	...	1
Sub total	...	...	12
Foreign Varieties		...	2
Total	...	...	14

Final Assessment of trials

(*a*) *Variety Trials planted in 1965*

The series of trials planted in 1965 reached the third ratoon in 1969. Analysis of results of the 1st and 2nd ratoon crops revealed the poor performance of the 59 varieties planted. It has been decided, therefore, to abandon these trials before harvest in 3rd ratoons. The 8 varieties of this series which need re-testing were planted in Multiplication Plots in 1969. A summary of results is presented on page 55.

(*b*) *Variety Trials planted in 1963*

The testing of varieties at the final stage having now been streamlined, it was decided to complete the study of the performance of varieties planted in an earlier (1963) series of trials.

Variety M.351/57 has emerged from this group as a suitable candidate for release and the necessary recommendation will be made to the Cane Release Committee in 1970. Data relevant to its performance are presented in Table 14. It should be noted that although the variety has not performed consistently better than the best control it has shown adaptation to the adverse conditions prevailing on the eroded slopes of the super-humid zone where its cultivation should be restricted. Other results of the analysis are presented on page 56.

(*c*) *Variety Trials planted in 1966*

This series of trials will be harvested in third ratoons in 1970. Results will therefore be presented in full next year. The information already available on variety S.17, however, shows that it should be recommended for release along with variety M.351/57. Data relevant to its performance are presented in Table 15.

Results of Variety Trials planted in 1965 (based on 1st and 2nd Ratoons)

Total no. of varieties planted: 59.

Total no. of varieties rejected: 51.

No. of varieties planted in Multiplication Plots for re-testing: 8.

Analysis of rejected varieties

Reasons for rejection	*M/Varieties*	*Others*	*Total*
Highly susceptible to gumming disease	6	3	9
Susceptible to gumming disease	7	—	7
Slightly susceptible to gumming disease; poor performance ...	6	—	6
Resistant to gumming disease; poor performance ...	23	1	24
No information on gumming disease; poor performance ...	4	1	5
Totals	46	5	51

List of rejected varieties

Varieties highly susceptible to gumming disease :

E.17/56, E.38/56, E.74/56, M.518/54*, M.248/57, M.451/57, M.61/58, M.76/58, M.100/58.

Varieties susceptible to gumming disease :

M.107/55, M.423/55, M.217/56, M.124/57, M.266/57, M.329/57, M.482/57.

Varieties slightly susceptible to gumming disease ; poor performance :

M.69/55, M.73/55, M.197/55*, M.91/58, M.94/58, M.112/58.

Varieties resistant to gumming disease ; poor performance :

E.77/56, M.187/54, M.323/54*, M.13/55, M.18/55, M.110/55, M.115/55, M.152/55, M.168/55, M.220/55, M.221/55*, M.426/55, M.267/56, M.303/56, M.358/56*, M.391/56, M.85/57, M.108/57, M.160/57, M.177/57, M.194/57, M.272/57, M.280/57, M.210/58.

Varieties of poor performance; no information on gumming disease reaction :

E. 39/56, M.200/54, M.223/55, M.135/57, M.261/57.

Varieties which need re-testing

The characteristics of the 8 varieties are listed below :

Slightly susceptible to gumming disease :

Varieties	*Parents*	*Characteristics*
M.315/57 :	E.1/37 x M.47/38	— An average performer in the 4 climatic zones.

Resistant to gumming disease :

Varieties	*Parents*	*Characteristics*
M.16/55 :	M.134/32 x M.147/44	— An average performer but with yields rather on the low side ; possibly a mid — to late maturer.
M.259/55 :	B.34104 x M.63/39	— A rich variety which appears to have a wide range of adaptation; it was tested in one trial in 1963.
M.225/56 :	B.34104 x M.213/40	— An average performer in the 4 climatic zones.
M.322/56 :	B.34104 x M.213/40	— An average performer with a slight preference for the sub-humid zone.
M.40/57 :	P.O.J.2878 x Co.290	— A rich variety which shows promise in the sub-humid area.
M.335/57 :	E.1/37 x M.147/44	— Possibly a late maturer; may be adapted to the sub-humid area.
M.158/58 :	B.34104 x M.213/40	— An average performer.

* These five varieties had been tested in 1964 as well.

Results of Variety Trials planted in 1963 (based on 1st, 2nd & 3rd Ratoons)

Total no. of varieties planted : 69

Total no. of varieties rejected : 54

Already released varieties : M.13/53, M.13/56, M.377/56, N : Co.376.

Varieties re-tested in trials by Estate Agronomists, planted in 1969 : M.305/51, M.351/57.

No. of varieties planted in Multiplication Plots for re-testing : 9.

Analysis of rejected varieties

Reasons for rejection	*M/Varieties*	*Others*	*Total*
Highly susceptible to gumming disease	10	—	10
Susceptible to gumming disease	13	1	14
Slightly susceptible to gumming disease; poor performance	2	—	2
Resistant to gumming disease; poor performance ...	19	5	24
No information on gumming disease; poor performance ...	2	2	4
Totals	46	8	54

List of rejected varieties

Varieties highly susceptible to gumming disease :

M.39/49, M.277/51, M.223/53, M.17/55, M.296/55, M.29/56, M.46/56, M.5/57, M·78/57, M.181/57.

Varieties susceptible to gumming disease :

E.127/56, M.132/54, M.7/55, M.260/55, M.262/55, M.401/55, M.85/56, M.145/56, M.189/56, M.220/56, M.245/56, M.107/57, M.130/57, M.393/57.

Varieties slightly susceptible to gumming disease; poor performance :

M.61/46, M.248/48.

Varieties resistant to gumming disease; poor performance :

E.3/48, E.88/56, E.118/56, P.T.43-52, Q.47
M.658/51, M.98/52, M.110/52, M.101/54, M.115/54, M.41/55, M.67/55, M.370/55, M.412/55, M.15/56, M.27/56, M.28/56, M.66/56, M.229/56, M.329/56, M.392/56, M.29/57, M.89/57, M.188/57.

Varieties of poor performance; no information on gumming disease reaction :

E.101/56, Q.56, M.382/52, M.100/55.

Varieties which need re-testing

The characteristics of the 9 varieties are listed below:

Resistant to gumming disease :

Varieties	*Parents*	*Characteristics*
C.B.38-22 :	C.P.27-139 x P.O.J.2878	— A rich variety with yields rather on the low side.
M.75/55 :	E.1/37 x M.213/40	— A rich variety which seems adapted to the super-humid area only.
M.255/55 :	B.34104 x M.63/39	— An average performer.
M.259/55 :	B.34104 x M.63/69	— Already described on page 55
M.63/56 :	B.37172 x E.1/37	— A rich variety, possibly mid-to late-maturer with yields somewhat on the low side.
M.69/56 :	B.34104 x M.63/39	— An average performer.
M.198/56 :	B.34104 x M.63/39	— An average performer.
M.325/56 :	B.34104 x M.213/40	— A rich variety with yields somewhat on the low side.
M.84/57 :	B.34104 x M.213/40	— A good yielder which seems adapted to the sub-humid area.

Table 14. Performance of Variety M.351/57*

Parentage : N : Co.310 × M.99/34 — Reaction to gumming disease : resistant

	YEAR	CROP CYCLE	BELLE VUE Sub-Humid Var.	Control	S.E. ±	REUNION Irrigated Var.	Control	S.E. ±	UNION ST. AUBIN Humid Var.	Control	S.E. ±	BRITANNIA Super-Humid Var.	Control	S.E. ±
WEIGHT (Tons/Arpent)	1965	1R	24.5	(25.5)	2.05	29.3	(24.1)	3.01	36.1	(38.1)	3.62	39.5	(33.3)	2.72
	1966	2R	24.1	(21.7)	1.63	29.4	(28.1)	1.83	38.5	(33.2)	2.86	32.0 S	(22.4)	3.60
	1967	3R	28.3	(27.1)	1.94	36.9	(33.7)	2.91	41.7	(38.0)	1.84	32.5	(30.0)	2.12
		1R + 2R + 3R	25.6	(24.7)	1.47	31.9	(28.2)	2.07	38.8	(36.3)	2.24	35.4	(30.5)	2.74
I.R.S.C. % Cane	1965	1R	10.0 S	(9.7)	0.22	12.4S	(11.2)	0.24	11.3	(11.6)	0.26	8.1	(8.9)	0.42
	1966	2R	11.4 R	(12.2)	0.23	12.2	(11.5)	0.28	9.5 R	(11.4)	0.22	9.9	(9.9)	0.37
	1967	3R	8.9 R	(9.7)	0.29	11.6	(11.4)	0.36	9.4	(9.8)	0.31	9.1	(10.0)	0.40
		1R + 2R + 3R	10.0	(10.4)	0.19	12.0 S	(11.4)	0.23	10.0 R	(10.9)	0.20	8.7	(9.5)	0.46
SUCROSE (Tons/Arpent)	1965	1R	2.4	(2.5)	0.20	3.6 S	(2.7)	0.34	4.1	(4.4)	0.40	3.2	(2.9)	0.28
	1966	2R	2.8	(2.6)	0.20	3.6	(3.2)	0.21	3.6	(3.8)	0.32	3.2	(2.2)	0.41
	1967	3R	2.5	(2.6)	0.20	4.3 S	(3.6)	0.22	3.9	(3.7)	0.19	3.0	(2.9)	0.25
		1R + 2R + 3R	2.6	(2.6)	0.15	3.8 S	(3.1)	0.20	3.9	(4.0)	0.24	3.1	(2.9)	0.34
PROFITABLE SUCROSE (Tons/Arpent)	1965	1R	1.5	(1.4)	0.12	2.4 S	(1.7)	0.22	2.7	(2.9)	0.27	1.6	(1.5)	0.19
	1966	2R	1.8	(1.8)	0.14	2.4 S	(2.0)	0.14	2.1	(2.4)	0.21	1.9	(1.3)	0.28
	1967	3R	1.4	(1.6)	0.12	2.8 S	(2.3)	0.11	2.3	(2.2)	0.14	1.7	(1.8)	0.19
		1R + 2R + 3R	1.6	(1.6)	0.10	2.5 S	(2.0)	0.11	2.4	(2.5)	0.16	1.7	(1.7)	0.24

CONTROL VARIETIES :

	BELLE VUE	REUNION	UNION ST. AUBIN	BRITANNIA
	M.147/44	M.147/44 M.253/48	M.147/44 M.93/48	E.1/37 M.93/48

PLANTING AND HARVESTING :

		BELLE VUE Date	Age (Wks)	REUNION Date	Age (Wks)	UNION ST. AUBIN Date	Age (Wks)	BRITANNIA Date	Age (Wks)
Planted		15. 5.63	—	30. 8.63	—	17. 8.63	—	26. 7.63	—
Harvested	V	26. 8.64	67	21.10.64	59	27.10.64	62	22.10.64	65
	1R	14.10.65	59	27.10.65	53	6.10.65	49	20. 7.65	39
	2R	30. 9.66	50	5.10.66	49	28. 9.66	51	18. 8.66	56
	3R	18. 8.67	46	23. 8.67	46	24. 8.67	47	25. 7.67	49

* (i) Figures in brackets refer to best controls in each trial.

(ii) S = Probably superior to best control.
R = Probably inferior to best control.

(iii) All results based on 3 replicates, except in the super-humid region where the 2nd ratoon and cumulative results are based on 2 replicates.

(iv) The variety is not inferior to the best control in the super-humid zone it has been observed that it performs better on the eroded slopes of that area.

Table 15. Performance of Variety S.17*

Parentage : P.O.J. 2725 × F.28 — Reaction to gumming disease : resistant

	YEAR	CROP CYCLE	MON LOISIR Sub-Humid			MEDINE-PALMYRE Irrigated			GROS BOIS Humid			F.U.E.L. Super-Humid		
			Var.	Control	S.E. ‡	Var.	Control	S.E. ‡	Var.	Control.	SE. ‡	Var.	Control	S.E. ‡
WEIGHT (Tons/Arpent)	1967	V	30.2	(26.9)	2.11	63.7 R	(71.3)	3.05	46.4	(52.3)	3.27	42.7 R	(49.8)	1.89
	1968	1R	44.4	(46.3)	3.15	52.9	(60.9)	3.74	33.2	(31.7)	1.82	45.2 S	(32.5)	3.29
	1969	2R	48.0	(44.6)	1.48	47.2 R	(57.3)	3.87	33.0	(31.1)	2.11	36.2	(36.3)	2.45
		V + 1R + 2R	40.9	(38.3)	1.31	54.6 R	(60.3)	2.58	37.5	(37.3)	1.90	41.3	(39.5)	1.94
I.R.S.C. % Cane	1967	V	10.9 S	(10.0)	0.39	11.1 S	(9.3)	0.39	12.2 S	(10.6)	0.25	10.8	(10.1)	0.37
	1968	1R	12.0	(11.5)	0.31	11.3 S	(9.9)	0.32	14.0 S	(11.9)	0.27	10.8 S	(10.0)	0.23
	1969	2R	12.8 S	(11.9)	0.28	12.2 S	(11.1)	0.30	13.3 S	(11.4)	0.27	12.3 S	(11.2)	0.32
		V + 1R + 2R	12.0 S	(11.3)	0.22	11.5 S	(9.9)	0.26	13.1 S	(11.2)	0.17	11.2 S	(10.4)	0.23
SUCROSE (Tons/Arpent)	1967	V	3.3 S	(2.6)	0.24	7.1 S	(6.1)	0.35	5.6	(5.6)	0.35	4.6	(5.0)	0.20
	1968	1R	5.3	(5.1)	0.38	6.0	(5.8)	0.40	4.7 S	(3.8)	0.23	4.9 S	(3.2)	0.30
	1969	2R	6.1 S	(5.0)	0.21	5.8	(6.2)	0.49	4.4 S	(3.3)	0.28	4.4	(4.1)	0.30
		V + 1R + 2R	4.9 S	(4.1)	0.18	6.3	(5.8)	0.29	4.9 S	(4.2)	0.22	4.6 S	(4.1)	0.19
PROFIATBLE SUCROSE Tons/Arpent	1967	V	2.1 S	(1.5)	0.18	4.5 S	(3.3)	0.27	3.8	(3.5)	0.24	2.9	(3.1)	0.13
	1968	1R	3.6	(3.2)	0.27	3.9	(3.3)	0.28	3.3 S	(2.5)	0.17	3.1 S	(1.9)	0.17
	1969	2R	4.2 S	(3.2)	0.17	3.9	(4.0)	0.34	3.1 S	(2.1)	0.20	3.0	(2.5)	0.21
		V + 1R + 2R	3.3 S	(2.6)	0.13	4.1 S	(3.5)	0.20	3.4 S	(2.7)	0.15	3.0 S	(2.5)	0.12
CONTROL VARIETIES :				M.147/44 M.93/48 M.442/51			M.147/44 M.93/48 M.442/51			M.147/44 M.93/48 M.442/51			M.147/44 M.93/48 M.442/51	

PLANTING AND HARVESTING		Mon Loisir *Date*	*Age (Wks)*	Medine-Palmyre *Date*	*Age (Wks)*	Gros Bois *Date*	*Age (Wks)*	F.U.E.L. *Date*	*Age (Wks)*
Planted		5. 5.66	—	17.7.66	—	13. 4.66	—	28.4.66	—
Harvested	V	15. 9.67	71	2.8.67	54	22. 8.67	71	30.8.67	70
	1R	5. 9.68	51	9.8.68	53	15. 8.68	51	25.7.68	47
	2R	3.10.69	56	30.9.69	60	1.10.69	59	29.9.69	62

* (i) Figures in brackets refer to best controls in each trial.

(ii) S = Probably superior to best control.
R = Probably inferior to best control.

(iii) All results based on 3 replicates.

5. RESULTS IN FINAL VARIETY TRIALS

P. HALAIS & G. ROUILLARD

This series of trials, located at eleven representative sites on sugar estate land, was planted in 1966. Results were obtained for first and second ratoons. The planning of the experiment is as described in the Annual Report for 1960, p. 84.

The eight varieties studied comprised :

- 2 contrasting controls, M.93/48 and M.442/51;
- 1 variety M.147/44, hitherto used as control, for purposes of comparison with the new controls;
- 4 newly released varieties : M.99/48, M.409/51, M.13/53 and M.13/56;
- 1 unreleased variety Ebène 74/56.

The important feature of these Final Variety trials is that the ratoons are reaped at the approximate age of 12 months at three different times, early (E), middle (M), and late (L) in the crushing season.

Three doses of sulphate of ammonia supplying 0, 30 and 60 kg N/arpent per annum were given in order to obtain, in addition to varietal performance, information on the differential response of the new varieties to nitrogen, the key to cane fertilization.

Foliar diagnosis is conducted regularly on all the trials in order to evaluate the variety corrections for the various nutrients. The trials also serve as a check on the interpretation of foliar diagnosis in relation to nitrogen fertilization.

The results which are averages for 1st and 2nd ratoons are given in terms of Profitability Indices [0.01 TCA (SM – 4)]. The whole series consisted of 1,584 plots which were weighed and analysed for sucrose in 1968 and 1969.

The first step was to calculate for each trial the combined (E, M, L) profitability indices of the two contrasting control varieties, M.93/48 and M.442/51, the differential behaviour of which under field conditions is well known. The results are given in Table 16. Three groups of ecological conditions were thus obtained : Group I for conditions where M.442/51 had substantially outyielded M.93/48 ; Group II where M.442/51 and M.93/48 were at par; and Group III where M.442/51 was outyielded by M.93/48 by a large margin.

Table 16. Grouping of results according to profitability indices of controls

			Profitability Index		
			M.442/51	*M.93/48*	*Difference*
Group I M.442/51 > M.93/48					
	Agro 14/66	La Mecque	2.10	1.67	+ 0.43
	8/66	Beau Vallon	2.33	1.95	+ 0.38
	9/66	Beau Séjour	2.62	2.35	+ 0.27
Group II M.442/51 M.93/48					
	Agro 13/66	Solitude	1.95	1.85	+ 0.10
	7/66	Mt Choisy	1.97	1.92	+ 0.05
	11/66	Fuel	3.12	3.14	— 0.02
	6/66	Belle Vue	1.66	1.79	— 0.13
Group III M.442/51 < M.93/48					
	Agro 12/66	Olivia	2.44	2.61	— 0.17
	17/66	Hermitage	1.47	1.79	— 0.32
	15/66	New Grove	2.04	2.67	— 0.63
	16/66	Mon Désert-Alma	1.31	2.15	— 0.84

The averages for each of the eight varieties and three dates of harvest were then calculated from the first three trials to constitute Group I results; from the next four trials to constitute Group II results; and from the last four trials to constitute Group III results. Table 17 gives the ratings in terms of profitability indices for the three best performers only. It is obvious that the differences in profitability indices should also be taken into account.

Table 17. Summary of results obtained in Final Variety Trials (Agro 1966 Series)

Ecological Grouping	*Group I (M.442/51 > M.93/48)*			*Group II (M.442/51 = M.93/48)*			*Group III (M.442/51 < M.93/48)*		
Time of reaping (12 months ratoons)	*Early*	*Middle*	*Late*	*Early*	*Middle*	*Late*	*Early*	*Middle*	*Late*
Plot replications in 2 years	*18*	*18*	*18*	*24*	*24*	*24*	*24*	*24*	*24*
Controls									
M.442/51		*2.60**	*2.56**			2.53***			
M. 93/48								*2.42**	*2.60**
Variety previously used as control									
M.147/44	1.96***			1.94***			1.88**		
New Varieties									
M. 13/56	*2.24**	2.46***	2.36***	*2.57**	*2.44**	*2.62**	*1.96**		
M.409/51	1.96***	2.47**	2.47**		2.27***	2.54**	1.83***	2.19**	
M. 99/48									2.29***
M. 13/53	2.12**			2.26**	2.40**				
Ebène 74/56								2.17***	2.32**

Note : As results are given for the three best performers only, the asterisks stand for 1st, 2nd and 3rd ratings based on profitability indices.

The condlusions which can be derived are as follows :

M.442/51 This cane should never be reaped early in the season. It is the best of the group for mid-season and late harvesting under Group I ecological conditions. However, unlike M.93/48 it is not suited to Group III conditions.

M.93/48 The variety should not be reaped early. It is the best for mid-season and late harvesting under Group III conditions. It is not suited to conditions prevailing under Groups I and II.

M.147/44 This variety will shortly be removed from the approved list on account of its susceptibility to gummosis. It is confirmed that the remaining fields under M.147/44 should be harvested early.

M.13/56 This variety is the oustanding revelation of this series of trials. Although it should undoubtedly be harvested early in the season, it still performs well under the ecological conditions of Groups I & II even when reaped later in the season. The cane has an unusual appearance with its small and narrow leaves, and is resistant to cyclonic winds.

M.409/51 This variety only attracts moderate interest. Furthermore, it has shown susceptibility to gummosis.

M. 99/48 Is the poor performer of the group and is also susceptible to yellow spot.

M. 13/53 A variety which should be harvested early under ecological conditions of Groups I & II. Cane yields are on the low side but sucrose content is the highest of the group. However, it has been consistently outyielded by M.13/56 on the basis of profitability indices.

Ebène74/56 The variety has a very low sucrose content especially when reaped early in the season. It will not be released.

An important conclusion is that it is clear that M.13/56 is an ideal replacement for the doomed variety M.147/44, the cane adapted to the ecological conditions of both Groups I and II for early harvest. However, no suitable variety for early reaping under Group III conditions has emerged from this series of Final Variety trials. The selection of a variety for such conditions constitutes one of the major aims of the Institute. The profitability index of the best variety reaped early (1.96) is too low, for the ecological conditions of Group III in which indices of 2.42 and 2.60 are reached for mid-season and late harvestings respectively.

In three out of the eleven trials, no response to nitrogen fertilization was observed. These are: Agro 6/66 (Belle Vue), 13/66 (Solitude) and 17/66 (Hermitage).

Table 18 gives the profitability indices, corrected for the cost of nitrogen (30 kg N corresponds to 100 kg of sugar), and refers to the eight trials in which responses to 30 N as compared to 0N were observed.

In spite of the small number of replications, the results are nevertheless interesting. It appears, on the whole, that response to N is usually at its highest level at the time best suited for harvest of the variety.

Thus, highest responses were obtained when varieties M.13/56, M.147/44, M.13/53 were reaped early (E) and varieties M.442/51, Ebène 74/56, late (L).

Table 18. Response to nitrogen expressed in terms of profitability indices

Date of harvest	*Early*	*Medium*	*Late*
Plot replications in 2 years	16	16	16
M.93/48	+ 0.56	+ 0.51	- 0.38
M.99/48	+ 0.41	+ 0.48	- 0.56
M.442/51 ...	+ 0.24	+ 0.41	0.52
M.409/51 ...	+ 0.28	+ 0.48	+ 0.39
M.147/44 ...	+ 0.42	+ 0.40	+ 0.31
Ebène 74/56 ...	+ 0.23	+ 0.22	0.53
M.13/56	+ 0.44	+ 0.16	- 0.11
M.13/53	+ 0.26	+ 0.21	- 0.12
Averages ...	*+ 0.36*	*+ 0.35*	*+ 0.37*

6. I. RESULTS OF EXPERIMENTS ON SOIL STERILIZATION WITH METHYL BROMIDE

L. P. NOEL, P. R. HERMELIN, R. JULIEN & S. DE VILLECOURT

During the past two years the number of seedlings produced per cross has been relatively on the low side. Investigations were therefore started to determine whether methyl bromide used as a soil sterilizer was having any effect on germination.

Sterilization* of the sowing mixture with methyl bromide was planned so that on the sowing date, the same for all treatments, four time intervals between treatment with methyl bromide and sowing could be obtained. The time intervals used were 2, 4, 8 and 16 days. Fuzz from two combinations : N:Co.310 × 58 B.38 and Co.976 × M.240/59 were used in the experiment, which consisted of 4 replicates each with 8 plots. The same weight of fuzz from each combination was sown in a tray and this constituted one plot. The number of seedlings in each plot was recorded at frequent intervals. A mean was calculated for each treatment and is given in fig. 19.

In all treatments the number of seedlings increased gradually and reached a maximum value 12 days after sowing. It may be assumed that germination was then completed. However, the total number of seedlings obtained when germination was completed is significantly different in the different treatments. Sowing at sixteen and eight days intervals gave the highest number of seedlings whilst sowing at two and four days intervals gave the lowest. It therefore appears that residual methyl bromide was still present after 4 days aeration and may have killed a certain percentage of seeds before they germinated. Furthermore, survival of germinated seedlings in the 8-and 16-day treatments was very high, and in fact in the 16-day treatment approached 100 %. However, in the 2-and 4-day treatments

* 1 lb. of methyl bromide was used for 27.3 cu. ft. of mixture, rate recommended for control of damping off organisms in well rotted compost or manure.

the seedlings progressively died, and out of a mean number of 120 germinated per tray, only 20 survived in the 4-day treatment. It was also observed that among the seedlings which had survived, many showed an abnormal development of leaves and root system. Several dying seedlings had swollen root tips. Moreover the root system was very often poorly developed as compared to normal seedlings, and the leaves were twisted. Residual methyl bromide had also an effect on the subsequent growth of seedlings. The slower growth rate of seedlings in the 2- and 4-day treatments as compared to the normal growth rate in the 8-and 16-day treatments is illustrated in fig. 20 and Pl. III.

It therefore appears that the soil must be well aerated for at least eight days, prior to sowing, in order to avoid the deleterious effects of methyl bromide, at the rate applied, on germination and growth of seedlings. Experiments will have to be set up to determine whether lower rates of methyl bromide are less inhibitory to germination, and also whether at these lower rates the control of weeds and pathogens is adequate.

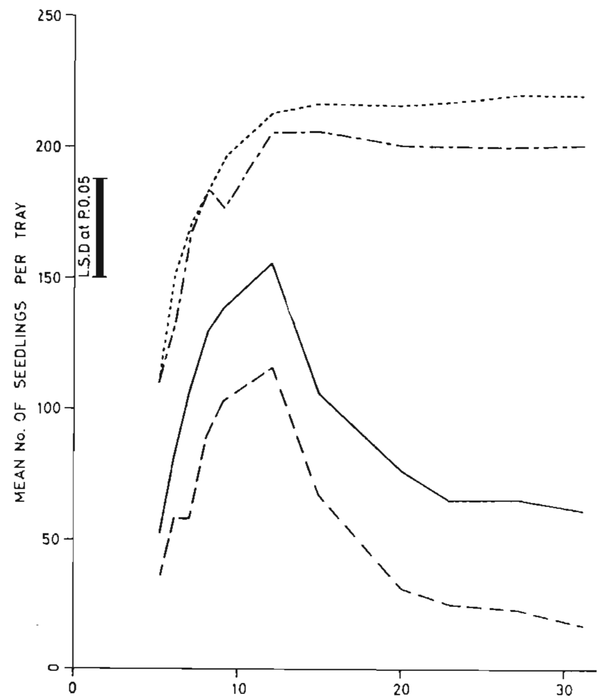


Fig. 19. Effect of time interval between treatment with methyl bromide and sowing on germination and survival of seedlings.

Line = Sown 2 days after treatment
Dashes = Sown 4 days after treatment
Dashes & Dots = Sown 8 days after treatment
Dots = Sown 16 days after treatment

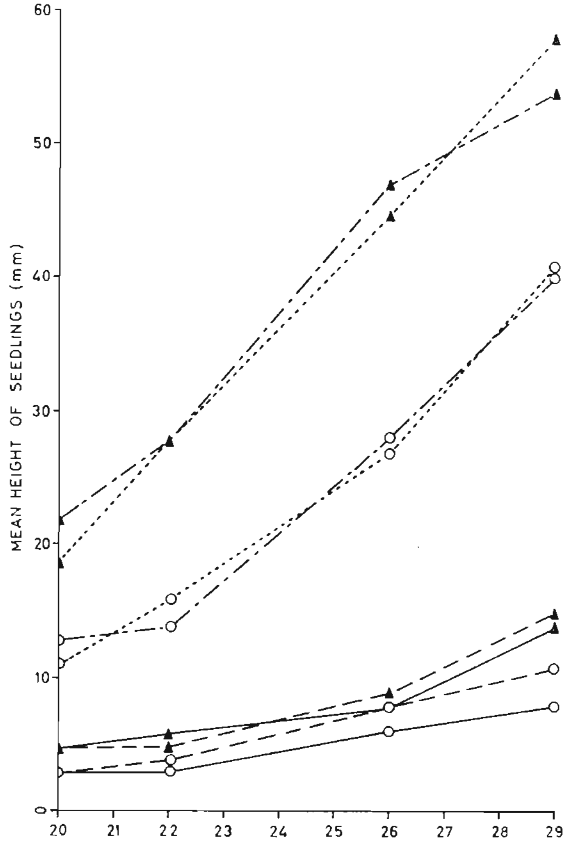


Fig. 20. Effect of time interval between treatment with methyl bromide and sowing on growth of seedlings.

Triangles = N:Co.310 × 58 B.38
Circles = Co.976 × M.240/59
Line = Sown 2 days after treatment
Dashes = Sown 4 days after treatment
Dashes & Dots - Sown 8 days after treatment
Dots Sown 16 days after treatment

8 Days V/s 2 Days

16 Days V/s 2 Days

8 Days V/s 4 Days

16 Days V/s 4 Days

Effect of methyl bromide on germination and growth rates of seedlings (5 weeks after sowing)

6. II. RESULTS OF EXPERIMENTS ON THE USE OF PRESERVATIVE SOLUTIONS DURING CROSSING

L. P. NOEL, P. R. HERMELIN, R. JULIEN & S. DE VILLECOURT

In an attempt to elucidate the factors which might influence the production of seedlings per cross, investigations were conducted during the past two years on the keeping quality of the preservative solution used.

The loss of sulphur dioxide from the preservative solution which contains :

Sulphur dioxide	...	100 p.p.m.
Orthophosphoric acid	...	50 p.p.m.
Nitric acid	...	25 p.p.m.
Sulphuric acid	...	25 p.p.m.

was first considered. The amount of sulphur dioxide was estimated by titrating a known amount of iodine liberated from a mixture of potassium iodate and iodide against the sulphur dioxide (SKINNER & BERDING). It was found that the rate of loss of SO_2 from uncovered buckets was very rapid, and that covering the bucket with polythene reduced the rate of loss although, within 4 days, a solution containing originally about 100 p.p.m. had lost all its SO_2.

Further experiments were therefore conducted to compare covered against uncovered buckets, and changed against unchanged preservative solution. The practice adopted so far was to change the solutions every three days in uncovered buckets; hence, this treatment is taken as control. The number of seedlings produced per cross for the four different treatments and two combinations are shown in fig. 21.

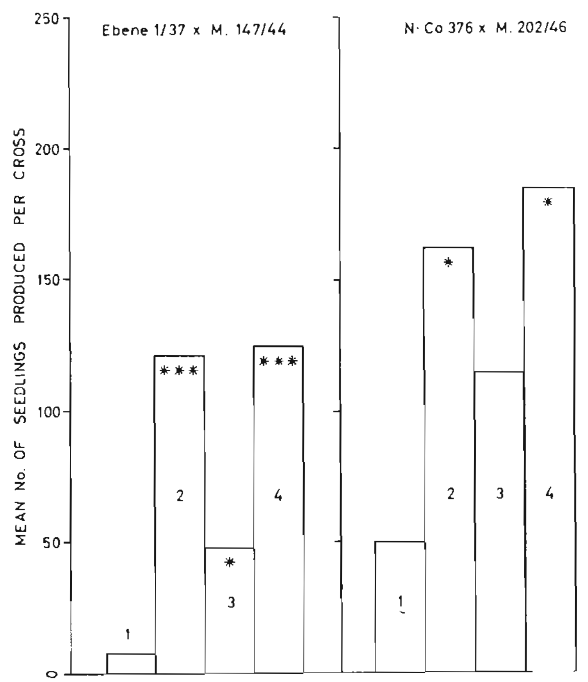


Fig. 21. Effect of changing solution and covering containers with polythene on production of seedlings.

Column 1 = Changed, not covered
Column 2 = Not changed, not covered
Column 3 = Changed, covered
Column 4 = Not changed, covered

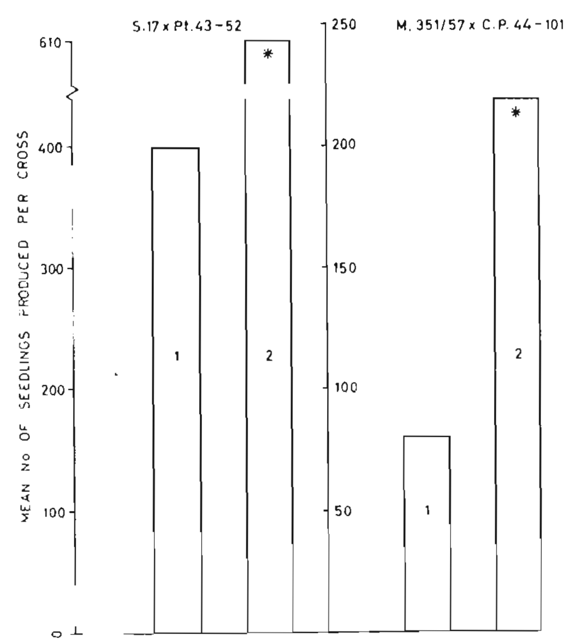


Fig. 22. Effect of changing solution on production of seedlings.

Column 1 = Changed, not covered

Column 2 = Not changed, not covered

Covering the buckets with polythene resulted in the production of a higher number of seedlings per cross, as compared to control (significant at P. 0.05). The effect of not changing the solution was more marked than covering with polythene. Significant differences at a probability of 0.001 were obtained in one experiment, in which solutions not changed in open buckets were compared to controls. These results have been confirmed in experiments involving two other pairs of parents (fig. 22). It seems therefore that not changing the preservative solutions has no deleterious effect on seedling production. In fact, there are strong indications that this procedure may be an improvement on control. Experiments will be conducted on a larger scale next year in an attempt to eludidate the above results.

REFERENCE

SKINNER, J. C. & BERDING N. (1969). Iodometric determination of SO_2 in crossing solution. (Personal communication)

Pleocyta sacchari infection on stool of M.13/56 after severe drought

Visual assessment of leaf infection by Yellow Spot (*Cercospora kœpkei*)
From left to right : 5%, 10%, 20%, 40%, 60% and > 80%.

CANE DISEASES

CLAUDE RICAUD

1. GUMMING DISEASE

Disease situation

Dry conditions which prevailed during the earlier part of the growing season hindered the dissemination of the pathogen, hence foliar infection. The disease was thus hardly seen in commercial plantations at the beginning of the year, the lowest incidence since the outbreak of the new epidemic in 1964. However, with the late-coming rains, infection spread rapidly and, as a result of the second drought period, widespread systemic infection occurred in certain fields. After harvest, the number of cases of systemic infection, with leaf chlorosis on young shoots, in fields of M.147/44, particularly in the North, was noticeably higher than in previous years.

Once again, the existence of certain areas, where the pathogen seems to be more virulent, was observed. Thus, on one estate, on dark magnesium clay soils, surrounded by hills, several varieties showed higher susceptibility than usual. The promising variety M.305/51, hitherto classed resistant, showed high susceptibility to foliar infection in that area, a reaction which has not been observed during surveys in other areas.

Resistance trials

Four resistance trials were concluded : one, the first-stage testing, the other three, the replicated second-stage testing. Infection was rather low in the first-stage trial with the new strain of the pathogen as the trial had to be inoculated fairly late. Table 19 summarizes the results obtained in this trial.

For the first time, since the implementation of the scheme for testing at two stages along the selection line, varieties which had previously been screened, reached the second-stage testing. The final rating of the 36 varieties included in the replicated second-stage trials was based on their overall behaviour towards both old and new strains and their reaction at the first-stage testing. The proportion of resistant and susceptible varieties in these trials, which included varieties selected from first selection trials in 1968, are presented in Table 20.

Table 19. Reaction of varieties to the new strain of the pathogen in the gumming resistance trial (first-stage testing)

*Rating**			*No. of varieties*
Resistant		I	14
		II	54
Susceptible		III	27
Highly susceptible	Foliar infection	IV	4
	Systemic infection	V	0
		VI	1
		VII	0
		Total no.	100

* Numbers correspond to the following ratings :
I = Absence of leaf stripes.
II = Few short stripes on old leaves.
III = Long stripes on old leaves, short stripes on young leaves.
IV = Heavy striping.
V = Heavy striping and chlorosis.
VI = Gum exudation from stalks, after sweating test.
VII = Death of stalks.

Table 20. Proportion of resistant and susceptible varieties coming out of first selection trials in 1968 (final rating)

Reaction		*No. of varieties*	*Percentage*
Resistant		27	75
Slightly susceptible		2	5.5
Susceptible		4	11.1
Highly susceptible	Foliar Infection	2	5.5
	Systemic Infection	1	2.9

The percentage of resistant varieties is high but this can be attributed to the fairly low level of infection in the trials with the new strain both at the second and first-stage testings, the latter having been carried out in an area where gumming disease is not usually severe. Many of the varieties will have to be re-tested.

The reaction of some varieties at present in the final stages of selection is as follows :

Resistant (2)*:	M.16/55,	M.75/55,	M.255/55,	M.259/55,	M.63/56,	M.69/56,
	M.198/56,	M.225/56,	M.322/56,	M.325/56,	M.40/57,	M.84/57,
	M.335/57,	M.9/58,	M.121/58,	M.128/58,	M.124/59,	M.384/59,
	M.438/59,	B.52107,	C.B.38-22.			
Moderately resistant (4):	M.356/53					
Slightly susceptible (5):	M.428/51,	M.144/56,	M.315/57,	M.124/58,	M.1006/59	
Susceptible (7):	B.51129 (to be confirmed)					
Highly susceptible (8, 9):	M.305/51 (to be confirmed)					

Four new trials have been set up for assessment of reaction in 1970. One hundred and fifteen varieties will be tested at stage one and twenty-six at stage two. In addition, several promising varieties have been re-included in the second-stage trials with the new strain.

Inheritance of resistance

Studies on the reaction of progenies from crosses involving resistant and/or susceptible parents are continuing. A trial has been laid out to test 720 seedlings from 8 parental combinations.

Gamma-irradiation to induce resistant mutants

Following reports from India of success in obtaining, by gamma-irradiation, red rot resistant mutants from varieties susceptible to the disease, the technique is being tried in an attempt to induce the development of mutants resistant to gumming disease. The variety M.377/56, a high yielder, which has shown a certain degree of susceptibility to the disease, is being used in this project.

* Numbers in bracket indicate I.S.S.C.T. disease resistance rating.

2. RATOON STUNTING

Varietal reaction

Three trials are being carried out to assess the reaction of newly released and promising varieties to ratoon stunting disease in comparison with the highly susceptible control, M.134/32. Five of the new varieties have been included in all three trials, while the seven others are in one or two only. Two of these trials are in the super-humid zone, one in plant cane and the other in 1st ratoon, while the third, also in plant cane, is conducted in the sub-humid zone.

In previous years, reaction to the disease has been assessed by comparing plots established with hot-water-treated cuttings (50°C/2 hr), or with progeny from disease-free nurseries, to those planted with cuttings derived from plants which had not received the heat treatment and which, in addition, had been inoculated with infected juice prior to planting the trial. In order to avoid any direct effect of heat treatment or of chlorotic streak infection, which can be expected to be higher in cuttings derived from non-treated canes than in progeny from heat-treated plants, cuttings for both healthy and diseased plots in the three trials set up, were taken from an R.S.D.-free nursery and comparisons made between inoculated and non-inoculated plots.

The usual randomized block with split plot design was adopted, each sub-plot consisting of 4 rows of 20 ft.

No effects of the disease were observed in the two trials in the super-humid zone. However differences were observed in plant cane in the third trial, established in the sub-humid zone. The results obtained in this trial are presented in Table 21.

Attention should be drawn to the reductions in yield caused by the disease in varieties M.305/51 (7.5%), M.442/51 (7.1%) and M.377/56 (11.7%) which are fairly severe compared to M.134/32 (6.7%), the susceptible control, and considering that the trial is in plant cane aud that the effects resulted solely from inoculation at planting. It is also true that a very severe drought prevailed during the year.

Table 21. Effect of ratoon stunting disease in plant cane on ten varieties at Pamplemousses Experiment Station

		Tons Cane /Arpent	*Tons Sugar /Arpent*	*No. of Millable Stalks/Arpent (× 100)*	*Mean Stalk Length cm*	*Mean Stalk Weight Kg*
M.134/32	Healthy	23.8	2.74	248	143	0.96
	Inoculated	22.2	2.64	216	135	1.03
	Reduction %	*6.7*	*3.6*	*12.9*	*5.4*	*-7.3*
M.305/51	Healthy	37.8	5.01	367	176	1.03
	Inoculated	35.0	4.88	349	166	1.00
	Reduction %	*7.5*	*2.6*	*4.8*	*6.0*	*2.9*
M.428/51	Healthy	27.8	3.08	334	118	0.83
	Inoculated	28.0	3.44	327	120	0.86
	Reduction %	*-1.1*	*-10.5*	*2.2*	*-1.3*	*-3.6*
M.442/51	Healthy	28.2	2.93	300	155	0.94
	Inoculated	25.6	2.51	291	156	0.88
	Reduction %	*7.1*	*14.3*	*3.0*	*-1.0*	*6.4*
M.13/53	Healthy	27.2	3.14	307	151	0.88
	Inoculated	27.8	3.44	318	155	0.88
	Reduction %	*-2.8*	*-8.7*	*-3.6*	*-3.0*	*0*
M.356/53	Healthy	26.4	2.93	353	150	0.75
	Inoculated	26.0	2.78	354	151	0.73
	Reduction %	*1.9*	*5.1*	*-0.3*	*-0.5*	*2.7*
M.13/56	Healthy	33.2	3.34	350	179	0.94
	Inoculated	32.0	3.03	334	180	0.96
	Reduction %	*3.5*	*9.3*	*4.6*	*-0.6*	*-2.1*
M.377/56	Healthy	33.0	3.76	242	169	1.36
	Inoculated	29.0	3.35	230	157	1.26
	Reduction %	*11.7*	*10.9*	*4.9*	*7.1*	*7.3*
M.351/57	Healthy	27.4	1.46	288	160	0.95
	Inoculated	28.6	1.49	300	164	0.95
	Reduction %	*-4.4*	*-2.0*	*-4.0*	*-2.5*	*0*
S.17	Healthy	32.6	4.18	276	170	1.18
	Inoculated	34.2	4.33	288	171	1.19
	Reduction % ...	*-5.1*	*-3.5*	*-3.8*	*-0.7*	*-0.8*

Control campaign

Now that the varietal replacement, which started after the outbreak of the new epidemic of gumming disease, is well in hand, efforts are being made to stimulate planters' interest, once more, in R.S.D. control. It is hoped that with co-operation from all sectors, the target aimed at, i.e. the establishment of all plantations with cuttings derived from R.S.D.-free nurseries will be reached.

The benefits that can be derived by the adoption of a centrally controlled network of R.S.D.-free nurseries for the propagation of all planting material, whereby other seed-borne diseases, such as leaf scald, can also be controlled by rogueing, cannot be over-emphasized.

As a result of difficulties encountered at the Central Nursery, run by the Sugar Planters Rehabilitation Fund Committee, mainly the scale insect and irrigation problems, following the severe drought, the Mauritius Sugar Producers' Association is contemplating setting up on a few estates, regional A nurseries which will supply cuttings for the establishment of individual B nurseries on all estates. Pending the implementation of this new scheme, 168 tons of cuttings were treated during 1969 in the Institute's small tank for setting up 40 arpents of individual nurseries on a few estates.

3. YELLOW SPOT

Assessment of varietal susceptibility

For the first time, this year, the determination of the relative susceptibility of varieties under selection was attempted. Varieties coming out of 1st selection trials were planted in an observation plot in the super-humid zone, where the disease is severe, each being represented by a 10 ft row. A design, which is a modification of the one used for gumming resistance trials was adopted. Varieties to be tested were in single rows separated by double rows of naturally infected B.3337, one of the most highly susceptible varieties in Mauritius at present. Along the rows, test varieties were separated from one another by 5 ft of B.3337. Several varieties of known susceptibility were included for purposes of comparison.

Assessment of reaction to yellow spot was made when infection was at its peak. A modification of a method, already adopted for this disease in other countries and generally used for leaf spot diseases of various crops, was used to determine mean percentage leaf infection on 10 stalk samples for each variety plot. Infection was graded 0, 1, 5, 10, 20, 40, 60, 80 and 100% depending on the aggregate leaf area covered by the spots (Pl.V.) As infection varied from the base to the tip of leaves, each leaf was roughly divided into three parts (base, middle, tip) which were assessed separately and then averaged. The percentage infection for each stalk was taken as the mean infection for leaves 1 to 8, leaf 1 being the first one more than half detached from the spindle. Eight leaves were taken because they represent the average number of fully functional leaves on a stalk.

The range of susceptibility among the 34 varieties, and the six controls, as assessed by the method described, is presented in Table 22.

There was a wide range of susceptibility in the group from those which showed high resistance with no infection at all, or a trace, to those which were as susceptible as the highly susceptible controls. This method of assessment is useful to sort out those varieties which are at the two ends of the scale : the highly resistant and the highly susceptible ones.

The high susceptibility of M.377/56 and of M.84/57, the latter in the final stages of selection, has been confirmed, although both are less susceptible than B.3337 or Ebène 50/47, the most highly susceptible canes which are going out of cultivation. Both S.17 and M.428/51 have shown fair resistance, while the promising cane M.907/61 is only slightly susceptible.

Similar assessment on several canes in the final stage of selection in two other observation plots gave the following order of susceptibility :

Plot A

B.3337 (52%), Ebène 50/47 (38.8%), M.84/57 (28.5%), M.377/56 (21.8%), M.356/53 (9.9%), M.409/51 (7.6%), M.75/55 (7.6%), M.144/56 (5.9%), S.17 (3.4%), M.428/51 (0.7%)

Plot B

M.84/57 (17.9%), M.377/56 (16.4%), M.144/56 (7.2%), M.198/56 (3.2%), M.93/48 (2.9%), M.393/57 (2.9%), S.17 (1.2%), Ebène 74/56 (1.0%).

Table 22. Relative susceptibility to yellow spot of 34 varieties and six controls* based on mean percentage leaf infection

		Mean % Infection
HIGHLY RESISTANT	M.391/60	0
	M.702/60	0
	M.857/60	0
	M.861/60	0
	M.870/60	0
	M.941/60	0
	M.1453/59	0
	M.962/60	1.0
RESISTANT TO SLIGHTLY SUSCEPTIBLE	M.558/60	1.8 ± 0.3
	M.1078/61	1.8 ± 0.3
	M.824/60	2.2 ± 0.6
	M.1006/59	3.2 ± 0.3
	*Ebène 74/56**	3.6 ± 0.2
	M.571/60	4.4 ± 0.5
	M.584/60	4.6 ± 0.7
	*S.17**	4.6 ± 0.5
	M.599/60	5.0 ± 0.4
	M.574/60	5.6 ± 0.9
	M.1016/59	5.8 ± 0.4
	M.527/60	6.3 ± 0.9
	M.1436/59	6.5 ± 0.4
	M.350/60	6.8 ± 0.8
	M.1230/61	6.9 ± 0.6
	*M.428/51**	7.0 ± 0.8
	M.283/61	7.3 ± 0.6
	M.554/60	7.3 ± 0.7
	M.907/61	7.6 ± 0.5
	M.467/60	8.2 ± 0.9
SUSCEPTIBLE TO HIGHLY SUSCEPTIBLE	M.635/60	10.0 ± 1.3
	M.1419/59	10.6 ± 1.0
	M.1239/61	10.8 ± 0.8
	M.963/60	13.1 ± 0.5
	M.582/60	14.3 ± 1.6
	M.1189/61	14.8 ± 1.5
	M.1415/59	15.2 ± 1.8
	M.65/59	17.3 ± 1.4
	*M.377/56**	18.7 ± 0.9
	*M.84/57**	23.1 ± 0.5
	M.958/60	24.6 ± 0.9
	*B.3337**	32.8 ± 1.2

Disease intensity in relation to date of harvest

Yellow spot infection in regular plantations usually starts towards the end of January when atmospheric humidity rises. In 1968, it was observed that fields of B.3337 harvested at the end of the previous crop season, which finished late, appeared less infected than usual. This seemed to indicate that the onset and intensity of infection depends on prevailing climatic conditions as well as on the age of the crop, in the latter case the important factors being probably the number of tillers and the degree of closing of the leaf canopy, both governing the micro-climate in the field.

If this assumption is correct, crops harvested late could be less affected by the disease. Furthermore, crops harvested early, i.e. just after the peak period of infection, might not have recuperated sufficiently to give their sucrose potential yield. This would mean that the disease might be less damaging in a variety planted for late harvest than in an early-maturing one. On the other hand, it should be noted that, in varieties harvested late, the period of infection coincides with the period of optimum growth, which is already restricted in the super-humid zone.

A trial was set up to test these assumptions. Plots of B.3337 were harvested at three different dates in 1968, at six weeks intervals : early, middle and late. As from the onset of infection, this year, progress of the disease was followed at monthly intervals and recorded according to the method described earlier for determining percentage leaf infection.

Unfortunately, plots harvested early were severely affected by dry conditions and ratooned slowly. At the time surveys were started, the plots harvested late were in fact the tallest. The experiment failed therefore to reveal conclusively any direct relation between date of harvest and disease intensity and subsequent effect of the disease. The yield of the different plots at harvest, which was carried out at the same time, because there was no need to continue the experiments, reflected well the better growth in plots harvested late (early : 297kg; middle : 322kg; late : 331 kg.)

However, the periodic surveys of infection did reveal differences in the progress of the disease, such progress being less marked in the slower growing plots harvested early (fig. 23). This shows that the onset of infection depends not only on prevailing climatic conditions but also on the stage of growth of the cane. In the light of these findings, the experiment will be repeated.

