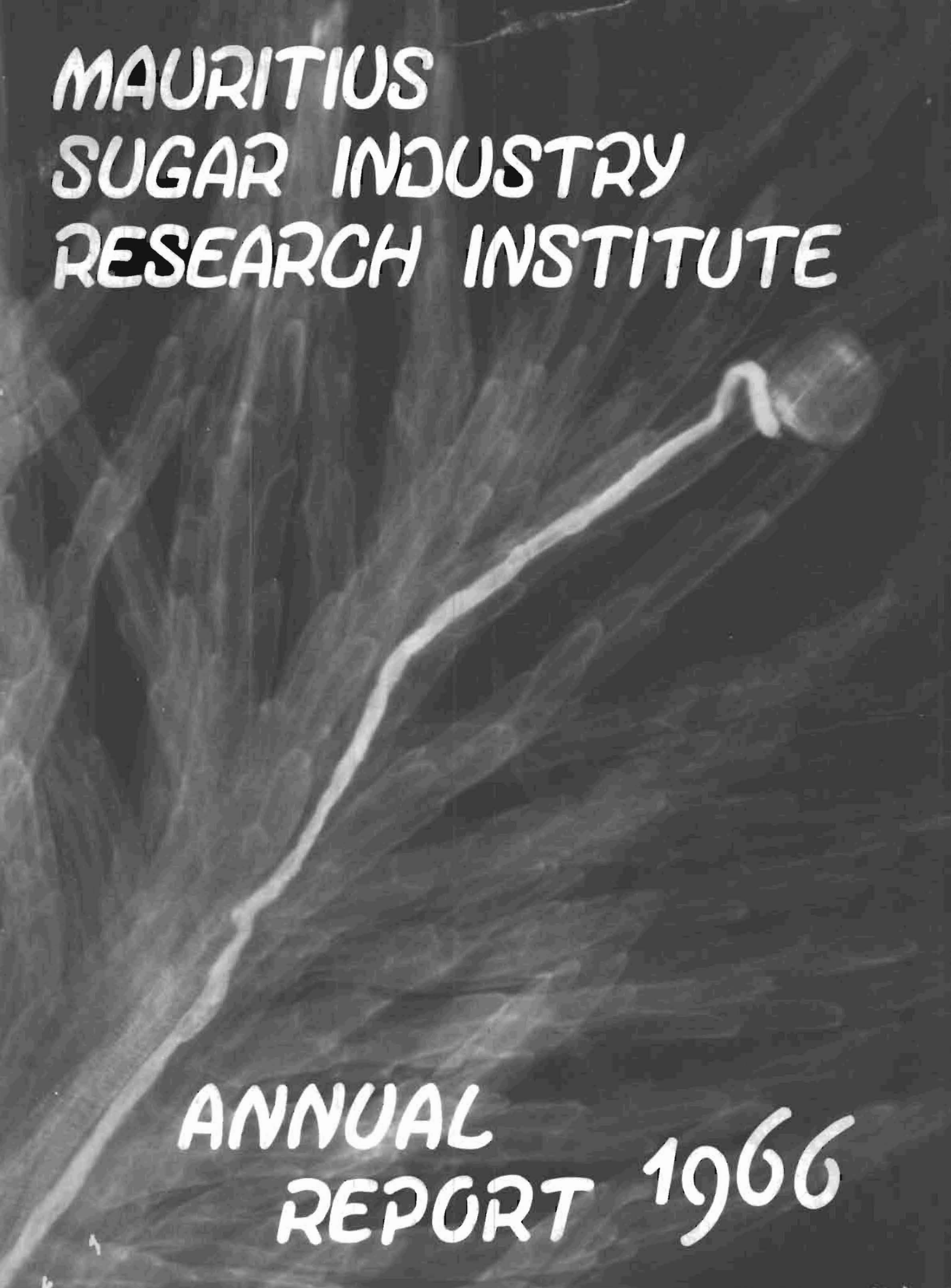
MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE



ANNUAL REPORT 1966

MAURITIUS SUGAR INDUSTRY

RESEARCH INSTITUTE

ANNUAL REPORT 1966

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CORRIGENDA

Mauritius Sugar Industry Research Institute

Annual Report 1966

p. 41, 2nd column, 9th line from bottom,
for M.577/59 *read* M.579/59.

p. 42, 1st column, 2nd line,
for M.377/51 *read* M.377/41.

p. 44, Table 10, 3rd line (Sub-humid) 7th column,
for 1.57 *read* 2.13.

p. 63, 2nd column, 24th line,
for borers *read* boxes.

p. 132, 1st column, 6th line from bottom,
for 299 p.p.m. *read* 293 p.p.m.

p. XXII, Statistical Table XXI, 4th line (2,4–D and 2,4–5–T esters), 5th column,
for 3,612 *read* 33,612.

p. XXVI, Statistical Table XXIII (ii) (b), foot-note 2,
for 3 pots/hole *read* 1 pot/hole.

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PLANT-SOIL-WATER RELATIONSHIPS

CLIMATE AND CULTIVATION

WEED CONTROL

SUGAR MANUFACTURE

APPENDIX

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* *Cover photograph : Germinating pollen grain, variety Uba Marot, stained by callose fluorochrome reaction* (x *650*).

MEMBERS EXECUTIVE BOARD

Mr. Jean Espitalier-Noel, *Chairman, representing the Chamber of Agriculture*

Mr. M. D. ffrench-Mullen, C.B.E., *representing Government*

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Mr. R. de Chazal } *representing factory owners*
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Mr. L. Desvaux de Marigny, *representing large planters*

Mr. S. Gaya }
Mr. Hamid Lallmahomed } *representing small planters*

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

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

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

and the senior staff of the Research Institute.

STAFF LIST (as at 31st December 1966)

Director	P. O. Wiehe, C.B.E., D.Sc. (Lond.), A.R.C.S.
Chief Agriculturist	G. Rouillard, Dip. Agr. (Maur.)
Senior Field Officers	G. Mazery, Dip. Agr. (Maur.)
	F. Mayer, Dip. Agr. (Maur.)
	M. Hardy, Dip. Agr. (Maur.), *i/c Réduit Expt. Station & Irrigation.*
	R. Béchet, Dip. Agr. (Maur.), *i/c Belle Rive Expt. Station.*
Field Officers	R. Ng. Ying Sheung, Dip. Agr. (Maur.), *i/c Union Park Expt. Station.*
	L. Thatcher, Dip. Agr. (Maur.), *i/c Pamplemousses Expt. Station.*
	G. Mc. Intyre, Dip. Agr. (Maur.)
Consulting Agronomist ...	P. Halais, Dip. Agr. (Maur.)
Chief Chemist	D. H. Parish, M. Agr., Ph.D. (Q.U.B.), F.R.I.C., resigned 30.4.66.
Chemist	Y. Wong You Cheong, B.Sc., B. Agr. (Q.U.B.), A.R.I.C.
Asst. Chemists	L. Ross, Dip. Agr. (Maur.)
	P. Y. Chan, B.Sc. (Lond.), appointed 1.6.66.
	L. C. Figon
Laboratory Assistants ...	C. Cavalot
	H. Maurice
Chief Entomologist	J. R. Williams, M.Sc. (Bristol), D.I.C.
Laboratory Assistant	M. A. Rajabalee
Chief Plant Pathologist ...	R. Antoine, B.Sc. (London.), A.R.C.S., Dip. Agr. Sc. (Cantab.), Dip. Agr. (Maur.), *i/c Plant Breeding & Pathology Divisions.*
Plant Pathologist	C. Ricaud, Ph.D. (Lond.), D.I.C.
Laboratory Assistant	S. Sullivan
Plant Breeder	L. P. Noël, Dip. Agr. (Maur.)
Biometrician	J. A. Lalouette, Dip. Agr. (Maur.)
Associate Plant Breeder ...	P. R. Hermelin, Dip. Agr. (Maur.)
	M. Pérombelon, M.Sc. (Aberdeen), Dip. Agr. (Maur.), resigned 31.5.66.
Assistant Plant Breeder ...	H. R. Julien, B.Sc. (Reading), appointed 1.5.66.
Field Assistant	S. de Villecourt
Chief Botanist	E. Rochecouste, Ph.D. (Lond.), resigned 30.4.66.
Plant Physiologist	C. Mongelard, M.Sc. (Lond.), D.I.C., M.I. Biol.
Laboratory Assistant	J. Pitchen
Chief Sugar Technologist ...	J. D. de R. de Saint Antoine, B.S. (L.S.U.), Dip. Agr. (Maur.)
Chemist	E. C. Vignes, M.Sc. (Lond.), A.R.I.C., Dip. Agr. (Maur.)
Associate Sugar Technologist ...	E. Piat, B.Sc. (Glasgow), Dip. Agr. (Maur.)
Instrument Engineer	F. Le Guen, B.Sc. (Lond.), D.N.C.L.
Senior Asst. Sug. Technologist ...	R. H. de Froberville, Dip. Agr. (Maur.), resigned, 31.7.66.
Assistant Sugar Technologists ...	M. Randabel, Dip. Agr. (Maur.)
	S. Marie-Jeanne, Dip. Agr. (Maur.), appointed 1.8.66.
Laboratory Assistants ...	L. Le Guen
	M. Abel
Temporary Sugar Technologist ...	A. Bérenger, appointed 1.7.66.

Secretary Accountant ...	... P. G. du Mée
Asst. Secretary Accountant	... J. Desjardins
Librarian	... Miss M. Ly-Tio-Fane, B.A. (Lond.)
Draughtsman-Photographer	... L. S. de Réland, Grad. N.Y.I.P.
Clerks	... Mrs A. Baissac
	Mrs. M. T. Rae
	Mrs. J. R. Williams
	Miss J. Desvaux de Marigny, resigned 31.5.66.
	Mrs. M. Le Guen, appointed 1.6.66.

THE MAURITIUS HERBARIUM

Honorary Curator ... ... R. E. Vaughan, O.B.E., D.Sc. (Lond.), F.R.I.C.

REPORT OF THE CHAIRMAN

EXECUTIVE BOARD 1966

BEFORE starting my report on the activities of the Board in 1966, I should like to record my congratulations and those of my colleagues to Mr. D. ffrench-Mullen on his appointment as a Commander of the Order of the British Empire last June.

The changes on the Board for the year under review were the replacement of Messrs. René Noël and Georges Rouillard by Messrs. Francis North Coombes and Loïs Desvaux de Marigny, and of Sir André L. Nairac, C.B.E., Q.C., as Chairman, by myself.

The Board held 12 meetings during the year, three of which were held jointly with the Research Advisory Committee.

ESTABLISHMENT

We regret to record, once again, the resignation of fully qualified members of our staff who left the Institute in 1966, having been offered better conditions outside Mauritius, or in the sugar industry.

Dr. E. Rochecouste retired and left for Australia to take up an appointment in Brisbane with Messrs. Dupont de Nemours. Dr. Rochecouste has, during eleven years, devoted all his time to serve and promote our objectives. His services have been invaluable both to the Institute and to the sugar industry.

Dr. D. H. Parish resigned to take up the chair of Agricultural Chemistry at Makerere University College in Uganda.

Mr. R. Huët de Froberville left the Institute to assume the post of Factory Manager at Rose Belle S.E., and Mr. M. Pérombelon resigned, having accepted an appointment as Senior Experimental Officer at the Scottish Horticultural Research Institute, Dundee.

As a result of these resignations, Mr. Y. Wong You Cheong was appointed Chemist in charge of the Chemistry Division, and Mr. C. Mongelard was appointed Plant Physiologist.

The Board decided to re-style and re-classify the following posts :

Pathology and Plant Breeding

Mr. R. Antoine	was appointed	*Chief Pathologist*
Dr. C. Ricaud	,, ,,	*Pathologist*
Mr. L. P. Noël	,, ,,	*Plant Breeder*
Mr. P. R. Hermelin	,, ,,	*Associate Plant Breeder*
Mr. J. A. Lalouette	,, ,,	*Biometrician*

Sugar Technology

Mr. J. D. de R. de St. Antoine	was appointed	*Chief Sugar Technologist*
Mr. E. C. Vignes	,, ,,	*Chemist*
Mr. F. Le Guen	,, ,,	*Instrumentation Engineer*

Entomology

Mr. J. R. Williams	,, ,,	*Chief Entomologist*

Agronomy

Mr. P. Halais	,, ,,	*Consulting Agronomist*

The following appointments were also made : Mr. H. R. Julien, Assistant Plant Breeder, to replace Mr. Pérombelon; Mr. P. Y. Chan, Assistant Chemist; Mr. S. Marie-Jeanne, Assistant Sugar Technologist; Mrs. M. Le Guen, Clerk Typist; Messrs H. Maurice, J. Pitchen and S. Sullivan, Laboratory Assistants; Mr. S. de Villecourt, Field Assistant, and finally Mr. A. Bérenger, who had been for many years Factory Manager of Highlands S.E. until he retired, was appointed Temporary Sugar Technologist.

FINANCE

I must now deal briefly with the vital question of finance which my predecessors have also felt necessary to include in their respective reports. Three considerations prompt me to raise it again this year.

First, it is evident from our published accounts that the income which the Institute derives from the statutory levy on sugar exports is insufficient to allow for the building up of a strategic reserve to guard against inevitable crop shortfalls and consequent reduction of revenue in lean years.

Secondly, such annual income, inevitably variable in amount as it is, cannot even now provide for the budgeting of worthwhile extensions to our research programme, with the result that promising, useful, and sometimes urgent projects often have to be postponed for lack of funds.

Thirdly, this insufficiency is more acutely felt when it prevents the Institute from securing or retaining the services of the best available technicians it requires to function competently and efficiently. The fact that so many members of our staff have left us during these recent years to accept more attractive offers elsewhere, is a sad reflection on the capacity of the Institute to compete successfully with similar foreign institutions for the recruitment of its cadres.

The inescapable conclusion to be drawn from the above considerations is that the financial resources of the Institute are inadequate. I earnestly hope that the Government will accept this fact, and will agree to examine with the Board the possibility of raising the annual levy to a level commensurate with our present needs.

The sugar industry in our wholly agricultural country cannot thrive without research; and research – if it is to remain as outstanding as Lord Campbell of Eskan publicly declared it to be when he visited Mauritius – cannot live improvidently. The Insitute must be given the means to make financial provision for the future, to plan and carry out a programme of work without the fear of having to curtail it, or of leaving it unfinished, for want of technicians.

AIME DE SORNAY SCHOLARSHIP

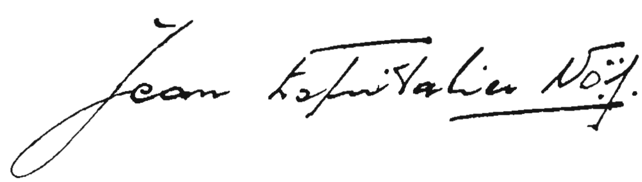
The scholarship was awarded in 1966 to Mr. J. M. H. Maingard who came out third, with 71.8% of the marks, at the entrance examinations of the College of Agriculture in April.

PERSONALIA

During the year under review the Institute had the pleasure of welcoming many distinguished visitors : Lord Campbell of Eskan, Chairman of Messrs. Booker Brothers and also Chairman of the Commonwealth Sugar Exporters Group in London; Mr. D. Rhind, C.M.G., Adviser on Agricultural Research, Ministry of Overseas Development; Mr. J. Debiesse, Directeur du Centre d'Etudes Nucléaires de Saclay, France, who was accompanied by Messrs. Barbier and Buscarlet of the same Institute; Dr. L. Nickell, Assistant Director of the H.S.P.A. Experiment Station; Mr. M. de Pompignan, Directeur du Centre d'Etudes de la Canne et du Sucre, Martinique. The interest which they showed in the Institute's work is of the greatest encouragement.

ACKNOWLEDGMENTS

I wish to record my grateful thanks to my colleagues of the Executive Committee who have extended to me their most valuable help and support. To our Director and his Staff, I wish to express my deep appreciation of their precious collaboration throughout the year, and I would like to offer a special word of thanks for their unremitting devotion to duty and their valuable assistance.



Chairman

30th January, 1967

REVENUE AND EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1966

Running & Administrative Expenses ...		1,715,872.81	Cess on Sugar exported		2,029,714.94
Herbarium Expenses		7,200.70	Miscellaneous receipts		91,323.23
Interest Paid		36,562.62			
Leave and Missions Fund		125,000.—			
Depreciation		133,424.10			
Excess of Revenue over Expenditure ...		102,977.94			
	Rs.	2,121,038.17		Rs.	2,121,038.17

BALANCE SHEET

AS AT 31st DECEMBER, 1966

ACCUMULATED FUNDS		1,452,096.92	FIXED ASSETS (at cost less Depreciation and amounts written off)		
REVENUE FUNDS		103,431.17	Land & Buildings ...	1,412,029.33	
			Equipment	48,356.55	
AIMÉ DE SORNAY FOUNDATION ...		25,000.—	Agricultural Machinery and Vehicles	38,855.50	
LOAN FROM ANGLO MAURITIUS ASSURANCE SOCIETY LTD. ...		43,807.—			1,499,241.38
			CURRENT ASSETS		
GOVERNMENT OF MAURITIUS (Purchase of Buildings)		102,175.60	Sundry Debtors	148,716.43	
			Aimé de Sornay Foundation Account	25000.—	
			Cash at Banks & in hand ...	53,552.88	
					227,269.31
	Rs.	1,726,510.69		Rs.	1,726,510.69

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December 1966, 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 1966, 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) JEAN ESPITALIER-NOEL } *Board Members*
(sd) D. FFRENCH-MULLEN }
(sd) P. O. WIEHÉ *Director*

(sd) P.R.C. DU MÉE, C.A. (S.A.), F.S.A.A.

DE CHAZAL DU MÉE & Co.

Chartered Accountants

Port Louis,
Mauritius,
4th February, 1967.

INTRODUCTION

THE 1966 SUGAR CROP

THE amount of sugar produced in Mauritius in 1966 was nearly 20% below that of a normal year, and approximately, 15% less than in 1965.

Although the crop started well with abundant rains early in the growing season, climatic conditions which followed from December 1965 onwards were detrimental to growth. Rainfall was considerably below average from December 1965 to June 1966, the sum of monthly deficits being 23.7 inches, a figure which was exceeded only seven times in the last ninety years. Maximum temperatures were significantly below average during the first six months of the growing season, while the daily range of temperature was smaller than normal. In addition, cyclone *Denise* in early January caused appreciable damage, with winds at 45 miles per hour over one hour and gusts exceeding 100 miles per hour, while cyclone *Kay* occurring in March, although less severe, caused damage to plantations at higher elevations.

Of the five main climatic factors affecting cane growth, therefore, four were unfavourable, namely : rain, temperature, range of temperature, and wind, only the fifth factor, hours of sunshine, having been above average.

The area harvested was slightly larger than in 1965, yet cane production was reduced by more than one million tons, so that the average cane yield per arpent was 19.5% below that of the preceding year, ranging from 19.7 tons per arpent for planters' land to 29.5 tons per arpent on estates, compared with 25.3 and 35.7 respectively in 1965.

Conditions during the maturation season from July to November were more favourable, there were no rain excesses during that period and sucrose content averaged 13.20%. This figure, however, is disappointing and is below that which might have been expected, probably because of the poor physiological condition of the cane which had suffered a prolonged drought period, and which is reflected in the high proportion of fibre, scum, and molasses produced. It should also be pointed out in this connection that minimum temperatures, which are closely associated with high sugar content, were above average by 0.4°C during the harvest season. Finally, it should be borne in mind that, while the returns of sugar per arpent have significantly increased in recent years, at least two of the varieties (M.147/44 and M.93/48) which represented 41% of the canes crushed in 1966 contain less sugar than other varieties.

In general, flowering was more abundant than is normally the rule in Mauritius.

The salient features of the 1966 sugar crop compared to those of 1965 are summarized below, and in figs. 1 to 6.

	1966	*1965*
Area cultivated, arpents	206,000	205,600
Area harvested, ,,		
Estates	100,990	101,287
Planters	94,746	93,637
Total	195,736	194,924
Weight of canes, metric tons	4,842,915	5,984,458
Tons cane per arpent :		
Estates	29.5	35.7
Planters	19.7	25.3
Average, Island ...	24.7	30.7
Commercial sugar recovered % cane...	11.60*	11.10

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

	1966	*1965*
Tons sugar per arpent		
Estates	3.42	3.96
Planters	2.28	2.81
Island	2.87	3.41
Duration of harvest, days	139	156
Tons cane per hour ...	97.3	100.6
Tons cane crushed weekly	244,400	268,700
Sucrose % cane ...	13.20	12.49
Fibre % cane... ...	13.46	12.95
Molasses % cane ...	2.75	2.53
Filter cake % cane ...	3.37	2.90
Purity mixed juice ...	87.7	88.0
Reduced mill extraction	96.1	96.0
Sucrose % bagasse ...	2.05	1.93
Reduced boiling house recovery	88.4	88.8
Reduced overall recovery	85.0	85.3
Total sucrose losses % cane	1.73	1.55
Tons sugar 98.8 pol metric tons ...	561,800	664,500

Fig. 1 Rainfall and temperature in 1966, weighted average over the five sugar sectors of Mauritius. Rainfall was markedly below average throughout the growing season except in January (cyclonic rains) and June, and also during the harvest season. Maximum temperatures were below normal from November 1965 to April 1966, while minimum temperatures were above normal throughout the maturation period. (For detailed information, *cf.* tables VII & VIII of Appendix).

Fig. 2 Relative sugar yields (metric tons, 98.8 pol) obtained by estates and planters in different sectors of the island in 1966. Estate yields exceeded planters' by 1.14 tons per arpent. The lowest yields were recorded in the North and Centre, the first sector having suffered more from drought, and the second from cyclonic winds.

Fig. 3 Rain deficits for consecutive periods of 10 days during the growing season of 1965-1966, showing the prolonged period during which the plant was under water stress.

Fig. 4 Variation in sucrose % cane during the harvest season of 1966 compared to the preceding 5-year average. It will be observed that no deterioration in sugar content occurred in the latter part of the harvest, probably because of the continued dry conditions.

Fig. 5 Yield of virgin and ratoon canes in 1966 compared to the preceding 5-year average.

Fig. 6 Variety trend in the sugar industry of Mauritius as expressed by the area under cultivation and the area planted in 1966 (the variety M.253/48 which occupies only 2% of the cultivated area is not shown). The ratio area planted to area cultivated expresses the popularity of a given variety.

THE CANE VARIETY POSITION

The varietal composition of the 1966 crop was largely dominated by three varieties : M.147/44, M.202/46, and M.93/48, except in the Centre where Ebène 1/37 and Ebène 50/47 occupied together 45% of the cultivated area.

The performance of varieties, assessed in terms of cane yields, is summarized on p. 18, varieties being arranged in order of merit above or below a line representing the average yield for the sector. The percentage area under cultivation is shown in brackets.

An examination of this table reveals that, of the varieties which occupy more than 10% of the cultivated area, M.202/46 and M.93/48 were the best cane producers in 1966. Yields of M.147/44 were generally lower than average, a fact which indicates that this variety also suffers from prolonged dry periods.

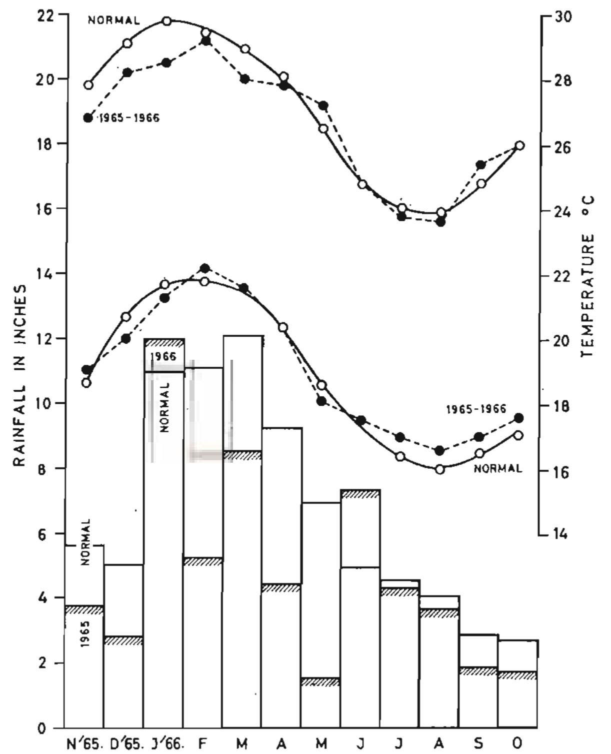


Fig. 1. Rainfall, maximum and minimum temperatures, during the growing and harvest season of 1966.

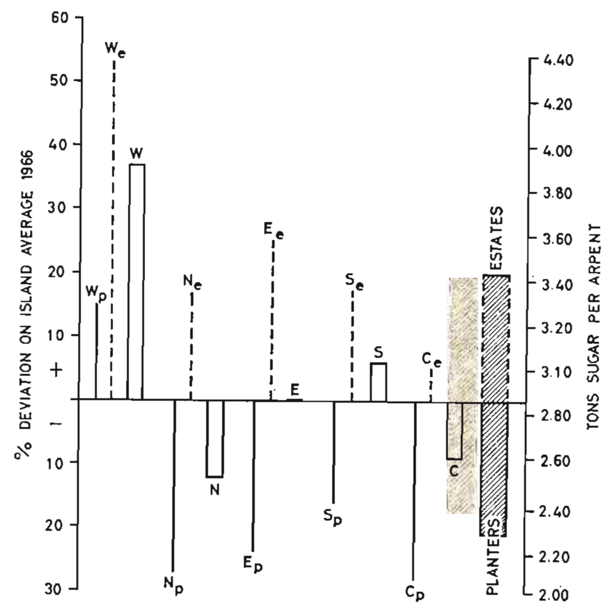


Fig. 2. Relative yields of sugar per arpent in different sectors. Average island yield = 2.87 m. tons of 98.8 pol sugar.
Plain line : planters ; broken line : estates ; columns : sector average.

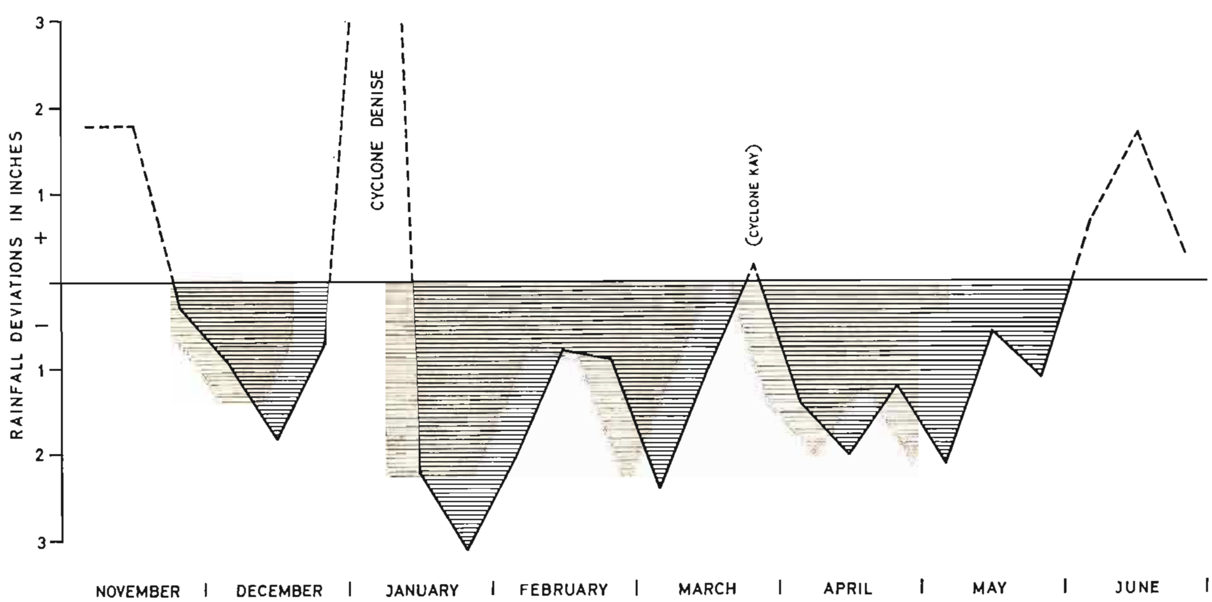


Fig. 3 Rain deficits (average for all sugar cane sectors) during the growing season of 1965 - 1966.

WEST	NORTH	EAST	SOUTH	CENTRE	ISLAND
M.442/51 (6) M.202/46(20) M.253/48(10)	M.93/48(7)* M.442/51(9) M.202/46(12) Eb.50/47(2)*	M.202/46(15) M.93/48(14) M.31/45(9)	M.442/51(4) M.31/45(4) M.202/46(14) B.37172(10) M.134/32(4) M.147/44(20)	M.93/48(33)	M.442/51(5) M.31/45(4) M.202/46(13) M.93/48(16)
35.9	28.6	31.1	29.2	26.4	29.5
M.147/44(32) M.31/45(2) B.37172(9) B.34104(12) M.134/32(2)	M.147/44(46) M.31/45(4) B.37172(9) M.134/32(7)	M.442/51(4) M.253/48(2) Eb.1/37(8) Eb.50/47(4) M.147/44(28) B.37172(7) B.3337(5)	M.93/48(15) Eb.50/47(6) Eb.1/37(9) B.3337(6)	M.202/46(5) Eb.1/37(24) M.147/44(4) Eb.50/47(21)	B.37172(8) M.147/44(26) M.134/32(3) B.34104(1) Eb.1/37(9) Eb.50/47(6) B.3337(4)

The mediocre yield of Ebène 1/37 is to be attributed to its susceptibility to high winds. Concerning varieties occupying less than 10% of the cultivated area, M.31/45 gave excellent results, while Ebène 50/47 was very variable, being very poor in the Centre. M.442/51 was harvested on a large scale for the first time in 1966, yields were high, and factory tests carried out in several localities confirmed that sucrose content is good from September onwards. Although B.37172 is a variety on its decline, its performance in the South was excellent.

The present varietal trend is indicated in fig. 6, which shows the area cultivated and the area planted under each variety during the year. Excluding newly released varieties which are in the stage of being rapidly multiplied, four varieties are being extended : M.442/51, M.93/48, M.202/46 and M.31/45; four varieties were replanted over relatively small areas : Ebène 1/37, Ebène 50/47, M.147/44 and M.253/48, while the remaining four commercial varieties were not replanted (B.3337, B.34104, B.37172 and M.134/32).

Before concluding these remarks on established commercial varieties, it is important to draw attention to the weakness of M.202/46, namely its susceptibility to leaf scald and to *Fusarium* wilt. Because of these diseases, a large scale extension of this variety is not recommended.

A critical study was made, during the year, of all observations available on the effect of gumming disease on M.147/44, as a result of which it was recommended to Government that this variety should be maintained on the list of approved canes until 1973 instead of 1970.

The Cane Release Committee met twice during the year and recommended the release of M.409/51, M.13/53, M.13/56, M.377/56 and N : Co.376. Short notes on these varieties and on M.99/48, which was released at the end of 1965, are given below.

M.99/48 (B.34104 x M.213/40). The primary object in releasing this variety was that it could replace B.3337 under inferior conditions of soils and climate. It is a vigorous variety which matures late in the season and ratoons well. It is susceptible to yellow spot, a disadvantage for any variety grown in the super-humid area. Sugar yields are comparable to those of M.93/48. M.99/48 appears to be adapted also to irrigated areas and to hydromorphic soils of the lowlands.

* The distribution of these varieties is confined to the moister part of the North receiving 60" of rain or more per annum.

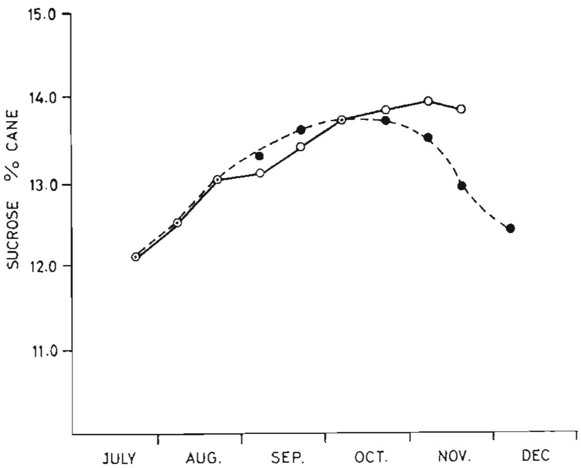


Fig. 4. Variation in sucrose content in 1966.
Plain line : 1966 ; broken line : average 1961 - 1965.

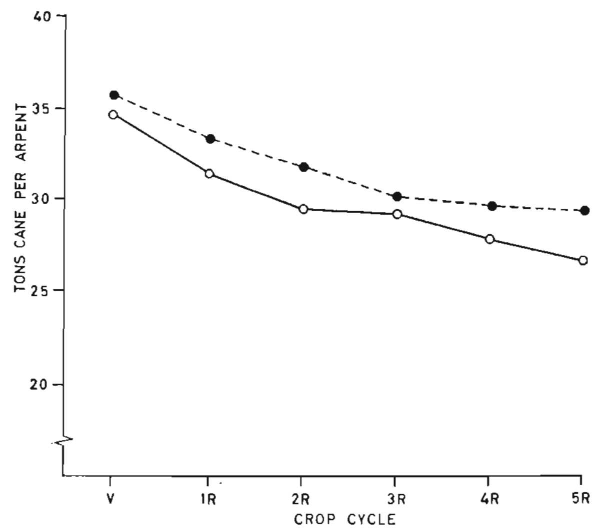


Fig. 5. Cane yields in 1966 (plain line) compared to the average 1961 - 1965 for all estates of the island (broken line).

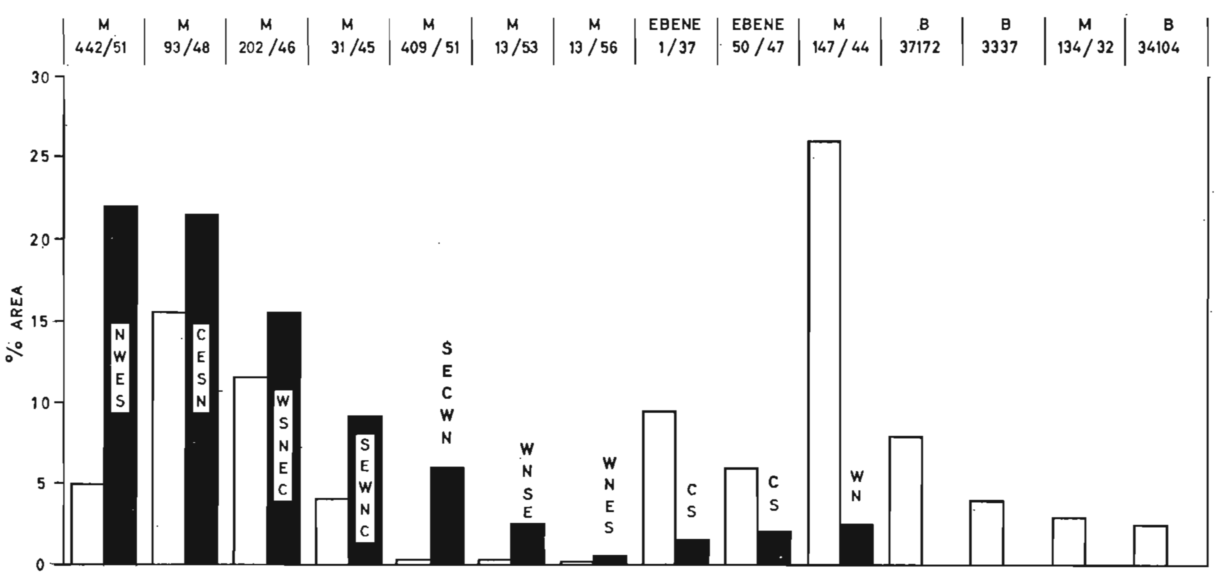


Fig. 6. Variety trend as shown by area cultivated (plain columns) and area planted in 1966 (black columns). Letters denote sectors arranged in descending order of importance of plantations made in 1966.

M.409/51 (M.112/34 x D/109). This variety is not adapted to a wide range of conditions. It is neither drought-resistant, nor does it tolerate high rainfall. Because of its good performance under humid conditions however, it is hoped that M.409/51 may help in the replacement of M.202/46. Average results of seven trials in the sub-humid and humid areas are shown in fig. 7A

M.13/53 (M.60/44 x M.72/31). A medium-to thin-stalked variety whose chief characteristic is its high sucrose content. Average results of nine trials in comparison with M.147/44 are shown in fig. 7D. M.13/53 has performed better in trials and observation plots in the North, East and West, than in the South. It appears to be fairly tolerant to dry conditions but is not adapted to the super-humid area.

M.13/56 (M.241/40 x M.147/44). A thin stalked variety which is very vigorous and whose sucrose content is higher than that of M.147/44. Average results of four trials are shown in fig. 7E. M.13/56 offers promise of being a successful variety in a wide range of environments, including dry areas.

M.377/56 (B.34104 x M.213/40). One of the best varieties tested in recent years. It combines high sucrose with vigour and adaptation to a wide range of environmental conditions. Average results of field trials in comparison with M.147/44 and M.93/48 are shown in fig. 7C.

N:Co.376 This variety was introduced from South Africa in 1956. Judging from its performance in trials, it should prove a useful variety in the super-humid zone where it has outclassed both standards, Ebène 1/37 and M.93/48, in cane yields and sucrose content. It is an early maturing variety; amongst its defects, mention must be made of its clinging trash and heavy flowering.

CANE BREEDING AND SELECTION

It had been contemplated to curtail considerably the crossing programme in 1966 on account of the large amount of fuzz left over from the 1965 season and kept in cold storage. However, with the excellent flowering season which prevailed, the opportunity could not be missed to duplicate certain combinations of suspected low fertility made the previous year, in order to be able to assess the value of each cross. Also, a number of new combinations, not attempted in 1965, were made. On the whole, 455 crosses were carried out, involving 115 combinations. A total of 93 different parents were used, comprising 53 clones as females, 37 as males, and 3 as both male and female. Nobilization of *Saccharum robustum* has now reached the second generation, and more nobilizations of both *S. robustum* and *S. spontaneum* were carried out. The breeding plots of noble varieties at Palmyre and hybrid parents at Pailles, planted late in 1965, produced few flowers which were utilized in the breeding work.

Sowing started in late October, most of the fuzz from the 1965 crosses was sown together with duplicate crosses made in 1966. The bulk of the 1966 fuzz is being kept for sowing late in 1967. A small amount of fuzz stored from the 1964 season was also sown. The germination capacity after two years' storage although slightly reduced was still reasonable. The remaining fuzz was left in storage for further testing in 1967. All sowings were carried out in the greenhouse at Réduit, and potting done at both Réduit and Pamplemousses

The number of seedlings potted, mostly in bunches of three, amounted to approximately 84,586, thus giving about 28,933 pots. The seedlings are to be planted in the field in February-March 1967, part of which will be bunch-potted at three pots of seedlings per hole.

Good progress was made in the recording

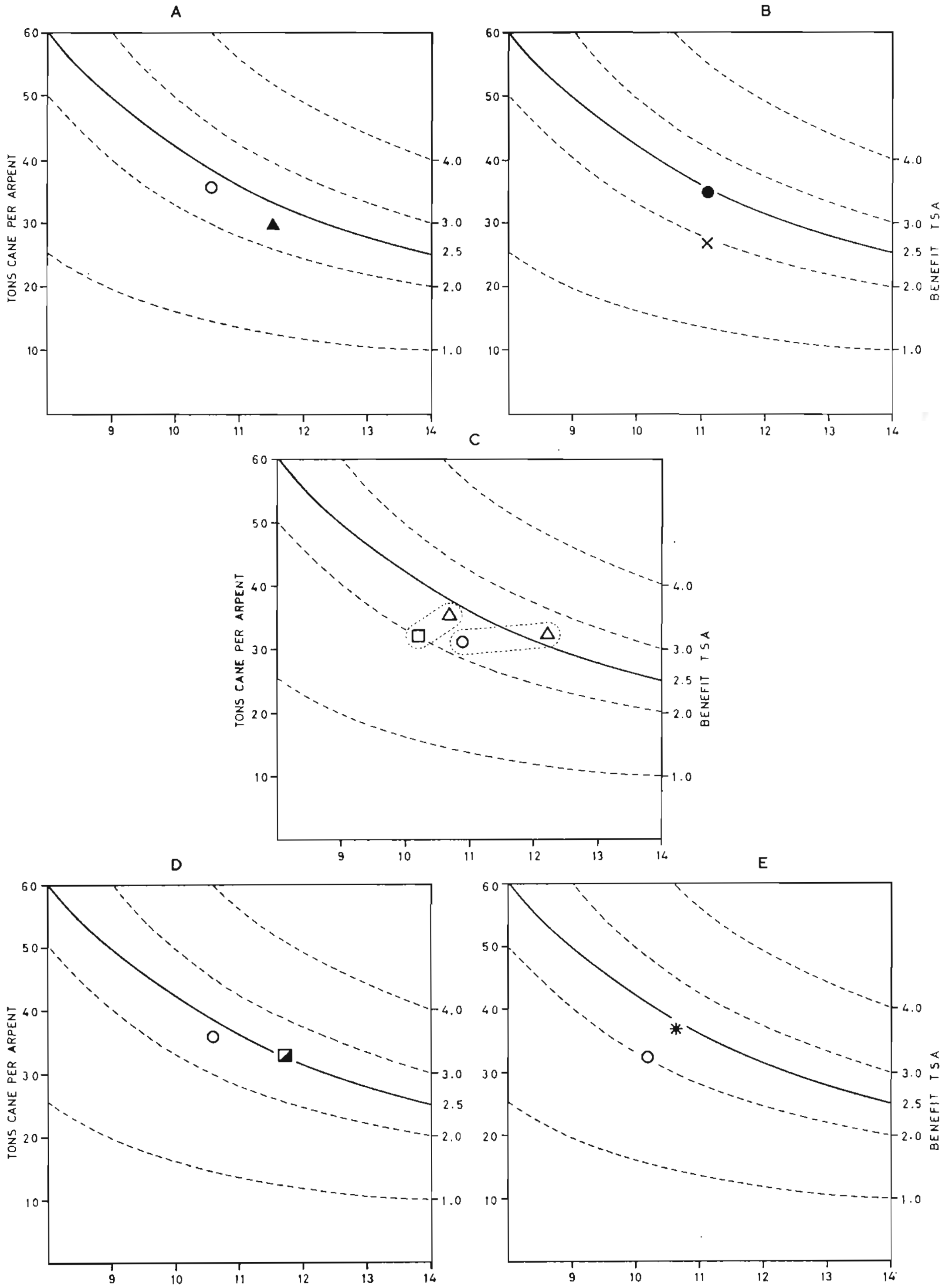


Fig. 7. Benefit curves for ratoons at levels of 1.0 to 4.0 tons of commercial sugar per arpent. Five varieties released in 1966 are compared to the standards.
A. M.409/51, 7 trials, 17 comparisons (1961 - 1966). B. N:Co. 376, 2 trials, 6 comparisons (1962 - 1966).
C. M.377/56 (i) 5 trials, 8 comparisons with standard M.147/44 (1965 - 1966).
(ii) 3 trials, 5 comparisons with standard M.93/48 (1965 - 1966).
D. M.13/53, 9 trials, 17 comparisons (1961 - 1966). E. M.13/56, 4 trials, 9 comparisons (1963 - 1966).
Standards : O = M.147/44 ; × = Ebène 1/37 ; □ = M.93/48
New varieties : ▲ = M.409/51 ; ◪ = M.13/53 ; * = M.13/56 ; Δ = M.377/56; ● = N:Co. 376

of data on punch cards started in 1965. The following machines have been installed in the Biometry section of the Institute : an automatic puncher, a sorter, and a tabulator. Data relevant to all stages of selection for the year 1966, and to the first stage of selection from 1953 onwards, have been punched on cards. Processing of these data is in progress, and it is hoped that enough information will have been gathered early in 1967 to help rationalize the crossing and selection programme. Furthermore, the visit of Dr. Gavin Ross, from the Statistical Department of Rothamsted Experiment Station, arranged through the kind services of Mr. D. Rhind, of the Ministry of Overseas Development, should prove of great value. Dr. Ross is to spend two months in March-April 1967 to advise the Institute on statistical problems.

Some headway was made with the use of the fluorescence technique in the study of pollen germination. Indications have been obtained that the time between pollination and fertilization may be longer than thought hitherto.

Basic research in the physiology of flowering continued.

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

(a) Seedlings from 1964-1965 series planted in March-April 1966 :
  (i) Singly planted at Réduit from nobilization crosses ... 2,350
  (ii) Singly planted from specific crosses for a study of inheritance of resistance to gumming disease ... 765

(b) 1963-1964 series. Varieties in bunch selection plots ... 23,406

(c) 1961-1963 series. Varieties in propagation plots for selection in first ratoons 4,585

(d) 1959-1962 series. Varieties in first selection trials to be selected in second ratoons 578

(e) Varieties in multiplication plots for establishing field trials in 1967 : 1959-1960 series ... 45

(f) Varieties in trials on estates :

1946-1959 series	189	
Ebène varieties	10	
Foreign varieties	17	
	——	216

The number of variety trials standing in 1966 amounts to 86 distributed in the four climatic zones of the island. The following varieties are showing promise : M.305/51, M.428/51, M.356/53, M.75/55, M.260/55, M.145/56 M.220/56, M.84/57, M.130/57, M.351/57, M.393/57. Of these, M.220/56, slightly susceptible to gummosis and M.130/57, slightly susceptible to leaf scald, are being closely watched. Two promising varieties, M.189/56 and M.180/58, having shown susceptibility to gumming disease had to be discarded.

Of the other varieties mentioned in the 1965 report, M.658/51 is erratic, and in general performed poorly in trials, and the two Ebène canes, Eb.88/56 and Eb.118/56, have shown susceptibility to leaf scald, particularly the former. Another Ebène variety, Eb.74/56, which seems well adapted to a wide range of conditions, reacted as susceptible (slight to moderate) to both strains of the gumming disease bacterium. In view of this, the variety will not be considered for release until more information is obtained.

A new series of final variety/fertilizer trials were started in 1966, including twelve sites and six varieties : M.99/48, M.409/51, M.442/51, M.13/53, M.13/56, and Ebène 74/56, with two standards : M.147/44 and M.93/48.

CANE DISEASES

Attention was focussed mainly on gummosis, leaf scald, and *Fusarium* wilt, but as usual, several other problems had to be attended to.

Gummosis. Work on gumming disease was restricted mainly to a thorough survey of fields of M.147/44 in order to assess the importance of the disease in that variety, especially in sub-humid regions where an early maturing, drought-resistant substitute still has to be found. Cyclone *Denise* early in the year had given ideal conditions for dissemination of the pathogen, and by March the disease had been found to be severe in M.147/44 with widespread, heavy leaf striping. However, when the island-wide survey was made at the beginning of harvest, in late July, the disease was found to be, on the whole, of moderate intensity, with very few cases of systemic infection except in fields under spray irrigation. It is now considered that the disease does not appear to cause damage in the dry coastal areas of the North and North-West. An analysis of yields of the variety M.147/44 for the past three years has not revealed a decline in cane yields which could be attributed to the disease. In view of the above, it has been decided to recommend that the period for the compulsory uprooting of M.147/44 be extended to December 1973.

The regression in the epidemic during 1966 can be attributed to the severe drought which occurred during the growing season. Analysis of climatic factors which prevailed in 1964, 1965, and 1966, in relation to the gradual regression of the epidemic, has led to a better understanding of the epidemiology of the disease and confirmed assumptions made last year that high rainfall and strong winds during the growing season, followed by an early maturing season with low temperatures and low rainfall, are conducive to a severe epidemic, as was the case in 1964.

The procedure of testing varieties at two stages during selection is now well established. Two trials are at present under way for the first stage-testing with the new strain of the pathogen involving 377 and 217 varieties.

At the second stage, during which varieties screened from the 1st selection trials are included, it has been found worthwhile to continue testing of both old and new strains in two separate trials in two localities, thus obtaining information on the degree of virulence of the two strains. Forty-two new seedlings were tested in these trials in 1966, while 21 more were re-included in the trial with the new strain for confirmation of results obtained. Out of the 63 varieties, 18 have shown moderate susceptibility, and 6 high susceptibility, including the very promising varieties mentioned in the 1965 report : M.579/59 and M.1007/59. Another trial was established to study the susceptibility of seedlings issued from selected crosses.

Investigation on the effect of systemic infection on yield is continuing.

Laboratory work on the two strains of the bacterium is progressing. Isolates from a range of susceptible canes undergoing selection, growing in different localities, are being tested on the tetrazolium medium in order to study strain distribution in the island.

Studies have also revealed morphological differences between individual bacterial cells of the old and new strains when isolates are cultured on the medium containing triphenyl tetrazolium chloride.

The Fusarium problem. The outbreak of *Fusarium* wilt reported in 1965 has been more severe this year in humid and super-humid areas. The variety M.202/46 was the most affected, but M.93/48 and Ebène 1/37 also showed some susceptibility. Diseased fields were harvested as early as possible, but in cases where infection had set in at the beginning of the growing season, severe reductions in yield and sucrose content were experienced. The disease has also been found to affect ratooning due to infection of young shoots and buds of the rhizome. Fields thus affected had to be recruited or replanted with another variety. In rare cases, the disease has been found to affect newly planted canes through infection of setts, either in plantations established near diseased fields, or in diseased patches which had been recruited.

Extensive surveys were carried out by estate agronomists in order to assess the distribution of the disease and its economic importance in susceptible varieties.

Fusarium wilt being usually associated with specific unfavourable growth conditions, there is no reason to be unduly alarmed. In fact, as already indicated, both M.202/46 and M. 93/48 have produced high yields in 1966. The precaution which should be taken is to refrain from cultivating these varieties in poorly drained fields, for it is known that under waterlogged conditions the disease is at its worst.

Experiments are underway to test the effect of fungicidal applications, particularly to promote ratooning. The effect of a short fallow before replanting diseased fields is also under study.

Numerous cases of inflorescence rot in M.202/46 and Ebène 50/47, caused by what appears to be the same organism as the wilt fungus, namely *Fusarium moniliforme*, have been observed all over the island. The condition is attributed to the high incidence of flowering, coupled with the severe drought which delayed the rate of emergence of inflorescences already produced. Affected canes contained less sucrose due to profuse development of side shoots.

Comparative studies are in progress on isolates of *F. moniliforme* from the different types of infection : wilt, pokkah boeng, inflorescence rot, and stem rot.

Leaf Scald. Leaf scald is still a problem in fields of M.202/46, especially in humid to super-humid regions. Knife sterilization during preparation of cuttings and rogueing of diseased stools in nurseries, have been effectively followed on several estates, but the results are not entirely satisfactory. However, it has been observed that wherever such practices are not followed, disease incidence can increase considerably. A survey revealed up to 1,000 diseased stools per arpent in a field of M.202/46, but cane yields were not apparently affected, suggesting a certain tolerance to the disease. However, a decrease in sucrose content of diseased shoots was observed. The evolution of the disease has been followed in individual naturally infected stalks of Ebène 88/56. A number of infected stalks died, the others did not recover until harvest, and an average reduction in growth rate of 44% in the diseased stalks was observed.

A new resistance trial was established with 24 varieties at Belle Rive Experiment Station.

Ratoon Stunting Disease. The reactions of varieties to gumming disease — both new and old strains — having been assessed, a new series of ratoon stunting trials will be established in 1967 after sufficient planting material has been bulked up at the Central Nursery.

Estates and planters were supplied with 2,715 tons of planting material from the Nursery in 1966, as compared to 3,000 tons in 1965. A total of approximately 132 arpents were under A and B nurseries in 1966 for the supply of disease-free planting material in 1967. About 260 tons of cuttings were treated at the Central Hot-Water Treatment Station in 1966 to plant 67 arpents of land at the Central Nursery. Thirty-five new promising varieties were established for inclusion in trials after propagation.

The Nursery is faced with a serious problem of scale infestation. Experiments on the hot-air treatment of cuttings in an attempt to control the insect have shown that the cane buds will not tolerate the time/temperature combinations needed to kill the scale.

Miscellaneous. Studies on chlorotic streak transmission are continuing. Two new greenhouse experiments were set up to investigate transmission by Chytrids. A field trial was also laid down to study the effect of organic soil amendments in delaying re-infection of treated cuttings.

Yellow spot was less severe in 1966, and symptoms disappeared from affected fields earlier than usual, probably on account of the dry conditions which prevailed.

All varieties released from quarantine during the year are now well established. A new quarantine cycle was started in September with 43 varieties, mainly breeding canes, obtained from Australia (8), U.S.D.A. (24), Taiwan (2), India (2), Barbados (7).

CANE PESTS

Intensive laboratory breeding of *Diatraeophaga striatalis* Tns. (Tachinidae, Diptera), the Javanese cane borer parasite, was carried out from February onwards at Pamplemousses Experiment Station, where an existing building has been modified specially for this purpose. The parasites reared were liberated in selected cane fields. This work, which is continuing, is an endeavour to establish the parasite in Mauritius for biological control of the major cane pest, the moth-borer *Proceras sacchariphagus* Boj.

Diatraeophaga occurs naturally as a parasite of *Proceras* in Java. It is not known to occur elsewhere, and it is the only species of Tachinidae recorded from Pyralid cane borers in the Old World. It was first obtained from Java in 1961 as a result of an expedition initiated and financed by the Institute, and conducted by the Commonwealth Institute of Biological Control. A second expedition, helped by information acquired during the first, was organized in 1964 by the *Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières* (IRAT) for introduction of the parasite into Madagascar and Réunion, where *Proceras* is also an important cane pest. These expeditions enabled the release in Mauritius of about 700 and 1,500 parasites in 1961 and 1964 respectively. Establishment did not result, and difficulty was encountered in breeding the parasite in the laboratory, but the essential features of its biology were determined and valuable experience was gained. A laboratory culture maintained by IRAT-Madagascar since 1964 served for further study of breeding methods, and in 1965 a particularly successful culture was started in Réunion. Both countries, Mauritius and Réunion, are currently endeavouring to establish *Diatraeophaga* with laboratory-reared stocks.

Requisites for the establishment of *Diatraeophaga* are a suitable environment and release of adequate numbers of adults. There is no assurance that Mauritius provides the former, although it seems unlikely that all regions are unsuitable, and this factor can be explored only by liberations in various districts. The number to be released for establishment to occur in the field under any given conditions is unknown. It follows that the only procedure for testing the potential of the insect as a parasite of *Proceras* is the release of as many adults as possible in different climatic areas, at different times of the year. Little significance can be attached to the negative results of the 1961 and 1964 liberations in view of the small numbers released.

Beginning at the end of February with 200 *Diatraeophaga* pupae received from IRAT-Réunion, nine parasite generations comprising 27,300 adults were reared during the year. To accomplish this, over 55,000 borers were collected and artificially parasitized. The techniques used are described and illustrated elsewhere in this report. The parasites were released in two localities, Belle Vue, during March-September, and Le Vallon, during October-December. As the females need to mate only once for all eggs to be fertilized, and there is a gestation of about one week, the procedure adopted was to mate as many females as possible and then to retain them for a few days before release. This circumvents the possibility of males and females not finding each other in the field after their release, owing to dispersion and limited numbers, and ensures the deposition of eggs shortly after release and, therefore, over a limited area. The total number of mated females released was 9,742 out of 13,802 obtained. All parasites released, including males, totalled about 22,200. Attempts to determine if the insect has established itself in the field would be premature at this stage.

Heavy infestations of the scale insect, *Aulacaspis tegalensis* Zhnt., were again experienced in many fields of the Central Cane Nursery. The installation of facilities for heat-treatment of canes leaving the nursery is under study. Experiments on hot-air treatment of cuttings did not lead to practical applications.

No unusual pest outbreaks occurred during the year apart from a severe, localized attack on young plant cane in the north by the beetle *Alissonotum piceum*.

Although the white grub, *Clemora smithi*, is now seldom found in high numbers in cane field soils, the growing of flowering shrubs, such as *Eupatorium* which attract its parasites, is still to be recommended. Unfortunately, the numbers of these around cane fields have been steadily diminishing.

NUTRITION AND SOILS

Unfavourable growth conditions which prevailed in 1966 had a direct bearing on the results of field trials on cane nutrition; thus in many cases the results of experimentation were completely invalidated by the prolonged drought and cyclonic winds early in the season. Further, the 1966 results of foliar diagnosis from the permanent sampling units have had to be studied with caution, in particular for nitrogen, because of sampling difficulties when the plant is under water stress. Since these results are averaged over a period of three years, it was still possible to make recommendations for the best fertilizer treatments to be adopted.

An interesting N fertilizer which may be suitable for gravelly soils, where leaching of nitrogen presents a problem, is being compared with sulphate of ammonia. This fertilizer is a high N-containing (38% N) urea-formaldehyde polymer which contains one third of its total N in a soluble form, and the rest in a slowly available form. However, this fertilizer is expensive and its use, should its efficiency prove to be high, cannot be envisaged for the moment with the current low sugar prices.

Concerning phosphorus, it may be confidently asserted that the phosphate status of cane soils on estates is now generally good, but it is still essential to obtain a basic understanding of the behaviour of fertilizer phosphorus on the different soil groups of Mauritius. Preliminary results have shown that on the more weathered mature soils, there is a direct correlation between the extractable aluminium and phosphorus retention; on the younger and immature soils, free iron oxide content assumes greater importance as regards phosphorus retention.

An analysis of the figures available for soil P, as determined by the modified Truog's method, and soil pH (KCl), revealed that for both the latosols and the latosolic groups of soils, a correlation exists between these two factors. The satisfactory level of phosphorus, as reflected by foliar analysis, in very acid soils (pH 4.0) is much lower than that of weakly acid soils (pH 6.5), the levels being 12 and 75 p.p.m. P respectively. Furthermore, at the same pH, the phosphorus level of immature soils is higher than that of mature soils because of the relatively smaller volume of soil.

The modest facilities for radiotracer work available in the Chemistry Laboratories, have permitted the initiation of several lines of research which would have otherwise been difficult to pursue. The labile phosphate (L) values of Mauritius soils are being correlated with plant phosphorus uptake. It has also been possible to study the behaviour of exchangeable (mobilisable) phosphate in these soils. Several autoradiographs have been obtained which show that the movement of phosphate in acid soils is very restricted, whereas on alkaline soils there is a fair amount of movement. The distribution and behaviour of labelled phosphate esters in the sugar cane are also being studied.

Very few studies have so far been carried out on the breakdown of cane trash in the soil and on the behaviour of the nutrients released. Some soil groups are high in organic matter, and soil organic phosphorus may be an important source of phosphorus to sugar cane. It is hoped to use radioisotope techniques to study soil organic matter in the near future.

Preliminary work on the effect of phosphate spraying on the ripening of sugar cane has shown that past the peak of maturation, phosphate spraying carried out a month before harvest has a deleterious effect on sucrose content. More trials will be carried out in 1967 to investigate the effect of phosphate spraying during the pre-maturation period. As yet, there is no conclusive evidence from other cane-growing countries either in favour of, or against, phosphate spraying for cane ripening.

For several years past, attention has been drawn in these reports to the interaction of Mn, Al, Si and Ca, and the importance of a correct balance between these elements, in order to ensure maximal growth of sugar cane. Recent reports from Hawaii on the successful use of calcium silicate slag on low silicon soils are therefore of special interest to Mauritius. The use of calcium silicate to redress cane nutrition when an unfavourable Si/Mn ratio occurs, may prove of significant economic importance on the highly weathered aluminous ferruginous latosols of the island. A comprehensive series of trials with calcium silicate slag originating from Japan will be undertaken early in 1967. A study of data from permanent sampling units has further shown that there is a close correlation between leaf sheath and soil Si, Mn and Ca, so that it is possible from sheath analysis data to obtain precise information on the stage in the evolution of local soils.

SOIL-PLANT-WATER RELATIONS

With the development of irrigation in the island, soil-plant-water relation studies assume a greater importance. Three divisions of the Institute are concerned in these investigations, and it is gratifying to record that outside assistance has been promised for 1967. Thus, a soil physicist, member of the F.A.O. Special Fund Project team, will be attached to the Institute for a period of one year, while the Director of the *Centre d'Etudes Nucléaires de Saclay* has agreed to lend a neutron probe on long term, and to provide technical assistance for training personnel. Progress in several research projects related to the study of soil-plant-water relations is briefly outlined below.

Effect of soil-water potential on growth. Further experiments were carried out in 1966 to determine the effect of varying soil moisture stresses on cane growth. The variety Ebène 1/37 (drought-susceptible) was compared to M.147/44 and M.442/51, two varieties adapted to dry areas. The maximum soil-water potentials allowed in the various treatments were : –0.25, –0.5, –0.75, –3.0 and –9.0 atmospheres.

It was established that, under the conditions of the experiment, shoot height, leaf area and dry weights were adversely affected by even a small decrease in soil-water potential measured at 6 inches below soil level.

The difference in response to the different water régimes between the variety Ebène 1/37 and the variety M.147/44 was more pronounced than that obtained between the variety Ebène 1/37 and the variety M.442/51. It must be emphasized, however, that the greatest effect of soil-water potential on growth of the variety Ebène 1/37, in contrast to the other two varieties, was more marked in the – 0.25 to – 0.75 atmosphere potential range when the soil-moisture throughout the root zone was evidently still fairly high. Similar experiments with six other varieties are being followed.

Measurements of plant-water potential. With a view to obtaining a rapid and reliable method of determining the plant-water status, and hence irrigation needs, several series of experiments were undertaken to measure the plant-water potential. Studies on the Schardakow density column technique for measuring plant-water potential proved too cumbersome to be helpful in general practice. The Refractive index method of measuring plant-water potential is being investigated.

Studies on drought resistance. The effect of solute potential on cane growth with a view to determining varietal drought resistance is under investigation. Preliminary experiments using sodium chloride as the osmoticum have shown that cane growth is affected at solute potential equivalent to – 1 atmosphere. To investigate any possible toxic effect of the salt, comparable experiments with polyethylene glycol will be initiated.

Effect of soil-moisture stress. In a different approach to the study of drought resistance of different cane varieties, high soil-moisture stresses were repeatedly imposed to the growing canes. Single-eyed cuttings of different varieties were planted side by side in soil in shallow trays and allowed to grow for two months with adequate moisture. After this initial growth period, watering was stopped until conditions of extreme water stress were reached, as evidenced by severe drying of leaves. The soil in the trays was then watered and the cycle of drying out and re-watering was repeated a number of times until the canes were five months old. From these preliminary experiments, it was possible to classify the varieties studied in different groups as regards drought susceptibility, but confirmation of these results is required.

Evapotranspiration of sugar cane. The lysimetric studies referred to in the 1965 Annual Report are progressing satisfactorily. Data are now available for virgins and two ratoons of M.147/44 on three soil types. The experiment will be continued until the 1967 harvest. Preliminary compilation of the figures obtained revealed the following salient facts :

(a) consumptive use of water for yields in the range of 60 tons per arpent is 65 inches per annum;

(b) the rate of evapotranspiration varies with the age of the crop and time of the year;

(c) peak water consumption occurs from November to January with an average maximum of 0.34 inches per day;

(d) water consumption is at its lowest point between July and September, with an average minimum of 0.06 inch per day for young canes, and 0.11 inch per day for canes nearing maturity.

(e) the ratio Et/Eo (pan*) increases from 0.3 immediately after harvest to 1.2 in December when the plant resumes full growth;

(f) the gross amount of water needed to produce one ton of millable cane is 140 tons equivalent to 1,330 tons per ton of commercial sugar produced in the field.

WEED CONTROL

The trend in the type of herbicide used on cane plantations in Mauritius continues to be in favour of the pre-emergent residual chemicals, the substituted ureas and the triazine compounds. Three main factors, however, restrict the use of existing pre-emergent weed killers : their high price, their differential efficacity under different climatic conditions, and their selectivity. Total pre-emergence weed control, however, is rarely possible and the addition of 2, 4–D esters to the residual herbicides has given excellent results. The selectivity of many herbicides results in infestation by certain tolerant weeds, thus shifting the weed spectrum to resistant species. For example, at present, species of *Paspalum*, *Kyllinga* and *Cyperus* are encroaching dangerously in cane fields, in the South in particular. Experiments on the control of these weeds are in progress, and promising results have been obtained.

Herbicides are expensive chemicals, and in view of the large sum of money involved annually in their purchase and application (sales exceeded Rs 5,000,000 in 1966), it is imperative that careful thought should be given by cane growers to the following questions : what herbicide to use in given circumstances? when should the selected herbicides be applied? at what rate? are the spraying operations carried out to ensure maximum efficiency? has attention been given to cane varieties, age of canes, soil type, soil moisture, rainfall régime and weed species?

Experiments in progress on weed control are briefly recorded hereunder :

Evaluation of new herbicides. The herbicides coded NPH/1232, U.C. 40.0, and U.C. 40.1 were included in a screening test and compared with DCMU in a logarithmic trial using the Chesterford logarithmic spraying machine. The

* Using the U.S. Weather Bureau Class A pan for evaporation measurements.

rates used ranged from a 5 lb. a.i. per arpent concentration to 1.6 lb. a.i. per arpent. The herbicides were applied before crop and weed emergence. The experimental plots were surveyed three months after spraying. DCMU gave the best results, and NPH/1232 was more effective than U.C. 40.0 and U.C. 40.1 in checking weed growth. No adverse effect on cane germination and growth was observed with any of the herbicides tested. Two relatively new herbicides Herban and Cotoran were compared to DCMU and Atrazine at the same dosage rates in a series of three trials at Eau Bleue, Etoile and Britannia. Herbicides were applied in pre-emergence of cane and weeds at the rate of 4.8 lb. a.i. plus 1 lb. a.e. of a 2,4-D ester in 60 gallons of water per arpent. Weed surveys were made about three months after herbicide application. The results obtained at Etoile with the four herbicides were comparable. DCMU gave the best weed control at Eau Bleue, whereas Herban, Atrazine, and Cotoran gave approximately the same results. At Britannia, both Atrazine and DCMU proved superior to Cotoran and Herban. The main disadvantage of the new herbicides is their low efficiency in controlling *Ageratum conyzoides* (Herbe bouc), *Setaria pallide-fusca* (Millet sauvage), and *Digitaria timorensis* (Meinki), which have rapid rates of invasion and must be adequately controlled at an early stage to avoid their competition with germinating canes.

Special weed problems

(a) *Paederia fœtida* (Liane lingue). Tordon 101 and various brushkillers have been included in a trial at Ferney to evaluate the effect of these herbicides on *Paederia fœtida* in cane fields. Tordon 101 was applied at the rates of 2 and 4 lb a.e. of the mixture per arpent, and 2, 4, 5-T esters at 2 lb. a.e. per arpent. The results showed that Tordon 101 at 2 lb. a.e. per arpent was, by far, more effective than the other brushkillers in controlling this vine. Further experiments are necessary to determine whether or not Tordon 101 can be safely used in cane fields, and also the lowest rate at which it can be used to obtain optimum results.

(b) *Cyperus rotundus* (Herbe à oignon) and *Kyllinga monocephala* (Petit mota).

Application of DCMU 4 lb. a.i. + gramoxone ¼ lb. and DCMU 4 lb. + U_{46} Special 1 lb. a.e. in 60 gallons of water per arpent gave promising results on the above mentioned weeds in ratoons. The slight damage caused to the senescent cane leaves by gramoxone should not deter the use of that herbicide at the rates recommended.

FIELD EXPERIMENTATION

Results of field experiments in 1966 were affected in many cases by the unfavourable climatic conditions which prevailed during the growing season. This applied in particular to trials on fertilization and amendments. On the other hand, interesting results were obtained on the series of experiments on cultural practice including spacing, selective harvesting, and method of planting. No valid conclusions, however, can be drawn until data have been accumulated over at least a complete rotation. The four permanent trials, initiated in 1954 to compare mineral fertilization with organic matter, were replanted for the third time according to the original design. A review of results obtained on two permanent fertilizer trials established by the former Sugar Cane Research Station, and which have been maintained by the Institute, is given in this Report.

The trial using 'petroleum mulch' on cane interlines, and described in the 1965 Report, was harvested, but no significant difference on yield could be attributed to the 'mulch' treatment. The effect of uniformity of fertilizer application under normal field practice has been studied with interesting results, and it has been found that the variability of experimental plots can be markedly reduced by improving the locally accepted method of fertilizer application.

In view of the importance of food production in the island, twelve trials were planted in 1966 comparing four types of spacing of potatoes in cane interlines. Unfortunately, results could be obtained from 8 of these trials only, the others having been abandoned because of severe attacks of bacterial wilt in four cases, and drought in two others. Yields of cane and sugar will be determined in 1967; meanwhile it is interesting to summarize those obtained with potatoes, which were as follows :

1 line of potatoes every alternate cane line				1.60T/ap.	
2 lines	,,	,,	,,	2.55	,,
1 line	,,	,,	interline	3.22	,,
2 lines	,,	,,	,,	5.14	,,

A preliminary discussion of these results appears elsewhere in this report.

Mention should also be made that a new automatic hitching system for tractor-trailer assembly has been devised, which appreciably improves the safety in the steering of the assembly, the comfort of the driver, and in most cases, the sturdiness of the linkage between tractor and trailer.

A new self-loading system for trailers and lorries is also under experimentation.

The cane crop on the four stations of the Institute totalled 1270 tons, as follows : Réduit 266 tons, Belle Rive 196 tons, Pamplemousses 472 tons, and Union Park 235 tons. The smaller production obtained is due mainly to the relatively large areas which are kept under fallow from the preceding crop for replanting seedlings in bunch selection plots and first selection trials.

The Institute maintained close liaison with cane planters and sugar producers, 1,297 visits having been made by the staff in 1966.

A summary of field trials carried out in 1966 is given in the next column; 5000 cane samples from these experiments were analysed for sucrose content, purity, and fibre in the laboratories of the Institute.

	Estates	*Stations*
*Variety**		
Variety trials	86	1
Pre-release trials ...	12	—
Final variety trials ...	12	—
Special variety trials (with Estates' Agronomists) ...	2	—
Ratooning capacity ...	—	6
Observation plots on drought resistance ...	6	—
Fertilization and amendments		
Nitrogen	15	—
Phosphate	19	—
Calcium & phosphate ...	2	—
Potassium, calcium & magnesium	8	—
Basalt	8	—
Method of fertilizer application	3	—
Organic and mineral fertilization	5	4
Permanent fertilizer demonstration plots ...	—	4
Cultural Practice		
Spacing	10	—
Burning	1	4
Interline cultivation ...	3	—
Method of planting ...	4	—
Selective harvesting ...	6	—
Potato in cane interline ...	8	—
Petroleum 'mulch' ...	—	1
Diseases	9	4
Herbicides	12	1

SUGAR MANUFACTURE

Raw Sugar Filterability

Most of the research activities of the Sugar Technology division was centered around the problem of raw sugar quality. The Sugar Producers' Association constituted a technical committee to study the question of filterability of local raws, on which the Chief Sugar Technologist and the S.T. Chemist represented the Institute. It is gratifying to record that, as a

* Excluding selection plots up to first selection trials.

result of several measures adopted by sugar factories, the quality of the sugar produced was much improved in 1966.

Investigations on raw sugar filterability carried out by the Institute included the following subjects :

(*a*) *Enzymatic removal of starch.* Since a definite relationship exists between starch and filterability of raws, particular attention was paid to the enzymatic removal of starch from raw juice. Following encouraging results obtained in 1965, a number of factories decided to adopt the enzymatic process. Much time was devoted to the study of the influence of the process on sugar filterability, particularly at Britannia and Rose Belle factories. A large number of analyses of factory products were carried out, and the results obtained are discussed in a special article in this report. As a consequence of the adoption, amongst other things, of the enzymatic process, it is expected that the average starch content of 1966 sugars will be lower than that of previous years.

(*b*) *Phosphate.* The amount of phosphate in clarified juice appears to have an influence on the filterability of the resulting sugar. In order to study this relationship, it became necessary to develop a more accurate method of analysis for phosphate. The well-known colorimetric method, based on the reduction of phospho-molybdic acid by stannous chloride to molybdenum blue, was accordingly modified and found to give complete satisfaction in practice. As a result, it was possible to obtain reliable data for soluble and total phosphate in clarified juice from a number of factories throughout the crop period. A statistical analysis of these figures is being carried out.

(*c*) *Juice turbidity.* A similar study had been projected between turbidity of clarified juice and filterability of raw sugar. Unfortunately, practical difficulties were encountered in the choice of a suitable filter aid for making a blank when using an ordinary laboratory colorimeter, but some progress has been achieved, and these investigations will be continued in 1967.

(*d*) The influence of temperature of exhaust steam used for heating evaporators and vacuum pans, on colour, viscosity and rate of filtration of syrup, A, B and final molasses, was investigated.

(*e*) Laboratory experiments on the effect of adding phosphate to refined and plantation white sugar was studied. The results obtained are interesting; increase of phosphate produces a decrease in filterability until a minimum is reached. No further effect is observed on further addition. It is intended to pursue this line of research.

(*f*) Studies were initiated, and are being pursued, to determine the influence of grain size on starch, phosphate, and filterability by means of a "peeling" test.

(*g*) *Laboratory vacuum pan.* In order to study more critically the causes of poor filterability of raw sugars, it was judged necessary to build a laboratory vacuum pan. So far, using the original prototype, it has been possible to obtain several massecuites of different origins. It is now proposed, in order to achieve better control, to add a cuitometer and a mechanical circulator to the pan.

(*h*) *Sugar analysis.* Correlation studies between starch content and filterability of 1965 average sugar samples from each factory.

(*i*) Determination of starch content of new cane varieties.

(*j*) The determination of filterability of sugars from Réunion island for comparative purposes.

Other studies

(*a*) *Continuous Centrifugal.* A continuous B.M.A. K.1000 centrifugal was used for the curing of C massecuites at Britannia S.E. in comparison with a batch 42″ × 24″ Broadbent machine. The B.M.A. manufacturers also supplied a massecuite reheater specially designed for reheating 60 cubic feet of massecuite per hour up to a temperature of 50° C. This new installation lived up to expectations, and during a series of tests carried out by the staff of the Institute, it was found to cure 56 cubic feet of massecuite per hour, yielding molasses having a purity of only 0.7 degree higher than that of the batch machine.

(*b*) *Molasses analysis*. The relationship between refractometric Brix, sulphated ash and dry matter in final molasses was investigated, and a new formula for calculating dry matter was worked out. This had been made necessary following the adoption of the refractometer for chemical control, the formula, calculated in 1958, correlating dry matter with densimetric Brix and sulphated ash no longer being applicable for assessing the exhaustibility of local molasses.

A detailed analysis of crop samples of 1965 final molasses from all factories was carried out to determine :

- (i) The effect of the removal of suspended matter on the refractometric Brix.
- (ii) The causes of the somewhat large difference existing between the refractometric Brix and the densimetric Brix in some factories.

(*c*) A complete survey of (i) clarifier capacity, (ii) flash tank and vent pipes dimensions, (iii) temperature of exhaust steam used in evaporators and vacuum pans, (iv) capacity of vacuum pans, was carried out during the crop. As a result, a number of modifications were made in several factories in connection with items (ii) and (iii).

(*d*) A comparison between the digestion method and a modified blender method for the determination of pol. in bagasse was completed.

(*e*) The effect on the quality of clarified juice when partially substituting lime by soda ash during liming was studied in the laboratory.

(*f*) 'Long tests' were made in certain factories for determining the sucrose content of new cane varieties, in particular of M.442/51.

(*g*) A number of analytical methods in the hand-book *Official Methods of Control and Analysis for Mauritian Sugar Factories* were revised and communicated to factory chemists at an informal meeting held in the Bonâme Hall.

Instrumentation

At the request of various factories, the Instrument Engineer undertook this year the commissioning of the automatic controls of several important pieces of equipment, namely high pressure boilers, pressure reducers and desuperheaters, maintenance and repair upon pH controllers. He also gave advice in connection with problems of liming and pH control of juice immediately before clarification.

LIBRARY AND PUBLICATIONS

Although the accessions numbered only 425 in 1966, the new material was interesting. It included an important collection from the South African Bureau of Standards, and a group of 14 volumes of the *Sugar Cane* presented by the library of the H.S.P.A. Experiment Station; the collection of this early sugar journal is now complete except for volume 18 (1886). Several new titles received mainly on an exchange basis were added to the current journals and reports received in the library, bringing these to a total of 381, an increase of 30 titles over the preceding year.

The following publications were issued during the year :

Annual Report 1965. 136, xxvi p., 30 figs., 8 pl. French summary in *Revue agric. sucr. Ile Maurice* **45** (2) 1966 : 62-100.

Occasional Paper

No. 24 Williams, J. R. The position of the spear guiding ring in *Xiphinema* species. (Originally appeared in *Nematologica* **12**, 1966 : 467-469).

Leaflet

No. 11 ROCHECOUSTE E. *and* VAUGHAN, R.E. Weeds of Mauritius. 15. *Setaria barbata* (Lam.) Kunth (Herbe Bambou, Herbe Bassine). 16. *Setaria pallide-fusca* (Schumach). Stapf. & C. E. Hubbard (Millet sauvage.) 6 p., 1 pl. Illus. by Lyda Belcourt.

Technical Circulars (mimeographed)

No. 26 NOEL, L. P. Danger des confusions variétales: le problème de la M.93/48. 8 p., 2 figs.

No. 27 M.S.I.R.I. Notes on noble cane varieties in the breeding plot at Médine S.E. (Palmyre). 7 p., 1 plan.

No. 28 PARISH, D.H. Sugar cane fertilization; a summary of present practical knowledge. (Rev. ed. of Tech. Circ. no. 16, 1960). 17 p., 3 figs.

No. 29 HALAIS, P. Le silicate de chaux, un nouvel amendement pour la régénération des sols ferrallitiques séniles en vue de la culture de la canne. 13 p.

No. 30 WIEHE, P.O. *et* Robert ANTOINE. La gommose et le problème variétal. 20 p., 8 figs.

Private Circulation Reports (mimeographed)

No. 19 ROUILLARD, G. Observations faites au cours d'une mission à Formose. 25 p., 4 figs.

No. 20 VIGNES, E. C. Report on a tour of factories, refineries and sugar research centres in Europe, and on the 14th Session of I.C.U.M.S.A. 40 p., 2 figs.

Contrôle Mutuel Hebdomadaire. 20 issues.

Bulletin Hebdomadaire. Evolution Campagne Sucrière. 19 issues.

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

LE GUEN, F. Contrôle des chaudières à haute pression. **45** (3) 1966 : 209-212.

PIAT, E. Méthodes d'échantillonnage et de pesée en sucrerie de cannes. **45** (1) 1966 : 23-31.

ROUILLARD, G. Histoire des domaines sucriers de l'Ile Maurice. 2. Pamplemousses et Rivière du Rempart (suite). **45** (2) 1966 : 106-137.

Articles in Foreign Journals

SAINT ANTOINE, J. D. de R. de *and* VIGNES, E. C. Juice preservation during shut-downs. *Int. sug. J.* **68** (805, 806) 1966 : 11-14; 35-36.

ROCHECOUSTE, E. *and* PILOT, J. The control of weeds in tea by herbicides in Mauritius. *Weed Res.* **6** (1) 1966 : 50-57.

GENERAL

The Research Advisory Committee met twice during the year to discuss the current research programme, and three times jointly with the Board to visit Pamplemousses, Belle Rive and Union Park Experiment Stations.

The following meetings were held in the Bonâme Hall :

22nd February — P.O. WIEHE *and* L.P. NOEL. Danger des confusions variétales : le problème de la M.93/48[1].

21st March — C. RICAUD. Maladies de la canne[1]

5th April — J.D. de R. de SAINT ANTOINE. Développements récents dans la qualité des sucres de Maurice.[2]

20th April — S.F. HADAS (Director of the Standards Institute of Israel). The economic importance of standardization[3]

3rd May — L.P. NOEL *and* J.A. LALOUETTE. Nouvelles variétés de cannes;

problèmes posés par la sélection.[1]

16th-20th May — Société de Technologie Agricole et Sucrière. Congrès 1966[4].
P.O. WIEHE. Recherches sur la canne à sucre à la M.S.I.R.I. en 1965.

30th May — L. G. NICKELL (Assistant Director, H.S.P.A. Experiment Station.) Physiological varietal differences[5].

20th June — Y. WONG YOU CHEONG. Alimentation en phosphore de la canne[1].

21st June — 3 films on the various aspects of the exploitation of petroleum.[6]

28th June — N. MAGASINER (Thompson Boilers Co. Ltd.). Boiler design and selection in the cane sugar industry[5].

25th July — J.D. de R. de SAINT ANTOINE *and* E.C. VIGNES Quelques aspects du contrôle chimique[1].

30th August — P. HALAIS. Le silicate de chaux, un nouvel amendement pour les latérosols séniles.[1]

27th September — G. ROUILLARD. Culture de la pomme de terre en entrelignes de cannes (résultats préliminaires)[1]

30th September — G. ERDTMAN (Director, Palynological Laboratory, Stockholm) *and* J. ROWLEY (University of Massachusetts). Pollen grains and spores, and their significance in taxonomy, palaeobotany and genetics.[7]

25th October — P. O. WIEHE *and* Robert ANTOINE. La gommose et le problème variétal[1].

10th November — M.J. DELAVIER (Technologist, Berlin Sugar Institute). The Berlin Sugar Institute[5].

6th December — J.R. WILLIAMS. Introduction and breeding of the parasitic fly *Diatraeophaga striatalis* for control of the spotted borer.[1*]

16th December — J. DEBIESSE (Directeur, Centre d'Etudes Nucléaires de Saclay.) Les sciences et techniques nucléaires[8].

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

1.* Talk given at Mon Plaisir, Pamplemousses.

2. Joint meeting of the Mauritius Sugar Syndicate and M.S.I.R.I.

3. Meeting under the auspices of the Ministry of Industry, Commerce, and External Communications of Mauritius.

4. *Vide Revue agric. sucr. Ile Maurice* **45**, 3, 1966.

5. Joint meeting *Société de Technologie Agricole et Sucrière and M.S.I.R.I.*

6. Joint meeting *Société de Technologie Agricole et Sucrière* and Engineers' Association of Mauritius.

7. Joint meeting Royal Society of Arts & Sciences of Mauritius and M.S.I.R.I.

8. Meeting under the auspices of the Government of Mauritius.

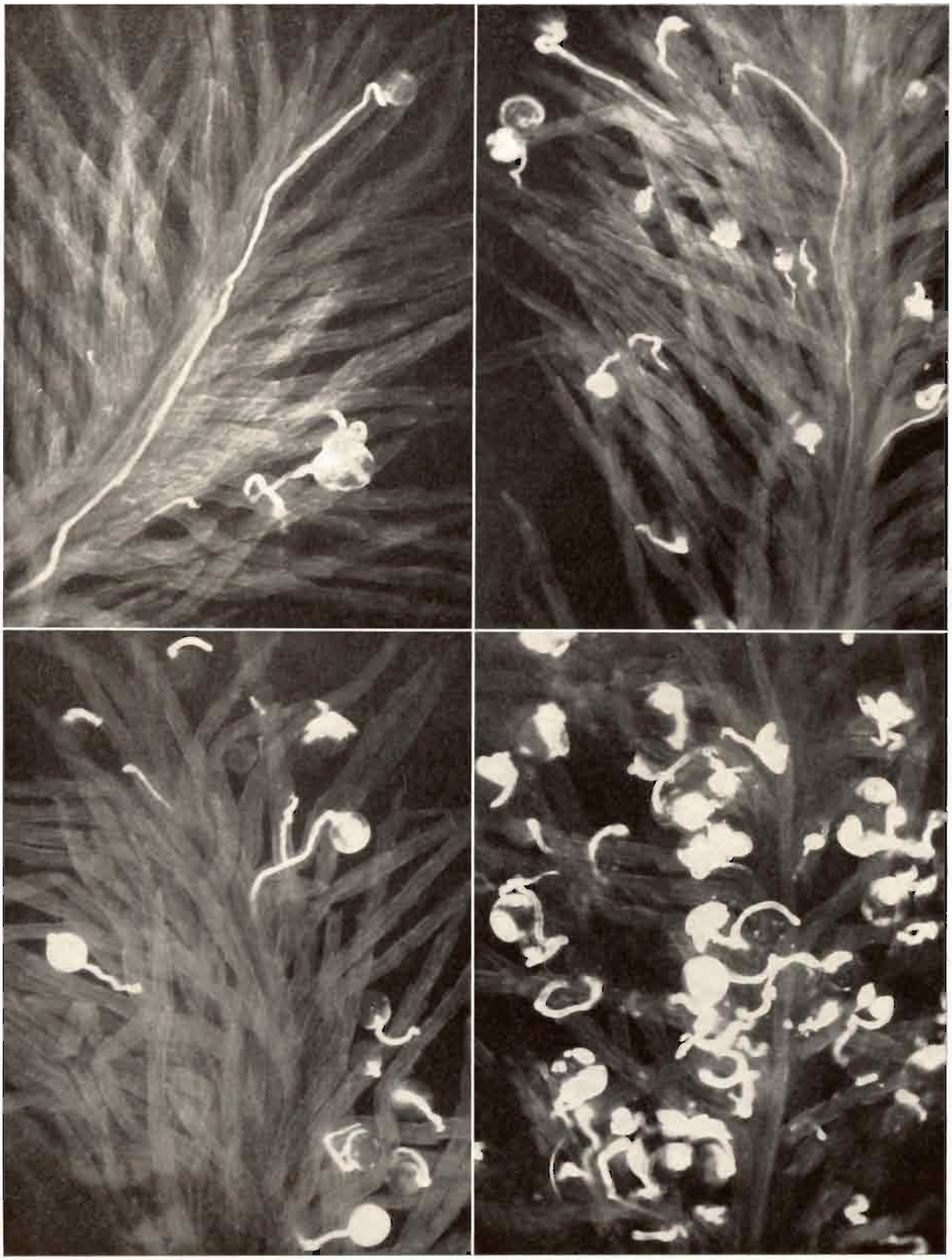
Staff Movements. Overseas leave was granted to Messrs. Vignes, Williams, Hardy, Antoine and Wong, the latter having obtained a Commonwealth scholarship tenable at Queen's University, Belfast.

At the request of the Mauritius Sugar Syndicate, Mr. J. D. de R. de Saint Antoine visited sugar refineries in Malaya in January, and spent a fortnight in South Africa in May to study and discuss problems of raw sugar quality. Mr. Vignes attended the 14th session of I.C.U.M.S.A. in Copenhagen, while Miss Ly-Tio-Fane was a delegate at the 8th meeting of the International Commission of Maritime History held in Beirut in September. On the invitation of the International Atomic Energy Commission, Vienna, Mr. Chan attended a course on radioisotope techniques at the University of Lovanium, Kinshasa. Mr. G. Mazery spent a week in Réunion in May in connection with irrigation studies. Mr. Antoine and Dr. Ricaud visited Madagasikara in March in connection with the Fiji disease resistance trials. The Director and Mr. Antoine were delegates at the 15th meeting of the *Comité de Collaboration Agricole* held in Madagasikara from the 15th to 22nd November.

In concluding this report, I should like to express my gratitude to the Director of Agriculture and his staff for their collaboration in many respects, to Estate Managers for their assistance in connection with field experiments, and to the staff of the Institute for their loyal co-operation.

Director

24th January, 1967



Pollen germination in sugar cane as seen with blue light fluorescence using callose fluorochrome reaction (x160 approx.)
For explanation see text, p. 37

Representative pots from NPK factorial trial on noble sugar cane variety *Chalain.*

Left, with and without N ; *centre*, with and without P ; *right*, with and without K.

CANE BREEDING

1. MODIFICATIONS TO BREEDING PROGRAMME

J. A. LALOUETTE

As mentioned in the Annual Report for 1965, the sowing programme had to be curtailed considerably that year in order to streamline the selection procedure and keep the number of seedlings at various stages of selection at a manageable level. As an unavoidable sequel, and with the same aim in view, the selection policy had to be modified in 1966. Thus the third selection stage, the propagation plots, were planted in one environment only, and the first selection trials selected on results of virgins and first ratoons only. These temporary measures have helped to reduce the volume of selection work in hand.

The factors which through the years 1960 to 1964 have led to the greater volume of selection work are :

- (i) considerable increase in yearly seedling production;
- (ii) increase in yearly number of parental combinations involved in crossing;
- (iii) use of new parents, as imported canes became available after regular quarantine cycles;
- (iv) planting of seedlings and bunch selection plots under optimal climatic conditions;
- (v) planting of all varieties in two contrasting environments as early as possible, i.e. after the second selection stage, followed by independent selection in both environments;
- (vi) the policy adopted in recent years, according to which the two initial stages serve to eliminate inferior varieties rather than to select superior ones.

As a result, the convergent effect of these factors has been a considerable increase in the number of varieties to be handled at each of the four selection stages leading to the final stage at which each variety undergoes trial on estate land in the four main environments simultaneously.

Concurrently, it became evident that it was necessary to undertake a study of all parental combinations going through the selection screen in order to assess as rapidly as possible the merits of the parents involved. These considerations led to the decision of transferring all available information from 1953 onwards to punched cards. Consequently, an automatic puncher, a sorter, and a tabulator were installed at the Institute during the last quarter of 1966, a full time assistant was appointed, and much time and effort is now spent on planning and running the system. Processing of available data is in progress, and it is hoped that enough information will have been gathered in 1967 to help rationalize the crossing and selection programme.

There are, of course, a number of problems attached to such a change in data recording and processing and, during the year under review, some standardization in the selection procedures involved has already been effected.

As a corollary research tool, in a study into the causes of low fertility in some crosses, good headway was made with the callose fluorochrome reaction for following pollen germination and the growth of the pollen tube *in vivo*. (Pl. I). Indications were obtained that the time between pollination and fertilization may be longer than thought hitherto.

2. INVESTIGATIONS ON FLOWERING

R. JULIEN

Experimentation was started in 1965 as a first step towards a better understanding of the mechanism of flowering in sugar cane, knowledge which could help to control arrowing for breeding purposes. It is too early to report on results obtained, some of which being in conflict with previous findings. It has, therefore, been decided to intensify experimentation along the following lines and, to that effect, experiments were laid down towards the end of 1966.

(*a*) *Induction to flower*

Investigations were carried out on the effect on flowering of different soil moisture tensions during induction time; on the onset of the induction period and its duration; on the number of cycles required for induction of flowering; and on the perception of the flowering stimulus and its translocation.

(*b*) *Retardation of flowering*

Chemicals, such as the growth retardants CCC (2-Chloroethyltrimethylammonium chloride) and Phosfon D (2, 4-dichlorobenzyltributylphosphonium chloride), at various concentrations and times of application were used. In addition, a comparative study on the effects of CCC and GA on the growth of the flower primordium is under way. Furthermore, night interruption, using lights of various intensities and wavelengths and at different times during the night, is under investigation as well.

(*c*) *Age of the plant and flowering*

Results obtained in 1966 having shown that plots of variety US 48-34 cut as late as December 1st flowered at the same time and with the same intensity as plots cut earlier, a result in contradiction with previous ones, the experiment is being repeated using four varieties : D.109, US 48-34, N:Co.310 and M.112/34 cut at different times up to December 15th.

(*d*) *Flowering of noble varieties*

The observed fact that noble varieties, so far, flower very poorly, if at all, may be due to a number of factors; namely, poor vegetative growth, the number of right photoperiodic cycles, or genetical reasons.

Investigations are therefore being conducted in an attempt to induce noble canes to flower. These include factorial experiments using inorganic and organic fertilizers, separately and in combination (Pl. II), and exposure of the plants to the right photoperiodic cycle for various lengths of time.

3. CROSSING AND SELECTION

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

Crossing

An excellent flowering season prevailed in 1966 and, although it had been decided to reduce considerably the crossing programme on account of the bulk of fuzz left over from the 1965 season, such a favourable opportunity could not be missed. Consequently, combinations of suspected low fertility made the previous year were duplicated in order to allow a better assessment of the value of each cross. Several new combinations were also effected and more nobilizations of *Saccharum robustum*, which had reached the second generation, and of *S. spontaneum* were carried out.

On the whole, 455 crosses were made, involving 115 combinations in which entered 93 different parents, of which 53 were female, 37 male, and 3 male and female.