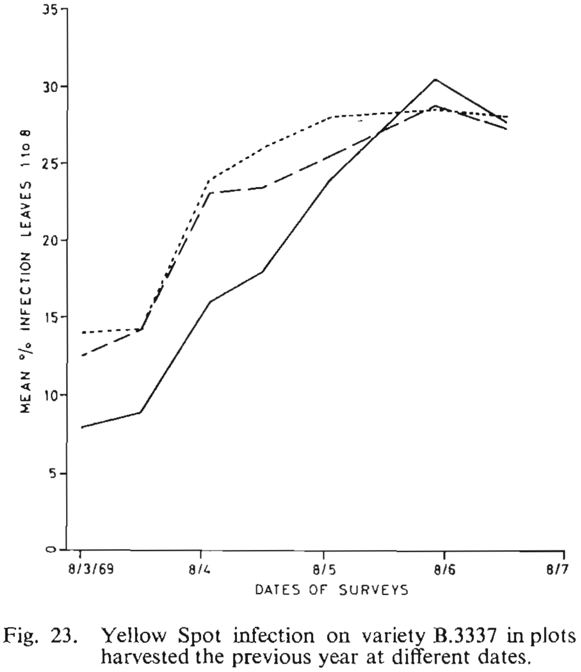


Fig. 23. Yellow Spot infection on variety B.3337 in plots harvested the previous year at different dates.
Line = Harvested 23/7/68
Dashes = Harvested 3/9/68
Dots = Harvested 15/10/68

Preliminary spraying trial with the systemic fungicide Benlate*

Control of the disease by spraying or dusting with copper fungicides has met with limited success in Queensland and India and has never become current practice.

Preliminary reports on the use of Benlate against *Cercospora* infection in other crops claimed the long-lasting systemic action of the fungicide even when applied to the soil. A preliminary field trial was conducted to test the efficacy of this systemic fungicide against yellow spot. A fourth ratoon field of B.3337 in the super humid zone was selected for this purpose. Individual plots were delimited in the field by cutting off paths and uprooting the cut stools.

The compound was tested at three concentrations : 2, 4 and 6 oz a.i. in 100 gallons of water/arpent, using the 50% wettable powder formulation, and each concentration was applied at three frequencies, i.e. one, two and three sprayings. A split plot design was adopted, each frequency of application being randomized into 4 blocks and split into 4 sub-plots which included a control and the 3 concentrations. Each sub-plot consisted of 4 rows of 20 ft and was separated from others by an unsprayed row. One gallon of solution was used for spraying each sub-plot using a motor sprayer. No surface active compound was added to the fungicide.

The first spraying was carried out shortly after the onset of infection in the field, and the others after 3 and 7 weeks respectively.

Growth rate in the different treatments was determined by measurement of stalk samples at weekly intervals. Percentage foliar infection was assessed at about 2-3 weeks intervals according to the method described earlier on 10-stalk samples in each of two replicates of each treatment. Yield of cane was determined at harvest and adjusted in relation to the number of stalks in the different plots by a co-variance analysis.

* Benomyl fungicide (methyl 1 — (butylcarbamoyl) — 2 — benzimidazolecarbamate) manufactured by Dupont de Nemours Co. (Inc.) Delaware, U.S.A.

The mean percentage foliar infection in different treatments as revealed by the periodic surveys is shown in fig. 24, in which lines represent control ; dashes, single spraying ; dashes and dots, two sprayings ; dots, three sprayings ; arrows, dates of sprayings.

The preliminary results and conclusions derived from this trial can be summarized as follows :

(a) Benlate is effective as a foliar spray against *Cercospora kœpkei* in sugar cane, the optimum concentration being 4-6 oz a.i./arpent.

(b) The beneficial effect of one spraying appears to last for about 6-7 weeks; therefore, more than one spraying and a good timing of applications are necessary to give adequate control throughout the period of infection which lasts from February to June.

(c) The beneficial effect of the spraying in disease control was not reflected in increased growth rate or final cane yield, nor did the fungicide have any phytotoxic effect.

Further tests will be conducted in 1970.

In addition, the fungicide was tested on individual stalks and stools of the same variety to check its systemic activity up the stalks in the following ways :

(i) As a soil drench at a concentration of 0.3 gm a.i./stool, applied in 3 litres of water.

(ii) In soil of marcotted stalks at concentrations of 5 ppm., 25 ppm. and 50 ppm. a.i. (weight/vol. of soil).

(iii) Injected at the base of stalks as a suspension of 12% a.i. allowing 0.05 gm a.i./ stalk.

None of these applications gave disease control on the leaves.

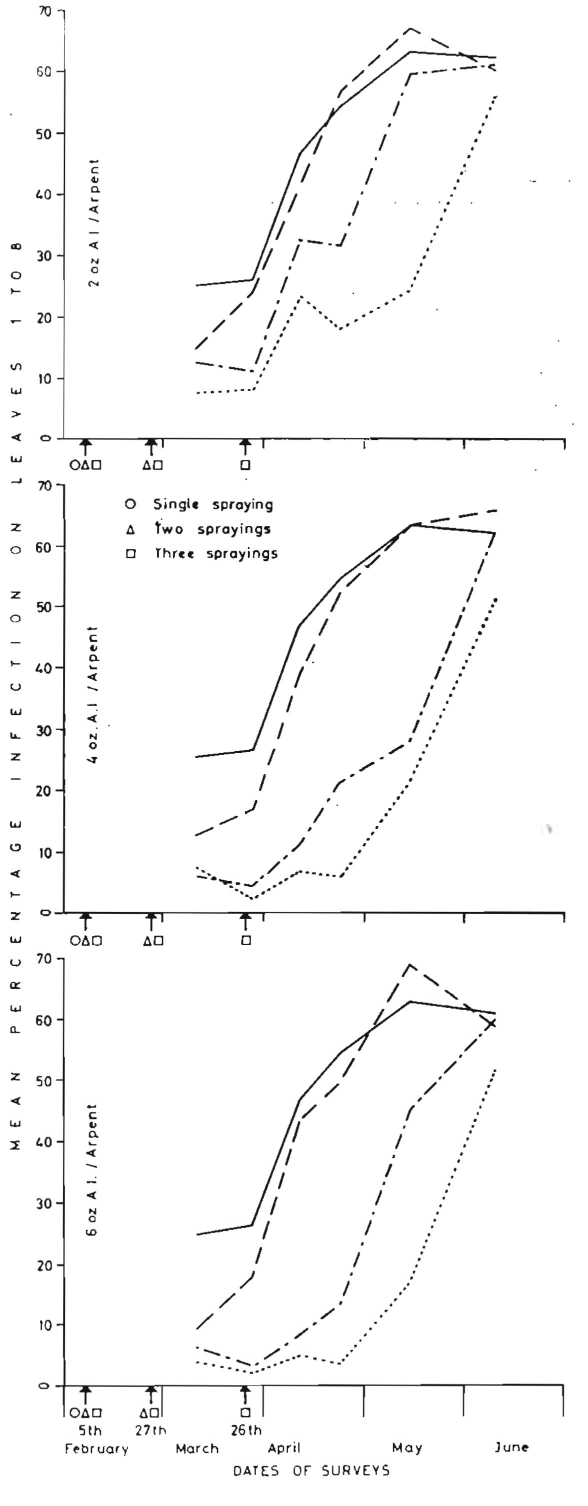


Fig. 24. Development of yellow spot infection on variety B.3337 in plot sprayed with different concentrations of systemic fungicide Benlate.

4. NOTES ON THE DISEASE REACTION OF NEWLY RELEASED AND PROMISING VARIETIES

Gumming disease, leaf scald, chlorotic streak and ratoon stunting constitute the major diseases in Mauritius at present. Yellow spot is now proving to be important, but only in super-humid areas, while wilt complex (a complex of soil factors resulting in root and stem deterioration and infection by *Fusarium moniliforme*) can be troublesome in localized patches in humid and super-humid regions. Red rot and smut have been of rare occurence in recent years. Rust has not, so far, proved to be of much greater importance than other minor leaf spots, except in the case of one or two imported varieties, and the same applies to eye spot, which is of sporadic occurrence.

Reaction of varieties under selection to gumming disease, leaf scald and ratoon stunting are assessed in orthodox resistance trials carried out yearly for the first mentioned disease, and periodically for the other two. Reaction to chlorotic streak is assessed in observation plots and this year another observation plot was set up specially for yellow spot. In addition, reaction to most of the diseases mentioned is confirmed, or obtained, during inspections of variety trials and multiplication plots in the four climatic zones.

Importance is attached to the selection for resistance to gumming disease which should be conducted as early as possible in the breeding programme, and to leaf scald, at a later stage. The assessment of reaction to other diseases, such as chlorotic streak, yellow spot, ratoon stunting does not necessarily lead to the discard of the highly susceptible canes but serves as a guide for the implementation of control measures and may sometimes restrict the cultivation of a variety to a particular climatic zone.

Short notes on the disease reaction of a few newly released varieties and two promising ones in the final stages of selection are given below, while the reaction of the most important varieties under cultivation, and of the two to be recommended for release to planters, are given in Table 23.

Table 23. Reaction of the most important varieties in Mauritius to diseases of primary importance

Variety	*Chlorotic Streak*	*Gumming*	*Leaf Scald*	*Ratoon*** Stunting*	*Wilt Complex*	*Yellow Spot*
M.31/45	S* (7)**	R (2–3)	R (2–3)	S.S	R (2–3)	R (2–3)
M.202/46	S (7)	R (2–3)	S (7)	S	H.S (8–9)	R (2–3)
M.93/48	S.S (5)	S.S (5)	R (2–3)	S	S (7)	R (2–3)
M.409/51	S (7)	H.S (8–9)	S.S (5)	—	—	S.S (5)
M.442/51	H.S (8–9)	R (2–3)	R (2–3)	—	S.S (5)	S (7)
M.13/53	S.S (5)	R (2–3)	R (2–3)	—	H.S (8–9)	S.S (5)
M.13/56	S.S (5)	R (2–3)	R (2–3)	—	R (2–3)	R (2–3)
M.377/56	S (7)	S (7)	S.S (5)	S	S (7)	H.S (8–9)
M.351/57	H.S (8–9)	R (2–3)	R (2–3)	—	R (2–3)	R (2–3)
N : Co.376	S (7)	R (2–3)	R (2–3)	S	H.S (8–9)	R (2–3)
S.17	S (7)	R (2–3)	S.S (5)	—	—	R (2–3)

* R = Resistant; S.S = Slightly susceptible; S = Susceptible; H.S = Highly susceptible
** Proposed ISSCT international disease rating system
*** No precise rating available.

Released varieties :

M.13/53—Resistant to gumming and leaf scald in resistanee trials, but occasional mild cases of the latter disease have been found on the variety in commercial plantations; slightly susceptible to chlorotic streak and to yellow spot in trials in the super-humid zone; several cases of wilt complex leading to poor ratooning have been observed.

M.13/56—Has in general a good level of resistance to diseases present in Mauritius ; although odd cases of mild leaf scald infection have been observed, it has shown good resistance in the resistance trial; frequently shows leaf freckling or bronzing due to minor element unbalance or deficiency, under conditions of water stress.

M.377/56—This high yielder has unfortunately shown varying degrees of susceptibility to most of the diseases prevailing in Mauritius; although it is fairly tolerant to many of these, particular attention should be paid to adequate control measures whenever applicable; a few cases of smut have, in addition to the data given in Table 23, been observed on this variety.

N : Co.376—Resistant to gumming and leaf scald; susceptible to chlorotic streak; has been severely affected by wilt complex in a few fields of the super-humid zone and its cultivation must therefore be envisaged with caution; the disease may not be damaging in the high rainfall areas, provided field drainage is adequate, the same applying to the heavy dark magnesium clays with proper irrigation management ; found susceptible to ratoon stunting in South Africa.

To be recommended for release :

M.351/57—Resistant to gumming and yellow spot; highly susceptible to chlorotic streak, but appears to tolerate infection well as ratooning vigour does not appear thereby affected in super-humid regions. Death of stools has, however, been noticed in one field, indicating that the disease could prove troublesome in older ratoons; leaf scald has been observed in a few cases in multiplication plots and variety trials, but good resistance has been shown in the resistance trial.

S.17—Resistant to gumming and yellow spot; susceptible to chlorotic streak; showed slight susceptibility to leaf scald in resistance trials, and a few cases observed in variety trials and multiplication plots; a few cases of smut and several cases of inflorescence rot have also been observed.

5. SOME PATHOLOGICAL PROBLEMS RESULTING FROM DROUGHT

The year under review has been one of the driest on record for slightly more than 30 years. There were two periods of severe water stress, one at the beginning of the growing season lasting from just after harvest in 1968 until about April 1969, and the second from September to the end of harvest. The second drought period which followed a late rainy season which extended well into the maturation period, affected canes due for harvest as well as young virgin canes planted errlier in the year.

On cane at harvest

In mature canes, widespread cases of sour rot (*Pleocyta sacchari*), varying in intensity in different fields, were encountered in the North where irrigation had to be discontinued through shortage of water following the severe drought. As a result, a severe drop in cane purity was observed on some estates; in one extreme case, falling as low as 81.2% and accompanied by difficulties in processing of the juice.

In the more severe cases, the percentage of dead and desiccated stalks was quite high, while most canes were discoloured externally and, when split, showed a muddy discoloration in the internode and a reddish-brown coloration at the nodes. The sour smell was readily noticeable in such fields.

In less affected fields, canes had a normal appearance apart from a severe drying of the leaves, but a red discoloration could be found on closer observation, at the points of entry of the associated organism : in the nodal region, through leaf scars, root primordia and even buds, and through wounds. In a few fields, infection was restricted to one or two nodes, at a common level, about 2 ft. above ground, in all infected stalks. This was attributed to the entry of the organism through wounds resulting from the manual thrashing which had been performed earlier in the fields.

On rare occasions, mild red rot infection was also identified in the affected field.

The variety M.442/51 was the most affected. It should be pointed out however, that the problem is not specific to this variety and that such infection will occur in most varieties affected by drought or other set-backs, but M.442/51 being one of the last to be harvested was the most seriously hit by the drought. On the other hand, varieties which are more drought-resistant due to a better root system, such as M.147/44, are less prone to this deterioration. Similarly, canes grown without irrigation were in general less affected by the drought than those which had been irrigated earlier, their root system being no doubt more extensively developed.

As it was fortunately possible to harvest affected canes quickly, infection did not develop in the underground stubble and ratooning was not affected in these fields.

On young plant cane

Fields of young virgin cane were also seriously hit in certain sectors by the second drought period. The varieties most affected were M.13/56, M.377/56 and S.17. The effect on M.377/56 was slightly different from that on the other two. This variety is susceptible to leaf burn under water stress; in some fields the top part of the spindle also was affected. This, as well as the check on growth, favoured infection by spores of the pokkah bœng fungus (*Fusarium moniliforme*). Infection was sometimes restricted to the top part of the spindle, but in other cases progressed downwards, finally causing death of the growing point. When rains started and apical growth resumed in those stalks where the growing point had not been killed, numerous cases of typical pokkah bœng symptoms as well as tangle top could be seen in the affected fields (Pl. VI). In addition, there was heavy production of side-shoots even in stalks where the growing point was still alive.

In varieties M.13/56 and S.17, symptoms of tangle top were not found in fields affected by drought and top rot was of rare occurrence, but side-shooting was common and in S.17 profuse development of adventitious roots occurred too.

Although borer attacks had contributed to side-shooting in many cases, this was not always the rule. The effect could be partly attributed to the trash which was still clinging to the stalks as a result of the drought, but the effect of an upset in hormone balance following the drought-induced stress should not be ruled out.

A survey in M.13/56 on an estate in the North revealed as much as 60% of the stalks with side shoots. Wherever top rot had occurred and side-shooting was heavy and the fields were still at an early stage of growth, it was recommended to cut affected stalks at ground level to allow better growth in the unaffected stalks. A short agronomic study is being undertaken to assess the effect of such side-shooting on yield.

In one field where soil conditions were poor, water stress was so severe that death of stalks or of entire stools occurred with infection at the base and in the rhizome by *Pleocyta sacchari* (Pl. IV).

6. MISCELLANEOUS

Chlorotic streak

Agronomic studies on factors affecting re-infection of stools established with treated cuttings are being pursued in view of improving disease control by cultural practices. In an experiment started in 1966 to compare the effect of organic amendments as opposed to inorganic fertilizers on such re-infection, a greater build-up of the disease had been found in plots receiving organic amendments : scums and/or molasses. Not only did this difference persist in 1969, but a greater intensity of symptoms was observed in "organic" plots. A trial set up last year to confirm the above results has just been ratooned, symptoms have not so far been observed. The validity of these findings may help to throw some light on the nature of the disease organism or its vector.

Another trial was set up in the super-humid zone to compare the effect of planting on the ridge, as opposed to furrow planting, on rate of

A B C D E F

Fusarium moniliforme infection on M.377/56 following drought. A.-D :- Progressive stages in spidle infection leading to death of growing point.

E : Typical pokkah-boeng symptom. F : Tangle top.

Rice varieties in quarantine. Ears covered with cellophane caps to prevent cross-pollination re-infection and ultimate development of the disease in the plant and its effect on yield. A beneficial effect has already been observed on germination and early growth in plants derived from treated, as well as non-treated, cuttings, when plantations are made on ridges. Shoot counts were inferior by 9.7% for furrow planting in the case of treated and by 13.0% in the case of non-treated cuttings.

In the meantime, research is continuing in the attempt to elucidate the nature of the disease organism or its vector. The co-operation of Dr. I. MacFarlane of Rothamsted Experiment Station, United Kingdom, has been obtained and diseased material has been sent to him for investigations using the electron microscope.

Leaf scald

In an attempt to throw some light on strain variation of the bacterium, a comparative study of the reaction of several important varieties from different countries is being made in Mauritius and elsewhere. The following varieties were included in a trial which has been established and will be inoculated in 1970 :

M.134/32, M.112/34, M.147/44, M.31/45, M.202/46, M.13/56, M.907/61
B.34104, B.37172, B.46364, B.49119, B.51129, B.52107
Co.290
C.L. 41-223
C.P. 29-116, C.P. 44-101
H.32-8560, H.38-2915, H.48-3166, H.49-3533
N.Co.310, N.Co.376
P.O.J. 2878
Q.61, Q.68, Q.70, Q.78, Q.82
R.447
Ragnar, Vesta.

Strains of the pathogen encountered locally have been sent to the Commonwealth Mycological Institute in London for serological studies.

Fiji disease in Madagascar

The disease is now no longer of economic importance on the East Coast of Madagascar and no cases have been observed lately in the zone formerly infected, apart from those in the resistance trials at Menarano. Due credit should be paid to the Agricultural Authorities in Madagascar who have succeeded in controlling the disease in a fairly short time. Mention should also be made of their constant efforts in the implementation of restrictions, at times very unpopular, in order to check the spread of the disease, and in so doing they have protected not only the sugar industry of Madagascar, but also those of Réunion and Mauritius. Also, facilities are available for testing in resistance trials the reactions of varieties important to the two islands. The success in controlling the disease has been achieved through the cultivation of resistant canes. The only varieties, all resistant to the disease, authorized for planting on the East Coast of Madagascar are the following : B.46364, B.49119, CL.41-223, Co.290, C.P.44-101, M.165/38, M.63/39, M.31/45, M.202/46, Pindar, Q.50, Q.57, Q.58, R.331, Ragnar, S.17, Trojan. Those cultivated on a large scale are : Pindar, S.17 and Q.57.

The construction of an insect-proof greenhouse for testing resistance to the disease in Tananarive has started and the house should be operational in 1970. This project is being financed by the three countries. It is contemplated, if room is available, to test varieties of interest to other countries, especially the neighbouring ones on the African continent.

In the meantime, resistance trials in the field at Menarano will continue until 1971. The Mauritian varieties M.377/56 and M.351/57 have been included in the trial planted in 1969. The reaction of Mauritian varieties included so far in the resistance trials are as follows :

Highly resistant	: M.165/38 M.63/39, M.31/45, M.202/46		
Resistant	: M.76/39		
Susceptible	: M.112/34, M. 39/49, M. 13/53, M.212/56	M.213/40, M.423/51, M.225/53,	M.253/48, M.658/51, M.117/55,
Highly susceptible	: M.134/32, M.442/51,	M.147/44, M.272/52	M. 93/48,

Quarantine

The cane quarantine cycle which was due to start in 1968 had to be postponed for one year as the greenhouse had to be utilized during the first part of the year under review for quarantining 23 varieties of rice (Pl. VII), to assist the agricultural services of the Ministry of Agriculture. This project was run by the Pathology Division of the Institute. The following were introduced, the yields obtained for each variety being indicated in brackets:

From Madagascar— 9 varieties — : A.C. (260 gm), A.T. (213 gm), Dulac 1632 (193 gm), IR 8 (224 gm), Taichung native 1 (175 gm), Taïnan III (206 gm), 1329 (155 gm), 1345 (152 gm), 63.83 (237 gm).

From International Rice Research Institute Philippines— — 11 varieties — : IR 5 (228 gm), IR 262-43-8-11 (707/934) (172 gm), IR 532-9311 (176 gm), IR 532-9319 (175 gm), IR 532-9334 (133 gm), IR 665-6291 (163 gm), IR 665-6292 (130 gm), IR 665-178-305-604 (110 gm), 722 IR 400-28-4-5 (149 gm), 793/1000 — Milfor 6(2) (75 gm), Palawan (251 gm).

From Taiwan — 3 varieties — : Kaoshiong No. 64 (174 gm), Kaoshiong No. 136 (222 gm), Kaoshiong No. 137 (120 gm).

A new cane quarantine cycle was started in September with the following varieties :

From Barbados : B.55362, B.60256, B.60321, H.J.57/41.

From Cuba : My-53108, My-5239, My-5465.

From Hawaii : H.60-6909.

From India : Co. 1001.

From Philippines : Phil. 56226, Phil. 58260.

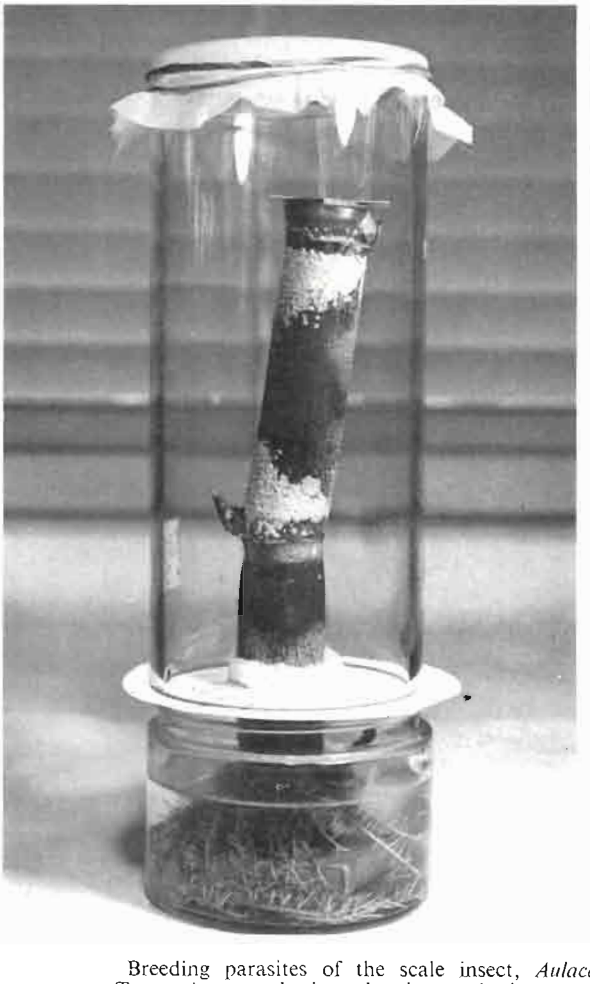
From Queensland : Q.85, Q.87, Q.88.

From Reunion : R.512, R.526, R.541, R.543.

From South Africa : N.55-805.

From Taiwan : F.156, F.160, F.163.

From U.S.A. (mainland) : C.P.52-43, C.P.61-37, C.P.62-258, L.60-25, L.61-67, L.62-96.



Breeding parasites of the scale insect, *Aulacaspis tegalensis* (Zehnt.), in the laboratory. *Top* : A general view showing scale insects developing on cane-pieces (background) and parasites being reared in cylinders enclosing infested cane-pieces. *Bottom* : Close-ups of methods of enclosing infested cane-pieces for rearing of parasites

CANE PESTS

J. R. WILLIAMS

1. BIOLOGICAL CONTROL OF THE SCALE INSECT, *AULACASPIS TEGALENSIS*

STUDIES on the locally-occurring natural enemies of the scale insect, which are to be described fully elsewhere, have led to the conclusion that the introduction of parasites and predators from abroad may serve to decrease the frequency and intensity of scale insect attacks. The local enemies of the scale insect include Coleoptera, Hymenoptera, Acarina and Fungi and their combined action is considerable and important economically. However, they seem most effective in reducing infestations of the scale insect rather than preventing their occurrence. In this connection, it may be significant that the only parasite that is constantly associated with the scale insect, namely *Adelencyrtus miyarai* Tachikawa (previously recorded as *A. femoralis* Comp. & Annecke), is very heavily hyperparasitized, while the Coleopterous predators that seem well adapted to a cane-field environment are limited to two species, *Lindorus lophanthae* Blaisd. and *Cybocephalus mollis* Endr.-Younga.

A. tegalensis also exists in East Africa where its complex of natural enemies differs from that in Mauritius. With the aid of the Commonwealth Institute of Biological Control, the predators *Chilocorus discoideus* Crotch and *C. distigma* Klug (Coccinellidae), and the parasite *Physcus* sp. (Aphelinidae) were imported from East Africa during the year.

Chilocorus discoideus **and** *C. distigma*

A first trial shipment of *C. discoideus* adults in June, 1968, was destroyed on arrival when it was realized that precautions would be necessary to ensure that the beetles on receipt were free from undesirable organisms, in particular scale insect eggs and mites, adhering to their bodies. Thereafter, both laboratory-reared and field-collected beetles were isolated and fed on a synthetic diet for about 10 days before shipment to Mauritius. The isolation period plus the few days in transit was long enough to result in the death of the organisms mentioned.

Details concerning the shipments and liberation of the Coccinellids are given in Table 24. Mortality in transit was usually negligible and the beetles, on arrival, were released as soon as possible in fields infested with scale insect. The majority were released in two circumscribed areas at Pointe aux Sables.

During May-August, larvae, pupae and freshly-emerged adults of *C. discoideus* were often seen at, or near, the liberation sites, while adults continued to be seen until October, by which time most of the cane had been cut and scale insect had become scarce. Larvae of *C. distigma* were seen only on one occasion and in small numbers. These observations, at least as far as *C. discoideus* is concerned, are encouraging, and establishment would now seem to depend on whether the colonies survive until about March-April when the scale insect normally reappears in quantity on cane stems.

Table 24. Importation and liberation of *Chilocorus discoideus* **and** *Chilocorus distigma*

A. *C. discoideus*

Shipment No.	*Date received*	*No. sent*	*No. received alive and liberated*	*Date liberated*	*Liberation site*
1	11/6/68	200	—		
2	27/1/69	250	250	27/1/69	**Pte. aux Sables**
3	3/3/69	420	420	3/3/69	,,
4	17/3/69	640	640	17/3/69	,,
5	31/3/69	340	340	31/1/69	,,
6	14/4/69	360	360	14/4/69	,,
7	29/4/69	220	170	29/4/69	,,
8	19/5/69	388	388	21/5/69	,,
9	27/5/69	565	565	28/5/69	,,
10	10/6/69	520	250	11/6/69	,,
11	18/6/69	900	880	18/6/69	,,
12	1/7/69	420	200	1/7/69	,,
			220	1/7/69	**Chebel**
13	8/7/69	1050	400	8/7/69	,,
			650	8/7/69	**Pte. aux Sables**
14	27/7/69	400	350	28/7/69	**Sauveterre**

B. *C. distigma*

Shipment No.	*Date received*	*No. sent*	*No. received alive and liberated*	*Date liberated*	*Liberation site*
1	27/1/69	100	100	27/1/69	**Pte. aux Sables**
2	3/3/69	175	175	3/3/69	,,
3	17/3/69	120	120	17/3/69	,,
4	31/3/69	95	95	1/3/69	,,
5	14/4/69	130	130	14/4/69	,,
6	29/4/69	165	160	29/4/69	,,
7	19/5/69	138	138	21/5/69	,,
8	8/6/69	100	50	8/6/69	**Réduit**
9	1/7/69	115	115	1/7/69	**Chebel**
10	8/7/69	75	75	8/7/69	**Pte. aux Sables**
11	27/7/69	200	150	28/7/69	**Sauveterre**

C. Summary

		C. discoideus	*C. distigma*
Total no. imported		6673	1413
No. liberated at :	Pte. aux Sables (Jan.-July)	5113	993
	Chebel (July)	620	115
	Sauveterre (July)	350	150
	Réduit (June)	—	50
	Total no. liberated	6083	1308

Physcus sp.

The females of this minute Hymenopteran are wingless and parasitic on female *Aulacaspis :* the males are winged and parasitic on females of their own kind. The males may also have the ability to develop hyperparasitically on other Hymenoptera but, if so, this is not considered a factor that would outweigh the beneficial primary parasitism of the females.

Five small shipments of adult *Physcus* were received by air between May and September to initiate a laboratory culture. The first requisite was a method of breeding the host insect, *Aulacaspis*, in quantity and after initial difficulties owing to parasitic mites (*Hemisarcoptes* sp.) in the insectary, a suitable technique was devised. This consists in obtaining eggs by sieving masses of scale insects scraped off infested canes and then attaching containers with eggs to cane pieces held erect in water by nailed lead weights. Crawlers hatching from the eggs settle on the cane pieces more readily if the latter are covered or placed in a dark chamber. The cane pieces put out roots and remain fresh long enough for the purpose intended. Dipping the cane pieces in dicofol immediately before use proved to be a method of eliminating troublesome mites without affecting development of the scale insect. For breeding *Physcus*, the infested cane pieces are enclosed in glass cylinders or in cages (Pl. VIII).

Regular releases of *Physcus* at 2-3 day intervals at one site were in progress at the end of the year and the insect's multiplication in the field at this site was confirmed by collection of many parasitized scale insects.

2. INTRODUCTION OF *PEDIOBIUS FURVUM* GAHAN

Pediobius furvum Gah. (Eulophidae, Hymenoptera) is a parasite which is widely distributed in Africa where it attacks the pupae of Lepidopterous borers of *Gramineae,* including Noctuid and Pyralid borers of maize and sugar cane.

The insect was received in January from the East African Station of the Commonwealth Institute of Biological Control, and also from IRAM, Madagascar, for trial against local borers, particularly *Chilo sacchariphagus* (Boj.). There was initially some doubt as to the advisability of releasing the insect owing to reports that it could develop hyperparasitically. However, it failed to develop when presented with cocoons of *Apanteles flavipes*, *A. sesamiae* and *Enicospilus* sp., all of which are cane borer parasites, and tests of a similar nature in East Africa also led to the decision that the insect could be safely released.

Pediobius adults mate immediately on emergence and the females attack fresh host pupae. Gregarious parasitism is the rule and hundreds of individuals can develop successfully in one host pupa. To breed the parasite, larvae of *Sesamia calamistis* (pink borer) and *Chilo sacchariphagus* (spotted borer) were collected and reared to the pupal stage. The fresh pupae were placed in pieces of dry cane leaf rolled up into little tubes : these were placed in jars containing freshly emerged parasites and left for two days. After removal from the jars, the pupae were kept in carton cups, one pupa to a cup, to await emergence of the adult parasites.

Parasites emerged from about 35% of the 3150 *Sesamia* pupae that were used. *Chilo* pupae were less satisfactory as hosts, at least with the technique used, and only 13% of the 1550 pupae used yielded parasites. The total number of adult parasites obtained for release was about 250,000 and details of the releases made are given in Table 25. No attempt was made in 1969 to recover the parasite in the field.

Table 25. Liberation of *Pediobius furvum* Gah., 1969

Locality	*Period*	*No. of parasites (approx.)*
Valetta	January — March	55,400
Moka	January — April	4,600
Henrietta	February — March	34,000
Tamarin Falls	February — May	61,000
Goodlands	March — April	20,600
Pointe aux Sables	March — May	53,200
La Marie	March	4,800
Bonne Fin	March	3,400
Réduit	April — May	9,000
Côte d'Or	May	5,400
	Total	251,400

3. THE PINK BORER, *SESAMIA CALAMISTIS*

The benefit derived from introduction of parasites or predators in attempts to control pests biologically is usually difficult to assess unless sudden, dramatic control results shortly after such introductions have been made. A case in point is that of the pink borer, *Sesamia calamistis,* which is considered to have decreased in importance as an early-shoot borer subsequent to the introduction in 1952 of *Apanteles sesamiae* Cam. from Kenya. Quantitative data are not available to sustain opinions on the status of *Sesamia* as a cane pest over the years and a further complication in judging its frequency is the presence of other early-shoot borers that cause similar damage. Improved weed control may also have been responsible for less shoot mortality by *Sesamia* because the moth normally lays its eggs on grass weeds.

The collection of *Sesamia* larvae and their retention until pupation was necessary during the year in order to breed the pupal parasite *Pediobius* (*see above*) and the opportunity was taken to record larval parasitism. Collections were made continually for one month in various fields in the Henrietta region. Table 26 shows the numbers of larvae collected and the incidence of parasitism. Parasitism by *A. sesamiae* per day's collection was never less than 40% and on one occasion exceeded 70%, while the parasitism of all the 7555 larvae collected was 60%. Such data lend strong support to the contention that *Sesamia* has decreased in importance because of *Apanteles sesamiae.*

Table 26. Larval parasitism of *Sesamia calamistis* Hamps. collected at Henrietta, 1969

Date		*No. larvae collected*	*Parasitized by Apanteles sesamiae*		*Parasitized by Enicospilus sp.*	
			No.	%	*No.*	%
February	12	322	134	41.6	6	1.9
,,	13	505	217	43.0	4	0.8
,,	18	400	283	70.8	6	1.5
,,	19	400	266	66.3	3	0.7
,,	20	400	216	54.0	5	1.3
,,	21	450	260	57.8	2	0.4
,,	24	549	312	56.8	4	0.7
,,	25	560	285	50.9	4	0.7
,,	26	610	354	58.0	2	0.3
,,	27	608	393	64.6	1	0.2
March	3	525	348	66.3	13	2.5
,,	6	502	342	68.1	13	2.6
,,	7	494	337	68.2	8	1.6
,,	10	520	356	68.5	5	0.9
,,	11	313	196	62.6	5	1.6
,,	13	192	111	57.8	5	2.6
,	17	205	146	71.2	2	1.0
		7555	4556	60.3	88	1.2

4. MISCELLANEOUS

(a) *Trichospilus diatraeae* C. & M. (Eulophidae, Hym.) was reared from a pupa of the spotted borer, *Chilo sacchariphagus,* collected at Valetta in April. The parasite was introduced from India and released in large numbers in 1963-64 (*see* Annual Report for 1963 & 1964). Its recovery so many years after its release shows that it is firmly established. The difficulty of collecting pupae of *Chilo* precludes ready assessment of the degree of parasitism that exists.

(b) *Ichneumon unicinctus* Brullé (Ichneumondae, Hym.) was reared from the pink borer, *Sesamia calamistis,* in February. The parasite has not been previously recorded from any host in the island. *I. unicinctus* appears to be a native insect and occurs also in Réunion Island, Madagascar and the Seychelles. It attacks its host in the larval stage and emerges from the pupa.

(c) *Oryctes rhinoceros* (L.), the notorious coconut pest first found in Mauritius in 1963, was found attacking sugar cane on two occasions during the year. In January, a large number of well-grown larvae destroyed the roots of a patch of cane at FUEL and, in July, an adult was found tunnelling in a mature cane stalk at Henrietta. Such attacks are a curiosity and nothing more. The insect is known in other countries to eat sugar cane occasionally, but never to any important extent.

(d) Mr. R.H.G. Harris, an entomologist from the Mount Edgecombe Sugar Cane Experiment Station, Natal, South Africa, spent two weeks in Mauritius in January-February. He was assisted in the collection and dispatch to South Africa of *Tytthus mundulus* (Bredd.), required for biological control work.

(e) Dr. D.J. Greathead of the East African Station of the Commonwealth Institute of Biological Control spent three weeks in Mauritius in May-June at the request of the M.S.I.R.I. to study the possibilities of biological control of the scale insect and other cane pests.

(f) Three shipments of *Apanteles sesamiae* Cam. were sent by air to IRAM, Madagascar, in January.

5. RATS AS CANE PESTS

M. A. RAJABALEE

In the eighteenth century, rats and locusts were considered the most formidable enemies of the Mauritian sugar cane planter. The extent of damage done by rats in some parts of the island is still important to-day, although there appears to have been no attempt to study their habits under local environments with a view to rationalizing control measures.

Early in this century, an attempt to control rats biologically with "virus Danysz" was inconclusive. At about the same time, the mongoose was introduced, but as elsewhere it proved a mixed blessing because of its various predatory activities. Acute poisons in use before 1950 included arsenic, phosphorus, strychnine, barium carbonate, thallium sulphate and Red Squill. At present anticoagulants, such as warfarin, are the poisons most widely employed in cane fields.

Two species of rats are known to exist locally : the Norway rat, *Rattus norvegicus* Berk., also called the common, field or brown rat, and the Black rat, *Rattus rattus* L., also called the house or ship rat. The former has been thought to be largely responsible for cane damage but no trapping has been done in the past to substantiate this. Trials done elsewhere have shown the Norway rat to be five times more susceptible to anticoagulants than the Black rat, a concentration of 0.005% in baits being sufficient for this species. Consequently it is important to determine which species is normally responsible for damage to sugar cane, or if mixed infestations are common : this may vary with locality and environment. To this end, trapping in cane fields was started during the year.

Work was also started to assess the amount of rat damage in sugar cane fields, and on methods of control most suited to local conditions. Data collected from sugar estates included the amount spent on rat control and methods of control currently used.

In 1953, 9 out of the 19 estates that replied to a questionnaire were applying control measures againts rats. In 1969, 23 estates representing 65,594 arpents under cane provided data. Of this area 12,490 arpents were in the sub-humid zone, 40,656 in the humid zone, and 13,448 in the super-humid zone. Eighteen estates (55,075 arpents) were carrying out control measures using poison baits. Damage was generally reported to be slight in the sub-humid zone, and from appreciable to considerable in the humid and super-humid zones. Degree of infestation, as judged by cane damage, varies a lot from place to place, even within a field, but heavy infestation is almost invariably confined to fields bordering sites which can provide good, permanent shelter and water for the rats, e.g. heaps of stones and thicketed banks of streams or rivers. Lodged canes suffer most.

Anticoagulants were by far the most popular poisons in use : 7 estates (19,869 arpents) were using only paraffin blocks con-

Table 27. Amount spent by estates on rat control in 1969

	Area (arpents)	*Application cost (Rs)*	*Poison cost (Rs)*	*Total cost (Rs)*	*Cost per arpent (Rs)*
Sub-Humid	12,490	2,630.	3,817.	6,447.	0.52
Humid	40,656	19,002.	44,939.	63,941.	1.57
Super-Humid	13,448	5,308.	13,425.	18,733.	1.39
Total	66,594	26,940.	62,181.	89,121.	1.34

taining an anticoagulant; 6 estates (13,549 arpents) were using anticoagulant bait mixtures either in plastic bags, in bamboos or under drums; 5 estates (17,261 arpents) were using alternatively blocks and bait mixtures, and 2 estates (4,396 arpents) were using anticoagulant bait mixtures and an acute rodenticide (Thallium sulphate). In general, results obtained appeared satisfactory.

Table 27 shows the amount spent by the estates that carried out control measures; the average cost per arpent per estate varied from 0.25 cs to as high as Rs. 7.00. The cost per arpent in the sub-humid and humid zones (Table 27) probably reflects the relative importance of rat damage in these regions. Most estates prepare the poison baits themselves nad some have them applied by sirdars during their routine rounds, thus rendering application costs negligible. Other estates, especially where rats are more or less chronic pests, employ labour solely for rat control during part of the year, and this in some way explains the difference in the amount spent between estates.

The economics of rat control depend entirely on the efficiency of the technique used and an infinite number of variations are possible by altering bait composition, the poison employed, the timing of application, the number of applications etc.

NUTRITION AND SOILS

1. TRACE ELEMENT STATUS OF CANES IN MAURITIUS

Y. WONG YOU CHEONG

THE rare cases of trace element deficiency reported in sugar cane in Mauritius must have occurred under atypical conditions as, apart from these reports, no leaf symptoms have been observed by other workers.

The trial laid down in 1958 on a coral sand soil at St. Félix to study the effect of fritted trace elements containing Fe, Cu, Zn, Mn, B and Mo on sugar cane yield did not show any significant yield response to these elements. Trace element deficiency symptoms occasionally appear on leaves of sugar cane growing in this type of soil, particularly during dry spells, but they do not last very long and have no measurable effect on cane yield.

Other trials carried out at Union Park in previous years (1956 and 1957) had not shown any beneficial effect of the addition of trace elements. EVANS (1959) reported having in the past observed interveinal chlorosis, attributed to manganese deficiency, in cane growing on a site previously used as a dumping place for lime. In 1963, a series of trials to investigate the effect on cane growth of the application of zinc, copper and molybdenum were laid down by PARISH *et al.* (1965); while they did not observe any significant yield response to copper and zinc, they however obtained a significant response to molybdenum in a Low Humic Latosol, but it was only an isolated case.

It appears, therefore, from the experimental evidence accumulated above that the occurrence of any trace element deficiency in canes growing in Mauritius is unlikely. However, as the critical levels of the more common trace elements in leaf lamina have been cited by many authors, it was decided in 1968 to carry out an analysis of as many elements as were present in leaf lamina and sheath in order to compare with these critical levels. Should any deficiency be suspected, it might be necessary to include the analysis of that element in the routine technique of foliar diagnosis.

Leaf and sheath sampling

The leaves and sheaths were sampled from canes of the variety M.93/48 planted on eleven experimental sites chosen to represent the whole range of climatic and soil conditions occurring on the island. The canes had all received the standard rate of nitrogen, phosphate and potassium fertilizers.

The tissues chosen were the middle portion of the third leaf lamina (mid-rib removed) and the sheaths of the 3rd, 4th, 5th and 6th leaves (bulked together). Precautions were taken to prevent contamination of the samples during handling and preparation. After the samples had been dried at 90°C, they were sent to the Macaulay Institute for Soil Research, Aberdeen, for analysis.

Results and discussion

The leaf lamina analysis is given in Table 28 and leaf sheath analysis in Table 29.

Relationship between leaf and sheath contents

The significant relationships between the levels of each element in the leaf and sheath are given in Table 30.

Table 28. Leaf lamina analysis of trace and secondary elements (ppm of dry matter)

Site	*Soil group*	*Ag*	*B*	*Ba*	*Co*	*Cr*	*Cu*	*Fe*	*Mn*	*Mo*	*Ni*	*Pb*	*Sn*	*Sr*	*Ti*	*V*	*Zn*
6/66	LHL	< 0.04	9.6	37	0.05	0.22	6.6	64	96	0.05	0.42	0.41	0.07	52	2.2	0.03	18
7/66	LRP	< 0.04	8.2	2	0.05	0.21	6.8	63	43	0.10	0.19	0.37	0.07	99	2.0	0.03	15
8/66	LRP	< 0.04	7.8	6	0.03	0.18	6.8	52	39	0.11	0.21	0.35	0.11	45	1.6	0.02	16
9/66	LRP	< 0.04	10.3	5	0.08	0.22	6.6	65	81	0.04	0.41	0.48	0.11	27	1.5	0.02	16
11/66	LHL	< 0.04	7.1	10	0.06	0.34	7.9	63	81	0.03	0.47	0.41	0.07	33	1.9	0.02	14
12/66	HL	< 0.04	6.8	12	0.02	0.20	7.9	59	66	0.04	0.21	0.49	0.07	43	1.7	0.03	15
13/66	LHL	< 0.04	9.4	15	0.09	0.23	7.8	68	67	0.09	0.51	0.63	0.06	47	2.5	0.04	13
14/66	LRP	< 0.04	11.0	3	0.05	0.21	6.8	57	45	0.07	0.24	0.22	0.10	16	1.7	0.02	11
15/66	LBF	< 0.04	6.0	5	0.07	0.21	6.8	61	55	0.10	0.39	0.45	0.16	33	1.9	0.03	16
16/66	LBF	< 0.04	5.8	7	0.05	0.21	6.9	63	56	0.06	0.29	0.48	0.18	32	2.1	0.03	16
17/66	HFL	< 0.04	5.8	10	0.03	0.20	7.9	66	58	0.05	0.26	0.53	0.14	34	2.2	0.04	18
	Mean	< 0.04	*8.0*	*10*	*0.05*	*0.22*	*7.2*	*62*	*63*	*0.07*	*0.33*	*0.44*	*0.10*	*42*	*1.9*	*0.03*	*15*
			±1.8	*±9*	*±0.02*	*±0.04*	*±0.6*	*±5*	*±18*	*±0.03*	*±0.12*	*±0.11*	*±0.04*	*±21*	*±0.3*	*±0.01*	*±2*
Critical levels		?	1	?	?	?	4	5	20	0.03	?	?	?	?	?	?	15

Table 29. Leaf sheath analysis of trace and secondary elements. (ppm of dry matter)

Site	*Soil group*	*Ag*	*B*	*Ba*	*Co*	*Cr*	*Cu*	*Fe*	*Mn*	*Mo*	*Ni*	*Pb*	*Sn*	*Sr*	*Ti*	*V*	*Zn*
6/66	LHL	0.04	5.0	19	0.06	0.23	3.3	45	107	0.03	0.22	0.29	0·07	32	1.3	0.02	26
7/66	LRP	0.04	4.3	3	0.04	0.24	2.6	36	33	0.11	0.14	0.23	0.05	49	1.1	0.02	20
8/66	LRP	0.04	4.3	3	0.03	0.17	2.9	36	38	0.11	0.14	0.34	0.05	23	1.0	0.02	24
9/66	LRP	0.04	4.5	3	0.04	0.30	3.2	37	84	0.03	0.24	0.49	0.11	14	1.5	0.02	33
11/66	LHL	0.04	4.3	4	0.07	0.33	2.7	44	81	0.03	0.29	0.31	0.08	13	1.8	0.05	21
12/66	HL	0.04	3.7	5	0.02	0.32	2.4	42	70	0.03	0.17	0.30	0.09	19	1.3	0.04	13
13/66	LHL	0.04	5.4	6	0.08	0.37	6.0	42	46	0.04	0.15	1.37	0.11	14	1.7	0.03	32
14/66	LRP	0.04	4.5	3	0.06	0.42	2.6	38	53	0.10	0.18	0.88	0.43	7	1.7	0.03	16
15/66	LBF	0.04	4.3	3	0.08	0.35	2.9	32	84	0.05	0.25	0.91	0.21	19	1.4	0.02	21
16/66	LBF	0.04	4.3	4	0.07	0.30	3.1	42	86	0.07	0.21	0.62	0.09	20	1.4	0.04	17
17/66	HFL	0.04	3.8	6	0.02	0.30	3.3	41	74	0.05	0.21	0.63	0.14	15	1.8	0.04	21
	Mean	*0.04*	*4.4*	*5*	*0.05*	*0.30*	*3.2*	*40*	*69*	*0.06*	*0.20*	*0.58*	*0.13*	*20*	*1.5*	*0.03*	*22*
			±0.5	*±5*	*±0.02*	*±0.07*	*±1.0*	*±4*	*±23*	*±0.03*	*±0.05*	*±0.35*	*±0.11*	*±11*	*±0.27*	*±0.01*	*±6*

Table 30. Relationships between leaf and sheath contents of elements

Element	*B*	*Ba*	*Co*	*Mn*	*Mo*	*Sr*
Correlation cœfficient	0.624*	0.976**	0.735**	0.756**	0.696*	0.932**

* Sig. to P 0.05
** Sig. to P 0.01

The relationships between leaf and sheath levels of the elements Ag, Cu, Cr, Fe, Pb, Sn, Ni, Ti, V and Zn were not significant.

Depending upon the behaviour of each element in the sugar cane plant, it is obvious that there will be no simple relationship between the level of that element in the leaf and in the sheath. It is therefore not possible to deduce critical levels in leaf lamina of all elements from a knowledge of such levels in leaf sheath; these values can only be obtained by experiment. Also, varietal differences must surely occur.

Toxicity

The leaf contents of the elements are below "toxicity levels" and it seems, therefore, that problems of toxicity of any element do not arise.

Critical values

As it has been decided to discontinue with the leaf sheath analysis in foliar diagnosis, the critical values of the leaf lamina only are given in Table 28. These values are taken from SAMUELS (1969). Although the eleven sites covered the whole range of climate (40-200″ of rain per annum) and soil (pH 4-7) occurring on the island, the variations in leaf lamina contents of the elements at the different sites were relatively small. Therefore, it is improbable that these small variations could be responsible for a deficiency in an element.

No information is available in the literature on sugar cane on the need for the elements Ag, Ba, Cr, Ni, Pb, Sn, Sr, Ti and V for cane growth but again, such need is highly unlikely. As to the elements whose critical values have been given, molybdenum and zinc are the only ones whose contents were anywhere as low as the critical levels at a few of the experimental sites. This is in accordance with the observation made by PARISH *et al* (1965) as regards molybdenum but so far, no leaf symptoms have ever appeared on canes growing in Low Humic Latosols. Molybdenum deficiency usually occurs on acid soils, but the Low Humic Latosols are not particularly acid so that it appears the critical level of Mo must be below 0.03 p.p.m.

To conclude therefore, leaf lamina analysis indicates that the possibility of any large-scale trace element deficiency occurring in sugar cane growing in Mauritius is unlikely but the supply and uptake of molybdenum and zinc need a closer study.