A summary of crossing work is given in Table 1

Table 1. Crossing work in 1966

	No. of crosses made		
Station	*Greenhouse Bi-parental*	*Fields Bi-parental*	*Total*
Réduit ...	388	—	388
Pamplemousses	—	67	67
Total ...	388	67	455

At the crossing stage, emphasis is now placed on combinations rather than on year of crossing. In the past, crosses made in any one year were kept separate, even when only part of the fuzz from that particular year was sown, the rest being stored for utilization the following year. Thus, emphasis was on the year rather than on the parental combination. From now onwards, crosses involving the same combination will be grouped together in the field, irrespective of the year they were made. In order to allow for better control and facilitate field work, this procedure will be followed by a change in the numbering system of M. varieties; thus, the series M/64 will be the last series in which /64 refers to the year the cross was made. This series was sown separately, and will be planted separately. The germination capacity after two years' storage, although slightly reduced, was still reasonable. The new commercial series will start with M/66, /66 referring to the year the fuzz was sown. Only a small fraction of the fuzz derived from the 1965 crosses was sown last year as the /65 series. Also all the nobilization crosses made in 1965 and 1966 have now been sown.

Most of the fuzz from the 1965 crossing year was sown together with part of that from 1966. They will together form the M/66 series as outlined above; accordingly, the sowing programme for 1966, which started on 27th October and ended on 22nd December, comprised fuzz derived from crosses made in 1964, 1965, and 1966.

Table 2. Sowing in 1966

Crosses	*Year of crossing*	*No. of not germinated*	*crosses germinated*	*No. of Sdlgs obtained*	*No. of Combinations*
Involving Nobilizations	1965 1966	33	65	3,701	27
Commercials	1965 1966	236	689	80,598	217
Commercials	1964	2	11	287	5

Further, this year, most combinations have been potted 3 seedlings per bunch and then grouped according to the number of seedlings obtained. These combinations, giving more than 300 pots, i.e. more than 900 seedlings, will be bunch-potted in the fields at 3 pots of seedlings per hole; combinations giving between 16 and 300 pots, i.e. between 48 and 900 seedlings will be bunch-planted as usual, i.e. 1 pot of 3 seedlings per hole, and combinations giving less than 16 pots, that is 48 seedlings will be grouped in the field, where possible, so that combinations having the same female parent may be planted together. In this way, it is hoped that the number of seedlings to be dealt with annually will be kept at a manageable level, making possible at the same time a better assessment of combinations and parents from which they are derived.

The replanting of the breeding plots started last year was continued in 1966. The variety collection at Réduit has been completely replanted and provides room for 440 varieties. Of these, 91 are noble canes; in addition, 22 varieties and one noble cane coming out of quarantine will be planted after bulking-up.

Adjoining the variety collection, a breeding plot has been planted and accommodates 41 of our best nobles and 29 other varieties. More nobilizations were attempted in 1966 and each year part of the crossing effort will be directed towards that end.

Selection

As already mentioned, the adopted selection procedure had to be modified to allow efficient handling of the increased number of seedlings produced since 1960 and present in the various stages of selection. For example, in 1965, as a result of the considerable increase in the amount of work to be carried out at selection time, the selection period stretched over five months (July to December). In order to shorten that period to an acceptable maximum of three months, while more liberal selection was continued in the initial stages, as shown by selections for bunch selection plots which amounted to 23,574 in 1965 and 23,406 in 1966, compared to 5,127 in 1963 and 8,049 in 1964, the following measures had to be adopted :

(i) all the land needed for the planting of trials in 1966 was abandoned after the 1965 crop and prepared well in advance;

(ii) all bunch seedlings were selected during the intercrop (mid-March to mid-April). This can be done as only visual selection is effected at this stage;

(iii) selections from bunch selection plots to propagation plots were planted in one region only, Minissy, and not replicated at Belle Rive and Union Park, as is the usual practice at this stage;

(iv) Brixing and weighing of propagation plots in virgins were done in one environment only, Minissy, where yields were much higher than at Belle Rive and Union Park;

(v) varieties in virgins in first selection trials, being too young due to the late planting in 1965, were cut without brixing or weighing;

(vi) a day to day selection routine had to be strictly adhered to from the beginning of July until September.

First Selection Trials. First selection trials were brixed, weighed, and selected as from the 1st of July, and sent to Médine S.E. for plantation in multiplication plots. These operations covered three weeks. Furthermore, in view of the fact that (a) only a small number of varieties (62) were present in 2nd ratoons (selection in first selection trials are usually done in 2nd ratoons); and (b) a very large number of varieties in propagation plots (2,565) will have to be selected in 1967, it was decided to select varieties in first selection trials in 1st ratoons on the combined data obtained in virgins and 1st ratoons. This measure will liberate more land on stations and reduce the amount of work in 1967 in doing away with selections in first selection trials for this year.

Bunch Selection Plots. The selection of 23,574 varieties in bunch relection plots took the whole month of August. 2,020 varieties were selected and planted at Minissy. Special attention was taken to select varieties with a high brix reading (the mean level of brix required for a variety to be selected was much higher than in preceding years).

Propagation Plots (Virgins). The 2,565 varieties planted at Minissy only were brixed in mid-September and weighed at the end of the month. Those replicated at Belle Rive and Union Park, having made poor growth, were not tested. Selection is to be performed on 1st ratoons in 1967, in the two environments.

Propagation Plots (Ratoons). Brixing, weighing, selecting and planting of selections from propagation plots into first selection trials, were carried out in two stages. At Pamplemousses and Réduit, out of 900 varieties, 195 were selected in early September. At Union Park and Belle Rive, however, out of the 900 replicated varieties, 94 selections only were obtained in late September.

From the total of 289 varieties obtained, 47 were selected in two environments. The low percentage of selection in the super-humid region (Belle Rive and Union Park) is due to the unfavourable growth conditions which prevailed, leading to the death of several varieties.

During the last week of July, the new breeding plot and variety collection were replanted at Réduit. Recruitings in first selection trials were also conducted. The selection operations thus covered the scheduled period of three months.

A summary of selection work conducted in 1966 is given in Table 3.

Table 3. Selection work in 1966

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 ...	5,707	—	49	3
Pamplemousses	9,197	—	146	8
Belle Rive	—	—	34	15
Union Park	—	—	60	12
FUEL-Union	4,457	—	—	9
Minissy ...	4,045	2,020	—	—
	23,406	2,020	289*	47**

* From this number, 47 varieties (26 M. and 21 foreign) are planted in 2 regions, making a total of 242 different varieties.

** From this number, 2 varieties were selected in 2 environments, making a total of 45 different varieties.

4. VARIETY TRIALS

R. ANTOINE & G. ROUILLARD*

In 1966, 12 trials were planted and distributed in the 4 climatic zones of the island. In addition, 14 trials are conducted by Estate Agronomists for further testing of varieties recommended by the Institute under more specific conditions of soil and climate. Twelve varieties are thus being tested with two controls. Results will be recorded for virgins, 1st and 2nd ratoons.

In 1966, a total of 208 varieties were being assessed in 103 trials (Tables 4 and 5).

Table 4. Varieties tested in trials on estates

Series	*No. of Varieties*
1946	1
1948	2
1951	6
1952	2
1953	6
1954	16
1955	31
1956	37
1957	49
1958	16
1959	17
Sub-total ...	183
Ebène varieties ...	10
Imported varieties	15
Total	208

Table 5. Distribution of trials on estates in 1966

Year of planting	*Sub-humid*	*Humid*	*Super-humid*	*Irrigated*	*Total*
1958	—	—	—	1	1
1960	—	—	1	1	2
1961	1	2	0	1	4
1962	2	3	1	3	9
1963	6	7	6	7	26
1964	7	6	6	7	27
1965	5	5	5	5	20
1966	5	3	3	3	14
Total	26	26	22	29	103

The performance of the most promising varieties is given below. Of the varieties noted in the report for 1965, M.577/59 and M.1007/59 showed high susceptibility to gummosis, and the Ebène varieties 118/56 and 88/56 proved susceptible to leaf scald. The others, M.658/51, M.110/52 and M.361/53 have been discarded due to poor performance.

M.305/51 (B.34104 x M.63/39) has performed well under humid and sub-humid conditions, and appears to be a potential variety for the

* With the collaboration of R. Béchet, M. Hardy, F. Mayer, R. Ng, and L. Thatcher.

latter zone. It has an average sucrose content.

M.428/51 (M.377/51 x M.213/40) is a very rich variety with satisfactory yields in 1st ratoons in humid and irrigated localities.

M.356/53 (Ebène 1/37 × Co.290). A promising variety with a reasonable yield and a good sucrose content. It is being further tested by Estate Agronomists under humid and super-humid conditions. The variety is moderately resistant to gummosis.

M.75/55 (Ebène 1/37 × M.213/40). Has given good results in the super-humid zone only. The variety is being further tested in this locality.

M.260/55 (B.34104 × M.63/39). Has again shown adaptation to sub-humid areas in which yield and sucrose content were both superior to the control.

M.145/56 (M.241/40 × M.147/44). Another variety which seems adapted to sub-humid conditions, under which its performance in yield and sucrose content were superior to the control.

M.220/56 (B.34104 × M.213/40). Variety with high sucrose content and yields superior to the control except under super-humid conditions. It is being further tested for its reaction to gummosis, having shown slight susceptibility.

M.84/57 (B.34104 × M.213/40). A very promising variety with an average sucrose content. It has outyielded the control in 1st and 2nd ratoons in sub-humid, humid, and irrigated localities.

M.130/57 (ML.3-18 × M.63/39) is a rich variety and has given high yields in the super-humid zone only. Unfortunately it has shown signs of susceptibility to gummosis and leaf scald.

M.351/57 (N :Co.310 × M.99/34) has again performed well, this time in 2nd ratoons, under all climatic conditions. Its sucrose content is fair; however, it flowers abundantly.

M.393/57 (M.241/40 × M.147/44). A variety showing a wide range of adaptation. Its sucrose content is comparable to that of the controls. It is slightly susceptible to gummosis.

Ebène 74/56 (Ebène 1/37 × M.147/44). A very promising variety which seems well adapted to a wide range of conditions. However, as it has shown susceptibility (slight to moderate) to both strains of the gumming disease organism, the variety will not be considered for release until more information is available.

5. VARIETIES RELEASED IN 1966

R. ANTOINE & G. ROUILLARD

Five varieties were released during the year, three of which, M.409/51, M.13/53 and M.13/56, have been included in final variety trials for further studies. The two other varieties, N :Co.376 and M.377/56, could not be included owing to lack of sufficient planting material.

The characteristics of these varieties are as follows :

M.409/51 is less vigorous than M.147/44, but produces more sugar per acre in humid and irrigated localities on account of its high sucrose content. It is a semi-erect variety with medium to thick, waxy stalks. Leaves broad, sheaths hairy, but trashes easily. Arrowing is low and ratooning seems fairly good. The variety appears to be resistant to cyclones, is resistant to gummosis and leaf scald, but susceptible to chlorotic streak. Cases of stem deterioration have been observed.

M.409/51 has been studied since 1959, in six trials in ratoons (two in sub-humid, one in humid, two in irrigated and one in super-humid localities) and has given the following results :

Table 6. **Results of variety trials in sub-humid, humid, and irrigated localities**

Zone	T.C.A.		I.R.S.C.		T.S.A.		Relative benefit	
	M.147/44	M.409/51	M.147/44	M.409/51	M.147/44	M.409/51	M.147/44	M.409/51
Sub-humid ...	32.8	26.1	11.2	11.7	3.68	3.05	2.36	2.01
Humid ...	31.1	28.2	10.5	11.8	3.26	3.34	2.02	2.20
Irrigated ...	46.3	42.2	10.3	11.2	4.76	4.71	2.92	3.04

Table 7. **Results of variety trials in the super-humid zone**

T.C.A.		I.R.S.C.		T.S.A.		Relative benefit	
M.93/48	M.409/51	M.93/48	M.409/51	M.93/48	M.409/51	M.93/48	M.409/51
35.1	29.4	10.4	11.1	3.65	3.26	2.25	2.09

M.409/51 appears to be a rather exacting variety, requiring the best conditions for growth. It may prove to be a useful transitory variety, in particular as a replacement for M.202/46, until better yielding varieties are available.

M.13/53. A semi-erect variety, stalks of thin to medium thickness, and long waxy internodes which have a tendency to split. It produces many stalks per stool, ratoons well, and trashes easily, but is fairly hairy. The colour of the stem varies from yellow to purplish with corky patches.

The variety, although not a high yielder in cane, has a high sucrose content which accounts for its good performance under irrigated conditions. In humid and sub-humid localities it has, in general, equalled M.147/44, but is not adapted to super-humid, or to very dry, conditions.

M.13/53 is resistant to gummosis and leaf scald, but slightly susceptible to yellow spot.

The variety has been studied in eleven trials, two in sub-humid, two in humid, three in super-humid localities, and four under irrigation.

Table 8. **Results of variety trials in sub-humid, humid, and irrigated localities**

Zone	T.C.A.		I.R.S.C.		T.S.A.		Relative benefit	
	M.147/44	M.13/53	M.147/44	M.13/53	M.147/44	M.13/53	M.147/44	M.13/53
Sub-humid ...	38.3	33.4	10.8	11.5	4.12	3.84	2.60	2.50
Humid ...	37.1	30.0	10.5	11.8	3.88	3.53	2.41	2.34
Irrigated ...	35.3	34.1	10.7	11.8	3.78	4.03	2.37	2.66

Table 9. **Results of variety trials in the super-humid zone**

T.C.A.		I.R.S.C.		T.S.A.		Relative benefit	
M.93/48	M.13/53	M.93/48	M.13/53	M.93/48	M.13/53	M.93/48	M.13/53
32.8	26.0	9.6	10.1	3.15	2.63	1.84	1.59

M.13/56. A vigorous variety with a wide range of adaptation, including dry conditions. Its sucrose content, purity and fibre content are satisfactory, it is not hairy and is easy to trash. On the debit side may be placed the large number of thin stalks it produces. These are of a purplish colour, with large corky patches and a dark growth ring. The leaf triangle is narrow and purplish-red.

The variety is resistant to gummosis, and no case of leaf scald has been recorded. It has been studied in 1st and 2nd ratoons in four trials in three climatic zones, and the results obtained under sub-humid, humid, and irrigated conditions are the following :

Table 10. Results of variety trials in sub-humid, humid, and irrigated localities

Zone	*T.C.A.*		*I.R.S.C.*		*T.S.A.*		*Relative benefit*	
	M.147/44	*M.13/56*	*M.147/44*	*M.13/56*	*M.147/44*	*M.13/56*	*M.147/44*	*M.13/56*
Sub-humid ...	28.1	29.3	11.6	11.7	3.27	3.42	1.57	2.26
Humid ...	26.5	33.3	9.2	9.8	2.44	3.26	1.38	1.93
Irrigated ...	36.6	41.1	10.1	10.5	3.71	4.33	2.23	2.67

In the trial of the super-humid zone, yields have been comparable to those of the control in virgins, but in 1st and 2nd ratoons they were inferior. However, owing to the heterogeneity of this trial, no conclusions can be drawn as to the performance of M.13/56 under conditions of high rainfall. Other trials were therefore established in 1966.

M.377/56. A vigorous and rich variety with thick stalks, brownish in colour. It has a semi-erect habit and is a shy arrower. The variety has shown good adaptability to a wide range of soils and climate. It was selected in first selection trials at Belle Rive in 1962, and at Réduit in 1963. The variety has performed exceedingly well in 1st and 2nd ratoons. It is resistant to gummosis, apparently resistant to leaf scald, and somewhat susceptible to yellow spot.

M.377/56 has been studied in ratoons in seven trials, five in comparison with M.147/44 and two with M.93/48. The results obtained are summarised below :

Table 11. Results of variety trials in sub-humid, humid, and irrigated localities

Zone	*T.C.A.*		*I.R.S.C.*		*T.S.A.*		*Relative benefit*	
	M.147/44	*M.377/56*	*M.147/44*	*M.377/56*	*M.147/44*	*M.377/56*	*M.147/44*	*M.377/56*
Sub-humid ...	28.8	30.2	10.6	12.3	3.06	3.70	1.90	2.51
Humid ...	24.7	27.6	10.9	11.8	2.70	3.27	1.70	2.15
Irrigated ...	38.4	38.7	11.1	12.5	4.27	4.84	2.73	3.29

Table 12. Results obtained in the super-humid zone

T.C.A.		*I.R.S.C.*		*T.S.A.*		*Relative benefit*	
M.93/48	*M.377/56*	*M.93/48*	*M.377/56*	*M.93/48*	*M.377/56*	*M.93/48*	*M.377/56*
37.7	41.0	9.5	10.0	3.57	4.06	2.07	2.46

N:Co.376. An erect, vigorous variety with good sugar, high purity and high fibre, characterized by the large number of thin stalks. It is not hairy, but the trash is fairly clinging. Characteristic cream–coloured blotches are present on the lower surface of leaves, particularly along the midrib. It flowers abundantly and appears to be an early maturing variety.

The variety has been studied in six trials in ratoons, one of which, located in the humid zone, had to be discarded on account of an outbreak of root disease. Of the five remaining, one is located in the sub-humid zone, two in irrigated localities and two in the super-humid zone.

Table 13. Results of variety trials in sub-humid and irrigated localities

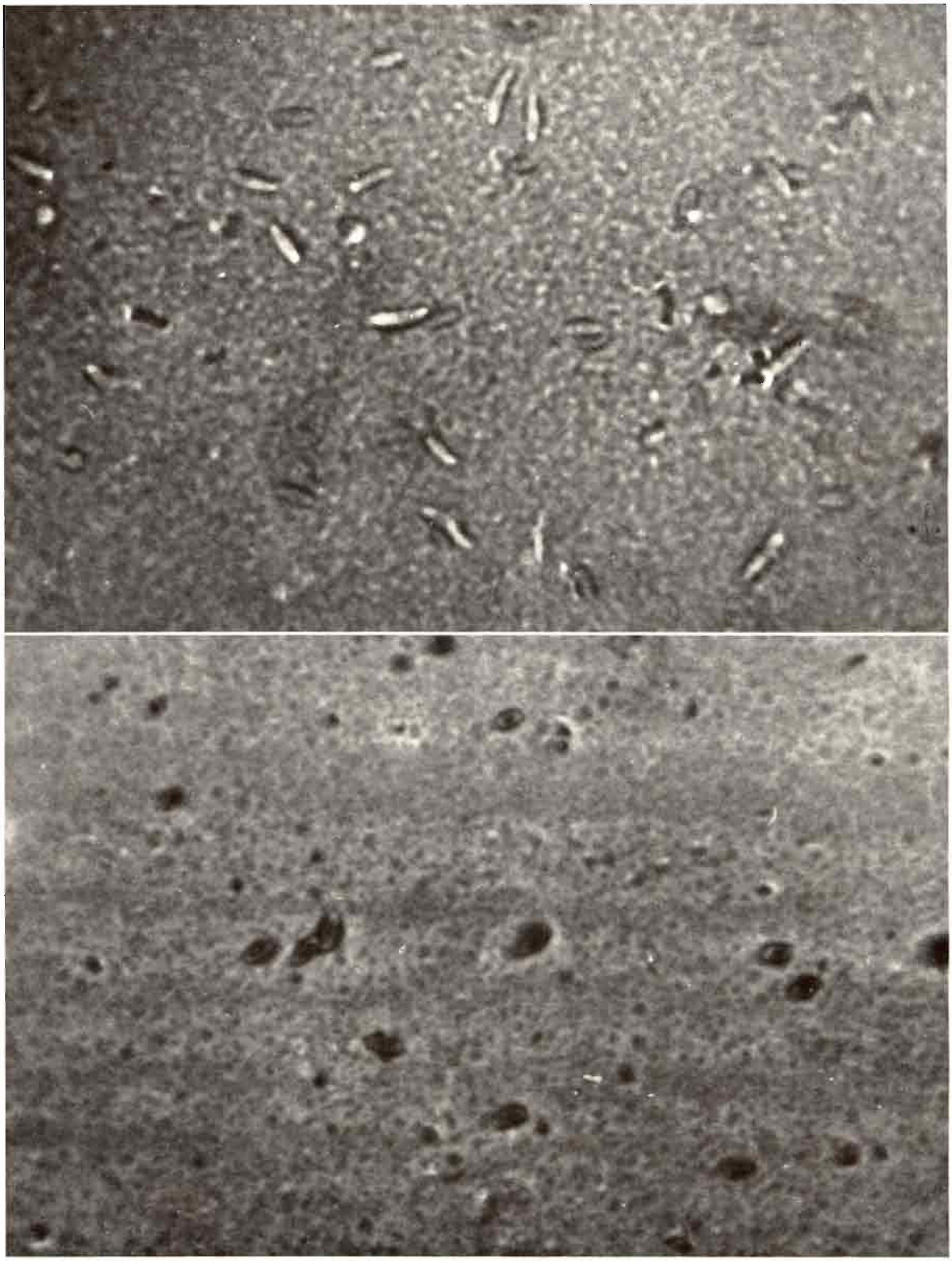
Zone	*T.C.A.*		*I.R.S.C.*		*T.S.A.*		*Relative benefit*	
	M.147/44	*N:Co.376*	*M.147/44*	*N:Co.376*	*M.147/44*	*N:Co.376*	*M.147/44*	*N:Co.376*
Sub-humid ...	20.7	17.9	9.1	9.2	1.88	1.65	1.06	0.93
Irrigated ...	40.8	41.4	10.5	11.0	4.29	4.56	2.65	2.90

Table 14. Results of variety trials in the super-humid zone.

T.C.A.		*I.R.S.C.*		*T.S.A.*		*Relative benefit*	
M.93/48	*N:Co.376*	*M.93/48*	*N:Co.376*	*M.93/48*	*N:Co.376*	*M.93/48*	*N:Co.376*
29.6	35.2	10.8	10.9	3.20	3.84	2.01	2.43

The results show that the variety should be particularly useful in the super-humid zone, if harvested early.

Water culture experiment on chlorotic streak transmission in the Pathology greenhouse.



Morphological differences between the "new" (*above*) and "old" (*below*) strains of *Xanthomonas vasculorum* (Cobb) Dows. cultured on a medium containing tri-phenyl tetrazolium chloride (x 3,200).

CANE DISEASES

1. THE IMPACT OF CANE DISEASES ON THE VARIETY PROBLEM

R. ANTOINE

WHEN the Research Institute was created in 1953, the major pathological problems which confronted the sugar industry were ratoon stunting disease and chlorotic streak. Gummosis and leaf scald, through the routine testing of promising varieties in resistance trials and the release for cultivation of resistant ones only, were no longer encountered in commercial plantations. The varieties under cultivation were either resistant, or tolerant, to red rot, and pineapple disease was well under control through the treatment of planting material in an organo-mercurial fungicide. However, the picture was complicated in 1954 by the appearance of Fiji disease, heretofore confined to the South-West Pacific area, on the East Coast of Madagascar and the potential threat it represented to the sugar industry of Mauritius. Consequently, during the first ten years of pathological research, all efforts were concentrated on the two major diseases with an economic significance: ratoon stunting and chlorotic streak, while the full co-operation of the Institute was given in the desperate battle to eradicate Fiji disease on the East Coast of Madagascar.

In 1964, through the establishment, with heat-treated material, of a central nursery to supply secondary nurseries on estates, the control of ratoon stunting was well in hand. Furthermore, through the installation of new and more efficient treatment tanks on estates, the losses due to chlorotic streak were being considerably reduced, while some knowledge on the transmission of the disease was being obtained. In Madagascar, Fiji disease, although still present in small, scattered plantations in the jungle, was no longer encountered in regular plantations; the resistance trials had shown that at least two canes, commercially important in Mauritius, were resistant to the disease and, amongst other measures, a strict control of the port area of Tamatave was a safeguard against the introduction of the disease into Mauritius.

There was therefore perhaps some ground for complacency when, in 1964, the whole picture was all of a sudden completely altered. Indeed, that year, the two major bacterial diseases, gummosis and leaf scald, appeared once more in commercial plantations, the former rapidly assuming epidemic proportions. There is good ground to believe now that the outbreak can be attributed to new strains of the bacterial pathogens originating from the neighbouring island of Réunion. Furthermore, two other diseases, yellow spot and rust, were identified for the first time in Mauritius.

Efforts were immediately re-orientated in order to face the new problems, particularly the one set by gummosis which, by its very nature, rapidly spread over the whole island. Three of the varieties under cultivation, M.147/44 B.3337 and B.34104, showed high susceptibility, with systemic infection, and their replacement had to be contemplated. The varieties grown at the time, the climatic zones to which they are adapted, their reactions to the disease, and the percentage composition of the crop are given in Table 15.

Table 15. Reactions of varieties under cultivation in 1964 to the new strain of the gumming disease bacterium

Variety	*Climatic Zone*	*Rating*	*% Crop*
M.147/44	Sub-humid	Highly susceptible	31
B.3337	Super-humid	,, ,,	6
B.34104	Irrigated	,, ,,	2
B.37172	Sub-humid to humid	Susceptible	11
Ebène 1/37	Humid to super-humid	,,	15
M.93/48	,, ,,	Moderately susceptible	9
M.442/51	Sub-humid	Moderately resistant	<1
M.134/32	Sub-humid to humid	Resistant	6
M.31/45	Humid	,,	3
M.202/46	,,	,,	8
M.253/48	Irrigated	,,	2
Ebène 50/47	Humid	,,	5

It follows from this table that resistant varieties were immediately available for replacement of the three highly susceptible canes. However, with M.134/32 on its decline, a problem had to be faced in the sub-humid zone, particularly the very dry coastal areas, in which the only variety available for replacement was M.442/51, a late maturer, which consequently had to be harvested late in the crop season. It was therefore important to obtain as early as possible an early-maturing cane resistant to both strains of the gumming disease bacterium, as well as to drought.

Research work led rapidly to the development of a test, using a culture medium, containing tri-phenyl tetrazolium chloride, whereby the two strains could be easily differentiated. It was therefore possible to conduct disease resistance trials in which the reactions of promising varieties to both strains of the disease organism could be assessed separately. Furthermore, the problem of rapidly inoculating canes providing infection in large scale trials was solved through the development of an inoculation head adapted to a plastic knapsack sprayer. It was thus possible to test the reactions of promising varieties to the new strain of the pathogen at an earlier stage of selection, and to the old strain at the usual stage later. Between 1964 and 1966, the number of varieties tested amounted to 809 (Table 16) as compared to 1,269 for the period 1932-1963.

Table 16. Number of varieties tested to the old and new strains of the gumming disease pathogen, 1964-1966.

Year	*Old Strain*	*New Strain*	*Total*
1964	63	265	328
1965 ...	42	69	111
1966 ...	50	320	370
Total ...	*155*	*654*	*809*

Out of the 809 varieties tested, 22 or 2.7% which proved highly susceptible had to be rejected, including a few very promising canes. However, on the asset side, it was possible to release five resistant canes in 1966, four locally bred and one imported : M.409/51, M.13/53, M.13/56, M.377/56 and N:Co.376. Of these, M.409/51 and M.13/53 are adapted to the humid zone, N:Co.376 to the super-humid, and M.13/56 and M.377/56, although performing well under dry conditions, can be profitably grown under more humid environments.

By the end of 1966 therefore, the picture had improved considerably, the more so that several promising canes in the later stages of experimentation have shown resistance to both strains of the pathogen.

The trend in varietal changes which reflects the immediate reaction to face a serious problem over a span of only two years, all to the credit of the Mauritian planter, is well illustrated in Table 17.

Table 17. Percentage area planted under different varieties 1963-1966

Variety	*1963*	*1964*	*1965*	*1966*
M.147/44(H.S.)*	31.0	22.5	3.6	2.5
B.3337(H.S.) ...	5.8	3.1	—	—
B.34104(H.S.) ...	1.2	0.2	—	—
M.134/32 ...	—	0.6	1.3	—
M.31/45 ...	1.7	6.2	9.4	9.4
M.202/46 ...	14.8	21.3	21.1	16.2
M.93/48 ...	24.4	25.5	26.3	22.7
M.99/48 ...	—	—	3.4	3.6
M.253/48 ...	1.7	1.4	2.7	0.5
M.442/51 ...	—	4.2	18.8	24.1
Ebène 1/37 ...	4.5	1.7	1.7	3.4
Ebène 50/47 ...	9.7	7.6	4.4	2.1
B.37172 ...	2.4	1.5	0.4	—
Other varieties ...	2.8	4.2	6.9	15.5

*(H.S.) = highly susceptible

To summarize, it follows from the foregoing that the gumming problem is now well in hand and that the eradication of this disease, a major threat to the sugar industry, can once more be envisaged with confidence, while it can be assumed that, in the meantime, the adverse effect upon the sugar economy of the island will be at a minimum, if any, given favourable environmental conditions.

The outbreak of leaf scald although perturbing could have been considered less serious than the gummosis one. Indeed, as leaf scald is not rapidly disseminated by natural means, as the disease is damaging under specific environmental conditions, and as only two commercial varieties, M.202/46 and M.147/44, the latter already doomed, were susceptible, there appeared to be no immediate urgency to tackle the problem. However, as it was suspected that the new epidemic was being caused by a new strain of the pathogen, as in the case of gummosis, and not by an upsurge of the old one, the outbreak had to be considered a new disease and measures adopted at once for its control. As M.202/46 in 1964 was the best yielder in the humid zone of the island, it was decided to try and maintain that variety under cultivation until equivalent or better substitutes were available. Recommendations that lightly infected fields be rogued thoroughly, heavily diseased ones uprooted, and planting material taken from disease-free fields only, were followed at once, and by the end of 1966 the incidence of leaf scald in M.202/46 had decreased considerably. Furthermore, several varieties are now available for replacement, and it would appear that M.409/51 will gradually replace M.202/46 and, with the elimination of M.147/44, leaf scald should be once more eradicated from commercial plantations. The policy of the Institute is, therefore, not to recommend the release of susceptible canes, however promising they may be, in order to bring the disease under control as soon as possible. Fields of M.202/46 and M.147/44, particularly in the higher and wetter regions of the South where disease incidence was high, should be replanted with other varieties better suited to the locality anyway, and measures should be taken for the early removal of volunteer stools of the susceptible varieties.

Yellow spot and rust had been observed in Madagascar in the very recent past, and it was not surprising therefore to identify the two diseases in Mauritius in 1964. The outbreak of these two fungal diseases cannot in any way be compared to that of the two bacterial ones in importance. However, their discovery in 1964 served but to complicate an already intricate disease picture. Fortunately, the variety which showed high susceptibility to yellow spot and suffered economic losses was B.3337 which was being discarded on account of its high susceptibility to gummosis. Two other varieties, Ebène 50/47 and M.99/48, showed moderate leaf symptoms without apparent influence on yield. As for rust, three varieties contracted infection : M.147/44, M.202/46 and M.442/51. The last one, resistant to gummosis and leaf scald and adapted to dry conditions, was being propagated on a large scale to replace M.147/44 in the sub-humid zone. It was feared at one time that through the attacks of rust and thrips early in the season, resulting in a general unhealthy, yellowish-brown appearance of the foliage, the extension of that variety would have been affected. However, by 1966, planters had realised that these temporary attacks did not result in loss in yield, and the acreage under M.442/51 is increasing steadily.

In conclusion, it can be said that the eradication of the two major bacterial diseases is now in sight, and that efforts can henceforth be once more directed towards the insidious disease, ratoon stunting. Indeed, the varietal changes during the last two years have perturbed the whole planting and distribution programme at the Central Nursery, and a better streamlining of the control campaign is already under way.

2. THE CANE DISEASE SITUATION IN 1966

C. RICAUD

The two bacterial diseases, gummosis and leaf scald, have been the major concern in plant disease control since 1964. Fortunately, climatic conditions in 1966 have been conducive to a minimisation of the damage that they could cause, especially in the case of the former disease. However, *Fusarium* wilt, especially on M.202/46 in humid and super-humid regions of the South and East, has been another worry for the planter.

Cyclone *Denise* at the beginning of the year gave ideal conditions for the dissemination of the gumming pathogen, and by March, heavy leaf striping was widespread in susceptible varieties. It was thought that a severe epidemic would ensue, but with the drought which followed, the worst experienced in the island for years, infection was considerably reduced.

The dry conditions were also responsible for a reduction in intensity of yellow spot in super-humid regions, and the disease disappeared from affected fields earlier than in previous years. With the rapid replacement of B.3337, its distribution is becoming restricted.

Also due to the dry season, eye spot was not observed in commercial plantations. However, a seedling was found severely affected in a trial in the super-humid zone, resulting in top rot due to infection of the growing point by the causal fungus, a dangerous stage of the disease which is very rarely encountered locally.

On the other hand, dry conditions have in some way favoured wilt disease, and been responsible for a spectacular development of inflorescence rot over the whole island, especially in M.202/46 and Ebène 50/47. In the case of wilt, conditions in 1965 had been favourable to a build-up of the fungus in the soil, leading to increased infection in 1966. With the dry season, infected plants have been more vulnerable.

Unexpected reductions in yield in the R.S.D.–susceptible variety M.147/44, considered drought-resistant, have been observed in many areas, but it has not been possible to assess the role played by ratoon stunting disease in this connection.

Smut was, as usual, observed only in foreign varieties and seedlings in observation plots in the sub-humid zone.

3. GUMMING DISEASE

R. ANTOINE & C. RICAUD

Epidemiology

Efforts were concentrated in 1966 on a thorough survey in fields of M.147/44, especially in the sub-humid zone, in order to assess the distribution and intensity of the disease and the damage it causes in this variety.

As already stated, climatic conditions at the beginning of the year had been ideal for the dissemination of the pathogen, but with the dry season which followed, infection of younger leaves decreased. By harvest time, when the survey was carried out, the disease was of moderate intensity everywhere with very few cases of systemic infection, except in fields under spray irrigation, and specific localized regions, such as on mountain slopes where conditions for infection are excellent. The disease was virtually absent from the non-irrigated, sub-humid regions of the North and North-West and the coastal belt of the South and East.

Thus, since the outbreak in 1964, conditions in 1965 and 1966 have not been favourable for the disease to be in its worst form and it has not been possible to assess the effect of severe systemic infection in M.147/44. A few varieties under selection have shown abundant gum exudation from cut stalks at harvest in 1965 and 1966. It is therefore possible that, compared to these varieties, M.147/44 possesses a certain degree of tolerance whereby the deleterious effects of systemic infection do not occur in this variety.

An analysis of the climatic conditions during the past three years in relation to the intensity and distribution of the epidemic in the island has led to a better understanding of their interaction. Climatic fluctuations can account in a large measure for the changes in varietal reaction. If the three factors, wind speed, rainfall and temperature, are taken into account, an epidemic will be favoured by high wind speeds and high rainfall during the growing season which will disseminate the pathogen and cause maximum infection owing to mechanical damage to the leaves, while low temperatures and low rainfall during the maturing season, by slowing down growth, will aggravate the effect of systemic infection.

Fig. 8 shows mean deviations from normal values for wind speed, rainfall and air temperature during 1964, 1965 and 1966. Dark areas indicate those factors which favour the disease and hatched areas indicate those which are unfavourable. Thus in 1964, the three climatic factors involved were favourable to disease development, particularly high rainfall and high wind speeds due to two cyclones during the growing season, and low temperatures during the maturing season. This led to an outbreak of the epidemic. In 1965, all three factors were unfavourable, especially high rainfall and high temperatures during the maturing season which, by favouring the growth of the plant, increased its tolerance and checked the development of systemic infection. In 1966, favourable wind speed and rainfall prevailing at the beginning of the year gave a good start to the disease but the severe drought which followed reduced infection before the onset of the cool season.

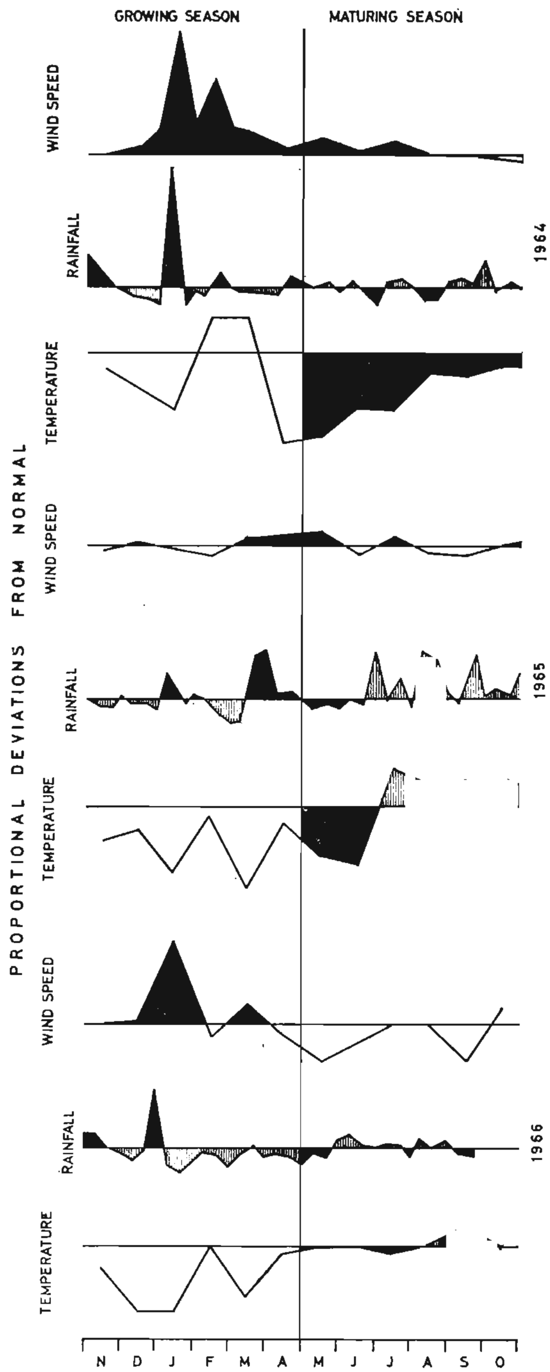


Fig. 8. Fluctuations in climatic conditions in 1964, 1965 and 1966. Dark areas indicate factors favourable to gumming disease, and hatched areas, factors non favourable.

The distribution of heavily infected fields, with cases of systemic infection, mainly of M.147/44, in the whole island in 1964 and 1966, is shown in fig. 9.

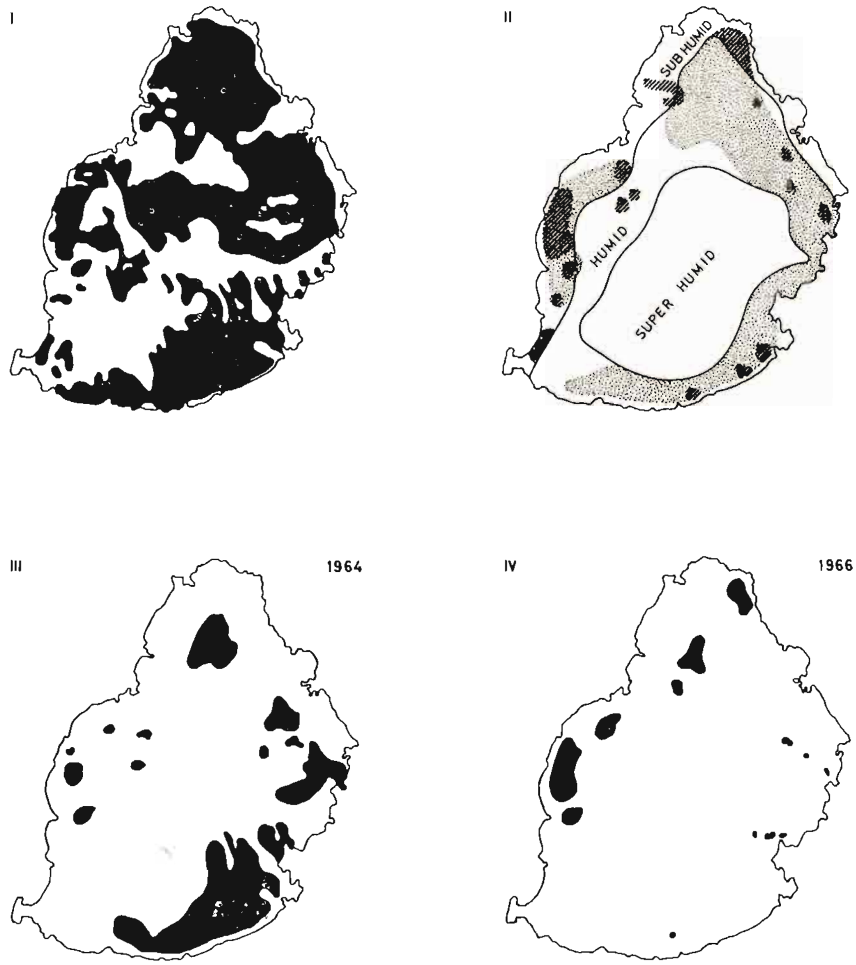


Fig. 9. Distribution of the new epidemic of gumming disease.

I. Distribution of cane lands. II. Areas where the disease could cause economic losses in M.147/44 given favourable climatic conditions (dotted). Areas under irrigation are indicated (hatched). III. & IV. Areas where the disease has been severe in 1964 and 1966 respectively, particularly in M.147/44, with cases of systemic infection.

The gradual dwindling of the epidemic is well illustrated in Table 18 which shows the number of stools with systemic infection observed in 14 fields of M.147/44, representing a total acreage of 68 arpents approximately, which have been regularly surveyed a few weeks after harvest, for the past three years.

From the results of surveys on the distribution of the disease in the whole island, and with a better understanding of the climatic factors favouring disease development, it has been possible to map those areas where the disease could be expected to cause economic losses in M.147/44, given favourable climatic conditions (fig. 9, II). The dangerous zone covers the humid areas of the South and East, and the irrigated areas, particularly under spray irrigation, of the North and West. It is reasonable to assume that the disease will not cause severe losses in M.147/44 in the dry coastal areas of the North and North-West.

Table 18. Decrease in number of stools showing systemic infection in fields of M.147/44 since 1964

Fields	*Acreage (arpents)*	*No. of diseased stools per arpent* 1964*	1965	1966
A	3.87	20	16	3
B	7.02	193	49	3
C	5.73	346	118	10
D	5.41	81	15	8
E	4.99	398	28	16
F	3.59	173	39	18
G	1.00	206	79	13
H	2.00	76	76	10
I	7.70	48	20	1
J	7.32	171	42	2
K	3.27	200	9	3
L	5.95	138	24	14
M	6.75	65	19	10
N	3.19	92	40	9
Total	*67.79*	*Mean 158*	*38*	*8*

* Diseased stools were rogued that year.

An analysis of yields in M.147/44 over the past three years has not revealed any decline which could be attributed to the disease. In the light of the above findings, the period for compulsory uprooting of M.147/44 has been extended to December 1973. It is however worth stressing that, in the humid regions and where spray irrigation is practised, the early replacement of M.147/44 is highly desirable in order not to maintain a reservoir of the pathogen with all the dangers involved. On the other hand, the complete replacement of susceptible varieties may well bring the disappearance of the new strain of the pathogen from plantations.

Resistance trials

The procedure of testing varieties for resistance at two stages of selection is now well established. Two trials are at present under way for the first-stage testing at the first selection trial stage, with the new strain of the pathogen, involving 377 and 217 varieties respectively.

At the second-stage testing, during which varieties screened from first selection trials are included, it has been found worthwhile to continue testing to both old and new strains in two separate trials in two localities, thereby obtaining replication in space; also, as the strains differ in virulence, a better interpretation of reaction can be made in doubtful or border line cases on first assessment.

Forty-two new seedlings were tested in the second-stage trials this year, while 21 more were re-included in the trial with the new strain for confirmation of results obtained in 1965. The number of resistant and susceptible varieties in the trial with the new strain is shown in Table 19.

Table 19. Number of varieties resistant and susceptible to the new strain in the 1966 gumming trial

*Rating**		*No. of varieties*	*% of total tested*
Resistant	1 ...	9	14.3
	2 ...	30	47.6
Susceptible	3 ...	22	34.9
Highly Susceptible	4 ...	1	1.6
	5 ...	1	1.6
	6 ...	0	0

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

Of the 22 varieties which reacted as susceptible (Rating 3), four having been found susceptible to the old strain also, are considered highly susceptible.

Disease reaction of noble varieties

The appearance of a new strain of the gumming pathogen has adversely affected the release of new varieties with better potential. Thus, the number of seedlings in final stages of selection found susceptible to gumming disease has passed from an average of 9% before 1964 to 25% in 1965. Out of 42 such seedlings tested in 1966, 50% were found susceptible, of which five were highly susceptible and had to be discarded. The search for new parents that could confer resistance has thus become imperative. With this end in view, the reaction to gummosis of 77 noble canes in a collection has been assessed. Although the standard method of artificial inoculation of infection rows was not adopted for this purpose, the level of natural infection in the collection was sufficiently high for the observations to be reliable. Twenty-six varieties were rated highly susceptible, twenty were susceptible, and thirty-one were found resistant.

The following is a list of the apparently resistant noble canes :

Bois Rouge	B.3390	M.13/18
Branchue rayée	B.6308	M.7/23
Fotiogo	Ba.7924	M.14/26
Gros Genoux	Ba.8846	M.109/26
John Bull	BH.10(12)	M.211/33
Korpi	DK.74	M.213/33
Knox	M.23/16	M.5/38
Mapou Perlée	M.27/16	NG.89(striped)
Mignonne	M.29/16	R.P.6
Tombiapa	M.35/17	R.P.8
		27 MQ 1124

The collection is situated in an irrigated area, and is surrounded by diseased fields of M.147/44. It is therefore very likely that the canes have been subjected to infection by the new strain of the pathogen. Some evidence of this has been obtained with isolates from the susceptible Louzier, which gave the same reaction as isolates from M.147/44 on the tri-phenyl tetrazolium chloride medium.

A trial has been established to study the susceptibility of seedlings issued from four selected crosses involving susceptible and resistant parents.

Morphological differences between the two strains of the pathogen

In 1964, cultural differences between the two strains were observed, especially when grown on an agar medium containing tri-phenyl tetrazolium chloride. Isolates of the new strain always ran down agar slopes more rapidly than those of the old strain. This differential rate of flow down an agar slope, which has been confirmed, could be attributed to a difference in the nature of the polysaccharide slime around the bacterial cells. It has since been observed that isolates of the new strain, contrary to the old strain, lost their viability very quickly in slant cultures on Wilbrink agar, and could not be maintained easily in culture unless frequently transferred. This character also could in some way be associated with the nature of the polysaccharide slime.