Acknowledgement

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2. CANE YIELD RESPONSES TO CALCIUM SILICATE APPLICATION

Y. WONG YOU CHEONG

The calcium silicate trials laid down in 1967 in soils known to be low in silicon were harvested in first ratoon in 1969.

Yield results in 1968 had shown that the growth of virgin canes in these soils was significantly increased by the application of calcium silicate. Although conclusive evidence of the beneficial nature of calcium silicate in virgin canes has thus been obtained, it would have been prematuie to deduce that such spectacular response would be carried over in ratoons. The greater root volume of ratoon crops would result in a greater uptake of soil silicon and therefore, it was more than likely that the responses to calcium silicate would decrease with increasing age of the ratoons. For this reason, the behaviour of ratoons had to be observed first, and great caution exercised before any recommendations could be made on the large-scale application of calcium silicate.

The experimental evidence so far obtained is not sufficient to state precisely the rôle played by the silicate in cane nutrition. While it was pointed out that toxicities of iron and manganese could not have been the main factors limiting yields in those soils, no evidence was obtained on the rôle of other elements. Also, the relative yield response to calcium silicate in the Chamarel trial, which site had by far the lowest amount of concretions, was much less than in the other trials, although the extractable soil silicon content was of the same order as at the other sites.

As the experimental sites occurred under rainfall averaging 200 inches a year, leaching of silicate would probably occur, particularly if it had been applied in heavy doses. It was thus necessary to carry out another series of trials to compare the efficacy of one large single dose of calcium silicate applied at planting with that of the same dose split up into smaller annual applications. This series of trials was laid down in 1969.

Results

The individual yields of first ratoon crops are given in Table 31 and the bulked results in Table 32.

Table 32 shows that highly significant yield responses to calcium silicate have also been obtained in first ratoons, although these responses were smaller than those obtained in the previous year in virgins (WONG YOU CHEONG and HALAIS, 1968). The application of 3 tons of calcium silicate at planting increased the yield in first ratoons by 2.9 tons of cane per acre for the variety Ebène 1/37 and 8.2 tons for the variety M.93/48, whereas at the higher level of silicate application (6 tons/acre), the increase in yield was 5.8 tons for the variety Ebène 1/37 and 9.1 tons for the variety M.93/48.

However, the mean annual response (virgins and first ratoons) was 5.8 tons for the variety Ebène 1/37 and 9.5 tons for the variety M.93/48 at the lower level of calcium silicate application, and 8.7 tons and 10.6 tons respectively, when 6 tons of calcium silicate had been applied. The total responses over the two years are of course double these values, i.e. 11.6 and 19.6 tons at the 3 tons/acre rate of silicate application, and 17.4 and 21.1 tons respectively at the higher rate of silicate application.

It would appear that there exist some varietal differences in the responses to calcium silicate as the yield increases of the variety Ebène 1/37 were smaller than those of the variety M.93/48.

The results of the Chamarel trial 7/67 have not been presented because the canes were severely attacked by pokkah-boeng.

No significant yield response, or increase in sucrose content, was obtained in first ratoons from the coral sand treatment.

Sucrose

The sucrose content was also significantly increased by calcium silicate application.

Table 31. Mean cane yields and sucrose contents of first ratoon crops

Treatment	*METHELINE 6/67* *M.31/45* Yield (TCA)	Sucrose %cane	*M.93/48* Yield TCA	Sucrose % cane	*RIOUX 8/67* *Ebène 1/37* Yield TCA	Sucrose % cane	*M.93/48* Yield TCA	Sucrose % cane	*PLAINE SOPHIE 10/67* *Ebène 1/37* Yield TCA	Sucrose % cane	*M.93/48* Yield TCA	Sucrose % cane
Control	43.9	14.0	36.2	13.9	15.3	6.9	14.4	9.0	27.1	13.4	24.3	12.4
3 tons $CaSiO_3$/acre	48.2	13.8	42.9	14.2	26.7	9.0	30.1	11.7	26.4	12.7	31.7	12.4
6 ,,	47.5	13.5	47.8	14.1	29.7	8.8	31.5	11.6	28.3	13.4	33.8	12.7
4 tons coral sand/acre	42.6	14.1	43.1	13.2	16.9	7.1	11.8	9.8	27.4	12.5	26.2	11.9

Treatment	*VALETTA 11/67* *Ebène 1/37* Yield TCA	Sucrose % cane	*M.93/48* Yield TCA	Sucrose % cane	*UNION PARK 12/67* *Ebène 1/37* Yield TCA	Sucrose % cane	*M.93/48* Yield TCA	Sucrose % cane	*FUEL 13/67* *Ebène 1/37* Yield TCA	Sucrose % cane	*M.93/48* Yield TCA	Sucrose % cane
Control	37.2	9.2	41.0	7.9	43.9	13.1	39.9	13.3	34.0	11.3	40.2	13.3
3 tons $CaSiO_3$/acre	40.8	8.9	43.7	8.2	40.4	13.3	48.9	14.2	36.4	12.1	48.5	13.1
6 ,,	44.5	9.5	42.5	8.1	44.6	13.5	49.1	13.5	41.6	12.6	45.9	12.9
4 tons coral sand/acre	36.8	8.5	37.7	10.6	35.5	13.3	43.3	13.3	34.2	11.0	42.7	13.0

Table 32. Mean cane yields and sucrose contents of first ratoons, and virgins + first ratoons, of six trials

Treatment	*Ebène 1/37* Yield (TCA) 1R	Yield (TCA) (V + 1R)/2	Sucrose % cane 1R	Sucrose % cane (V + 1R)/2	*M.93/48* Yield (TCA) 1R	Yield (TCA) (V + 1R)/2	Sucrose % cane 1R	Sucrose % cane (V + 1R)/2	*Mean of 2 varieties* Yield (TCA) 1R	Yield (TCA) (V + 1R)/2	Sucrose % cane 1R	Sucrose % cane (V + 1R)/2
Control	33.6	25.8	11.3	11.8	32.7	24.4	11.6	11.9	33.2	25.1	11.5	12.1
3 tons $CaSiO_3$/acre	36.5	31.6	11.6	12.1	40.9	33.9	12.3	12.6	38.7**	32.8**	12.0	12.5*
6 ,,	39.4	34.5	11.9	12.4	41.8	35.0	12.2	12.4	40.6**	34.8**	12.1*	12.6**
4 tons coral sand/acre	32.2	26.8	11.1	11.6	34.1	27.2	12.0	12.0	33.2	27.0	11.6	12.1
LSD (P = 0.05)									2.7	2.2	0.6	0.3
,, (P = 0.01)									3.6	3.0	0.8	0.5

Leaf analysis

The mean third leaf lamina levels of silica in these trials are shown in Table 33.

Table 33. Mean silica contents of the third leaf lamina of first ratoons at the six sites

	Third leaf silica (SiO_2 % d.m.)	
	Ebène 1/37	*M.93/48*
Control	0.98	0.96
3 tons $CaSiO_3$/acre ...	1.59	1.52
6 tons ,, ...	1.79	1.85
4 tons coral sand ...	0.92	0.93
LSD (P = 0.05) ...	0.25	0.21
,, (P = 0.01) ...	0.34	0.29

As the experimental data have been obtained in only one ratoon crop, it has been decided to wait for another ratoon crop before the results collected can be analysed critically. However, a quick examination of Tables 32 and 33 indicates that the leaf silicon threshold value would be around 1.50 SiO_2% d.m. On this basis, it would appear, from the foliar diagnosis data collected in 1969, that 29% of the Permanent Sampling Units are deficient in silicon and would presumably benefit from an application of calcium silicate. These deficient Units include soils from the Low Humic Latosol, Humic Latosol, Latosolic Brown Forest, Humic Ferruginous Latosol and Mountain Slope Complexes groups.

Silicate materials

There are now several silicate materials of good agronomic value on the market. The price has also come down considerably but the basis of comparison should remain the cost per unit of soluble SiO_2. The method used for the determination of acid-soluble silica is the *Official Method of the National Institute of Agricultural Sciences, Tokyo*, August 1967.

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3. VARIETY CORRECTIONS FOR FOLIAR DIAGNOSIS

P. HALAIS & Y. WONG YOU CHEONG

As new varieties are introduced, varietal corrections have to be determined for the inclusion of these varieties in routine foliar diagnosis and for the interpretation of the analytical data obtained. These corrections are in addition to those applied for different ages of the ratoons and moisture status of the spindles or 4-5 internodes.

The eleven Final Variety Trials (series Agro.'66) were used to determine variety corrections for the four important varieties M.147/44, M.93/48, M.442/51 and M.13/56. The tissue taken in each case was the central portion of the third-leaf lamina of ratoons about 5 months old, sampled during the summer boom stage when moisture was not limiting.

Table 34 shows the mean nutrient contents of all the varieties at the different sites, followed by the levels of the four main varieties.

Table 34. Leaf lamina analysis (mean of all varieties)

	Ash	*SiO₂*	*N*	*P*	*K*	*Ca*	*S*	*Mn*
			% d.m.					*ppm d.m.*
Agro 14/66 La Mecque ...	8.53	4.98	1.91	0.218	1.20	0.314	0.156	38
13/66 Solitude ...	7.85	4.00	2.21	0.216	1.42	0.309	0.201	39
9/66 Beau Séjour ...	7.72	4.28	1.77	0.204	1.23	0.327	0.174	55
7/66 Mt. Choisy ...	7.37	3.71	1.93	0.205	1.24	0.357	0.205	30
6/66 Belle Vue ...	7.29	3.48	2.13	0.211	1.27	0.350	0.199	97
11/66 FUEL ...	6.38	2.69	2.00	0.210	1.23	0.312	0.188	73
8/66 Beau Vallon ...	6.25	2.78	1.98	0.198	1.13	0.279	0.179	35
16/66 Mon Désert-Alma	5.82	2.01	2.29	0.230	1.22	0.322	0.176	50
17/66 Hermitage ...	5.48	1.47	2.29	0.246	1.21	0.281	0.160	44
15/66 New Grove ...	5.20	1.59	2.12	0.220	1.11	0.259	0.164	51
12/66 Olivia ...	5.10	1.37	1.94	0.217	1.16	0.307	0.174	53
Mean	*6.63*	*2.95*	*2.06*	*0.216*	*1.22*	*0.311*	*0.180*	*51*
Variety M.147/44 ...	6.01	2.60	2.00	0.215	1.18	0.261	0.149	38
,, M.93/48 ...	7.09	3.25	2.00	0.215	1.25	0.362	0.192	70
,, M.442/51 ...	7.08	3.48	2.06	0.221	1.24	0.324	0.188	57
,, M.13/56 ...	6.32	2.55	2.15	0.211	1.27	0.295	0.194	43

The silica content does not have to be determined analytically but can be calculated from the known values of ash and potassium according to the following equations :

Ash	*No. of observations*	*Equation*
<5.00	13	$1.04\ (SiO_2) = 4.70(ash) - (1.26\ K + 2.40)$
5.00 — 6.00	9	$1.58\ (SiO_2) = 5.38(ash) - (1.22\ K + 2.58)$
>6.00	13	$3.28\ (SiO_2) = 7.28(ash) - (1.30\ K + 2.70)$

4. NITROGEN AND SULPHUR STATUS OF CANE LEAVES AS INFLUENCED BY SULPHATE OF AMMONIA APPLICATIONS

PIERRE HALAIS & CLAUDE FIGON

This study has been made on the series of Final Variety trials (Agro. '66) consisting of eight varieties, planted at eleven sites, which had received nitrogen in the form of sulphate of ammonia at the rates of 0, 30 and 60 kg N/arpent/year.

The canes were weighed and analysed for sucrose in virgins in 1967, and subsequently in 1st and 2nd ratoons.

In the present discussion, only results in ratoons have been used.

A high yield response to the application of sulphate of ammonia was obtained in three of the trials, a moderate response in five other trials, whereas the remaining three trials did not show any response.

Fig. 25 shows the average profitability indices, for each of the three groups, corrected for the cost of fertilizer (30 kg N corresponding locally to 100 kg of sugar).

Profitability index = 0.01 TCA(SM−4)
where TCA = tons cane per arpent
SM = sugar made % cane

Foliar diagnosis results for N and S are also represented as well as the corresponding sugar responses for the doses 0 to 30 and 30 to 60 kg N.

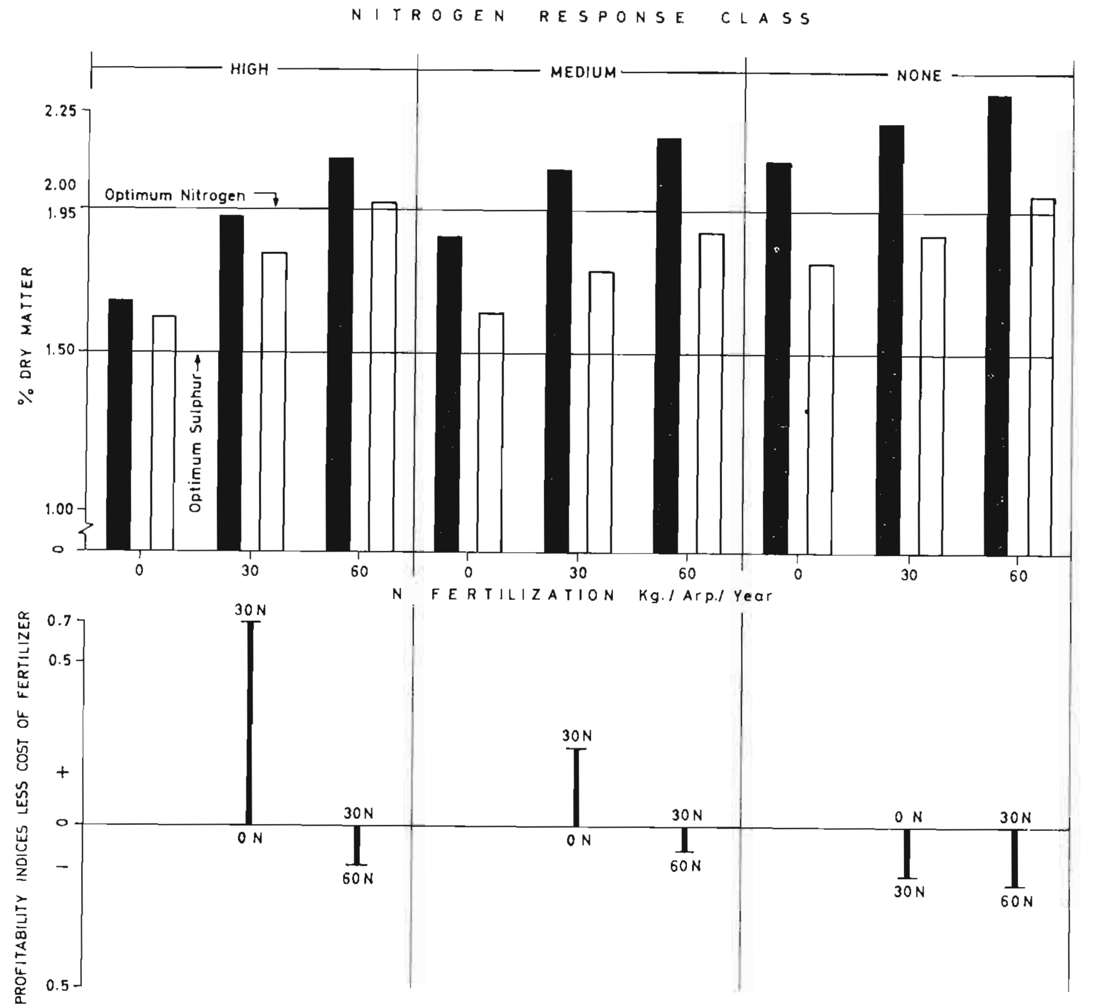

Fig. 25. Leaf nitrogen and sulphur, and sugar responses to an application of 30 Kg. N. as sulphate of ammonia.

Foliar diagnosis has faithfully demonstrated the changes in N and S status of cane leaves following the addition of sulphate of ammonia as fertilizer. The nitrogen contents are about eleven times those of sulphur. The following regression has been calculated to relate the initial N content to final N content of leaves following the application of a fixed dose of 30 kg N/arpent/year

$$\text{Final leaf N} = 2.14 + 0.685\ (\text{initial leaf N} - 1.97)$$

$$(\text{for } n = 22,\ r = 0.710^{**})$$

The present data confirm the validity of the already established level of 1.95 N% dry matter as being the critical value for adequate nitrogen nutrition.

It should be noted that three out of eleven trials, a fraction which is far from being negligible, did not show any response to nitrogen in spite of the fact that applications of sulphate of ammonia were repeated three years running in virgins, 1st and 2nd ratoons. The checking up of the nitrogen status of sugar cane crops by means of foliar diagnosis is once more shown to be indispensable if financial losses, through irrational fertilizer applications, especially excessive dressings of nitrogen, are to be avoided.

It is the first time in Mauritius that foliar diagnosis for sulphur has been conducted systematically on leaves of canes which had received different levels of sulphate fertilizers.

The analytical method of BLANCHAR, REHM and CALDWELL (1965) used for sulphur determinations in cane leaves has proved to be at the same time sensitive, reproducible, and rapid.

There is very little information from world literature available on the relationship between S status of sugar cane leaves and field response to sulphur. However, tentative critical limits have been recently suggested in Queensland (LEVERINGTON *et al.*, 1969), Rhodesia (GOSNELL, and LONG, 1969) and Puerto Rico (SAMUELS, 1969). The level of 0.15 S% dry matter in the central leaf lamina sampled at standard boom stage is suggested. No response to sulphur has yet been demonstrated under normal conditions prevailing in Mauritius. However, a special series of ten field trials, in which calcium ammonium nitrate and sulphate of ammonia are being compared, should yield further information on the behaviour of sulphur in sugar cane.

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5. YIELD RESPONSE OF SUGAR CANE TO PHOSPHATE APPLICATION IN RATOONS

Y. WONG YOU CHEONG

During the last decade, the application of large amounts of phosphate, mainly in tricalcic form, either mixed in with the soil or broadcast in the furrow at planting, has been regular practice on sugar cane plantations. Such practice has resulted in boosting up soil phosphate reserves, so that phosphate deficiency, as shown by foliar diagnosis, is no longer a common event. Soil analysis sometimes indicates deficiency in some fields coming to the end of their cycle, that have never received any large amount of phosphate in the past.

Soluble phosphate in complex form is also applied in small amounts in ratoons, but it is often asked whether this phosphate is necessary, particularly when leaf phosphate levels have been shown by foliar diagnosis to be adequate.

That soluble phosphate applied in ratoons can be taken up by the plants has been demonstrated by PARISH (1963), who obtained significant yield responses to the application of 25-40kg P_2O_5 per acre. However, should phosphate be applied in ratoons if adequate phosphate is already available in the soil ? The response to applied phosphate is greater in plant canes than in ratoons, and it decreases with increasing age of the ratoons. It would seem, therefore, that if adequate phosphate has been applied at planting, addition of this nutrient in following ratoons would have no real immediate benefit on plant growth although it would enrich soil phosphate reserves.

Field trials were therefore laid down in 1965 to compare yield responses to phosphate applied by two different methods in plant canes, and also to study the effect of applying phosphate in ratoon canes.

Experimental

In the trials, the results of which are given below, two methods of application of phosphate at planting, namely placement (small heaps of fertilizer placed at intervals of 6″ in the furrow) and banding (a band of fertilizer 2″ wide in the furrow), were compared at rates of 0, 15, 30, 45 and 60kg P_2O_5 per acre as triple super. The experimental design was a split-plot latin square, phosphate being either "placed" or "banded" in the two sub-plots of each plot, and the trials were carried out on sites representing the main soil groups of Mauritius.

After the first harvest, no phosphate was applied in the sub-plots in which it was previously banded, whereas in the remaining sub-plots, the phosphate applications were continued as in the preceding year.

Results and discussions

Plant canes

(a) Yield response to phosphate application.

Yield results of plant canes are given in Table 35.

Table 35. Cane yields (means of two methods of application) TCA

	5/65	*6/65*	*7/65*	*8/65*	*9/65*	*10/65*	*11/65*	*12/65*	*13/65*	*Mean*
0 kg P_2O_5 acre	24.9	30.0	31.0	31.3	31.1	38.1	7.6	9.4	18.0	24.6
15 ,, ,,	25.4	30.0	30.0	29.4	32.7	37.7	7.8	10.3	20.8*	24.8
30 ,, ,,	24.7	32.5	29.2	33.0	32.2	37.1	8.6	11.7	19.6	25.4
45 ,, ,,	24.8	30.6	31.1	31.0	34.9*	42.3	10.1	10.6	20.5*	26.2*
60 ,, ,,	24.8	32.1	33.2	32.0	34.7*	42.6	9.5	11.8	19.7	26.7**
LSD (P = 0.05)	4.0	3.5	3.9	3.2	1.9	5.1	1.1	3.4	2.0	1.2
CV % ...	5.2	3.6	4.2	3.3	1.9	4.2	4.0	10.3	2.7	

*Sig. to P = 0.05

**Sig. to P = 0.01

It shows that a significant yield response to phosphate has been obtained in only two trials (9/65 and 13/65); it is interesting to note that experimental variations were smallest in those trials. It is therefore possible that in some of the other trials where the higher rates of phosphate had outyielded controls, the greater experimental variations present could have masked any significance in the yield responses obtained.

The fact that the lowest rates of phosphate application did not produce any significant increase in yield could also mean that a minimum amount of phosphate had to be applied before any yield response could be obtained. Under normal agricultural practice, however, much larger amounts of phosphate are in fact applied at planting.

Although only two trials have shown any significant response to phosphate when considered individually, an overall significant response at the two highest rates of application was obtained when the trials were grouped together.

(b) Effect of method of application.

The effect of placement and banding of phosphate on cane yield is given in Table 36.

Table 36. The effect of placement and banding of different levels of phosphate on virgin cane yields (means of 10 trials)

	Cane yields (T.C.A.)		
	Placement	*Banding*	*Difference*
15 kg P_2O_5 acre	25.2	24.5	+ 0.7 N.S.
30 ,,	25.4	25.3	+ 0.1 N.S.
45 ,,	26.8	25.6	+ 1.2 N.S.
60 ,,	26.6	26.8	— 0.2 N.S.

It shows that there was no significant yield difference between the two methods of application at all levels of phosphate. Previous results had indicated that even when soluble phosphate was mixed up with the soil, thereby inducing maximum fixation of that nutrient, there was no adverse effect on the uptake of phosphate by the plant. It follows, therefore, that the method of application of soluble phosphate is immaterial to the sugar cane plant.

Ratoon canes

Yield response to phosphate application.

In order to study the effect of the application of soluble phosphate in ratoons, the sub-plots in which phosphate was banded stopped receiving phosphate after the harvest of plant canes and were thereafter considered as controls in the ratoons. The two sub-plots within the same plot could be considered to have had the same phosphate "history" at the end of the first year because no significant difference had been obtained on the effect of the two methods of application on cane growth. Some of the trials were allowed to go as far as the 3rd ratoons, but in Table 37 the results from all the trials were grouped together, the values representing yield results obtained over several years. Although there was a significant response to the addition of 45 and 60kg P_2O_5/acre in plant canes, the same treatment in ratoons did not produce any significant yield response. It is therefore evident that ratoon canes must be better equipped, probably through a more extensive root system, than plant canes in making use of the available phosphate in the soil. A slight increase in cane yield has been obtained with increasing rate of phosphate application, but was not significant and in practice would have been uneconomic.

Table 37. Yield responses to the application of soluble phosphate in ratoons (means of 22 results)

Rate of phosphate application	*Cane yields (TCA)* Phosphate added	No phosphate added	Difference
15 kg P_2O_5/acre	34.7	35.1	$-0.4^{N.S.}$
30 ,,	35.3	34.8	$+0.5^{N.S.}$
45 ,,	35.3	34.5	$+0.8^{N.S.}$
60 ,,	35.9	35.6	$+0.3^{N.S.}$

The addition of phosphate to ratoons when adequate phosphate has been applied at planting is clearly not justified, but in the event where foliar diagnosis shows a deficiency, then phosphate must be applied. However, such phosphate is not lost and can be considered as an addition to the phosphate reserves of the soil.

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6. INFILTRATION CAPACITIES OF SOME MAURITIUS SOILS

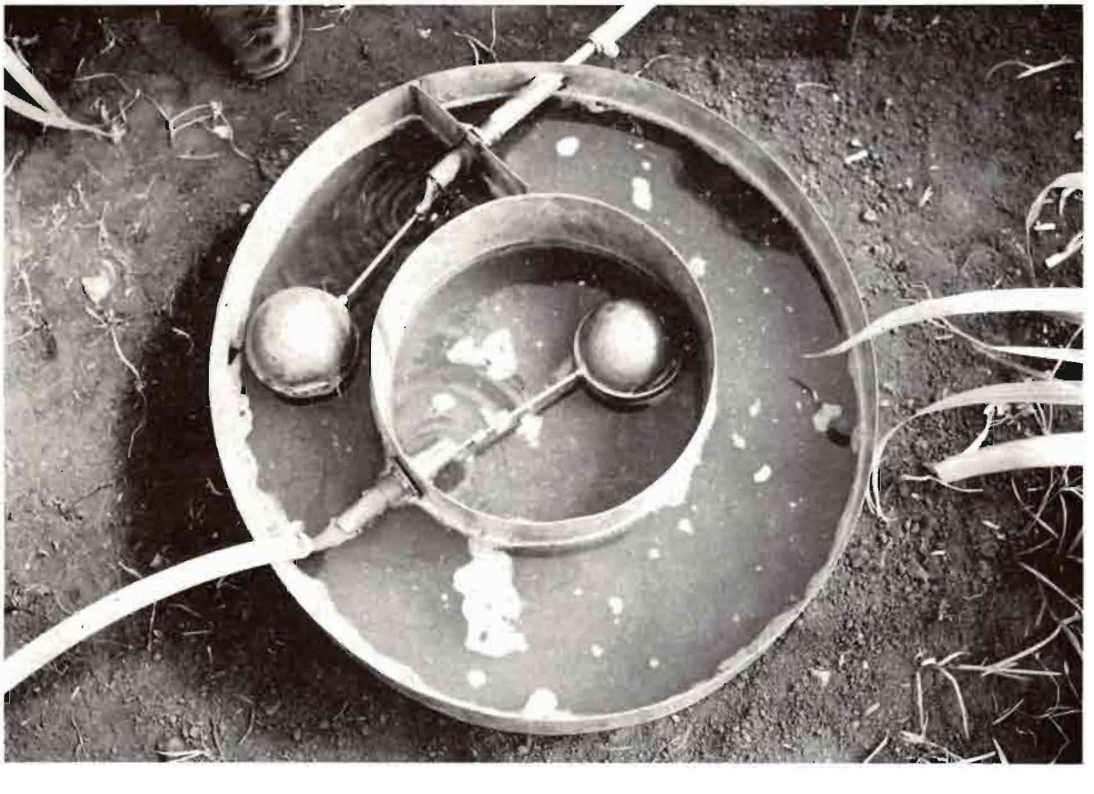
E. Z. ARLIDGE

(*F.A.O. Technical Officer*)

The infiltration capacity of soils, or the rate at which water can enter soils, is an important factor in design and operation of all irrigation systems. In sprinkler irrigation systems, a basic requirement is that water application rate should not exceed infiltration capacity of the soil, otherwise runoff will result, leading to wastage of water and possible soil erosion. In furrow irrigation systems, the infiltration capacity of the soil for a particular land slope and ground surface roughness, determines the length and width of furrows and amount of inflow water required.

Water infiltration rate influences the selection of irrigation method. For example, for a soil which is highly permeable throughout the profile and where water resources are limited, a sprinkler irrigation system would provide the best control for minimising percolation losses below the root zone.

In irrigation research, soil infiltration capacity is determined by means of *infiltrometers* of which there are two main types :



Determination of water infiltration rate by means of the cylinder infiltrometer

(i) spray or sprinkling infiltrometers; and (ii) flood or cylinder infiltrometers. Essentially, each type measures the rate of water intake per unit area of soil, and usually the known surface area is confined within a metal frame or cylinder pressed down into the soil to a required depth.

In the sprinkling-type method, water from a spray nozzle is applied at a rate so as to exceed the infiltration rate and produce runoff. The runoff water is collected and measured, the infiltration capacity of the soil being the difference between applied and runoff rates per unit area. In the cylinder-type infiltrometer the rate of fall of the surface of water ponded on the soil, or the rate of use of water from a supply source that maintains a constant head of water on the surface, is taken as the rate of water intake. To control the lateral movement of water through the soil under the cylinder, which is the cause of unrealistically high values obtained with small cylinders (less than 12 in. diameter), most researchers use two concentric cylinders and keep ponded water in both of them, while making the measurement of water intake in only the centre cylinder.

Materials and methods

In the present studies the infiltration capacities of some Mauritius soils have been determined using a set of five double-cylinder infiltrometers. The field set-up of an individual infiltrometer is shown in Pl. IX, a.

The equipment comprises two concentrically arranged cylinders, an inner one of 12 in. diameter and 12 in. height embedded 4 in. into the soil, and an outer of 18 in. diameter and 9 in. height pressed about 2 in. into the soil. Water is supplied through plastic hoses to the cylinders from reservoirs supported about 18 in. above ground level. Each reservoir is fitted with a glass manometer for siting the water level, the manometer of the reservoir supplying the inner cylinder being marked in 0.1 in. graduations. Water gravitating from the reservoir enters the cylinder through a ball-cock which regulates the flow by the rising and falling of the hollow floating ball on the ponded water surface (Pl. IX, b.). The position of the ball-cocks is adjusted so as to maintain an approximately 2 in. head of water on the soil surface in the cylinders.

At the start of a test, water is poured from cans to quickly establish the 2 in. head, firstly in the outer cylinder, and then the inner one. The soil surface enclosed by the inner cylinder is covered with a plastic disc to prevent disturbance of the soil; the disc is removed immediately the water has been poured and the ball-cock released from the shut-off position. This operation marks zero time. The water level in the manometer of the inner cylinder reservoir is recorded at regular time intervals. Since the diameters of reservoir and inner cylinder are the same, the measured drop in water level in the reservoir is the cumulative water intake of the soil. Infiltration rate is found from the graph of cumulative water intake versus time.

The infiltration capacities of soils of the Richelieu family of Low Humic Latosols (2 sites) and of the Balaclava (one site) and St. André (2 sites) families of Grey Hydromorphic Soils have been determined. In all tests the typical pattern of infiltration was obtained. This shows a relatively rapid initial intake rate within the first 10 minutes or so, falling off to a steady minimum rate after 1 to 2 hours, depending on the soil.

Results

The results of the infiltration tests are summarised in Table 38. Minimum infiltration rates of the Richelieu and Balaclava soils fall respectively into the rapid and slow classes of infiltration. These results were anticipated but not those of the St. André soil which surprisingly has a very rapid infiltration capacity. Although the tests on this soil were carried out under dry to very-dry soil conditions, which would promote more rapid initial infiltration rates, there was no apparent falling-off of the very rapid intake rates, even after as much as 14 ft of water had been applied in 5 hours to the inner cylinder. The St. André soil, although moderately hydromorphosed in the upper part of the profile, appears to be comparatively deep

Table 38. Minimum infiltration rates of some Mauritius soils

Soil	*Location*	*No. Tests*	*Minimum infiltration rate (in/hr)*	
			Range	*Mean*
Low Humic Latosol (Richelieu Family)	Palmyre *Site 1 :* small area above pump house.	15	0.4– 9.8	3.6 ± 0.9
	Site 2 : larger area below pump house	20	0.1–17.5	6.9 ± 1.0
Grey Hydromorphic Soil (Balaclava Family)	Solitude *Site :* about ½ mile S.W. of factory	13	0.02– 1.7	0.66 ± 0.2
Grey Hydromorphic Soil (St. André Family)	Solitude *Site 1 :* about 3/4 mile S. of factory west side of road	8	4.5–20.0	12.4 ± 1.7
	Site 2 : about 3/4 mile S. of factory east side of road	10	5.3–14.0	9.2 ± 0.8

and freely permeable. The results from Site 2 are probably more representative.

The high variability among results for any one series of measurements is indicated by the standard errors of the mean minimum infiltration rates. Standard errors range from about 8% of the mean, for the ten tests at Site 2 on the St. André soil, to 30% of the mean for thirteen tests on the Balaclava soil.

One of the main disadvantages of the flooded plot method, even when employing a double-cylinder infiltrometer, is that measurements are usually subject to considerable error, and this problem is more acute when working with non-uniform soils which are common to Mauritius. It is mainly for this reason that efforts are being made to construct a fairly sophisticated sprinkler infiltrometer which should provide more realistic and less variable results.

Conclusions

The main conclusions of practical significance resulting from the present work are :-

(a) Soils of the Richelieu family of Low Humic Latosol and probably all Low Humic Latosols and Latosolic Reddish Prairie soils, as well as the St. André Grey Hydromorphic Soils can readily accept the water application of about 1 in/hr by the *Boom-O-Rain* and *Target-master* overhead sprinklers.

(b) for irrigating sugar cane and other row crops growing in the Balaclava Grey Hydromorphic Soils, the flood (furrow) system would be more suitable.

(c) the Balaclava Grey Hydromorphic Soils appear to be suitable for paddy rice, but not the St. André soils because of likely high water losses through deep percolation.

CLIMATE AND CULTIVATION

1. WEATHER CONDITIONS AND SUGAR PRODUCTION IN 1969

PIERRE HALAIS

DURING the last decade (1960-1969) the cane area reaped annually has not varied much, the highest figure being 196,000 arpents in 1966 and the lowest 188,000 in 1960 and in 1969. The proportion, on estates, of new plantations (virgin canes) to already established crop (ratoon canes) has also not varied considerably, as shown by the following extreme values on percentage weight of milled canes : virgins 18%, ratoons 82% in 1960, and virgins 11%, ratoons 89% in 1967. Field operations such as varietal replacement, improved fertilization, and irrigation practices have been so gradually introduced that their impact on year-to-year sugar production has been less conspicuous owing to the dominating influence of large fluctuations in weather conditions.

For the sugar industry as a whole, the conditions, especially maximum wind speed, associated with the passage of tropical cyclones near, or over the island, during the summer growing period have proved by far the most adverse to cane production. In extreme cases, as it occurred in 1960, following the passage of the two unusually violent cyclones *Alix* and *Carol*, cane quality was in addition substantially lowered.

Other adverse conditions, such as a drought when it occurs during the summer growing period, also reduce cane yields in localized areas where the climate is essentially sub-humid, where no irrigation is practised, or water not available at the critical time.

Abnormally cool weather, when it occurs at the end of the vegetative season, may also curtail cane growth too soon for maximum production.

Furthermore, unfavourable weather conditions during the winter maturation period may prevent canes from reaching the desired maturity. The dominant factors in this connection are : too high minimum temperatures during the first part of the period (May-July), and excessive rainfall during the second part of the period (August-October).

It follows that the ten major cyclones which visited the island, ranging from those of exceptional intensities such as *Alix* and *Carol* (1960), and *Jenny* (1962) to the more moderate ones, such as *Ida* and *Monica* (1968), have been responsible for a 14% reduction of the sugar output for the decade as a whole. If the year 1960 is ruled out as exceptional, the damage attributed to cyclonic conditions for the nine remaining years can be evaluated at approximately 8%, a figure still higher than that already deduced from data collected over a long period of time.

Under the present circumstances, the normal cane production per arpent reaped is estimated at 31.0 tons in the absence of an adverse cyclone, when other weather conditions, such as sum of monthly rainfall deficits and mean air temperatures for the growing period from November to June, do not deviate much from normal values.

The sugar made % cane has been ascribed a normal value of 11.5 when weather conditions, especially mean minimum temperatures from May to July, and total rainfall from August to October, do not depart markedly from normals.

It follows that the normal sugar output per arpent reaped is now estimated at 3.57 tons, and as the area harvested is at present around 188,000 arpents, the normal sugar production of the island is reckoned to be about 670,000 tons of sugar annually in the absence of cyclones.

However, if drought, associated with comparatively cool weather, occurs from November to April and later on from May to July, if mean minimum temperatures are above normal during that latter period, and, still more, during August to October; and if total rainfall is in excess of normal values, both cane tonnage and cane quality will be considerably affected, resulting in a sugar production much lower than the normal value of 670,000 tons, even in the absence of an adverse cyclone. On the other hand, if regular rains and high mean temperatures prevail from November to April, and mean minimum temperatures stay below normal values from May to July, while dry weather is experienced during the subsequent period August to October, both cane tonnage and cane quality will rise above normal expectations, causing the total sugar output to reach figures in excess of 700,000 tons for the year, under present cultural conditions.

A recent critical examination of the whole problem of the interaction of weather and sugar production has led to the formulation of rules simpler than those previously published, the dominant factors being the only ones retained. Furthermore, both vegetative and maturation periods have been subdivided into two sub-periods. It will be observed that the two months May and June, which are really transition ones, have been placed in the second vegetative sub-period as well as in the first maturation sub-period.

The weather data, obtained from the Meteorological Services, refer to rainfall for the whole sugar area, to temperatures for the key station at Plaisance Airport, and to the wind speed for the five sugar sectors W,N,E,S, & C taken separately.

Table 39. Meteorological conditions prevailing during the vegetative period, 1967-1969

	Sum of monthly rainfall deficits (inches)		*Mean air temperature (°C)*		*Highest wind speed for one hour (miles)*	
	I	II	I	II	I	II
	NDJF	MAMJ	NDJF	MAMJ	NDJF	MAMJ
	D_1	D_2	T_1	T_2	V_1	V_2
Normals	*7.8*	*7.2*	*25.0*	*23.5*	*24* (*median*)	*21* (*median*)
1960-69 *high*	20.4 (61)	13.8 (66)	+ 0.3 (67)	+ 1.1 (61)	83 I (60)	31 E (68)
1960-69 *low*	0.0 (62)	3.4 (67)	— 0.4 (63)	— 0.5 (64-65)		
1967	7.7	3.4	+ 0.3	+ 0.2	45 S (*Gilberte*)	
1968	8.0	8.5	— 0.3	— 0.4		31 E
1969	14.2	7.2	+ 0.1	+ 0.9		(*Monica*)

Table 40. Cane production, 1967-1969

	TCA (average) 1st August	Final	*Conversion Factor (average millers)*
Normals	*31.0*	*31.0*	*0.856*
1960-69 *high*	31.4 (65-67)	30.9 (69)	0.874 (68)
1960-69 *low*	10.7 (60)	12.7 (60)	0.820 (61)
1967	31.4	30.3	0.858
1968	26.0	27.2	0.874
1969	31.2	30.9	0.856

Canes during the 1969 vegetative period did not suffer from any adverse cyclonic conditions, but during the first part of the period a drought was experienced: D_1, 14.2 in. against a normal figure of 7.8in. The crop prospects were then rather gloomy. However, conditions improved during the second part, in which a deficit of only 7.2 in. was recorded, the normal value. The beneficial rains during this second part of the period were also accompanied by high mean temperature (T_2, + 0.9 °C) and cane growth was, as a result strongly boosted.

The final yield (tons of cane per arpent) reached the high value of 30.9, which is very near the present *normal* of 31.0.

Table 41. Meteorological conditions prevailing during the maturation period, 1967-1969

	Total rainfall (in) I	II	*Mean min temperature (°C)* I	II	*Cane quality sugar made % cane*	
	MJJ P_1	ASO P_2	MJJ Tm_1	ASO Tm_2	*1st Aug.* SM_a	*Final* SM_f
Normals	*16.5*	*9.9*	*18.1*	*17.6*	*10.2*	*11.5*
1960-69 *high*	19.7 (61)	19.6 (65)	+ 1.1 (69)	+ 0.8 (60)	10.8 (64)	11.9 (64)
1960-69 *low*	11.9 (60)	6.1 (63)	— 1.2 (62)	— 0.9 (63)	9.2 (61)	9.8 (60)
1967	18.0	15.1	+ 0.7	+ 0.2	10.2	11.0
1968	14.6	9.1	+ 0.6	— 0.1	10.7	11.6
1969	15.8	6.6	+ 1.1	+ 0.7	9.5	11.5

The 1969 maturation period started unfavourably as a result of high minimum temperatures which occurred during the first part of the period (Tm_1, + 1.1). The actual sugar made % cane on the 1st of August was only 9.5. However, during the second part of the period, the rainfall was very low (P_2, 6.6) against a *normal* of 9.9. There was a spectacular rise in cane quality of + 2.0 which ended with the value of SM % cane of 11.5, equalling the *normal* value.

With a high cane yield of 30.9 TCA and a sugar made % cane of 11.5 equal to the *normal* value, the sugar made per arpent reached 3.55, very near the present calculated *normal* value 3.57. As the area reaped was 188,500 arpents, the sugar production for the 1969 campaign amounted to 668,700 tons, only exceeded by the record production of 685,500 for the 1963 campaign when 194,100 arpents were reaped. However, the 1969 crop, according to comparative mid-harvest dates has grown for an extra 13 days compared to that of 1963 which was short by 9 days.

The 1969 campaign was, however, most rewarding as the cane recovered very well from two serious set backs : the early drought during the first half of the vegetative period and the low maturity of the canes at the start of the crushing season.

Although effects of weather conditions on cane yields are known, it has not been possible, up to now, to evaluate their influence on final cane tonnage. The first reliable information in this connection is only available after the start of the crushing season. The bulletin issued regularly since 1955 by the Institute on the evolution of the sugar crop gives the needed information on the tonnage of cane per arpent reaped weekly by millers. It has been observed that, for the last five-year period, 1965-1969, the final cane yield per arpent obtained by millers equals the figure recorded on the 1st August. By multiplying this figure by the proper conversion factor (0.856), the tons of cane per arpent finally made for the island can be obtained.

The same bulletin also gives the sugar made % cane on the 1st August. However, it is not possible to derive the sugar finally made % cane from this early figure as the rise in cane quality is dependent upon weather conditions, especially average minimum temperature and total rainfall which prevail later on from August to October. For the period 1955 to 1969, this rise in SM % cane has averaged 1.3, with extremes of 2.5 in 1955 and of 0.4 in 1960.

The following regression (1) has been worked out from existing data :

$$SM_f - SM_a = 0.824 - 0.0862\ (P_2 - P_1) - 0.108\ (Tm_2 - Tm_1) \quad (1)$$

SM_a sugar made % cane on 1st of August

SM_f sugar made % cane final

P_1 total rainfall inches for MJJ

P_2 total rainfall inches for ASO

Tm_1 average min. temp. C. for MJJ

Tm_2 average min. temp. C. for ASO

The correlation cœfficient for the 15 years from 1955 to 1969 between observed and calculated SM rise is highly significant ($r = 0.863$).

The conclusion is that this rise in SM from the 1st of August to final realization is dependent almost entirely on weather conditions. The relationship holds good for the period prior to 1960, as well as for the subsequent one. It holds also for all cyclonic years as shown in fig. 26.

It has been possible, in addition, to derive more complex regressions linking final SM % cane to four selected weather variables (2) and to the two dominant ones (3).

$$SM_f = 19.40 - 0.247\ Tm_1 - 0.108\ Tm_2 - 0.0334\ P_1 - 0.0862\ P_2 \quad (2)$$

$$SM_f = 17.00 - 0.247\ Tm_1 - 0.0862\ P_2 \quad (3)$$

The figures 19.40 and 17.00 in the equations (2) and (3) hold good for the cane varieties and general conditions prevailing after 1960 and will be amended later on, if needed.

The following table gives comparative final values SM :

Table 42. Comparative final SM values, 1960-1969

Years	*1960*	*1961*	*1962*	*1963*	*1964*	*1965*	*1966*	*1967*	*1968*	*1969*
SM observed	9.8	11.2	11.5	11.9	11.9	11.1	11.6	11.0	11.6	11.5
SM calculated, 4 variables (2)	11.4	11.3	11.7	12.1	11.6	10.7	11.8	10.9	11.9	11.6
SM calculated, 2 variables (3)	11.4	11.5	11.7	12.0	11.6	10.8	11.8	11.0	11.9	11.7

Apart from the discrepancies which occur in 1960, the abnormal year when cane yields were reduced by more than 50% as a result of the two exceptionally violent cyclones, the correlation between observed and calculated values for final SM % cane is surprisingly good, especially regression (3) which implies the use of two dominant variables : average minimum temperature for the three months MJJ and total rainfall for the three months ASO.

The above regressions, however, have no prediction value, they only give a rational explanation of observed SM values from year to year. For, if on the 1st of August, the final cane tonnage can be predicted reasonably well, it is not possible to do so for final SM % cane.

Attempts have been made during the last three years, 1967, 1968 and 1969, to explore the possibilities of pre-harvest weighing of standing crops at monthly intervals from the 1st of April to the 1st of July for the eastern sector of the island to predict final yields. The results, to-date, have been disappointing.

The best solution available is to use the average final SM for the last five years, (presently evaluated at 11.4), together with the estimated final cane tonnage per arpent, (estimated from 1st of August values), in order to obtain the required predicted final sugar made per arpent. This last figure should be multiplied by the expected area to be reaped to obtain the earliest final production figure.

The following examples for the last four sugar campaigns show that this method of prediction works reasonably well.

	Predicted 1st August (thousand tons)	*Actual sugar production (thousand tons)*
1966	550	562
1967	661	638
1968	614	597
1969	662	669

The 1969 sugar production data for each of the five sugar sectors are compared to present *normal* values in the table on page 102. Of course, weather conditions cause different interactions to take place each year in each sector.

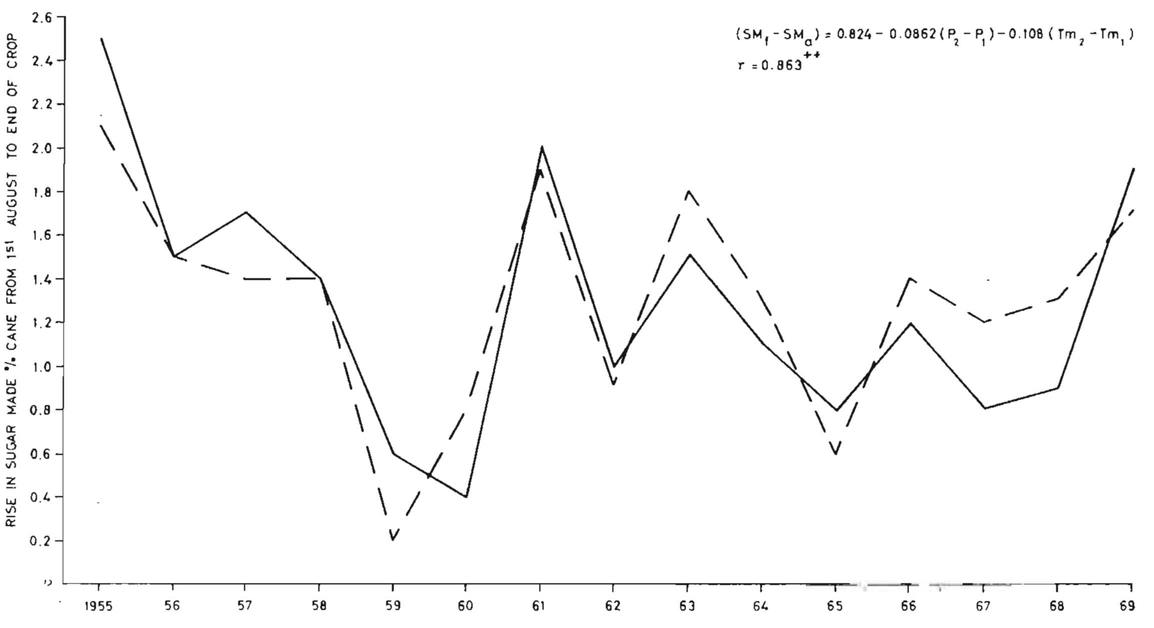


Fig. 26. Relationship between change in weather conditions and rise in cane quality.

Line : Observed

Dashes : Calculated

Sugar production in 1969

	West	*North*	*East*	*South*	*Centre*	*Island*	
Normals	*36.3*	*29.4*	*30.7*	*31.4*	*31.0*	*31.0*	
1969 ...	30.9	29.0	32.8	30.2	33.4	30.9	*T C A*
Difference	— 5.4	— 0.4	+ 2.1	— 1.2	+ 2.4	— 0.1	
Normals	*12.1*	*11.4*	*11.3*	*11.4*	*11.7*	*11.5*	
1969 ...	12.8	11.6	11.2	11.4	11.4	11.5	*SM % cane*
Difference	+ 0.7	+ 0.2	— 0.1	0.0	— 0.3	0.0	
Normals	*4.49*	*3.45*	*3.47*	*3.58*	*3.63*	*3.57*	
1969 ...	3.95	3.35	3.66	3.44	3.82	3.55	*T S M A*
Difference	—0.54	—0.10	+ 0.19	—0.14	+ 0.19	—0.02	
Normals	*2.94*	*2.18*	*2.24*	*2.32*	*2.39*	*2.33*	
1969 ...	2.72	2.20	2.36	2.23	2.47	2.32	*Profitability Index* (PI)
Difference	—0.22	+ 0.02	+0.12	—0.09	+ 0.08	—0.01	*(0.01 TCA (SM — 4))*

The rating of Profitability Indices in descending order for 1969 is :

	East	*Centre*	*North*	*Island*	*South*	*West*
Difference	+ 0.12	+ 0.08	+ 0.02	—0.01	—0.09	—0.22

The low ratings for the southern and western sectors observed in 1969 can be asscribed to the drought that prevailed during the first part of the vegetative period.

The comparative Profitability Indices ratings for each sector are given for the last five years in descending order :

Years	*Sectors*					*Sugar production Island (th. tons)*
1965	W	E	C	S	N	664
1966	W	S	E	C	N	638
1967	C	S	W	N	E	638
1968	N	S	C	W	E	597
1969	E	C	N	S	W	669

These indicate how each sector is diffirently affected by the climatic conditions prevailing in any one year.