Attempts were thus made to detect any morphological differences between individual bacterial cells of the old and new strains that could be revealed microscopically. A method of capsule staining was adopted for the examination. Two-week-old cultures of the bacteria, growing on slants of the medium containing tri-phenyl tetrazolium chloride, showing well the differential rate of flow, were used. Suspensions of the bacterial cells in water were mixed with Nigrosine, and smears were prepared. After drying and fixing, the smears were counter-stained with 0.5% aqueous safranin. Eighty per cent alcohol was used to remove excess safranin to improve contrast. The bacteria were observed under phase contrast with an oil-immersion objective. The method failed to reveal the slime coating around bacterial cells, but morphological differences were observed between individual cells of the old and new strains. Cultures of the new strain showed a much greater proportion of long fusiform cells (Plate IV).

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4. LEAF SCALD

C. RICAUD

Although the distribution and intensity of leaf scald was slightly lower in 1966, the disease is still a problem in fields of M.202/46 in humid and super-humid regions. The recommendations of the Research Institute for knife sterilization during the preparation of cuttings at planting time with the germicide Iosan, and the systematic rogueing of diseased stools, especially in nurseries, have been followed by several estates. Although the surveys are not entirely reliable owing to the masking of symptoms in diseased fields, it has been observed that wherever such practices are not followed, the incidence of the disease can be very high. Thus, a survey in a field of M.202/46 in first ratoon revealed an average of more than 1000 diseased stools per arpent. Yet, the yield was not apparently affected, averaging 43 tons per arpent, suggesting a certain tolerance of the variety to infection. However, an analysis of sucrose content in representative samples of healthy and diseased stalks showed a reduction of 11% in diseased stalks with side shooting, as follows :

	Pol.
Healthy stalks	16.3
Diseased stalks	
(i) With side shoots ...	14.5
(ii) Without side shoots ...	16.4

The evolution of the disease in the above field after harvest is being followed. A block of 28 rows of 150 ft. (approximately 0.5 arp.) has been marked and surveys are carried out at intervals, noting the number of stools showing symptoms for each 10-foot row. The results obtained so far are shown in Table 20.

Table 20. Evolution of leaf scald in a field of M.202/46

Survey	*Total no. of diseased stools*	*Stools showing*			
		Stripes		*Chlorosis*	
		No.	*%*	*No.*	*%*
At harvest	525	—	—	—	—
Weeks after harvest					
11	172	100	58.6	72	41.4
13	112	26	23.2	86	76.8
16	172	52	30.2	120	69.8
21	204	96	47.1	108	52.9
25	353	274	77.6	79	22.4

Some stools showed striking chlorosis, while others exhibited only leaf-striping; in the latter case, only those showing characteristic symptoms were considered. Many of the originally diseased stools did not show symptoms some time after harvest, but there was a gradual build-up in expression of symptoms as the ratoon crop grew. However, a decrease in the number of diseased stools was observed at the second post-harvest survey. This could be explained by the fact that a number of young shoots are inoculated by the cutting knife at harvest and immediately show symptoms but die rapidly, whereas the disease develops in the rhizome and new shoots developing at the base of dead ones may later show symptoms.

The preliminary conclusions to be drawn from these observations are that the first rogueing should be done fairly soon after harvest, about 5 to 6 weeks, as the canes resume growth, in order to detect those stools which become infected by the cutting knife at harvest. Care should be taken not to miss those stools which show the less conspicuous stripe symptoms, especially in the case of nurseries. A second rogueing should be done as late as possible but before the cane canopy closes in.

The evolution of the disease has been followed also in 50 individual naturally-infected stalks of the highly susceptible variety Ebène 88/56 showing varying degrees of chlorosis. Twelve per cent of the stalks died, while the others never recovered until harvest. Measurement of growth rate, over a period of two months, in comparative healthy and diseased stalks, showed an average reduction of 44% due to the disease.

A new resistance trial was established at Belle Rive Experiment Station, including the following varieties : M.31/45, M.202/46, M.99/48 M.409/51, M.442/51, M.484/51, M.13/53, M.356/53, M.359/53, M.361/53, M.260/55, M.13/56, M.220/56, M.377/56, M.84/57, M.130/57, M.351/57, M.124/59, M.579/59, M.1007/59, Ebène 74/56, Ebène 88/56, B.51129, B.52107, N: Co.376 and S.17.

5. TWO ASPECTS OF *FUSARIUM* INFECTION

C. RICAUD

Wilt

The outbreak of wilt disease caused by a strain of *Fusarium moniliforme*, reported in 1965, has been more severe in 1966. The disease was encountered in humid and super-humid regions, especially in the southern and eastern sectors of the island where it has been reported on no less than seven estates. On one estate in the super-humid zone, where it had assumed alarming proportions, a systematic survey carried out by the Agronomist of the estate revealed its presence with medium to high intensity in 46 fields, mainly M.202/46, representing about 330 arpents or 6% of the total acreage. The variety M.202/46 has again been the most seriously affected, but the disease was observed in M.93/48 and Ebène 1/37 as well.

The emergency harvesting of diseased fields has been recommended, and followed wherever possible. In general, only localized patches in fields were affected, but in few cases whole fields were attacked. No severe losses have been experienced, except in one field where, due to infection starting early in the growing season, the canes were stunted.

In the majority of cases, symptoms appeared in late May or June, on 8- to 9- month old canes nearing maturity. On two occasions, young plant canes were affected due to infection through setts. In one case, foliar symptoms were observed in young shoots in a patch on the leeward side of affected mature cane in an adjoining diseased field. Infection of the setts had probably arisen from spores disseminated by wind. The setts were found heavily infected and infection passed along vascular bundles into the young shoots. Growth was unthrifty and several shoots showed proliferation of adventitious roots, but none were killed by the infection. Affected shoots recovered from the disease after some time. In the second case, a badly diseased patch in 1965 had been recruited with cuttings of M.202/46. The disease developed in the young plants through the setts. At harvest in 1966, the canes were very stunted, with very few stalks per stool, and showed severe wilt symptoms in the leaves.

Infection of the spindle by the fungus causing pokkah boeng is very common in the affected fields. The young leaf sheaths inside the spindle develop a deep red coloration wherever infected. In many cases, such infection results in top rot, and affected stalks then deteriorate from the top as well as from the bottom. In one diseased patch of M.93/48, few stalks showed top rot but, instead, young developing leaves showed distortions of the midrib indicative of mild pokkah boeng.

An important aspect of the disease is the reduction in ratooning capacity. In some severely affected fields, a great number of stools died after harvest, and ratooning was so poor that the fields had to be completely replanted. Death of stools is brought about by infection of the underground stubble. Furthermore, young buds at the base of stalks become infected externally at various stages of their development. Thus in diseased patches, a striking reduction in the number of young tillers was observed. It can be expected that, if diseased fields are left standing too long, stubble deterioration will be more severe and thus ratooning capacity more affected.

Stools which are not killed resume growth after a certain time and the new shoots that develop are healthy. However, a reduction in the number of stalks per stool has been observed in the ratoon crop.

The fungus responsible for the infection of young buds is being investigated. A trial has also been laid down in a diseased field to study the beneficial effect of fungicide applications after harvest to promote ratooning by reducing infection of young buds.

The fungus causing wilt is generally considered a weak wound parasite which sporadically shows outbursts of greater parasitic activity. The factors which bring about such enhanced

Inflorescence rot caused by *Fusarium moniliforme* var. *subglutinans* on M.202/46. *Left*. Affected field showing canes at flag stage with leaves dropping and arrows failing to emerge. *Right*. Close-ups of split stalks ; note pithiness and side shooting.

Effect of cyclone on B.49119 showing twisted and dead stalks.

pathogenicity have not yet been completely defined. All conditions which lower the vitality of the plant may be conducive to an attack. An association of soil type and climatic conditions seem to be important, especially when a period of high soil moisture is followed by dry conditions. High soil moisture weakens the plant through partial root asphyxiation, and at the same time favours growth of the fungus leading to infection, whereas dry conditions aggravate the course of infection in the plant. Thus the disease is observed in humid to super-humid regions, very often in localized spots with bad drainage, or on heavy soils. Yet this year it was most severe owing to the drought.

The disease being usually associated with specific unfavourable growth conditions, there is no reason to be unduly alarmed. In fact, the susceptible varieties M.202/46 and M.93/48 have on the whole produced high yields in 1966. The precautions to be taken are to refrain from cultivating these varieties in poorly drained areas where the disease is at its worst; to harvest infected fields early, at least those patches where infection is severe, to prevent excessive loss in sucrose and minimize ratoon failures ; to replant badly diseased fields. An experiment is under way to study the effect of allowing a short fallow before replanting diseased fields. Particular care should be given to the organo-mercurial sett treatments especially when replanting diseased fields or recruiting diseased patches. The concentration of fungicide solutions should not fall below 0.015% Hg. For continuous treatments it is best to start with solutions of 1% of the 3% (or 0.5 % of the 6%)Hg formulations.

Inflorescence rot

Numerous cases of inflorescence rot, also caused by a strain of *Fusarium moniliforme*, were observed throughout the island in 1966 in several varieties, in particular M.202/46 and Ebène 50/47 (Pl V). The incidence was highest in humid and sub-humid regions.

Flowering was heavy during the year and severe water stress in April and May retarded the emergence of the inflorescences already formed inside the spindles, whereby infection started, causing deterioration. Cut spindles showed aborted inflorescences at different stages of development. Sometimes infection led to death of leaves, leaving the stalks bare, the field appearing as if affected by a very serious disease. The influence of water stress was obvious in fields where symptoms were concentrated in patches where the soil was shallow with underlying rocks.

Infection led to a greater pithiness of the stalk and decrease in sucrose content than in canes flowering normally. The pithiness and sucrose loss were aggravated by profuse development of side-shoots. Infection developed down the stalk but not to a great extent, except in rare cases.

The disease is strictly seasonal and has been due to extremely favourable climatic conditions. Severe losses should not be experienced if diseased fields are harvested with minimum delay.

Comparative studies are in progress on isolates of *F. moniliforme* from the different types of infection: wilt, pokkah bœng, inflorescence rot and stem rot.

6. MISCELLANEOUS

R. ANTOINE & C. RICAUD

Chlorotic Streak

Studies on the transmission of the disease are continuing. Two greenhouse experiments were set up (Pl. III), one in water culture, and the other in basalt sand with nutrients, to investigate the role of chytrids in transmission. The infectivity of diffusates from roots of diseased plants in combination with filtered and non-filtered soil extracts from diseased and disease-free areas is being studied. The infection of healthy plants will be followed in relation to the presence of chytrids in the roots.

A field trial has been laid down in the super-humid zone to compare the effects of inorganic fertilization and organic fertilization in the form of factory residues, on yields in two varieties : one highly susceptible to the disease (M.442/51), and the other moderately susceptible (M.93/48). Cuttings have been hot-water treated at planting, and the rate of re-infection with chlorotic streak will be followed to detect any beneficial effect of the organic soil amendments. The effect of organic soil amendments in retarding re-infection is being simultaneously studied on M.442/51 under more strictly controlled conditions in concrete containers.

Cyclone damage

Abnormal bending of stalks was observed in the variety B.49119 in variety trials (Pl. VI). The malformation could be mistaken for herbicide damage (*Rep. Maurit. Sug. Ind. Res. Inst.* **VI**, 1959: 59 & fig. 24), but close examination showed that the initial bending in a stalk did not result from cell elongation in the growth band. Only the upper parts of the stalk showed such development of the growth band which allowed the canes to straighten up after the initial bending. Several canes were found broken at more or less the same level as the bending.

The abnormal development was attributed to the effect of the cyclone which struck the canes earlier in the season. Bending occurs in the weak malleable top part of the stalk still enclosed in the leaf sheath.

At the time this report is being written, the symptoms have again been observed, after the passage of another cyclone, in several canes in variety trials.

Ratoon stunting disease

The reactions of varieties to gumming disease, both new and old strains, having been assessed, a new series of ratoon stunting trials will be established in 1967 after sufficient planting material has been bulked up at the Central Nursery.

Estates and planters were supplied with 2,715 tons of planting material from the Nursery in 1966 as compared to 3,000 tons in 1965. A total of approximately 132 arpents were under A and B nurseries in 1966 for the supply of disease-free planting material in 1967. Just under 260 tons of cuttings were treated at the Central Hot-Water Treatment Station in 1966 to plant 67 arpents of land at the Central Nursery. Thirty-five new promising varieties were established for inclusion in trials after propagation.

The Nursery is faced with a serious problem of scale infestation. Experiments were started in co-operation with the Entomology Division on the hot-air treatment of cuttings in an attempt to control the insect. The effective time/temperature combinations were found to be 60°C for 90 minutes, 70°C for 60 minutes and 80°C for 30 minutes.

Fiji disease in Madagascar

The reaction to Fiji disease of all varieties tested to-date in the resistance trials on the East Coast of Madagascar is given in Table 21.

Table 21. Reaction of sugar cane varieties to Fiji disease in Madagascar

Highly susceptible	*Susceptible*	*Moderately susceptible*	*Resistant*
B.34104	Azul	Atlas	B.46364
B.37172	Co.421	B.3337	B.49119
B.4098	C.P.29/116	B.37161	Cl.41/223
B.42231	Ebène 50/47	B.41227	Co.290
B.4362	H.44-3098	Co.281	C.P.44/101
B.45151	M.423/51	M.74/39	M.165/38
B.4744	M.99/48	P.O.J.3067	M.63/39
Ebène 1/37	P.R.1013	R.366	M.31/45
F.108	Q.47	R.383	M.202/46
H.32-8560	R.447	Uba	Pindar
H.39-3633			Q.50
M.134/32			Q.57
M.272/52			Q.58
M.93/48			R.331
M.442/51			R.430
N:Co.310			R.445
N:Co.376			R.511
P.R.980			R.512
P.R.1000			R.514
Q.42			R.519
Q.49			R.520
R.337			Ragnar
			S.17
			Trojan

A major cause for concern is the observation made during the last two years that the environment provided by the highly susceptible M.134/32 is gradually becoming less infective. This is due to the fact that a large number of diseased plants in the rows providing infection are considerably dwarfed, bearing witches' brooms or coarse, dark green leaves probably unattractive to the vector. Attempts to build up once more the infective environment through the release of viruliferous vectors have, so far, met with limited success.

Quarantine

At the end of the 1964-66 quarantine, 41 varieties out of 44 were released; two varieties failed to germinate and one was destroyed after showing leaf symptoms suggestive of mosaic.

The new quarantine cycle started in September, and the following 43 varieties were received and have been successfully established in the greenhouse :

Originating from Australia : Q.69, Q.72, Q.76, Q.78, Q.80, Q.82, Q.83 and Q.86.

From the West Indies : B.4906, B.60267, B.60191, B.6103, B.5908, B.62110 and B.5913.

From India : Co.775 and Co.976.

From Taiwan : F.146 and F.153.

From the U.S.A. : Phil. 53-3, Phil. 53-33, Chino, Chinois, Chunnee, Agoule, Hathuni, Seretha, C.P. 55/30, 21 N.G. 31, 28 N.G. 27, 51 N.G. 13, 51 N.G. 153, 57 N.G. 52, 57 N.G. 57, 57 N.G. 68, 57 N.G. 77, 57 N.G. 123, 57 N.G. 127, 57 N.G. 155, 57 N.G. 198, 57 N.G. 233, P.R. 1013 and P.R. 1059.

CANE PESTS

J. R. WILLIAMS

THERE were no unusual outbreaks of pests during the year. Apart from cane borers, there were minor attacks by armyworms, and the white grub *Clemora smithi* was numerous in some fields in the super-humid zone. Planters should not ignore the advisability of growing *Eupatorium* bushes to encourage the parasites of white grubs to frequent cane areas. An attack of *Alissonotum piceum* (Fabr.) occurred over a few arpents of young virgin cane in January, the beetles destroying small shoots by chewing them below soil level.

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

Diatraeophaga striatalis Townsend (Tachinidae, Diptera), or the Javanese fly, is the only Tachinid parasite of Pyralid cane borers known to occur naturally in the Old World. It is native to Java where its host is *Proceras sacchariphagus* Boj., and there are no records of its occurrence elsewhere, or of other hosts. Apart from an attempt made in 1915 to introduce the insect into Formosa, the use of *Diatraeophaga* for biological control of cane moth-borers remained unexplored until the M.S.I.R.I. initiated and financed a collecting expedition to Java in 1961 (GHANI and WILLIAMS, 1963). By contrast, there are several Tachinid parasites of Pyralid cane borers in the New World which have been used intensively, with several successes, in biological control campaigns against the Neotropical *Diatraea* cane borers.

In 1961, shipments of *Diatraeophaga* pupae collected in Java by Dr. M. A. Ghani of the Commonwealth Institute of Biological Control enabled preliminary studies on the biology of the parasite and the release of about 660 adults. In 1964, a second collection of *Diatraeophaga* pupae in Java was organized by the *Institut de Recherches Agronomiques Tropicales* (IRAT) for introduction of the parasite into Madagascar and Réunion where, as in Mauritius, *Proceras sacchariphagus* (the spotted borer, or 'le borer ponctué') is also an important cane pest (BRENIÈRE *et al.*, 1966). IRAT kindly diverted some of the pupae collected in Java to Mauritius, enabling the release of about 1500 flies. To date, there is no evidence that *Diatraeophaga* is established in Mauritius, Réunion, or Madagascar from releases of flies collected as pupae in Java.

Studies on rearing methods were pursued in 1964-65 by IRAT in Madagascar, and in 1965 a successful laboratory culture was established in Réunion (ETIENNE, 1965). From the latter, 200 pupae were received in February and rearing was started at Pamplemousses Sugar Experiment Station where an existing building had been modified specially for the purpose. The release of laboratory-bred *Diatraeophaga* is now being carried out concurrently in Mauritius and Réunion with the common object of releasing as many flies as possible at different seasons, and in different localities, to establish the insect and explore its potential as a control agent of *Proceras*.

Breeding technique

The successive steps in the breeding of *Diatraeophaga* are described below. The insectary at Pamplemousses, where this work is done, has no provision for control of temperature and humidity, and its only special feature is a ventilated darkroom. Borers for breeding the parasite are collected by a roving field gang of about a dozen labourers and boys.

Impregnation of the females. The pupae are kept in cages in the darkroom and the adults, which emerge mostly between 8.0 - 11.0 a.m., are each morning removed, counted, and sexed. Up to about 100 females are placed in a white organdie cage 18″ x 18″ x 18″ with about an equal number of males. The males, like the females, may be freshly emerged, but virgin males of the previous day's emergence are usually used. This 'mating cage' is then placed outdoors in direct sunshine (Pl. VII, a) and mating couples (Pl. VII, b) removed in specimen tubes. When a couple separates (mating may last a few minutes or nearly an hour), the male is returned to the mating cage and the impregnated female is put aside with others in smaller 'storage' cages about 10″ x 10″ x 10″. Generally, most of the females mate by about noon when the cage is placed in the darkroom to be taken out next morning to try to mate the few virgin females it still contains.

Darkness inactivates the flies, and placing them in sunshine after they have emerged in the dark, or have been for a period in the dark, stimulates them to mate. Thus, the mating cage is sometimes returned to the darkroom for 1/2 hour or so in mid-morning. The use of a darkroom for emergence of flies and for keeping mixed sexes enables precise control of mating, preventing it when the flies are not under surveillance, and stimulating it when they are.

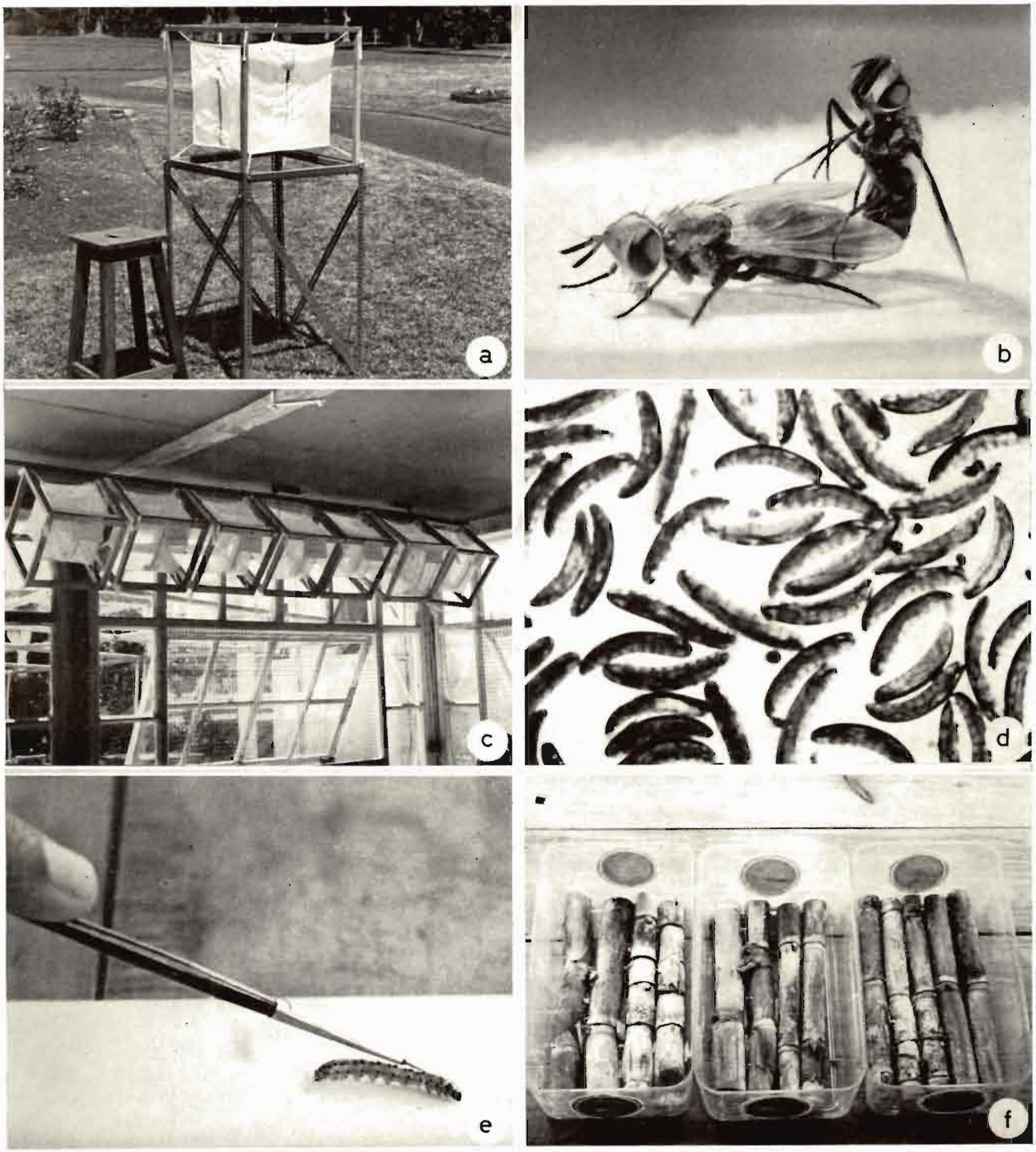
It was ascertained that a virgin male may mate twice on the morning of emergence, and on both occasions provide a female with enough sperm to fertilize her full complement of eggs. In practice, about 90% of the females mated by the procedure described are fully impregnated.

Gestation. After impregnation, eggs descend from the ovaries, are fertilized, and held in the uterus until ready to hatch. The lowermost eggs in the uterus, i.e. the first to descend from the ovaries, are the first to complete their development, which takes five days or more according to temperature. However, a female does not normally lay even fully developed eggs without the stimulation provided by traces of a borer (i.e. any object or surface which has recently been in contact with a borer) and, for purposes of breeding, the impregnated females are kept for 7-8 days in the hot season, or 9-10 days in the cool season, when nearly all the eggs in the uterus are then fully developed and ready to hatch. The females are kept in the storage cages (Pl. VII, c) referred to above, up to about 100 per cage, and provided with water, sugar and honey.

Parasitizing the host. In nature, the eggs hatch as they are laid and it is the tiny, 0.6 mm long, first-stage larva which finds and attacks the host. Most are probably dropped at the entrance of borer tunnels. The larvae are very delicate and soon perish in the absence of moisture.

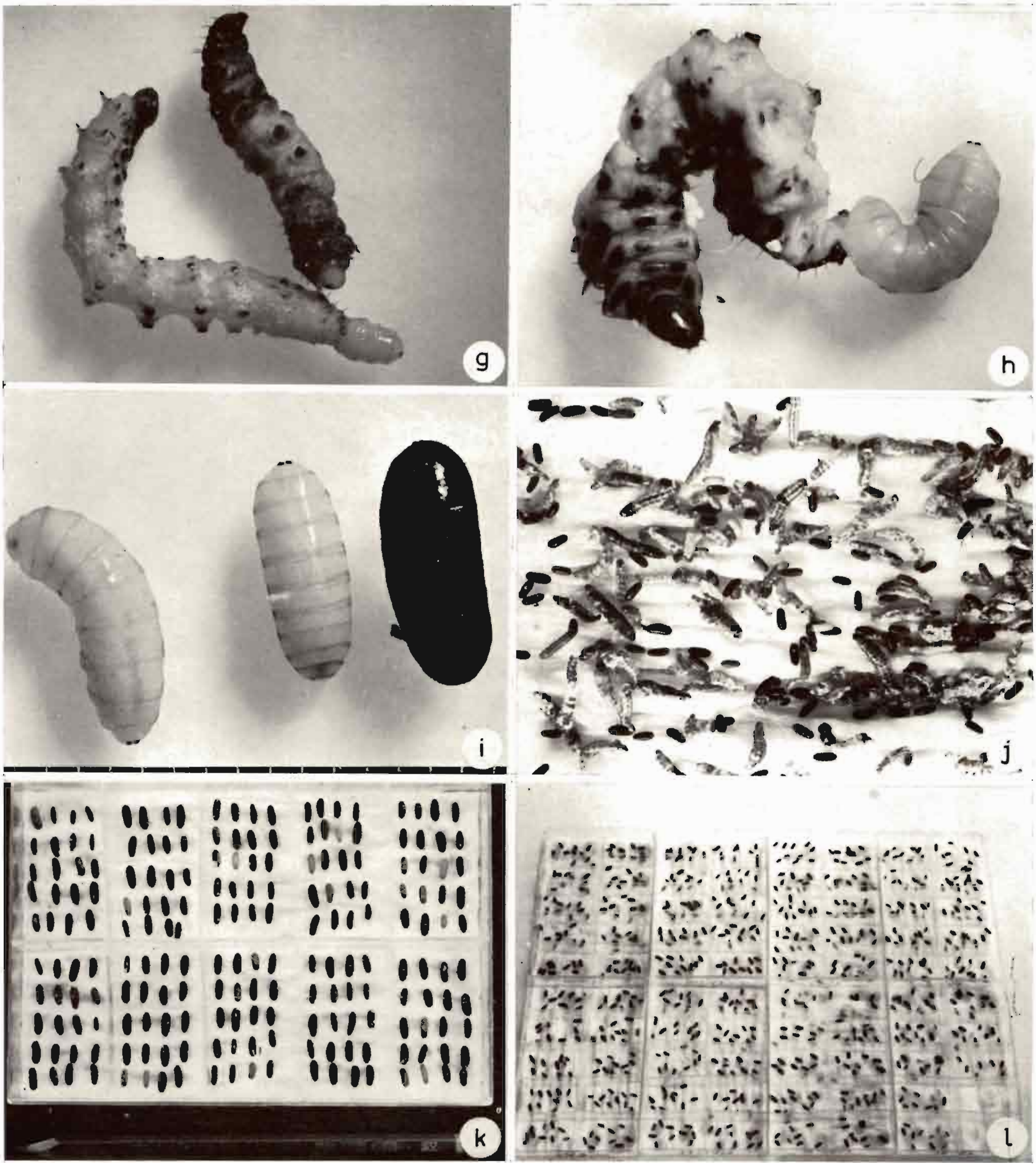
The first-stage larvae are obtained in the laboratory by removing the uterus of a gravid female and opening it in a drop of distilled water. The eggs so freed (Pl. VII, d) hatch immediaetely, or within a matter of minutes, and two or three larvae are placed on a borer (Pl. VII, e) with the aid of a fine brush and a stereoscopic microscope. This operation is generally referred to as 'inoculation' of borers and, like mating the adults, is a critical step in the breeding technique. The exact sequence followed, with one person at the microscope manipulating the parasite larvae and another manipulating the borers, is (1) a borer is dipped in distilled water and dropped into a plastic pill-box; (2) the parasite larvae are placed on the borer (three on the biggest borers, two on all others); (3) the pill-box is closed and set aside for about 1/2 hour. Wetting the borers is intended to promote the survival and activity of the parasite larvae while they are endeavouring to enter their hosts, and the period in the pill-box is to permit entry of the parasites before further manipulation of the borers.

The number of first-stage parasite larvae obtained from one female fly varies considerably and depends primarily on the size of the fly; also, some eggs may not have been fertilized, some are not ready to hatch when the fly is dissected, and some flies oviposit before dissection. Generally, 150 to 300 are obtained and enable, with two or three per borer, 50 to 150 inoculations. The average number of borers inoculated per impregnated female fly has been 76. With practice, two people — one at the microscope and one handling the borers — can inoculate 300



Stages in the breeding of *Diatraeophaga striatalis* Tns.

(a) Cage for mating the adults
(b) A male and female *in copula* (x5½ approx.)
(c) Storage of mated females during gestation
(d) Eggs dissected from female's uterus and about to hatch (x33 approx.)
(e) "Inoculation" of a borer. A minute parasite which has just hatched is being placed on a borer, which it enters
(f) Boxes with split canes for storage of inoculated borers



Stages in the breeding of *Diatraeophaga striatalis* Tns.(cont.)

(g) Mature parasite larvae breaking out from their hosts

(h) A mature parasite larva and the dead borer from which it has emerged

(i) Stages in the transformation of a parasite larva into a pupa

(j) Dead borers and the parasites which have emerged from them

(k, l) Storage of parasite pupae for emergence of adults borers an hour. Borers less than about 15 mm. long are not generally used.

Development of parasite in the host. The inoculated borers are removed from their pill-boxes to plastic boxes that have tightly-fitting lids and bronze-gauge windows for ventilation (Pl. VII., f). A box about 9″ x 5½″ x 3½″ is satisfactory for keeping 100 borers. Split cane is provided as food and is changed every other day until the parasitized borers have died.

Parasitized borers begin to die after about 7 days. The fully grown parasite larvae break out from their bodies a day or so later (Pl. VIII, g, h) and pupate (Pl. VIII, i). On the fourth and subsequent changes of cane, therefore, dead borers, after their removal from the plastic boxes, are placed on wet pads for the parasite larvae to emerge from them and pupate (Pl. VIII, j). Parasite pupae which have formed already in the boxes are also removed.

Retention of pupae. The parasite pupae are kept on moist pads in trays (Pl. VIII, k, l) and placed in cages in the darkroom until emergence of the adults about 12 to 14 days later.

Results of breeding and efficiency of breeding technique

Nine generations of the parasite were reared during February-December. Details are given in Table 22 and the ratios at the foot of the table are measures of the overall efficiency, or economy, of the technique used over the nine generations.

The average number of parasite pupae obtained per 100 inoculated borers (an inoculated borer may yield 0, 1, 2 or 3 pupae) was 58.2 ; in only two generations, the first and eighth, was it below 50 ; in three generations, the third, fourth and ninth, it exceeded 70. Losses at this stage of breeding result from following :

(1) Mortality of inoculated borers from
  (a) undetermined causes ; probably the result of handling the borers when they are collected, during inoculations, when their food is changed, etc. ;
  (b) *Apanteles flavipes*, some borers being parasitized by *Apanteles* when they are collected. This factor is minimized as far as is possible by collecting borers in areas where *Apanteles* is least active. Loss of inoculated borers from *Apanteles* was usually less than 5% and never exceeded 10%.

(2) Pupation of inoculated borers. A parasite larva may complete its development despite host pupation, but it is usually unable to break out through the tough pupal integument. This factor has been negligible : few inoculated borers pupate before the parasites kill them.

(3) Inoculation failures. All first-stage parasite larvae do not penetrate the borers on which they are placed and some borers remain unparasitized.

(4) Accident. Some inoculated borers are regularly and unaccountably lost; others may be accidentally killed when their food is being changed. Formalin-contaminated borers caused the death of several hundred borers during the eighth parasite generation. Such losses seem inevitable when thousands of borers are being continually handled.

Emergence of adults from pupae varied between 80 to 89% with an average of 84.4%, giving 49.1 flies per 100 inoculated borers.

The 1 : 1 sex ratio reduced female flies per 100 inoculated borers to 24.8. The percentage of females which mated varied from 65 to 94%, with an average of 83.4%, giving 20.7 mated females per 100 inoculated borers. Mated females are often kept for a few days before their release and some may die; others are kept for breeding. About 85% of all mated females were released, or 17.6 per 100 inoculated borers. The final reduction results from unimpregnated mated females, which as already mentioned comprised about 10% of mated females, giving a final figure of about 16 impregnated females released for every 100 borers inoculated.

When all the operations involved in breeding, starting with collection of borers, are considered, the number of man-hours to produce 16 impregnated females is appreciable. Maintain-

Table 22 Laboratory-rearing of *Diatraeophaga*, Feb.-Dec. 1966

Generation	*Month*	*Borers inoculated*	*Pupae obtained*	*Flies obtained*		*Mated females*	
				Both sexes	*Females*	*Obtained*	*Released*
1	Feb.-April	4205	1345	1165	600	495	361
2	March-May	6760	3501	3118	1517	1252	1042
3	April-June	8224	5893	5081	2612	1688	1519
4	May-July	3488	2603	2195	1137	997	904
5	July-August	3152	2122	1692	822	769	672
6	August-Sept.	3107	1952	1691	837	749	571
7	Sept.-Nov.	6754	3612	2884	1425	1314	1039
8	Oct.-Dec	11324	5226	4365	2274	2061	1757
9	Nov.-Jan	8567	6100	5108	2578	2192	1877
Totals		55581	32354	27299	13802	11517	9742
Ratios		100	58.2	49.1	24.8	20.7	17.6
			100	84.4	42.7	35.6	30.1
				100	50.6	42.2	35.7
					100	83.4	70.6
						100	84.9

ing and improving the efficiency of breeding becomes progressively more difficult with increase in size of the culture. The best way of improving efficiency is by inoculating only large borers. In tests with fully-grown, or nearly fully-grown, borers, using the methods described, 100 borers inoculated with two and three first-stage parasite larvae yielded 134 and 128 pupae, respectively; somewhat smaller, though still big, borers yielded 95 and 108 pupae, respectively. Such results were not obtained during routine breeding (the 4th and 9th generations, the best in this respect, gave 75 and 71 parasite pupae, respectively, per 100 inoculated borers) because the supply of borers never exceeds demand, and elimination of all but large borers to increase efficiency of breeding would reduce overall production of parasites. Big borers may also be kept without food after their inoculation, with a saving of much labour : 445 picked out from inoculated borers of the 4th parasite generation and kept in boxes with only moist tissue paper yielded 552 parasite pupae, i.e. 124 pupae per 100 inoculated borers.

The breeding cycle

The length of the life cycle of *Diatraeophaga* and the frequency of the generations reared have been indicated above, but fig 10 shows more explicitly the sequence of events during rearing. The figure relates to a small generation reared in the cooler months and to a large generation reared in hot months, and their comparison shows that extending the inoculation period results in overlapping of different stages and generations, taxing the capacity of a small insectary. Conversely, reducing the inoculation period simplifies breeding but reduces production, unless numbers inoculated daily are increased. The number of daily inoculations is, however, limited by the number of borers available.

The approximate average duration of the different stages of the life cycle at Pamplemousses is shown below

	November-December 23-29°*C* (*Mean min. and max. temp.*)	*July-August* 20-24°*C* (*Mean min and max. temp.*)
Egg (gestation)	5	7
Larva (in host)	9	12
Pupa ...	10	15
	24 days	34 days

Liberations

The mating of females before their release, referred to above, is considered advisable in case dispersion and limited numbers of released flies result in inability of the sexes to find each other : that is, mating the females before release ensures their fertility. A good proportion of such females are also held in the laboratory for a few days after mating (Table 23) to reduce the duration of gestation in the field : this should reduce natural mortality before reproduction and also reduce dispersion of progeny. By release of mated females, males which are released serve only to augment an incipient natural population resulting from earlier releases.

The number of mated females released was 9742 (Table 23). About 10% should be

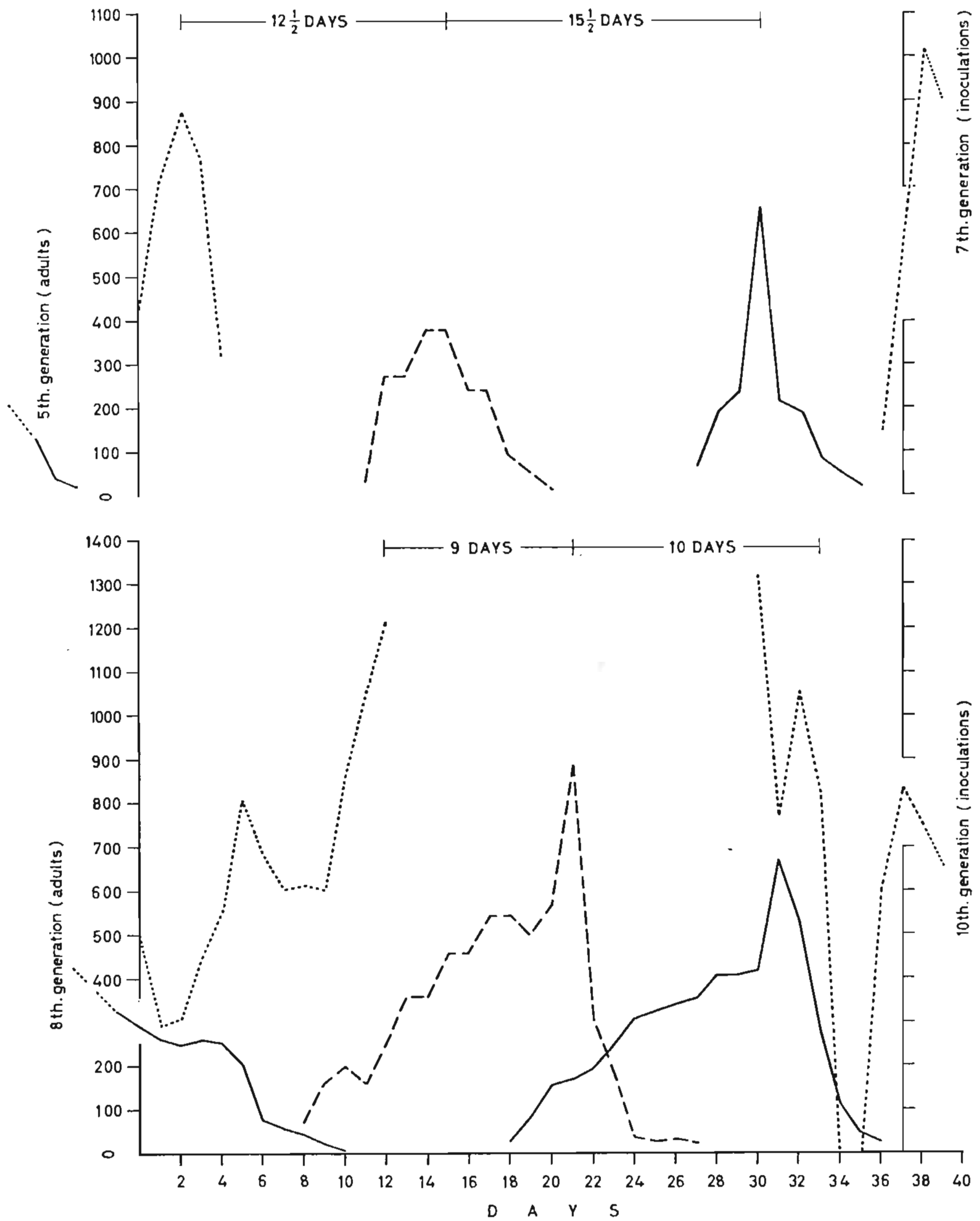


Fig. 10. *Top :* 6th parasite generation, 16th Aug. — 20th Sept. Mean minima and maxima daily temperatures 19.4°C & 24.2°C respectively.

Bottom : 9th parasite generation, 28th Nov. — 3rd Jan. Mean minima and maxima daily temperatures 24.1°C & 29.7°C respectively.

Dotted line = Borers inoculated
Broken line = Parasite pupae
Plain line = Parasite adults

Table 23 (a) Liberation of *Diatraeophaga* at Belle Vue

Date of release	*Mated females* — *Days after mating (= age)* 3	4	5	5+	*Total*	*Other flies (mostly males)*
28/3/66				20	20	
29/3/66				40	40	
30/3/66				46	46	
31/3/66				45	45	
1/4/66				20	20	
2/4/66				53	53	590 (28/3/66–9/4/66)
4/4/66				13	13	
5/4/66				58	58	
6/4/66				27	27	
7/4/66			5	21	26	
9/4/66		8		5	13	
24/4/–7/5/66			750	292	1042	1640
23/5/66						180
25/5/66			26		26	530
26/5/66			19		19	290
27/5/66			35		35	280
28/5/66			94		94	255
29/5/66						290
30/5/66			188	177	365	250
31/5/66			91		91	340
1/6/66			112	5	117	170
2/6/66			40	6	46	180
3/6/66			55	5	60	165
4/6/66			149	8	157	100
6/6/66			121		121	
7/6/66			105		105	
8/6/66			215		215	50

Date of release	*Mated females* — *Days after mating (= age)* 3	4	5	5+	*Total*	*Other flies (mostly males)*
11/6/66				16	16	
12/6/66			29		29	
13/6/66			23		23	
26/6/66						64
27/6/66						105
28/6/66						150
29/6/66						143
30/6/66		27			27	
2/7/66		55			55	
3/7/66		99			99	
4/7/66		80			80	
5/7/66		109			109	613 (30/6/66–11/7/66)
6/7/66		111			111	
7/7/66		75			75	
8/7/66		63			63	
9/7/66		132			132	
11/7/66		48	45	60	153	
8/8/66			91	26	117	
11/8/66				91	91	775 (8/8/66–16/8/66)
13/8/66		62	68	137	267	
16/8/66	9	26	66	90	191	
19/8/66				6	6	
18/9/66			36		36	
20/9/66			253	60	313	800 (19/8/66–23/9/66)
21/9/66		80	85	16	181	
23/9/66			41		41	
Totals	9	975	2742	1343	5069	7960

Table 23 (b) Liberation of *Diatraeophaga* at Le Vallon

Date of release	*Mated females* — *Days after mating (= age)* 1	2	3	4	5	5+	*Total*	*Other flies (mostly males)*
22/10/66	59	53	33	21			166	
26/10/66	158	166	145	116			585	
29/10/66	47	75	109			7	238	1310 (22/10/66–4/11/66)
31/10/66						33	33	
4/11/66						17	17	
23/11/66		144	56	7			207	150
26/11/66		76	105	109			290	202
28/11/66		179	170			10	359	350
30/11 66			143			14	157	230
1/12 66			126			11	137	310
3/12 66			113	105			218	240
7/12/66		24	29	83	106	108	350	175
9/12/66	7	9	11		12		39	60
21/12/66	62	55	66	39			222	154
24/12/66	116	101	73				290	177
27/12/66	146	142	134			11	433	385
31/12/66	232	232	148	129	18	3	762	322
3 / 1/66	11	44	115				170	400
Totals	838	1300	1576	609	136	214	4673	4465

considered as not impregnated, bringing the effective number released to about 8800. In addition, other females and males were released, usually when two or three days old. The details of all releases are given in Tables 23a and 23b, and show a grand total of 22,167 adults released.

The two sites chosen for release of *Diatraeophaga* are markedly different, and are characterized as follows :

Belle Vue : Annual rainfall about 50″; mean max. temperature 31.0° C. in January, mean min. temperature 15.7° C. in August. Situated in the northern plain amid extensive cane plantations, i.e. environment is unvaried. All releases were made in, or around, one field.

Le Vallon : Annual rainfall about 110″; mean max. temperature 30.0° C in January, mean min. temperature 17.6° C in August. Situated in a deep valley with steep, heavily-wooded sides; cane plantations, about 1 mile wide at most, extend about 3 miles up the valley; a stream with dense vegetation and trees along its banks meanders through the plantations. Releases were made on the valley floor, near the stream, in a number of fields.

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2. THE SCALE INSECT

Heavy infestations of the scale insect, *Aulacaspis tegalensis* Zhnt., were again experienced in many fields of the Central Cane Nursery. The installation of facilities for heat-treatment of canes at the Nursery, so that planting material leaving the nursery may be treated to destroy scales as and when may be necessary, was considered. Hot-water treatments which destroy the scale had already been determined (*Rep. Maurit. Sug. Ind. Res. Inst.* **11** (1964) : 70), but it was suggested that hot-air treatment might be more appropriate at the Nursery and tests were therefore made.