2. RESULTS ON SPACING EXPERIMENTS

GUY ROUILLARD

In order to investigate the effect of spacing on crop yield in sugar cane varieties, ten experiments were planted in 1963, two in each of the following localities :

(a) Sub-humid, not irrigated— < 50″ of rain annually

(b) Sub-humid, irrigated— < 50″ of rain annually

(c) Humid, medium elevation— 50-75″ of rain annually

(d) Humid, medium elevation— 75-100″ of rain annually

(e) Super-humid, high elevation— > 100″ of rain annually

The layout adopted was a 4 × 4 latin square, including four spacings : 3′, 4′, 5′ and 6′ which were considered as main plot treatments. Each main plot was split in two, allowing two varieties with different growth habits to be planted in each trial. The varieties chosen were the best adapted to the five localities at the time, and included B.37172 and Ebène 50/47 (erect type); M.147/44 and M.93/48 (procumbent type).

The main plots were 30′ wide and 60′ long and the sub-plots were of the same width but half the length.

High levels of fertilizers were applied to prevent any deficiency. One ton of phosphatic guano was broadcast before planting. At planting, 100 kg of soluble phosphate and potassium were applied in the furrows. A dose of 60 kg of nitrogen, 50 kg of soluble phosphate and of potassium, was applied annually.

Yield comparisons were obtained by weighing a varying number of rows in the middle of each plot in order to keep the area for each spacing constant; for the 5-foot spacing a correction factor had to be used. Cane weight was therefore obtained from the following :

(a) 3-foot spacing 4 rows per plot
(b) 4-foot spacing 3 rows per plot
(c) 5-foot spacing 2 rows per plot (x1.2)
(d) 6-foot spacing 2 rows per plot

Each plot was sampled for analysis of sugar.

The two trials of the super-humid zone had to be discarded due to accidental causes, and the results are derived from the other eight trials.

Table 43 gives average results obtained from virgins to 5th ratoons in each experiment.

Table 43. Average yields of commercial sugar produced per acre for each of the eight trials.

Virgins to 5th ratoons at spacings of 3, 4, 5 and 6 feet. *Varieties : M.147/44, B.37172, Ebène50/47, M.93/48*

LOCALITY	*ALTITUDE (feet)*	*RAINFALL (inches)*	*VARIETY*	*SPACING* 3 ft	4 ft	5 ft	6 ft
Mont Choisy	30	42	M.147/44	2.5	2.9	2.5	2.4
			B.37172	2.3	2.2	2.2	2.4
St. Antoine	100	52	M.147/44	3.8	4.0	3.7	3.6*
			B.37172	3.5	3.7	3.7	3.4
Médine	300	40	M.147/44	4.4	4.5	4.2	4.0*
		(Irrigated)	B.37172	3.7	3.9	3.5	3.4*
St. André	180	49	M.147/44	3.9	4.2	3.6	3.7
		(Irrigated)	B.37172	3.4	3.6	3.3	2.8**
Bénarès	250	74	Ebène 50/47	4.1	3.9	3.8	4.1
			M.93/48	4.5	4.0	4.4	4.2
Grande Rosalie	650	87	M.147/44	3.5	3.7	3.7	3.3
			B.37172	3.7	3.6	3.5	3.4
Trois Ilots	250	90	Ebène 50/47	3.8	3.8	3.7	3.4**
			M.93/48	4.3	4.3	4.1	3.9*
Union	480	93	M.147/44	4.1	4.3	4.5	4.4
			B.37172	3.9	4.2	4.0	3.9**
I.R.S.C.	...	... ...	...	10.8	10.9	10.7	10.7
T.C.A.	...	... ...	...	34.5	35.0	34.1	33.0

* Denotes significant difference between 4' and 6' spacings at P. 0.05

** Denotes significant difference between 4' and 6' spacings at P. 0.01

The results show that in 11 cases out of 16, the 4-foot spacing gave better results than the 6-foot spacing; differences were significant in 8 of these cases. On the other hand, spacing has no effect on sucrose content, hence differences in sugar yields may be mainly attributed to differences in weight of cane (Table 43).

In spite of the range of environmental conditions (the super-humid zone excluded) under which the experiments were carried out from 1963 to 1969, and considering that different varieties were tested, there is no indication that climatic factors and growth habits have an influence on spacing.

The small increase in yield observed in favour of 4-foot spacing does not justify a change in current cultivation practice.

3. OBSERVATIONS ON THE EVAPOTRANSPIRATION OF SUGAR CANE

(FINAL RESULTS OF LYSIMETER EXPERIMENTS)

M. HARDY

Preliminary results of the Palmyre lysimeter experiments were published in the Annual Report 1966, pp. 95—101. These experiments were continued in 1967 and 1968, but owing to a severe drought which occurred during the first semester of 1968 (January 1968 having been in fact the driest since 1915), adequate irrigation of the experimental plots after March was not possible. It has therefore been decided not to consider the results obtained in 1968. The experiments are now terminated.

Results and discussion

Cane and sugar yields per arpent of third ratoons and mean values for the whole experiment (1964-1967) are given in Table 44. High mean yields of both cane and commercial sugar (62 tons and 6.2 tons, respectively) for the four crops were obtained in spite of the relatively severe cyclone *Danielle* which markedly depressed cane yields of the virgin crop in 1964.

Table 44. Cane and sugar yields per arpent for lysimeters, controls and field

Type of soil	*3rd Ratoon 1967*		*Mean (1964-67)*	
	TCA	*TSA*	*TCA*	*TSA*
L.R.P. (Médine) Lys. II	65	7.50	57	6.22
L.H.L. (Richelieu) Lys. I, III, V ...	63	5.54	62	6.29
L.H.L. (Réduit) Lys. IV, VI	69	5.48	67	6.11
Mean Lys. (prop).	*67*	*5.85*	*62*	*6.20*
Controls I - III	65	5.62	60	5.51
Rest of Field	62	5.27	57	5.42

The acute water demands of the crop during the peak months of November to January again amounted to about 7 inches, which have to be supplied either by rainfall or irrigation.

The results obtained in 1967 again confirmed the fact that when the lysimeters, after being irrigated to saturation, were allowed to dry out to a point corresponding to a soil-water tension of 7/8 atmosphere in the LRP soil, no great difference was observed in the evapotranspiration of canes growing in the different soil types.

The close relationship between rate of growth and evapotranspiration was once more observed (fig. 27). Peak growth occurred from November to January, during which period 40% of the total crop was produced. It is therefore extremely important that water be in adequate supply during this period.

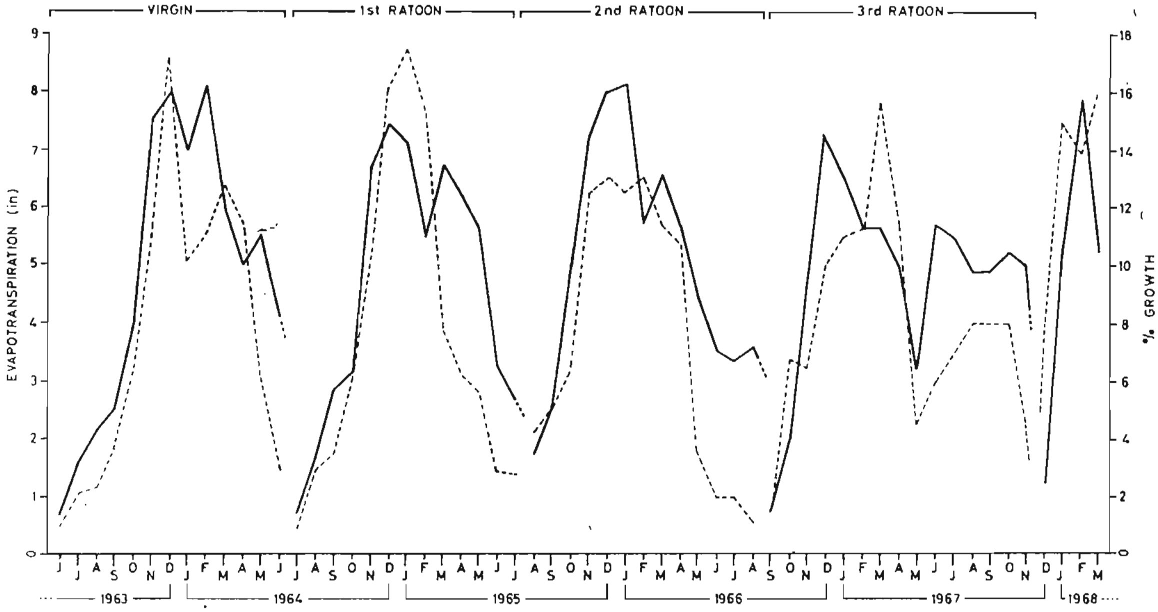


Fig. 27. Evapotranspiration and relative growth.
Line = Evapotranspiration (in.)
Dashes = % growth

Open pan evaporation and evapotranspiration

Results have confirmed that open pan evaporation could be used as a good estimate of evapotranspiration, particularly during periods of optimum growth. However, as shown by the results already published, open pan evaporation values were much higher than evapotranspiration rates during pre-harvest and post-harvest periods (from June to full canopy).

The time taken to reach full canopy is probably more dependent on the date of harvest than on the category of the crop (Table 45). Therefore, the recommendations made in the preliminary report should be modified to take into account the different times taken to reach full canopy. The water needs of the crop are thus evaluated as follows :

(a) *Post harvest period :* 40% the USWB pan reading *until* the canes have closed in.

(b) *Full growth period:* 100% of the USWB pan reading, the canes *having already* closed in.

(c) *Pre-harvest period :* 75% of the USWB pan reading (approx. two months before harvest, depending on the maturation program. Further experimentation on this is required).

Table 45. Time taken to reach full canopy

Category	*Period to reach full canopy*	*Time taken*
Virgin	17th June/63 — 27th October/63	4 months 10 days
1st Ratoon	23rd July/64 — 23rd November/64	4 months
2nd Ratoon	2nd August/65 — 12th November/65	3 months 9 days
3rd Ratoon	22nd September/66 — 30th November/66	2 months 10 days
4th Ratoon	15th December/67 — 31st January/68	1 month 16 days

Conclusions :

The main conclusions of the Palmyre experiment are :

1. Plant indicator methods, such as the measurements of cane elongation and moisture in the 4-5th internodes, for the assessment of water requirements of the cane plant suffer from distinct disadvantages.

2. The simplest and most reliable method of determining evapotranspiration requirements of the cane plant is to relate evaporation from a USWB Class-A pan to the state of vegetation in the cane field.

3. Very high yields (62 T.C.A. or 6.20 T.C.S.A.) can be obtained if water is adequately supplied at all times. Three months i.e. November, December and January, are most important for cane growth as 40% of total growth occurs during that period and at least 7 inches of water per month must be received then, either through rainfall or by irrigation.

4. For a 62 tons crop, the consumptive use of water is 60 inches. In the absence of rain 72 inches must be applied at the sprinkler nozzle. This corresponds to 1.2 inches of water per ton of cut canes or 12 inches per ton of sugar produced.

5. The mean daily evapotranspiration rate is 0.06 inch for young unclosed canes, 0.15 inch for fully canopied canes and 0.11 inch for maturing cane.

4. IMPROVED SELF-LOADING AND TIPPING DEVICE FOR THE HAULAGE OF SUGAR CANE AND OTHER MATERIAL

G. MAZERY

The object of this new device is to reduce the strain on the winch cable and other parts of the vehicle as experienced in the case of the standard "Self-Loader" generally in use for the transport of sugar cane in Mauritius, and which had been designed and tested by the writer in 1955.

The special features of the new device may be described as follows :

A rectangular tipping frame is fixed at the rear end of the chassis of the vehicle, or of a support thereof. The frame is about the length of the crates to be used, and wide enough to carry the rollers over which the crate has to travel during haulage. Three such rollers are mounted on the frame, one above the rear end, the second above the revolving axis of the frame, and a third towards its fore end. A pulley, or a small-grooved roller, is fixed at the front extremity of the tipping frame, and two small wheels of about 10 inches diameter by 4 inches wide are fixed one on each side below the rear end. The pivoting axis of the frame must be mounted parallel to the rear axle of the vehicle, as close as possible to the vertical plane passing through the axle's centre.

When the vehicle is ready to move, the tipping frame lies horizontally over the chassis of the vehicle at a level which enables the crate to clear the road wheels.

During haulage, the rear end of the tipping frame is lowered until the small rear wheels rest on the ground; while the fore end, carrying the pulley is raised to such a level that the tension of the cable from the winch (which passes over the pulley and extends over the rollers) will first lift the front of the loaded crate to about 18″ until it comes in contact with the rearmost roller. Thereafter, the cable will pull in line with the direction of progression of the crate over the remaining rollers until the frame tips back to its horizontal position and the crate is then ultimately secured in its final position.

Top : Self-loading trailer (patent applied for). *Bottom* : Demonstration by inventor of a new hitching device for train of trailers (patent applied for)

Tests carried out during the last crop have proved that the reduction in the strain on the winch, resulting from arrangement described above, enables the haulage of appreciably heavier loads, while reducing the wear and tear of the whole equipment to a considerable extent.

5. NOTES ON EXPERIMENTS CONDUCTED WITH RIPENER DA5

J. A. LALOUETTE, G. MAZERY & R. NG YING SHEUNG

Experimental procedure

Four experiments were carried out in 1969 with the growth regulator coded DA5. These experiments included varieties M.93/48, M.442/51 and M.351/57. The rates of application were 0, 2 and 4 lb a.i./arpent and the volume of solution sprayed/treatment was constant at 3 litres per 100 ft. of line. Two times of application were included in each experiment, bringing the number of treatments to 6. Essential details concerning the 4 trials are presented in Table 46.

Table 46. Experiments with sugar cane ripener DA 5

Essential data concerning the four trials

Trial No.	*Locality and Characteristics*	*Variety Crop Cycle Date last harvest*	*Weather and Rainfall (24 hrs.)*	*Dates*		*Age*	
				Application	*Harvest*	*Application (Wks)*	*Harvest (Wks)*
1	Fontenelle No. 1 Alt. 300 ft. Rainfall 77″/Annum	M.442/51 2R 29.10.68	Fine 0.25″ Night	15.4.49	16.6.69	24	33
			Fine Nil	14.5.69	15.7.69	28	37
2	Union Nos. 50/54 & 49/55 Alt. 150 ft. Rainfall 57″/Annum	M.442/51 3R 4.11.68	Fine Nil	16.4.69	18.6.69	23	32
			Slight drizzle Nil	15.5.69	17.7.69	27	36
3	Rohee Nos. 2 & 3 Alt. 1300 ft. Rainfall 140″/Annum	M.351/57 V 10.8.68	Cloudy 0.70″ Night	10.5.69	8.7.69	39	47
			Cloudy Nil	9.6.69	5.8.69	43	51
4	La Flora No. 30 Alt. 1100 ft. Rainfall 135″/Annum	M.93/48 7R 27.7.68	Slight drizzle Nil	12.5.69	10.7.69	41	50
			Cloudy Nil	10.6.69	22.7.69	45	51

Experimental Design

The 4 experiments were laid out as randomised blocks in 8 replications.

Plot size

The determination of plot size was governed by two factors which are discussed below. As it was contemplated to conduct a mill test from each treatment, it was necessary to decide on a reasonable combination of plot size and number of replications which would enable the cane from every plot to be bulked up, after weighing and sampling, to be sent to the factory. However, a much smaller amount of

DA5 than promised for experimentation was received and, as a consequence, the mill test had to be abandoned. The other factor which influenced plot size was the actual spraying operation, as no knowledge was available on the technique to be used on tall cane. It was therefore decided to allocate a larger number of border rows in order to eliminate any effects due to wind drift. The spraying technique described further along proved satisfactory and it is even contemplated to reduce the number of border rows in future. Plot size was 10 lines × 50 feet. Two lines were left untreated on each side of a plot leaving 6 treated lines. Of these, only the 4 middle ones were weighed and sampled for sucrose determinations.

Spraying technique

Equipment

The sprayer used was a C.P. 201 model of 3 to 3 1/2 gallon capacity. During the spraying operation two operators carried the boom and the sprayer tank respectively. The boom was connected to the container by a long flexible pressure tubing fitted with a control valve. The uniform level of the nozzles above the leaf canopy could be maintained by adjusting the length of the rod.

Details of the special boom designed for the purpose are given in fig. 28.

Operation

About half of the spraying solution was applied during a first passage through the 3 pairs of cane lines to be treated per plot; the other half was applied during a second passage as the operator walked back to the starting point. A uniform rate of application on the six treated lines was thereby ensured.

Observations

One important aspect of the treatment lies in the purplish discoloration of the leaf sheath

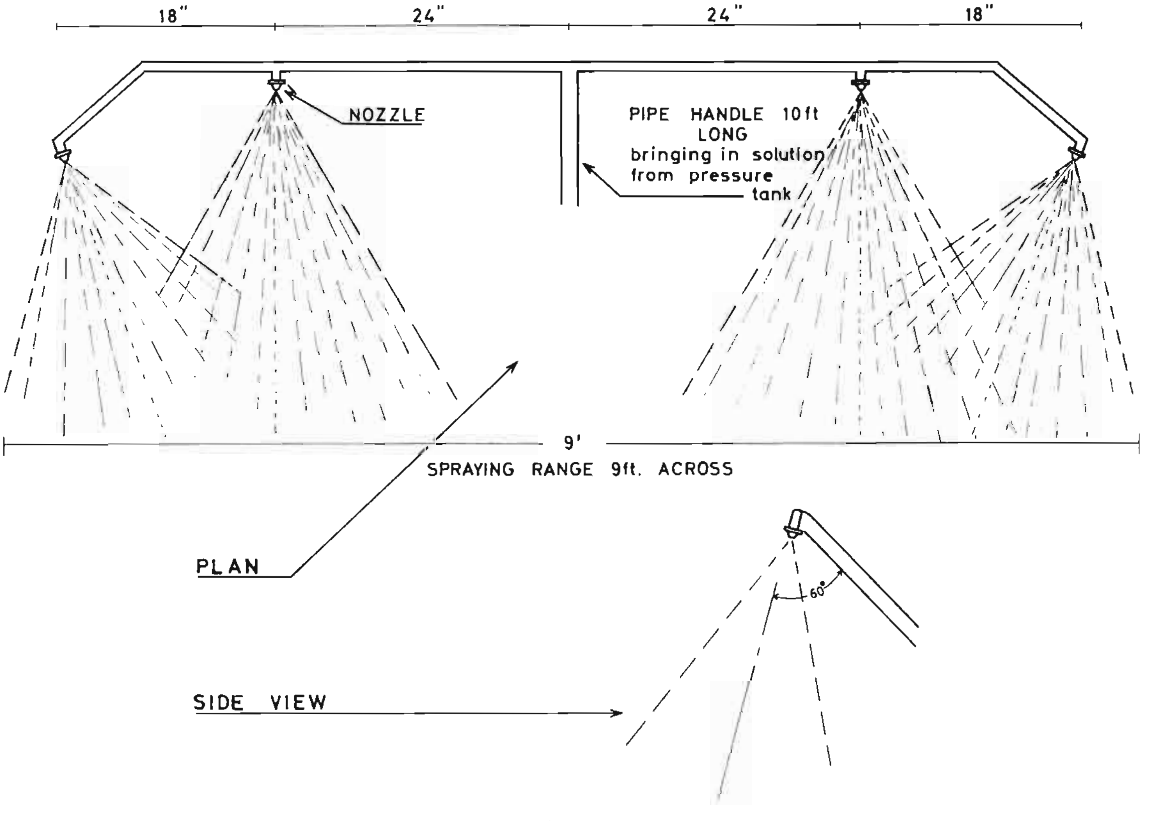


Fig. 28. Details of special boom designed for spraying with DA5.

following application. The three varieties showed this discoloration at both the 2-lb and 4-lb rates. Such a change in colour is a useful indication that the treatment has been effective, this being specially important if rain occurs after treatment. It also serves to indicate whether any wind drift has occurred. In the experiment, all untreated border lines kept the natural coloration of their leaf sheath, while all treated lines showed the discoloration very clearly.

Results

The three main characters have been analysed. They are : weight of cane, industrial recoverable sucrose % cane (I.R.S.C.), and weight of sugar. Mean values are presented in Table 47. The trend of response for I.R.S.C is also given in figs. 29-30. Refractometric Brix .was measured in the fields for all trials at approximately weekly intervals. It is unfortunate that measurement of this character could not be started early enough, i.e., prior to the beginning of spraying. However, measurements were continued on the 2 treated border lines of each plot as long as possible after harvest. Curves for M.442/51 and M.351/57 are presented as examples in fig. 30.

Table 47. Experiments with sugar cane ripener DA 5

Average values obtained in the four trials

Trial No.	*Variety*	*Treatments*	*T.C.A.* Harvest 1st			*I.R.S.C.* Harvest 1st			*T.S.A.* Harvest 1st		
			1st	*2nd*	*Mean*	*1st*	*2nd*	*Mean*	*1st*	*2nd*	*Mean*
					±0.78			*±0.08*			*±0.06*
1	M.442/51 2 R	Control	28.3	26.6	27.4	5.34	7.23	6.28	1.51	1.92	1.71
		2 lb/arp.	29.2	27.0	28.1	5.17	7.57	6.37	1.51	2.04	1.77
		4 lb/arp.	27.0	25.8	26.4	5.07	7.93	6.50	1.37	2.05	1.71
		Mean	*28.2*	*26.5*	*27.3*	*5.19*	*7.57*	*6.38*	*1.46*	*2.00*	*1.73*
					±0.73			*±0.11*			*±0.05*
2	M.442/51 3 R	Control	33.5	31.3	32.4	5.44	7.00	6.22	1.78	2.19	1.98
		2 lb/arp.	35.0	33.1	34.1	5.45	7.32	6.38	1.90	2.41	2.15
		4 lb/arp.	31.9	32.9	32.4	5.72	7.19	6.45	1.82	2.36	2.09
		Mean	*33.5*	*32.4*	*33.0*	*5.53*	*7.17*	*6.35*	*1.83*	*2.32*	*2.08*
					±0.68			*±0.13*			*±0.04*
3	M.351/57 V	Control	27.3	29.8	28.5	5.62	7.32	6.47	1.52	2.18	1.85
		2 lb/arp.	26.9	30.8	28.9	6.30	7.45	6.88	1.68	2.29	1.99
		4 lb/arp.	27.0	29.5	28.3	6.78	7.68	7.23	1.83	2.27	2.05
		Mean	*27.1*	*30.0*	*28.5*	*6.24*	*7.49*	*6.86*	*1.68*	*2.25*	*1.96*
					±0.87			*±0.06*			*±0.09*
4	M.93/48 7 R	Control	30.2	32.8	31.5	9.23	10.02	9.63	2.78	3.29	3.03
		2 lb/arp.	30.6	31.0	30.8	9.81	10.55	10.18	3.00	3.27	3.14
		4 lb/arp.	29.9	34.5	32.2	9.78	10.68	10.23	2.92	3.67	3.30
		Mean	*30.2*	*32.8*	*31.5*	*9.61*	*10.42*	*10.01*	*2.90*	*3.41*	*3.15*

N.B. 1. Standard errors refer to means of treatments averaged over both harvests, and are based on 16 plots.

2. I.R.S.C. = Industrial recoverable sucrose % cane.

Yield of cane

(i) No significant differences between cane yields for the various treatments for all three varieties could be detected.

(ii) Yields of M.442/51 did not improve significantly with time during the period between the two harvests, i.e., four weeks. This is true for both sites where this variety was under investigation. Yields of M.351/57 and M.93/48 increased significantly with time, irrespective of treatments.

I.R.S.C.

As was to be expected, there were highly significant differences in sucrose content between the two times of harvest for all three varieties.

M.442/51 at Union showed no significant difference between treatments for both times of application. There was therefore no response. At Fontenelle, however, the only significant component apart from time, was the interaction treatment × time. When this component was investigated further, it was found that the first time of application at 24 weeks, harvested at 33 weeks, showed a slight insignificant downward trend with rates, while the second treatment at 28 weeks, harvested at 37 weeks, produced definitely significant results, response in this case being linear with respect to rate of application. The Brix curves for this variety indicate that harvest may have taken place too late after application.

*M.*351/57 responded linearly to rate at both times of application. Further, there was a significant difference in the response slope, the earlier treatment giving a better response.

*M.*93/48. This variety had a different pattern of response from the two others, which was however the same for both times of harvest. It must be borne in mind that, although the time lapse between the two applications was four weeks as for the other varieties, the lapse between the two harvests was only twelve days. This was motivated when it was observed that the difference in Brix between treated and control plots was decreasing rapidly. Because average deviations from linearity are highly significant, it would appear that the maximum response with this variety lies between 0 and 4 lb/arpent, possibly in the region 2 to 4 lb.

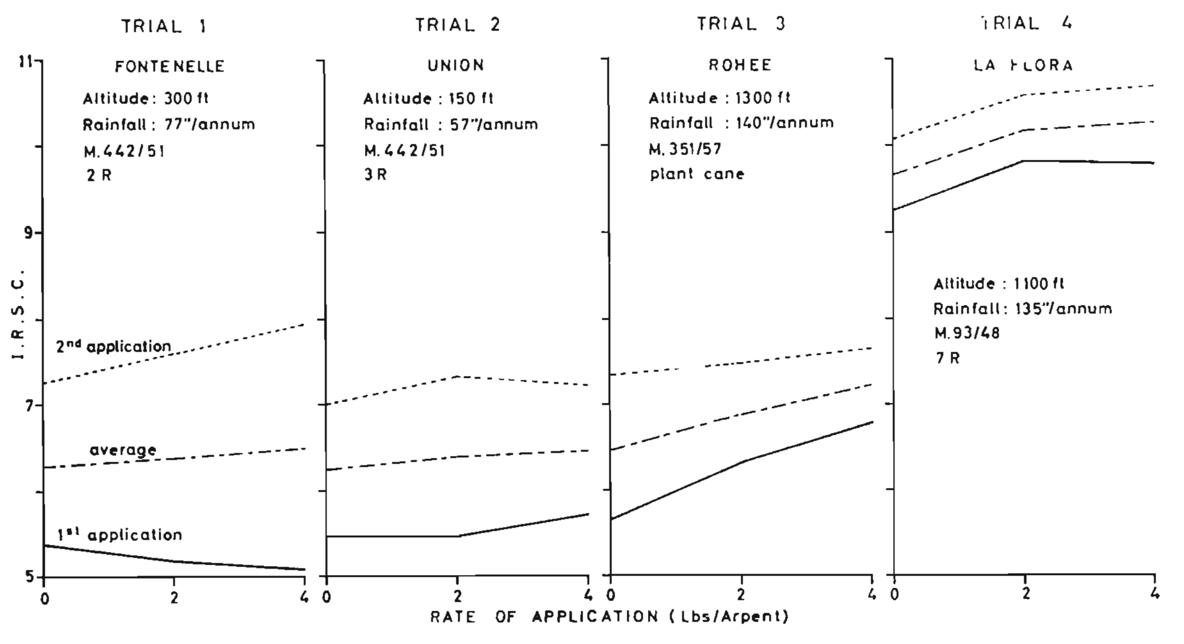


Fig. 29 I.R.S.C. — Trend of response to applications of DA5.

Yield of sugar

As could have been predicted, all three varieties yielded significantly more sugar/arpent when harvested at the later date.

With M.442/51 no significant differences could be detected between yields of the three treatments for both times of application and at the two sites.

Both M.351/57 and M.93/48 showed a significant average linear response with rate of application; the absence of interaction with time indicated identical response on both occasions.

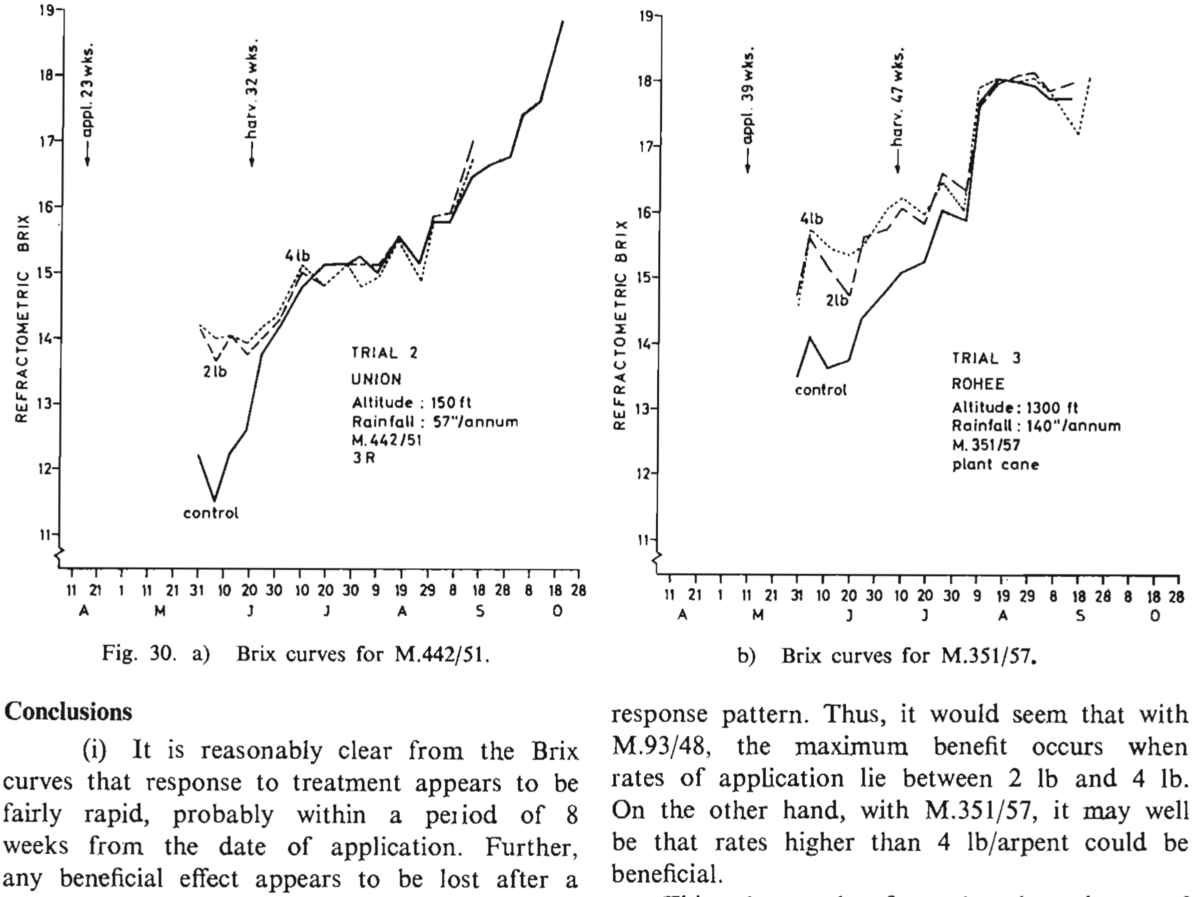


Fig. 30. a) Brix curves for M.442/51.

b) Brix curves for M.351/57.

Conclusions

(i) It is reasonably clear from the Brix curves that response to treatment appears to be fairly rapid, probably within a peiiod of 8 weeks from the date of application. Further, any beneficial effect appears to be lost after a period of approximately 10 weeks.

(ii) One problem needs investigation : this concerns the marked differences between measurements of Brix in the fields and sucrose determinations in the laboratory for treated plots. Although the Brix values for both the 2-lb and 4-lb treatments are well above that for controls, the Brix curves show very little difference between responses from these two treatments. It is therefore difficult to explain the big differences observed between the responses to these treatments for varieties M.93/48 and M.351/57 when sucrose determinations are considered.

(iii) Varieties appear to differ in their response pattern. Thus, it would seem that with M.93/48, the maximum benefit occurs when rates of application lie between 2 lb and 4 lb. On the other hand, with M.351/57, it may well be that rates higher than 4 lb/arpent could be beneficial.

This shows therefore the dependence of response on a number of factors, such as the variety, the maturity behaviour, the age at application, and the season.

The present investigation has indicated that there is some promise in the use of ripeners for increasing sugar content early in the season. It would also be inteiesting to investigate the response of the plant to applications of the chemical later in the season.

In concluding, it should be stressed that if sugar cane ripeners show promise, they should be handled with care. The conditions necessary for obtaining a maximum benefit must be investigated accurately for each variety.

WEED CONTROL

C. MONGELARD & G. Mc. INTYRE

1. LOGARITHMIC SCREENING OF NEW HERBICIDES

THE annual screening of new herbicides with the logarithmic sprayer comprised two experiments laid down in November 1968 and in April 1969.

First Series

Only 3 herbicides, C.15935, R.P.17623 and Daxtron, were available for the November trial in the super-humid zone and were tested in pre-emergence treatments of both canes and weeds at rates ranging from 5 lb a.i. to 1.25 lb a.i. per arpent. The experiment lasted 86 days (rainfall 27.94 inches) and the main weed species in the control plots at the end of the experiment were *Ageratum conyzoides, Kyllinga monocephala, Kyllinga polyphylla, Cyperus rotundus, Digitaria timorensis* and *Oxalis* spp.

The weed assessment data and measurements of cane germination and cane growth 86 days after planting, are summarized in Tables 48 and 49.

Table 48. Weed assessment

Herbicides		*DOSAGE RATES 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*
C. 15935	A	14.0	21.0	23.0	27.0	28.0
	B	11.0	16.5	28.0	24.5	28.5
Daxtron	A	4.0	6.0	9.0	16.0	17.0
	B	2.0	3.5	5.0	9.0	12.5
R.P. 17623	A	10.0	17.0	25.0	32.0	24.0
	B	6.5	18.0	23.0	38.5	30.0

A = Frequency-abundance % control.
B = Weed cover (control : 100).

Table 49. Effects of herbicides on germination and growth of the cane variety M.93/48, 86 days after application

Herbicides		*DOSAGE RATES 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*
C. 15935	A	81	85	95	108	100
	B	75	100	106	91	104
Daxtron	A	77	78	88	95	102
	B	88	109	114	115	110
R.P. 17623	A	111	117	110	107	110
	B	130	144	135	125	129

A = Dewlap height % control.
B = Cane germination % control.

This experiment illustrates the severe competition between the crop and the weeds, mainly *Ageratum conyzoides* and *Digitaria timorensis*. The highly toxic effects of Daxtron at rates aboves 2.15 lb a.i. per arpent reported in a preceding trial were confirmed, and at the high dosage rates many cane shoots were killed. C.15935, at rates above 2.85 lb a.i. per arpent, produced severe leaf chlorosis on the crop (variety M.93/48), but the deleterious symptoms were less apparent at the low dosage rates. Fairly good control of weeds was obtained, with the exception of *Cyperus rotundus*, *Kyllinga monocephala* and *Digitaria timorensis*.

R.P.17623 proved the best product in this series. This chemical did not show ill-effects on the cane, but gave good control of weeds at rates higher than 2.15 lb a.i. per arpent. The weeds that were tolerant to this herbicide were *Cyperus rotundus*, *Kyllinga monocephala*, and at the lowest dosage rate, moderate tolerance was shown by *Ageratum conyzoides*.

Second Series

In the second series, nine herbicides were compared to DCMU in the super-humid zone at dosage rates varying from 5 lb a.i. to 1.25 lb a.i. per arpent in per-emergence application in plant canes of the variety M.93/48. They were : Igran 50, Saminol 1089, G.S. 14254, G.S.13529, G.S.14259, R.P.17623, C.15935, Lasso and P.P.493. The experiment started on 18th April, was concluded 111 days after planting, and the total rainfall during that period was 38.03 inches. A very large weed spectrum was obtained ; 32 weed species were recorded in the control plots, of which the most abundant ones were *Ageratum conyzoides*, *Cyperus rotundus*, *Oxalis* spp., *Kyllinga monocephala*, *Apium leptophyllum* and *Kyllinga polyphylla*.

The weed assessment data by the frequency-abundance method expressed in percentage of the control are presented in Table 50. The figures represent a mean of 2 replicate plots.

Table 50. Weed assessment data 111 days after spraying

	DOSAGE RATES OF HERBICIDES (lb a.i. per arpent)				
Herbicides	*5.0 - 3.8*	*3.8 - 2.85*	*2.85 - 2.15*	*2.15 - 1.65*	*1.65 - 1.25*
DCMU	16.4	19.1	21.6	26.1	33.4
Igran 50	32.9	32.9	37.2	43.6	50.0
Saminol 1089	40.0	47.2	57.9	61.4	67.9
G.S. 14254	21.4	22.9	25.7	25.7	30.0
G.S. 13529	27.1	32.2	36.4	36.4	41.4
G.S. 14259	22.1	22.9	27.2	28.6	30.0
R.P. 17623	17.9	18.6	18.6	25.7	26.4
C. 15935	32.9	38.6	42.2	53.6	57.9
Lasso	37.2	50.0	100.0	100.0	100.0
P.P. 493	97.2	100.0	100.0	100.0	100.0

No toxic effects on cane germination and growth were recorded in this experiment, but too much reliance should not be put on these results on account of the poor growing conditions, probably due to low temperature, observed in the control plots.

It would be useful if attention were drawn to the drawbacks of each of these chemicals regarding the control of the most abundant weeds present. To set up a comparison, a grading scale 1 to 9 has been adopted in Table 51, grade 1 representing total check of the weed with a gradual drop in efficiency to grade 9 which represents complete tolerance of the weed to the herbicide at all dosage rates.

Table 51. **Grading scale of efficacy of herbicides on weeds**

	Herbicides									
	DCMU	*Igran 50*	*Saminol 1089*	*G.S. 14254*	*G.S. 13259*	*G.S. 14259*	*R.P. 17623*	*C.15935*	*Lasso*	*P.P.493*
Ageratum conyzoides	1	6	5	1	3	2	3	3	8	9
Apium leptophyllum	1	6	5	2	4	4	2	4	2	8
Cyperus rotundus	8	9	6	8	9	8	8	5	5	6
Digitaria timorensis	1	4	4	1	2	1	1	2	9	9
Kyllinga monocephala	7	6	9	7	9	7	8	9	9	9
Kyllinga polyphylla	2	5	5	4	4	5	3	2	4	9
Lobelia cliffortiana	4	1	5	1	1	1	1	6	4	9
Oxalis spp.	5	7	8	9	6	9	1	5	6	9
Plantago lanceolata	9	1	1	1	1	1	1	4	4	9
Sisyrinchium chilense	2	1	7	1	1	1	1	6	3	9
Solanum nigrum	1	2	4	1	1	1	1	2	1	1
Sonchus asper	1	6	9	1	1	1	1	2	7	7
Youngia japonica	2	3	7	1	1	1	1	5	8	9

The most promising herbicides in this series were R.P.17623, G.S.14254, G.S.14259 which appear to be the most serious competitors of DCMU at equal dosage rates. G.S.13529, C.15935 and Igran 50 have shown sufficient weed control properties to warrant further studies. Both Lasso and P.P.493 gave disappointing results and should they prove to be of similar standard in the humid zone, further tests with these chemicals will have to be discontinued.

2. SECOND-STAGE SCREENING TRIALS

These experiments consisted of replicated plots of 1/100 arpent at various dosage rates. They were carried out in virgin and ratoon canes of different varieties in pre-emergence and post-emergence applications in both humid and super-humid zones. As a large number of herbicides was included in these series at different dosage rates, mention will only be made of the best results obtained. All the trials consisted of randomized blocks with three replicates for each treatment.

I. Pre-emergence trials in virgin canes

Humid zone

The soil type at Savannah was a Low Humic Latosol which was fairly moist at the time of spraying. The number of cuttings of the variety M.377/56 was the same in all plots at planting two days prior to herbicide treatment. Four months after spraying a weed survey by the frequency-abundance method, and measurements of cane germination and growth were made. A summary of the results is presented in Table 52.

Under the conditions of the experiment, R.P.17623 was by far the best chemical, the only really resistant weed being *Cyperus rotundus*. There was a dense population of *Oxalis* spp. which was adequately controlled by R.P.17623 and to a lesser extent by Planavin, but not at all by the other herbicides. The weed spectrum consisted mainly of *Oxalis* spp., *Cyperus rotundus*, *Solanum nigrum*, *Phyllanthus tenellus*, *Bothriospermum tenellum*, *Youngia japonica* and *Lobelia cliffortiana*.

Table 52. Results of herbicide treatments on weeds and canes four months after spraying

Herbicides	*Dosage rates lb a.i./arpent*	*Weed assessment % control*	*Effects on cane germination*	*Effects on cane growth*
1. R.P. 17623	4	16.1	—	—
2. R.P. 17623	3	22.6	—	—
3. Planavin	4	45.2	+	+
4. Cotoran	5	46.1	—	—
5. Atrazine	4	48.6	—	—
6. BAS. 2103H	4	51.6	—	—
7. C. 6313	5	51.8	—	—
8. C. 15935.	3	53.2	—	—
9. C. 15935	4	53.6	—	—
10. BAS. 2440H	4	54.8	—	—
11. BAS. 2440H	3	54.8	—	—
12. Cotoran	4	56.3	—	—
13. C. 6313	4	57.1	—	—
14. Planavin	3	58.1	—	—
15. C. 15935	2	66.4	—	—
16. Cotoran	3	67.9	—	—
17. BAS. 2103H	3	71.0	—	—
18. Asulam	3	80.6	—	—

Key to symbols : — no effect; + showing some effects (needs confirmation); ++ toxic symptoms positive.

Super-humid zone

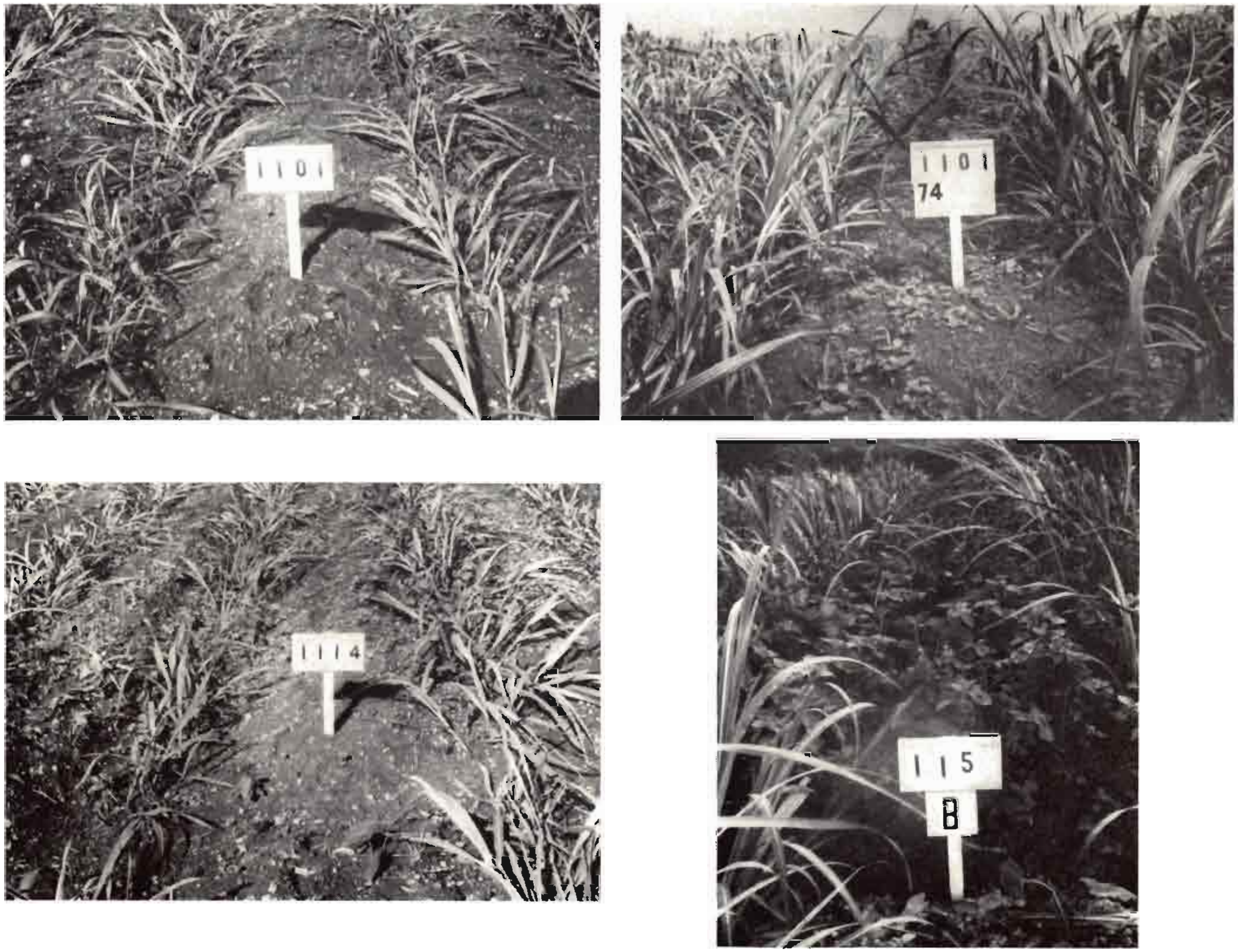
The experiment was carried out at Rose Belle with the cane variety M.202/46 in a Humic Ferruginous Latosol soil. The experiment lasted 74 days during which heavy rainfall (39 inches) was encountered. One month after the herbicide application, weed growth was negligible and the control plots were fairly free of weeds. Plate XI, illustrates the results obtained then in a control plot compared to a DCMU treatment at 4lb active ingredient per arpent. Six weeks later however, the efficacy of the herbicide treatment was evident as illustrated in Pl. XI.

A weed and a crop assessment 74 days after spraying were made and the results obtained with the different herbicides are presented in Table 53.

Table 53. Results of herbicide treatments on weeds and canes 74 days after spraying (Rose Belle) trial

Herbicides	*Dosage rates lb a.i./arpent*	*Weed assessment % control*	*Effects on cane germination*	*Effects on cane growth*
1. R.P.17623	4	27.7	—	—
2. DCMU + Sinbar	2 + 0.75	30.9	—	++
3. C.15935	4	32.0	++	++
4. Cotoran	5	33.1	—	++
5. DCMU	4	33.5	—	—
6. C.15935	3	37.5	++	+
7. Daxtron	2	39.3	++	++
8. Daxtron	1	41.2	++	++
9. C.15935	2	42.0	—	—
10. DCMU	3	45.6	—	—
11. BAS.2103H	4	48.3	—	—
12. Cotoran	4	50.5	—	—
13. Planavin	5	50.5	++	++
14. BAS.2440H	4	56.3	—	—
15. Asulam	4	73.0	—	—

Key to symbols : — no effect; + showing some effects (needs confirmation); ++ toxic symptoms positive



Pre-emergence experiments in the super-humid zone.
Top left : DCMU, 4lb a.i./arp. 30 days after spraying. *Top right :* DCMU, 4lb a.i./arp. 74 days after spraying
Bottom left : Control after 30 days. *Bottom right :* Control after 74 days

The main species were : *Ageratum conyzoides*, *Oxalis* spp., *Cyperus rotundus*, *Kyllinga polyphylla*, *Paspalum paniculatum*, *Setaria pallidefusca*.

A comparison of the trials in the humid and super-humid zones reveals a difference in the response of the crop to the same herbicide. The toxic symptoms found at Rose Belle may be a result of varietal susceptibility, or of a leaching of the chemical in the cane root zone. Planavin, and C.15935 at the 4lb rate did positively check both cane germination and growth. Daxtron, because of its high toxicity in other trials as well, cannot be regarded as a safe herbicide to be used in sugar cane plantations. Tests with R.P.17623, C.15935, C.6313 and BAS.2440H on a small scale on sugar estates should be contemplated by estate agronomists.

II. Post-emergence trials in virgin canes

The object of these trials was to compare the advantages and disadvantages of pre-emergence treatments of cane fields to semi-post-emergence treatments. A few theoretical considerations are worth mentioning before giving the results obtained in trials carried out in the humid zone at Beau Champ and in the super-humid zone at Valetta.

It goes without saying that in general, pre-emergence treatments of cane fields are to be preferred to post-emergence treatments. The following conditions for pre-emergence treatments should however be borne in mind :

(i) A good weed control for at least 3 months, and in some cases 4 months, is required so as to avoid a second application which necessarily involves additional expenditure. In the super-humid zone, a second treatment of cane fields can rarely be avoided.

(ii) The use of a long residual herbicide is imperative in the humid and super-humid zones.

(iii) The concentration of the herbicide should be sufficient to give the desired weed control, without affecting cane germination and growth.

(iv) The relatively high costs of long residual herbicides at the required dosage rates should be given careful consideration.

(v) Maximum results from the use of expensive herbicides should be a *sine qua non* condition to avoid an economically dangerous situation.

(vi) The chemical should be safe enough so as to have a minimum effect on cane growth which may already be affected by drought conditions.

Post-emergence treatments can be considered if they satisfy the following conditions :

(i) They should prove less expensive than pre-emergence treatments.

(ii) They should be applied before competitition between weeds and crop is likely to affect the returns on a crop. In other words, weed growth should be checked at a fairly early stage.

(iii) The treatments should prove effective in killing established weeds, and keep check on further weed growth for a required period of time.

(iv) The existence of a good organization on the sugar estates to cope with delayed herbicide treatments of cane fields that require weeding.

(v) They should have no effect on cane growth.

The use of a long residual herbicide with sufficient post-emergence properties in order to allow a delayed application, possibly 4-6 weeks after planting, and having at the same time pre-emergence properties to keep check on further weed growth for at least 3 months, was required. Hence the inclusion of Ametryne and C.15935 in these trials. Other treatments consisted of a mixture of a long residual herbicide with Actril-D, a post-emergent herbicide that had given excellent results in the trials conducted in 1968.

Humid zone (Beau Champ trial)

The cane variety was M.13/56 planted in a Low Humic Latosol soil under fairly dry conditions. The post-emergence treatments were compared to a pre-emergence treatment of Atrazine at 4lb a.i. per arpent, sprayed 6 days after planting on 18.2.69. All the other plots did not receive any herbicide treatment until it was found that weed growth was sufficient to warrant spraying which was made 7 weeks later on 10.4.69. Weed assessment and cane growth measurements were made 3½ months after planting and the results presented in Table 54.

Table 54. Results of herbicide treatments on weeds and canes 3½ months after planting (Beau Champ trial)

Herbicides	*Dosage rates lb a.i./arpent*	*Weed assessment % control*	*Effects on cane germination*	*Effects on cane growth*
DCMU + Sinbar + Actril-D	2 + ¾ + 1	26.0	—	++
BAS.2440H + Actril-D	4 + 1	26.5	—	—
C.15935	2 + 1	31.4	—	—
C.15935 + Actril-D	3 + 1	31.8	—	+
BAS.2440H + Actril-D	3 + 1	32.5	—	—
Atrazine + Actril-D	3 + 1	35.5	—	—
Cotoran + Actril-D	4 + 1	35.9	—	—
C.15935 + Actril-D	1 + 1	38.2	—	—
Cotoran + Actril-D	2 + 1	38.8	—	—
BAS.2103H + Actril-D	4 + 1	40.5	—	—
C.6313	4	42.2	—	+
Actril-D	3	42.5	—	+
C.15935	2	47.0	—	—
Actril-D	2	48.0	—	—
BAS.2103H + Actril-D	3 + 1	50.0	—	—
Ametryne	3	69.0	—	+
Cotoran	3	83.3	—	—
C.15935	1	100.0	—	—
Atrazine*	4	100.0	—	—

* Pre-emergence treatment.

Key to Symbols : — No effect; + showing some effects (needs confirmation); ++ toxic symptoms positive.

The weed population consisted mainly of *Cyperus rotundus*, *Oxalis* spp., *Solanum nigrum*, *Bothriospermum tenellum* and *Amaranthus caudatus*. The absence of graminaceous weed species explains the outstanding results obtained with all Actril-D mixtures. Both Ametryne and the mixture DCMU + Sinbar + Actril-D adversely affected cane growth. C.6313 at 4 lb, C.15935 at 3 lb and Actril-D at 3 lb, also affected cane growth, but to a lesser extent.

Super-humid zone (*Valetta trial*)

The experimental field (Low Humic Latosol) was planted on 17.4.69 with the cane variety M.93/48 and the pre-emergence treatment was DCMU at the rate of 4 lb a.i. per arpent sprayed on 23.4.69. All the post-emergence treatments were applied early on 16.5.69. Low ambient temperatures during these months were not conducive to both weed and cane growth, though very humid conditions prevailed. By mid-June the weed infestation in the control plots showed that the post-emergence spraying could have been delayed. A weed assessment and cane growth measurements were made 4 months after planting and a summary of the results are shown in Table 55.

Table 55. Results of herbicide treatments on weeds and canes 4 months after planting (Valetta trial)

Herbicides	*Dosage rates lb a.i. per arpent*	*Weed assessment % control*	*Effects on cane germination*	*Effects on cane growth*
C.15935 + Actril-D	4 + 1	26	—	—
C.15935 + Actril-D	3 + 1	26	—	—
DCMU + Sinbar + Actril-D	2 + ¾ + 1	28	—	+
C.15935	4	28	—	—
Cotoran + Actril-D	4 + 1	31	—	—
DCMU + Actril-D	3 + 1	33	—	—
R.P.17623 + Actril-D	2 + 1	33	—	+
Cotoran + Actril-D	3 + 1	33	—	—
C.15935	3	33	—	—
Ametryne	3	35	—	+
DCMU + Actril-D	2 + 1	36	—	—
BAS.2440 H + Actril-D	3 + 1	37	—	—
C.15935 + Actril-D	2 + 1	38	—	—
Cotoran + Actril-D	2 + 1	39	—	—
C.15935	2	44	—	—
BAS.2440 H + Actril-D	4 + 1	46	—	—
DCMU*	4	49	—	—
BAS.2103 H + Actril-D	4 + 1	49	—	—
Asulam + Actril-D	3 + 1	51	—	—
BAS.2103 H + Actril-D	3 + 1	55	—	—
C.15935 + Actril-D	1 + 1	62	—	—
Actril-D	2	77	—	—

* Pre-emergence treatment.

Key to Symbols: — No effects; + showing some effects (needs confirmation); + + toxic symptoms positive.

A broad weed spectrum was encountered in this experiment and more than 20 weed species were listed, of which the most frequent were *Cynodon dactylon*, *Bothriospermum tenellum*, *Cyperus rotundus*, *Lobelia cliffortiana*, *Oxalis* spp., *Digitaria timorensis*, *Setaria pallide-fusca* and *Youngia japonica*.

The results of these trials show that adequate control of weeds can be obtained by post-emergence spraying with a mixture of a reduced rate of a long residual herbicide and Actril-D. The use of this technique in the winter months and during the dry season from April to November should prove an economic proposition. Following the results obtained in the last two years' trials, recommendations were made to test the validity of this technique on sugar estates. More than 25,000 acres have been treated with different combinations of DCMU, Cotoran, Atrazine in mixture with Actril-D, and in most cases excellent results have been obtained. Some foliar damage on the fully expanded leaves was recorded in rare cases on the varieties M.99/48, M.377/56 and S.17, after an application of 2 to 4 lb DCMU + $1\frac{1}{2}$ to 2 litres of Actril-D. It must be recalled that attention has already been drawn to the fact that M.99/48 is susceptible to DCMU, and it appears that the deleterious effects of DCMU on this variety are enhanced by the addition of Actril-D. The use of Cotoran and Atrazine should be preferred in this case. The variety M.377/56, though tolerant to pre-emergence treatment, seems prone to damage with foliar sprays of DCMU + Actril-D. Caution in spraying fields planted with this variety is therefore recommended. Since the effects are more serious under dry conditions, pre-emergence treatments with a substituted urea, followed if necessary by a post-emergence spray with Actril-D alone, are not likely to give any trouble. Some scorching effects on the variety S.17 were also recorded with DCMU + Actril-D under drought conditions.

In all these cases, however, the symptoms disappeared less than one month later and recovery was more rapid when the fields were irrigated.

Sufficient evidence has been obtained regarding the advantages of post-emergence treatments of cane fields compared to pre-emergence treatments, but the success of this practice will depend on the following conditions :

(i) A good organization of the herbicide section on the sugar estate, so that fields in need of weeding may not get out of hand. This implies that pre-emergence treatments should form part of the estate practice, especially in the humid hot months of December to March when weed growth is rapid and the post-emergence spraying is not likely to be a good economic proposition. The labour force on hand should also be given careful consideration.

(ii) Weed growth should be checked before competition between weeds and crop sets in. This will depend on the period of the year, the ambient conditions particularly temperature and humidity, the crop variety, the weed spectrum and the soil conditions.

(iii) The careful choice of the long residual herbicide in the mixture for the best control of the weed population obtained in a particular field.

(iv) The dosage rates used will have to be decreased under very dry conditions if scorching effects are to be avoided.

III. Pre-emergence trials in ratoon canes

Humid zone

Spraying was done in pre-emergence of the weeds, on 22.7.69 on canes reaped 3 weeks earlier on very dry soil of the Low Humic Latosol type. The duration of the experiment was 64 days only, because heavy weed growth was obtained in all plots, probably due to high rainfall conditions (35.3 inches) during the experiment. The cane variety was M.147/44 which showed good tolerance to all treatments. Because of the particular weed growth conditions, fairly detailed results of the weed survey, in terms of percent weed coverage, are given in Table 56.

It will be observed that the occurrence of a single weed species, *Bothriospermum tenellum*, which is not controlled by Cotoran and R.P. 17623 at the 2-and 3 lb-rates, can lead to erroneous conclusions on the herbicidal activity of different chemicals. This experiment illustrates the importance of closing the right chemical for the particular weed spectrum in the field to be treated.

Other examples of such a situation are fields infested with *Plantago lanceolata*, which precludes the use of DCMU, or those infested with *Digitaria timorensis*, where poor results follow an Atrazine treatment.

Super-humid zone

No effect on the cane variety M.93/48 was recorded in any treatment. The results of the weed survey made by the frequency abundance method 96 days after spraying are given in Table 57.

Table 56. Percent weed cover of individual weed species 64 days after spraying (Trois Ilots trial).

Treatments	Dosage rate lb. a.i. arpent	WEED SPECIES Amaranthus viridis	Bothriospermum tenellum	Cardiospermum halicacabum	Cyperus rotundus	Oxalis spp.	Setaria pallide-fusca	Solanum nigrum	Sonchus asper	Others	Total weed cover
Atrazine	3	0	0	2	3	3	1	1	1	1	12
Cotoran	2	6	27	0	1	3	5	2	1	3	48
Cotoran	3	5	26	0	1	2	8	4	1	1	48
C.15935	1	3	24	0	1	1	1	9	4	2	45
C.15935	2	2	17	1	1	2	1	5	3	10	32
C.15935	3	2	3	0	2	3	1	3	3	0	17
C.6313	3	0	3	0	4	2	0	3	1	3	16
C.6313	4	1	1	0	1	2	0	2	0	1	8
R.P.17623	2	0	18	6	2	0	1	0	0	2	29
R.P.17623	3	0	14	1	1	0	1	0	0	3	20
R.P.17623	4	0	4	0	1	0	2	0	0	2	9
BAS.2103 H	4	6	2	3	2	2	1	5	2	2	25
BAS.2440 H	4	4	6	0	1	3	2	7	3	3	29
DCMU + Sinbar	$2 + \frac{3}{4}$	3	6	1	1	1	0	3	0	3	18
TCA + Sodium Chl. + 2,4-D	$7\frac{1}{2}+1\frac{1}{2}+3$	3	25	0	1	4	3	12	1	4	53
Control		5	27	1	2	15	4	20	15	11	100

Table 57. Weed assessment in percent of control 96 days after spraying (L'Etoile trial)

Herbicides	*Dosage rates lb. a.i./arpent*	*Weed assessment % control*
R.P.17623	3	21.6
R.P.17623 + DCMU	1 + 2	24.3
R.P.17623 + DCMU	2 + 1	25.7
R.P.17623	2	25.7
DCMU + Sinbar	2 + ½	27.0
C.15935 + MCPA + TCA	2 + 2 + 4	33.8
DCMU	3	37.8
BAS.2103 H	5	39.2
C.15935	3	40.5
Cotoran	3	41.9
BAS.2440 H	5	41.9
C.15935	2	44.6
R.P.17623	1	55.4
C.15935	1	77.0

The weed population consisted mainly of the following species : *Bothriospermum tenellum*, *Cyperus rotundus*, *Digitaria timorensis*, *Euphorbia hirta*, *Oxalis* spp., *Setaria pallide-fusca*, *Solanum nigrum* and *Sonchus asper*.

The best herbicide in this series was R.P.17623. Excellent results were obtained with mixtures of R.P.17623 and DCMU where total control of *Digitaria timorensis*, *Setaria pallide-fusca* and *Oxalis* spp., was recorded. R.P.17623 alone at 2lb-rate gave better control of the three above mentioned species than DCMU at 3 lb rate. DCMU, on the other hand, gave a better check on the population of *Bothriospermum tenellum*. Because of the absence of a toxic effect on the crop in pre-emergence treatments with R.P. 17623 and its high effectiveness on the control of weeds in both the humid and super-humid zones, this herbicide should be tested in further trials in mixtures with DCMU, C.15935, C.6313 or Atrazine.

IV. Post-emergence trials in ratoon canes

Humid zone

An experiment was started to study the effects of various mixtures in post-emergence treatments compared to a pre-emergence treatment of Atrazine at 3 lb a.i. per arpent. Unfortunately, hand weeding of the experimental plots was carried out by error prior to the post-emergence treatments and the experiment has had to be postponed.

Super-humid zone

The experiment was set up at St. Avold in a Humic Ferruginous Latosol on the variety M.351/57. Spraying was made one month after reaping and a weed survey carried out 58 days after spraying. The best results were obtained with a mixture of DCMU and Actril-D at the rates of (2 + 1) lb active material per arpent. Poor control of weeds with the other treatments was obtained with the exception of DCMU + 2,4-D at the rates (4 + 2) lb active material per arpent which gave however infeıior results to the DCMU + Actril-D mixture. Scorching effects on the crop with C.6989 and R.P.17623 in post-emergence sprays render the use of these herbicides in crop post-emergence application inadvisable.

General Conclusions

To summarize the results obtained in the trials carried out in 1969 and the results of spraying made on sugar estates on a fairly large scale in some instances, the following general conclusions can be made :

(i) Post-emergence application techniques should prove an economic proposition during the months of April to November.

(ii) The best up-to-date post-emergent herbicide is Actril-D. It has given the best results in mixtures with DCMU, with an indication of a possible synergistic effect in such mixtures.

(iii) Because of the increased activity of the mixture DCMU - Actril-D on both weeds and crop, a decreased dosage rate should be used under drought conditions. Alternatively, the use of other long residual herbicides in the mixture, such as Cotoran, C.15935 or Atrazine should be contemplated.

(iv) Scorching effects on the crop, depending on variety, do not last long, but such effects should be preferably avoided.

(v) *Cyperus rotundus*, which sets an important weed problem, should never be hand-weeded. The best control of this weed is up to now obtained with Actril-D at 1½ litres per arpent 3 weeks after emergence, control being more effective under dry hot conditions.

(vi) Post-emergence sprays on young canes of some varieties, e.g. M.377/56 and S.17, under drought conditions should be avoided when mixtures of DCMU and Actril-D are used.

(vii) The best pre-emergence herbicides requiring attention in small-scale experiments are G.S.14254, G.S.13529, G.S.14259; and in field-scale experiments R.P.17623, C.15935, C.6313, BAS. 2440 H. and combinations of these herbicides with DCMU and Atrazine.

(viii) Post-emergence spraying mixtures containing R.P.17623 and C.6989 are not to be recommended, except in the case of directed sprays.

Potato (Variety "Up to Date") grown in inter-rows of 4th ratoon canes at Rose Belle Sugar Estate

Potato variety trial at Médine Sugar Estate

FOOD CROPS

1. RESULTS IN POTATO VARIETY TRIALS

J. R. MAMET AND G. ROUILLARD

COMPARATIVE potato trials were conducted in 1969 to determine the yield of selected potato varieties when grown under different conditions of soil and climate.

A first series of trials was carried out in May when 4 varieties, King George and Up-to Date (from South Africa), Noorin No. 1 and Wheeler (from Japan), were planted. Seeds of two different sizes (large and small) of the King George variety were grown so that the rates planted per arpent were approximately in the ratio of 1 : 2.

In the second series of trials (August), 9 varieties were compared :

(i) King George, Up-to-date, Cedara, B.P.1., Van der Plank and Maris Peer (South African-grown seeds kindly supplied by the South African Potato Board, through the Mauritius Marketing Board);

(ii) Delaware (Australian-grown seeds);

(iii) Noorin No. 1 and Wheeler (Japanese-grown seeds).

Location of trials

	Location (climate and type of soil)			
Trial	*Sub-humid zone*	*Sub-humid (irrigated) zone*	*Humid zone*	*Super-humid zone*
May	Bon Espoir (Latosolic Reddish Prairie)	Tamarin (Low Humic Latosol)	Côte d'Or (Humid Ferruginous Latosol)	New Grove (Latosolic Brown Forest)
August	Bon Espoir (Latosolic Reddish Prairie)	La Mecque (Low Humic Latosol)	Olivia (Low Humic Latosol)	Union Park (Latosolic Brown Forest)

Experimental procedure

Varieties in all locations were hand-planted in furrows; weights planted in both trials are given in Tables 58 and 59

All seeds were disinfected with Captan 50 fungicide (slurry method) at a dosage rate of 5 grm. Captan 50/litre of water.

Planting distance, plot size, number of replicates, age (in weeks) at harvest and method of harvesting are given in Tables 60 and 61.

Cultural practices (including fertilization and fungicidal treatment against late blight) for each trial were similar to those adopted for commercially-grown potatoes.

Table 58. Potato variety trial : May

Weights planted (Tons/arpent)

Variety	*CLIMATIC ZONE*			
	Sub-humid	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George (small)	0.74	0.74	0.70	0.78
King George (large)	1.58	1.58	1.30	1.51
Up-to-Date	1.20	1.04	1.20	1.16
Noorin No. 1	1.04	1.03	1.00	1.16
Wheeler	1.03	1.18	1.16	1.12
S.E.	±0.021	±0.014	±0.017	±0.051

Table 59. Potato variety trial : August

Weights planted (Tons/arpent)

Variety	*CLIMATIC ZONE*			
	Sub-humid	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George	0.73	0.77	0.89	0.93
Up-to-Date	0.89	0.97	0.97	1.10
Cedara	0.95	1.20	1.18	1.13
B.P.1	1.09	1.39	1.43	1.43
Van der Plank	0.97	1.19	1.16	1.19
Maris Peer	0.86	1.19	1.15	1.13
Delaware	0.88	1.14	1.16	1.23
Noorin No. 1	0.98	1.26	1.20	1.29
Wheeler	1.00	1.17	1.25	1.26
S.E.	±0.024	±0.039	±0.036	±0.044

Table 60. Potato Variety Trial : May

Data on trials, planting and harvest

Type of trial : latin square, 5 × 5
Plot size : 4 rows × 40 ft.
Harvest in each plot : 2 mid-rows

Climatic zone	*Date planted*	*Planting distances*	*Age at harvest (weeks)*	*C.V. %*
Sub-humid	31.5.69	2½ ft × 14 in	13	5.66
Sub-humid (Irrigated)	29.5.69	2½ ft × 13 in	15	5.49
Humid	3.6.69	2½ ft × 14 in	13	9.39
Super-humid	30.5.69	2½ ft × 14 in	13	21.13

Table 61. Potato Variety Trial : August

Data on trials, planting and harvest

Type of trial : randomised block, 6 replicates
Plot size : 6 rows × 40 ft
Harvest in each plot : 4 mid-rows

Climatic zone	*Date planted*	*Planting distances*	*Age at harvest (weeks)*	*C.V %*
Sub-humid	1.8.69	2½ ft × 15 in	13	10.47
Sub-humid (irrigated)	8.8.69	2½ ft × 12 in	14	26.50
Humid	6-7.8.69	2½ ft × 12 in	12	5.82
Super-humid	4.8.69	2½ ft × 12 in	15	9.13

Results

Yields (tons/arpent) obtained in the different climatic zones are given in Tables 62 and 63. Yields (tons/arpent) adjusted for the regression of means (i.e. when weights planted are taken into consideration) are given in Tables 64 and 65.

Table 62. Potato variety trial : May

Yields at harvest (Tons/arpent)

Variety	*CLIMATIC ZONE*			
	Sub-humid	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George (small)	8.09	9.58	8.45	8.16
King George (large)	10.33	11.76	10.76	9.82
Up-to-Date	11.66	11.77	10.18	9.48
Noorin No. 1	8.49	9.67	9.22	7.80
Wheeler	9.88	11.98	10.70	6.07
S.E.	±0.25	±0.27	±0.41	±0.78

Table 63. Potato variety trial : August

Yields at harvest (Tons/arpent)

Variety	*CLIMATIC ZONE*			
	Sub-humid	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George	4.45	8.39	5.97	7.22
Up-to-Date	5.53	10.84	7.25	8.33
Cedara	4.64	6.63	6.13	7.48
B.P.1	5.15	7.69	7.39	7.13
Van der Plank	4.50	4.67	5.52	5.85
Maris Peer	4.03	6.66	5.70	5.88
Delaware	4.88	7.93	5.28	6.72
Noorin No. 1	4.67	8.20	6.75	5.97
Wheeler	4.77	6.45	7.00	6.31
S.E.	±0.22	±0.81	±0.15	±0.25

Table 64. Potato variety trial : May

Yield at harvest adjusted for Regression of Means (Tons/arpent)

Variety	*CLIMATIC ZONE*			
	Sub-humid	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George (small)	9.21	10.58	9.96	9.07
King George (large)	8.91	10.50	9.82	8.89
Up-to-Date	11.39	11.96	9.65	9.43
Noorin No. 1	8.70	9.45	9.50	7.75
Wheeler	10.12	11.79	10.33	6.12
byx *	3.03***	2.69***	4.07***	2.52 N.S.

* y = weight harvested
x = weight planted

Table 65. Potato variety trial : August

Yield at harvest adjusted for Regression of Means (Tons/Arpent)

Variety	CLIMATIC ZONE *Sub-humid*	*Sub-humid (irrigated)*	*Humid*	*Super-humid*
King George	4.68	6.86	6.36	6.75
Up-to-Date	5.58	10.14	7.52	8.17
Cedara	4.62	6.88	6.08	7.37
B.P.1	4.96	8.73	6.97	7.57
Van der Plank	4.45	4.88	5.50	5.85
Maris Peer	4.11	6.87	5.70	5.77
Delaware	4.94	7.93	5.26	6.79
Noorin No. 1	4.61	8.70	6.67	6.15
Wheeler	4.69	6.57	6.85	6.44
byx *	1.16 N.S.	—4.14*	1.50***	—1.82**

* *y* = weight harvested
x = weight planted

Conclusions

It can be concluded from the above results that :

(i) Variety Up-to-Date is definitively the most promising one when grown in all climatic zones in May and August.

The adjusted yields of variety King George planted in May were, on the whole, slightly lower than that of Up-to-Date. However, in the August trials, the adjusted yield of that variety was markedly inferior to that of Up-to-Date.

(ii) The plot size of 4 rows × 40 ft. leaving two exterior lines as borders appears reasonable.

(iii) The May trials have given better adjusted yields than those of August. This can be attributed to the different climatic conditions, particularly to the abnormally dry weather, which prevailed during the latter trials.

(iv) The yields at harvest seem to be closely related to the weight of seeds planted. This has been clearly demonstrated in the May trials when King George seeds of different sizes and weights (ratio 1 : 2) were planted. When the weights at harvest are adjusted by linear regression for the different weights planted, no significant differences in yield were noted when either the small or the large seeds are planted.

Two other trials were established in two locations in the humid zone : Olivia and Réduit.

The Olivia trial was lost accidentally.

The Réduit trial suffered such a severe attack of bacterial wilt that it had to be abandoned. However, it was noticed that among the varieties planted, one — Unzen — from Japan, showed some promise of tolerance to the disease.

2. RESULTS IN GROUNDNUT VARIETY TRIALS

J. R. MAMET and G. ROUILLARD

Eight trials were conducted in late 1968 — early 1969 with nine groundnut varieties : Virginia Bunch, NC_2 and Florigiant (from U.S.A.); S.A.156, B_1 and Natal Common (from South Africa); Manipintar (from East Africa); Beit Dagan (from Israel) and "Cabri" (a locally grown variety of the Natal Common type). These trials were located in the four climatic zones (2 trials per zone) in order to assess comparative yields of fresh pods, dry seeds and oil per arpent, as well as behaviour towards major diseases, such as *Cercospora* leaf spot and bacterial wilt.

Location of trials

The trials were carried out in the following places :

Sub-humid zone	Labourdonnais Schœnfeld
Sub-humid (irrigated) zone	Solitude Médine
Humid zone	Bénarès Riche-en-Eau
Super-humid zone	Union Park Britannia (Tivoli)

Experimental procedure

Data on the trials and method of planting in each of these locations are as follows :

Randomized blocks with 4 replicates.
Planting distance : 18 in. between rows × 18 in. between seeds.
Dimensions of individual plots : 8 lines × 18 ft. long, thus giving 96 stools per plot; plots separated from one another by a path 3 ft. wide.
Number of seeds per stool : 3
Planting depth of seeds : 1 — 1½ in.
Seed disinfection : All seeds were disinfected with a mixture of Thiram and Agallol (1 : 1 by weight) at the dosage rate of 1 gm. mixture/kg. seeds.
Fertilizer mixture used : 10 N : 40 P_2O_5 : 40 K_2O kg/arpent at planting time; 4 to 6 weeks after planting 10 kg N/arpent were applied to growing plants.
One light earthing-up operation was carried out 4 to 6 weeks after planting.

Harvest

Harvest was conditioned by the maturity appearance (dropping of leaves) of the different varieties. Some were harvested 16 weeks after planting, and the others after about 23 weeks.

Only pods from plants growing in the 6 mid-rows of each plot were weighed for the assessment of yield.

Results

Tables 66, 67 and 68 summarize the results of the trials as far as yield of fresh pods (at harvest), yield of dry seeds and oil % dry seeds (all expressed in Tons/arpent) are concerned.

Visual observation of the degree of incidence of *Cercospora* leaf spots and bacterial wilt enabled the following grading in susceptibility to :

i) *Cercospora leaf spot :*

Very susceptible varieties : B_1, Natal Common, "Cabri" (local).
Less susceptible varieties : Manipintar, Virginia Bunch, NC_2, S.A. 156, Beit Dagan, Florigiant.

ii) *Bacterial wilt :*

Very susceptible variety : B_1.
Susceptible variety : Natal Common.
Fairly susceptible varieties : NC_2, "Cabri" (local).
Fairly resistant varieties : Manipintar, Beit Dagan.
Resistant variety : S.A. 156.

Varieties Virginia Bunch and Florigiant have shown a good degree of resistance to bacterial wilt in all locations except at Solitude where they were grown in a field which was very highly contaminated by the pathogen.

Table 66. Yield of fresh pods (Tons/arpent)

VARIETY	*CLIMATIC ZONES AND LOCATIONS*								
	Sub-humid		*Sub-humid (Irrigated)*		*Humid*		*Super-humid*		
	Labour-donnais	*Schœn-feld*	*Médine*	*Solitude*	*Bénarès*	*Riche-en-Eau*	*Tivoli*	*Union Park*	*Average*
Manipintar	1.79	2.22	2.24 S	3.58 S	2.25 S	3.19 S	1.51	1.86 R	2.33 S
Virginin Buach	2.23 S	2.83 S	1.59	2.66	2.22 S	3.33 S	2.33 S	2.79 S	2.50 S
NC_2	2.07	2.85 S	1.59	2.15 R	1.74	2.25	0.96 R	1.59 R	1.90
S.A. 156	2.22 S	2.46 S	1.85 S	3.08 S	2.16 S	2.75 S	0.87 R	1.06 R	2.06
B_1	1.60	1.66	1.68	1.19 R	1.54	1.89	1.82 S	2.43	1.73
Natal Common	1.35 R	1.53	1.59	2.08 R	2.05	1.90	1.39	1.84 R	1.72
"*Cabri*" (local)	*1.84*	*1.75*	*1.44*	*2.65*	*1.73*	*1.88*	*1.44*	*2.23*	*1.87*
Beit Dagan	2.02	2.05	1.56	2.67	2.80 S	2.98 S	1.06 R	2.37	2.19
Florigiant	1.90	2.50 S	1.30	1.61	2.28 S	3.10 S	2.07 S	1.94	2.09

S = probably superior compared to variety "Cabri" (local)

R = probably inferior compared to variety "Cabri" (local)

Table 67. Yield of dry seeds (Tons/arpent)

VARIETY	*CLIMATIC ZONES AND LOCATIONS*								
	Sub-humid		*Sub-humid (Irrigated)*		*Humid*		*Super-humid*		
	Labour-donnais	*Schœn-feld*	*Médine*	*Solitude*	*Bénarès*	*Riche-en-Eau*	*Tivoli*	*Union Park*	*Average*
Manipintar	0.571 R	0.643	1.285 S	1.417 S	0.987 S	0.857 R	0.420	0.626 R	0.851
Virginia Bunch	0.969 S	1.016	0.720	1.103	0.966 S	1.260	0.255	0.520 R	0.851
NC_2	0.770	1.056 S	0.742	0.888 R	0.897 S	1.177	0.199 R	0.385 R	0.764
S.A. 156	1.004 S	1.009	1.086 S	1.415 S	1.117 S	1.107	0.328	0.604 R	0.959
B_1	0.806	0.725	0.725	0.529 R	0.542	1.075	0.644 S	0.869	0.739
Natal Common	0.531 R	0.721	0.720	0.928 R	0.774	1.143	0.481	0.625 R	0.740
"*Cabri*" (local)	*0.719*	*0.816*	*0.769*	*1.158*	*0.660*	*1.074*	*0.373*	*0.795*	*0.796*
Beit Dagan	0.868 S	0.798	0.734	1.151	1.410	1.140 S	0.207 R	0.648	0.870
Florigiant	0.921 S	1.101 S	0.602 R	0.700 R	0.667	1.704 S	0.394	0.587 R	0.835

S = probably superior compared to variety "Cabri" (local)

R = probably inferior compared to variety "Cabri" (local)

Table 68. Yield of oil (Tons/Arpent)

VARIETY	*CLIMATIC ZONES AND LOCATIONS*								
	Sub-humid		*Sub-humid (Irrigated)*		*Humid*		*Super-humid*		
	Labour-donnais	*Schœn-feld*	*Médine*	*Solitude*	*Bénarès*	*Riche-en-Eau*	*Tivoli*	*Union Park*	*Average*
Manipintar	0.268	0.302	0.597 S	0.667	0.448 S	0.371 R	0.190	0.275	0.390
Virginia Bunch	0.416 S	0.422	0.319	0.486	0.405	0.484	0.088	0.196 R	0.352
NC_2	0.325	0.405	0.328	0.388 R	0.382	0.497	0.073 R	0.147 R	0.318
S.A. 156	0.516 S	0.531 S	0.567 S	0.744 S	0.585 S	0.559	0.153	0.287	0.493 S
B_1	0.361	0.328	0.340	0.227 R	0.207	0.479	0.288 S	0.414 S	0.331
Natal Common	0.224 R	0.306	0.332	0.412	0.326	0.509	0.193	0.257 R	0.320
"*Cabri*" (local)	*0.308*	*0.354*	*0.342*	*0.519*	*0.303*	*0.476*	*0.147*	*0.340*	*0.349*
Beit Dagan	0.391 S	0.300	0.327	0.508	0.611 S	0.450	0.073 R	0.245 R	0.363
Florigiant	0.416 S	0.494 S	0.263 R	0.318 R	0.262	0.756 S	0.144	0.232 R	0.361

S = probably superior compared to variety "Cabri" (local)

R = probably inferior compared to variety "Cabri" (local)

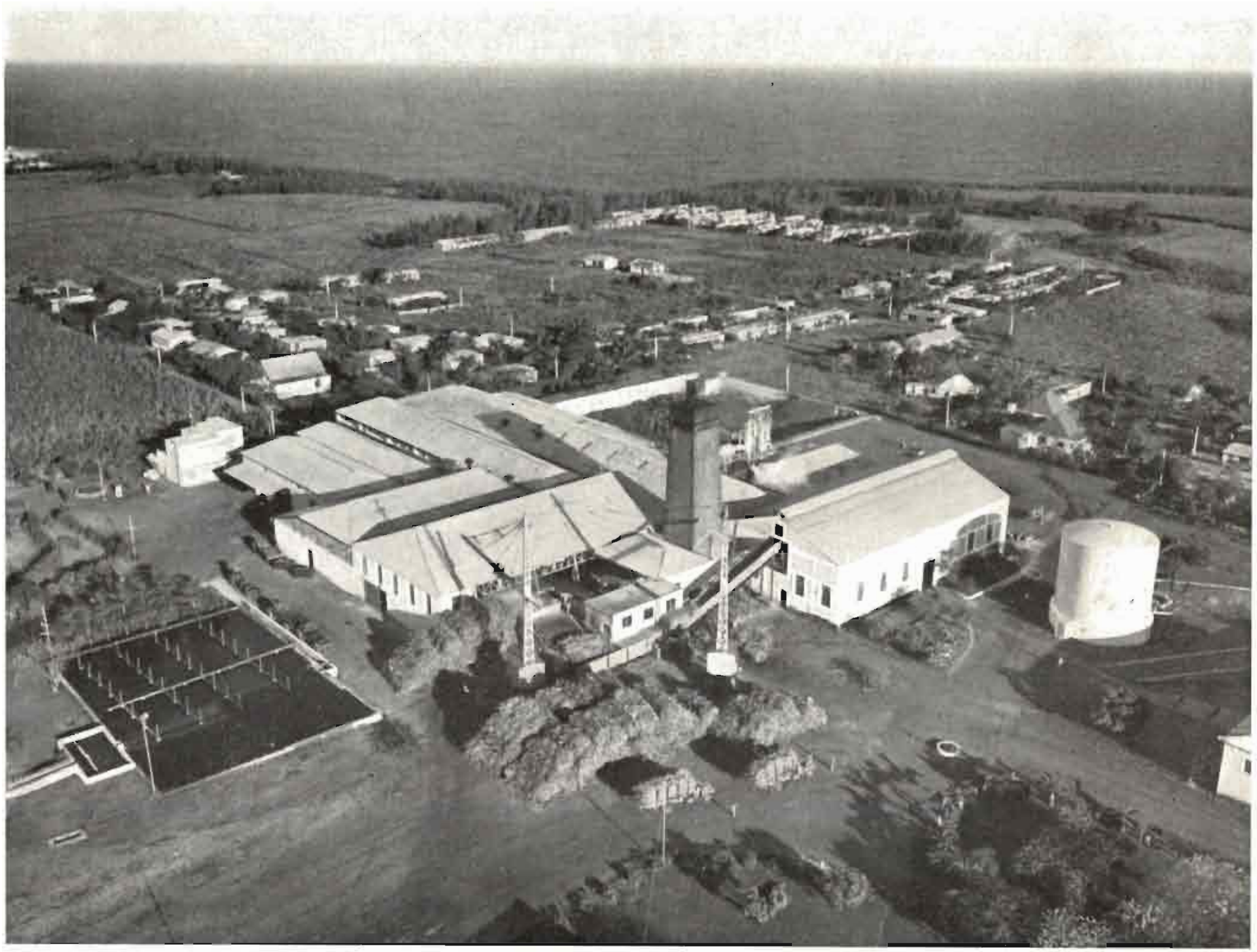
Conclusions

On the basis of these results the following remarks can be made :

(i) *Varieties grown for oil extraction.* The varieties Manipintar, S.A.156 and B_1 have proved superior in all climatic zones to the local variety "Cabri" or to the other varieties that were tried. It would not be advisable to grow variety B_1 on account of its high susceptibility to bacterial wilt and *Cercospora* leaf spot and to its average low yield.

(ii) *Large-seeded "table" varieties* : Among the large-seeded "table" varieties tested, Virginia Bunch, Florigiant and Beit Dagan appear to have better yield potential than NC_2. Beit Dagan seems to be more adapted to the humid zone, while Virginia Bunch and Florigiant can be grown under all climatic conditions, particularly in the sub-humid and humid zones.

(iii) *Small-seeded varieties* : Varieties such as "Cabri" (local) and Natal Common would perhaps be suitable for confectionery purposes. Furthermore, their oil content is rather low. It is to be noted that variety "Cabri", which has for many years been grown in Mauritius, readily finds a market locally.



Aerial view of Bénarès sugar factory

Automatic polarimeter used for the first time in a sugar factory (Union St. Aubin)

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1969

J. D. de R. de SAINT ANTOINE

BÉNARÈS, one of the smallest factories in the island, with a cane production of about 125,000 metric tons, and a crushing capacity of 55 metric tons per hour, closed down after the 1968 crop. The cane from its factory area was re-allocated to the neighbouring factories of Union-St. Aubin, Britannia and Savannah, whilst its quota of plantation white sugar manufacture, amounting to 7,500 tons, was produced at Bel Ombre factory by juice sulphitation in 1969.

Cane and sugar production

Sugar production in 1969 was the second best ever achieved in Mauritius, amounting to 668,700 metric tons, a figure which is only about 17,000 tons lower than that of the record 1963 crop when 685,000 metric tons were produced. However the area harvested was significantly lower, amounting to 188,500 arpents as compared to 194,100 arpents in 1963. As a result, sugar produced per arpent was slightly better in 1969, amounting to 3.55 tons as compared to 3.52 tons in 1963. Table 69 gives the area harvested, cane crushed and sugar produced during the past six years.

Table 69. Area harvested (thousand arpents), cane crushed and sugar produced (thousand metric tons) 1964-69

	1964	*1965*	*1966*	*1967*	*1968*	*1969*
Area harvested	195.4	194.1	195.7	191.7	189.0	188.5*
Cane crushed	4375	5985	4843	5814	5152	5824
Sugar produced	519.0	664.5	561.8	638.3	596.5	668.6

* Provisional figure

Cane quality

The climatic conditions which prevailed during the vegetative and maturation periods are summarized below. The first part of the vegetative season was marked by a drought, the sum of monthly deficits for the months of November to February amounting to 14.2 inches, as compared to a normal figure of 7.8 inches. However, during the second part of the vegetative season the mean air temperature exceeded the normal by 0.9°C and good growth conditions prevailed. As a result, cane yields were generally high, but sucrose was very low at the beginning of the crop. Fortunately, however, the drought which occurred in August, September and October allowed the cane to mature rapidly and sucrose kept going up almost until the end of the crop, as shown in fig. 3 on page 16 of the introduction to this report. But the sucrose content of the cane was so low at the beginning of the crop that, in spite of the favourable conditions which prevailed during the maturity period, sucrose per cent averaged only 13.01 , a figure which is only slightly better than the average of 12.94 obtained for the period 1964-68.

Table 70 gives sucrose per cent cane, fibre per cent cane and Gravity Purity of mixed juice for the years 1964 to 1969 (Gravity Purity for 1964 is not given as refractometer Brix was adopted in all factories as from the 1965 crop). Fibre per cent cane was a little lower in 1969 as compared to the figure for 1964-68, mostly as a result of the high yields

Table 70. Sucrose per cent cane, fibre per cent cane and mixed juice Gravity Purity, 1964-69

	Sucrose % Cane	*Fibre % Cane*	*Gravity Purity Mixed juice*
1964	13.45	13.85	—
1965	12.50	12.92	88.0
1966	13.20	13.46	87.7
1967	12.46	13.13	87.5
1968	13.10	13.52	88.3
Average 1964-68	*12.94*	*13.38*	*87.9**
1969	13.01	12.84	87.1

* Average 1965-68

of cane obtained last crop. Gravity Purity of mixed juice was also lower, 87.1 as against 87.9. This is due to the drought conditions which prevailed during the maturity period and which were the cause, in certain dry localities, of very low purities during the last days of the crop. It will thus be observed from Table XVIII (ii) of the *Appendix* that crop average mixed juice Gravity Purity registered at Solitude, Beau Plan and Saint Antoine were respectively 84.4, 85.1 and 85.4, as compared to an average of 87.1 for all the factories.

Milling

Milling figures for the period 1964-69 are given in Table 71, from which it will be observed that milling work in 1969 was at par with that of previous years. The only figure which calls for comment is the average crushing capacity which, following the closing down of Bénarès factory, increased slightly from 101.9 to 106.4 metric tons of cane per hour. By modern standards however, this figure is still quite low. Thus in South Africa and Queensland the average crushing capacities were respectively 161 and 196 metric tons in 1967. Further, the rate of increase in crushing capacity has been much more rapid in these countries than it has been in Mauritius, as shown in Table 72 and fig. 31.

Table 71. Milling results, 1964-1969

	1964	*1965*	*1966*	*1967*	*1968*	*1969*
No. of crushing days	100	128	111	130	106	115
Net crushing hours/day	19.96	20.28	19.57	19.07	20.67	21.73
Hours stoppages/day*	0.83	0.92	0.62	0.65	0.63	0.89
Factory running efficiency	96.0	96.6	96.9	96.7	97.0	96.1
Tons cane/ hour	95.4	100.6	97.3	101.9	101.9	106.4
Tons fibre/hour	13.21	13.00	13.10	13.39	13.72	13.66
Imbibition % fibre	228	220	230	223	224	221
Pol % bagasse ...	2.03	1.93	2.05	1.89	2.04	1.99
Moisture % bagasse	48.5	48.9	48.7	48.6	48.6	48.8
Reduced mill extraction	96.2	96.0	96.1	96.1	96.1	96.1
Extraction ratio	31.0	31.7	31.9	31.2	31.8	31.3

* Exclusion of stoppages due to shortage of cane

Table 72. Average hourly crushing rates, metric tons

	Mauritius	*South Africa*	*Queensland**
1958	83	95	116
1959	88	95	117
1960	77	102	119
1961	93	105	120
1962	91	108	131
1963	98	120	136
1964	95	125	155
1965	101	125	172
1966	97	148	188
1967	102	161	196
% Increase	*19*	*41*	69

* Excluding CSR mills

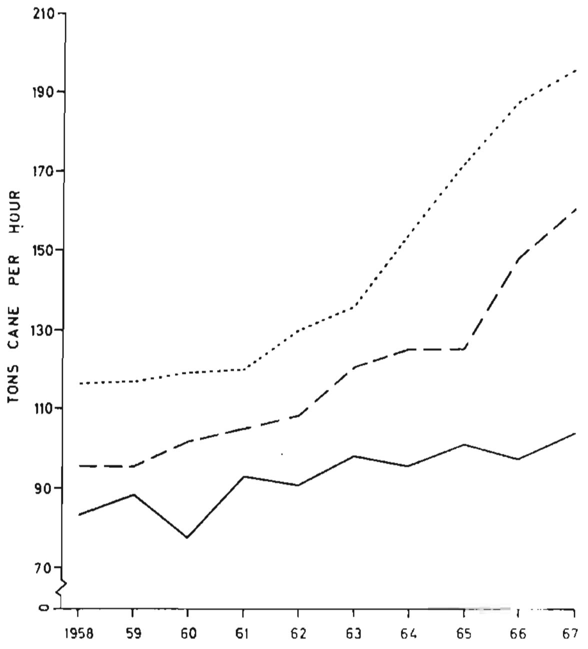


Fig. 31. Increase in average factory capacity in Mauritius, South Africa and Queensland.

Line = Mauritius
Dashes = South Africa
Dots = Queensland

Another way of looking at the problem is to consider the average sugar production per factory. When this is done, Mauritius is seen to lag far behind South Africa and Queensland, as shown in Table 73.

Thus whereas the average sugar production per factory was only 27,800 tons in 1967, comparative figures for Queensland and South Africa are 65,600 and 91,000 tons respectively. It is true that the harvesting season is longer in Natal than in Mauritius, but in Queensland it is of about the same duration as in Mauritius. It is also true that, with the closing down of Bénarès factory, the situation has improved slightly since 1967; and that with the probable closing down of Ferney factory it will improve further, but only to a small extent, since Ferney is the smallest factory in the island, with a sugar production of about 13,000 tons. It is also pertinent to point out that in Réunion island energetic measures have been taken to increase factory production by closing down the smaller and less efficient units. Thus, whereas in 1969 there were 12 factories in operation, with an average sugar production of about 21,000 tons, there will be only 9 in operation in 1970, and only 5 in 1975 when the average production per factory will be about 50,000 tons.

Table 73. Comparative production figures for Mauritius, South Africa and Queensland (exclusive of CSR mills)

Year	*Mauritius* 1969	*Mauritius* 1967	*South Africa* 1967/68	*Queensland* 1967
Cane produced, m. tons	5,824,000	5,814,000	16,919,000	13,199,000
Sugar produced (98.5 pol), m. tons	670,400	640,000	1,820,000	1,770,000
Number of factories	22	23	20	27
Average sugar production/factory	30,500	27,800	91,000	65,600

It should not be forgotten that the price paid to the signatories of the Commonwealth Sugar Agreement is calculated in such a way as to ensure a reasonable margin of profit to the *efficient* producer. There is no doubt that, unless centralisation of Mauritius factories keeps pace with that of other cane sugar producing areas, the relative cost of production of our raws will go up, and the profit margin of the industry, which is already small, will decrease further. It is true that the closing down of factories raises a number of problems, but these problems can and must be solved. Otherwise the efficiency of the industry will drop and it will become more and more difficult to sell, with profit, the main produce of the island in a market which is becoming more and more competitive.

Specific feed rates, dilution ratios and reduced mill extractions for individual factories are given in Table 74. It will be observed from this table that Highlands factory has achieved a reduced mill extraction of 97.4 (actual extraction 97.7 at 11.12 per cent fibre) with a dilution ratio of 85. This is the highest average extraction ever achieved in Mauritius, but it should be

Table 74. Comparative milling results 1969 crop

Factory	*Set of knives*	*Shredder*	*No. of rolls*	*Specific feed rate*	*Imbibition % fibre*	*Dilution ratio*	*Extraction ratio*	*Reduced mill extraction*
Médine	1 x 40 1 x 100	1	18	74	198	79	28.2	96.5
Belle Vue	1 x 68 1 x 72	—	12	68	206	73	29.5	96.4
F.U.E.L.	1 x 60 1 x 80	—	21	68	188	72	34.6	95.7
Mon Loisir	2 x 35	1	15	66	211	71	32.8	96.0
St. Antoine	1 x 36 1 x 44	—	15	64	225	71	36.8	95.5
Mon Désert-Alma	1 x 34 1 x 92	—	15	62	226	77	26.6	96.6
Constance	1 x 24 1 x 32	1	15	61	186	69	28.7	96.5
Savannah	1 x 28 1 x 48 1 x 92	—	12	61	221	71	33.8	95.8
Beau Champ	1 x 42 1 x 72	—	15	59	264	70	30.2	96.2
St. Félix	1 x 12 1 x 32	1	12	58	255	67	34.1	95.8
Rose Belle	1 x 24 1 x 42	—	12	55	273	69	35.6	95.5
Réunion	1 x 80	1	15	55	203	73	32.4	96.0
Ferney	1 x 84 1 x 60	—	12	51	224	70	35.7	95.6
Riche-en-Eau	1 x 54 1 x 104	—	15	51	287	75	30.0	96.3
Solitude	1 x 42 1 x 84	—	14	50	190	75	31.9	96.0
Bel Ombre	1 x 32	1	12	46	215	66	39.6	95.1
Beau Plan	1 x 42 1 x 100	—	14	42	230	79	21.8	97.3
Mon Trésor	1 x 40 1 x 80	—	12	42	260	71	35.0	95.6
Union St. Aubin	1 x 28 1 x 64	—	15	42	246	70	33.6	95.8
Britannia	1 x 32 1 x 60	—	14	41	227	67	35.3	95.6
The Mount	1 x 34 1 x 88	—	15	39	219	77	25.7	96.8
Highlands	1 x 32 1 x 64	—	15	33	222	85	20.5	97.4

observed that the specific feed rate is very low, amounting to only 33 lb of fibre per hour per cubic foot of total roller volume, the factory being equipped with 5 mills of 36″ × 72″ and crushing only 95 tons of cane per hour.

Once again, the importance of high dilution ratios should be stressed and its significance explained. As pointed out in the 1965 Annual Report, dilution ratio was first proposed by DOUWES DEKKER (1961) for gauging the efficiency of the imbibition process. It expresses the actual drop in Brix of juice from cane to bagasse as a percentage ratio of a target drop arbitrarily chosen as 85 per cent of the original Brix in cane. The dilution ratio depends on :

(a) the percentage of juice expressed by the first unit of the tandem;

(b) the amount of imbibition water applied;

(c) the number of imbibition steps;

(d) the extent to which imbibition liquid and residual juice mix at the various mills.

There is generally not much that can be done about (b), the maximum amount of imbibition water compatible with re-absorption and with evaporator capacity being usually employed. Similarly, the number of imbibition steps is governed only by the number of units of the tandem. However, first mill juice extraction, which has a marked influence on overall extraction, should be checked daily, whereas calculation of the dilution ratio will indicate whether it is possible to improve the mixing of imbibition liquid and residual juice. It would therefore be profitable to pay more attention to dilution ratios in industrial control. It will be recalled that, in the Annual Report for 1968, it was pointed out that the marked drop in reduced mill extraction obtaining at Beau Champ factory from 1966 to 1968 could be attributed mostly to the deterioration of the dilution ratio. During the 1969 crop attention was paid to the problem; the dilution ratio jumped from 64 in 1968 to 70 last crop and the reduced mill extraction increased from 96.0 to 96.2 in spite of an increased fibre throughput, the specific feed rate in 1969 amounting to 59 lb per hour per cu.ft. of total roller volume, as compared to 52 lb in 1968, whilst imbibition per cent fibre was just about the same.

As pointed out in the introduction to this Report, further studies were made during the crop to ascertain whether the increase in dextran content from first expressed to mixed juice could be used to assess inversion losses in the milling train. The results obtained have shown that there is a substantial increase in dextran % Brix in the juices sampled from the first to the last mill, even when the samples are taken during the first 15-20 minutes of crushing when the thoroughly cleaned mills resume crushing after the week-end shut down. Hence the method cannot be used to assess inversion losses in milling tandems.

Clarification and filtration

No clarification problems were encountered in 1969 except in certain factories during the last days of the crop when, following drought conditions, low juice purities prevailed, as mentioned earlier.

Several factories adopted saccharate liming with success, registering lower clarified juice turbidities and higher raw sugar filterabilities. The sugar solution used to prepare the saccharate varied from factory to factory, being either clarified juice, cloudy filtrate, diluted syrup or C-sugar remelt. It should be borne in mind that when sucrose reacts with lime, calcium monosaccharate, disaccharate or trisaccharate will be formed according to the conditions under which the reaction takes place. And, in order to avoid precipitation of insoluble trisaccharate it is necessary :

(a) To use only a slight excess of sucrose over that theoretically required for the formation of soluble calcium monosaccharate;

(b) to avoid high temperatures.

Further, most of the reducing sugars present in the sugar solution are rapidly destroyed when the reaction takes place. Hence it would appear that it is preferable to use a sugar solution having a low reducing sugars to sucrose ratio when preparing the saccharate. Tests carried out in the lab. to prepare lime saccharate under the conditions obtaining in four factories yielded the results given in Table 75. These results clearly indicate that more attention should be paid to the industrial preparation of lime saccharate, as in two of the four cases studied the amount of sucrose present in the solution used was slightly insufficient, whilst in the two others it was largely in excess.