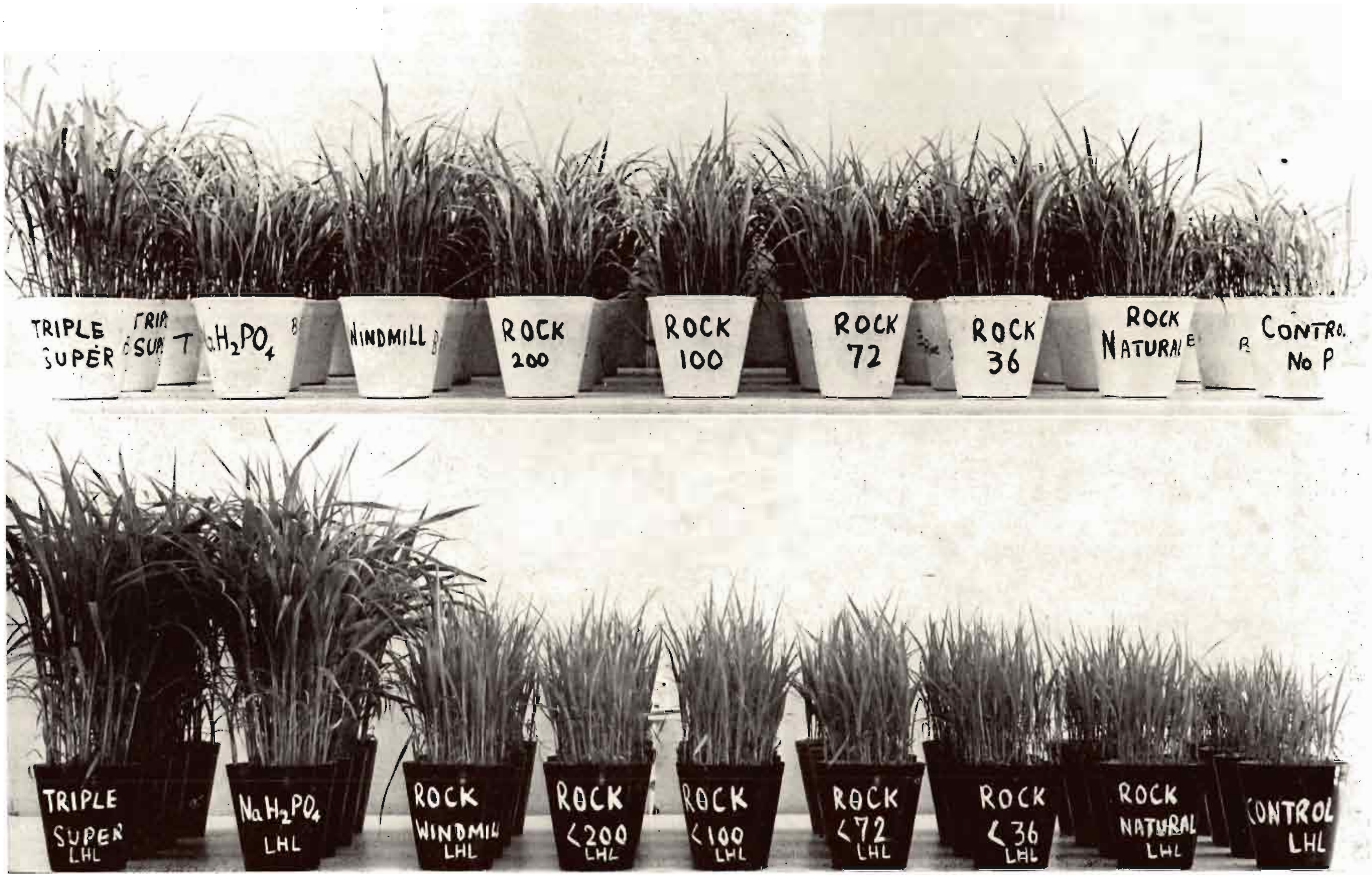
A laboratory oven with internal dimensions of 50 x 50 x 45 cm, thermostatic control, and a fan for internal air circulation, was used for the tests. Thirty 3-bud cuttings were distributed over three perforated shelves in the oven for each test, the cuttings being inserted when the oven temperature had stabilized at the required level. Temperature naturally fell after insertion of the cuttings so that the treatment temperatures were initial oven temperatures. Repeated tests were made with different time/temperature combinations, and for complete destruction of all stages of the scale on all cuttings the following combinations were required :

Temp. (°C)	*Time (min)*
80	30
70	60
60	90
50	180+

Tests at 50°C. could not be completed because of the lack of infested material at the end of the year.

Germination tests, carried out by the Pathologist, of cuttings treated as above at 60°, 70° and 80° C. gave unfavourable results, and the treatment time required at 50°C. is too long for practical purposes.

It is therefore concluded that hot-air treatment of nursery seed cane in unpractical.



Effect on growth of fineness of grinding of tricalcium phosphate (guano) compared to soluble phosphate (triple superphosphate and sodium phosphate) and apatite (300 mesh). *Above :* Humic Ferruginous Latosol (Belle Rive); *below :* Low Humic Latosol (Réduit).

NUTRITION AND SOILS

1. THE AVAILABILITY OF ROCK PHOSPHATE AND THE EFFECT OF FINENESS OF GRINDING

Y. WONG YOU CHEONG

SOLUBLE phosphate has been shown to be generally superior to tricalcium phosphate for sugar cane (PARISH and FEILLAFE, 1958), but the yield differences tend to be smaller on more acid soils. This is attributed to the greater availability of tricalcium phosphate at lower pHs of the soil.

Similarly, yield differences due to the fineness of grinding of tricalcium phosphate would tend to disappear as the acidity of the soil increases. Furthermore, in the hot and humid tropics, climatic conditions cause soil-fertilizer interactions to occur rapidly so that the physical character of the fertilizer becomes less important. Except on phosphate-deficient soil, it would be difficult to detect any effects of fineness of grinding on the availability of rock phosphate on a field scale for the following reasons :

(i) there must be a yield response to phosphate;

(ii) the treatments of fertilizer must be low to correspond with the sharply rising part of the yield response curve;

(iii) the treatment response must be higher than the experimental error.

These conditions are difficult to fulfil with field trials, whereas pot experiments are ideally suited for this kind of work. If no yield difference is obtained with pot experiments, then it is extremely unlikely that a difference will be obtained on a field scale.

Materials and methods

Guano phosphaté, apatite rock phosphate, triple superphosphate and sodium di-hydrogen phosphate were used.

The guano phosphaté, a coarse and natural form of tricalcium phosphate obtained from coral islands, was ground to pass completely through the following sieves : 36, 72, 100 and 200 mesh B.S.S. The apatite rock phosphate was a uniform material passing through a 300 mesh sieve, whilst the triple superphosphate was granular.

The analysis of the fertilizer materials is given in Table 24.

Table 24. Total P contents of fertilizer materials

		%P
Guano phosphaté	natural	12.5
	< 36 mesh	12.8
	< 72 mesh	12.9
	< 100 mesh	13.3
	< 200 mesh	13.3
Rock phosphate (apatite)	< 300 mesh	13.6
Triple superphosphate		20.6
Sodium di-hydrogen phosphate		22.5

Soils

Soils of two well-defined groups, a Low Humic Latosol and a Humic Ferruginous Latosol, with the following characteristics were used:

Soil Characteristics	Low Humic Latosol	Humic Ferruginous Latosol
pH	6.4	5.0
Organic matter (%) ...	5	10
Cation exchange capacity (m.e. %)	25	20
SiO_2 / Al_2O_3	2.0	0.5
Extractable aluminium (p.p.m.)	17	200

Citrate solubility of fertilizers

Citrate solubility of fertilizers was determined by shaking 1 gram of fertilizer with 100 ml of citrate solution for half an hour : the phosphate in the extract was then determined by the method of DICKMAN & BRAY (1940).

Citrate buffer solutions of pH 3.5 – 9.0 were prepared thus : 40 ml of citrate solution was adjusted to the required pH by the addition of HCl or NaOH and made up to 100 ml. The citrate solution was prepared by dissolving 21 gm. of pure citric acid in 200 ml of N. NaOH and diluting to 1 litre.

After the shaking of the fertilizer in the citrate solution, careful and repeated centrifuging was carried out to remove the finely dispersed suspension. Dissolved P was then determined, and concentration plotted against the final pH of the solution.

Soil-fertilizer incubation

Guano phosphaté at the rate of 1 ton per acre was well mixed with each of the soils which were kept for one month at 40% and 90% maximum water holding capacity at temperature of 20°C and 35°C respectively. Available phosphate was determined by the methods of TRUOG (modified by PEECH, 1944, and AYRES, 1952) and SAUNDER (1956). Treatments were carried out in duplicates.

Pot experiments

1 gram of guano phosphaté was mixed with 800 g. of soil per pot, to which were added solutions giving 250 mg N, 1 g K_2O, 350 mg CaO, 350 mg MgO, 250 mg S and a mixture of trace elements per pot.

For triple super, sodium di-hydrogen phosphate and rock phosphate treatments, levels giving an equivalent amount of P_2O_5 were used. All the fertilizers were mixed with the soil. In the sodium phosphate treatment, extra Ca was added to make up for the Ca in the guano in the other treatments.

Each pot was seeded with sorghum (*var.* Sweet Sudan), and after germination, thinned down to 20 plants. Weekly additions of nitrogen were made at the rate of 120 mg N per pot. After 6 weeks of growth (Pl. IX), the plants were harvested, dried at 70°C, finely ground in a Wiley mill and analysed for P, K and Ca.

Procedure

0.5 gm of dry matter was carefully ashed in a muffle furnace at 400-450°C for about five hours : the cold grey ash was treated with 5 ml of conc. HCl, evaporated to dryness on a silica sand bath, followed by two hours in an oven at 180°C to dehydrate silica. The residue was taken with 1 ml of 6 N. HCl and made up to volume (25 ml).

Phosphorus was determined on aliquot by development of the yellow vanado phosphomolybdate complex; potassium was read directly from the solution in a flame photometer, and calcium was also read by flame photometry after the removal of phosphorus and other interfering ions by zirconyl oxychloride.

Results and discussion

1. *The effect of pH and fineness of grinding on the solubility of guano phosphaté*

Fig. 11 shows the variation in solubility of the phosphate materials with pH and fineness of grinding. For all the materials, solubility increased with the acidity of the media. There was a moderate increase in solubility as the pH of the medium fell to a value around 4.7 ; then the solubility rose more sharply at lower pHs.

The differences in solubility due to fineness of grinding did not vary much over the central range of pH, and the main factor influencing the solubility of tricalcium phosphate was the acidity of the medium, although there was increased solubility with smaller particle size.

Proper utilization of rock phosphate is therefore only possible on very acid soils. On less acid soils it is obvious that the finer the fertilizer particle, the greater would be its solubility. The physical unavailability of tricalcium phosphate on the commoner slightly

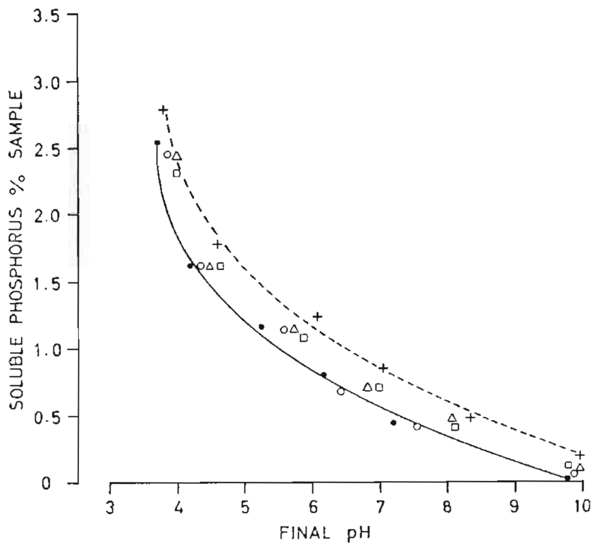


Fig. 11. Citrate solubility of guano at different particle sizes and pH levels.

dots	: natural		
circles	: to pass	36 mesh	sieve
triangles :	,,	72	,,
squares :	,,	100	,,
crosses :	,,	200	,,

Curves drawn show differences in solubility of natural and 200-mesh sieved material.

acid to neutral soils is thus an important problem, and in the light of physico-chemical properties alone, it would seem desirable to have a material which is as finely-ground as possible. ARMIGER and FRIED (1957), among other authors, concluded that ammonium citrate and citric acid solubility tests are efficient indices for predicting the relative values of phosphate rock as sources of P for plant growth. The soil is, however, complex, and soil-fertilizer interactions may be so important on certain soils that it would be undesirable to have too fine a material.

If solubility data could be applied to soil conditions, it would appear that under very acid conditions of the soil, the particle size of the guano phosphaté would not be an important factor. Any calcium carbonate coating of the fertilizer would be dissolved, liberating at the same time the phosphate within the granule which was previously unavailable. Conversion into the more soluble monocalcium would also occur. Under less acid conditions, however, the fineness of grinding would assume greater importance. From Fig. 11, at a pH of 6.5, there was as much as 25% difference in the solubilities of the natural guano and the 200 mesh material. In alkaline media, this % difference was even more marked.

ELLIS *et al* (1955), carrying out pot experiments with oats, found that rock phosphate gave the highest yield at pH 5.5, and decreasing yields with increasing pH; they also obtained a marked reduction in yield at pH 4.9. On solubility data alone, there is no reason why there should be a reduction in yield at pH 4.9. The authors suggested that some element released from the fertilizer at this pH was inhibiting the plant uptake of phosphorus, or was producing some toxic condition. The fluoride anion was suspected.

2. *Soil-fertilizer incubation experiments*

COOKE (1956) declared that in the tropics, fineness of grinding may be less important because of the prevailing high soil temperatures and moistures.

The effect of soil temperature and moisture on the available phosphate of soil which has been incubated with guano at different fineness of grinding has therefore been studied. The results are expressed graphically in Fig. 12.

As the Truog's dilute acid extractant has a mild action on the soil phosphate, it is taken to represent the easily available phosphate, whilst Saunder's alkaline extractant releases inorganic phosphate bound to Fe and Al and thus gives a measure of the soil phosphate reserve.

PARISH, WONG YOU CHEONG and ROSS (1965) have shown that there is good correlation between Saunder's available phosphate and phosphate uptake by sugar cane. It can therefore be assumed that low Truog values, if accompanied by high Saunder values, suggest that the fertilizer, although it has been converted into a less mobile form, is still available, at any rate, to sugar cane.

For both the Low Humic Latosol and the Humic Ferruginous Latosol, there was a general decrease in the Truog phosphate with diminishing particle size of the fertilizer at the two temperatures and moistures of the soil. Both high temperature and moisture tended to give

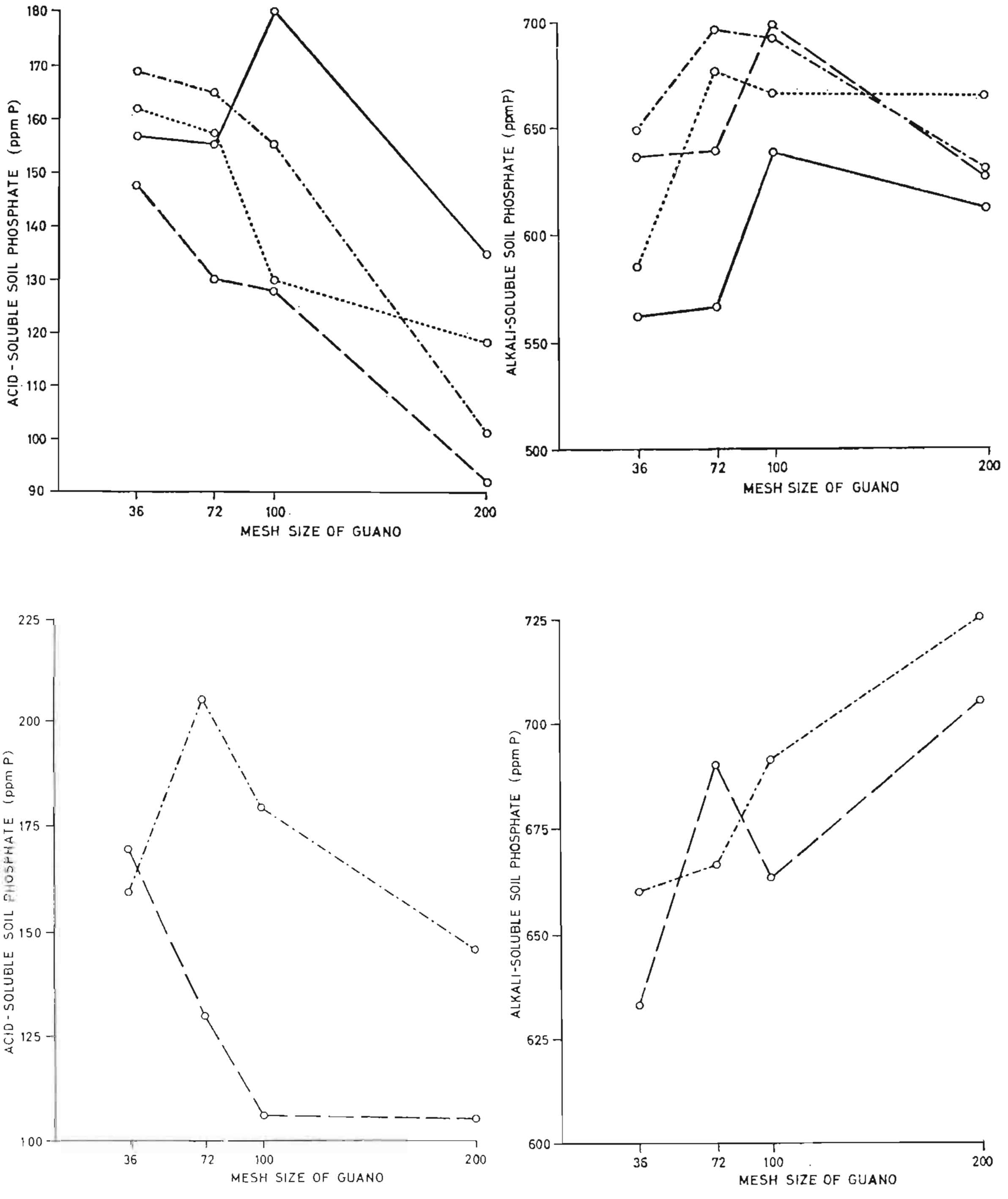


Fig. 12. Effect of fineness of grinding of guano on the available phosphate after soil-guano incubation.

Top Low Humic Latosol. *Bottom* Humic Ferruginous Latosol.

o——o Incubation at 20°C, 40% M.W.H.C.
o- - - - -o ,, ,, 20°C, 90% M.W.H.C.
o-·-·-·-o ,, ,, 40°C, 40% M.W.H.C.
o— — —o ,, ,, 40°C, 90% M.W.H.C.

lower Truog values. On soil with a high capacity for phosphorus fixation, greater solubility of a fertilizer is automatically followed by the fixation of the soluble phosphate by the soil as aluminium and iron phosphates. There is very little calcium in these highly weathered soils; the Truog extractant, being a weak acid, does not extract this fixed phosphate to any great extent and consequently gives low values. From Fig. 12, the decreasing Truog values with finer materials indicate the greater solubility of these finer materials. The greatest solubility was obtained with the 200-mesh particle size. Also, high soil temperature and moisture increased the solubility of the fertilizer on both soils.

The increased fixation of fertilizer phosphorus by the soil in the case of the fine materials need not necessarily be a disadvantage, for in terms of sugar cane nutrition it has been shown that soluble phosphate, which is immediately fixed by latosols, is generally superior to tricalcium phosphate.

Another mechanism which may explain these decreasing values of acid-soluble phosphate with fineness of grinding, is the formation or deposition during soil reactions of hydrous ferric oxides on the surface of the fertilizer, thereby sealing off the fertilizer particle. The extent to which this mechanism will affect the value of the available phosphate is in function of the surface area of the fertilizer or its degree of fineness, and also depends on the soil properties. However it is unlikely that this mechanism occurs to any great extent, because Saunder's available phosphate, which is mainly composed of sorbed phosphate (Fe and Al phosphates), shows generally increasing values up to the 100-mesh fineness, except in the case of the 200-mesh sample, when this mechanism may become important.

It seems, therefore, that on these two soils, a particle size of tricalcium phosphate of at least 100 mesh B.S.S. is desirable; beyond this fineness, soil-fertilizer interactions may exert a negative effect on the available phosphate.

3. *Pot experiments*

Plant yields and composition data are given in Table 25.

There has been a response to phosphate application in both pot experiments and the soluble phosphate sources have proved to be much superior to tricalcium phosphate. There is no significant difference in either dry matter production or plant composition due to fineness of grinding of guano phosphaté on the Humic Ferruginous Latosol. Yet, the finely-ground apatite phosphate gave higher yields than any of the forms of the guano phosphaté; this is probably not a particle size effect, but is due to differences in the fertilizer composition. On the less acid Low Humic Latosol there is a definite effect of particle size of the insoluble phosphate up to the 100 mesh B.S.S. on plant growth and nutrient uptake.

From the solubility v/s pH data, it is shown that fineness of grinding of tricalcium phosphate becomes less important with decreasing pH. The pot experiment results seem to support this observation.

On the Low Humic Latosol, the leaf phosphorus levels for the tricalcium phosphate treatments showed no increase over that of the control; they were, on the whole, very low. Therefore, phosphorus deficiency was still limiting plant growth to such an extent that the small quantities of added phosphate available for growth increased the production of dry matter more than the plant P levels.

Soluble phosphate gave high plant phosphorus levels for both soils, although on the more acid Humic Ferruginous Latosol lower levels were obtained. Also, yield differences between soluble and insoluble phosphates were smaller on the latter. At the low pH of the soil, soil-fertilizer interactions become important and may mask any effects of increasing availability of fertilizer phosphorus due to fineness of grinding alone. Extractable aluminium is high in this soil group, and it has been observed by the author that a good correlation exists between phosphorus retention and extractable aluminium (unpublished data).

The higher plant phosphorus levels (though lower potassium and calcium levels) on the Low Humic Latosol, as compared to the Humic Ferruginous Latosol, indicate that this soil has a smaller capacity for fixing phosphorus in less available forms. Solubility data have shown

Table 25. Plant yields and composition data (mean values of 4 replicates).

(a) Low Humic Latosol

	Fresh wt. (g.)	*Dry wt. (g.)*	*P % D.M.*	*P uptake (mg.)*	*K % D.M.*	*Ca % D.M.*
Control ...	2.41	0.66	0.090	0.61	2.95	1.55
Natural guano ...	3.96	0.99	0.086	0.85	2.76	1.26
Guano <36 mesh	4.73	1.18	0.090	1.06	2.68	1.20
Guano <72 mesh	5.80	1.34	0.088	1.18	2.88	1.18
Guano <100 mesh	6.21	1.47	0.091	1.33	2.80	1.16
Guano <200 mesh	5.95	1.39	0.087	1.21	2.95	1.16
Rock phosphate <300 mesh	7.01	1.63	0.088	1.44	2.99	1.12
Triple super ...	42.35	7.45	0.207	15.40	3.56	1.02
NaH_2PO_4 ...	45.80	8.02	0.238	19.10	3.68	0.81

(b) Humic Ferruginous Latosol

	Fresh wt. (g.)	*Dry wt. (g.)*	*P % D.M.*	*P uptake (mg.)*	*K% D.M.*	*Ca % D.M.*
Control ...	3.3	0.68	0.078	0.55	3.04	0.352
Natural guano ...	8.0	1.49	0.099	1.48	3.19	0.357
Guano <36 mesh	7.7	1.42	0.106	1.51	3.19	0.376
Guano <72 mesh	8.5	1.61	0.107	1.73	3.34	0.375
Guano <100 mesh	8.1	1.57	0.104	1.64	3.43	0.396
Guano <200 mesh	8.4	1.53	0.104	1.57	3.18	0.364
Rock phosphate <300 mesh	11.9	2.25	0.109	2.46	3.80	0.397
Triple Super ...	16.5	2.99	0.149	4.39	4.08	0.391

(c) Analysis of variance

	Low Humic Latosol		*Humic Ferruginous Latosol*	
	Dry weight (g.)	*P uptake (mg.)*	*Dry weight (g.)*	*P uptake (mg.)*
Guano natural ...	0.99	0.85	1.49	1.48
,, <36 mesh ...	1.18	1.06	1.42	1.51
,, <72 mesh ...	1.34	1.18	1.61	1.73
,, <100 mesh ...	1.47	1.33	1.57	1.64
,, <200 mesh ...	1.39	1.21	1.53	1.57
LSD (P = 0.05) ...	0.11	0.13	0.43	0.58
,, (P = 0.01) ...	0.15	0.18	0.60	0.81
CV (%)	2.80	3.80	9.20	11.30

that at this pH (6.4), a smaller particle size of the fertilizer increases its solubility, and the additional phosphate thus released from the fertilizer can be taken up by the plant.

According to NELLER (1962), from the results of pot experiments, mesh size of a water-soluble phosphate fertilizer for a soil of low P fixation capacity was unimportant, except in the case of low-solubility fertilizers when a reduction in growth was obtained. For these fertilizers with low water-solubility, mesh size was important for soils with both high and low phosphorus fixation capacity. Liming reduced plant growth and phosphorus uptake in both types of soils, but this effect was counteracted by a high water solubility of the phosphate fertilizer.

The importance of particle size of low solubility phosphate fertilizer has also been stressed by other authors (NELLER & BARTLETT, 1957, BOULDIN & SAMPLE, 1959).

From field and pot experiments, COOKE (1956) concluded that a fineness of grinding of 80-90% through a 100 mesh B.S.S. sieve was necessary for the proper utilization of rock phosphate.

In Mauritius, PARISH (1963) found that yields of sugar cane fertilized with finely-ground imported rock phosphate were higher than when it was fertilized with the coarser local material. The difference in yields was small, however, and the author stated that «*a minimum grinding standard must be set*».

All this evidence leads us to conclude that grinding of the coarse natural guano phosphate is beneficial to plant growth. It seems from the solubility and pot experiment data obtained that a fineness of grinding of 100 mesh B.S.S. sieve should be attained. The main advantage of rock phosphate is that it is cheap, but the production of a finer material would invariably step up its cost.

Although the soluble phosphate sources were well mixed with the soils, they still gave higher yields than the tricalcium phosphate materials. The roots had penetrated throughout the whole soil volume and had absorbed enough phosphorus to satisfy the plant requirements.

Potassium uptake on both soils increases with increasing phosphorus uptake. Uptake of calcium on the Humic Ferruginous Latosol follows the same trend, but on the Low Humic Latosol, high plant phosphorus is accompanied by low calcium levels. Although FRIED and MACKENZIE (1949) reported that low plant calcium suggested a low solubility of rock phosphate, the lower plant calcium levels obtained at the higher plant phosphorus levels are due to a dilution effect of the greater dry matter production.

Summary

Citrate solubility v/s pH curves showed that the main factor governing the citrate solubility of guano (tricalcium) phosphaté was the pH of the medium, and to a lesser extent, its fineness of grinding. Particle size had very little effect on the solubility at low pH.

From soil-fertilizer incubation experiments, high soil temperature and moisture released more phosphate from the fertilizer on the two soils used. There was a similar effect due to the fineness of grinding of the fertilizer up to 100 mesh B.S.S.

Pot experiments results showed a significant response to fineness of grinding up to 100 mesh B.S.S. on the Low Humic Latosol, but no response was obtained on the more acid Humic Ferruginous Latosol.

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2. DETERMINATION OF TOTAL AND ORGANIC PHOSPHORUS IN LATOSOLS

Y. WONG YOU CHEONG

Owing to the high content of iron and aluminium oxides in the latosols, the usual methods of phosphate analysis may not be applicable to these soils. Acidic and alkaline treatments bring into solution a great amount of these elements which may cause interference during the development of the coloured phosphate complexes.

Methods of determination of total phosphorus should take into account reductant-soluble phosphorus, which has been shown to constitute an important fraction of the total phosphorus in soils which are specially rich in iron oxides (PARISH, WONG YOU CHEONG and ROSS, 1965). AUNG KHIN and LEEPER (1960) have obtained figures of reductant-soluble phosphorus as high as 2050 p.p.m. P. For this form of phosphate to be released, the iron oxide coating has to be solubilized but at the same time, to prevent interference during the colour development, there should be as little soluble ferric iron as possible.

The turn-over of organic matter in a sugarcane soil being high, organic phosphate may be an important source of phosphate. Some soil groups contain as much as 11% organic matter. For accurate soil organic phosphorus studies, a sound method of analysis of that fraction is required. As yet, no direct method is available, for in all the current methods, organic phosphorus is determined by difference from total and inorganic phosphorus values.

The current methods of analysis of total and organic phosphorus are compared for the soils of Mauritius.

Methods

Total P is determined by (a) the sodium carbonate fusion method, and (b) the perchloric acid digestion method.

Synthetic soil containing kaolin, iron and aluminium oxides, and phosphorus, is prepared according to KITTRICK's and JACKSON's procedure (1955).

Organic phosphorus is obtained by the ignition method of SAUNDERS and WILLIAMS (1955), the acid and alkaline extractions of MEHTA *et al* (1954, modified by PATEL *and* MEHTA, 1961) and the Na-EDTA and the alkaline extractions of HARRAP (1963). The residue left after the treatments is determined by perchloric acid digestion.

The soils used are from the following groups : Regosol, Latosolic Reddish Prairie, Low Humic Latosol, Humic Latosol, Latosolic Brown Forest and Humic Ferruginous Latosol.

Results and discussion

Total phosphorus

The results of total phosphorus are given in Table 26.

(a) On the alkaline soils, the sodium carbonate fusion method gives lower results than the perchloric acid digestion method, but the difference is not significant. It is evident that acid digestion would extract all the forms of phosphate present in these soils with high calcium carbonate content.

The lower values of total phosphorus obtained with the fusion method can be explained by the fact that, as there is much more calcium than silicon in these limestone soils, some phosphate is retained in the curd (JACKSON, 1958), presumably as tricalcium phosphate, and consequently, does not take part in the colour development.

The sodium carbonate method is therefore not suitable for alkaline soils.

(b) On 13 slightly acid to acid soils, there is no significant difference between the total phosphorus obtained by both methods. In both methods, there are inherent factors which may introduce errors in the determination.

It may be quite impossible to maintain all the phosphate present in the soluble form after fusion as resorption of phosphate on the iron hydrous oxides quite probably does occur, specially under the mild conditions of the extract after fusion. The extent to which this mecha-

Table 26. Total phosphorus content of Mauritius soils

Alkaline soils

pH	Total phosphorus (mg P/100 g. soil)	
	Na_2CO_3 fusion	$HClO_4$ digestion
8.0	80	95
7.9	75	86
8.2	102	107
7.9	135	137
8.2	97	112
8.5	136	201
8.0	75	113
8.3	202	290
Mean	*113*	*143*

LSD between means (P=0.05)=37.0

Acid soils

pH	Total phosphorus (mg P/100 g. soil)	
	Na_2CO_3 fusion	$HClO_4$ digestion
6.4	120	119
6.3	144	122
6.7	133	145
5.9	173	197
5.6	43	42
6.0	177	180
6.2	107	104
5.9	113	121
5.3	142	142
5.2	150	153
5.1	160	164
6.2	104	99
6.2	78	85
Mean	*125*	*129*

LSD between means (P=0.05)=6.6

Very acid soils

pH	Total phosphorus (mg P/100 g. soil)	
	Na_2CO_3 fusion	$HClO_4$ digestion
4.9	199	202
4.6	156	153
4.8	122	114
4.7	95	73
4.8	130	120
5.0	144	140
Mean	*141*	*134*

LSD between means (P 0.05)=12.6

Synthetic soil

Total phosphorus (mg P/100 g. soil)	
Na_2CO_3 fusion	$HClO_4$ disgestion
181	181

% recovery by both methods = 98.9

nism occurs will depend upon the iron oxide content of the soil, but the percentage retention of phosphate will be greater on deficient soils. With perchloric acid digestion, the high acidity and the solubilization of iron would reduce to some extent this resorption of phosphate.

Although the development of the molybdo-phosphoric blue complex in the fusion method is more susceptible to interference from ferric ions, it is unlikely that there are significant amounts of ferric ions in solution in spite of the high iron oxide content in these soils. However, the perchloric acid method tolerates much higher levels of soluble ferric ions, as is shown in Table 27.

Table 27. Spectrophotometer reading

50 µg P +	0ppm Fe (ic) ...	152
,,	+ 200 ,, ...	152
,,	+ 400 ,, ...	158
,,	+ 800 ,, ...	157

Muir (1952) reported that the fusion method increased the amount of soluble silicates which form coloured complexes during the colour development of the phosphate complex and hence, gave higher values of total phosphorus. He proposed the use of tartaric acid to reduce this interference.

The fact that there is no significant difference between the two methods on this group of soils suggests that, although these side-reactions may occur and have different effects on the total phosphorus value, the net effect is not of significant importance.

(c) Although there is no significant difference between the total phosphorus obtained by the two methods for very acid soils, the fusion method tends to give higher values.

As these soils which contain a large amount of iron oxide concretions have received phosphate for many years, they may have a high proportion of reductant-soluble phosphorus. In the latosols, this fraction may reach values of over 400 p.p.m. P. Muir (1952) reported that perchloric acid extracted only 50-70% of the amount of phosphate released by hydrofluoric acid. It has also been suggested that a double acid treatment might be more effective.

Both methods give the same value of total phosphorus for the synthetic soil; there is almost total recovery of phosphorus by both methods.

Organic phosphorus

The organic phosphorus results of 16 acid soils are given in Table 28.

The ignition method gave values of organic phosphorus which were significantly lower than those obtained by the other two methods. The Na-EDTA values were just significantly higher ($P = 0.05$) than those obtained by Mehta's method.

A generally accepted criterion of validity and superiority of a method of determination of organic phosphorus when compared to other methods, is that it should give higher values than the rest. This criterion is justifiable because all the common methods are beset by limitations which tend, in fact, to reduce the actual values of soil organic phosphorus. The nature and behaviour of the different soil organic phosphorus fractions are still not much understood and the common methods, which are largely empirical, are lacking for this very reason.

The organic phosphorus content is obtained indirectly by difference from the inorganic and total phosphorus extracted. From the analytical point of view, this is undesirable as the precision of the final value is reduced by the cumulative errors from two separate determinations. On account of the complexity and varied nature of the organic phosphorus fractions in the soil, it is doubtful whether a truly specific and accurate method for organic phosphorus can be obtained.

On top of the difficulties in getting a true assessment of organic phosphorus content with the actual methods, are added those present in the evaluation of inorganic phosphorus. This factor may be important on the acid soils of Mauritius which are high in iron oxide. On these soils with a high capacity for fixing phosphorus, an extractant has to be able not only to extract the total organic phosphate, but also to prevent it, or any inorganic phosphate formed from it, from being sorbed by the soil. There are several possible reasons for the much lower values of organic phosphorus obtained with the ignition method :

(a) The inorganic phosphate derived from organic phosphate by the ignition process is not completely removed in the extract. The addition of phosphate to the main soil groups and subsequent extraction with 0.2 N H_2SO_4 led to very poor recoveries (30-70 %) of the added phosphate (unpublished data). The soils of Mauritius having the property of strongly fixing phosphate, losses of organic phosphate in this way, particularly when the level of soil organic phosphorus is low, speak against the validity of the ignition method.

(b) The nature, and hence the solubility of the inorganic phosphate, may be altered during the ignition. The extent to which this phenomenon will affect the value of the organic phosphorus is unknown and depends upon the nature of the inorganic phosphate fractions present.

(c) The acid conditions during the extraction of the inorganic phosphate in the unignited sample may cause the hydrolysis of the more labile phosphate esters, with a consequent reduction in the value of organic phosphorus. This mild acid extraction is, however, preferred to the hot acid (conc. HCl) extraction of Legg and Black (1955) in order to minimise losses of organic phosphate in this way.

Legg and Black (1955) proposed an ignition temperature of 240°C because they have found that above that temperature, there is a positive error due to the increased solubility of inorganic phosphate and below it, there is a negative error due to the incomplete decomposition of organic phosphate. The two sources of error cancel out at 240°C. They did not take into consideration any hydrolysis of labile esters that might be caused by their use of strong HCl as an extractant.

Obviously, the optimum ignition temperature will depend upon the type of soil and the nature of the inorganic and organic phosphate. These authors derived an equation relating the organic phosphorus obtained by their ignition method with that obtained by the Mehta method, but they suggested that an independently derived equation should be available for local soils.

Mc Conaghy (1966) found extractable phosphate to increase with temperature of ignition up to about 450°C after which there was an appreciable fall in extractable phosphate at

Table 28. Organic phosphorus content of Mauritius soils (mgP/100 g. soil)

Soil No.	pH	Inorganic + Organic			Inorganic			Organic			Residue		*Total P*		*Total P*
		Saunders & Williams	Mehta	Harrap							$HClO_4$ digestion		Inor. + org. + residual		$HClO_4$ digestion
		(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(b)	(c)	(b)	(c)	(d)
L2	6.4	30	133	95	10	85	42	20	48	53	8	33	141	128	119
L8	6.3	21	140	104	12	105	57	9	35	47	4	16	144	120	122
L10	6.0	31	146	106	16	117	65	15	29	31	4	17	150	123	126
P4	6.7	66	175	112	16	113	53	50	62	59	3	26	178	138	145
P5	5.9	75	239	156	22	165	85	53	74	71	5	33	244	189	197
P9	6.2	39	168	112	14	104	50	25	64	62	13	30	181	142	133
B8	4.8	13	154	101	8	122	68	5	32	33	0	16	154	117	120
B12	5.1	48	198	148	18	134	81	30	64	67	5	14	203	162	164
F6	4.6	19	195	139	15	152	98	4	43	41	7	22	202	161	153
F9	4.8	13	144	109	10	99	60	3	44	49	5	21	149	130	114
101	6.0	45	198	123	12	135	58	33	63	65	13	70	211	193	180
65T/102	5.6	18	38	25	3	26	9	15	12	16	6	11	44	36	42
103	5.9	33	130	71	6	104	40	27	26	31	11	44	141	115	121
104	5.8	52	171	127	10	104	55	42	67	72	8	33	179	160	153
105	6.2	27	119	59	5	95	31	22	24	28	15	40	134	99	104
106	5.0	23	148	100	8	116	56	15	32	44	12	40	160	140	140
Mean								*23.0*	*44.5*	*48.1*			*163.4*	*134.6*	*133.3*

ORGANIC P

LSD	(P = 0.05)	between means of	(a) & (b)	= 9.4
,,	(P = 0.01)	,,	,,	= 13.0
,,	(P = 0.05)	,,	(a) & (c)	= 10.5
,,	(P = 0.01)	,,	,,	= 14.5
,,	(P = 0.05)	,,	(b) & (c)	= 3.4
,,	(P = 0.01)	,,	,,	= 4.7

TOTAL P

LSD	(P = 0.05)	between means of	(b) & (c)	= 9.6
,,	(P = 0.01)	,,	,,	= 13.3
,,	(P = 0.05)	,,	(b) & (d)	= 9.3
,,	(P = 0.01)	,,	,,	= 12.8
,,	(P = 0.05)	,,	(c) & (d)	= 5.9
,,	(P = 0.01)	,,	,,	= 8.1

higher temperatures.

From the values of total phosphorus given, it is seen that mild acid extraction only removes between 15-40% of total phosphorus; incomplete extraction of organic phosphate is quite likely to occur.

MEHTA's (1954) hot acid treatment may cause the hydrolysis of some labile phosphate esters. To prevent the hydrolysis of labile esters like inositol hexaphosphate, glycerophosphate, nucleic acids, and glucose-1-phosphate, which is an acid-labile phosphate, ANDERSON (1960) did a preliminary mild alkaline extraction before the acid treatment. HANCE and ANDERSON (1962) found that this modification of Mehta's method was the overall best extraction procedure on Scottish soils but that the ignition method gave higher values than the extraction methods. They concluded that the ignition method was the most useful for the general analysis of Scottish soils.

The strong acid and alkaline extractions of Mehta remove nearly all the phosphate present; very little phosphate is left in the residue. Aluminium and iron phosphates are brought into solution. However, as high values are involved and organic phosphorus is obtained by difference, there is a tendency for the value of organic phosphorus to be less accurate.

HARRAP's (1963) Na-EDTA modification of the Mehta's procedure avoids the hot acid treatment during which hydrolysis of the organic phosphate compounds may occur. It is also a less vigorous extraction procedure; consequently, unnecessary inorganic phosphate (reductant-soluble) is not solubilized. The Na-EDTA forms complexes with polyvalent cations and releases the phosphate bound to them.

The total phosphorus values obtained by Mehta's procedure significantly exceed those obtained by a direct perchloric acid digestion, whilst there is no significant difference between Harrap's procedure and perchloric acid digestion. The hot acid treatment has probably released the silicate present in the soil; this silicate is brought into solution by the subsequent hot alkaline treatment and causes interference in the colour development. This does not occur with the Na-EDTA method as there is no hot acid treatment.

The validity of a method of determination of organic phosphorus depends upon the chemical and physical characteristics of the soil, the nature and behaviour of the different inorganic and organic phosphate fractions in the soil.

On Mauritius acid soils, it appears that the Na-EDTA extraction method is the most suitable one. Mehta's extraction method is nearly as suitable; Saunders' and Williams' ignition procedure gives low results.

Summary

The total phosphorus of the latosols of Mauritius is determined by the perchloric acid digestion and the sodium carbonate fusion methods. On alkaline soils, the perchloric acid method gives higher values than the sodium carbonate method but the difference is not significant. There is no significant difference as well on the slightly acid to very acid soils, although for the very acid soils, the sodium carbonate fusion method tends to give higher values.

In the determination of the organic phosphorus content of acid soils, SAUNDERS' and WILLIAMS' ignition procedure gives significantly lower values than the extraction procedures of MEHTA and HARRAP. HARRAP's Na-EDTA method gives the highest values and appears to be the most suitable method.

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3. IMPROVEMENT OF THE KEY OF INTERPRETATION OF SOIL PHOSPHORUS FOR ADVISORY WORK

P. HALAIS, Y. WONG YOU CHEONG & L. ROSS

In spite of the fact that actual analytical techniques in the laboratory have been greatly simplified in recent years with the advent of such chemical tests as, for example, Truog's method (H.S.P.A. modification using 0.02 N H_2SO_4) or that of Saunder (using 0.1 N NaOH for the extraction of some forms of soil phosphorus), the problem remains unsolved if the methods have been chosen without due account of the effective nutritional status of the sugar cane crop as revealed by direct physiological tests, such as foliar diagnosis.

The attempt made during 1965 in this connection (*vide Rep. Maurit. Sug. Ind. Res. Inst.* **12**, 1965 : 56-59) has lead to inconclusive results probably on account of inherent soil sampling difficulties : foliar diagnosis data collected on the permanent sampling units were derived from three years' systematic observations made in duplicate, whereas soil analysis for P was carried out, in the great majority of cases, on a single composite sample collected over each unit. Furthermore, the mathematical treatment of the comparative data for foliar diagnosis and soil tests for P made by means of regression equations is probably too rigid for data of this kind. Consequently, it has been found advisable to attempt another method of interpretation making use of median figures within class groupings as a more appropriate approach to the problem involved. This note is based on this new approach.

Under normal field conditions in Mauritius, soil sampling, especially for P analysis, offers major difficulties for the main reason that sugar cane is cultivated in rows and gets its P fertilizers and factory scums in the planting furrow or near the cane lines. Movement of P within the soil is known to be quite negligible and no ploughing is resorted to under Mauritius conditions; it follows consequently that soil P presents a very heterogenous pattern which is a real obstacle to representative soil sampling.

This abnormal condition obviously leads to the recommendation of triplicate soil samples taken independently on the same field to be studied, each one being made by appropriate mixing of ten individual samples taken to represent, as far as possible, the first 30 cm of arable soil. In order to discard abnormal concentrations of soil P, the three composite samples should be analysed separately in the laboratory and the median figure kept. Such a precaution, though quite unusual, certainly complicates soil analysis for advisory work, but it seems better to get a small number of reliable tests than a large number of fictitious ones.

The permanent sampling units (PSU) for which comparative data are presently available for foliar diagnosis, soil P and soil pH (KCl) have been grouped in the following manner : the units selected are those showing foliar diagnosis for P within the desired range of 0.18-0.20 P% D.M. of 3rd leaf (mid rib excluded) after appropriate age and variety corrections. Those units with high or low leaf P have been discarded as showing undesirable P nutrition.

Table 29 gives the general relationship observed between Truog (H.S.P.A.) soil P and soil pH (KCl) on the permanent sampling units known for their desirable P nutrition of sugar cane according to foliar diagnosis data. The soils are also separated into two groups : the Latosols (free soils) and the Latosolic Reddish Prairie soils and Latosolic Brown Forest soils (rocky or gravelly soils).

Table 29. Relationship between Truog (HSPA) soil P and soil pH (KCl)

Soil Group	*Number of units*	*pH* 4.0–4.9	*Number of units*	*pH* 5.0–5.9	*Number of units*	*pH* 6.0–6.9
Latosols ...	(54)	15 p.p.m. P	(39)	23 p.p.m. P	(10)	76 p.p.m. P
Latosolic soils	(29)	18 p.p.m. P	(39)	40 p.p.m. P	(8)	160 p.p.m. P

Table 30 gives similar data for Saunder soil P and soil pH (KCl).

Table 30. Relationship between Saunder soil P and soil pH (KCl)

Soil Group	*Number of units*	*pH* 4.0–4.9	*Number of units*	*pH* 5.0–5.9	*Number of units*	*pH* 6.0–6.9
Latosols ...	(45)	394 p.p.m. P	(34)	369 p.p.m. P	(9)	251 p.p.m. P
Latosolic soils	(26)	345 p.p.m. P	(36)	453 p.p.m. P	(9)	394 p.p.m. P

It follows from the examination of the above tables that P nutrition of sugar cane ratoon crops will be satisfactory (within the range of foliar diagnosis 0.18-0.20 P% D.M.) if the soils show the characteristics given below, provided that the usual P fertilization and the return of factory scums are regularly practised at planting time. If soil P falls short of these values, P fertilization of the ratoon crops will be advisable.

Soil pH (KCl) range	*Truog P p.p.m.* *Latosols (free soils)*	*Truog P p.p.m.* *Latosolic soils (rocky or gravelly)*	*Saunder P p.p.m.* *Latosols (free soils)*	*Saunder P p.p.m.* *Latosolic soils (rocky or gravelly)*
pH 4.0 - 4.9	15	20	400	475
pH 5.0 - 5.9	25	40	350	425
pH 6.0 - 6.9	75	160	300	375

The lower soil P contents considered satisfactory in the case of the Latosols compared to the Latosolic Reddish Prairie and Latosolic Brown Forest soils for the provision of the same P nutrition of the sugar cane plant reflect the fact that the volume of soil at the disposal of the roots is higher with the Latosols (free soils) than with the Latosolic soils (rocky and gravelly soils).

Conclusions

A useful scheme of soil P testing for advisory work should be run on the following lines to meet local conditions :

(1) Soil sampling offers the first major difficulty, and should be made in triplicate composite samples to represent the field to be studied.

(2) Analyses should be carried out on each of the three composite samples separately, and the results of the median figures kept for interpretation.

(3) No single chemical test now available for routine work is sufficiently accurate. Two sets of extracting solutions should be used simultaneously, such as Truog (acid extraction) and Saunder (alkaline extraction).

(4) For the correct interpretation of the tests as viewed from the angle of effective P nutrition of the cane crop, additional data, such as soil pH (KCl), is essential and the great soil groups should be known, on one side (free soils) and on the other (rocky or gravelly soils), to account for the volume of soil at the disposal of the roots.

(5) The key of interpretation should be a mobile one to cope with intrinsic differences in soil properties.