Table 75. Figures relating to preparation of lime saccharate in various factories

Factory	*1*	*2*	*3*	*4*
Product used	*Clarified juice*	*Syrup*	*Cloudy filtrate*	*C-sugar remelt*
Parts sucrose theoretically required/100 parts CaO for monosaccharate formation	610	610	610	610
Parts sucrose actually used/100 parts CaO	510	1150	1670	570
R.S./sucrose ratio of sugar solution used	0.033	0.090	0.053	0.007
Parts R.S. originally present/100 parts CaO	17	102	89	4.0
Parts R.S. destroyed after 4 hours/100 parts CaO	16	100	83	2.5

Boiling house work

A source of sucrose loss in the boiling house is entrainment in multiple effect evaporators. As also reported in the introduction to this report, further work was carried out on quantitative measurement of entrainment from the last body of quadruple-effect evaporators. The results obtained, which are given in Table 76, indicate that the three catch-alls tested are efficient and that the amount of sucrose left in the vapour going to the condenser is so small that it cannot affect the undetermined losses.

Table 76. Sucrose entrained in vapour from last effect of quadruple-effect evaporators

Factory	*Type of catch-all*	*Crushing rate t.c.h*	*Abs. Press. in lasteffect ins. Hg*	*Sucrose in vapour ppm. Before catchall*	*Sucrose in vapour ppm. After catchall*	*Catchall efficiency*	*Sucrose lost/hour kg.*
Constance	Umbrella	93	6.2	—	22	—	0.42
Mon Désert-Alma	Baffle	150	4.7	134	18	87	0.44
Highlands	Single Vortex	88	5.0	419	11	97	0.13

Whereas in 1968 three factories followed the two boiling system during the whole crop, whilst two others used it during part of the crop, in 1969 twelve factories adopted the process, and there is no doubt that others will follow suit next crop.

Boiling house figures for the past five years are given in Table 77.

Table 77. Syrup, Masse-Cuites & Molasses 1965 - 1969

	1965	*1966*	*1967*	*1968*	*1969*
Syrup Gravity Purity	88.0	88.0	87.5	88.5	87.1
A-Mcte App. Purity	84.9	86.0	85.2	85.2	83.3
Purity drop A-mcte	20.3	18.4	19.4	19.5	22.2
,, ,, B-mcte	21.0	20.0	20.2	20.0	21.0
,, ,, C-mcte	25.1	25.2	26.1	25.6	27.0
Crystal % Brix in C-mcte	38.6	39.3	39.9	39.1	40.8
Magma Purity	86.7	87.0	86.4	85.9	84.6
Final Molasses : Gravity purity	38.3	39.1	38.0	38.6	38.0
Red sugars % Brix	15.5	14.9	17.0	16.3	19.8
Total sugars % Brix	53.8	54.0	55.0	54.9	57.8
Wt. % cane at 85° Brix	2.64	2.88	2.76	2.62	2.97

It will be observed from this table that :

(a) A-mcte purity dropped by about two points in comparison with 1968 following the more widespread adoption of the two-boiling process,

(b) For the same reason, A-mcte purity drop increased by 2.7 points as compared to 1968,

(c) C-mcte purity drop went up to 27.0 and crystal % Brix in C-mcte averaged 40.8 Both of these figures are the highest registered during the past five years. As a result final molasses purity dropped to 38.0, but this better exhaustibility is also greatly due to the higher reducing sugar content of the molasses;

(d) Weight of molasses per cent cane was the highest for the period under review as a result of the lower mixed juice purity obtained in 1969 in comparison with previous years. Consequently, and in spite of the lower final molasses purity recorded last crop, sucrose lost in final molasses per cent sucrose in cane was slightly larger than in 1968, as shown in Table 78.

Table 78. Losses & Recoveries 1965 - 1969

	1965	*1966*	*1967*	*1968*	*1969*
Sucrose lost in bagasse % sucrose in cane	4.10	4.30	4.07	4.32	4.02
Sucrose lost in filter cake % sucrose in cane	0.49	0.46	0.43	0.43	0.43
Sucrose lost in final molasses % sucrose in cane	6.87	7.23	7.15	6.70	7.36
Undetermined losses % sucrose in cane	0.92	1.13	1.33	1.22	1.06
Industrial losses % sucrose in cane	8.29	8.82	8.91	8.41	8.85
Total losses % sucrose in cane	12.39	13.13	12.98	12.73	12.87
Overall Recovery	87.6	86.9	87.0	87.3	87.1
Reduced Overall Recovery	85.3	85.0	85.0	84.8	85.5

This table also shows that losses in bagasse were small, amounting to only 4.02 per cent of the sucrose in cane, that filter cake and undetermined losses were normal, amounting to 0.43 and 1.06 per cent respectively, and that the highest losses are encountered in the final molasses, as would be expected. Hence the efforts of the industry should be directed primarily towards curtailing these losses. But, in order to cut down further on them, the Process Manager must first know the minimum theoretical or target purity that applies to his product. With the object of providing him with a means of calculating this purity the Sugar Technology Division has worked out (de St. Antoine & Vignes, 1969) a regression with the help of which actual and target true purities of monthly samples of final molasses from all the factories are calculated and circularized. This service has been operated by the Division during the past two crops, and will continue in 1970. Work has also started on boiling down tests in order to obtain a better evaluation of target purities.

The second aspect of the problem lies in the adoption of processes which lead best to well-exhausted molasses. It is pertinent to point out in this respect that the procedure followed in Mauritius differs somewhat markedly from that adopted in some other sugar producing areas, Queensland for example, where sucrose losses in final molasses are smaller than those prevailing here. In Mauritius the general practice is to boil light to medium-heavy C-massecuites, to cool them in crystallizers during 48 hours to about 30°C, in certain cases to dilute lightly in the crystallizer as soon as the load on the motor becomes excessive, and to reheat to 45-50°C with water at 60-70°C. Although it is not possible to compared Brix values of C-massecuites in Mauritius and in Queensland, as the methods of analysis differ, yet there is no doubt that in Queensland heavier boiling is practised, with more exhaustion taking place in the pans, and that the massecuites are dropped at a higher Brix. Since a higher Brix implies a higher viscosity, these massecuites cannot be cooled to as low a temperature as is customary in Mauritius. Hence they are generally cooled to about 45°C only and are reheated to 55-60°C prior to centrifugalling.

The immediate reaction of many local Process Managers will be to wonder how :

(a) By cooling to only 45°C, better exhaustion can be achieved;

(b) By reheating to 55-60°C, re-solution does not take place.

Commenting recently on this aspect of processing, CHAPMAN (1970) reports the results of boiling down tests carried out by MICHELI, and says : "The final temperature was found to have very little effect when reduced below 45°C, for the rate of crystallization at 45°C had already become very low. With any given material, the concentration, expressed as Impurity/Water, appeared to be the only factor which had any considerable effect on the final purity". CHAPMAN also reports the work of MC. CLEERY who confirmed that high-Brix massecuites are necessary for maximum results and found that large purity drops in the pan appeared to be more important in securing maximum final results than good crystallizer work alone.

If the problem is analysed from a more theoretical aspect, the same general conclusions are arrived at. Thus in relation to high-Brix boiling, WEST (1966) says : "Theoretical considerations show that, in the normal range of operation, and assuming the same conditions of supersaturation exist, for every unit increase in total dry matter of the mother liquor there will be a decrease of about 2 units in the sucrose content of the molasses. Thus the highest concentration consistent with subsequent handling should be maintained". Commenting on the results obtained in Barbados, WEST shows that, if it is assumed that the crystallizers are capable of processing massecuites containing mother liquor with a maximum viscosity of 140 poises after cooling, this condition may be produced from the following combinations of total dry matter and final temperature :

(a) 40°C and 82.7 TDM
(b) 45°C and 83.5 TDM
(c) 50°C and 84.3 TDM
(d) 55°C and 85.3 TDM

From theoretical considerations the author then shows that these combinations, under the same conditions of supersaturation and solubility coefficient, will yield mother liquors with the following true purities : (a) 43.5, (b) 43.2, (c) 42.8 and (d) 41.8. In other words, best results would be obtained in case (d) by producing a heavy massecuite which when cooled to 55°C in the crystallizers would yield a mother liquor containing 85.3 per cent total dry matter. The author further points out that, under Barbados conditions, the optimum conditions for exhaustion usually correspond to cooled massecuite temperatures lying between 45° and 55°C.

Another argument against low final massecuite temperatures is the loss of sucrose by inversion and destruction when the massecuite is kept too long in the crystallizer. In that case part of the purity drop observed is not due to crystallization of sucrose from the mother liquor and sucrose recovery is not proportional to purity drop. Thus CHAPMAN (*loc. cit.*) reports on trials carried out at Plaistow Wharf Refinery which showed that with 72 hours air cooling, fifty per cent of the drop in total sugars could be due to loss of sucrose and reducing sugars.

It may therefore be concluded that the sucrose losses in the final molasses of Mauritius could be curtailed by the adoption of boiling and crystallization techniques which are theoretically sound and which are already implemented in other sugar producing areas. It should be recalled that when Dr. H. W. KERR visited Mauritius in 1957 he mentioned that it is probably at the pan stage that there exists the greatest scope for increased sugar recovery in the island. Dr. KERR was also struck by the very free nature of most massecuites boiled in Mauritius, and felt that very much heavier boiling could be practised if factory arrangements and equipment were adequate for the job. The equipment of Mauritius factories has improved quite a lot since 1957, but its lay-out has in certain cases not been planned for heavy boiling. Adoption of the latter, however, would in most instances call for only minor modifications.

Raw Sugar Filterability

The CSR filterability index of affined raws was very good in 1969, averaging 10 points more than in both 1968 and 1967 when the same figures were recorded.

Following the adoption by most factories of the enzymatic process of starch removal, the starch content of the affined raws was much lower in 1969 than in 1968 as shown in Table 79. It will be observed from this table that sixteen factories, with a production representing 81% of the total, shipped raws with starch contents varying between 35 and 150 ppm. Of the six factories left, four were not equipped to follow the enzymatic process, whilst in the two others the process was operating quite satisfactorily. As from next crop however, all the factories will be using the process. Further, a bonus/penalty system, based on starch content and on filterability index, will be enforced, and there is no doubt that, as a result, the refining properties of Mauritius raws, which are already good, will improve further.

Table 79. Starch content of affined raws, 1968-69

Factory	*Raw sugar produced (m. tons) 1969*	*Starch content of affined raw (ppm)* 1969	1968
F.U.E.L.	87,294	39	141
Réunion	23,255	76	189
Highlands	25,179	79	118
Mon Désert-Alma	42,075	88	184
Beau Champ	39,445	89	163
Rose Belle	26,011	93	126
Solitude	25,317	95	185
Riche-en-Eau	25,319	109	169
Beau Plan	24,832	110	123
Mon Loisir	31,684	117	252
Belle Vue	33,571	118	225
Ferney	5,031	119	155
The Mount	25,226	121	155
Savannah	32,976	125	171
Médine	48,700	142	118
Britannia	24,610	150	203
Union St. Aubin	28,736	163	166
St. Antoine	20,193	182	317
Constance	28,667	201	314
St. Félix	13,230	245	301
Mon Trésor	25,591	348	371
Bel Ombre	8,732	371	363

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2. THE USE OF BACTERIAL AMYLASE FOR REDUCING THE STARCH CONTENT OF SUGAR PRODUCTS

E. C. VIGNES, M. ABEL & L. LE GUEN

Introduction

Although refiners seldom advise raw sugar producers when they are sold sugars of better quality than their average blend, in which case they make additional profits, yet they often complain when the raws supplied do not come up to expectation. Some of them claim that raw sugar containing more than 150-200 ppm of starch slows down filtration rates in carbonatation refineries, thereby increasing processing costs.

In the case of Mauritius sugars a direct relationship has been found between starch and filterability (VIGNES, 1962) and consequently, in recent years, particular attention has been paid to the reduction of starch in mixed juice, and especially to its removal by natural enzymes. Thus the adoption of the enzymatic process by an increasing number of factories since 1966 has played a major part in the improvement in the quality of Mauritius raws. In 1969, nineteen out of twenty-two factories had adopted the process, and the three remaining ones will be doing so next crop.

Further, in order to encourage the production of better sugars in the future a system of premiums and penalties based on starch content and on filterability index will be applied as from the 1970 crop. It is nevertheless realized that if, for some reason, the enzymatic process does not reduce the starch content of the mixed juice to a sufficiently low level, the producer may in spite of his efforts be penalized. In order to avoid this possibility and to make available to the producer an additional means of ensuring low starch containing sugars, experiments were carried out with a bacterial amylase received during the last days of the campaign. The trade name of the enzyme used is Amylase CS250, but there are other makes, for example Bactamyl-D which has found fairly wide use in Natal recently.

The removal of starch by the addition of enzymes to cane juices or syrup has been described by many authors (HADDON, 1928; FEUILHERADE, 1929; BOYES, 1960), but the calculated costs of treatment were shown to be uneconomical at that time. Bacterial amylases, on the other hand, are now available commercially in large quantities. They have the advantage of retaining their activity at high temperatures and are free from invertase activity. They have been used successfully on a commercial scale in South Africa (BRUIJN & JENNINGS, 1968).

Laboratory Experiments

For the tests, laboratory-pressed juice, mixed juice as well as factory — or laboratory-prepared clarified juice and syrup were used indiscriminately, as available.

Effect of amylase on juices

In the first place the optimum temperature for maximum activity of the amylase in the juice was determined. For this purpose, canes were passed through a cane chipper, pressed, and the juice clarified by liming. This clarification step effectively destroyed all natural enzymes. A beaker full of clarified juice was kept in a water-bath at constant temperature. Amylase, at the rate of 5 ppm on the clarified juice, was added and the effect on the starch present determined by removing samples at the beginning of the test and after a 5-minute interval. This test was carried out at different temperatures and Table 80 summarizes the data obtained during two series of experiments.

Table 80. Destruction of starch in clarified juice by 5 ppm of bacterial amylase in 5 minutes

Temperature °C	*% Starch reduction*
66	74
75	76
80	63
85	43
92	15

It will be noticed that 75°C appeared to be the optimum temperature under the conditions prevailing. Therefore, during other tests, care was taken that the temperature of the juice at the time of enzyme addition was as near as possible to 75°C.

Secondly, the effect of several concentrations of amylase on the rate of decomposition of starch, in mixed (boiled or otherwise) and clarified juices for periods of 15 and 30 minutes, was determined. The results are shown in Tables 81 and 82.

The rate of elimination of starch in mixed juice by natural enzymes (Table 81) varies between wide limits. After 30 minutes only, 12% of the starch content was destroyed in one case, whilst in another the percentage of elimination rose to 37, although experiments conducted in 1966 showed that keeping mixed juice for 8 minutes at 73-76°C caused 63-69% of starch to be eliminated. Moreover, the addition of even 10 ppm of amylase did not increase the percentage hydrolysed to above 46. On the other hand, the same amount of amylase accounts for 88% of decomposition

Table 81. Reduction of starch in mixed juice with bacterial amylase

Test	Juice treatment	Amylase ppm	% Starch reduction after 15 minutes	30 minutes
1	Heated to 75°C	0	4	12
	Heated to 75°C	5	9	42
	Heated to 75°C	10	46	39
	Boiled & cooled to 75°C	10	—	88
2	Heated to 73°C	0	33	37
	Boiled & cooled to 73°C	5	81	81
	Boiled & cooled to 73°C	10	92	92
3	Boiled & cooled to 73°C	5	82	82
	Boiled & cooled to 73°C	10	82	86
4	Boiled & cooled to 73°C	5	67	67
	Boiled & cooled to 73°C	10	88	88

after 30 minutes in boiled mixed juice, i.e. when the starch was solubilized. Evidently the rate of hydrolysis of starch by bacterial amylase depends on the amount in solution, and it would appear that part of the starch in unboiled mixed juice had not dissolved. This factor accounts for the improvement in the rate of elimination in clarified juice where all the starch must have been in solution (Table 82). Only 5 ppm of amylase are necessary for eliminating 75% after 15 and up to 86% of starch after 30 minutes. Increasing the amylase added to 10 ppm raised the amounts hydrolysed to 83% and 93% respectively. These results thus suggest the possibility of eliminating starch in cooled clarified juice, but this would be unpractical industrially.

Table 82. Reduction of starch in clarified juice cooled to 75°C with amylase

Test	Amylase ppm	% Starch reduction after 15 minutes	30 minutes
1	5	75	82
	10	83	83
2	5	75	86
	10	86	93

Bacterial amylases are claimed free from invertase activity. However, apart from invertase, chemical inversion, which depends on such factors as pH, salt concentration and temperature, may result from their addition to cane products. This possibility was checked by determining the percentage of reducing sugars in the juice after different treatments as set out in Table 83.

Table 83. Effect of bacterial amylase on reducing sugars in pressed juice

Test	Treatment	Amylase ppm	R.S. %g after 0 minute	15 minutes	30 minutes
1	Heated to 73°C	0	1.81	1.82	1.90
	Boiled & cooled to 73°C	0	1.84	1.92	1.96
		5	1.84	1.92	1.96
		10	1.92	1.96	1.98
2	Heated to 73°C	0	2.08	2.12	2.18
	Boiled & cooled to 73°C	0	2.17	2.19	2.25
		5	2.17	2.24	2.25
		10	2.21	2.25	—
3	Heated to 73°C	0	1.36	1.36	1.38
	Boiled & cooled to 73°C	0	1.39	1.40	1.41
		5	1.40	1.41	1.43
		10	1.43	1.43	1.43

Reducing sugars were determined by the Lane & Eynon method. As the rate of inversion was insignificant even after 30 minutes, it is clear that the risk of inversion, during the application of amylase for reducing the starch content of sugar juice, is inexistant.

Effect of amylase on syrup

It is evident that addition of amylase may also take place in one of the last bodies of the evaporator where the temperature is not too high to cause inactivation. On account of the influence of viscosity on the reaction rate, it is necessary to determine the maximum decomposition obtainable under the conditions prevailing in the body selected.

Accordingly, the effect of viscosity and temperature was investigated. Amylase, equivalent to 10 ppm on clarified juice, was added to syrup and the amount of starch, hydrolysed at different temperatures, determined after 5 minutes. The results obtained are shown in Table 84.

Table 84. Hydrolysis of starch in syrup with amylase equivalent to 10 ppm on clarified juice

Temperature (°C)	*Brix*	*% Starch reduction*
64	50	33
64	32	59
75	32	59
84	32	58
89	32	45

The effect of viscosity can be judged from the greater reduction in the starch content when working at a lower Brix at 64°C. Between 64° and 84°C there did not seem to be a pronounced optimum temperature. These tests thus suggest that the place to add amylase to syrup should be the third body of the quadruple effect.

For confirmation of these results, different amounts of amylase were added to syrup under two sets of conditions and the reduction assessed after 5 minutes (Table 85).

Table 85. Reduction of starch in syrup after 5 minutes, (a) at 62°C and 50° Brix, and (b) at 85°C and 32° Brix

Amylase ppm on clarified juice	*% Starch reduction*	
	(a)	*(b)*
2	9	33
5	24	47
10	29	74

As may be seen from these figures the action of amylase was more marked when the temperature was high, but the Brix (i.e. the viscosity) was low. Hence amylase added to the third effect would cause starch to be hydrolysed at twice the rate it would be in the last effect. This interesting property of the amylase was further investigated when it was added at the rate of 10 ppm on clarified juice to syrup from different sources with the results shown in Table 86.

Table 86. Reduction of starch after 5 minutes in syrup at 85°C and 32° Brix

	% Starch Reduction
1.	65
2.	65
3.	63
4.	58
5.	65
Average	*63*

Hence, on average 63% of the starch remaining in the syrup is liable to be eliminated if amylase is added to the third body of the quadruple effect evaporator.

Conclusion

As reported in an earlier study (VIGNES & MARIE-JEANNE, 1967), the enzymatic process on its own can achieve spectacular results. However, should it fail for some reason or other to reduce the starch content of mixed juice to a satisfactory level, then a bacterial amylase could be used in conjunction.

Although a number of possible combinations exists for using the natural enzymes together with amylase for starch elimination, yet the simplest method, according to the data reported in this article, would be to add the amylase to the third body of the quadruple effect evaporator. The cost of the installation for amylase addition would be very small. The level of enzyme added would have to be worked out and the expense assessed, in actual industrial practice. Owing to variable factors, such as variety of cane and climatic conditions, enzyme concentrations during addition would have to be established for each individual mill in order to achieve the necessary reduction of starch.

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3. NOTES ON SLURRY PREPARATION AND PAN SEEDING

J. D. de R. de SAINT ANTOINE

In true pan seeding, the quantity of seed added in the slurry must be such that it contains a sufficient number of seed nuclei to produce an equivalent number of crystals of a given size in the finished strike. In order to achieve good results, it is further necessary that the seed material be homogeneous in size and as small as possible, because the amount of slurry required will be much greater with coarser nuclei since the ratio of seed to finished crystals by weight varies as the cube of their linear dimensions. Thus, the theoretical weight of seed crystal of an average size of 10 microns (0.010 mm) required for the production of 60 metric tons of 95 per cent Brix massecuite containing, on Brix 40 per cent crystals of 0.30 mm on striking will, according to JENKINS (1966), be approximately :

$$60000 \times 0.40 \times 0.95 \quad \left(\frac{0.010}{0.30}\right)^3 = 0.8 \text{ kg}$$

But if the average size of the crystal nuclei is 40 microns, the theoretical weight of seed crystal required will be approximately :

$$60000 \times 0.40 \times 0.95 \quad \left(\frac{0.040}{0.30}\right)^3 = 54.0 \text{ kg}$$

It should be observed that the use of Brix, instead of true dry substance, as well as that of Apparent Purities for calculating crystal per cent, as is the current industrial practice, introduces a small error in the above calculations. But, since the error involved due to the difficulty of calculating the true average particle size of the seed is much larger, as shown further, the use of Brix and Apparent Purities may be resorted to here.

In several factories of Mauritius icing sugar is still used for seeding vacuum pans. This type of seed, even when dried and sieved through a 100-mesh sieve, is very irregular, containing crystals varying in size between a few microns and 150 microns, with an average size of about 40 microns. With such coarse seed it is evidently not possible in practice to achieve true pan seeding since the quantity of seed required would be prohibitive as shown in the above calculation.

In more numerous instances, however, slurry is used in Mauritius for pan seeding. The fineness and regularity of the seed crystals then depend on the efficiency of the ball mill used and on the time of grinding. According to JENSEN (1967), an efficient ball mill should yield crystals of five microns on the average, with the largest sizes ranging between ten and twenty microns. But are these conditions met in the industry ? In all those factories where slurry is used, is true pan seeding being achieved, as it is believed to be, or is shock taking place ?

In order to be in a position to reply to these questions, it was decided to make a survey 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) Quantity of slurry of a given average crystal size used per ton of massecuite.

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

The results of the survey carried out have shown that fifteen factories use slurry and seven icing sugar. The amount of icing sugar used in all cases is so small that the seeding is doubtless occurring through shock. Of the fifteen factories using slurry, four have "Ditmar" ball mills, one an "Atomicer", whilst eleven use locally made equipment. The details and specifications of each of these mills are given in Table 87.

In order to evaluate the average seed crystal size of the slurries produced in each case, samples were collected from the fifteen factories and examined under the microscope. These data, expressed in terms of percentages of seed crystals of various dimensions, are given in Table 88.

Discussion

In practice it is difficult to calculate both average seed dimension and grams of seed required per ton of finished strike.

For the purpose of this study the method used for evaluating the size distribution of the slurry samples was as follows : the two visible lineai dimensions — length and width, exclusive of thickness or depth — of 75-100 adjacent crystals were measured in microns. The figure l x w was calculated in each case and the crystal classified under 0-5 microns if the result gave a figure less than 25, whilst it was classified under 5-10 microns if the figure was between 25-100, and so on. Thus in the case of Factory *2*, the following results were obtained.

Average Linear dimension	*No. of Crystals*	*Percentage*
0 — 5	28	35.0
5 — 10	45	56.2
10 — 15	7	8.8

The average seed dimension may then be calculated as follows :

$$\left[(35.0 \times 2.5) + (56.2 \times 7.5) + (8.8 \times 12.5)\right]/100 = 6.2 \text{ microns}$$

It would have been more accurate to use the actual average dimension of each crystal instead of assuming that, for instance, the 28 crystals of the 0-5 micron group have an average dimension of 2.5 microns. But that would have entailed lengthy calculations without probably adding much to the accuracy.

The above method, however, does not appear to be correct since what one is really interested in is the mean weight of the average crystal, or a figure proportional to the mean weight, rather than its average dimension. This may be achieved by using the cube of the average linear dimension when calculating the weighted mean. Then one obtains :

$$\sqrt[3]{\frac{(35.0 \times 2.5)^3 + (56.2 \times 7.5)^3 + (8.8 \times 12.5)^3}{100}} = 7.4 \text{ instead of } 6.2 \text{ microns}$$

This will naturally make a lot of difference in the amount of slurry necessary to seed one ton of massecuite. Thus for the factory concerned, where the following figures prevail :

Bx massecuite	95.4
Crystal % Bx	36.7
Av. crystal size, mm	0.25

the number of grams of seed crystals theoretically needed per ton of massecuite for true seeding will be :

Case 1 $\quad 1{,}000{,}000 \times .954 \times .367 \left(\dfrac{.0062}{.25}\right)^3 = 5.4 \text{ grams}$

Case 2 $\quad 1{,}000{,}000 \times .954 \times .367 \left(\dfrac{.0074}{.25}\right)^3 = 9.1 \text{ grams}$

It would appear that the first method given above, *Case 1*, is incorrect and results in low values. On the other hand, the second method, *Case 2*, yields inflated values since the thickness or depth of the average seed crystal is probably smaller than its average linear dimensions l and w. Hence, in addition to the difficulty of calculating average seed dimension, the calculation of the quantity of seed required to produce, say one ton of massecuite of a given Brix, crystal content and final crystal dimension also raises a problem. The method generally followed makes use of the following relationship, as already seen :

$$\text{Grams seed crystals/ton massecuite} = 1{,}000{,}000 \times \frac{Bx}{100} \times \frac{\text{Crystal \% Bx}}{100} \times \left(\frac{l}{L}\right)^3$$

where l and L are the average dimensions of the seed and of the finished crystals.

Now, the shape of the slurry particle, as seen under the microscope, corresponds more or less to an ellipsoid. Its volume is equal to $\frac{4\pi}{3} \frac{l_1}{2} \frac{l_2}{2} \frac{l_3}{2}$ where l_1, l_2 and l_3 are the three axes. If it is assumed that l is the average linear dimension of the particle, the volume becomes $\frac{4\pi}{3} \frac{l^3}{8}$, i.e. the volume of a sphere of diameter l.

On the other hand, as pointed out by GILLETT (1948), the volume of a sugar crystal is approximately equal to 0.7 L^3, where L is the average linear dimension of the crystal. Since in true pan seeding the number of nuclei introduced is equal to the number of sugar crystals in the finished strike, then,

$$\frac{\text{Wt of slurry particles}}{\text{Wt of finished crystals}} = \frac{n \times 4/3\,\pi\,\frac{l^3}{8} \times D}{n \times 0.7\,L^3 \times D} = 0.75\left(\frac{l}{L}\right)^3$$

where n is the number of nuclei in the seed and of crystals in the finished strike and D is the specific gravity of sucrose.

Then, for a massecuite having a Brix of $\frac{Bx}{100}$ and a crystal per cent Brix of $\frac{C}{100}$ the number of grams of slurry required per ton for true pan seeding will be :

$$1{,}000{,}000 \times \frac{Bx}{100} \times \frac{C}{100} \times 0.75\left(\frac{l}{L}\right)^3$$

This is the equation which was actually used for calculating the figures given in the last line of Table 87. However, another source of error is introduced in the calculation if a number of minute seed nuclei are present but not visible under the microscope used, and consequently not taken into consideration. But, as pointed out by JENKINS*, it is probable that the smallest seed crystals dissolve due to their substantially higher solubility compared with those of larger size. Further, as the slurry is generally suspended in a volatile liquid, some of them, particularly the smaller ones, are probably lost by flash of the liquid in the vapour space.

Conclusions

An examination of Tables 87 and 88 leads to the following comments :

(a) The main difference between imported equipment — Ditmar and Atomicer — and locally made ball mills lies in the former's larger percentage volume occupied by the steel balls and higher speed of rotation.

(b) The quality of the slurry produced by imported equipment is not necessarily better than that of local ball mills. However, the results obtained with some of the latter are very poor, as exemplified by the slurries of Factories *12* to *15*.

* Private communication.

(c) Factories *1* and *2* are the only ones in which relatively good slurries are produced, but even there the average seed dimension is somewhat in excess of the five micron set by JENSEN. It should be observed that Factory 1 uses a rod mill, which is preferable to a ball mill, for preparing slurry.

(d) Good slurries may be produced by different types of ball mills. However, the only way to determine whether the seed crystal is sufficiently fine and homogeneous is to carry out a microscopic examination of the slurry and to study the resulting size analysis data.

(e) It is only in the case of Factory *5* that the amount of seed used is slightly in excess of that calculated as necessary for true pan seeding. Hence in all the other factories shock seeding is no doubt occurring. But even in Factory *5* shock is also most probably taking place since, as reported by JENKINS*, experiments carried out in laboratory vacuum pans show that the actual number of seed nuclei required for true pan seeding is always largely in excess of the calculated values. Similar conclusions have been arrived at by WRIGHT* who used a Coulter Counter for determining the number of seed nuclei present per unit volume of slurry and found out that whereas the counter registered a figure of about 360 million nuclei per millilitre, yet only about one-third of those persisted in the pan. And it should be pointed out that the latter was a small laboratory pan fitted with mechanical agitation in which excellent conditions for true seeding prevailed, whereas in commercial pans inferior conditions are probably met with and greater loss of seed nuclei taking place as a result.

It may therefore be concluded that :

(i) It is not possible in practice to calculate the amount of seed required to produce true pan seeding, as this amount is always largely in excess of that obtained by calculation. Hence it is only by trial and error that the right proportion may be found.

(ii) Although true seeding cannot be practised unless the seeding pan is equipped with proper instruments and a number of variables are carefully controlled, yet the first requirement is to use sufficient seed of small and regular dimensions. Such seed may be obtained in practice by paying more attention to slurry preparation through microscopic study of the seed nuclei and study of size analysis data.

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4. CHEMICAL CONTROL NOTES

I. INVESTIGATIONS ON THE REPRODUCIBILITY OF FINAL MOLASSES ANALYSIS

M. RANDABEL

In experiments carried out to compare different types of equipment, or different boiling house processes, the conclusions to be drawn very often depend on the analysis of final molasses, particularly on the determination of the Gravity Purity.

The Sugar Technology Division carries out every crop, in parallel with the factory chemists, the analysis of monthly final molasses samples from all the factories so as to calculate their Expected True Purities, and hence to assess the efficiencies of the low grade departments. The present investigation was planned to obtain preliminary information on the possible cause. of variation affecting the determinations mades

Table 89. Results of analysis of two samples of final molasses for Brix, sucrose, reducing sugars and ash.

(each sample analysed five times by five analysts)

Treatment	*BRIX*			*SUCROSE*			*PURITY*			*R.S.*			*ASH*		
	Sample 1	*Sample 2*	*Average*	*Sample 1*	*Sample 2*	*Average*	*Sample 1*	*Sample 2*	*Average*	*Sample 1*	*Sample 2*	*Average*	*Sample 1*	*Sample 2*	*Average*
1	89.22	89.27	88.60	32.83	31.37	32.10	36.78	35.66	36.22	22.52	26.45	24.49	14.75	12.29	13.52
2	89.27	88.56	88.92	33.18	31.92	32.55	37.16	36.04	36.60	22.67	26.47	24.57	14.72	12.33	13.53
3	88.85	88.03	88.44	32.52	31.72	32.12	36.60	36.04	36.32	22.70	25.76	24.23	14.76	12.51	13.64
4	89.04	88.03	88.54	32.93	31.46	32.20	37.00	35.72	36.36	23.43	27.82	25.63	14.81	12.61	13.71
5	89.27	88.62	88.95	32.28	31.35	31.82	36.18	35.38	35.78	21.17	25.36	23.27	—	15.06	15.06
Average	*89.13*	*88.24*	*88.69*	*32.75*	*31.56*	*32.16*	*36.74*	*35.77*	*36.26*	*22.50*	*26.37*	*24.44*	*14.76*	*12.96*	*13.89*

Table 90. Analysis of Variance

		BRIX		*SUCROSE*		*PURITY*		*R.S.*			*A S H*	
	D.F.	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*D.F.*	*M.S.*	*S.L.*
Treatments	4	0.52	***	0.69	***	0.90	***	7.13	***	3	0.085	***
Molasses	1	9.75	***	17.51	***	11.90	***	187.87	***	1	53.94	***
Treat. × Mol.	4	0.16	***	0.24	**	0.21	*N.S.*	0.65	***	3	0.036	**
Residual	39	0.0259	—	0.0459	—	0.0585	—	0.0129	—	32	0.0050	—
Coeff. of Variab. %		0.18		0.67		0.67		0.47				

Table. 91. Analysis of comparison between treatments 1 and 2

	BRIX		*SUCROSE*		*PURITY*		*R.S.*		*ASH*	
D.F.	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*M.S.*	*S.L.*	*M.S.*	*S.L.*
1	0.51	***	1.01	***	0.72	**	0.036	*N.S.*	0.0003	*N.S.*

D.F. = Degrees of freedom

M.S. = Mean square

S.L. = Significance level

N.S. = Not significant

** = Significant at 1% level

*** = Significant at 0.1% evell

Method

Two samples of final molasses were sent to five chemists who were asked to sub-sample each lot five times and to perform complete analysis on each sub-sample in their own laboratory. Results for Refractometric Brix, Sucrose, Gravity Purity, Reducing Sugars and Sulphated Ash are presented in Table 89, and the methods of analysis followed are given in appendix.

Discussion

The following possible sources of variation in molasses analysis are postulated :

1. Sampling
2. Analytical methods : this includes influence of possible differences in amounts of reagents used, time taken for various analytical operations, etc.
3. Analysts : this includes differences in ability to handle the analytical operations; differences in ability to read optical apparatus, and finally possible biases in apparatus, each analyst working in his own laboratory.

In the analyses of variance presented in Table 90, the source named "treatments" includes all of these; however, two of the analysts (treatments 1 & 2) worked in the same laboratory and used the same apparatus throughout. This eliminates some of the biases such as those due to differences in apparatus, and it was therefore possible to separate this comparison as a single component from the treatment sums of squares as shown in Table 91.

As will be clear from the analyses, there are large differences between treatments; even more important there are also large interactions with molasses; further, the comparison mentioned above between two analysts (treatments 1 and 2) shows marked differences between their assessments for all characters.

Some figures available from 1968 determinations have been used to investigate the component due to analytical methods and that due to analysts. They are presented in Tables 92 and 93, and refer to analyses of three molasses in four replicates by each of two analysts working in the same laboratory. However in this case and for each sample of molasses, both analysts used a unique source of deleaded solution; this, therefore, eliminates the effect of lead addition and removal of excess lead thought to be one of the major sources of variation.

Table 92. Analysis of variance for sucrose

Source of Variation	*D.F.*	*M.S.*	*S.L.*
Treatments	1	0.078	10%
Molasses	2	10.011	***
Treat. & Mol.	2	0.004	N.S.
Residual	18	0.0257	—
Coeff. of Variab. %		0.48	

Table 93. Results of sucrose analysis of three samples of deleaded solutions of final molasses (each sample analysed four times by two analysts)

Analysts	*Sample 1*	*Sample 2*	*Sample 3*	*Average*
Treatment 1	33.23	34.84	32.72	33.60
Treatment 2	33.37	34.98	32.78	33.71
Average	33.30	34.91	32.75	33.65

It will be seen from the figures presented that the interaction with molasses virtually disappears. On the other hand, the difference between the two treatments, i.e. analysts, still approaches significance; this may possibly be attributed to personal equations arising from the reading of apparatus.

It is therefore felt that, although the precision of the analyses is high, as indicated by very low cœfficients of variability for all characters (less than 1%), yet a number of causes have still to be investigated before results from different individuals or laboratories can be safely compared.

APPENDIX

Analytical methods used :

(*a*) *Brix :* A 1 : 6 wt/wt solution of molasses is prepared and the Brix is read using a Bausch and Lomb precision refractometer.

(*b*) *Sucrose :* 300 g of the 1 : 6 wt/wt molasses solution is weighed into a 500 ml volumetric flask and the volume is brought up to the mark with distilled water to give finally a 1 : 10 wt/vol. solution.

The refractometric Brix of this 1 : 10 wt/vol solution is also determined so as to obtain the value of the Clerget factor.

400 ml of the 1 : 10 wt/vol. solution is taken and 16 g of dried, basic lead acetate added and clarification is allowed to proceed for about 45 minutes. The clarified solution is filtered, the first 50 ml of filtrate are discarded and 4 g of dried potassium oxalate are added to the rest of the filtrate in order to remove the excess of lead.

Sucrose is then determined according to the Jackson and Gillis Method No. IV with inversion carried out at 60°C, the solution being agitated for 3 minutes and allowed to remain in the bath for a total time of 13 minutes.

(*c*) *Reducing sugars :* The 1 : 10 wt/vol. molasses solution is diluted to give a 2% or a 1% wt/vol. solution depending upon the reducing sugars content of the molasses. Clarification is done with the minimum amount of neutral lead acetate and the excess of lead is removed with dried potassium oxalate.

Reducing sugars are determined by the method of Lane and Eynon.

(*d*) *Sulphated ash :* About 5 g of molasses is weighed into a silica crucible and is moistened with about 5 ml of concentrated sulphuric acid. The sample is carbonised and heated in a muffle furnace for one hour at 550°C. The ash is then re-sulphated by adding about one ml of concentrated sulphuric acid and, after evaporation of the acid, the crucible is finally heated at 800°C for three hours. It is then allowed to cool in a desiccatcr and weighed.

II. THE DETERMINATION OF BRIX OF FINAL MOLASSES FOR EXPORT

M. RANDABEL, M. ABEL & J. D. de R. de SAINT ANTOINE

Prior to the 1969 crop, The Mauritius Molasses Company Limited advised this Institute that overseas importers of final molasses envisaged to change the analysis clause for Brix determination and sought the advice of the Sugar Technology Division on the method advocated. In this method it is stipulated that the Brix spindle reading will be observed after the sample has been diluted with an equal weight of water and allowed to stand at 20°C for twenty minutes.

It was therefore decided to investigate the matter during the 1969 crop, particularly with reference to the time of settling of 20 minutes which was believed to be too short. The temperature condition set, although correct, cannot be accepted since no sugar factory laboratory is equipped with a constant temperature room. Hence there is for the time being no alternative than to use a temperature correction. However, it would be desirable to let the solution stand at a temperature as close to 20°C as possible since the temperature corrections have been calculated for pure sucrose solutions.

When a molasses solution is spindled for Brix, two main precautions should be taken : the occluded air should be removed or allowed to escape, and the solid particles in suspension should be allowed to settle at the bottom of the cylinder into which the solution has been poured. The object of allowing the solution to stand for a certain time before brixing is to meet these desiderata. In order to ensure complete air removal it is recommended in certain countries to apply a vacuum on top of the cylinder before brixing. Similarly, to ensure that solid suspended particles and occluded air do not affect the Brix reading, it is sometimes recommended to centrifuge the solution first. However, this recommendation has not been adopted, mostly because sugar factory laboratories are generally not equipped with appropriate centrifuges.

In the experiments reported on below a bulk solution of final molasses, 1 : 1 wt/wt, was prepared and the Brix determined by spindle under the following conditions :

(i) Part of the solution was centrifuged at 2,600 rpm for 30 minutes, poured gently into a cylinder, and the Brix determined at once.

(ii) Another part of the solution was poured in a cylinder, vacuum applied continuously for 30 minutes, and the Brix read at once.

(iii) The rest of the bulk solution was used to fill up ten cylinders; the Brix of the solution in the first cylinder was read after a standing time of 20 minutes, that of the solution in the second cylinder after 40 minutes and so on after standing times of 60, 80, 100 minutes and 2, 3, 4, 5 and 6 hours.

The whole experiment was repeated with nine other samples of final molasses, and the results obtained are given in Table 94. An examination of these results leads to the following comments :

(a) Since the two main precautions to be taken when determining the Brix are the removal of air bubbles in suspension and the settling of solid, suspended particles, the best treatment of a molasses solution prior to the Brix determination should be centrifugation, since it ensures elimination of the solid particles and very efficient removal of air bubbles. Hence the centrifuged solutions are those in which the two main sources of error have been most efficiently eliminated and this is reflected in the results obtained. The Brix of the centrifuged solutions are always the lowest, being on the average 0.4° lower than the Brix values obtained after 3 hours settling and 1.4° lower than the values obtained after 30 minutes of de-aeration under vacuum;

(b) It was found necessary to apply vacuum continuously for at least 30 minutes on top of the hydrometer jars to remove all the occluded air bubbles. The Brix values were determined just after and were found, on an average, to be higher than the Brix values obtained after centrifugation by 1.4 and higher than the Brix after 3 hours settling by 1.0. This indicates that although air bubbles have been removed after 30 minutes, yet this amount of time is not sufficient to allow the settling of the solid, suspended matter;

(c) When the Brix is measured after allowing the molasses solution to stand for various times it is observed that the Brix values decrease rapidly at first; it is only after 2½ to 3 hours that they become stable but they are still then on an average about 0.4° higher than the Brix of the centrifuged solutions. A curve showing the average drop in Brix reading for the ten molasses samples analysed against increasing settling times is given in fig. 32.

Even after 6 hours standing, only five molasses came to within 0.2° of the Brix obtained after centrifugation, whilst the other five samples were still 0.5 to 0.7° higher and would probably require much longer standing times to approach the Brix values of the centrifuged solutions. This is probably due to the presence in these molasses of very fine and light particles of suspended solids that require a much longer time to settle or may even settle only when centrifuged.

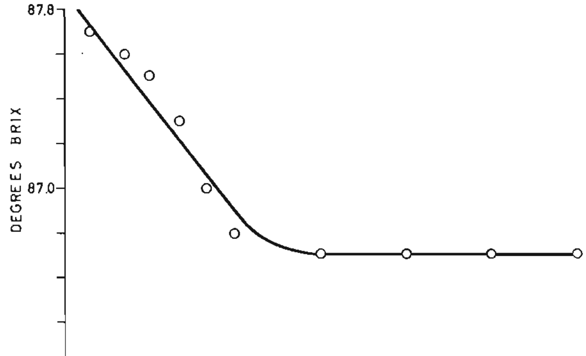


Fig. 32. Effect of settling time on spindle Brix of a 1 : 1 wt/wt final molasses solution.

Table 94. Effect of centrifugation, de-aeration and settling time on spindle Brix of *1 : 1* wt/wt final molasses solutions

Sample	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Average*
Centrifugation at 2600 rpm for 30 mins	81.3	81.2	84.3	86.2	85.5	87.8	89.1	88.9	88.9	90.1	86.3
De-aeration under vacuum for 30 mins	82.6	82.8	85.9	87.0	87.2	89.4	90.1	90.2	90.6	91.5	87.7
Settling time 20 mins	82.6	83.6	85.5	86.6	87.3	89.8	89.8	90.0	90.6	91.5	87.7
Settling time 40 mins	82.5	83.2	85.5	86.6	87.2	89.3	89.8	89.6	90.6	91.3	87.6
Settling time 1hr 00	82.4	83.1	85.4	86.6	86.6	89.1	89.8	89.6	90.6	91.3	87.5
Settling time 1 hr. 20 mins	82.4	82.9	85.4	86.5	86.1	88.8	89.6	89.6	90.3	91.3	87.3
Settling time 1 hr. 40 mins	82.2	81.6	85.4	86.3	85.8	88.4	89.5	89.5	89.8	91.3	87.0
Settling time 2 hr. 00	82.0	81.5	85.3	86.3	85.7	88.1	89.5	89.5	89.5	90.8	86.8
Settling time 3 hr. 00	81.8	81.5	85.0	86.2	85.6	87.9	89.3	89.5	89.4	90.7	86.7
Settling time 4 hr. 00	81.7	81.5	85.0	86.2	85.6	87.9	89.3	89.4	89.4	90.7	86.7
Settling time 5 hr. 00	81.7	81.5	85.0	86.2	85.6	87.9	89.3	89.4	98.4	90.7	86.7
Settling time 6 hr. 00	81.7	81.3	85.0	86.2	85.6	87.9	89.3	89.4	89.4	90.7	86.7

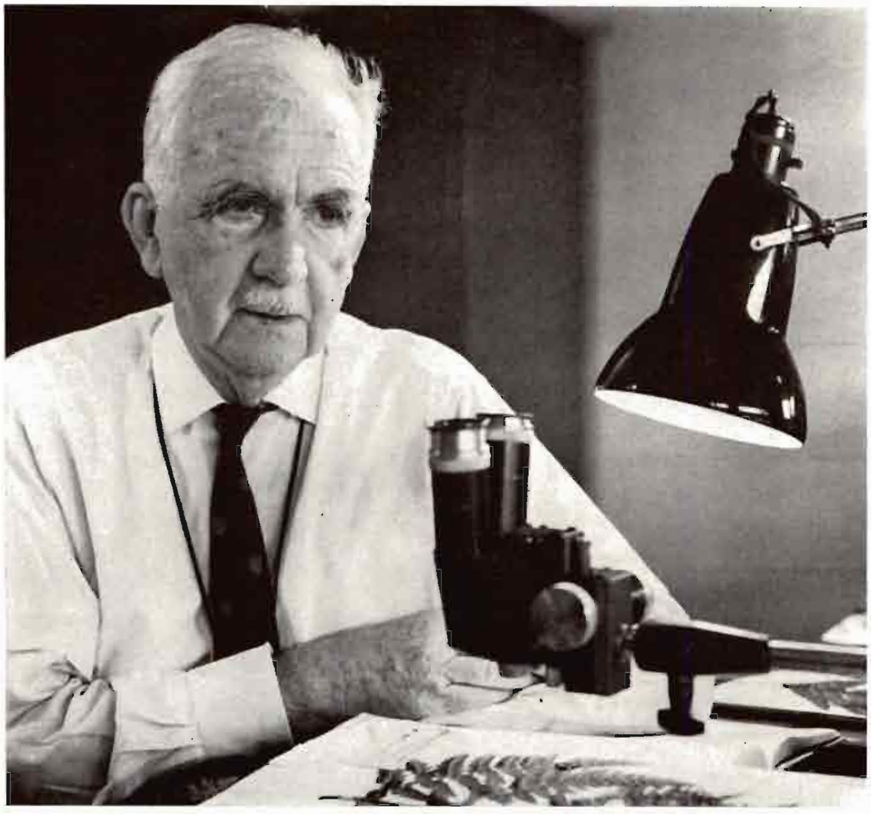
Centrifugation prior to Brix determination should be the best procedure to follow but sugar factory laboratories would have to be equipped with appropriate centrifuges if the method were to be adopted. For the time being, therefore, the best practical procedure would be to allow the molasses solution to stand for at least 3 hours before reading the Brix.

It should also be pointed out that the Brix spindles used should have been correctly standardized and that the height of the hydrometer jar should exceed the total height of the spindle by at least three inches. With many molasses the suspended solids settle loosely at the bottom of the jar where they may sometimes occupy a depth of several inches. If the tip of the spindle plunges into this layer a serious error may result.

Finally, it should be recalled that whereas the Brix reading of a pure sucrose solution diluted 1 :1 wt/wt is exactly one-half that of the original because the contraction upon dilution is taken into account in the graduation of the spindle, in impure solutions like those of final molasses a higher result is always obtained because the contraction is greater than in pure sucrose solutions of the same original density. According to BROWNE and ZERBAN (1948), the average correction to be applied to the Brix found by double dilution is —2.0 for Cuban final molasses. In Mauritius the average correction has not been worked out, but it is customary to deduct from the Brix of the diluted solution, corrected for temperature and multiplied by 2, a correction equivalent to 1.75 per cent of the Brix thus obtained.

REFERENCE

BROWNE, C.A. and ZERBAN, F. W. (1948). Physical and chemical methods of sugar analysis. New York, John Wiley & Sons Inc. p. 79.



Dr. R. E. VAUGHAN, O.B.E.,
Curator, Mauritius Herbarium

APPENDIX

THE MAURITIUS HERBARIUM

R. E. VAUGHAN

This year marks the 10th anniversary of the foundation of the Mauritius Herbarium. For this reason the first part of the Annual Report will be concerned with the origins, evolution of herbaria in Mauritius, and the organization and functions of the Herbarium at the present time.

I. ORIGINS AND EVOLUTION

The eighteenth and early nineteenth century naturalists who visited the Mascarene islands, including Commerson, Aubert Dupetit-Thouars, Willemet and others, made extensive collections of Mascarene plants which were eventually taken to Europe and distributed to various national herbaria.

About 1819, the Austrian naturalist and traveller, Franz Wilhelm Sieber, set about organizing an expedition to East Africa and Madagascar. For this purpose he selected two young botanists, Charles Hilsenberg of Erfurt with Wenceslas Bojer as his assistant. They arrived in Mauritius in 1821. Three years later, Hilsenberg died suddenly in Madagascar, but Bojer was persuaded to stay on in Mauritius and continue his studies in natural history. In 1829 he became a foundation member and vice-president of *the Société d'Histoire Naturelle de l'Ile Maurice*, now styled the *Royal Society of Arts & Sciences of Mauritius*, and formed a close friendship with a resident of Mauritius and dedicated naturalist, Louis Sulpice Bouton. Bouton was also a foundation member of the Royal Society and its devoted Secretary for nearly forty years. The Bojer-Bouton collaboration, lasting for more than twenty years, led to the formation of the first local herbarium, called the "Colonial Herbarium", and housed in the old Royal College, Port Louis.

Their work was supplemented by Philip Burnand Ayres who, for six years, held various Government medical posts in Mauritius. Ayres died in 1863 while he was compiling a comprehensive descriptive list of Mauritius plants; six volumes of his manuscripts are now in the library of the Mauritius Herbarium. The collections, botanical notes and publications of Bojer and Bouton together with Ayres papers, formed the main material which J. G. Baker used in the preparation of his *Flora of Mauritius and the Seychelles* published in 1877. Later in the century, Colonel Henry Halcro Johnston (in Mauritius, 1887-1890), investigated the flora of the islets round the coast of Mauritius and made an attempt to fill up some of the many gaps in Baker's flora. The Mauritius Herbarium possesses many of his carefully annotated herbarium specimens. John Horne, for ten years Director of Woods, Forests and Gardens (1880-1890), directed his botanical work mainly to studying the vegetation of the Seychelles and the islets of Mauritius.

Apart from the work of Johnston and Horne, interest and research concerning Mascarene vegetation, instead of being stimulated by Baker's *Flora*, seems to have been virtually eclipsed for many years. Indeed, even today, one hundred years later, many monographs on plant genera including revisions of Engler's

Pflanzenreich do not quote any material other than that collected by the Bojer-Bouton-Ayres trio. Baker himself may have contributed to the idea that, with the publication of his Flora, there was little more to be done. In his introductory notes he says "He (Bojer) explored the botany of the island so thoroughly that he left very little for his successors to discover... " This rather hasty prediction has proved very wide of the mark ! Baker never visited the Mascarene islands and probably conceived a kind of homogeneous plant cover over the whole island, whereas there are scores of different micro-climates and ecological situations, each with its highly specialized floristic composition.

To return now to the fortunes (or rather the misfortunes) of the Colonial Herbarium. About 1868 the Herbarium was transferred from the Royal College, Port Louis, to a building in the Royal Botanic Gardens Pamplemousses, then under the enlightened direction of James Duncan who was struggling to restore and revitalize the Gardens after many years of neglect. This step was a logical one in certain respects. Many National Botanic Gardens and Herbaria have grown up together, Kew perhaps being the most famous example of this collaboration.

Unfortunately, an ill-considered trend in policy concerning the objectives and aims of the Colonial Herbarium was taking place. The plants of Mauritius, being of great interest and novelty, were eagerly accepted by overseas Herbaria. This distribution in itself was highly commendable because it made the flora of the island more widely known. But the nature of the material received in exchange was not planned or directed. The result was that the Colonial Herbarium became swamped with a mass of exotic specimens of little regional value or significance. Moreover there was no trained official directly responsible for the maintenance and preservation of the Herbarium.

In 1879 the Royal Botanic Gardens were extended to include the adjacent Mon Plaisir buildings and grounds which supplied, according to the official report "... additional accommodation for the Library, Herbarium and Offices; the former available space being altogether inadequate, and practically rendered all progress impossible." Ten years later, however, the rapid deterioration and neglect of the Herbarium was revealed in the Annual Report on the Gardens. This resulted in the appointment of a member of the Forests & Gardens staff, Mr. Fernand Bijoux, to be employed in the Herbarium.,

> "... overhauling, cleaning, repoisoning and mounting botanical specimens. A large number of these specimens had not been poisoned or mounted properly and many of them were in a dilapidated state. Some of them were so decayed that only small portions of them could be kept."*

However, Fernand Bijoux's painstaking efforts were soon to be interrupted. Early in 1899 a patient at the former public hospital at Powder Mills, Pamplemousses, died of bubonic plague. The Mon Plaisir building was commandeered at twenty-four hours' notice as a segregation centre. The Library, Museum, and Herbarium were hurriedly moved to the Director's house and the Herbarium later thrown into the nearby parsonage of St. Barnabas. Little more is heard of the Herbarium until 1903 when the Director of Forests & Gardens reported that attempts were being made at its restoration. A Keeper of the Herbarium, Miss R. Dagorne, was appointed to undertake this work; her salary Rs. 12 (eighteen shillings) per mensem. The Keeper worked under the supervision of Fernand Bijoux who was probably one of the very few persons at this time with a working knowledge of, or interest in, the local vegetation. In 1913 the Department of Agriculture was created and the Royal Botanic Gardens, together with the remnants of the Botanical Museum and Herbarium, handed over to its care.

The Mauritius Institute (Public Library and Museum) Port Louis now comes into the picture. In 1928, a Museum Reorganization Committee was appointed and two of its recommendations, finally accepted, are the direct concern of this Report. These were (i) to form a regional museum with special emphasis

* SCOTT, William. Report on the Gardens for the year 1890 : 7.

on the educational, cultural and scientific importance of Mascarene natural history; (ii) to set up a botanical section, including a herbarium of Mascarene plants.

At this time it must be noted that the Museum had no trained technical or professional staff and was run on a "voluntary helper" basis. The writer offered, in his "spare time", to organize the botanical section, and it was agreed that the Mascarene specimens still surviving at the Royal Botanic Gardens, Pamplemousses, should form the basis of the new Herbarium. The rather tedious work of sorting out the material at the Royal Botanic Gardens Herbarium took some years to complete and had to be done with care as many specimens were types collected by Bouton and Bojer. The large number of exotics were distributed to interested Herbaria overseas. On one occasion when a parcel of specimens was being removed from a cupboard a large gravid rat jumped out. It seemed sad to disturb her because it would probably have been the first record of a rat having her brood in a herbarium cabinet. Eventually the work was completed and the Herbarium became an integral part of the Mauritius Institute Museum. During the Second World War progress was very slow. The writer was immersed in war duties and, owing to an enemy presence in this part of the Indian Ocean, the Herbarium was packed up and sent back to the Royal Botanic Gardens for the duration of the war as a precautionary measure.

In the meanwhile two other Institutions had begun the formation of herbaria to serve their special needs. These were the Department of Agriculture and its offspring the Sugar Cane Research Station which was replaced later by the Mauritius Sugar Industry Research Institute. In 1958 it was proposed that these two herbaria and that of the Mauritius Institute and Public Museum should be combined and transferred to air-conditioned quarters at the newly founded Sugar Industry Research Institute. The Department of Agriculture agreed to make a grant to the Institute to assist in defraying essential expenses and financial commitments. These arrangements were finally approved and the work of transferring and combining the three herbaria was completed two years later when, in 1960, "The Mauritius Herbarium" came into being.

Finally at the end of the current year an important change was made in the status of the Herbarium. The Executive Board of the M.S.I.R.I. decided that the Herbarium should become fully integrated with the Botany Division of this Institute, the Botanist in charge assuming the post of Curator. In this way it was considered that the future and security and expansion of the Herbarium would be ensured and its value as a centre of education and research be preserved. In view of the many problems and complexities yet to be tackled in the field of studies of Mascarene vegetation, it was agreed that the retiring Curator, Dr. R. E. Vaughan, should continue to act in a consultative capacity.

II. THE MAURITIUS HERBARIUM TO-DAY (1969)

A quick glance may now be taken at the work and policy of the Mauritius Herbarium at the present time. The Herbarium is strictly regional in character covering the three Mascarene Islands, Réunion, Mauritius and Rodriguez, and the small islet dependencies of Mauritius to the north including St. Brandon and the Chagos Archipelago. The range of material is all-embracing, though some sections are more advanced than others owing to individual preferences or to research by workers in Mauritius or overseas on special genera or families. The Herbarium at the time of writing comprises about 17,000 sheets supported by carpological collections and microscope slides.

The Herbarium library has taken many years to assemble and comprises a unique collection of books, original papers, manuscripts and field notes which are irreplaceable. Mention of a few of the precious holdings may be made here. These include the Ayres manuscripts (already referred to on page 157); an album of water-colour sketches of Réunion orchids executed by Mme. Eudoxie de Cordemoy, wife of the author of *Flore de l'Ile de la Réunion*; a collection of paintings of indigenous Mauritius plants by Mme. de Chazal-Moon used by Baker in the preparation of his *Flora*, and photostats of Philibert Commerson's copious and unpublished notes on Mascarene vegetation from the Library of the Museum National d'Histoire Naturelle, Paris. Recently a map section has been formed covering the Mascarene area and the islands of the South-West Indian Ocean illustrating geology, soils, topography and vegetation; included also are Admiralty Charts of the region.

An important function of the Herbarium is to gather and disseminate information concerning Mascarene plants; it follows that field studies and collection of plant material are given high priority. Each of the Mascarene Islands has its own special problems.

(i) In Mauritius, part of the field work is organized on a definite plan. A number of special sites each supporting a high proportion of indigenous vegetation are visited at different seasons. All individual plants within these areas can eventually be recognized or marked by suitable labels. In this way, flowers and fruits can be obtained from the same specimen, its habit and annual life cycle noted. In addition, some material of various kinds comes to the Herbarium from institutions or through the efforts of private collectors. The need in Mauritius to step up field work is important because the indigenous vegetation is gradually being eliminated. The Nature Reserves are useful, as they give a breathing space during which some aspects of the vegetation can be studied; but even in these areas deterioration is all too evident. On the whole, the outlook for the indigenous plant life is gloomy so that emphasis must now be placed on preservation of good herbarium material rather than conservation in the field.

(ii) In the case of Rodriguez it is usually possible to mount an expedition once or twice a year and valuable co-operation is obtained from the Forest Department which has a permanent resident officer on the island. It must be said here that some of the endemic plants are probably extinct. On the other hand, critical material of new or little known species has been obtained in recent years.

(iii) The island of Réunion presents special difficulties and problems. Fortunately a dedicated student of natural history resident in Réunion is now working in co-operation with the Mauritius Herbarium, and a steady trickle of material is coming in. This has been augmented during the past few years by important collections made by visitors to the island using Mauritius as a base. In Réunion the terrain is a challenge to the plant hunter and mountaineer alike. Field work often involves negotiating ravines and gorges four thousand feet deep. Some of these isolated ravines, "enjoying" a rainfall estimated at more than 350″ p.a., are botanically more or less *terra incognita*.

On arrival at the Herbarium the specimens are placed in a specially designed heater to ensure quick drying as the material is mostly woody or succulent. In certain difficult cases, hot water or formol treatment is used. When the specimen has been dried, poisoned, mounted and labelled, it is given a serial number and entered in an Accession Book. Experience has proved that in smaller herbaria this method of registration is essential and a great help to research workers who may be confused by symbols, letters and numbers used by different collectors. About 400-600 sheets are "laid in" every year.

Some hundreds of specimens are brought to the Herbarium in the course of the year by schools and other institutions. Much of this material, usually common weeds or cultivated plants, can be named without difficulty*. But

* The naming of common plants in the island by the Herbarium fulfills a wish expressed by the Director of the Royal Botanic Gardens, Kew, as long ago as 1884. The following passage from a despatch from Secretary of State for the Colonies, Lord Derby, is worth recording ;
..."The institution of such local herbaria in connection with the various Colonial Botanic Gardens is a work of the highest utility. Without an institution of this kind we are burdened with the task of naming and identifying for our correspondents year after year the same plants. Their preservation at each botanical centre of accurately named types of the vegetation of their respective countries obviate this task and sensibly relieves our overburdened correspondence..."
Extract from a letter from the Director of Kew Gardens to the Colonial Office, dated 30th of October, 1884.

in the wonderful climate of Mauritius almost any plant in the world can be grown. The identification of these cultigens is often beyond the resources of the Herbarium and such material has to be sent overseas for examination by large National Herbaria.

The Mauritius Herbarium is often called upon to advise schools and educational authorities on plants and regions suitable for study in connection with overseas examinations. A long overdue change has recently been noticed in these schedules, the emphasis now being placed on testing the examinee's knowledge of the plant life in his own country rather than on more abstract or theoretical principles. The task of preparing these programmes and organizing the fieldwork required is rendered much more difficult by the lack of any guide or recent flora of the region.

A welcome result of modern air communications is that naturalists and botanists are now visiting Mauritius in ever-increasing numbers. The Mauritius Herbarium is required to host these visitors and arrange excursions to places of botanical interest. Visitors usually find it convenient to leave their collections at the Herbarium for processing and preliminary determinations, after which they are despatched to the collector. In some cases living plants have to be sent overseas; this involves the Herbarium in the evergrowing complexities of phyto-sanitation and the permits and regulations required for different countries. As the work of the Herbarium becomes better known, so the request for material on loan or for duplicates increases, a kind of botanical Parkinson's law. This trend has been very marked in recent years. It is a basic policy of the Mauritius Herbarium to make a wide distribution to the national herbaria of the world. In return, an expert opinion is obtained concerning the species. This is the appropriate place to express warm thanks to the many specialists the world over who have added immensely to the value of the Mauritius Herbarium collections by their co-operation and critical determinations.

Two functions undertaken by the Curator must be mentioned here :

(i) He is an ex-officio member of the recently constituted Royal Botanic Gardens, Pamplemousses, Advisory Committee. The Herbarium has undertaken the determination of the unknown species in the Gardens, to organize the labelling of the plants and the construction of a revised working plan. The Curator has agreed to contribute the botanical section of a guide book to the gardens now in preparation.

(ii) The Herbarium has a direct interest in Nature Reserves. These are visited as often as possible and recommendations made to the appropriate authorities concerning their management and extension.

The Herbarium is collaborating with the Sugar Industry Research Institute in the publication of a *Weed Flora*, with particular reference to those aggressive weeds which are a nuisance value in cane cultivation. Each weed or group of weeds is illustrated, and the text comprises a botanical description together with notes on ecology and methods of control. Up to the present, accounts of seventeen weeds have been published out of a projected number of twenty-five to form the first series.

In concluding this section on the Mauritius Herbarium to-day, it must be mentioned that the Curator, in addition to the routine duties enumerated above, will himself be engaged on the many pressing problems in taxonomic and ecological research which need to be tackled.

III. TOWARDS A FLORA OF THE MASCARENE ISLANDS

The three "official" floras of the Mascarene Islands were all published during the XIXth century; they may be very briefly reviewed here in chronological order :

(i) J. G. BAKER, *Flora of Mauritius and the Seychelles* (1877). This was one of a series of "Colonial" floras initiated at Kew, ranging from Hong Kong and British India to Tropical Africa and Australia and other countries. As already mentioned above, Baker did not visit the Mascarene Islands. It is not clear from his Preface whether he consulted the collections of Philibert Commerson whom he rightly calls the "father of Mauritian Botany." It may be inferred that he did not do so, though a careful study of Commerson's material is essential to unravelling the many taxonomic and nomenclatural problems concerning Mascarene plants. Baker's *Flora* is not illustrated and includes little more than half the indigenous and adventive species now known to occur in Mauritius.

(ii) I. B. BALFOUR. *Botany of Rodriguez* published in the *Philosophical Transactions of the Royal Society* Vol. 168 (extra volume) 1879. Balfour took part in the Transit of Venus Expedition to Rodriguez in 1874. Four months (August-December) were spent on the island and, as Balfour says, the party had plenty of time to explore its 55 square miles. Unfortunately most of this period included the dry season, and many indigenous plants only come into flower during, or at the end, of the summer rains.

(iii) E. JACOB de CORDEMOY. *Flore de l'Ile de la Réunion* (1895). Cordemoy's situation was the exact opposite of that of Baker. He was unable to leave St. Denis where he had a medical practice, and while compiling his flora he relied entirely on correspondence he had with botanists in France and elsewhere. Over 100 pages of his flora are devoted to elaborate descriptions of orchids prepared with his friend Charles Frappier. The rest of his work is very uneven with no proper keys and very scanty accounts of the new species he created. Some of those were based on leaves only, or on plants seen in the field of which no specimen can be traced. Part of his herbarium appears to have been unearthed at Marseilles and its study may help to solve some of these problems. The two floras of Baker and Cordemoy cannot be used as companions. On the contrary, the same plant is often given different names, or placed in different genera, and in other cases when the name of the plant is the same it proves to be a different species ! These floras are now very rare or extremely expensive placing them (perhaps fortunately) outside the reach of most institutions and individuals.

It is not necessary to write at length on the obvious and urgent need for a modern flora of this region and the many useful purposes it would serve in the fields of education, technology, and scientific research. Teachers and lecturers in schools and colleges complain of their difficulty in studying the local vegetation and interesting their pupils therein because of the want of any guide to the origins, status and uses of Mascarene plants. This important question has already been mentioned above in connection with examination schedules.

The needs of the amateur plant lover or naturalist must not be overlooked. A modern flora would stimulate an interest in the peculiar and fascinating plant life of the region, and help to bring home to the community the urgent need for conservation and protection of what remains.

The lack of a flora is felt by agronomists and field-workers now engaged in many schemes mounted by F.A.O. and other bodies connected with land use, development projects and the like. A standard reference work on the vegetation of Mauritius is needed by research workers the world over in many fields such as systematics, tropical plant ecology and plant geography.

The three Mascarene Islands, Réunion, Mauritius and Rodriguez form a natural phytogeographical unit and the contrasts and relationships of their vegetation are highly significant. The importance of Mascarene vegetation is far greater than the superficial area of the three relatively small islands suggests. A glance at the map shows that they are subjected to the south-east trade winds for the most part of the year and they lie in the path of the westerly flowing south-equatorial current. Furthermore, the three islands are geologically of different ages, Réunion being relatively young with an active volcano and a central peak rising to 10,000 ft., Mauritius middle-aged, perhaps 8,000,000 years; Rodriguez relatively ancient. In addition therefore to problems of plant dispersal and distribution which these facts present, the comparative study of vegetation in the three islands could yield results of great significance in the fields of speciation and evolution.

While this report was going to press, plans were initiated for the preparation of a *Flora of the Mascarene Islands* in collaboration with members of O.R.S.T.O.M. (*Office de la Recherche Scientifique et Technique Outre-Mer*) who have shown the greatest keenness and enthusiasm for the publication of a bilingual flora embracing the three Mascarene Islands. There are many financial and technical problems to be tackled which are now under careful and active review. There is no doubt that with the sympathetic co-operation and support from all parties concerned this project will be successfully launched in the near future.

IV. REPORT FOR 1969

Accessions. During the year under review 721 herbarium specimens were laid in.

These may be summarized as follows :

Mauritius	486
Réunion	168
Cargados Carajos (St. Brandon) & Tromelin Island ...	67
	721

The Réunion material was mostly collected by Sir Colville Barclay and Mr. L. F. Edgerley during a visit to the island in November, 1968. Among the more interesting material from Réunion were some good specimens of rare and little known species such as the endemic monotypic *Maillardia borbonica* (Moraceae), and the peculiar epiphytic *Medinilla loranthoides* (Melastomataceae).

Field work. A visit to Rodriguez was organized in December, sixteen days were spent studying the vegetation of the Coral Plain, the offshore islets and the remnants of indigenous vegetation on Grande Montagne. Seventy-nine species of flowering plants were collected, fifty-seven of these being indigenous. This material is now under examination and a detailed report will be submitted later.

The Perrier Nature Reserve. During the year an important cleaning and weeding operation was started by the Forest Department in the small nature reserve at Perrier near the Mare aux Vacoas, and the Curator undertook to assist in supervising the work. This area had become badly overrun with exotics such as *Psidium* ("Guava") and *Rubus* which were suppressing the germination of indigenous plants and forming an impenetrable thicket of exotic weeds. Judging by the progress so far made and the high concentration of indigenous seedlings revealed, it is possible that, if the work can be maintained, a good restoration and reconstitution of the vegetation approaching its original form will come about. Further, many of the small tree species cut by marauders are showing signs of regeneration and forming coppice shoots. The Perrier Reserve is botanically of great interest. In a small area of less than four acres there is remarkable richness and diversity of small indigenous trees and shrubs closely packed together and comprising more than seventy-five different species, some on the verge of extinction. There are also beautiful clumps of the endemic *Pandanus eydouxia.* Formerly common in open indigenous woods and thickets in the uplands, this species is now disappearing and Perrier is one of the few remaining sites where its life-history and ecology can be studied.

Much time during the year has been devoted to the study of genera in the family *Sapotaceae.* This family comprises a high percentage of the large canopy trees in both medium altitude and upland forests in Mauritius and Réunion. In former times, when they were more abundant, they were much prized as timber for construction and cabinet making. Some genera have an important place in the plant succession from early stages to the climax forest.

It is surprising that their relationships and taxonomy are so confused. This is partly due perhaps to the very inadequate herbarium specimens in overseas institutions, the lack of critical field studies and the great variation in a single species, particularly in leaf and fruit morphology. Complications also arise because the vernacular names used in Mauritius and Réunion do not correspond and the same name may refer to different species.

The material found during the excavations made in the Mare aux Songes in the last century revealed, in addition to Dodo and Tortoises' bones, a quantity of sub-fossil hard woody seeds very much resembling those of

Calvaria major Gaertn. (Tambalacoque) but about half the size. These were given the name *Calvaria hexangularis* Gaertn. and it was supposed that the tree which yielded them was extinct. Now it has been found that these seeds are those of a tree called *Sideroxylon longifolium* DC., common on the southern mountain slopes of the island.

Fruiting material, hitherto unknown, of another species of Sideroxylon, *S. boutonianum* A. DC. common in the lowlands, has been gathered from a tree growing on Ile aux Aigrettes; the seed is about the size of a pea and is surrounded by a hard Calvaria-like endocarp.

Some authentic material of *Cyperus esculentus* L. was received from Dr. S. T. Blake, Queensland Herbarium, Australia, for comparison with Mascarene varieties of the common "nutweed", *Cyperus rotundus* L. Professor Harold St. John, Bernice P. Bishop Museum, Honolulu, Hawaii, kindly presented the Herbarium with some species of Mascarene *Pandanus* collected when he was visiting the Mascarene Islands in 1961. Among this material was a good example of the rare Réunion species *P. sylvestris* Bory, an important addition to the Pandanus collections in the Herbarium.

Determinations and distribution of material. An increasing flow of material has been sent overseas to research workers and institutions, a brief summary of which is given here. To Dr. C. M. Calder, University of Melbourne, 100 plants of *Poa annua* for studies in its variation and adaptation to different environments; eleven species of marine algae from ten genera to Dr. H. B. S. Womersley, Department of Botany, University of Adelaide; specimens of flowers of the diœcious indigenous tree *Psiloxylon mauritianum* to Dr. Alan Graham, Kent State University, U.S.A. for pollen studies; specimens of the red alga *Grateloupia filicina* to Dr. W. F. Farham, Portsmouth College of Technology for comparison with plants of the same species growing in temperate seas; flowering material of indigenous *Hibiscus* spp. to the Director, Arnold Arboretum, Harvard University; seeds of *Coffea mauritiana* for the Kawanda Research Station, Kampala, collected by Dr. D. J. Greathead.

About two hundred specimens were brought to the Herbarium for determination by interested persons or by schools and other institutions. In addition, examination and naming of 37 marine algae from Réunion and Madagascar was made for Mr. G. Faure, Centre d'Enseignement Supérieur Scientifique, St. Denis, Réunion, and Mr. Y. Cabanis, Tananarive, Madagascar. Determinations of a batch of plants were gratefully received from the Herbarium, Royal Botanic Gardens, Kew. These comprised indigenous species in the difficult genera *Gaertnera* (Rubiaceae) and *Pilea* (Urticaceae) and some exotic trees cultivated in the Royal Botanic Gardens, Pamplemousses. The latter included two species of *Crataeva*, *Lafœnsia vandelliana* related to the well-known genus *Lagerstrœmia*, *Aphanamyxis polystachya*, a beautiful shade tree with large leaflets and orange red seeds known in Mauritius as "Amoora"

Visitors. In March, Mr. J. Bogner of the Munich Botanical Gardens, was able to come here for a few days after a trip to Madagascar. At the Herbarium he was particularly interested in fresh water angiosperms and their relations to the Malagasy species.

Dr. H. B. S. Womersley, Botany Department, University of Adelaide spent some time in Mauritius in June, collecting and studying marine algae.

In July, Dr. D. R. Stoddart, Department of Geography, Cambridge University who is a member of the Royal Society of London's Aldabra Research Committee and leader of the Society's expedition to Aldabra was able to spend eight days in Mauritius. He attended a meeting of the Council of the Royal Society of Arts and Sciences of Mauritius and gave valuable advice and suggestions concerning the protection and conservation of wild-life in the area, with particular reference to the difficult and pressing case of Round Island.

Later Dr. Stoddart gave a conference on the aims, objectives and progress of the Royal Society's Aldabra project. He invited naturalists and research workers in Mauritius to visit Aldabra where specialized techniques are used for investigating the ecology of the wild-life thereon.

In August, Prof. C.A. Schroeder, Department of Botanical Sciences, University of California, spent three days in Mauritius. He visited the Nature Reserves and studied in the field and in the Herbarium various plants of economic value. Mr. Alister Baxter, Institute of Geology, Edinburgh, worked from August to November on a geological project sponsored by his University. The Herbarium staff was able to assist him in his field-work by acting as guides to various sites of geological interest. Mr. J.S.L. Gilmour, Director, University Botanic Garden, Cambridge, was able to make a day's stop-over in Mauritius in September. He managed to visit some of the Nature Reserves in the uplands and the Royal Botanic Gardens, Pamplemousses.

Concluding this section on visitors to the Herbarium, we are glad to mention the interest shown by overseas delegations of teachers and students from Réunion and Madagascar, as well as of delegates of the *Comité de Collaboration Agricole, Madagascar—Maurice—Réunion*, whilst on a general visit to the Mauritius Sugar Industry Research Institute.

Publications. An annotated list of original papers, books and reports of special interest to students of Mascarene vegetation received by the Herbarium Library during the year is given below :

BLAKE, S. T. (1942) *Cyperus rotundus* (Nut Grass) and its allies in Australia. *University of Queensland. Department of Biology Papers*, **2** (2) : 1-14.

BROUARD, N. R. (1968). Annual Report of the Forest Department for the year 1967. Port Louis, Mauritius, Government Printer.

DE CORDEMOY, E. Jacob (1891). *Flore de l'Ile de la Reunion.* Fascicule I, *Cryptogames Vasculaires* (Fougères, Lycopodes, Sélaginelles), Saint-Denis (Réunion). Ce fascicule est accompagné de planches, représentant les caractères des genres, dessinées et lithographiées par Madame Eudoxie Jacob de Cordemoy.

An extremely rare item and a precursor to the author's, *flore de l'Ile de la Réunion* published in 1895.

DE CORDEMOY, E. (1899). *Révision des orchidées de la Réunion. Revue gén. Bot.* **2** : 409-430, pl. 6-11.

The illustrations were prepared from water-colour sketches made by Mme. Eudoxie de Cordemoy, wife of the author.

KUNIKAZU UEKI (1969). Studies on the control of Nutsedge (*Cyperus rotundus* L.). On the germination of a tuber. *Second Asian-Pacific Weed Control Interchange, University of Philippines.*

MONTAGNE, C. & MILLARDET, M. (1862). Botanique, Cryptogamie, Algues. Annexe O, 1-25, with coloured plates XXIV - XXVII.

In *Notes sur l'Ile de la Réunion* by L. Maillard. Editor, Dentu, Paris 1862.

SCHLIEBEN, H. J. (1967). Sammelreise zu den Maskarenen-Inseln. *Der Palmengarten* **31** (7) : 107-110; *et seq.*

An account of a plant-hunting expedition to Mauritius and Réunion in 1966.

STONE, B. C. (1967). Carpel number as a taxonomic criterion in *Pandanus. Am. J. Bot.* **54** (8) : 939-945.

STONE, B. C. (1968). Morphological studies in *Pandanaceae.* I. Staminodia and Pistillodia of *Pandanus* and their hypothetical significance. *Phytomorphology*, **18** : 498-509, text figures 1-4.

A revealing research into the origin and evolution of the *Pandanus* inflorescence. Refers to several species, endemic in Mauritius, in which staminodia and pistillodia have been found.

STREETS, R. J. (1962). *Exotic Forest Trees in the British Commonwealth.* Oxford, Clarendon Press.

TAYLOR LT. A. J. (1833). Account of the ascent of the Peter Botte Mountain, Mauritius, on the 7th September, 1832. *J.R. Geogrl. Soc. Lond.*, **3** : 99-104.

TOUCHAIS, J. - M. (1956). *Contribution à l'Etude de l'Aphloia de Madagascar.* Le Havre, (Thèse Doct. Univ. (Pharm.) Paris).

A botanical and biochemical survey of *Aphloia theiformis* Benn. and its varieties. Very common in upland woods and thickets in Mauritius where it is known as "Bois Fandamane".

STATISTICAL TABLES*

* *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°
AVERAGE TEMPERATURE °C JUL.	21.0°	20.5°	19.5°	19.0°	17.5°
CYCLONIC WINDS, greater than 30m.p.h. during 1 hour	December to May				
PEDOLOGY Great Soil Groups	Soil Families				
Low Humic Latosol	« Richelieu »	« Richelieu » « Réduit »	« Réduit » « Bonne Mère »	« Réduit »	« Réduit » « Ebène »
Humic Latosol	—	« Rosalie »	—	« Riche Bois »	« Riche Bois »
Humic Ferruginous Latosol	—	—	« Sans Souci »	« Belle Rive » « Sans Souci » « Midlands » « Chamarel »	« Belle Rive » « Sans Souci » « Midlands »
Latosolic Reddish Prairie	« Médine »	« Labourdonnais » « Mont Choisy »	« Mont Choisy »	« Labourdonnais » « Mont Choisy »	« Médine »
Latosolic Brown forest	—	—	« Rose Belle »	« Rose Belle » « Bois Chéri »	« Rose Belle » « Bois Chéri »
Dark Magnesium Clay	« Lauzun » « Magenta »	« Lauzun »	—	—	—
Grey Hydromorphic	« Balaclava »	« Balaclava » « St. André »	« Balaclava »	—	—
Low Humic Gley	—	—	« Valetta »	—	« Valetta » « Petrin »
Lithosol	—	« Melleville »	« Pl. des Roches » « Melleville »	« Melleville »	—
IRRIGATION	Common	Some	Rare		
APPROXIMATE AREA 1000 arpents Sector	56	91	72	160	63
APPROXIMATE AREA 1000 arpents Cane	12	54	47	65	27
CANE PRODUCTION 1000 metric tons (1969)	382	1459	1393	1799	791
SUGAR PRODUCTION 1000 metric tons (1969)	49	169	155	206	90
SUGAR FACTORIES production in 1000 metric tons 1967-1969	Médine 50	Belle Vue 33 Mon Loisir 30 St. Antoine 27 Solitude 25 The Mount 24 Beau Plan 23	Union Flacq 74 Beau Champ 34 Constance 29	Savannah 31 Mon Trésor 27 Riche en Eau 24 Rose Belle 24 Union 22 Bel Ombre 18 Britannia 20 St. Félix 14 Ferney 13	Mon Désert 38 Highlands 23 Réunion 22

Table II. Area under sugar cane in thousand arpents(1), 1961 - 1969

Year	Area under cane Island	Area reaped					
		Island	West	North	East	South	Centre
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	203.02	189.25	12.34	50.58	42.29	59.88	24.14
1969(2)	203.00	188.49	12.35	50.33	42.46	59.64	23.71

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), 1961 - 1969

Crop Year	No. of factories operating	Av. Pol.	Island	West	North	East	South	Centre
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	23	98.8	596.5	49.5	161.3	117.8	192.1	75.8
1969(2)	22	98.8	668.7	48.7	168.6	155.4	205.5	90.5

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), 1961 - 1969

SECTORS	1961	1962	1963	1964	1965	1966	1967	1968	1969(2)
ISLAND									
Millers	32.2	28.0	35.1	26.2	35.7	29.5	35.3	31.2	36.1
Planters	20.5	19.5	23.7	18.5	25.3	19.5	24.7	22.8	25.2
Average	26.4	23.9	29.6	22.4	30.7	24.7	30.3	27.2	30.9
WEST									
Millers	35.3	31.8	37.8	32.3	43.5	35.9	40.3	37.0	35.2
Planters	23.4	22.7	27.8	25.0	34.7	28.5	29.8	30.3	26.5
Average	27.8	26.2	32.1	28.1	38.9	32.1	35.0	33.7	30.9
NORTH									
Millers	29.2	31.1	35.0	29.0	35.5	28.6	37.7	34.1	36.1
Planters	20.6	21.4	24.0	19.2	24.4	17.8	24.6	24.4	24.9
Average	23.5	24.7	27.8	22.5	28.2	21.5	29.3	27.8	29.0
EAST									
Millers	32.7	29.0	37.6	28.0	39.0	31.1	36.0	29.5	40.7
Planters	17.9	17.1	21.3	16.0	23.5	18.8	23.0	19.6	24.8
Average	24.4	22.5	28.9	21.5	30.9	24.8	29.5	24.6	32.8
SOUTH									
Millers	31.7	27.8	33.4	24.5	33.2	29.3	33.3	30.3	33.0
Planters	20.8	20.1	24.6	18.7	25.7	21.0	25.2	22.2	24.7
Average	28.3	25.5	30.7	22.7	30.9	26.6	30.7	27.7	30.2
CENTRE									
Millers	36.7	22.1	36.2	23.3	35.7	26.4	34.7	30.2	38.1
Planters	23.7	15.8	24.1	16.9	25.5	18.6	24.3	21.0	27.0
Average	30.8	19.3	30.8	20.5	31.2	23.0	30.2	26.3	33.4

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), 1960 - 1969

Crop Year	Island	West	North	East	South	Centre
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	11.58	11.91	11.47	11.34	11.59	11.96
1969(2)	11.48	12.77	11.56	11.15	11.42	11.44

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, 1960 - 1969

Crop Year	Island	West	North	East	South	Centre
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	3.15	4.01	3.19	2.79	3.21	3.14
1969(1)	3.55	3.95	3.35	3.66	3.44	3.82

NOTE: (1) *Provisional figures*

Table VII. Monthly rainfall in inches, 1954 - 1969. 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	0.36 9.83	0.00 14.12
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
1969	*3.39*	*4.24*	*3.01*	*8.11*	*7.93*	10.82	*5.82*	*2.79*	21.63	*7.19*	*4.25*	2.01	0.36	2.70

NOTE : To convert into millimetres, multiply by 25.4

Table VIII. Monthly mean maximum and minimum air temperatures, 1954 - 1969 as recorded at Plaisance Airport

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 1954-58	27.3	19.5	28.6	21.3	29.0	22.3	29.3	22.5	28.8	22.3	27.8	21.0	26.0	19.3	24.7	17.8	23.8	17.3	23.7	17.2	24.5	17.4	25.6	18.3
1954	27.5	20.0	28.1	21.6	29.3	22.5	29.5	22.6	29.0	22.1	27.6	21.8	26.3	20.9	24.5	18.1	23.9	18.6	24.1	18.0	24.4	18.4	26.1	18.0
1955	27.3	20.0	28.7	20.4	30.5	22.9	29.3	21.9	28.7	22.6	27.8	21.2	26.3	19.7	24.7	18.5	24.0	17.9	24.0	17.0	24.6	17.0	25.4	17.0
1956	27.8	19.2	28.1	20.8	29.2	22.1	28.6	22.1	28.6	21.6	27.4	20.0	26.0	20.3	24.3	17.4	23.9	16.0	24.5	16.4	25.8	17.5	27.4	18.6
1957	29.0	18.8	29.2	20.9	30.1	22.4	29.0	21.9	29.2	21.8	27.5	20.1	26.5	18.9	24.5	17.3	25.0	17.1	24.5	17.2	25.5	17.4	27.4	18.6
1958	29.0	18.6	29.7	21.8	28.5	22.6	29.4	22.6	29.1	23.1	28.6	22.9	25.7	19.0	24.3	17.3	23.8	16.1	24.4	17.3	25.5	17.0	25.7	18.3
1959	27.7	18.6	29.7	20.9	29.8	22.0	29.5	22.7	29.0	23.3	27.7	21.3	26.1	18.4	24.7	17.2	23.4	17.3	23.5	17.1	24.0	16.9	25.1	18.5
1960	26.3	21.1	28.4	21.4	28.8	22.2	28.7	23.1	28.1	21.6	27.4	19.8	26.5	19.3	24.7	18.9	23.3	17.0	23.9	18.3	23.8	18.3	24.8	18.6
1961	26.5	19.3	28.8	21.6	29.5	22.9	30.8	21.9	29.8	22.3	29.2	21.4	28.6	20.0	26.8	18.7	24.6	17.8	23.9	17.3	24.7	17.1	26.1	18.8
1962	27.6	20.0	28.3	22.5	28.9	22.4	29.5	22.7	29.4	22.7	27.6	20.3	25.7	19.0	24.4	16.1	23.8	15.6	23.4	16.5	24.7	18.0	25.1	18.7
1963	26.6	19.1	28.1	21.6	28.7	22.0	28.9	22.2	28.3	21.7	28.1	21.2	25.5	18.5	24.7	18.6	23.5	17.3	23.2	16.0	23.9	16.5	25.1	17.7
1964	26.4	20.0	28.0	20.9	29.3	22.1	29.3	23.7	29.0	23.4	27.4	20.0	24.9	19.3	24.2	17.7	23.1	17.8	22.7	16.3	23.5	16.8	24.8	18.0
1965	27.5	19.1	28.5	21.3	28.5	22.0	28.9	22.5	27.6	21.4	27.0	21.6	25.1	19.9	24.3	16.9	23.8	17.9	23.1	17.5	24.1	18.3	25.1	19.1
1966	26.7	20.1	28.3	20.8	28.3	22.1	29.3	22.7	28.1	22.1	27.6	20.9	26.8	19.0	24.8	18.4	24.0	18.2	23.5	16.6	25.1	17.7	25.8	18.4
1967	27.6	19.5	29.1	22.0	29.2	23.0	29.6	22.8	29.8	22.6	28.9	21.6	23.6	20.1	24.5	18.7	23.8	17.7	23.2	17.7	24.0	17.6	24.7	18.2
1968	26.8	20.1	28.5	21.3	28.0	21.6	28.7	22.7	28.0	22.5	27.7	20.3	25.9	17.2	25.5	17.5	23.9	17.8	23.8	17.1	24.5	17.2	25.6	18.2
1969	27.2	19.4	28.7	21.1	30.1	22.7	29.3	22.3	30.4	22.8	28.6	22.3	27.4	20.9	25.1	18.2	24.1	18.4	23.4	17.4	24.7	18.0	26.8	19.6

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

Crop Year	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
November	14	16	12	13	13	19	16	18	15	17	15	17	14	19	17
December	15	17	13	13	14	15	15	*43*(2)	24	18	17	15	16	19	19
January	13	20	20	14	17	*53*(2)	16	20	26	*60*(2)	19	*45*(2)	*39*(2)	24	18
February	*34*(2)	16	19	18	17	*74*(2)	13	*59*(2)	16	*34*(2)	15	14	14	27	22
March	29	19	18	*33*(2)	18	15	13	18	17	24	21	25	12	25	12
April	16	17	16	28	17	15	12	21	16	18	21	15	12	14	14
May	19	18	15	14	16	17	13	20	20	22	24	13	21	16	18
June	22	17	13	14	17	17	19	17	18	20	17	16	20	18	17
July	17	15	12	11	16	15	19	19	17	20	20	18	20	20	18
August	20	14	17	20	18	16	20	22	15	20	18	20	22	21	19
September	19	17	17	17	17	20	21	18	17	20	17	14	17	21	20
October	14	18	15	17	18	18	19	22	16	17	18	20	23	18	16

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

(*2*) *Cyclonic wind above 30 miles per hour*

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, 1956 - 1969

%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)
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
1969	1	2	1	—	3	1	15	6	15	21	2	4	10	1	1	1	6	3

NOTE : Year of release shown in brackets

Table XII. Percentage annual plantations under different cane varieties on sugar estates, 1965 to 1969

Years / Varieties	Island					West					North					East					South					Centre				
	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969	1965	1966	1967	1968	1969
M.134/32 ...	1.3	—	—	—	—	1.4	—	—	—	—	3.2	—	—	—	—	1.2	—	—	—	—	1.0	—	—	—	—	—	—	—	—	—
M.147/44 ...	3.6	2.5	2.9	0.1	—	13.1	10.3	16.8	0.3	—	13.4	0.7	5.8	0.4	—	1.6	6.1	2.8	—	—	—	0.8	0.3	0.1	—	—	—	—	—	—
M.31/45 ...	9.4	9.4	6.3	7.4	1.9	6.2	11.6	3.0	7.5	0.3	7.5	3.6	1.6	0.3	0.8	22.3	12.6	10.8	23.5	5.2	7.9	13.1	9.4	5.4	1.6	0.6	2.1	0.5	0.1	—
M.202/46 ...	21.1	16.2	8.6	7.7	1.3	29.2	30.9	30.0	18.3	0.3	23.7	15.9	4.8	1.7	0.1	23.3	13.8	8.8	1.3	—	24.8	19.8	9.8	14.0	3.2	0.6	3.7	1.6	0.9	—
M.93/48 ...	26.3	22.7	20.2	23.7	13.3	0.9	—	1.2	—	—	18.8	12.7	4.6	0.7	1.7	19.1	32.2	24.3	27.8	5.7	22.9	16.0	18.4	17.1	9.5	67.9	50.5	45.2	74.0	54.7
M.99/48 ...	3.4	3.6	3.1	0.1	—	1.1	4.8	2.4	0.9	—	0.6	—	0.3	—	—	5.7	4.9	5.8	—	—	4.4	4.8	1.7	—	—	1.8	3.1	5.9	—	—
M.253/48 ...	2.7	0.5	0.3	—	—	20.6	0.3	0.5	—	—	1.6	0.3	—	—	—	0.9	0.7	0.8	—	—	1.5	0.8	0.2	—	—	—	0.2	—	—	—
M.409/51 ...	0.9	5.9	4.9	0.9	—	—	1.5	7.3	2.1	—	0.8	1.5	1.7	0.3	—	—	6.7	5.3	—	—	—	9.8	7.1	0.8	—	—	3.4	2.3	2.7	—
M.442/51 ...	18.8	24.1	24.4	11.7	4.1	23.8	29.2	17.6	13.2	1.3	26.6	55.3	56.8	36.8	6.5	18.4	19.1	27.7	10.3	7.6	20.9	17.9	17.1	5.1	3.0	1.8	1.3	1.0	1.7	—
M.13/53 ...	—	2.5	3.7	3.0	0.4	—	6.3	4.9	3.1	1.9	—	5.3	8.4	9.9	0.8	—	1.0	3.5	3.7	—	—	1.9	2.5	0.8	—	—	0.2	0.3	0.1	0.6
M.13/56 ...	—	1.1	7.9	22.9	24.8	—	3.0	4.3	9.2	21.5	—	1.9	14.6	41.4	58.7	—	0.1	2.9	16.6	21.6	—	1.3	10.8	24.4	18.8	—	0.2	1.7	10.3	5.8
M.377/56 ...	—	—	0.8	9.8	32.6	—	—	2.3	31.5	31.4	—	—	0.6	6.4	25.2	—	—	0.7	10.1	38.1	—	—	0.9	9.8	34.7	—	—	0.2	4.8	28.0
M.351/57* ...	—	—	—	—	9.9	—	—	—	—	3.6	—	—	—	—	—	—	—	—	—	12.2	—	—	—	—	16.2	—	—	—	—	4.5
Ebène 1/37 ...	1.7	3.4	0.2	0.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.4	3.9	0.6	0.3	—	1.5	13.3	1.0	—	—
Ebène 50/47...	4.4	2.1	0.4	—	—	—	—	—	—	—	1.4	1.2	—	—	—	2.4	1.5	—	—	—	7.1	3.8	0.6	—	—	5.5	1.0	—	—	—
N : Co.376 ...	—	—	0.8	1.9	0.9	—	—	—	1.1	6.7	—	—	—	0.1	—	—	—	—	—	—	—	—	2.0	4.1	1.2	—	—	—	0.6	0.3
Saïpan 17* ...	—	—	—	—	8.3	—	—	—	—	26.1	—	—	—	—	3.5	—	—	—	—	7.5	—	—	—	—	9.6	—	—	—	—	3.9
Other varieties	6.4	6.0	15.5	10.7	2.5	3.7	2.1	9.7	12.8	6.9	2.4	1.6	0.8	2.0	2.7	5.1	1.3	6.6	6.7	2.1	6.1	6.1	18.6	18.1	2.2	20.3	21.0	40.3	4.8	2.2
Total area arpents	13,400	11,021	12,020	12,986	13,984	1,045	804	777	774	897	2,255	2,212	2,355	2,298	2,480	2,554	2,281	2,520	2,531	3,142	5,593	4,090	4,396	5,452	5,413	1,953	1,634	1,975	1,931	2,052

* Varieties being considered for release

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

Year	Island	West	North	East	South	Centre
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
1969	86.4	88.5	86.1	88.3	85.4	84.9

NOTE: The weight of cane produced on estates in 1969 was: virgins 486,162 tons ratoons 3,085,398

Table XIV. Average yields of virgin and ratoon canes on estates
Tons per arpent. A: 1964 - 1968 B: 1969

Crop Cycle	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	36.3	41.6	44.2	41.6	38.6	40.9	37.1	44.3	34.3	39.4	34.2	45.4
1st Ratoon	33.5	38.7	38.3	36.9	35.7	39.0	34.6	44.6	31.7	34.8	31.8	40.1
2nd ,,	32.1	35.8	37.7	33.0	33.1	35.7	33.9	41.1	30.3	33.0	30.3	38.0
3rd ,,	30.9	35.4	35.6	34.5	32.2	34.9	32.1	39.8	29.3	32.4	29.6	38.7
4th ,,	30.1	35.2	34.7	33.2	30.9	35.4	32.0	39.1	28.5	32.0	28.5	38.1
5th ,,	29.9	34.6	34.4	32.6	31.2	33.7	31.5	39.6	28.0	31.9	28.0	36.8
6th ,,	29.7	34.8	32.9	34.9	31.4	34.1	30.4	40.2	28.4	31.0	28.4	36.2

Table XV. Evolution of 1969 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
	12th July						*19th July*						*26th July*						*2nd August*					
Cane crushed (1000 m. tons)	177	—	—	110	67	—	360	—	18	178	131	33	606	—	67	244	216	79	921	27	139	316	315	124
Sugar manufactured % cane	8.95	—	—	8.89	9.04	—	9.25	—	9.47	9.18	9.25	9.41	9.40	—	9.49	9.34	9.39	9.55	9.64	11.08	9.65	9.51	9.61	9.75
Sugar manufactured (1000 m. tons)	15.8	—	—	9.8	6.0	—	33.1	—	1.7	16.3	12.0	3.1	56.9	—	6.4	22.8	20.2	7.5	88.7	2.9	13.4	30.1	30.2	12.1
	9th August						*16th August*						*23rd August*						*30th August*					
Cane crushed (1000 m. tons)	1,238	49	224	382	415	168	1,552	70	306	451	512	213	1,868	94	387	523	606	258	2,181	117	472	590	701	301
Sugar manufactured % cane	9.85	11.31	9.80	9.68	9.83	9.95	10.03	11.53	9.93	9.83	10.04	10.12	10.18	11.66	10.06	9.96	10.17	10.26	10.32	11.82	10.20	10.08	10.29	10.41
Sugar manufactured (1000 m. tons)	121.8	5.5	22.0	37.0	40.6	16.7	155.7	8.1	30.4	44.4	51.3	21.5	190.1	10.9	39.0	52.1	61.6	26.5	225.0	13.8	48.1	59.6	72.1	31.4
	6th September						*13th September*						*20th September*						*27th September*					
Cane crushed (1000 m. tons)	2,499	140	557	658	697	347	2,815	163	636	727	897	392	3,136	186	720	796	996	438	3,458	210	804	865	1,093	486
Sugar manufactured % cane	10.44	11.92	10.32	10.19	10.41	10.54	10.56	12.06	10.45	10.31	10.52	10.66	10.67	12.18	10.58	10.40	10.62	10.76	10.79	12.31	10.72	10.51	10.72	10.87
Sugar manufactured (1000 m. tons)	260.8	16.6	57.5	67.1	83.0	36.6	297.2	19.7	66.5	74.9	94.3	41.8	334.6	22.7	76.2	82.8	105.6	47.3	373.0	25.9	86.2	90.9	117.2	52.8
	4th October						*11th October*						*18th October*						*25th October*					
Cane crushed (1000 m. tons)	3,777	233	888	932	1,192	532	4,091	255	971	999	1,288	578	4,397	275	1,050	1,067	1,382	623	4,708	302	1,130	1,133	1,476	667
Sugar manufactured % cane	10.89	12.40	10.86	10.60	10.82	10.95	10.99	12.47	11.00	10.69	10.91	11.04	11.09	12.53	11.11	10.78	11.01	11.13	11.19	12.62	11.22	10.87	11.11	11.22
Sugar manufactured (1000 m. tons)	411.3	28.9	96.4	98.8	128.9	58.3	449.6	31.9	106.7	106.8	140.5	63.7	487.7	34.5	116.7	115.0	152.2	69.3	526.8	38.2	126.8	123.1	163.9	74.8
	1st November						*8th November*						*15th November*						*22nd November*					
Cane crushed (1000 m. tons)	4,960	320	1,195	1,188	1,552	705	5,235	343	1,272	1,250	1,628	742	5,483	364	1,345	1,309	1,698	767	5,674	381	1,406	1,361	1,740	786
Sugar manufactured % cane	11.27	12.66	11.31	10.94	11.19	11.29	11.35	12.71	11.40	11.02	11.27	11.35	11.41	12.65	11.47	11.08	11.34	11.40	11.45	12.76	11.53	11.13	11.38	11.43
Sugar manufactured (1000 m. tons)	558.9	40.6	135.2	129.9	173.7	79.5	594.0	43.6	145.0	137.6	183.5	84.3	625.8	46.4	154.3	145.0	192.6	87.5	649.9	48.6	162.0	151.5	197.9	89.9
	29th November						*6th December*						*13th December*						*Total crop production (preliminary figs.)*					
Cane crushed (1000 m. tons)	5,761	382	1,437	1,389	1,762	791	5,802	382	1,458	1,393	1,778	791	5,820	382	1,459	1,393	1,795	791	5,824	382	1,459	1,393	1,799	791
Sugar manufactured % cane	11.47	12.77	11.55	11.15	11.39	11.44	11.48	12.77	11.55	11.15	11.41	11.44	11.48	12.77	11.56	11.15	11.41	11.44	11.48	12.77	11.56	11.15	11.42	11.44
Sugar manufactured (1000 m. tons)	660.8	48.7	166.0	154.9	200.7	90.5	665.6	48.7	168.3	155.4	202.7	90.5	668.1	48.7	168.6	155.4	204.9	90.5	668.7	48.7	168.6	155.4	205.5	90.5