4. Si, Ca & Mn CONTENTS OF CANE LEAF SHEATHS, A REFLEXION OF PEDOGENESIS

P. HALAIS

Systematic sampling of 3rd-6th leaf sheaths at the boom stage of ratoon canes has been carried out on a large number of permanent sampling units (P.S.U.) on already mapped soil families during four years, between 1963 and 1966. Chemical analysis of the plant tissue was conducted in the laboratory for silicon, calcium and manganese.

This mass of information collected with regards to two distinct disciplines – mineral composition of plant tissues and soil classification – offers a unique opportunity of studying, under an exceptional range of natural combinations, basic relationships of the major factors of pedogenesis : parent rock, climate, age and topography.

Ten soil groups, 22 soil families, 113 sampling units and 339 cane leaf sheaths samples were studied.

Great soil groups	*Soil families*	*No. of P.S.U.*	*No. of samples analysed*		*3rd-6th cane leaf sheaths*		
					SiO_2 %D.M.	*Ca %D.M.*	*Mn p.p.m.D.M.*
Low Humic Latosols	L1 Richelieu ...	9	25		3.53	0.186	49
	L2 Réduit ...	19	63		3.19	0.210	117
	L3 Ebène ...	1	2		3.88	0.215	106
	L4 Bonne Mère ...	2	6		3.08	0.177	89
	Total	31	96	*Mean* ...	*3.29*	*0.202*	*97*
Humic Latosols	H1 Rosalie ...	3	9		3.54	0.225	90
	H2 Riche Bois ...	11	33		2.99	0.201	115
	Total	14	42	*Mean* ...	*3.11*	*0.206*	*110*
Humic Ferruginous Latosols	F1 Belle Rive ...	7	21		3.05	0.185	133
	F2 Sans Souci ...	7	23		2.41	0.183	114
	F3 Midlands ...	—	—		—	—	—
	F4 Chamarel ...	1	2		1.30	0.176	163
	Total	15	46	*Mean* ...	*2.65*	*0.184*	*125*
Latosolic Reddish Prairie soils	P1 Médine ...	5	15		3.64	0.189	67
	P2 Labourdonnais	11	30		3.86	0.195	59
	P3 Mont Choisy ...	6	16		3.08	0.190	61
	Total	22	61	*Mean* ...	*3.60*	*0.192*	*62*

Great soil groups	Soil families	No. of P.S.U.	No. of samples analysed		3rd-6th cane leaf sheaths SiO₂ %D.M.	Ca %D.M.	Mn p.p.m.D.M.
Latosolic Brown Forest soils	B1 Rose Belle ...	13	41		2.93	0.190	109
	B2 Bois Cheri ...	1	3		2.91	0.171	181
	Total	14	44	*Mean* ...	*2.93*	*0.189*	*114*
Dark Magnesium Clays	M1 Plaine Lauzun	—	—		—	—	—
	M2 Magenta ...	3	6		4.47	0.178	83
	Total	3	6	*Mean* ...	*4.47*	*0.178*	*83*
Grey Hydromorphic soils	D1 Balaklava ...	2	7		3.97	0.173	75
	D2 St. André ...	1	3		3.80	0.205	87
	Total	3	10	*Mean* ...	*3.92*	*0.183*	*79*
Low Humic Gleys	G1 Pétrin ...	—	—		—	—	—
	G2 Valetta ...	—	—		—	—	—
Regosols	C Coral sands ...	2	8	*Mean* ...	*1.22*	*0.241*	*15*
Lithosols	T1	—	—		—	—	—
	T2	—	—		—	—	—
	T3	1	3		2.41	0.189	34
	T4	2	4		2.96	0.203	88
	Total	3	7	*Mean* ...	*2.72*	*0.197*	*65*
Mountain Slope Complex	S1	2	5		3.30	0.165	127
	S2	4	14		2.33	0.171	158
	Total	6	19	*Mean* ...	*2.58*	*0.169*	*150*

The influence exercised on the mineral composition of cane leaf sheaths by the four major contributors to pedogenesis will be studied in turn.

Parent Rock

Parent rock	*No. of P.S.U.*	*Cane leaf sheaths* SiO_2 *%D.M.*	*Ca %D.M.*	*Mn p.p.m.D.M.*
Basic Lava	111	3.19	0.194	99
Coral sand	2	1.22	0.241	15

The composition of the parent rock is reflected in the cane leaf sheath; the lava consisting of various silicates have given rise to acid soils still rich in combined silica and the coral sand, almost pure calcium carbonate, to alkaline soils very poor in silicon and manganese and exceptionally rich in calcium.

Climate

Climate	*Humidity province*	*Great soil groups*	*Cane leaf sheaths* SiO_2 *%D.M.*	*Ca %D.M.*	*Mn p.p.m.D.M.*
Mature soils	*Sub-humid to humid*	Low Humic Latosols ...	3.29	0.202	97
,,	*Super-humid*	Humic Ferruginous Latosols ...	2.65	0.184	125
Immature soils	*Sub-humid to humid*	Latosolic Reddish Prairie soils ...	3.60	0.192	62
,,	*Super-humid*	Latosolic Brown Forest soils ...	2.93	0.189	114

Leaching of silicon from the soil as reflected by the lower content in SiO_2 of the cane sheath and leaching of the bases from the soil as revealed by soil acidity, hence higher manganese content of the cane leaf sheath, is well demonstrated in both the mature (latosols) and immature (latosolic) groups of soils.

The contrast between the two extreme representatives of the Latosols is most striking as shown below :

Humidity province	*Great soil groups*	*Soil family*	*Cane leaf sheaths*		
			SiO_2 %D.M.	*Ca %D.M.*	*Mn p.p.m.D.M.*
Sub-humid	Low Humic Latosols	Richelieu	3.53	0.186	49
Super-humid	Humic Ferruginous Latosols	Chamarel	1.30	0.176	163

Age

The latosols are older, more mature than the Latosolic soils derived from later lava flows. Cane leaf sheath composition reflects this pedological difference : lower content of silicon and higher content of manganese in the old Latosols than in the younger latosolic soils located under similar climatic and topographic conditions.

Age	*Great soil groups*	*Humidity province*	*Cane leaf sheaths*		
			SiO_2 %D.M.	*Ca %D.M.*	*Mn p.p.m.D.M.*
Old soils	Mature Low Humic Latosols	Sub-humid to humid ...	3.39	0.202	97
Younger soils	Immature Latosolic Reddish Prairie soils	,, ...	3.60	0.190	62
Old soils	Mature Humic Ferruginous Latosols	Super-humid	2.65	0.184	125
Younger soils	Immature Latosolic Brown Forest soils	,, ...	2.93	0.189	114

Topography

Schematically three kinds of topography are observed in Mauritius apart from the normal slopes : the convex slopes which are subjected to excessive drainage and to erosion; the concave ones with impeded drainage, both giving rise to special types of soils; and a third kind of topography which accounts for the presence of intrazonal soils, the Dark Magnesium Clays, arising from the seepage of ground water from an upper plateau.

Topography	*Great soil groups*	*Cane leaf sheaths*		
		SiO_2 %D.M.	*Ca %D.M.*	*Mn p.p.m. D.M.*
Convex	Mountain Slope Complex ...	2.58	0.169	150
Concave	Grey Hydromorphic Soils ...	3.92	0.183	79
Seepage from upper plateau	Dark Magnesium Clay ...	4.47	0.178	83

The convex topography has given rise to soils on which the cane leaf sheaths show low silicon and calcium, and high manganese contents through excessive leaching and high soil acidity.

The concave topography produces cane leaf sheaths with high silicon and moderate manganese contents.

The special topographical features accounting for the dark magnesium clays produce cane leaf sheaths with very high silicon (4.47 SiO_2 % D.M., the highest on record) and moderate manganese contents. These soils are noted for the presence of a large proportion of clay fraction of the montmorillonite type, rich in silicon.

As a conclusion, silicon content of cane leaf sheaths is a sensitive reflexion of the soil reserves in combined silicon. Manganese content of this tissue also faithfully reflects soil acidity.

Consequently, organised leaf testing, in the case of the sugar cane, may constitute a new and valuable addition to the methods at the disposal of the soil scientist.

5. A REVIEW OF THE RESULTS OBTAINED SINCE 1934 ON TWO PERMANENT NPK TRIALS

L. ROSS & C. FIGON

With the creation of the Sugar Cane Research Station, Mauritius, in 1929, an important step was marked in research connected with the various aspects of sugar cane cultivation in Mauritius. One of the main objects of the Station was to establish more rational methods of fertilization. This implied the need for intensive field studies, and a large number of manurial trials were conducted in the island. Two of these trials at Réduit Experimental Station have been continued year after year in the same field, and are now maintained by the M.S.I.R.I. both as museum and reference plots. These trials were, some thirty years ago, used to initiate foliar diagnosis studies in Mauritius (HALAIS, 1956). The present paper gives a brief historical review of these trials and of the results obtained to date.

Trial No. 1

This trial was started in 1934 with the primary object of investigating border effects in the assessment of yields (NAQUIN, 1932). It consisted of nine plots of six lines, four A plots and five B plots placed alternately, the B plots receiving exactly four times the amount of fertilizers applied in A plots. With such a difference in the fertilization rates, border effects, if any, would then become important. In order to fulfil the requirements of this trial, the canes were reaped and weighed, row by row, and results obtained for the first rotation showed, as expected, that the outside rows gave better yields than the inner ones.

A second rotation started in 1938, but this time two varieties were planted, each plot consisting of three rows of each variety, so that apart from the study of border effects, comparisons between two commercial varieties, at two levels of fertilization, were made possible. As regards border effects, the results followed the same trend as in the first rotation; thus the practice of excluding outside rows when determining plot yields was established, and is still followed to day.

As well as proving the existence of border effects, the results also showed that the two varieties did not respond to the same extent to high fertilization, and it was felt that further experimentation was necessary. Three more rotations followed, the last being completed in 1964, and the mean yields for the five rotations together with the percent increase in yield are given in Table 31.

Table 31. Mean yields of five rotations (T.C.A.)

Period	*Variety*	*A series (low)**	*B series (high)*	*% increase in yield*
1935-38	M.27/16	19.2	32.4	69
1939-42	M.171/30	18.7	31.0	66
	M.134/32	25.1	35.4	41
1943-48	M.112/34	17.4	29.8	71
	M.134/32	15.2	30.9	103
1950-56	M.423/41	18.9	38.5	104
	M.134/32	19.6	34.2	74
1957-64	M.147/44	25.5	33.6	32
	M.31/45	22.2	29.5	33

* Low fertilization = 10 kg. N, 7 kg P_2O_5, 13 kg K_2O, per arpent.

The above figures show that for each variety there has been a marked difference in yields between the two levels of fertilization; in addition, these figures allow a comparative assessment of two varieties to be made each time, according to their ability to respond to high rates of fertilization. In fact, it is not the actual yield which is important but the percentage increase in yield, and it is interesting to note the good performance of M.134/32.

However, owing to new planting techniques and the general trend of fertilization based on the recommendations resulting from foliar diagnosis and soil analyses, it gradually appeared that the objectives of this trial were being outpaced. In 1965, therefore, a major modification was made in that it was decided that the experiment should be so directed as to allow a comparison between the effects of liberal and scanty nitrogen fertilization instead of between a *general high* and *low* fertilization.

The two varieties chosen were M.202/46 and M.442/51, the two levels of nitrogen being 0 N and 80 kg. N as sulphate of ammonia and nitrate of soda, adequate potash and phosphate being supplied. The aim of this trial is now to compare these two forms of N at a very high level in a locality where there is good response to both fertilizers, and also to study the behaviour of new commercial varieties towards nitrogen.

Trial No. 2

In order to throw more light on fertilization problems, the Sugar Cane Research Station laid down in 1936 a trial with the object of studying the effect of withholding phosphatic and potassic fertilizers from the fertilizer programme.

This trial was planted on a field adjacent to the above one. It was qualitative in character and was conducted on a randomized block layout with four replications of three treatments. Plots receiving either no phosphorus (–P), or no potassium (–K), were compared with plots receiving complete fertilizers, the whole trial receiving a basal dressing of 3 tons pen manure per arpent, no irrigation being practised (Craig, 1937).

At the same time, the S.R.S. had decided to turn over to leaf analysis as a test for plant food deficiencies, the previous method of cane juice analysis having proved unsatisfactory. So the practice of total leaf analysis for N P K adopted in this trial, ranked among the first of this nature to be applied in Mauritius. As a result, a reduction of total plant food content, expressed as a percentage of the dry matter in the leaf, was already observed in 1937 in the –K plots due to reduced intake of potash in both virgins and 1st ratoon (Craig, 1937). Also when either P_2O_5, or K_2O content, of leaf was calculated as a percentage of the total leaf constituent, the omission of either of the two fertilizers became apparent by an equivalent decrease in percentage, a fact which was again observed the following year.

Table 32. Results of 1st rotation (T.C.A.)

	Complete (N.P.K.)	*-K (N.P.)*	*-P (N.K.)*
Virgin (1937)	51.0	44.7	42.7
1st ratoon	33.2	26.2	24.7
2nd ,,	18.4	12.4	13.4

Data obtained for this rotation confirmed the depressing effect of withholding either potash or phosphate (Table 32). The first rotation ended in 1939, and it seemed that the experiment had served its full purpose.

However, the trial was to be replanted the next year with the variety M.134/32, so as to investigate the consequences of further depleting a soil of its feeding potential. Thus a series of rotations with different commercial varieties were to follow, and since then valuable data have accumulated (fig. 13).

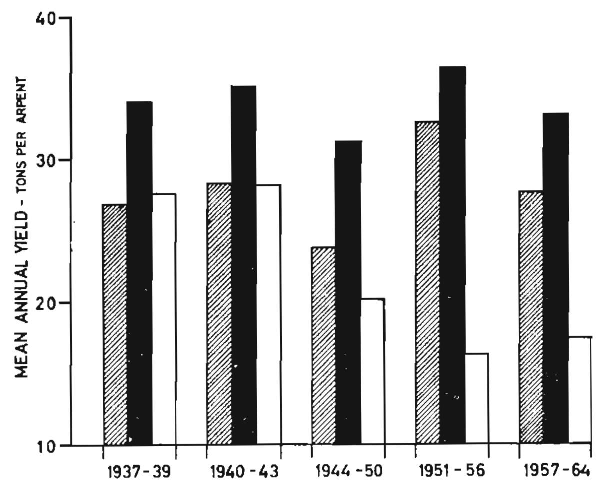

Fig. 13. Comparative yields of cane receiving complete and incomplete fertilization.

Black columns = NPK
Shaded columns = NK
Plain columns = NP

As shown in fig. 13, the omission of phosphate or potash from the fertilizer mixture has caused reduction in yields, the reduction being generally greater without potash.

After World War II, it was decided that this trial should be kept as a demonstration plot to stress the importance of balanced fertilization and, as such, it has proved to be of great value. As early as 1946 the young ratoons were showing definite leaf symptoms of potash deficiency. They actually showed a spotting and premature yellowing, drying of the tips, marginal scorching, and the shoots displayed a fan-like formation instead of showing normal development of the spindle (FEILLAFE, 1948).

The fifth rotation was completed in 1964, and before replanting, soil samples were taken from the various plots and analysed. The exchangeable potassium content of the soil was found to be 0.6 m.e.% in the control plots and 0.2 m.e.% in the no-potash plots, showing a definite depletion in its potassium status. However, the level of this element in the control plots was not as high as would normally be expected, showing that the potassium not used by the crop may have been leached.

Up to 1956 yearly applications of tricalcium phosphate were made in the control and –K plots, but soluble super-phosphate has solely been used as from the fifth rotation.

Fig. 13 shows that in the fourth rotation fairly high yields in –P plots were obtained. This was accounted for by the fact that soil was washed from a neighbouring highly fertilized field and deposited over the experiment after heavy rains in 1952 (FEILLAFE, 1954). As phosphate is not leached but retained in the upper soil, there was an appreciable uptake of phosphate in the –P plots due to the soil carried over. As early as 1941, CRAIG pointed out that lack of phosphorus showed itself more in the virgin crops than in succeeding ratoons, which is in keeping with the data available (Table 33) :

Table 33. Comparison of yields of virgins & ratoons in —P plots (T.C.A.)

Variety	*Complete (N.P.K.)*	*–P (N.K.)*	*–P% Complete*
BH.10/12 Virgins (1937)	51.0	42.7	83.7
1st Ratoon	33.2	24.7	74.3
M.134/32 Virgins (1940)	38.7	24.8	64.1
1st Ratoon	40.7	35.5	87.2
M.112/34 Virgins (1944)	26.3	16.2	61.6
1st Ratoon	27.2	20.7	76.8
M.423/41 Virgins (1951)	38.5	27.5	71.4
1st Ratoon	40.2	37.1	92.3
M.147/44 Virgins (1957)	33.2	26.4	79.5
1st Ratoon	39.5	33.3	84.3

This can be explained by the fact that the ratoons have a more extensive root system.

The phosphorus analysis and the pH status of the soil samples taken in 1965 gave the following figures (Table 34):

Table 34. Results of phosphorus analysis and pH status of soil samples

	Total phosphorus *p.p.m.*	*Truog's phosphorus* ($0.02N\ H_2SO_4$) *p.p.m.*	*Saunder's phosphorus* ($0.1N$ NaOH) *p.p.m.*	pH (H_2O)
Complete	1325	28	604	4.8
No phosphate ...	1000	5	261	4.6

The low pH of this site is probably due to the fact that since 1956 no tricalcium phosphate has been applied, the phosphatic fertilizers being superphosphates of various types, with the result that there was no material to neutralize to any extent the acidifying effects of sulphate of ammonia which has been regularly applied.

According to a new interpretation (*vide* p. 81-83) of the results of soil phosphorus analysis conducted according to the methods of Truog and Saunder, at such pH and on the Low Humic Latosols, the normal levels of phosphorus should be 12 p.p.m. (TRUOG) and 350 p.p.m. (SAUNDER). This implies that the phosphorus status of the NPK plots was optimum, whereas that of the –P plots showed a deficiency of this element. However, the status of total phosphorus in the –P plots amounted to 75% of the NPK plots, and this may account for the reasonable yield, almost 84% of the balanced plots for the last rotation.

Other available data in the 5th rotation completed in 1965 show that there was no tillering effect in the different treatments, and that the large difference in yields was due to stalk size (Table 35).

In 1965 this trial was replanted with M.202/46, with increased nitrogen (60 kg N/arpent) in order to investigate whether nitrogen was a limiting factor in the low difference in yields which was obtained between the control and the –P plots.

The two trials described above now form complete demonstration plots for major elements with the following combinations : NPK v/s PK, and NPK v/s NP and NK.

Table 35. Cane counts and stalk measurements, 1966.

Treatment	*Millable cane counts (av. per line, 38 ft.)*	*Diameter(cm) (mean of 10 canes at random)*	*Length(cm) (mean of 10 canes at random)*	*TCA*
NPK	150	2.7	185.4	37.2
NK	150	2.4	146.3	34.4
NP	147	1.7	67.1	11.8

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Top. General view of Plant Physiology greenhouse, with experiments on water requirements of sugar cane in progress. *Bottom.* Effect of solute potential on cane growth.

One of the experiments to illustrate the effect of soil-water potential on growth of two different cane varieties. The maximum water potentials allowed were, from left to right, — 0.25, – 0.5, — 0.75, — 3.0, and — 9.0 atmospheres.

PLANT - SOIL - WATER RELATIONSHIPS

THE study of cane-water relations is being carried out with two main objects in view: one consists of investigations concerning the water status in the soil and in the plant so as to determine optimum growth conditions; the second is concerned with studies on varietal drought resistance. Corollary experiments on water consumption of the plant are also reported.

1. SOIL WATER STATUS AND CANE GROWTH

C. MONGELARD

Water is the most important factor in plant growth, and the ideal condition is obtained when water is plentiful in the soil so long as aeration in the root zone is not impaired. Under field conditions, however, this ideal condition is almost never obtained. In many areas, water is a scarce commodity and the aim of investigations on plant-water relations is to be able to make recommendations on how to use the water available for irrigation at the most economic cost. A small increase in yield may sometimes not justify the costs of an additional irrigation, the amount of water to be applied per irrigation may vary with the soil and atmospheric conditions, as well as with the age of the crop; these are only a few examples of the problems that remain to be solved.

The first step in the elucidation of these problems is to start investigations on the effect of soil moisture potential on cane growth under greenhouse conditions, where experimental lay-out is less complex, and where control of soil moisture is more easily obtained than in the field.

An experiment was laid out with two varieties, Ebène 1/37 and M.442/51, imposed with five treatments which consisted in allowing the soil around the roots to dry to different water potentials before being re-watered to capacity.

Materials and methods

The containers were 44-gallon drums with holes at the base to allow free drainage of excess water. They were filled with Low Humic Latosol from Palmyre in the sequence of the different soil layers as they occur in the field. Twenty such drums were prepared to provide two replicates of five treatments for each of the two varieties Ebène 1/37 and M.442/51. The treatments consisted in allowing the soil water potential to decrease, before re-watering to capacity, to predetermined values of –0.25, –0.5, –0.75, –3.0, and –9.0 atmospheres respectively. The measurements of soil water potential were made with instruments placed at 6 inches below soil level. Tensiometers were used for the first three treatments, and moisture tensions of 3 and 9 atmospheres were measured with gypsum blocks previously calibrated in a pressure membrane apparatus.

Single-eyed cuttings of the two varieties received the short hot-water treatment (52°C/20 minutes) before being planted in small plastic bags (6″ × 4″) filled with Low Humic Latosol soil obtained at Palmyre from the «A» horizon. The cuttings were allowed to germinate and grow for one month under conditions of high soil moisture before they were selected (for uniform height and vigour) and transferred, after removal of the plastic bags, to the containers. The plants, six to each container, were allowed to grow for one further month with adequate moisture to ascertain whether or not transplantation had had any effect on their growth rate.

Measurements were made weekly until the plants were 3 months old, time when they had been under the different treatments for one month.

Results

The soil moisture/tension curve for the Low Humic Latosol of the «A» horizon is given in fig. 14. Fig. 15 shows the dates of re-watering of the soil when the pre-determined soil moisture potentials were reached. Three series of measurements were made to estimate plant growth and the results are presented graphically in figs. 16–18.

Shoot height measurements represent the height of the plant from soil level to the tip of the longest leaf, and dewlap height is the height from the soil level to the first visible dewlap. The differential increments in shoot height and dewlap height are necessarily the result of the different treatments applied. The difference in log mean leaf area of the two varieties resulting from the different treatments gives an indication of the decreased potential for future growth of the plants having undergone increasing moisture stress in their early growth phase.

Frequent irrigations in the early stages of growth help considerably the plant in establishing itself. Under the conditions of the experiment, allowing the soil water potential

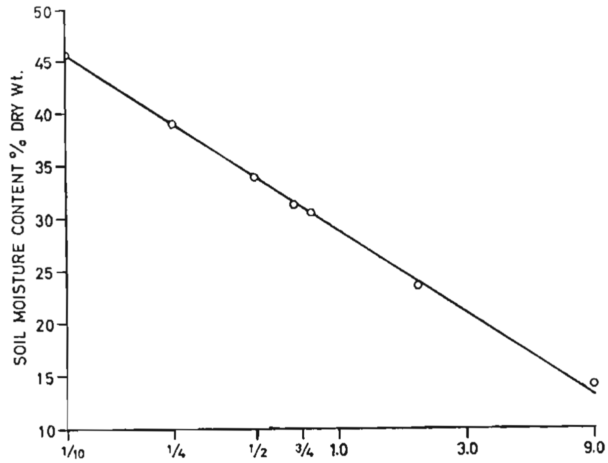

Fig. 14. Log linear relationship between soil suction and soil moisture content % dry weight of soil of Palmyre (Low Humic Latosol).

to decrease below $-\frac{1}{4}$ atmosphere results in a decrease in growth rate. Increasing soil moisture stress between $\frac{1}{4}$ and $\frac{3}{4}$ of an atmosphere appears to have more deleterious effects on the growth of the variety Ebène 1/37 than on that of the variety M.442/51, but both varieties were similarly affected at stresses increasing from $\frac{3}{4}$ of an atmosphere.

2. STUDIES ON VARIETAL DROUGHT RESISTANCE

C. MONGELARD

The improvement of the genetic basis of our sugar cane varieties for increasing sugar output per unit ground area is in itself a difficult problem. A large number of seedlings are produced every year, of which only a small proportion shows any potential for yielding good varieties. Most of these varieties will grow well under conditions of good water supply, whereas the chances of obtaining a variety adapted to dry areas are small. To date, the amount of work involved in classifying a variety as adapted to drought conditions is considerable. Studies on drought resistance have been initiated with a view to classifying drought-resistant varieties at a relatively early stage in the development of new varieties. These studies, however, involve so many physical and physiological properties, that investigation of the factors of such properties can be of practical use only if several of them are studied simultaneously. Although this is a difficult task with limited means, the problem has been approached from as many angles as possible. The studies were concerned with :

i) the effects of different soil-water stresses on growth of a supposed drought-resistant and of a drought-susceptible variety. These studies, described above, were concerned with the effect of soil dryness on the physiological growth aspects of the two varieties;

ii) the growth response of different varieties to decreasing solute potential;

iii) resistance of different varieties to tissue desiccation by imposing high soil moisture stresses;

iv) the effect of high temperature on water loss of excised leaves of a drought-resistant and of a drought-susceptible variety;

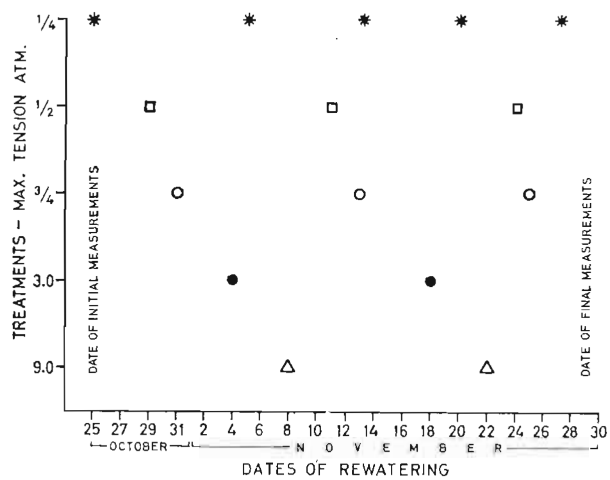

Fig. 15. Frequency of irrigation for the five different treatments during the experiment.

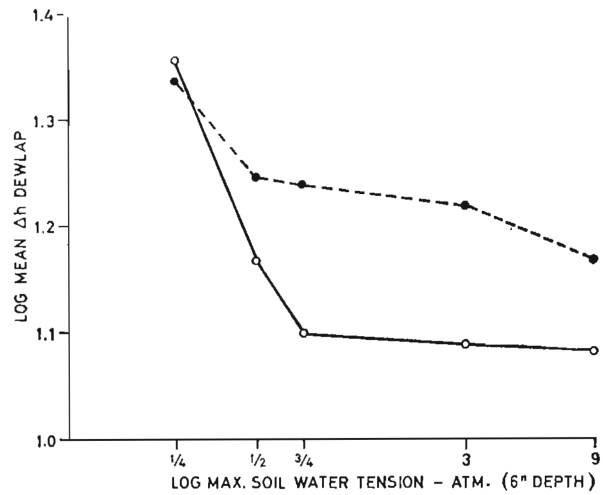

Fig. 17. Effect of different soil water stresses on increase in dewlap height (i.e. stem growth) of the varieties M.442/51 (dotted line) and Ebène 1/37 (plain line) during 35 days' treatment.

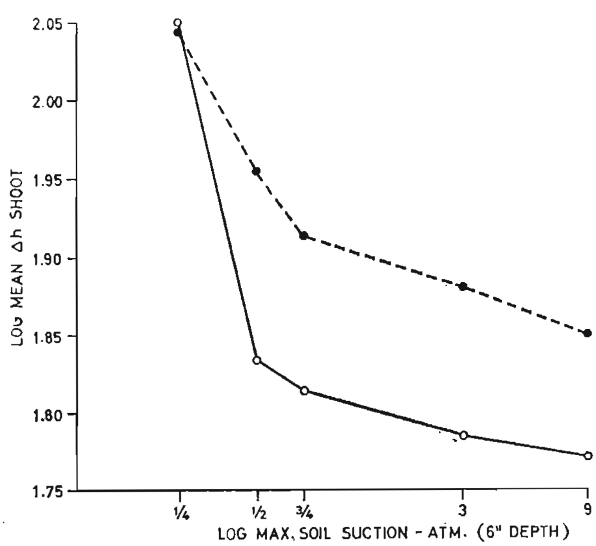

Fig. 16. Increase in shoot height of the varieties M.442/51 (dotted line) and Ebène 1/37 (plain line) during 35 days' treatment under different soil water régimes.

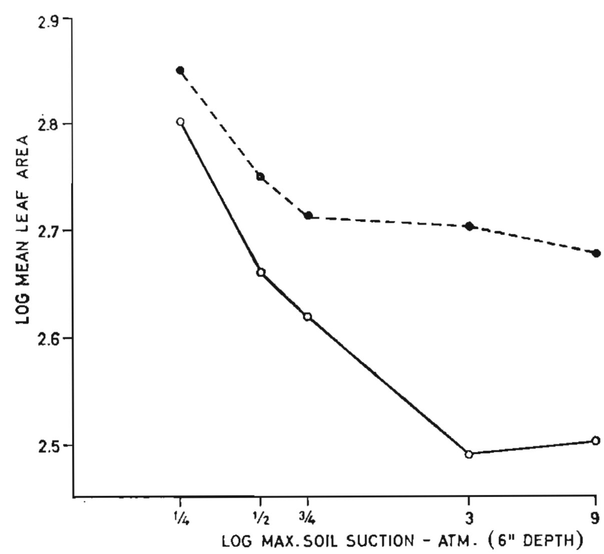

Fig. 18. Effect of different soil water stresses on leaf area of the varieties M.442/51 (dotted line) and Ebène 1/37 (plain line).

v) the relation between percent water loss in leaves and their water potential deficit.

The effect of solute potential on growth

Sodium chloride was used as the osmoticum in the first of a series of experiments to investigate the effect of solute potential on growth of different cane varieties. This preliminary experiment indicated that cane growth was affected at solute potential equivalent to -1 atmosphere (Plate X). To investigate to what extent salt toxicity affected the results obtained, comparable experiments are being carried out with the use of polyethylene glycol (carbowax 4000) as the osmoticum.

Resistance of different varieties to tissue desiccation

Preliminary experiments were carried out on twelve varieties to study their resistance to desiccation. In each of seven trays 6′ × 6″ × 6″, single-eyed cuttings of the varieties M.442/51, M.115/54, M.7/55, M.260/55, M.370/55, M.147/44, Ebène 1/37, M.85/56, M.377/56, M.84/57, M89/57 and M.351/57 were planted in Low Humic Latosol soil and allowed to grow for two months with adequate moisture. The soil was allowed to dry as a result of transpiration and by evaporation until signs of wilting became evident in all varieties. The soil was then watered to capacity and the cycle of drying out and re-watering was repeated a number of times until the canes were five months old.

An assessment of the resistance of the different varieties to withstand such severe drying cycles was made by allowing marks (maximum 10) according to the degree of resistance. The results are given in Table 36.

Table 36. Resistance of different varieties to drying treatment of soil.

	Replicates							
Varieties	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*Total score*
M.377/56	8	4	7	6	6	5	2	38
M.351/57	7	6	5	4	5	3	3	33
M.370/55	7	6	7	2	5	3	3	33
M. 84/57	6	2	4	2	5	3	0	22
M.147/44	6	2	0	2	6	2	1	19
M.260/55	7	2	1	2	0	3	2	17
M.115/54	7	5	2	0	0	2	0	16
M.442/51	8	3	2	0	0	0	1	14
M. 89/57	5	0	0	0	0	3	0	8
M. 85/56	4	0	2	0	0	0	1	7
M. 7/55	4	0	0	1	0	0	0	1
Ebène 1/37	0	0	0	0	0	0	0	0

It is interesting to note that varieties which have been classified as drought-resistant by independent assessment (M.377/56, M.351/57, M.370/55, M.84/57 and M.147/44) obtained the highest scores. Further, Ebène 1/37, which is a variety adapted to the super-humid région, has not withstood the drought treatment imposed, and this fact may have some significance. Further experiments are in progress.

The effect of high temperature on water loss of excised leaves

Leaf samples, 6 inch × 1 inch, were cut from the third leaves of the varieties Ebène 1/37 and M.147/44 in the afternoon and immersed overnight in water. The next morning, the excised leaves were blotted dry, weighed and introduced in boiling tubes immersed up to the mouth in a waterbath at 60°C. Every ten minutes, the leaves were removed, weighed on a torsion balance, and replaced in the tube as quickly as possible. Five experiments with five replicates each were carried out and the results, expressed as percent water loss of initial turgid weight, are presented graphically in fig. 19. Each point on the graph is the mean of 25 determinations.

The results show that the rate of water loss was more rapid in the variety M.147/44 than in the variety Ebène 1/37 during the first 30 minutes, the leaves of the former variety having suffered a loss of 25%, and the latter 18%, of their initial turgid weight. Between the 30th and 40th minute, there seemed to be

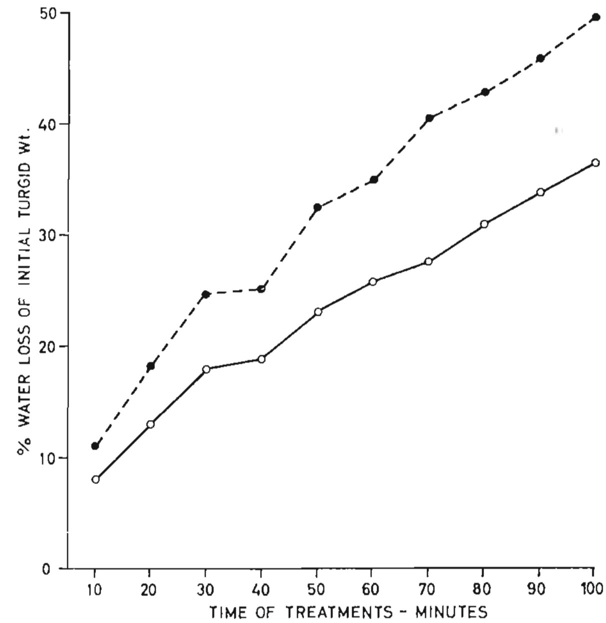

Fig. 19. Water loss expressed in % of their initial turgid weight of excised leaves of the varieties M.147/44 (dotted line) and Ebène 1/37 (plain line) as a result of heat treatment.

a check on water loss by the leaves of both varieties, which presumably was a result of stomatal closure.

After 100 minutes of this treatment, the leaves of the variety M.147/44 had lost 50%, and those of the variety Ebène 1/37 about 37% of their initial turgid weight.

These investigations are continuing with a view to determine (i) if this difference in the rate of water loss is related to the drought resistivity or drought susceptibility of the two varieties concerned; and (ii) how the observed water loss affects the leaf water potential deficit, which in turn, affects the suction force of the leaves.

3. WATER CONSUMPTION OF THE CANE PLANT

(PRELIMINARY RESULTS OF LYSIMETER EXPERIMENTS)

M. HARDY

Overhead irrigation in the sugar industry was started in Mauritius nearly 10 years ago.

Preliminary experiments on the economics of this practice were initiated by the M.S.I.R.I. in 1958 at Palmyre, and the first results appeared in the Annual Report for 1961. In 1962, attention was drawn to the profits to be derived from overhead irrigation applied on a commercial scale in the sub-humid regions of the island (*Rev. agric. sucr. Ile Maurice* **41**, 6 : 312-322). By the end of 1966, the total area under overhead irrigation amounted to 11,500 arpents, and showed a trend towards further expansion.

In 1963, experiments designed to obtain detailed information on the efficient use of water by the cane crop, as well as to collect data on the consumptive use of the sugar cane, were started.

Object of the experiment

The objects of the Palmyre experiment were :

i) to determine the consumptive use of the cane plant in relation to climatic and environmental factors in order to find a means of assessing irrigation needs ;

ii) to correlate cane growth and meteorological observations ;

iii) to determine crop response to irrigation in different soil types ;

iv) to carry out various subsidiary observations on leaching, maturation, compaction, etc.

Layout of experiment

Six lysimeters (fig. 20) were placed around a circle 80 ft. in diameter, as shown in fig. 21, on which the position of rainers is also indicated.

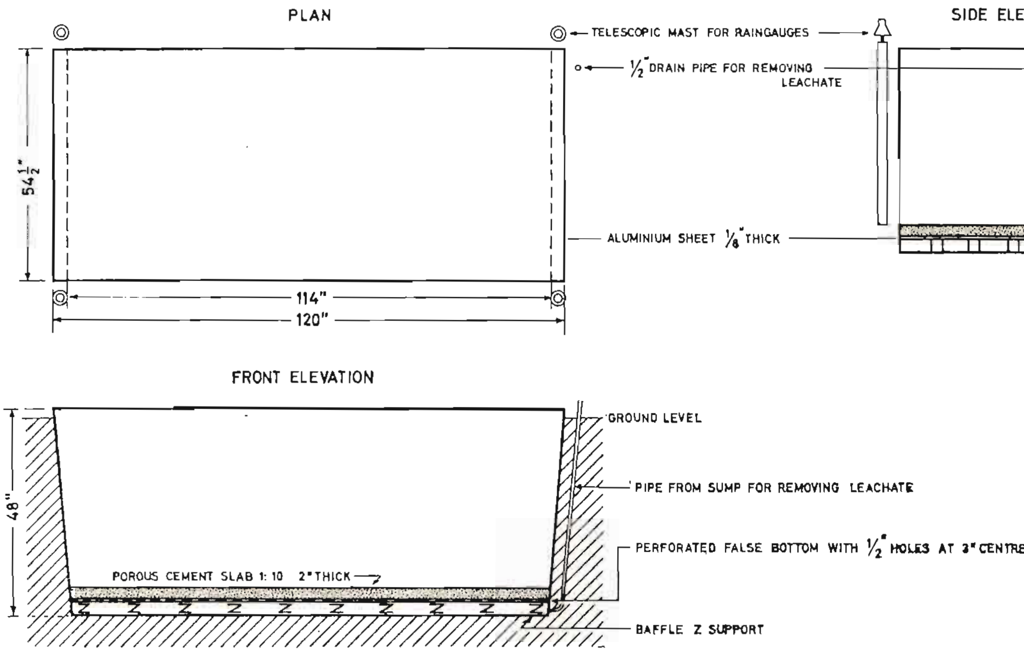

Fig. 20. Plan of a lysimeter

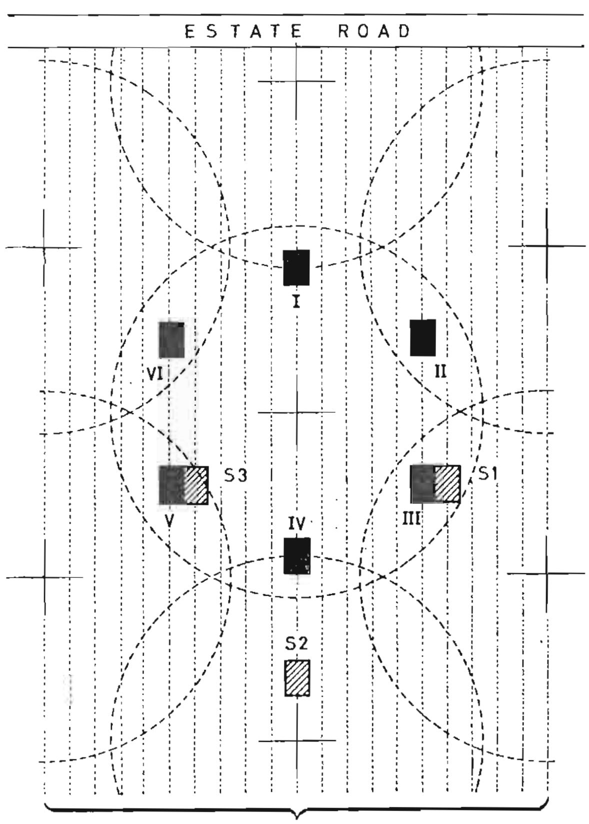

Fig. 21. Layout of experiment.
I to VI = lysimeters; S1 to S3 = standards; + = rainers.

The rainers were «Rain Spray No. 8» sprinklers, capable of discharging 127 G.P.M. at 70 lb pressure on a 225 ft diam. circle. Three soil types were studied in the lysimeters, as follows :

(a) Lysimeters I, III, V — "free soil" (Low Humic Latosols of the Richelieu family), from Palmyre dug from the pits in which the lysimeters were buried;

(b) Lysimeter II — "gravelly soil" (Latosolic Reddish Prairie of the Médine family), from Palmyre taken from a field one mile away;

(c) Lysimeters IV & VI — "free soils" (Low Humic Latosols of the Réduit family) from Savannah, taken 30 miles from the experimental site.

In Lysimeter I, however, the rocks and boulders found *in situ* and representing 29% by volume of the soil utilized, were replaced in the position they occupied in the soil profile.

The standards shown cross-hatched in fig. 21 were established to study the effect of soil disturbance, through digging, on compaction, and subsequent results on cane yields. They consisted of pits of the same dimensions as the lysimeters, filled up in the same way by 4 - inch layers; care was taken to restore the soil profile as closely as possible to reality.

The variety M.147/44 was planted throughout the experiment so that the cane row in the field continued through the lysimeters.

The cane received supra-optimal dressings of NPK fertilization at planting, as well as in the following ratoons, and foliar diagnosis was carried out in order to make sure that nutrition was not limiting.

At the beginning of the experiment, the soil was saturated with water from the rainers, and thereafter irrigation was applied to saturation point every time the "available soil moisture" in any one of the lysimeters fell below 65%. This value, as determined by Bouyoucos cells placed at a depth of 4 inches, corresponded approximately to a 7/8 atmospheric tension in the gravelly soil of Lysimeter II, which was usually the first to dry out.

Excess water applied through sprinkling, took three to six days to percolate down to the sump through the 4 ft. depth of soil in the lysimeters, and leachate was removed daily by means of a pneumatic hand pump. Thus, every time soil saturation was restored in the tanks, the volumetric evapotranspiration of the cane population in these tanks was obtained by substracting the amount of leachate removed from the amount of water added through irrigation and rainfall, as measured by the four corner rain gauges.

Results

By keeping separate records for each lysimeter, an assessment of the water requirements of the cane plant growing in the various types of soil was obtained. Fig. 22 illustrates this graphically, and Table 37 records the daily rate of evapotranspiration for each month of the year to the nearest hundredth of an inch. It will be observed that during the months of August to November, evapotranspiration is nearly the same for the various soil types. This is due to the fact that both transpiration and evaporation are much reduced at this time of the crop cycle, which corresponds to the post-harvest period, during which the leaves have not yet formed a canopy and do not transpire much water. Moreover, the heavy trash blanket lining every inter-line of cane considerably reduces evaporation from the soil surface. During June and July also, evapotranspiration is much the same in the three soil types and this corresponds to the pre-harvest or maturing period during which irrigation is cut off. Variations in the evapotranspiration rate in the different soil types do occur only during the grand period of growth, December to May, and

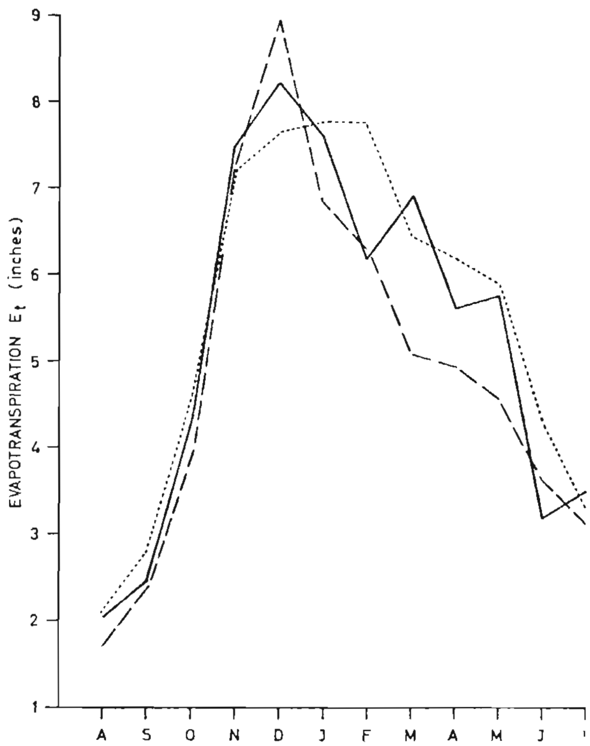

Fig. 22. Monthly evapotranspiration (mean of 3 years, 1964-1966)
Dotted line = L.H.L. (Réduit family)
Broken line = L.R.P. (Médine family)
Plain line = L.H.L. (Richelieu family)

Table 37. Daily rate of evapotranspiration in different soil types

Period (1964—1966)	*L.R.P. (Médine) Lys II*	*L.H.L. (Richelieu) Lys I, III, V*	*L.H.L. (Réduit) Lys IV, VI*	*Mean*
	Type of soil			
August ...	.05	.06	.06	.06
September	.08	.08	.09	.08
October ...	.13	.14	.14	.14
November	.24	.25	.24	.24
December	.29	.26	.25	.26
January ...	.22	.24	.25	.24
February	.22	.22	.27	.24
March ...	.16	.22	.21	.20
April ...	.16	.19	.21	.19
May ...	.15	.19	.19	.17
June ...	.12	.11	.14	.12
July ...	.10	.12	.11	.11

even then, the greatest difference between extremes never exceeds 1.8 inches per month, amounting to a total of 6.8 inches for the whole period. Total yearly evapotranspiration is shown in Table 38 and the mean varies only within narrow limits. Thoeretically, in fact, there should be no variation at all, provided each type of soil is maintained at the same moisture tension and the same soil profile is explored by the roots. In the experiment, as pointed out already, it is the moisture status of the lightest soil (L.R.P. of Lysimeter II) that was considered, when the irrigation cycle to be adopted for the whole experimental plot was decided upon, so that the cane in the other lysimeters were growing under reduced moisture stresses. This, therefore, is supposed to account for the difference in evapotranspiration rate, during the grand period of growth. To obtain a better picture, therefore, data from the three soil types have been grouped together and the mean figures taken. Thus, fig. 23 shows the mean monthly evapotranspiration rate drawn graphically from data in Table 39, and calculated from observations made on three crops, varying from $12\frac{1}{4}$ to $13\frac{1}{2}$ months; the mean, however, (fig. 23) representing a 12-month cycle, the normal one for Mauritius.