Table XVI. Evolution of cane quality during 1969 sugar crop

Week Ending	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
12th July	10.80	9.05	—	—	—	—	10.72	9.06	10.89	9.05	—	—
19th ,,	11.13	9.46	—	—	11.08	9.47	11.10	9.48	11.21	9.47	11.08	9.41
26th ,,	11.26	9.65	—	—	11.24	9.49	11.26	9.80	11.30	9.63	11.23	9.63
2nd August	11.76	10.12	13.02	11.08	11.58	9.80	11.58	10.11	11.79	10.13	11.65	10.09
9th ,,	11.93	10.42	13.41	11.59	11.67	10.05	11.82	10.47	11.93	10.40	11.84	10.49
16th ,,	12.17	10.71	13.70	12.01	11.87	10.28	12.00	10.63	12.26	10.82	12.11	10.77
23th ,,	12.30	10.87	13.78	12.07	12.09	10.54	12.09	10.78	12.29	10.88	12.29	10.95
30th ,,	12.49	11.13	13.93	12.46	12.33	10.85	12.33	11.04	12.35	11.05	12.55	11.30
6th September	12.66	11.26	13.92	12.43	12.50	10.98	12.43	11.16	12.67	11.25	12.63	11.35
13th ,,	12.91	11.51	14.22	12.89	12.83	11.32	12.64	11.38	12.86	11.39	12.86	11.59
20th ,,	13.00	11.61	14.40	13.04	13.05	11.59	12.71	11.39	12.92	11.44	12.84	11.63
27th ,,	13.40	11.96	14.71	13.34	13.50	11.96	13.13	11.78	13.29	11.78	13.15	11.91
4th October	13.43	12.00	14.60	13.17	13.78	12.17	13.17	11.79	13.19	11.84	13.09	11.74
11th ,,	13.68	12.19	14.63	13.19	14.06	12.47	13.42	11.90	13.47	11.99	13.33	12.05
18th ,,	13.96	12.42	14.85	13.32	14.26	12.52	13.62	12.09	13.92	12.42	13.60	12.31
25th ,,	14.20	12.58	14.95	13.59	14.50	12.68	13.84	12.27	14.11	12.48	13.95	12.49
1st November	14.35	12.69	15.00	13.34	14.75	12.82	14.09	12.51	14.35	12.68	13.89	12.45
8th ,,	14.49	12.74	15.06	13.42	14.68	12.74	14.20	12.48	14.54	12.82	14.10	12.61
15th ,,	14.62	12.83	14.83	13.39	14.81	12.76	14.25	12.47	14.73	12.98	14.39	12.96
22nd ,,	14.46	12.64	14.59	12.99	14.74	12.74	14.12	12.32	14.56	12.78	14.21	12.61
29th ,,	14.24	12.41	—	—	14.32	12.62	13.84	12.06	14.63	12.50	—	—
6th December	13.75	11.88	—	—	13.40	11.64	13.78	12.04	14.19	12.15	—	—

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 - 1969

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	10.3	169	52.0	159	40.3	140	65.8	132	29.4
1952	149	192.4	151	9.9	149	50.5	155	40.2	154	63.4	131	28.4
1953	158	205.7	162	11.8	167	57.7	161	42.5	153	66.0	145	27.7
1954	140	214.1	142	11.7	137	60.5	138	42.9	147	68.7	134	30.3
1955	133	222.6	134	12.8	122	64.2	140	41.5	140	71.6	127	32.5
1956	136	227.3	129	12.7	137	62.7	138	43.4	138	76.2	128	32.3
1957	128	237.5	144	13.3	104	68.2	133	42.9	141	78.6	129	34.5
1958	131	232.2	131	13.7	109	68.2	142	42.9	142	76.4	135	30.9
1959	134	248.4	127	15.5	106	71.8	152	46.7	148	79.4	136	35.1
1960	113	148.3	110	10.5	116	43.9	123	29.5	118	46.2	81	18.2
1961	150	230.2	147	13.6	126	66.2	160	44.6	165	72.2	154	33.6
1962	140	231.4	158	12.9	136	66.9	159	42.2	141	78.8	111	30.6
1963	153	263.3	160	16.3	132	75.4	174	50.6	156	86.0	154	34.9
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
1969	137	297.7	123	21.7	132	77.0	153	63.8	137	91.8	127	43.5

Table XVII (ii). Mid - harvest date (A) and average difference in the age of successive crops (B), days, 1955 - 1969

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
1969	15/9	+13	23/9	+19	21/9	+11	10/9	+15	12/9	+11	14/9	+15
Averages 1955 - 1969	*18/9*	—	*18/9*	—	*22/9*	—	*18/9*	—	*17/9*	—	*15/9*	—

Table XVIII. Summary of chemical control data 1969

(i) CANE CRUSHED AND SUGAR PRODUCED

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney
CRUSHING PERIOD	From	24/7	23/7	1/8	16/7	14/7	18/7	25/7	11/7	25/6	30/6	4/7
	To	21/11	8/12	9/12	1/12	24/11	19/11	21/11	19/11	1/12	25/11	7/11
	No. of crushing days	103	118	111	118	114	104	102	112	136	127	108
	No. of crushing hours per day	22.35	23.17	23.46	22.33	21.77	23.17	21.89	22.28	22.13	21.04	19.40
	Hours stoppage per day	0.92	0.39	0.54	0.48	1.86	0.49	0.88	0.59	0.59	0.49	0.64
	Overall time Efficiency	93.1	96.5	97.8	93.0	90.7	96.5	91.2	92.8	92.6	87.7	80.8
	Mechanical Efficiency	96.0	98.3	97.8	97.9	92.1	97.9	96.1	97.4	97.4	97.7	96.7
CANE CRUSHED (Metric Tons)	Factory	218,707	47,149	68,522	145,874	130,330	101,072	167,752	112,342	509,196	248,019	59,442
	Planters	162,531	169,858	135,551	71,636	158,847	150,385	111,796	147,249	270,498	106,374	65,760
	Total	381,238	217,007	204,073	217,510	289,177	251,457	279,548	259,521	779,694	354,393	125,202
	Factory % Total	57.4	21.7	33.6	67.1	45.1	40.2	60.0	43.3	65.3	70.0	47.5
	Per day	3,701	1,839	1,830	1,843	2,537	2,418	2,741	2,318	5,733	2,791	1,159
	Per hour actual crushing	165.6	79.4	78.0	82.6	116.5	104.4	122.7	106.8	258.0	132.6	59.7
VARIETIES CRUSHED (Factory	M.93/48 per cent	1.2	2.2	4.5	23.8	2.3	5.3	5.4	2.4	32.1	15.5	12.7
	M.202/46 per cent	25.0	38.5	18.7	18.5	10.2	7.7	4.1	13.6	15.4	22.1	23.1
	M.147/44 per cent	23.9	13.9	25.3	16.8	37.1	38.1	37.6	42.7	8.4	19.7	5.5
	M.442/51 per cent	10.0	14.1	16.5	16.9	19.9	19.4	37.0	17.5	9.4	5.5	15.3
	M.31/45 per cent	0.8	—	5.5	3.7	0.8	3.6	3.9	10.7	11.5	18.7	15.3
	M.13/56 per cent	1.8	9.1	10.4	9.2	10.4	11.4	1.8	2.6	1.7	1.9	5.2
	Ebène 50/47 per cent	0.6	4.4	1.3	0.6	1.8	—	0.1	2.9	1.3	3.1	3.5
	B.37172 per cent	6.0	2.3	1.2	—	4.1	8.6	1.8	—	1.0	5.0	2.0
	Ebène 1/37 per cent	—	—	—	—	—	—	—	—	0.8	0.5	—
	M.253/48 per cent	10.1	5.2	0.9	—	2.5	—	—	—	0.7	3.5	1.5
	M.409/51 per cent	0.8	1.4	—	0.6	0.1	1.3	0.2	—	3.0	0.8	2.5
	M.13/53 per cent	1.8	5.9	7.5	6.8	3.3	1.4	2.1	1.3	0.4	2.0	2.7
	M.377/56 per cent	5.0	0.9	2.6	—	1.1	2.0	—	3.3	1.1	0.5	1.7
	M.351/57 per cent	1.6	—	—	—	—	—	—	—	3.8	—	1.5
	M.134/32 per cent	1.0	1.3	2.0	—	3.2	—	4.1	—	0.3	—	—
	Other varieties per cent	10.4	0.8	3.6	3.1	3.2	1.2	1.8	3.0	9.1	1.2	7.5
SUGAR PRODUCED (Metric Tons)	Raw Sugar	48,700	25,317	24,832	25,226	33,571	20,193	31,684	28,667	87,294	39,445	5,031
	White Sugar	—	—	—	—	—	7,786	—	—	—	—	7,626
	Total Sugar	48,700	25,317	24,832	25,226	33,571	27,979	31,684	28,667	87,294	39,445	12,657
	Tons Sugar at 96° Pol.	50,090	25,934	25,507	25,953	34,454	28,845	32,539	29,497	89,695	40,596	13,105

		Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CRUSHING PERIOD	From	18/7	9/7	8/7	25/6	2/7	15/7	21/7	26/7	11/7	19/7	14/7	—
	To	15/11	17/11	27/11	30/10	26/11	13/12	18/11	10/12	6/11	12/11	25/11	—
	No. of crushing days	102	112	122	110	126	130	102	114	101	99	115	115
	No. of crushing hours per day	19.91	19.10	21.59	22.52	22.16	20.51	21.04	19.31	20.60	22.73	22.47	21.73
	Hours stoppage per day	0.46	0.30	0.14	1.02	0.64	2.68	0.42	4.49	0.65	0.35	0.45	0.89
	Overall time Efficiency	83.0	79.6	90.0	93.8	92.3	85.4	87.7	80.5	85.8	94.7	93.6	90.5
	Mechanical Efficiency	97.7	98.5	99.3	95.7	97.2	88.4	98.0	81.1	96.8	98.5	98.0	96.1
CANE CRUSHED (Metric Tons)	Factory	188,428	171,714	201,129	164,233	159,575	242,442	47,716	61,440	130,287	136,112	253,266	3,564,747
	Planters	27,910	37,128	82,001	67,577	56,838	10,860	70,222	84,964	77,083	77,758	116,662	2,259,488
	Total	216,338	208,842	283,130	231,810	216,413	253,302	117,938	146,404	207,370	213,870	369,928	5,824,235
	Factory % Total	87.1	82.2	71.0	70.8	73.7	95.7	40.4	42.0	62.8	63.6	68.5	61.2
	Per day	2,121	1,865	2,321	2,107	1,718	1,948	1,156	1,284	2,053	2,160	3,217	2,312
	Per hour actual crushing	106.5	97.6	105.6	93.6	77.5	95.0	54.3	66.5	99.8	95.0	143.2	106.4
VARIETIES CRUSHED (Factory	M.93/48 per cent	8.9	13.5	12.3	41.3	48.4	24.6	12.3	2.5	39.3	32.7	74.0	22.9
	M.202/46 per cent	14.9	18.1	21.6	37.6	11.8	9.2	6.9	15.7	13.6	0.8	1.0	15.4
	M.147/44 per cent	19.8	17.7	9.7	0.2	5.6	10.7	21.2	23.5	4.9	—	0.6	15.3
	M.442/51 per cent	7.2	10.6	6.1	0.8	3.2	8.7	8.4	15.0	4.5	—	0.9	9.9
	M.31/45 per cent	5.7	8.4	4.6	2.4	6.0	6.5	16.9	4.6	6.3	—	—	6.6
	M.13/56 per cent	7.8	12.2	5.9	—	2.6	7.4	3.1	8.0	0.8	1.5	2.0	4.1
	Ebène 50/47 per cent	3.4	5.0	3.4	2.3	0.1	10.8	3.8	6.4	3.6	27.9	1.8	3.7
	B.37172 per cent	6.6	1.2	6.8	—	—	0.7	6.6	7.0	—	—	—	3.0
	Ebène 1/37 per cent	0.5	2.1	7.1	8.9	5.2	4.4	2.2	0.1	6.9	4.0	5.0	2.3
	M.253/48 per cent	2.3	2.5	1.7	0.4	0.1	0.3	1.9	0.1	4.9	0.3	0.1	1.8
	M.409/51 per cent	0.8	3.5	5.5	1.6	0.3	0.8	1.1	0.7	1.9	2.7	0.9	1.6
	M.13/53 per cent	0.8	0.4	0.7	—	—	0.2	0.5	4.6	0.2	0.3	—	1.4
	M.377/56 per cent	0.7	0.6	2.9	0.8	0.9	0.5	3.2	6.3	—	—	0.8	1.3
	M.351/57 per cent	1.4	0.3	1.9	0.3	2.3	3.2	0.3	0.6	2.0	—	0.6	1.3
	M.134/32 per cent	0.3	0.3	0.8	—	—	5.7	2.1	1.0	1.2	—	0.1	1.0
	Other varieties per cent	18.9	3.6	9.0	4.4	13.5	6.3	9.5	3.9	9.9	29.8	12.2	8.1
SUGAR PRODUCED (Metric Tons)	Raw Sugar	25,319	25,591	32,976	26,011	24,610	28,736	13,230	8,732	23,255	25,179	42,075	645,674
	White Sugar	—	—	—	—	—	—	—	7,511	—	—	—	22,923
	Total Sugar	25,319	25,591	32,976	26,011	24,610	28,736	13,230	16,243	23,255	25,179	42,075	668,597
	Tons Sugar at 96° Pol.	26,100	26,339	33,918	26,837	25,300	29,588	13,632	16,780	23,911	25,881	43,304	687,805

Table XVIII. Summary of chemical control data 1969

(ii) CANE, BAGASSE AND JUICES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE/SUGAR RATIO	Tons cane per ton sugar made	7.83	8.57	8.22	8.62	8.61	8.99	8.82	9.06	8.93	8.98	9.89	8.54	8.16	8.59	8.91	8.79	8.82	8.91	9.01	8.92	8.49	8.79	8.71
	,, ,, ,, ,, ,, @ 96° Pol.	7.61	8.37	8.00	8.38	8.39	8.72	8.59	8.80	8.69	8.73	9.58	8.28	7.93	8.35	8.64	8.55	8.56	8.65	8.72	8.67	8.26	8.54	8.47
	Sucrose per cent	14.31	13.45	13.53	12.98	13.48	13.07	12.90	12.64	12.58	12.74	11.85	13.06	13.81	13.17	12.67	12.68	12.91	12.76	13.06	12.67	12.99	12.80	13.01
	Fibre per cent	13.94	13.11	13.90	13.21	13.81	14.04	13.74	14.69	12.43	12.25	14.23	12.79	12.31	13.03	11.26	11.80	12.35	13.40	12.59	13.08	11.12	11.11	12.84
BAGASSE	Pol. per cent	1.93	2.06	1.56	1.68	2.00	2.22	2.01	1.88	2.03	1.89	2.02	1.95	2.38	2.18	2.15	2.19	2.11	2.19	2.46	1.97	1.32	1.67	1.99
	Moisture per cent	49.3	49.2	45.0	47.2	47.1	50.5	49.6	45.6	50.1	47.9	49.5	48.1	47.8	48.0	49.6	48.3	48.5	46.8	49.2	49.3	48.6	48.7	48.6
	Fibre per cent	48.0	48.0	52.8	50.5	50.2	46.3	47.5	51.8	47.2	49.4	47.7	49.4	49.2	49.2	47.6	48.9	48.7	50.4	47.6	48.0	49.6	49.1	48.8
	Weight per cent cane	29.00	27.30	26.32	26.16	27.49	30.33	28.92	28.38	26.36	24.79	29.82	25.90	25.02	26.47	23.67	24.28	25.37	26.59	26.45	27.22	22.41	22.65	26.34
1st EXPRESSED JUICE	Brix (B_1)*	19.94	19.83	19.84	18.36	19.55	19.55	18.39	18.13	17.62	18.25	17.25	18.31	19.01	18.38	17.11	17.68	17.96	17.39	18.35	17.62	17.39	17.39	18.33
	Gravity Purity	88.4	86.1	87.0	89.4	89.3	87.7	88.6	88.3	88.8	88.2	86.7	88.6	90.8	89.3	89.7	90.0	89.5	88.5	89.3	89.7	89.4	89.3	88.8
	Reducing sugar/sucrose ratio	3.6	4.3	5.4	3.4	3.3	4.4	4.0	4.6	4.5	4.7	4.5	3.2	2.8	3.8	4.2	4.6	3.4	2.7	3.5	3.1	3.8	3.6	3.9
LAST EXPRESSED JUICE	Brix*	1.76	3.13	3.07	2.90	4.09	3.51	2.27	2.30	4.08	3.10	2.82	2.64	2.83	3.22	2.57	2.97	2.68	2.74	3.40	2.43	1.67	2.11	2.83
	Apparent Purity	73.0	74.1	72.4	73.8	74.6	70.2	69.5	71.2	75.0	69.7	73.1	79.2	80.4	78.9	77.4	77.6	75.0	77.7	76.4	74.6	71.9	73.0	74.5
MIXED JUICE	Weight per cent on cane	98.6	97.6	105.7	102.7	100.9	101.3	100.1	98.9	97.1	107.6	102.1	110.8	107.0	102.3	107.1	102.6	105.1	107.7	100.6	99.3	102.3	102.5	102.0
	Brix*	15.95	15.65	14.59	14.09	14.78	14.33	12.31	14.10	14.15	13.20	12.95	12.98	13.91	14.01	12.85	13.39	13.47	12.96	14.21	13.87	14.13	13.80	14.05
	Gravity Purity	87.4	84.4	85.1	86.7	86.7	85.4	87.2	86.9	87.7	86.4	85.1	87.4	88.7	87.9	88.4	88.4	87.5	87.2	86.8	88.1	87.8	87.9	87.1
	Reducing sugar/sucrose ratio	4.0	4.8	6.2	4.2	4.4	5.2	4.7	5.6	5.2	5.0	5.2	3.6	3.4	4.3	4.7	5.6	4.2	3.2	4.3	3.8	4.2	4.1	4.5
	Gty. Pty. drop from 1st expressed juice	1.0	1.7	1.9	2.7	2.6	2.3	1.5	1.4	1.1	1.8	1.6	1.3	2.1	1.4	1.3	1.6	2.0	1.3	2.5	1.6	1.6	1.4	1.6
ABSOLUTE JUICE	Brix (B_A)	19.17	18.45	18.57	17.36	18.16	18.00	17.35	17.22	16.50	16.95	16.37	17.21	17.83	17.31	16.25	16.36	16.96	16.98	17.32	16.67	16.73	16.49	17.25
	B_A/B_1	0.96	0.93	0.94	0.95	0.93	0.92	0.94	0.95	0.94	0.93	0.95	0.94	0.94	0.94	0.95	0.93	0.94	0.98	0.94	0.95	0.96	0.95	0.94
	Gravity Purity	86.7	83.9	84.6	86.2	86.1	84.5	86.2	86.1	87.0	85.6	84.4	87.0	88.3	87.4	87.9	87.9	86.9	86.7	86.2	87.8	87.4	87.3	86.5
CLARIFIED JUICE	Brix*	15.81	16.24	14.22	13.93	14.48	13.62	14.00	13.97	14.76	12.98	12.17	12.69	13.76	13.66	12.27	13.61	13.46	12.95	13.89	14.17	13.69	14.04	13.84
	Gravity Purity	—	85.2	85.7	87.6	86.9	86.0	—	86.6	87.7	86.9	86.4	88.5	89.2	88.0	—	90.1	—	87.7	87.0	88.5	88.1	88.3	87.5
	Reducing sugar/sucrose ratio	4.0	4.3	6.1	4.2	3.7	5.4	—	5.4	4.9	5.1	5.0	3.4	3.2	4.4	4.5	5.3	—	3.4	3.8	3.5	4.2	3.9	4.4

* *All Brix values are Refractometric*

Table XVIII. Summary of chemical control data 1969

(iii) FILTER CAKE, SYRUP, pH, FINAL MOLASSES, SUGAR

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Pol. per cent	1.35	1.27	1.25	1.67	0.63	0.99	0.94	1.20	0.38	1.42	0.47	1.28	1.67	1.18	2.46	2.11	1.99	7.88	4.20	7.50	2.94	2.92	1.67
	Weight per cent cane	3.83	3.31	4.35	3.49	4.00	4.36	2.75	2.55	3.13	3.38	3.77	5.06	3.80	2.17	2.20	3.42	2.60	1.88	3.12	1.99	2.76	4.57	3.33
SYRUP	Brix*	58.2	64.4	59.8	59.8	61.2	65.0	57.5	60.3	60.8	56.5	58.7	65.8	63.2	59.3	64.0	65.7	57.9	56.5	52.0	56.0	58.2	62.1	60.1
	Gravity Purity	—	84.7	85.3	87.6	87.5	86.4	—	86.6	87.2	86.7	84.9	87.5	89.2	88.1	-	89.1	—	87.2	86.2	87.9	87.9	88.2	87.1
	Reducing sugar/sucrose ratio	4.3	4.9	5.8	4.2	3.8	5.2	—	5.3	4.9	5.2	4.3	3.5	3.4	4.7	4.6	4.4	—	3.0	3.9	3.8	4.3	4.1	4.4
pH VALUES	Limed juice	8.1	8.1	8.4	7.9	8.3	7.8	—	7.8	8.3	8.3	—	7.3	—	7.3	7.8	8.0	—	—	7.8	8.4	8.2	7.8	8.0
	Clarified juice	7.3	7.1	7.1	7.0	7.1	7.1	7.1	7.2	7.4	7.4	6.9	7.1	7.2	7.0	7.3	7.1	7.2	6.9	6.7	7.3	7.5	7.2	7.2
	Filter Press juice	—	—	9.3	—	7.4	8.0	7.0	7.2	9.1	7.5	—	7.3	6.9	6.8	7.1	—	6.3	—	—	6.6	7.6	6.8	7.4
	Syrup	6.4	—	6.9	6.5	6.5	6.5	6.8	6.4	6.8	6.8	6.9	6.9	6.9	6.5	6.3	7.0	6.7	—	6.8	7.1	6.8	7.1	6.7
FINAL MOLASSES	Brix**	89.7	87.9	89.9	86.5	90.0	90.5	89.1	87.2	89.2	88.9	87.0	88.3	87.8	88.7	89.6	86.6	88.0	87.7	85.2	85.4	87.1	87.9	88.5
	Sucrose per cent	33.3	33.3	30.9	30.6	35.9	34.5	34.0	32.7	34.4	34.1	31.8	32.2	32.9	33.0	32.8	33.8	35.1	33.8	34.1	33.1	33.3	34.5	33.6
	Reducing sugar per cent	18.2	16.8	20.5	17.5	14.9	17.4	18.8	19.3	18.6	20.0	17.2	14.1	16.2	15.3	20.8	18.6	15.0	15.1	14.5	15.3	17.4	16.7	17.5
	Total sugars per cent	51.5	50.1	51.4	48.1	50.8	51.9	52.9	52.0	53.0	54.1	48.9	46.3	49.1	48.3	53.6	52.4	50.1	48.9	48.6	48.4	50.8	51.2	51.1
	Gravity Purity	37.1	37.9	34.3	35.4	39.9	38.1	38.2	37.5	38.6	38.4	37.3	36.5	37.4	37.2	36.6	39.0	39.9	38.5	40.1	38.7	38.2	39.3	38.0
	Reducing sugar/sucrose ratio	54.5	50.3	66.5	57.2	41.4	50.4	55.3	59.1	54.1	58.7	53.0	43.7	49.4	46.3	63.4	52.8	42.7	44.6	42.5	46.2	52.4	48.2	52.0
	Weight per cent cane at 85° Brix	3.06	3.60	3.59	3.00	3.26	3.77	3.19	3.21	2.88	3.02	3.29	2.66	2.79	2.78	2.48	2.44	2.75	2.60	3.18	2.40	2.71	2.73	2.97
SUGAR MADE	White sugar recovered per cent cane	—	—	—	—	—	3.10	—	—	—	—	6.09	-	—	—	—	—	—	—	5.13	—	—	—	0.39
	Raw ,, ,, ,, ,, ,,	12.77	11.67	12.17	11.60	11.61	8.03	11.33	11.04	11.20	11.13	4.02	11.70	12.25	11.65	11.22	11.37	11.35	11.22	5.96	11.21	11.77	11.37	11.09
	Total ,, ,, ,, ,, ,,	12.77	11.67	12.17	11.60	11.61	11.13	11.33	11.04	11.20	11.13	10.11	11.70	12.25	11.65	11.22	11.37	11.35	11.22	11.09	11.21	11.77	11.37	11.48
	Average Pol. of sugars	98.740	98.339	98.609	98.769	98.528	98.970	98.590	98.780	98.641	98.801	99.398	98.962	98.806	98.741	99.047	98.692	98.845	98.915	99.176	98.710	98.676	98.805	98.760
	Total sucrose recovered per cent cane	12.61	11.47	12.00	11.45	11.44	11.01	11.17	10.91	11.05	11.00	10.05	11.58	12.11	11.50	11.11	11.22	11.21	11.09	11.00	11.07	11.62	11.24	11.34
	Moisture content of raw sugar per cent	0.30	0.43	0.34	0.38	0.44	0.48	0.38	0.38	0.34	0.33	0.28	0.29	0.30	0.36	0.29	0.32	0.36	0.34	0.26	0.39	0.35	0.33	0.35
	Dilution indicator	31.7	34.5	32.6	44.5	42.5	55.8	36.5	39.4	33.5	37.2	28.4	31.9	33.5	39.3	44.2	31.7	44.9	45.4	39.5	43.4	36.5	36.4	39.3

* *Refractometric Brix 1 : 5 w/w*
** *,, ,, 1 : 6 w/w*

Table XVIII. Summary of chemical control data 1969

(iv) MASSECUITES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MAGMA	Apparent Purity	82.7	86.0	88.4	84.9	88.1	81.0	81.4	85.5	92.1	82.9	83.3	83.9	86.5	94.0	85.9	83.9	85.8	83.5	91.9	83.5	83.7	84.2	85.6
A-MASSECUITE	Brix	91.7	91.8	91.4	92.4	91.8	90.8	92.5	92.6	93.2	92.8	91.2	91.9	91.4	91.6	92.8	92.6	92.1	91.6	90.7	90.8	91.2	92.4	92.1
	Apparent Purity	86.2	82.7	84.9	85.1	83.9	83.7	79.8	79.8	81.0	83.4	83.0	87.5	88.0	84.3	85.7	82.7	82.2	82.6	86.4	85.1	83.8	82.0	83.3
	,, ,, of A-Molasses	68.6	58.5	65.5	61.1	61.2	63.4	55.8	54.3	55.8	59.1	65.3	66.6	66.6	66.2	58.0	58.1	60.2	59.1	73.4	68.3	63.1	59.3	61.1
	Drop in Purity	17.6	24.2	19.4	24.0	22.7	20.3	24.0	25.5	25.2	24.3	17.7	20.9	21.4	18.1	27.7	24.6	22.0	23.5	13.0	16.8	20.7	22.7	22.2
	Crystal per cent Brix in massecuite	56.1	58.3	56.2	61.7	58.5	55.5	54.4	55.8	57.0	59.4	51.0	62.6	64.1	53.6	66.0	58.7	55.3	57.4	48.9	53.0	56.1	55.8	57.0
	Cubic feet per ton Brix in Mixed Juice	31.1	33.8	26.8	32.1	29.5	33.3	32.2	35.1	32.7	37.3	33.5	25.5	23.2	33.0	34.9	34.7	41.5	39.7	28.7	25.4	43.2	41.1	33.3
	A-Massecuite per cent total massecuite	60.3	71.2	57.5	77.8	71.6	58.8	56.0	78.1	81.3	77.7	53.3	52.4	49.9	58.3	77.7	71.5	81.0	79.4	52.2	59.9	80.9	82.3	68.8
B-MASSECUITE	Brix	92.4	—	91.2	—	92.5	92.7	91.9	—	—	—	91.9	93.4	93.0	92.2	93.2	92.7	—	—	92.1	91.8	—	—	92.3
	Apparent Purity	76.0	—	73.7	—	72.4	72.5	73.0	—	—	—	75.2	75.3	75.3	76.3	81.8	72.6	—	—	78.1	76.0	—	—	75.0
	,, ,, of B-Molasses	56.0	—	48.6	—	52.0	51.3	52.1	—	—	—	59.3	52.9	48.7	59.4	51.8	48.4	—	—	61.0	53.4	—	—	54.0
	Drop in Purity	20.0	—	25.1	—	20.4	21.2	21.0	—	—	—	15.9	22.4	26.6	16.9	30.0	24.2	—	—	17.1	22.6	—	—	21.0
	Crystal per cent Brix in massecuite	45.5	—	48.8	—	42.5	43.5	43.7	—	—	—	39.1	47.6	51.9	41.6	62.2	46.9	—	—	43.8	48.5	—	—	45.7
	Cubic feet per ton Brix in Mixed Juice	11.4	—	10.5	—	2.4	12.9	15.5	—	—	—	16.5	12.5	14.4	14.9	0.7	2.4	—	—	14.1	10.1	—	—	5.5
	B-Massecuite per cent total Massecuite	22.2	—	22.6	—	5.7	22.8	27.0	—	—	—	26.3	25.8	31.1	26.3	1.4	4.9	—	—	25.6	23.8	—	—	11.4
	Kg. Sugar per cubic foot of A & B Massecuite	19.1	22.6	21.1	24.9	24.5	16.6	16.4	22.6	24.9	21.0	15.3	21.5	21.7	17.0	22.9	22.3	19.3	16.0	18.1	22.9	18.9	19.6	20.6
C-MASSECUITE	Brix	93.6	91.9	93.2	93.8	94.2	95.4	93.0	95.2	95.7	94.3	94.3	95.0	94.4	95.5	93.4	94.1	93.7	93.8	93.0	93.8	94.7	93.8	94.2
	Apparent Purity	61.2	60.1	58.6	61.5	61.6	58.7	58.4	59.8	59.2	60.0	61.6	61.8	60.1	61.5	63.1	61.8	61.4	61.5	65.3	58.5	63.8	63.0	60.9
	,, ,, of final Molasses	32.8	34.9	27.6	33.7	37.6	34.5	36.5	33.1	33.1	33.6	31.8	32.1	32.7	33.7	30.5	35.2	35.6	34.8	38.1	35.9	32.3	35.6	33.9
	Drop in Purity	28.4	25.2	31.0	27.8	24.0	24.2	22.0	26.7	26.1	26.4	29.8	29.7	27.4	27.8	32.6	26.6	25.8	26.7	27.2	22.6	31.5	27.4	27.0
	Crystal per cent Brix in massecuite	42.3	38.7	42.8	41.9	38.5	36.9	34.6	39.9	39.0	39.8	43.7	43.7	40.7	41.9	46.9	41.0	40.1	40.9	43.9	35.3	46.5	42.5	40.8
	Cubic feet per ton Brix in Mixed Juice	9.0	13.7	9.3	9.2	9.3	10.4	9.8	9.6	7.5	10.7	12.8	10.6	8.8	8.7	9.4	11.5	9.7	10.3	12.3	7.0	10.2	8.8	9.6
	C-Massecuite per cent total massecuite	17.5	28.8	19.9	22.2	22.7	18.4	17.0	21.9	18.7	22.3	20.4	21.8	19.0	15.4	20.9	23.6	19.0	20.6	22.2	16.5	19.1	17.7	19.8
TOTAL	Cubic feet per ton Brix in Mixed Juice	51.5	47.4	46.7	41.3	41.2	56.6	57.5	44.7	40.2	48.0	62.8	48.6	46.4	56.6	44.9	48.6	51.2	50.1	55.0	42.5	53.4	49.9	48.4
MASSECUITE	,, ,, ,, ,, sugar made	63.5	62.0	59.1	51.5	52.8	73.8	71.4	56.4	49.4	61.2	82.1	59.7	56.4	69.6	55.1	58.7	63.9	62.3	70.9	52.3	65.6	62.1	60.4

Table XVIII. Summary of chemical control data 1969

(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	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MILLING WORK	Imbibition water % cane	27.6	24.9	32.0	28.9	28.4	31.6	29.0	27.3	23.4	32.4	31.9	36.7	32.1	28.7	30.8	26.7	30.4	34.2	27.0	26.5	24.7	25.1	28.4
	,, ,, % fibre	198	190	230	219	206	225	211	186	188	264	224	287	260	221	273	227	246	255	215	203	222	226	221
	Extraction ratio	28.2	31.9	21.8	25.7	29.5	36.8	32.8	28.7	34.6	30.2	35.7	30.0	35.0	33.8	35.6	35.3	33.6	34.1	39.6	32.4	20.5	26.6	31.3
	Mill extraction	96.1	95.8	97.0	96.6	95.9	94.8	95.5	95.8	95.7	96.3	94.9	96.2	95.7	95.6	96.0	95.8	95.9	95.4	95.0	95.8	97.7	97.0	96.0
	Reduced mill extraction	96.5	96.0	97.3	96.8	96.4	95.5	96.0	96.5	95.7	96.2	95.6	96.3	95.6	95.8	95.5	95.6	95.8	95.8	95.1	96.0	97.4	96.6	96.1
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.56	0.56	0.41	0.44	0.55	0.67	0.58	0.53	0.54	0.47	0.60	0.50	0.60	0.58	0.51	0.53	0.54	0.59	0.65	0.54	0.30	0.38	0.52
	,, ,, in filter cake % cane	0.05	0.04	0.05	0.06	0.02	0.04	0.03	0.03	0.01	0.05	0.02	0.07	0.06	0.03	0.05	0.07	0.05	0.15	0.13	0.15	0.08	0.13	0.05
	,, ,, in molasses % cane	0.97	1.16	1.05	0.90	1.11	1.22	1.03	1.02	0.94	0.99	1.04	0.83	0.89	0.88	0.77	0.81	0.93	0.85	1.08	0.79	0.88	0.91	0.96
	Undetermined losses % cane	0.12	0.22	0.02	0.13	0.36	0.13	0.08	0.15	0.04	0.23	0.14	0.08	0.15	0.18	0.23	0.05	0.18	0.08	0.20	0.12	0.11	0.14	0.14
	Industrial losses % cane	1.14	1.42	1.12	1.09	1.49	1.39	1.14	1.20	0.99	1.27	1.20	0.98	1.10	1.09	1.05	0.93	1.16	1.08	1.41	1.06	1.07	1.18	1.15
	Total losses % cane	1.70	1.98	1.53	1.53	2.04	2.06	1.72	1.73	1.53	1.74	1.80	1.48	1.70	1.67	1.56	1.46	1.70	1.67	2.06	1.60	1.37	1.56	1.67
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	3.93	4.18	3.03	3.40	4.09	5.16	4.50	4.22	4.25	3.69	5.07	3.86	4.32	4.38	4.02	4.18	4.15	4.57	4.99	4.24	2.28	2.95	4.02
	,, ,, filter cake % sucrose in cane	0.36	0.31	0.40	0.44	0.19	0.33	0.20	0.22	0.09	0.38	0.15	0.50	0.46	0.20	0.42	0.57	0.40	1.16	1.00	1.18	0.63	1.05	0.43
	,, ,, molasses % sucrose in cane	6.75	8.62	7.74	6.95	8.23	9.33	8.04	8.10	7.51	7.74	8.78	6.32	6.43	6.69	6.09	6.36	7.22	6.69	8.28	6.25	6.78	7.12	7.36
	Undetermined losses % sucrose in cane	0.81	1.61	0.11	0.97	2.67	0.96	0.62	1.17	0.34	1.85	1.22	0.64	1.12	1.39	1.76	0.41	1.39	0.62	1.47	0.93	0.90	1.07	1.06
	Industrial losses % sucrose in cane	7.92	10.54	8.25	8.36	11.09	10.62	8.86	9.49	7.94	9.97	10.15	7.46	8.01	8.28	8.27	7.34	9.01	8.47	10.75	8.36	8.31	9.24	8.85
	Total losses % sucrose in cane	11.35	14.72	11.28	11.76	15.18	15.78	13.36	13.71	12.19	13.66	15.22	11.32	12.33	12.66	12.29	11.52	13.16	13.04	15.74	12.60	10.59	12.19	12.87
RECOVERIES	Boiling house recovery	91.8	89.0	91.5	91.3	88.4	88.8	90.7	90.1	91.7	89.7	89.3	92.2	91.6	91.3	91.4	92.3	90.6	91.1	88.7	91.3	91.5	90.5	90.8
	Reduced boiling house recovery (Pty. M.J. 85°)	89.9	89.5	91.5	90.0	86.7	88.4	88.9	88.4	89.6	88.4	89.2	90.5	88.4	88.9	88.4	89.7	88.3	89.3	86.9	88.6	89.2	87.8	89.0
	Overall recovery	88.1	85.3	88.7	88.2	84.8	84.2	86.7	86.3	87.8	86.3	84.8	88.7	87.7	87.3	87.7	88.5	86.8	86.9	84.3	87.4	89.4	87.8	87.1
	Reduced overall recovery (Pty. M.J. 85°, F % C 12.5)	86.8	85.9	89.0	87.2	83.5	84.5	85.3	85.2	85.8	85.0	85.3	87.1	84.5	85.2	84.4	85.7	84.6	85.5	82.6	85.0	86.9	84.9	85.5
	Boiling house efficiency	99.5	99.7	100.2	99.2	97.9	98.6	99.2	98.5	100.0	98.8	99.3	100.0	98.6	98.8	98.5	100.1	99.6	99.7	98.2	99.2	99.5	98.8	99.2

Table XIX. Production and utilization of molasses, 1949 - 1969

Year	Production	Exports	Used for production of alcohol	Other domestic uses	Available as fertilizer	N.P.K. equivalent in molasses available as fertilizer		
	M. tons	M. tons	M. tons	M. tons	M. tons	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				
1969	166,160	125,181	6,091	577	34,311	233	72	1,647

Table XX. Importation of inorganic fertilizers, in metric tons, 1954 - 1969

YEAR	N	P_2O_5	K_2O	SiO_2 *
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	7
1968	9,092	5,946	8,033	—
1969	8,706	4,970	8,650	90

*NOTE : * Acid soluble*

Table XXI. Sales of herbicides, 1967 - 1969

HERBICIDES	1967			1968			1969		
	Quantity		acid equivalent lb	Quantity		acid equivalent lb	Quantity		acid equivalent lb
	Imperial gallons	Kg.		Imperial gallons	Kg.		Imperial gallons	Kg.	
MCPA	8,978		35,912	8,738		34,550	6,380		27,935
2,4-D amines	15,760	2,255	82,632	18,201		102,025	14,202		90,362
2,4-D esters	12,017		61,528	6,196		41,107	2,374	3,705	14,242
2,4-D and 2,4-5T esters	4,172		21,838	5,355		28,393	5,771		30,406
Pentachlorophenol	149		224	270		405	225		337
Sodium chlorate		270,055			292,159			307,873	
Sodium trichloroacetate (TCA)		318,819			284,728			323,636	
Sodium 2,2-dichloropropionate (Dalapon, Basfapon, Unipon)		608			1,281			1,545	
Substituted ureas (Cotoran, DCMU, Linuron)		50,200			47,214			65,921	
Substituted triazines (Simazine, Atrazine)		37,544			40,753			34,522	
Unclassified	1,143		2,537	793			11,613		

Table XXII. Importation of major herbicides, 1959 - 1969

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.	Cotoran Linuron D.C.M.U. Kg.	Simazine Atrazine Kg.
			Imp. gall.	Kg.					
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
1969	307,873	—	28,727	3,075	323,636	1,545	225	65,921	34,522

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

NOTES

(i) Polycrosses

2 types are distinguished and are defined thus :-

Pol. 1 : *more than one female variety, crossed with a single male variety in a lantern or cubicle.*

Pol. S. : *one or several female varieties crossed with several male varieties in the same lantern or cubicle. The number following POL. S. gives the first cross number, that is the combination number of the polycross. It enables therefore to find out the other varieties entering the polycross when necessary.*

(ii) Reciprocal Crosses

e.g. : 615 *M.*202/46 x *RECI.*550/69.

*This means that variety M.*202/46 *was the male parent in a combination in which the first cross number was* 550/69 *: it was therefore placed in the top position in the lantern or cubicle; the male parent of M.*202/46 *in combination number* 615/69 *is therefore uncertain.*

(i) Early nobilisations of *S. spontaneum*, *S. robustum* and *S. sinense*

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
361	Co.331	x	Uba Marot	5	5	243*
514	M.26/20	x	M.B.6/64	4	1	1
47	M.26/20	x	Mol.5843	1	1	131
457	M.2/33	x	Uba Marot	2	2	7
777	*S. spont* Mandalay	x	M.Q.27/1124	2	2	20
487	Uba	x	M.Q.27/1124	2	2	50
Total		6		16	13	452

NOTE : * *All crosses planted 1 seedling/pot and transplanted 1 pot/location except Reference Cross No. 361 which was planted 3 seedlings/pot and transplanted 1 pot/location*

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(ii) (a). Further nobilisations of *S. spontaneum*, *S. robustum* and *S. sinense*

1 seedling/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
956	Gros Genoux	x	M.614/63	1	1	83
611	M.26/20	x	M.614/63	1	1	17
613	M.26/20	x	M.679/63	1	1	3
367	M.2/33	x	M.613/63	2	2	261
80	M.351/57	x	Co.213	3	3	126
795	M.C.3020/67	x	M.Q.27/1124	2	2	18
797	M.C.3059/67	x	M.5/38	1	1	180
798	M.C.3088/67	x	D.109	1	1	5
817	M.C.3315/67	x	M.5/38	2	1	36
36	S.17	x	Co.213	5	5	39
Total	10			19	18	768

(ii) (b). Further nobilisations of *S. spontaneum*, *S. robustum* and *S. sinense*

3 seedlings/pot, 2 pots/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
251	C1.41-142	x	M.241/59	2	2	366
221	Co.213	x	M.280/59	9	9	918
303	Co.976	x	M.240/59	10	8	564
241	C.P.50-28	x	B.5838	9	9	431
231	C.P.52-68	x	M.241/59	9	9	627
958	M.26/20	x	M.687/63	2	2	72
271	M.197/46	x	Co.213	10	10	909
271	M.197/46	x	Co.213	—	—	261
11	M.351/57	x	B.5838	10	10	297
293	M.239/59	x	B.5838	7	7	115
1	N :Co.310	x	B.5838	10	8	846
201	N :Co.376	x	B.5838	20	11	651
Total	11			98	85	6,057

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(iii) (a). Combinations having produced more than 9 seedlings

3 seedlings/pot, 2 pots/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
469	N :Co.376	x	M.907/61	9	8	522
566	Ragnar	x	M.147/44	7	7	531
459	Ragnar	x	M.69/56	18	17	585
71	S.17	x	M.147/44	5	5	477
489	S.17	x	M.69/56	15	15	747
5262	S.17	x	P.T.43-52	8	6	495
62	S.17	x	R.47/4066	5	5	648
531	Triton	x	M.202/46	8	7	1,170
Total		8		75	70	5,175

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(iii) (b). Combinations having produced more than 9 seedlings

3 seedlings/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
737	Ebène 1/37	x	M.9/58	6	4	117
731	Ebène 1/37	x	M.624/59	5	5	324
1000	M.13/56	x	M.69/56	8	8	89
283	M.351/57	x	C.P.44-101	10	10	486
505	M.351/57	x	Pol.S.505/69	9	9	180
583	M.351/57	x	R.47/4066	7	7	117
922	M.597/59	x	M.202/46	7	6	108
522	N : Co.376	x	M.147/44	14	14	349
550	N : Co.376	x	M.202/46	16	16	657
721	N : Co.376	x	M.537/57	4	4	450
978	N : Co.376	x	R.47/4066	15	13	157
793	P.R.980	x	M.147/44	2	2	287
323	P.R.1000	x	M.13/53	9	8	450
479	Q.61	x	C.B.41-35	6	6	267
637	Q.61	x	M.147/44	6	6	540
896	Ragnar	x	M.202/46	5	5	197
4976	Ragnar	x	R.47/4066	9	9	504
57	S.17	x	C.B.45-6	5	5	328
31	S.17	x	C.B.41-35	5	5	218
31	S.17	x	C.B.41-35	—	—	45
41	S.17	x	C.P.47-193	5	5	486
421	S.17	x	M.202/46	8	8	531
369	S.17	x	R.47/2777	3	3	126
67	Triton	x	M.12/49	4	3	106
631	Unknown	x	R.47/4066	5	5	270
Total	24			173	166	7,389

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(iii) (c). Combinations having produced more than 9 seedlings, 1 seedling/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations transplanted
5062	B.3337	x	M.84/57	3	3	45
5158	B.3337	x	R.47/4066	2	1	72
4241	Co.853	x	R.47/2777	5	2	36
677	Ebène 1/37	x	M.907/61	8	6	63
789	H.49-104	x	M.147/44	4	3	18
5267	H.40-3166	x	P.T.43-52	1	1	14
4343	I.216	x	Q.58	8	3	183
781	M.26/20	x	M.C.2302/66	2	2	9
573	M.134/32	x	M.13/53	9	9	45
333	M.241/40	x	M.13/53	9	9	45
994	M.31/45	x	M.69/56	6	6	225
615	M.202/46	x	RECI.550/69	16	13	27
839	M.202/46	x	RECI.834/69	4	4	158
5308	M.93/48	x	R.47/4066	5	5	12
643	M.93/48	x	Trojan	5	5	120
755	M.99/48	x	B.34104	3	3	135
599	M.12/49	x	R.47/4066	5	3	117
5182	M.305/51	x	C.B.41-35	1	1	25
5186	M.305/51	x	R.53/4132	5	2	131
5083	M.409/51	x	M.23/34	3	2	63
819	M.13/53	x	M.13/53	5	3	15
889	M.296/55	x	Pol.I.886/69	5	4	45
5913	M.13/56	x	C.B.45-6	4	2	11
937	M.13/56	x	M.202/46	8	7	27
449	M.69/56	x	M.69/56	4	3	35
844	M.69/56	x	RECI.834/69	4	4	18
880	M.198/56	x	M.202/46	6	4	18
21	M.351/57	x	Eros	10	10	72
431	M.351/57	x	M.69/56	7	7	234
749	M.513/57	x	Q.68	6	4	19
859	M.9/58	x	RECI.849/69	5	5	79
849	M.67/59	x	Pol.S.849/69	4	4	16
347	M.106/59	x	M.13/53	4	4	36
745	M.553/59	x	B.34104	4	2	9
834	M.553/59	x	Pol.S.834/69	5	5	90
343	M.625/59	x	M.13/53	3	3	24
799	N.10	x	M.69/56	2	1	182
713	N : Co.376	x	B.34104	8	7	34
962	N : Co.376	x	M.69/56	15	5	18
673	N : Co.376	x	Q.58	4	4	233
5897	Q.44	x	M.13/53	7	5	45
4514	Q.56	x	M.220/56	3	1	45
5130	Q.70	x	M.55/55	4	3	126
872	R.47/4066	x	RECI.864/69	5	5	41
83	Ragnar	x	B.34104	4	4	30
87	Ragnar	x	C.B.38/22	4	3	18
313	S.17	x	M.13/53	9	8	207
Sub-total		47		253	200	3,270

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(iii) (c). Combinations having produced more than 9 seedlings

1 seedling/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
98	S.17	x	M.377/56	6	6	216
51	S.17	x	P.R.1016	5	4	23
1009*	Mixed 1009/69	x	Mixed 1009/69	76	38	23
Total	50			340	248	3,532

NOTE : * *Combination No. 1009 involves 25 combinations. The real total no. of parental combinations involved here is therefore 74.*

(iii) (d). Combinations having produced less than 9 seedlings

1 sdlg/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
783	M.26/20	x	M.C.3088/67	2	2	6
5507	M.134/32	x	M.142/57	1	1	4
688	M.147/44	x	RECI.683/69	5	5	8
945	M.31/45	x	M.31/45	4	4	8
703	M.202/46	x	RECI.693/69	5	5	8
649	M.93/48	x	M.69/56	4	3	5
693	M.255/55	x	Pol.S.693/69	5	2	5
905	M.340/55	x	B.34104	4	4	4
5915	M.13/56	x	C.B.41-35	3	2	4
929	M.13/56	x	M.377/56	3	3	5
825	Mapou Perlée	x	M.C.2302/66	2	2	5
665	N : Co.376	x	Q.68	5	3	4
76	Ragnar	x	M.12/49	4	2	4
776	R.P.6	x	M.C.2302/66	1	1	2
93	S.17	x	B.34104	4	1	3
Total	15			52	40	75

Table XXIII. List of combinations transplanted in 1970 : M/69 Series

(iv). Combinations between Nobles, *S. officinarum*

1 sdlg/pot, 1 pot/location

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of crosses sown	No. of crosses potted	No. of locations trans-planted
774	M.Q.27/1124	x	M.Q.27/1124	2	1	2
45	M.26/20	x	M.Q.27/1124	2	2	207
105	Gros Genoux	x	Gros Genoux	1	1	18
1008	Beau Bois	x	Unknown	1	1	10
Total		4		6	5	237

Table XXIV. List of Approved Cane Varieties, 1970

M.134/32
M.134/32 white
M.134/32 striped
**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.3337
*B.34104
B.37161
B.37172
N : Co. 376

* *To be uprooted before 31st December, 1970*

** *To be uprooted before 31st December, 1973*