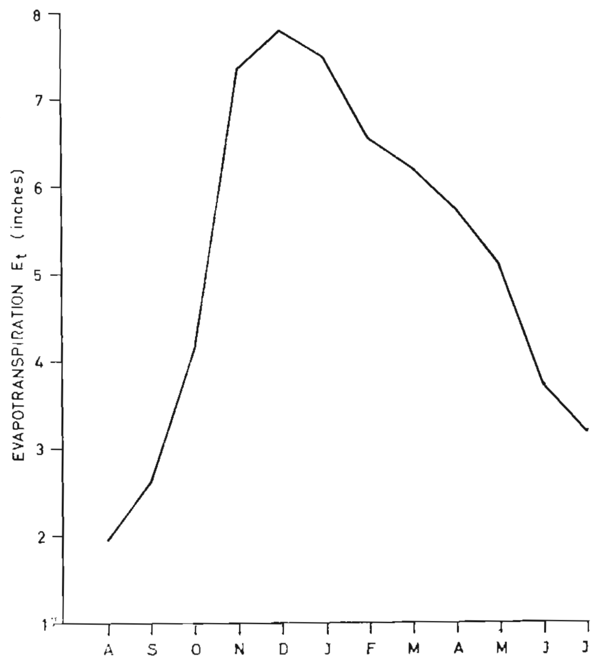

Fig. 23. Monthly evapotranspiration, (mean of three types of soil, and of three years, 1964-1966).

Additional information on amount of water supplied by rainfall and irrigation, as well as leachate removed from the lysimeters, is given in Table 40. It must be pointed out, at this stage, that the 1964 harvest was affected by two cyclones : *Danielle* in January and *Gisèle* in February; the 1966 harvest was also influenced, to a lesser degree, by *Denise* in January and *Kay* in March. Only the 1965 harvest was cyclone-free and this is reflected by cane yields shown in Table 41. On the other hand, consumptive use has been more efficient in the cyclone-free year, as shown hereunder :

	1964	*1965*	*1966*
Consumptive use expressed in tons of water per acre	7267	6405	7358
Cane yield (tons per acre)	61	65	63
Tons water per ton of cane produced ...	119	98	117

Discussion

Although the mean consumptive use has been nearly the same for the different soil types during the three years (Table 38), yet, cane yields showed marked variations from one soil type to another. This is important since there is an indication that a small difference in moisture stress may have a great influence on cane yield. When the "gravelly soil" in Lysimeter II was at 7/8 atm. tension at 4" depth, the "free soil" (Richelieu family) in Lysimeters I, III & V was at 5/8 atm. tension, and the one (Réduit family) in Lysimeters IV & VI at 4/8 atm. tension. In fig. 24, the curve obtained by plotting cane yields against water saturation in atm. tension illustrates this point.

Cane growth and meteorological observations kept at Palmyre were recorded regularly and various methods were tried to obtain a practical means of determining the irrigation cycle. Meteorological data obtained from the Gun Bellani radiation integrator, photo chemical solar integrator tube (developed in Hawaii), Wright Rain «Irrigation Indicator», as well as

Table 38. Yearly evapotranspiration (inches)

Type of soil	*1964* *Virgin*	*1965* *1st. Ratoon*	*1966* *2nd. Ratoon*	*Mean*
L.R.P. soil (Médine)-LYS II ...	65	55	64	61
L.H.L. (Richelieu)-LYS I, III, V	69	59	65	64
L.H.L. (Réduit)-LYS IV & VI	74	62	61	65

Table 39. Mean monthly evapotranspiration (inches) for three types of soil (6 lysimeters) & three crops

Period	*1964 Crop* *Virgin* *(17.6.63—22.7.64)*	*1965 Crop* *1st. Ratoon* *(25.7.64—1.8.65)*	*1966 Crop* *2nd Ratoon* *(5.8.65—21.9.66)*	*Mean Annual* *Jan.-Dec.* *(1964—1966)*
June ...	0.72	—	—	—
July ...	1.76	.51	—	—
August ...	2.24	1.87	1.84	1.98
September ...	2.60	2.72	2.55	2.62
October ...	4.48	3.22	4.80	4.16
November ...	7.92	6.76	7.24	7.31
December ...	(8.04)*	7.52	8.04	7.78
January ...	7.12	7.08	8.12	7.44
February ...	8.52	5.40	5.64	6.52
March ...	6.36	6.92	6.47	6.25
April ...	5.20	6.24	5.92	5.78
May ...	5.60	5.40	4.40	5.13
June ...	4.24	3.32	3.64	3.73
July ...	3.00	2.80	(3.50)*	3.10
August ...	—	—	(3.71)*	—
September ...	—	—	2.78	—
Total	67.80	59.76	68.65	61.80
Crop cycle (months)	13 ¼	12 ¼	13 ½	12

* Estimated

Table 40. Mean amount of water (inches) supplied and leached in the 6 lysimeters

	1964 *Virgin*	*1965* *1st. Ratoon*	*1966* *2nd Ratoon*
No. of irrigation rounds	19	12	19
Irrigation... ...	115.91	57.12	95.41
Rainfall	20.40	27.92	33.80
Total	136.31	85.04	129.21
Leachate	68.51	25.28	60.56
Evapotranspiration ...	67.80	59.76	68.65

Table 41. Cane & sugar yield per arpent for lysimeters, standards & field.

	Virgin *1964*		*1st. Ratoon* *1965*		*2nd. Ratoon* *1966*		*Mean* *(1964-1966)*	
Type of soil	*T.C.A.*	*T.S.A.*	*T.C.A.*	*T.S.A.*	*T.C.A.*	*T.S.A.*	*T.C.A.*	*T.S.A.*
L.R.P. (Médine)-LYS II ...	50	5.15	50	5.40	62	6.82	54	5.79
L.H.L. (Richelieu)-LYS I, III & V	57	5.87	65	6.04	66	7.72	62	6.54
L.H.L. (Réduit)-LYS IV & VI	70	6.58	73	6.50	60	5.88	67	6.32
Mean LYS (prop). ...	*61*	*6.10*	*65*	*6.11*	*63*	*6.74*	*63*	*6.32*
Standards I - III ...	54	4.86	61	5.36	63	6.23	59	5.48
Field	52	5.36	58	5.22	56	5.83	55	5.47

soil moisture readings from tensiometers, irrometers, Bouyoucos cells, were obtained and will be published later. Evapotranspiration curves calculated by the Penman, Thornthwaite and Turc formulae were also compared to actual evapotranspiration; but it seems that up to now, the cheapest, simplest, and sufficiently precise means of following evapotranspiration is by the use of the United States Weather Bureau Class A pan, described by various workers. In fig. 25, evapotranspiration is compared to pan observations for every month during the three years of experimentation, and it can be seen that both curves are very similar during the period November to June, which is the period of full canopy, while there is a marked difference between the curves during the period July to October which includes (a) the period, as pointed out already, preceding harvest

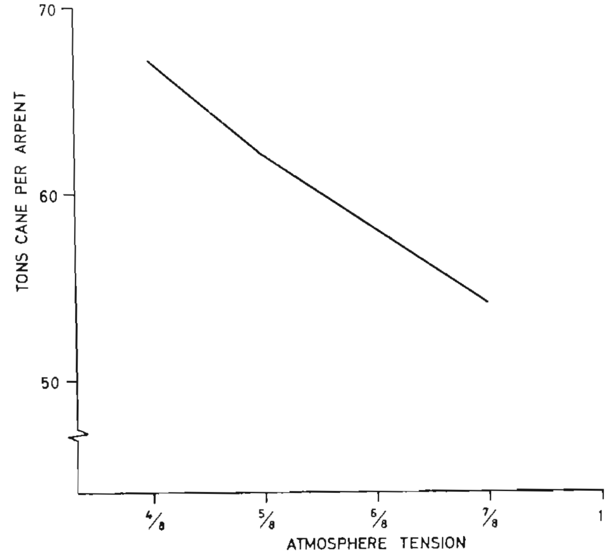

Fig. 24. Cane yield at various soil moisture tensions.

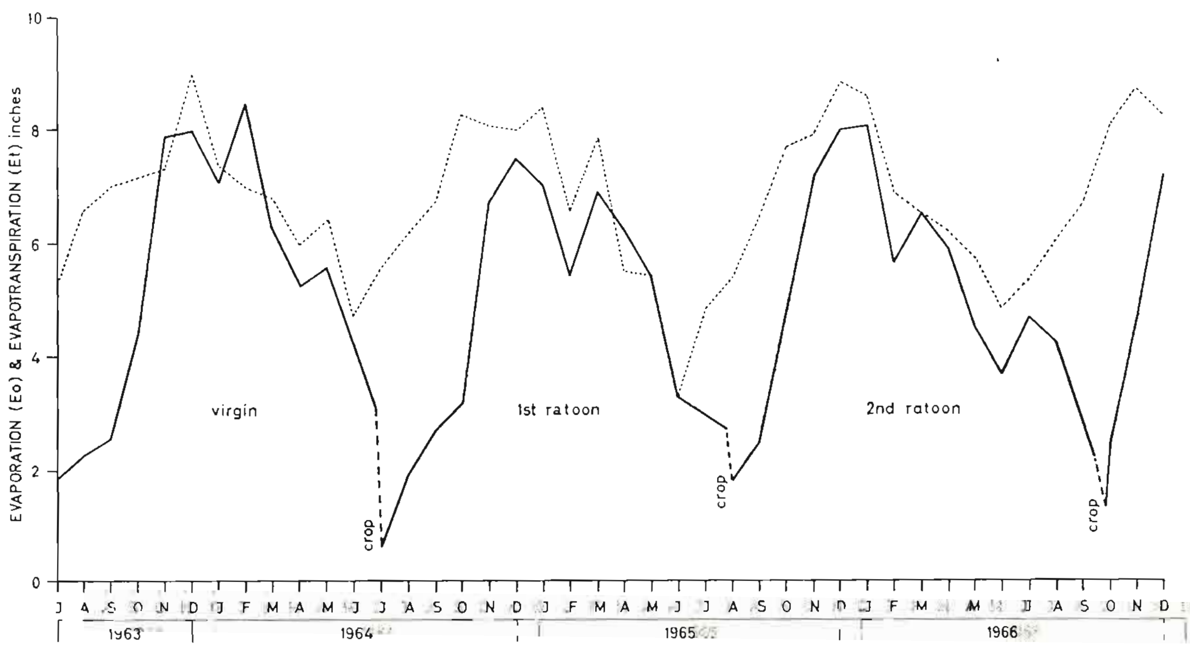

Fig. 25. Evapotranspiration compared to evaporation for three crop cycles.

Dotted line = Evaporation from a U.S.W.B. class A pan.

Plain line = Evapotranspiration (mean of three types of soil)

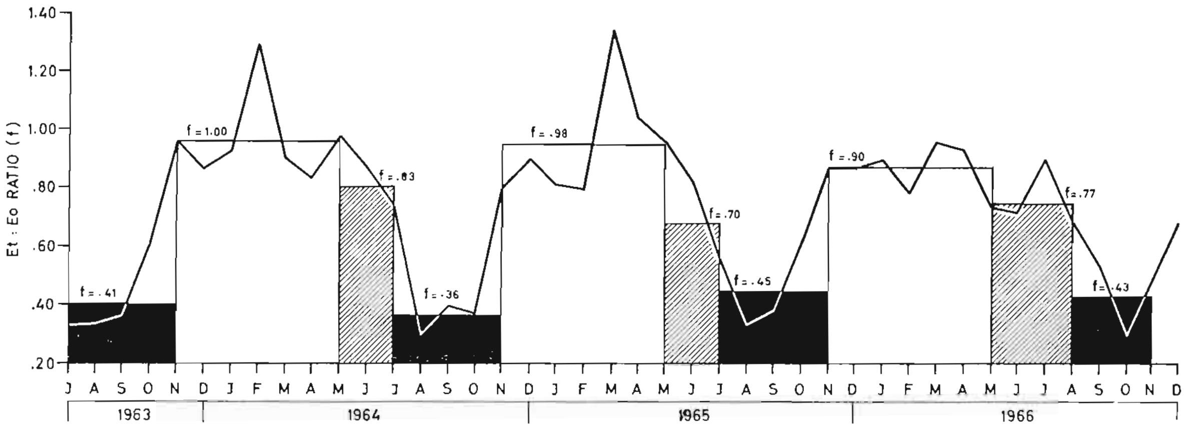

Fig. 26. Et/Eo for various crop stages

light = full growth period ; hatched = pre-harvest ; dark = post harvest

when water is cut off; and (b) the period just after harvest when the leaf canopy is still open.

By drawing the Et/Eo (class A pan) ratio for the three years 1964 to 1966 (fig. 26), it appears that the crop cycle can be divided into three periods, and three different factors can be safely adopted to obtain cane water needs with enough precision for practical purposes :

(i) the post-harvest period of about four months duration, (for virgins, however, this period is longer) when the cane needs are 40% of class A pan indication;

(ii) the full growth period from November to May, during which the water supplied to the cane should be not less than 95% of the pan figures;

(iii) the pre-harvest period (about two months) when the cane is maturing and needs 75% of the pan evaporation, depending on the drying-off programme.

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CLIMATE AND CULTIVATION

1. WEATHER CONDITIONS DURING 1966 CAMPAIGN AND SUGAR PRODUCTION

P. HALAIS

TEN days' deviations for rainfall and monthly deviations for highest hourly wind speed, mean and average minimum temperatures and relative insolation from corresponding normal values observed over Mauritius during the vegetative (November to June) and the maturation (July to October) periods of the 1966 campaign are shown graphically in figs. 27 to 30, together with similar data for the two previous years.

As a whole, the meteorological conditions which prevailed during 1966 diverged considerably from normal values and were mostly unfavourable to cane production.

After an exceptional and uninterrupted sequence of eleven favourable years from 1949 to 1959, Mauritius has suffered since 1960 from a series of meteorological setbacks, with the exceptions of the 1963 and 1965 campaigns, the latter for cane production at least.

Vegetative Period

At the beginning of the 1966 vegetative period, the young canes had already received during four previous months, July to October, the highest rainfall on record since 1875 so that they had reached unusual development in the unirrigated sub-humid regions, especially in the northern sector, at the time when cyclone *Denise* passed near Mauritius early in January.

The more advanced physiological age of the canes compared to their chronological age led to more profound internal and external damage than is usually experienced as a result of an early cyclone in January.

Subsequent recovery of the cyclone-stricken canes was slowed down by the dry conditions which set in for 14 consecutive ten-day periods ending only at the beginning of June when canes were less responsive owing to both cooler temperatures and more advanced age. In other words, the canes suffered from an abnormal sequence of meteorological conditions.

Campaigns characterized both by damaging cyclones (highest hourly wind speed equal to, or above 35 m.p.h.) and severe drought (sum of monthly rainfall deficits equal to, or above 20 inches) during the vegetative period from November to June are quite unusual. Only six have occurred since 1875 : in 1881, 1902, 1907, 1910, 1934 and 1966, an average frequency of once in 15 years. Consequently, our limited experience of combinations of weather hazards of this kind was responsible for the uncertainty that prevailed late in the season concerning crop forecast.

Table 42 gives for the vegetative period, November to June, comparative selected meteorological data for the last three campaigns, and extreme values observed since 1950.

Table 42. Variations in critical meteorological elements for vegetative periods and cane production per arpent

	Months	*Normals*	*1966*	*1965*	*1964*	*Extremes since 1950*
Highest hourly wind speed (m.p.h.)	Nov.-June	*26*	45 (Jan.)	24 (May)	60 (Jan.)	18 — 74 (1959) — (1960)
Sum of monthly rainfall deficits (in.)	,,	*15.0*	23.7	14.1	10.3	5.7 — 28.7 (1962) — (1961)
Relative insolation (%) ...	,,	*58*	65	59	55	53 — 66 (1963) — (1961)
Mean air temperature (°C) ...	Mar.-June (Autumn)	*23.3*	23.1	22.6	22.7	22.6 — 24.6 (1965) — (1961)
Tons cane per arpent, Island ...		*31.0*	24.7	30.6	22.5	12.7 — 30.6 (1960) — (1965)

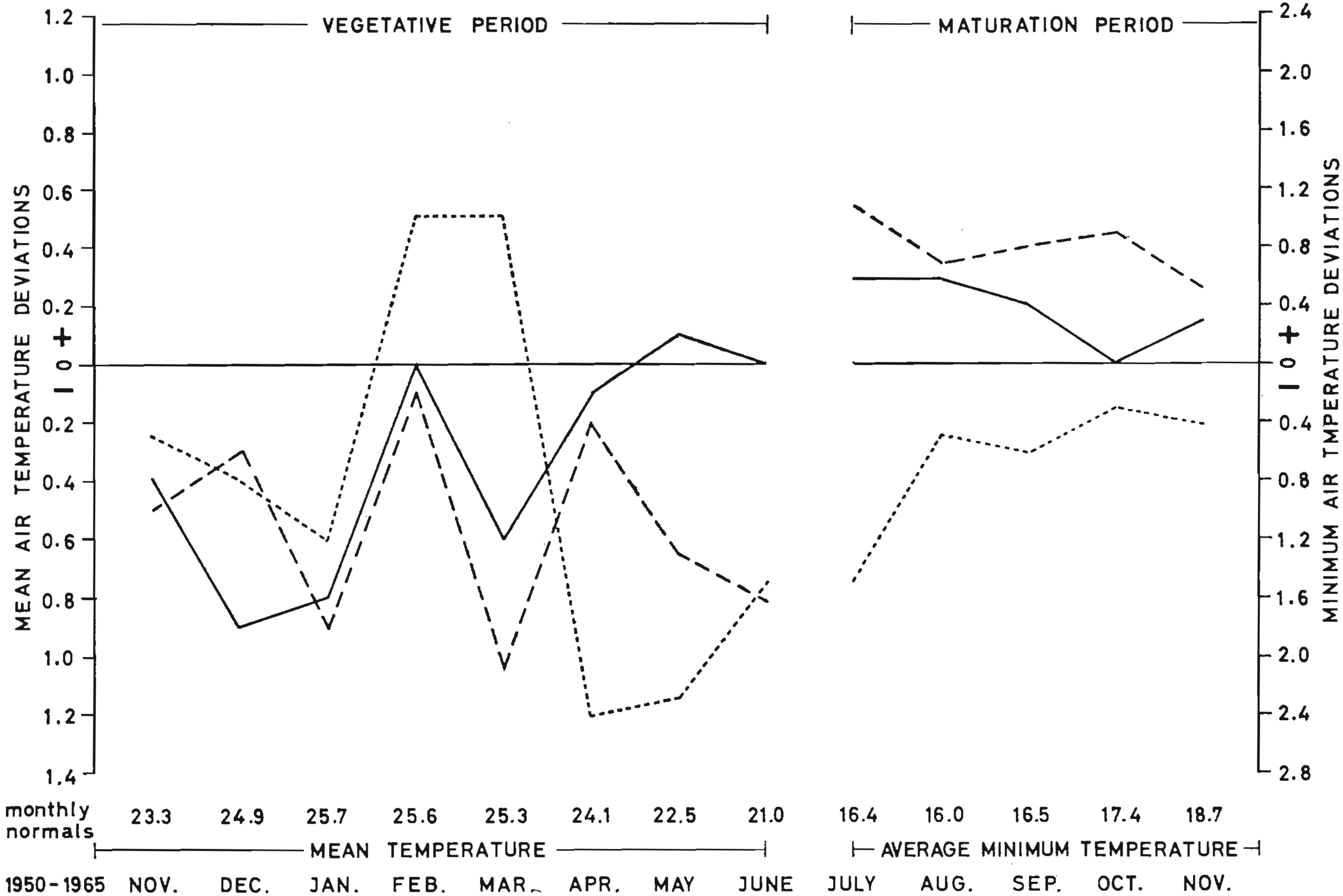

Fig. 27. Air temperature; deviations from monthly normal values.
Average mean temperature for vegetative period ;
Average minimum temperature for maturation period :
Dotted line : 1963-64.
Broken line : 1964-65.
Plain line : 1965-66.
Scale used for vegetative period is double that for maturation period.

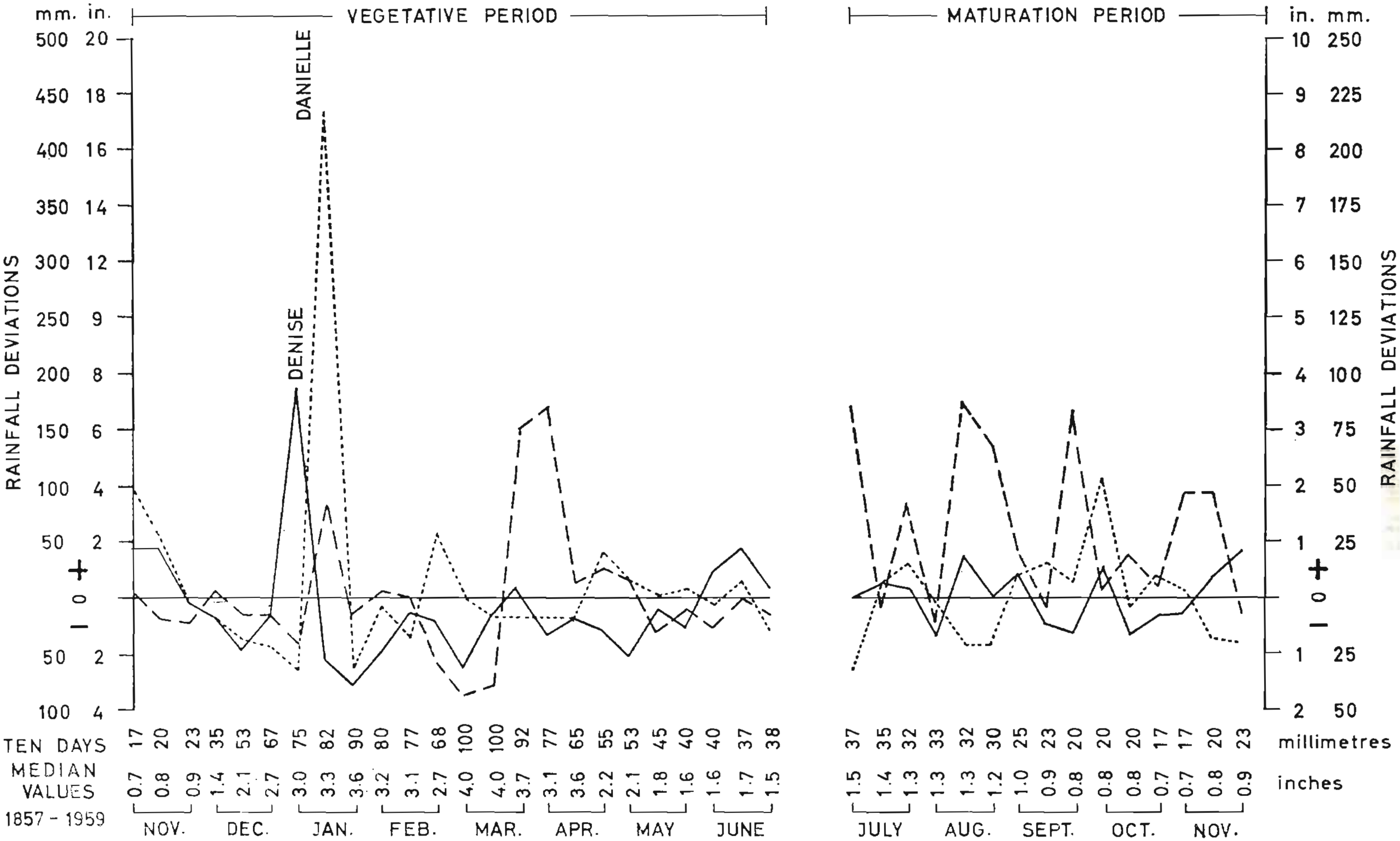

Fig. 28. Rainfall; deviations from 10 days' median values.
Dotted line : 1963-64
Broken line : 1964-65
Plain line : 1965-66
Scale used for maturation period is double that for vegetative period.

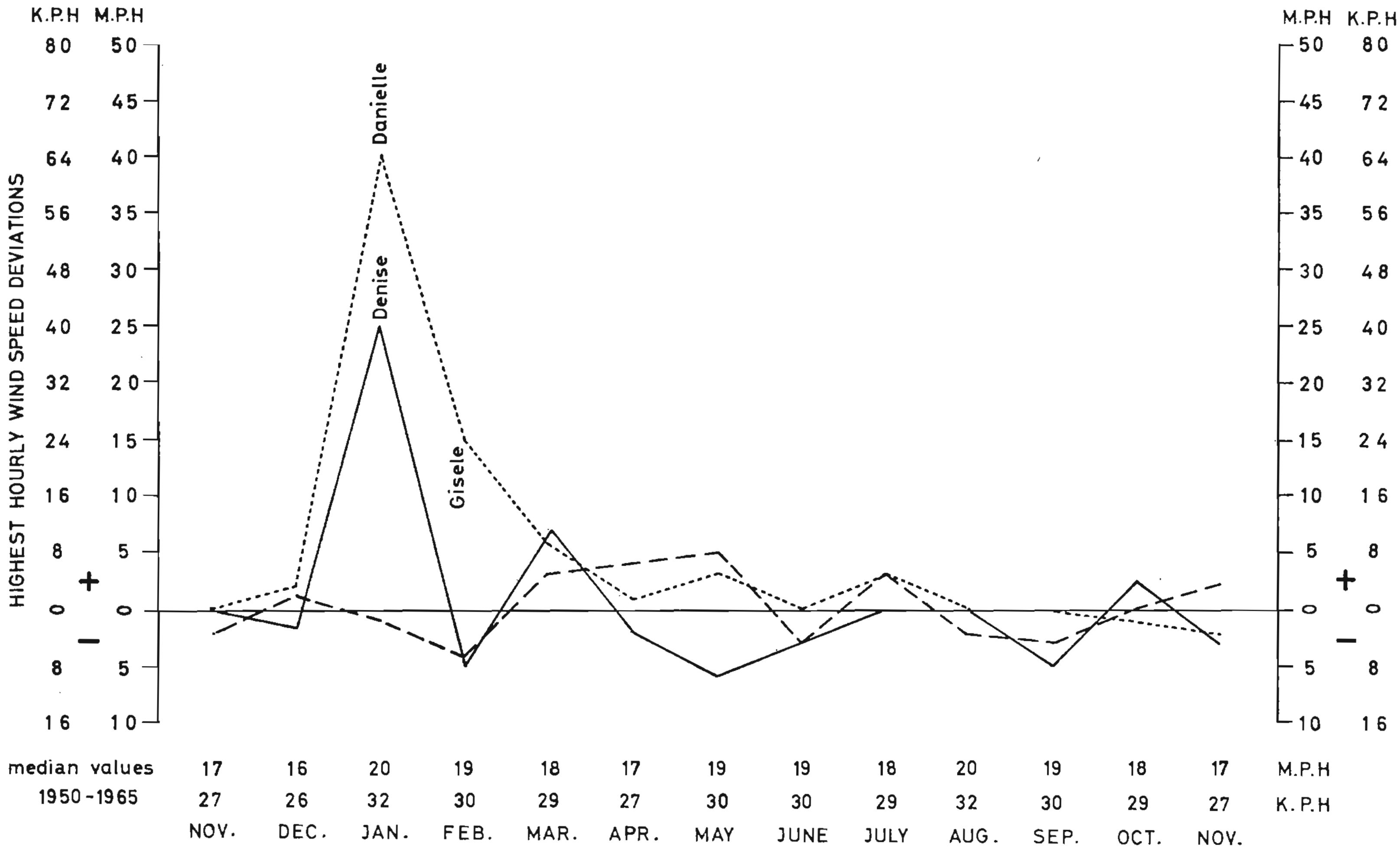

Fig. 29. Highest hourly wind speed; deviations from corresponding median values.
Dotted line : 1963-64
Broken line : 1964-65
Plain line : 1965-66

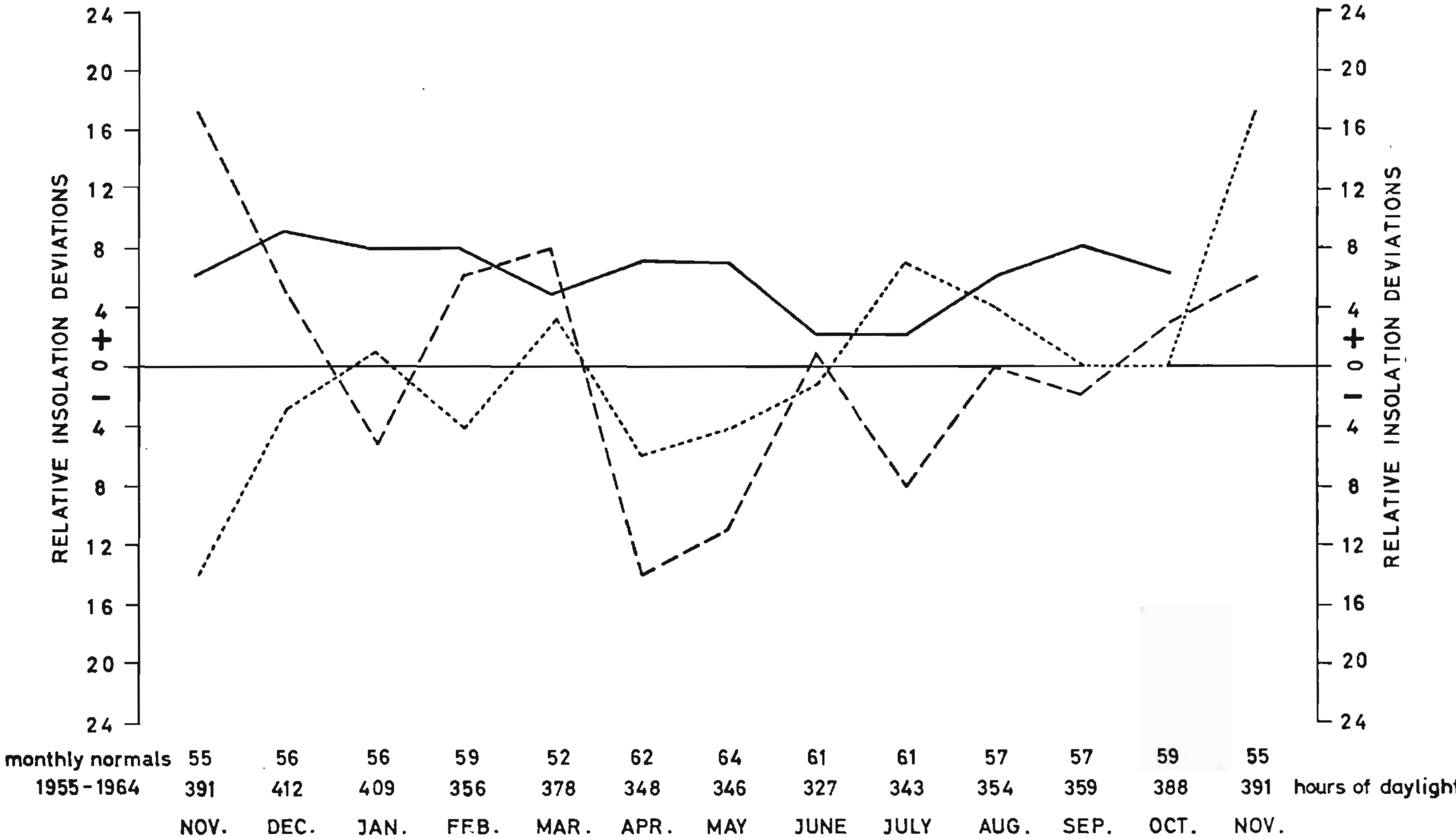

Fig. 30. Relative insolation; deviations from monthly normals.
Dotted line : 1963-64
Broken line : 1964-65
Plain line : 1965-66

The tonnage of cane harvested per arpent, 24.7, was well below the present normal value of 31.0 for the island, when no cyclonic winds occur and when the sum of monthly rainfall deficits from November to June amounts to approximately 15 inches. This shortage of 6.3 tons of cane per arpent is to be ascribed both to cyclone *Denise* (45 m.p.h.) in January and to the drought (D 23.7 inches) experienced later during the 1966 campaign.

Cane tonnages per arpent reaped, recorded on the five sugar sectors for the 1966 campaign, are compared below to corresponding normals adjusted to date :

	West	*North*	*East*	*South*	*Centre*	*Island*
Normals	*36.6*	*28.8*	*30.7*	*31.8*	*31.9*	*31.0*
1966	32.2	21.5	24.8	26.5	22.7	24.7
Differences	— 4.4	— 7.3	— 5.9	— 5.3	— 9.2	— 6.3

Cane yields in the northern and central sectors are usually influenced differently by annual changes in environmental factors ; however, for an abnormal campaign such as the 1966 one – with a cyclone and a drought occurring in succession – both sectors show large cane losses.

Maturation Period

Weather conditions which prevailed during the maturation period from July to October 1966 show some apparent contradictions. They are definitely on the favourable side as far as low rainfall excesses and high relative insolation are concerned. A sum of monthly rainfall excesses of 0.0 in. observed in 1966 occurred for the last time in 1956, and a relative insolation of 64% observed in 1966 was exceeded by a small margin (65%) during 1956 only. The maturation period for the 1956 campaign is known to have been one of the best on record. The mean highest hourly wind speed of 18 m.p.h. for the four months July to October 1966 was the same as the normal value.

On the other hand, air temperatures, as measured by average minimum and daily range, as well as by temperature ratio (*vide Rep. Maurit. Sug. Ind. Res. Inst.* **12**, 1965: 101-105) were all on the unfavourable side as far as cane maturation is concerned. Similar apparent lack of correlation between rain and insolation factors, on the one hand, and air temperature on the other, have occurred twice only during the last 18 years : in 1960 and in 1966. For 1966 and 1956 respectively, average minimum air temperature of 16.9°C and 16.2°C, mean daily range of 7.9°C and 9.3°C, and temperature ratio of 0.93 and 1.15 were recorded.

Table 43 gives for the maturation periods, July to October, comparative selected meteorological data for the last three campaigns and extreme values observed since 1950.

Table 43. Variations in critical meteorological elements for maturation periods, cane quality and sugar production

	Months	*Normals*	*1966*	*1965*	*1964*	*Extremes since 1950*
Mean of highest hourly wind speed (*m.p.h.*)	July-Oct.	*18*	18	18	19	15 — 22 (1957) — (1953)
Sum of monthly rainfall excesses (in.) ...	,,	*2.5*	0.0	14.1	2.9	0.0 — 14.1 (1956, — (1965) 1966)
Relative insolation (%)	,,	*58*	64	56	61	51 — 65 (1953) — (1956)
Average minimum air temperature (°C) ...	,,	*16.5*	16.9	17.6	15.8	15.7 — 17.6 (1963) — (1961-65)
Mean daily range (°C)	,,	*8.2*	7.9	6.7	7.9	6.7 — 9.3 (1965) — (1956)
Temperature ratio	,,	*0.98*	0.93	0.77	1.00	0.77 — 1.15 (1965) — (1956)
Sugar manufactured % cane ...		*11.6*	11.6	11.1	11.9	9.8 — 12.9 (1960) — (1956-57)
Tons sugar per arpent, Island		*3.60*	2.86	3.42	2.66	1.26 — 3.53 (1960) — (1963)
Area harvested, thousand arpt. ...		*196*	196	194	195	151 — 196 (1950) — (1966)
Total sugar production, thousand tons ...		*706*	562	665	520	254 — 686 (1960) — (1963)

The following figures for sugar manufactured % cane were obtained in the five sugar sectors for the 1966 campaign and are compared to the normal values adjusted to-date :

	West	North	East	South	Centre	Island
Normals	*12.1*	*12.1*	*11.4*	*11.2*	*11.8*	*11.6*
1966	12.2	11.8	11.5	11.5	11.4	11.6
Differences	+ 0.1	— 0.3	+ 0.1	+ 0.3	— 0.4	0.0

As shown above, cane quality was somewhat below expectation as a result of the dry and sunny maturation period which prevailed in 1966. But no definite explanation can be put forward for the comparatively low cane quality observed, especially in the northern and central sectors, apart from the initial setback resulting from the early cyclone *Denise* on canes already advanced in their physiological age, and from the unfavourable air temperatures recorded later, from July to October 1966. Furthermore, with the varietal changes which have occurred between 1956 and 1966, the relationship between cane quality and critical meteorological factors established earlier connot be expected to hold good for ever.

The following figures for tons of sugar manufactured per arpent harvested were obtained in the five sugar sectors for the 1966 campaign and are compared to the normals adjusted to date :

	West	North	East	South	Centre	Island
Normals	*4.43*	*3.48*	*3.50*	*3.56*	*3.66*	*3.60*
1966	3.93	2.53	2.86	3.04	2.59	2.86
Differences	— 0.50	— 0.95	— 0.64	— 0.52	— 1.07	— 0.74

Changes in environmental factors in the northern and central sectors influence sugar production in the same way as cane production, as mentioned earlier; and the abormal conditions which prevailed in 1966, a cyclone followed by a drought, affected adversely sugar production in both sectors.

Table 44 recapitulates salient weather conditions for both vegetative and maturation periods from 1960 onwards, together with sugar production in tons per arpent for the island.

Table 44. Recapitulation of weather conditions, 1960–1966.

Campaigns	*Vegetative Periods (November to June)*			*Maturation Periods (July to October)*			*Tons sugar produced per arpent reaped*
	Sum monthly rainfall deficits (in.)	*Highest hourly wind speed (m.p.h.)*	*Mean air temperature March-June (°C)*	*Sum monthly rainfall excesses (in.)*	*Relative insolation (%)*	*Temperature ratio*	
Normals	*15.0*	*26*	*23.3*	*2.5*	*58*	*0.98*	
1960	12.0	*Alix* (53) *Carol* (74)	23.2	5.2	57	0.86	1.26
1961	28.7		24.6	4.8	60	0.92	2.95
1962	5.7	*Beryl* (43) *Jenny* (59)	22.8	3.4	56	1.00	2.75
1963	13.9		23.2	2.2	51	1.11	3.53
1964	10.3	*Danielle*(60) *Gisèle* (34)	22.7	2.9	61	1.00	2.66
1965	14.1		22.6	14.1	56	0.77	3.42
1966	23.7	*Denise* (45)	23.1	0.0	64	0.93	2.86

2. A CLASSIFICATION OF VEGETATIVE SEASONS FOR CANE PRODUCTION FROM 1875 TO 1966

P. HALAIS

Under Mauritius conditions, the vegetative season for sugar cane crops extends over eight months, from November to June, when rainfall and air temperature are at a comparatively high level, the coincidence of these two major factors being conducive to the rapid growth of cane stalks. However, when rainfall deficits occur over the island, as measured by monthly values inferior to normals—long term averages—if cane growth is hindered, especially on the drier lowlands and leeward slopes, the crop is unaffected on the more humid high ground and windward slopes.

The sum of monthly rainfall deficits (D) for the vegetative season from November to June, averaged over the island, is used as a convenient index of the moisture factor in relation to sugar cane growth. This sum of monthly rainfall deficits has varied from 2 in. for a very humid season (1931) to 29 in. for very dry ones (1934 and 1961), the mean figure 15 in. being considered normal for cane production as far as moisture is concerned.

Three classes of moisture conditions have been recognized for the vegetative season from November to June : *humid* when D equals, or is inferior, to 10 in; *normal* when D lies between 11 and 19 in; and *dry* when D equals, or is superior, to 20 in. For the 92 vegetative seasons which have occurred between 1875 and 1966, the distribution of 21 *humid*, 49 *normal* and 22 *dry* seasons is symmetrical.

However, when the 92 vegetative seasons are subdivided into two groups, one of 60 seasons free from damaging cyclones, with winds speeds averaged over a whole hour inferior to the threshold value of 35 miles per hour, and the other of 32 seasons with damaging cyclones during which maximum hourly wind speeds are equal, or superior to 35 m.p.h., the distribution of *humid*, *normal* and *dry* seasons, is skewed as shown in Table 45. For the purpose of this classification of vegetative seasons, a threshold higher than the usually recognized value of 30 m.p.h. has been selected.

Table 45. Distribution of vegetative seasons from November to June, 1875-1966

Class	*All seasons*	*Without damaging cyclones*	*With damaging cyclones* $\geq$ *35 m.p.h.*
Humid D $\leq$ 10	21	9	12
Normal D 11-19	49	35	14
Dry D $\geq$ 20	22	16	6
Totals ...	*92*	*60*	*32*

In other words, dry vegetative seasons predominate over humid ones for the group of 60 seasons without damaging cyclones, and humid vegetative seasons predominate over dry ones for the group of 32 seasons with damaging cyclones.

From the agronomic point of view, it follows that the sugar cane in the drier climates of Mauritius is unable to take full advantage of humid vegetative seasons as these very often coincide with the occurrence of damaging cyclones. Consequently, apart from the three moisture classes, *humid*, *normal* and *dry*, mentioned above, a fourth class, *cyclonic*, is needed to complete the classification of vegetative seasons. In this *cyclonic* class, wind damage may be of such magnitude as to overshadow the moisture factor. However, vegetative seasons which have been *dry* and *cyclonic* have occurred in 1881, 1902, 1907, 1910, 1934 and 1966.

Table 46 compares the distribution of the four classes of vegetative seasons for three periods : the long term one of 92 years from 1875 to 1966 for which no complete record of cane yields per arpent reaped is available; the 56 years from 1911 to 1966 for which cane yields are known accurately for the island as a whole; and the more recent 20–year period from 1947 to 1966 for which cane yields are known with precision for each of the five sugar sectors :

Table 46. Comparative distribution of the four different classes of vegetative seasons

	Period 1875-1966	*Period 1911-1966*	*Period 1947-1966*	
Humid	9	7	5	(all grouped between 1951 & 1958)
Normal	35	23	7	
Dry	16	9	4	
Cyclonic	32	17	4	(all grouped between 1960 & 1966)
Totals	*92*	*56*	*20*	

Table 46 shows that even a period of 20 years, such as from 1947 to 1966, may offer a very abnormal distribution of the four classes of vegetative seasons as, for instance, the grouping of five humid vegetative seasons over a period of 8 years between 1951 and 1958, as compared to only four during a previous period of 76 years, 1875 to 1950. On the other hand, between 1947 and 1959, 13 years elapsed with seasons free from damaging cyclones, whereas for the 7 years between 1960 and 1966 four cyclonic vegetative seasons occurred, all four with cyclones of greater wind intensities than usually encountered.

Table 47 shows the distribution of the highest hourly wind speed for the 32 vegetative seasons with damaging cyclones, and the years when the most destructive ones occurred.

Table 47. Distribution of maximum hourly wind speed

Max. hourly wind speed, m.p.h.	*No. of vegetative seasons*	*Years when occurring*
35-49	10	
40-44	6	
45-49	4	1894, 1908, 1940, *1966*
50-54	3	1877, 1901, 1931
55-59	2	1898, *1962*,
60-64	5	1876, 1879, 1902, 1945, *1964*
65-69	—	
70-74	1	*1960*
75-79	1	1892
Total	*32*	

The median figure for highest hourly wind speed for the 32 vegetative seasons between 1875 and 1966 is 44 m.p.h. Six vegetative seasons (1879, 1892, 1926, 1946, 1960 and 1962) had two damaging cyclones, and one (1945) three damaging cyclones,

The monthly distribution of damaging cyclones for the 32 cyclonic vegetative seasons is given in Table 48. The highest frequencies are in January and February. It must be mentioned in this connection that for comparable maximum hourly wind speeds, cyclones occurring in December are much less damaging than those occurring later in the vegetative season.

Table 48. Monthly distribution of highest maximum hourly wind speed during cyclonic vegetative seasons

Month		*Number*
December	...	3
January	...	11
February	...	9
March	...	6
April	...	2
May	...	1
Total	...	*32*

Comparative indices of cane yields per arpent are given in Table 49, 100 being taken as the cane yield for the corresponding normal vegetative season — reference seasons — obtained by means of a graphic interpolation.

In view of the fact that the recent 20–year period from 1947 to 1966 is not at all typical, as far as the distribution of the classes of vegetative seasons is concerned, compared to the longer period of 56 years from 1911 to 1966, an attempt to adjust the comparative cane yield indices is needed. In addition, the comparative index for the dry seasons period, 1947-1966, is higher (95.9) than for the 1911-1966 period (93.9), and the one for the cyclonic seasons period 1947-1966 is lower (70.8) than for the 1911-1966 period (81.2). Consequently,

Table 49. Comparative cane yield indices for the island and the five sugar sectors

Range of climates		*Island* 1911-1966	*Island* 1947-1966	*West* 1947-1966 *sub-humid (irrigated)*	*North* 1947-1966 *sub-humid to humid*	*East* 1947-1966 *humid to super-humid*	*South* 1947-1966 *humid to super-humid*	*Centre* 1947-1966 *humid to super-humid*
Altitude in ft.	...			0-900	0-600	0-1200	0-1200	900-1800
Humid	...	103.1	103.1	100.5	110.3	104.5	98.0	100.0
Normal	...	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Dry ...	...	93.9	95.9	90.4	94.4	94.2	99.0	100.6
Cyclonic	...	81.2	70.8	78.4	76.3	69.9	71.2	57.8
Weighted Averages		*93.7*	*94.1*	*93.9*	*96.7*	*93.9*	*93.5*	*91.7*

appropriate conversion factors have been calculated (for dry season 1.49 and for cyclonic ones 0.64) and should be used to adjust the recent period of 20 years, for which cane yields are available for the five sectors, to the longer period of 56 years. This has been attempted in Table 50.

Table 51 gives the differential behaviour in cane production towards the different classes of vegetative seasons, averaged over Mauritius, for the various sugar sectors.

Two important conclusions may be drawn from Table 51 : the opposite response shown by the two sectors, North and Centre, and the comparable reaction of the eastern sector and island taken as a whole.

Table 50. Comparative cane yield indices adjusted to the 1911-1966 period

Class	*No. of seasons*	*Island*	*West*	*North*	*East*	*South*	*Centre*
Humid ...	7	103.1	100.5	110.3	104.5	98.0	100.0
Normal ...	23	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*
Dry	9	93.9	85.7	91.7	91.4	98.5	100.3
Cyclonic ...	17	81.2	86.2	84.8	80.7	81.6	73.0
Weighted Averages	*56*	*93.7*	*93.6*	*95.6*	*93.3*	*93.6*	*91.9*

Table 51. Differential behaviour of sugar sectors and island(M)

Vegetative seasons averaged over island(M)	*Cane production indices in descending order.*					
Humid	N(110.3)	E(104.5)	M(103.1)	W(100.5)	C(100.0)	S(98.0)
Dry	C(100.3)	S(98.5)	M(93.9)	N(91.7)	E(91.4)	W(85.7)
Cyclonic	W(86.2)	N(84.8)	S(81.6)	M(81.2)	E(80.7)	C(73.0)
Weighted Averages ...	N(95.6)	M(93.7)	S(93.6)	W(93.6)	E(93.3)	C(91.9)

It follows that the eastern sector is sufficiently representative of the various climates encountered over the island from the dry lowlands in the western and northern sectors to the super-humid region of the Central Plateau. This observation may lead to a considerable simplification of the pre-harvest scheme, for crop forecast in that the weighing of canes could be conducted after the cyclone season, from April to July, in micro-observation plots located in the eastern sector (Millers' plantations) only instead of over the whole island.

It would be useless to correlate the operative meteorological factors, whether moisture or wind, with cane pioduction, by taking into account data relevant to one year only. However, when statistical groupings are used over a number of years for the four classes of vegetative seasons, as in the present study, the results are bound to be more precise.

Finally, it is most probable that the cane production indices for the dry vegetative seasons are changing steadily, especially in the sub-humid western sector, through better use of irrigation, and elsewhere through the introduction of improved cane varieties showing better resistance towards moisture stresses.

3. EFFICIENCY OF WATER DISTRIBUTION BY SPRAY IRRIGATION

G. MAZERY

The object of this experiment was to compare the results obtained from a "Vermeer" boom working at different pressures, viz : 45, 55 and 75 lb. per square inch respectively, and to assess the merits of the instrument under each working condition.

Technique used

The boom was set in an open space and a number of rain gauges placed around it spaced 15′ × 15′ for the first two tests, and 15′ × 20′ for the third test. In each case there were enough gauges to cover the whole area sprayed. For technical reasons, the test had to be carried out on three different days, and the duration varied from 170 minutes for the first test to 140 minutes for the second, and 80 minutes for the third. At the end of each test, the volume of water collected in each rain-gauge was recorded.

Results

For the purpose of calculation, precipitation figures of less than 0.10 inches per hour have been discarded.

The "Uniformity Cœfficients" have been calculated according to Christiansen's formula in which an absolutely uniform distribution would correspond to a cœfficient of 100%, and less uniform distributions to lower percentages.

For determining the efficiency of water use, losses through direct evaporation and wind drift have been estimated at 0.12 inches per irrigation, and the water retention capacity of the soil in the root zone at 2.25 inches, all precipitations in excess of the total amount being considered as lost to the cane plant.

Table 52 gives the uniformity of water distribution at the different working pressures, the wetted area, as well as the average precipitation in each case, and the efficiency of water use for irrigation rounds of varying duration.

Table 52. Performance of the "Vermeer" sprinkler

(a) Output

	Working Pressure 45 *p.s.i.*	55 *p.s.i.*	70-75 *p.s.i.*
Water reaching the ground (cu.ft. per hour) ...	3842	3900	4100
Wetted area (sq. ft.) ...	80325	84600	85200
Av. diameter of wetted area (ft.)	320	328	330
Av. precipitation (in./hr.) ...	0.57	0.55	0.57
Uniformity cœfficient % ...	46	68	60

(b) Rate of water application

	Percentage Efficiency 45 *p.s.i.*	55 *p.s.i.*	70-75 *p.s.i.*
(a) Irrigation applied for 1 hr.	78	72	80
(b) ,, ,, 1½ ,,	80	80	86
(c) ,, ,, 2 hrs.	85	85	89
(d) ,, ,, 2½ ,,	84	87	89
(e) ,, ,, 3 ,,	81	88	84

It will be observed from the above that the highest "uniformity coefficient" has been obtained at a working pressure of 55 p.s.i., while the corresponding average precipitation has been the lowest. This is due to the fact that the increase in wetted area from 45 p.s.i. to 55 p.s.i. working pressure has not been accompanied by a corresponding increase in total precipitation.

On the other hand, the total precipitation having increased relatively more than the wetted area when passing from 55 p.s.i. to 70–75 p.s.i. working pressure, the average precipitation in this latter case has increased.

The wind speed during the tests could not be obtained with precision, but the nearest anemometer situated about seven miles away indicated wind speeds varying from 5 to 12 miles per hour during the tests.

Conclusions

(a) The low cœfficient of uniformity obtained at a working pressure of 45 p.s.i. rules out the possibility of working at this pressure on a commercial scale.

(b) The total precipitation, combined with the efficiency of water use when irrigating for periods of 3 hours, indicates no appreciable advantage for a working pressure of 70–75 p.s.i. over that of 55 p.s.i. For irrigation rounds of 2 to 2½ hours, i.e., for precipitations of 1.10 inches to 1.5 inches per round, an advantage of 9% would be obtained by working at 70–75 p.s.i. rather that at 55 p.s.i. as far as water applied is concerned. This advantage, however, would be off-set by the required increase in energy which would raise the total cost of water application by about 18%.

(c) In view of the above considerations, and of the fact that cœfficient of uniformity is highest at a working pressure of 55 p.s.i., it seems that the most advantageous pressures for operating the "Vermeer" boom, equipped with the nozzles installed during the tests, would be between 55 and 60 p.s.i.

4. PRELIMINARY NOTE ON THE CULTIVATION OF POTATOES IN CANE INTERLINES

GUY ROUILLARD

Growing of potatoes in cane interlines having recently been extended to large areas on sugar estates, it was found necessary to study the influence of this crop on sugar cane yields.

Experiments on the influence of different spacing systems on yield of cane and potatoes were conducted. Sugar cane plots will be weighed in 1967, but yields of potatoes have been determined for different spacing systems in 1966 and form the object of this study.

Potatoes have been cultivated in Mauritius for more than two centuries, but on a very limited scale. In spite of this fact, scientists have studied the crop since the early days of experimentation in Mauritius. At the end of the last century Bonâme, Director of the *Station Agronomique*, experimented on potatoes, and the first publication of the Department of Agriculture was devoted to the cultivation of the potato (*Leaflet series* No. 1, 1917).

After World War II it was possible to obtain certified seed, and the annual production has fluctuated around 4,000 tons, a figure which has more than doubled in 1966.

Potatoes are planted from April to September, summer rains being one of the limiting factors for the production of healthy crops. Storage facilities will have to be provided for a regular supply during the summer months.

Potatoes grow on all soils in Mauritius, except on the hydromorphic soils that are too compact to allow for good tuber formation.

The climate of the super-humid zone is not suitable for the cultivation of potatoes as frequent showers (except in October & November) offset the effects of fungicides applied to control blight.

Experimentation

Twelve trials were planted from April to August 1966 in the sub-humid, humid, and irrigated localities with the following varieties : King George 5, Up-to-Date 5, and Kennebec 2. Two of the trials planted with Up-to-Date had to be abandoned because of bacterial wilt, and the two planted with Kennebec failed as a result severe drought conditions. Yield results have thus been obtained on eight trials, five with King George and three with Up-to-Date.

Fertilization

The fertilizers employed per hole were the following :

Farmyard manure	...	600 grams
Sulphate of ammonia	...	12 ,,
Triple superphosphate	...	6 ,,
Sulphate of potash	...	6 ,,

Table 53. Fertilizers used, seed employed, and yields obtained per arpent of cane cultivated

	Holes per arpent	FYM tons	Sulphate of ammonia kg	Triple superphosphate kg	Sulphate of potassium kg	Seed employed tons	Potato yields tons
		Fertilizers employed per arpent					
a)	3,200	2	40	20	20	0.14	1.60
b)	4,265	3	60	30	30	0.20	2.55
c)	6,400	4	80	40	40	0.28	3.22
d)	8,350	6	120	60	60	0.40	5.14

Seed rate

Forty to fifty grams of seed previously treated with a fungicide (aretan or agalol at 1% concentration) were used per hole. The holes measured 8″ × 8″ and were 6″ deep.

Cultural operations and fungicides

Two earthing-ups were done during the growth period at 3 and 8 weeks after planting respectively.

Fungicides to control blight (Zineb or M 45 at 2 grs per litre) were applied every ten days.

Harvesting of potatoes was done between 85 to 96 days after planting.

Spacings adopted and results obtained

Four planting distances were tested :

a) 1 line of potatoes on every alternate cane interline
b) 2 lines ,, ,, ,,
c) 1 line of potatoes on every interline of cane
d) 2 lines ,, ,, ,,

The results show that there is a marked gain in production by planting double lines of potatoes on every cane interline. The effects on cane yields will be determined in 1967, but apparently the potato crop has had no adverse effect on the cane stand. In view of this fact, and of the possible return that may be derived from the potato crop, large scale plantations of this intercalary crop should be encouraged.

WEED CONTROL

C. MONGELARD

1. EVALUATION OF NEW HERBICIDES

IN the screening trial carried out in 1966 with the logarithmic spraying machine, three herbicides coded NPH/1232, U.C. 40.0 and U.C. 40.1 were compared to DCMU at dosage rates ranging from 5 lb a.i. to 1.6 lb a.i. per arpent. Each experimental plot consisted of four cane rows 45 ft. long and each treatment was replicated twice. The trial was conducted at Belle Rive Experimental Station in early June. The herbicides were applied before crop and weed emergence, and the plots were surveyed three months after application. Two methods were used to estimate weed infestation, (i) frequency abundance; (ii) percent weed coverage. The results are shown in Table 54.

Table 54. Weed Assessment

Treatments lb a.i. per arpent	*Frequency-abundance method Weed infestation % control*				*% Weed Cover (% weed cover in control = 97)*			
	5.0–3.8	*3.8–2.8*	*2.8–2.1*	*2.1–1.6*	*5.0–3.8*	*3.8–2.8*	*2.8–2.1*	*2.1–1.6*
DCMU	14.6	18.8	20.8	29.2	8	13	91	53
NPH/1232 ...	41.7	33.3	35.4	37.5	26	28	28	43
U.C. 40.0 ...	68.8	68.8	68.8	68.8	28	38	46	46
U.C. 40.1 ...	43.8	41.7	41.7	52.1	26	26	31	32

The two methods of weed assessment were complementary in that the frequency-abundance method gave a good estimate of all weed species occurring in the experimental plots, whereas the percent weed cover assessment gave adequate information of the infestation which can be visualised on looking at the recorded figures. The 97% weed coverage recorded in the control plots stresses the fact that weed infestation was very high and that DCMU, for instance, was very efficient in checking weed growth in the dosage range 5.0 — 3.8 a.i. per arpent. Fairly good results were obtained at lower concentrations, but at a rate lower than 2 lb a.i. poor control was obtained. The weed species present in the DCMU plots *Kyllinga polyphylla* and *Plantago lanceolata* are generally recognised to be resistant to this herbicide. These weeds were also not affected by the other herbicides tested; NPH/1232 was in addition not effective against the above mentioned weeds as well as against *Oxalis spp.* and *Cyperus spp.* The germination and growth of *Ageratum conyzoides* was only slightly checked by NPH/1232 at all concentrations used. The high percentage weed cover observed in the lowest concentration range was the result of a heavy infestation of *Hydrocotyle bonariensis*.

U.C. 40.1 showed poor control of *Kyllinga polyphylla*, *Ageratum conyzoides* and *Alternanthera sessilis*, and a high infestation of *Ageratum conyzoides* in all plots, except at the highest concentration range, was evident.

U.C. 40.0 was the least effective of the herbicides used in this trial. In addition to poor control of the weeds already listed, *Digitaria timorensis* was not affected by this herbicide at all concentrations.

2. EXPERIMENTS WITH HERBAN AND COTORAN

Three trials were laid down at Eau Bleue, Britannia and Etoile to compare the effectiveness of Herban and Cotoran with DCMU and Atrazine as pre-emergence weed-killers. Each trial was a randomised block with three replicates, and each plot consisted of 6 cane rows of 4 gaulettes. The herbicides were applied in pre-emergence of canes and weeds at the rate of 4.8 lb active ingredient + 1 lb a.e. of a 2,4-D ester in 60 gallons of water per arpent. Observations on cane germination and growth were made when the canes were two and three months old, and a weed survey was carried out three months after herbicide application.

Results

There was no deleterious effect on cane germination and cane growth with any of the four herbicides at the rate experimented with. The weed assessment (Table 55) was carried out using two methods : frequency-abundance, and percent weed coverage of individual species.

Table 55. Weed Assessment

	EAU BLEUE				*L'ETOILE*				*BRITANNIA*			
	D.C.M.U.	*Atrazine*	*Herban*	*Cotoran*	*D.C.M.U.*	*Atrazine*	*Herban*	*Cotoran*	*D.C.M.U.*	*Atrazine*	*Herban*	*Cotoran*
Mean % weed cover ...	34.0	37.5	65.5	61.8	28.2	37.4	31.0	15.2	29.6	27.9	69.0	39.6
Frequency abundance % control	14.7	19.7	23.2	17.3	16.0	15.7	16.3	12.3	25.7	20.7	36.3	52.7
Date sprayed	31.3.66				26.3.66				25.3.66			
Date surveyed	22.6.66				23.6.66				25.6.66			
Duration of treatment ...	83 days				89 days				92 days			

Dosage rates : All chemicals at 4.8 lb a.i./arpent

DCMU gave the best control at Eau Bleue in spite of a dense stand of *Colocasia antiquorum* which increased the percent weed coverage in the DCMU plots as compared with the Atrazine plots. Herban and Cotoran appeared to be less effective than Atrazine, but this was mainly due to the non-uniformity of infestation of all experimental plots by *Colocasia.*

The apparent superiority of Cotoran at Etoile is the result of a high infestation of *Cyperus rotundus* in the DCMU and Atrazine plots. The four herbicides gave equally good control of the weeds, apart from the fact that Herban was slightly less effective in the control of *Digitaria timorensis.*

At Britannia, both DCMU and Atrazine gave better overall results than Herban and Cotoran. In the Herban and Cotoran plots, there was a high infestation of *Ageratum conyzoides* whose growth was slightly checked by Cotoran, and apparently not at all by Herban.

3. THE URACIL COMPOUNDS

The herbicides H 732 – (5-chloro-3-tert-butyl-6-methyluracil) and H 767 were included in two trials at New Grove and La Flora to study their effect on cane germination and growth and assess their herbicidal properties.

Each trial was laid down in three randomised blocks with plot size 400 sq. feet, and eleven treatments were applied in pre-emergence of canes and weeds. The cane variety Ebène 74/56 was planted at New Grove and the variety M.99/48 at La Flora.

Two months after spraying, damage to the canes was estimated by allowing marks up to 10 for maximum damage. The estimates for the New Grove trial are given in Table 56.

Table 56. Estimates of herbicide effects on cane plants

Treatments (Rate active ingredient per arpent)	*Burning of leaf tips*	*Chlorosis*	*Curling of leaves*
DCMU — 4 lb	1.3	—	—
H732 — 1½ lb	2.0	1.3	1.0
H732 — 2 lb	2.3	1.7	1.3
H732 — 4 lb	8.0	6.7	5.3
H767 — 1½ lb	2.3	—	—
H767 — 2 lb	2.0	—	—
H767 — 4 lb	6.3	4.0	3.0
DCMU — 3 lb + H732 - 1 lb	2.3	1.3	—
DCMU — 3 lb + H732 - 2 lb	3.0	2.3	2.7
DCMU — 3 lb + H767 - 1 lb	2.7	1.0	—
DCMU — 3 lb + H767 - 2 lb	3.7	1.3	1.3

One month later, a weed survey, germination count and shoot height measurements were made to assess the efficacy of the different treatments on checking weed growth, and to determine more accurately the extent of the damage to the canes. The results are given in Table 57.

Conclusions

New Grove Trial. The new Uracil compounds H 732 (Sinbar) and H 767 proved highly efficient in controlling weed growth. Both herbicides showed such a high toxicity

Table 57. Effects of different herbicides on weeds and canes

NEW GROVE TRIAL	*DCMU 4 lb*	*Sinbar 1½ lb*	*Sinbar 2 lb*	*Sinbar 4 lb*	*H.767 — 1½ lb*	*H.767 — 2 lb*	*H.767 — 4 lb*	*DCMU 3 lb + Sinbar 1 lb*	*DCMU 3 lb + Sinbar 2 lb*	*DCMU 3 lb + H.767 1 lb*	*DCMU 3 lb + H.767 2 lb*	*CONTROL*	*Sig. diff. 5%*
Weed Survey													
(a) Frequency abundance % Control	29.2	20.2	19.8	6.9	26.1	21.9	8.6	20.8	11.5	17.7	11.5	100.0	
(b) Mean % Weed cover ...	18.0	10.8	18.6	1.9	19.9	11.9	6.2	14.1	4.1	11.5	5.3	94.0	
Germination counts	142	113*	121	84*	111*	101*	107*	112*	96*	121	113*	103*	25
Mean dewlap height (in cm) ...	23.5	20.3	20.7	15.9*	21.3	19.5*	18.5*	21.3	17.4	22.0	19.9*	23.2	3.2
LA FLORA TRIAL													
Germination counts	54*	54*	52*	39*	54*	52*	38*	41*	41*	43*	38*	71	8.58
Mean dewlap height (in cm) ...	19.3*	17.9*	17.7*	13.5*	18.8*	19.0*	14.1*	18.3*	18.0*	19.0*	15.5*	23.9	4.2

* Significant at 5% level

to sugar cane when applied at the rate of 4 lb a.i. per arpent that their use at rates higher than 1 lb a.i. is considered dangerous for general weed control. Compared to DCMU at 4.8 lb a.i. per arpent, which is the standard practice, both H 732 and H 767 at 1½ lb a.i. per arpent gave equally good results. Cane germination was adversely affected by weed competition in the control plots (94% weed coverage), and the highest germination rate was recorded in the DCMU treated plots. Compared to the latter, most treatments significantly affected germination, but cane growth was affected only in the plots with the higher dosage rates.

La Flora Trial. No weed survey was carried out at La Flora since weed growth was negligible in the control plots. Cane germination and cane growth were adversely affected by all treatments applied, and at the higher dosage rates, the new herbicides proved highly toxic.

The herbicidal properties of these chemicals will be assessed at rates ranging from ¾ to 1½ lb a.i. per arpent.

4. SPECIAL WEED PROBLEMS*

(*a*) *Paederia fœtida.* Excellent control of this weed in stone walls can be obtained by using Tordon 22K at rates recommended previously, viz. 2 lb a.e. per 60 gallons of water. When this herbicide was used in pre-emergence application in cane fields, deleterious effects on cane germination and growth were noted, and this precluded its use in cane fields at plantation.

Tordon 101 mixture containing 4-amino-3, 5,6-trichloropicolinic acid (5.7%) and 2,4-dichlorophenoxyacetic acid (21.2%) has been included in a trial at Ferney in comparison with three other brushkillers (mixed esters of 2,4-D and 2,4,5-T), to evaluate the effect of these herbicides on the control of *Paederia fœtida* in cane fields.

The trial consisted of a randomised block with three replicates, and was carried out in ratoon canes three months old. All experimental plots (1000 sq. ft. each) were heavily infested with *Paederia fœtida.* The herbicides were applied at 2 lb a.e. in 60 gallons of water per arpent rate. A higher rate of 4 lb a.e. of Tordon 101 per arpent was included in the treatments to determine whether or not any toxic effect on canes could be noted at this rate. Spraying was done on the clean interlines only, and observations were made 12 weeks after application.

Results

Treatments lb a.e./arp.		*% regrowth on sprayed interline*	*% regrowth on unsprayed interline*
Tordon 101	2 lb	0	3
Tordon 101	4 lb	0	1
Brushkiller 1	2 lb	20	20
Brushkiller 2	2 lb	12	25
Brushkiller 3	2 lb	11	20

Tordon 101 was more efficient not only in the control of the vine in the sprayed area, but gave excellent control of the weed in the unsprayed interline, indicating that translocation of the herbicide within the plant enhanced its activity.

No adverse effect on cane growth was apparent but further experiments are necessary to confirm this and also to determine the lowest rate at which Tordon should be applied to obtain optimum results.

(*b*) *Cyperus rotundus* and *Kyllinga monocephala.* As a result of an increasing infestation of *Cyperus spp.* and *Kyllinga spp.* in cane fields mainly in the south of the island, preliminary experiments have been carried out at Britannia S.E. A large number of herbicides and mixtures were tried, of which the most promising (DCMU + U_{46} Special) and (DCMU + Gramoxone) will be included in further trials this year.

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* Work done in collaboration with the Estate Agronomists, Messrs. A. Lagesse, A. Noël and A. Wiehe.

5. SHORT NOTE ON SPRAYING TECHNIQUE

G. Mc INTYRE

Herbicides are expensive chemicals, and great care in their application is essential in order to achieve economic results. The spraying technique used in Mauritius which consisted in trying to obtain complete surface coverage of the interline and half of the row of cane with the chemical while the operator walked in the middle of the interline was recently improved. The new technique consists in spraying only half the width of the interline and part of the row and in completing the spraying of the second half while the operator walks back in the same interline. Observations during spraying however revealed that though there was an improvement over the previous technique, insufficient surface coverage by the spray could result, and the unsprayed spots often become a source of early reinfestation which is highly undesirable. It was thought that by altering the position of the nozzles on the spraying lance a better surface coverage would be obtained, and experiments were initiated in an attempt to improve the spraying pattern.

The normal position of the nozzles on the spraying lance of the knapsack sprayer in use in cane fields is as shown in fig. 31(A). This position was altered by bending the handle-bar and turning the «inverted U» shaped nozzle holder through 90° to that shown in Fig. 31(B). The experiment consisted in comparing the spraying patterns obtained with the nozzles set in each of the two positions stated.

Materials and methods

The spraying ground consisted of white hardboard 10 ft. long and 5 ft. wide to simulate a cane interline (normally 5 ft. wide), and a solution of kiton red was used as spraying material to obtain a good contrast with the white surface of the board.

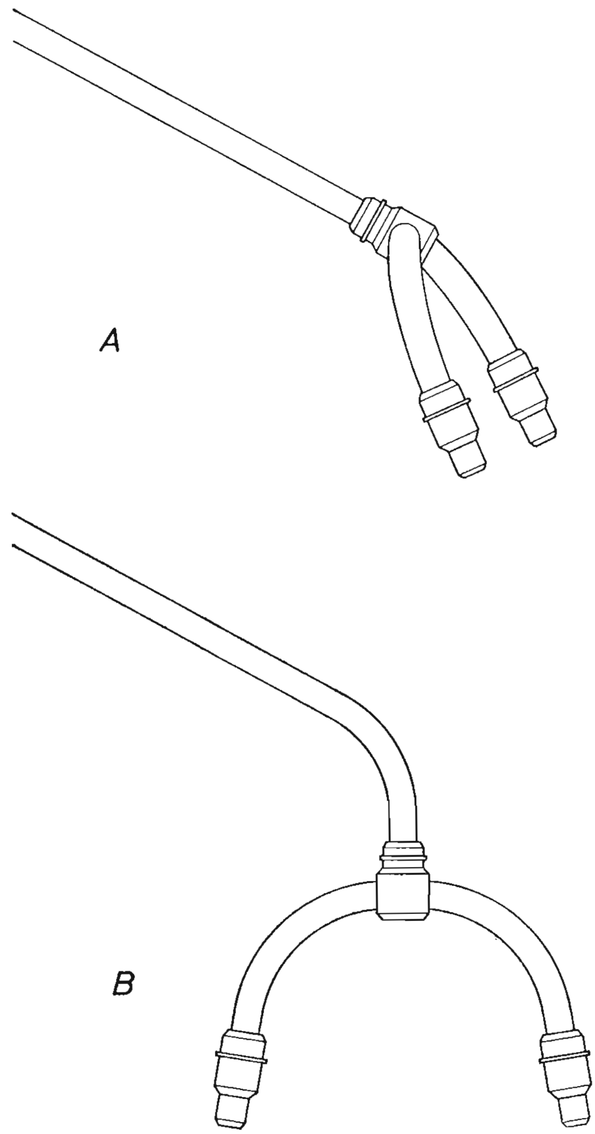

Fig. 31. A. Normal position of the nozzles on the handle-bar of the sprayer.

B. Adjusted position of the nozzles on the handle-bar of the sprayer.

The first trial was conducted with the nozzles in the normal position, while in the second trial the nozzles were in the adjusted position. Both trials were repeated three times and the mean time taken to complete the spraying was the same in both cases (four seconds).

Results

The surface of the board which was unsprayed after each spray was measured, including any part that was only slightly tinted red, the result of drift during spraying. The mean percentage of the surface that was left unsprayed with the nozzles in the normal position was found to be 16.7, and that with the nozzles in the adjusted position was only 1.5.

It is evident that a better application is obtained with the nozzles in the adjusted position. The gaps left unsprayed when the nozzles are in the normal position are often the cause of early re-infestation of weeds in the field, and it is expected that better and more persistent weed control would be obtained if the position of the nozzles on the spraying lance were altered in future to the so-called adjusted position.

Micro-organism developing profusely in mixed juice tanks at a sugar factory.
Top. Macrophotograph of lump showing fibrous texture. *Bottom.* Microphotograph of fibre showing hyphal strands and yeast-like budding of hyphal tips.

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1966

J. D. de R. de SAINT ANTOINE

A SYNOPSIS of the chemical control figures of the twenty-three factories of the island is given in Statistical Table XVIII, (i) to (v).

Cane and sugar production

Large rainfall deficits during most of the growing season, and cyclones *Denise* and *Kay*, which visited the island in January and March respectively, were the main causes of the large reduction of over one million tons of cane crushed in 1966 as compared to the 1965 figures, although a slightly larger acreage was harvested. Cane yield per arpent was almost 20 per cent below that of the previous year. As a result, in spite of a larger percentage of sucrose in the cane, total sugar production fell short of that of 1965 by over 100,000 tons. Table 58 gives the area harvested, cane crushed, and sugar produced during the past five years.

Table 58. Area harvested (thousand arpents), cane crushed, and sugar produced (thousand metric tons), 1962-66

	1962	*1963*	*1964*	*1965*	*1966*
Area harvested ...	193.8	194.1	195.4	194.1	195.7
Cane crushed	4624	5547	4375	5985	4843
Sugar produced ...	532.8	685.5	519.0	664.5	561.8

Cane quality

Sucrose content figures for the various sectors of the island for the period 1962-66 are given in Table 59, whereas fibre per cent cane and mixed juice Gravity Purity for the same period are shown in Table 60.

Table 59. Sucrose per cent cane, 1962-66

Year	*Island*	*West*	*North*	*East*	*South*	*Centre*
1962	13.19	13.61	13.73	12.85	12.85	13.26
1963	13.47	14.26	13.97	12.91	13.18	13.79
1964	13.45	13.75	14.35	13.14	13.02	12.97
1965	12.50	13.06	12.28	12.39	12.40	12.96
Av. 1962-65	*13.15*	*13.67*	*13.58*	*12.82*	*12.86*	*13.25*
1966	13.20	13.68	13.53	13.01	13.10	12.84

Table 60. Fibre per cent cane and mixed juice Gravity Purity, 1962-66

Year	*Fibre % cane*	*Mixed Juice Gravity Purity*
1962 ...	13.85	85.9
1963 ...	13.11	86.3
1964 ...	13.85	86.4
1965 ...	12.92	88.0
1966 ...	13.46	87.7

Sucrose per cent cane averaged 13.20 for the crop. As pointed out in the introduction to this report, this figure is disappointing and below what might have been expected since climatic conditions were generally favourable to maturity. It will be observed from Table 59 that last crop sucrose per cent cane for the northern sector of the island showed a slight decrease as compared to the average figure for 1962-65, probably as a result of the severe drought which prevailed in the drier parts of this sector. The decrease was much more marked for the central sector which is the one that suffered most heavily from cyclones *Denise* and *Kay*.

Fibre per cent cane averaged 13.46 in 1966, a figure which is not abnormal for a cyclonic and dry year. Juice purity was good, being slightly lower than the figure for 1965. It should be remembered that refractometric Brix has been adopted in all the sugar factories since 1965 and that, therefore, purity figures for 1965 and 1966 cannot be compared with those for previous years when densimetric Brix was used.

Milling

Crushing data and milling figures for the period 1962-66 are given in Table 61.

Table 61. Milling results, 1962-66

	1962	*1963*	*1964*	*1965*	*1966*
No. of crushing days	116	123	100	128	111
No. of net crushing hours/day	19.08	20.82	19.96	20.28	19.57
Hours of stoppages/day*	1.03	0.88	0.83	0.72	0.62
Factory running efficiency	94.9	95.9	96.0	96.6	96.9
Tons cane/hour	91.0	97.8	95.4	100.6	97.3
Tons fibre/hour	12.60	12.82	13.21	13.00	13.10
Imbibition % fibre	222	221	228	220	230
Pol. % bagasse	2.18	2.08	2.03	1.93	2.05
Moisture % bagasse	47.1	48.4	48.5	48.9	48.7
Reduced mill extraction	95.8	96.0	96.2	96.0	96.1
Extraction ratio	33.9	31.7	31.0	31.7	31.9

* Exclusion of stoppages due to shortage of cane

With the reduced tonnage of cane harvested, average number of crushing days per factory amounted to 111 as against 128 in 1965. The operation of several factories located in the northern sector of the island was handicapped by a severe shortage of water resulting from the prolonged drought. Large tonnages of cane had thus to be directed from certain factories to others, particularly from The Mount to Saint Antoine.

Average tonnage of cane crushed per hour was slightly lower than during the previous year, yet the tonnage of fibre ground per hour was larger as a result of the higher fibre content of cane last crop. Milling work was generally good, comparing favourably with that of previous years. Best results were obtained at Beau Champ where a reduced mill extraction of 96.9 and an extraction ratio of 25.0 were recorded.

The only factory where major alterations were brought to the milling plant is Médine where the 5-mill tandem of three 34 × 66 and two 35 × 72 inch mills was modified and enlarged into a six mill tandem made up of the following units : two 35 × 71, two 34 × 66 and two 35 × 72 inch mills; in addition, tall vertical chutes were fitted to the first three units. As a result, reduced mill extraction was much improved, averaging 96.3 for the crop, whilst the load on the mills, as determined by the specific feed rate was much reduced, dropping from 79.8 in 1965 to 61.1 in 1966.

Specific feed rates for all the factories are given in Table 62. It will be observed from this table that dilution ratios vary sometimes considerably from one factory to another. But since the ratio is influenced by the number of imbibition steps, only figures for tandems with the same number of mills should be compared. If this is done for the 15-roller mills of Table 62, it will be seen that the ratio varies within wide limits from 67 to 82. Hence, in many cases it would be profitable to pay more attention to the other factors that may influence its magnitude, particularly the first mill extraction and

Table 62. Comparative milling results, 1966 crop

Factory	*Set of knives*	*Shredder*	*No. of rolls*	*Specific feed rate*	*Imbibition % fibre*	*Dilution ratio*	*Extraction ratio*	*Reduced Mill extraction*
Belle Vue ...	1 x 34	—	12	67.3	271	73	30.8	96.2
FUEL ...	1 x 60 1 x 80	—	21	64.8	208	77	30.2	96.2
St. Antoine ...	1 x 36 1 x 44	—	15	61.4	221	67	38.9	95.3
Médine ...	2 x 36	1	18	61.1	214	77	30.0	96.3
Mon Désert ...	1 x 48 1 x 96	—	15	60.8	181	71	31.8	96.0
Mon Loisir ...	2 x 35	1	15	58.8	260	71	32.5	96.0
St. Félix ...	1 x 12 1 x 32	1	12	58.4	282	69	29.3	96.4
Savannah ...	1 x 28 1 x 48 1 x 92	—	12	58.0	233	68	36.4	95.5
Bel Ombre ...	1 x 16	1	12	56.6	303	72	33.4	95.9
Constance ...	1 x 24 1 x 32	1	15	56.4	217	69	29.8	96.4
Riche en Eau ...	1 x 54 1 x100	—	15	56.3	251	80	27.1	96.7
Beau Champ ...	1 x 42 1 x 72	—	15	55.1	228	77	25.0	96.9
Ferney ...	1 x 64 1 x 84	—	12	54.3	244	70	35.3	95.7
Rose Belle ...	1 x 24 1 x 42	—	12	54.2	244	69	34.6	95.7
Réunion ...	1 x 36	1	15	53.8	233	71	34.9	95.7
Solitude ...	1 x 40 1 x 60	—	14	52.3	198	73	33.8	95.8
Bénarès ...	1 x 44 1 x 62	—	14	45.7	188	55	39.5	95.1
Mon Trésor ...	1 x 40 1 x 92	—	12	45.1	238	67	38.7	95.2
Beau Plan ...	1 x 42 1 x 54	—	14	43.4	219	74	28.4	96.5
Britannia ...	1 x 30 1 x 60	—	14	41.6	221	66	38.9	95.2
The Mount ...	1 x 36 1 x 88	—	15	37.9	238	74	27.1	96.7
Union St. Aubin	1 x 28 1 x 32	—	15	35.6	263	74	31.2	96.1
Highlands ...	1 x 32 1 x 64	—	15	33.8	239	82	26.1	96.7

the extent to which imbibition liquid and residual juice mix at the various mills. Another important factor is, of course, the amount of imbibition water applied, but generally there is not much that can be done about this.

Clarification and filtration

Mixed juice purity was high in 1966 (87.7 as against 88.0 in 1965) and no clarification difficulties were encountered. Clarification efficiency in a number of factories was improved by adopting either hot liming or liming at the boiling temperature. But as this aspect of processing is discussed by the author in his article entitled *The filterability of Mauritius raws in 1966* which is published later in this report, it will not be dealt with here.

There is nothing of particular interest to mention regarding filtration, except that the amount of cake produced was larger than for the previous year, as shown in Table 63. This is doubtless mainly due to the use of more lime and to the adoption of hot or of boiling juice liming.

Table 63. Filtration results, 1962-66

	1962	*1963*	*1964*	*1965*	*1966*
Pol % cake	2.38	2.28	1.98	2.13	1.80
Cake % cane	3.2	3.1	3.4	2.9	3.4
Pol in cake % cane	0.08	0.07	0.07	0.06	0.06

Boiling house work

With the object of producing better filtering raws, a certain number of changes were brought to the boiling house work of all the factories, as described in the above-mentioned article on raw sugar filterability. These changes may be briefly summarized as follows :

(a) Remelting the C-sugar.

(b) Remelting part of the B-sugar in a number of factories, and bagging only the difference. At Mon Désert-Alma, the B-sugar was used as footing for the A-strikes, only that left over being remelted.

(c) Producing less B-sugar, independently of remelting, by modifying slightly the boiling process, e.g. by using part of the A-molasses for building the C-massecuite whilst feeding all or almost all the syrup to the A-massecuite only.

(d) Producing fine grain sugar.

Boiling house figures for the past five years are given in Table 64.

Table 64. Syrup, massecuites and molasses, 1962-66

	1962	*1963*	*1964*	*1965*	*1966*
Syrup gravity purity	86.5	86.6	87.0	88.0	88.0
A-mcte app. purity	82.2	83.0	82.8	84.9	86.0
Purity drop : A-mcte	20.3	20.3	20.7	20.3	18.4
B-mcte	21.2	22.2	20.7	21.0	20.0
C-mcte	22.9	24.3	23.6	25.1	25.2
Crystal % Bx in C-mcte	34.6	35.9	35.5	38.6	39.3
Magma purity	82.4	82.8	83.4	86.7	87.0
Final molasses : Gravity Purity	36.2	35.6	36.1	38.3	39.1
Red. sugar % Bx	13.8	15.0	12.8	15.5	14.9
Total sugars % Bx	50.1	50.4	48.9	53.8	54.0
Wt % cane @ 85° Bx ...	2.98	3.04	2.85	2.64	2.88

A comparative study of these figures for the years 1965 and 1966, when refractometer Brix values were used, leads to the following remarks :

(a) A-massecuite purity was higher in 1966 than during the previous crop, with consequently less boiling back of molasses. It will further be observed from Statistical Table XVIII (iv) that in only three factories did A-massecuite purities drop below 85; in two of these cases, average values of 81.9 and 78.6 were registered, values which are far too low and which do not reflect sound boiling house work.

(b) Purity drops of the high grade strikes were smaller in 1966, particularly for the A-massecuites. This may be attributed to the higher purity of these massecuites and to the adoption of remelting processes in a number of factories.

(c) Final molasses gravity purity in 1966 exceeded the 1965 figure by 0.8. In addition, molasses production was also higher so that the amount of sucrose lost in the product was the highest for the period 1962-66, as shown in Table 65.

Table 65. Losses and recoveries, 1962-66

	1962	*1963*	*1964*	*1965*	*1966*
Sucrose lost in final mol. % cane	0.92	0.89	0.91	0.86	0.95
Undetermined losses % cane	0.21	0.18	0.18	0.12	0.15
Industrial losses % cane	1.21	1.14	1.15	1.04	1.16
Boiling house recovery	90.4	91.2	91.0	91.4	90.8
Reduced boiling house recovery	89.9	90.2	90.0	88.8	88.4

An explanation for these higher losses in 1966 has been sought, and it would appear that they may be attributed to the drought conditions which prevailed during the year.

Thus if figures for the factories most affected by the drought, namely St. Antoine, Mon Loisir, Constance, Belle Vue, Solitude, Beau Plan and The Mount (Group A) are averaged and compared to those for the remaining factories (Group B), the following results are obtained :

Table 66. Influence of drought on final molasses quality and production

	1965		*1966*		*Increase in*	
	Clerget Purity	*Molasses % cane*	*Clerget Purity*	*Molasses % cane*	*Clerget Purity*	*Wt. of Molasses %*
Group A ...	37.2	2.78	38.6	3.30	1.4	0.52
Group B ...	38.6	2.58	39.3	2.72	0.7	0.14

As may be observed from Table 66, the increase in purity from 1965 to 1966 was twice as high for Group A than for Group B, whilst the increase in molasses production was almost four times as high.

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2. INDUSTRIAL APPLICATION OF ENZYMATIC REMOVAL OF STARCH FROM JUICE

E. C. VIGNES & S. MARIE-JEANNE

It is now well established that starch is one of the major impurities responsible for poor filtering sugars (ALLEN, 1966; ANON, 1966; BUCHANAN, 1959; DOUWES DEKKER, 1964; KING, 1966; YAMANE *et al*, 1965). Not surprisingly, Tate & Lyle specifications for raw sugars do not include filterability but starch content, and this underlines the importance refiners attach to starch (ALEXANDER, 1966).

As far as Mauritius sugars are concerned, a close relationship has been found between filterability (CSR) and starch content of raws (VIGNES, 1961). Fortunately it is easy to remove starch, and therefore eliminate its detrimental effect on filterability by the process of enzymatic action in the juice. This process has been in operation in South Africa for several years with satisfactory results, and its use in all sugar factories there has been advocated (DOUWES DEKKER, 1964). In Australia, following the adoption of the enzymatic process, starch is no longer regarded as a major filter-impeding impurity (KING, 1966). The Australian practice is to heat unlimed juice to 70-80°C and store it for 20 minutes when, it is claimed, 70 per cent reduction in the starch content is obtained (KING, 1966).

In this country, preliminary investigations carried out (VIGNES & ST. ANTOINE, 1965) both in the lab and on an industrial scale have shown that :

(i) the percentage of starch eliminated is of the order of 50 per cent after 12 minutes storage;

(ii) loss of sucrose by inversion is negligible provided the conditions under which the process is employed are carefully controlled.

The process is moreover simple and does not require expensive equipment. In view of the encouraging results obtained in 1965, a number of factories decided to adopt the process during the 1966 crop. In this survey, industrial results obtained are presented and discussed.

Two of the factories in which the enzymatic removal of starch was adopted are Britannia and Rose Belle. Both averaged low filterabilities and high starch content in 1965 as shown in Table 67.

Table 67. Average filterability and starch content of raw sugar for 1965

Factory	*Filterability*	*Starch p.p.m.*
Britannia ...	19.2	420
Rose Belle ...	26.1	370

With a view to improving the filtering quality of Britannia sugars, the recommendation that, during 1966, priority should be given to the enzymatic removal of starch from raw juice was implemented as from 29.8.1966 and continued for 6 weeks, in the first instance. The procedure employed was the following : mixed juice was heated, stored for 8 minutes at an average temperature of 74°C, and then limed at the outlet of the storage tank. The limed juice was then heated to c.105°C and sent to the clarifier. pH of the clarified juice was maintained at about 7.5.

Table 68. Effect of juice storage on filterability and starch content of sugar

Week ending	*Enzymatic process*	*Raw sugar filterability*	*Starch in raw sugar, p.p.m.*
16/ 7/66	—	33.2	320
23/ 7/66	—	30.1	385
30/ 7/66	—	29.9	—
6/ 8/66	—	29.0	502
13/ 8/66	—	27.7	515
20/ 8/66	—	24.3	—
27/ 8/66	—	27.7	355
3/ 9/66	+	39.5	134
10/ 9/66	+	49.3	170
17/ 9/66	+	56.7	115
24/ 9/66	+	54.0	110
1/10/66	+	55.5	94
8/10/66	+	50.0	174
15/10/66	—	44.6	260
22/10/66	—	51.2	204
29/10/66	+	52.1	164
5/11/66	+	45.6	157
12/11/66	+	47.3	102
19/11/66	+	54.2	79
26/11/66	+	54.6	102
3/12/66	+	44.6	106

It will be observed from Table 68 that, for the period preceding the enzymatic process, average filterability was only 28.8, and average starch content 415 p.p.m., a figure comparable to that obtained in 1965 (Table 67). Eliminating starch has an immediate effect on filterability.

At the end of only one week a gain of 11.8 points is noticed due, no doubt, to starch which has decreased from 355 to 134 ppm. There is a more or less steady improvement in quality in the course of the following weeks. During that time, starch in the commercial sugar is kept well below the 200 p.p.m. level which has been found in practice to be the maximum compatible with good refinery behaviour.

At the end of the 13th week of crushing it was decided to stop the enzymatic process for a while, by by-passing the storage tank, in order to determine what effect, if any, this step would have on the filterability. The result was an immediate drop from 50.0 to 44.6 and a corresponding increase in starch from 174 to 260 ppm. At about this time in the campaign until the end, probably due to climatic conditions, starch in the juice entering the factory was low, and therefore despite the suspension of the enzymatic process, average filterability rose to 51.2 for the week ending 22.10.66. Significantly starch was down to 204 p.p.m., that is lower than the previous week.

During the last six weeks of the season the enzymatic process was again put in operation. As noticed previously, these was a gradual improvement in the filtering property of the sugar associated with low starch content, except for two weeks when there was a sudden change in the quality of the juice when only the variety B.3337 and young virgin cane were being milled. The last figures of Table 68 were obtained on liquidation.

Fig 32 illustrates clearly the close correlation existing between filterability of Britannia raws and their starch content. A statistical analysis of the results shown in the table gave a correlation coefficient of 0.88 for 19 pairs between filterability and starch. This is significant at 0.1% level.

As well as assessing the quality of raw sugar in relation to starch content, careful analysis of mixed and treated juices was carried out to determine whether keeping heated mixed juice for 8 minutes caused appreciable

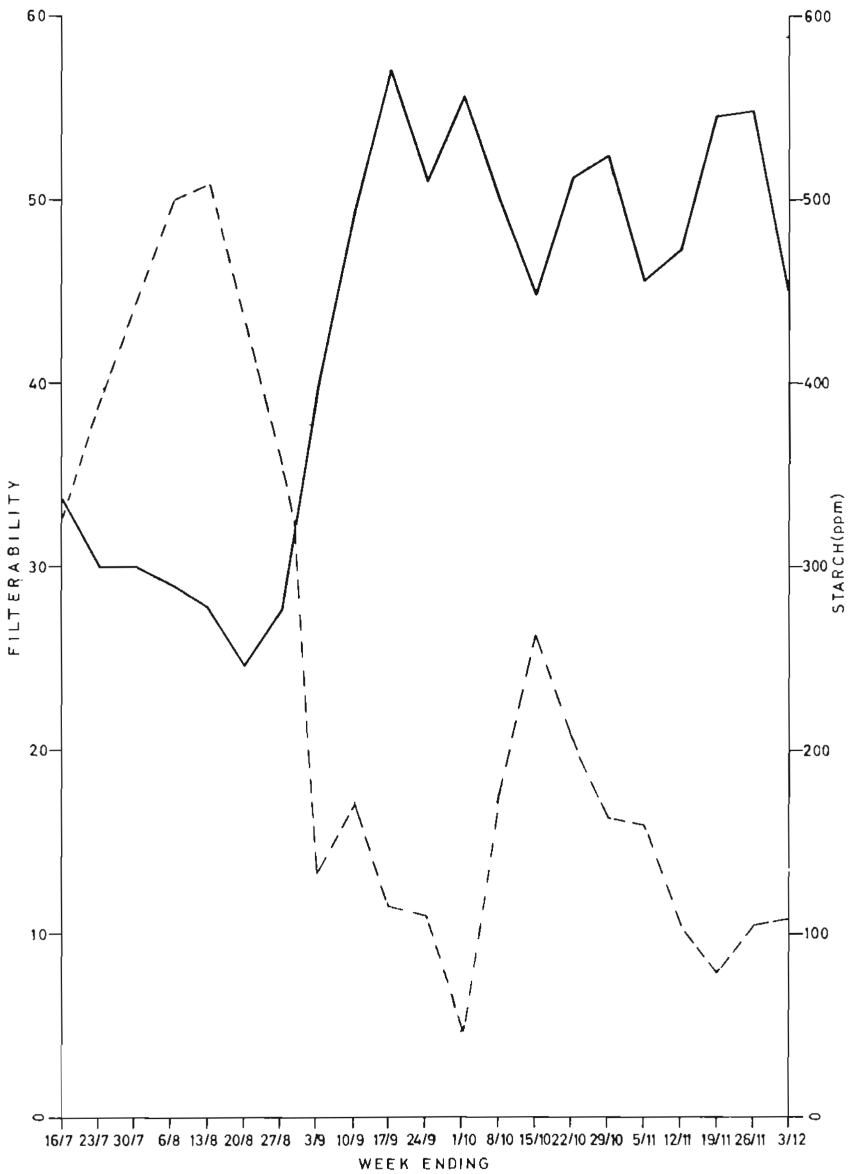

Fig. 32. Filterability and starch content of raw sugar, Britannia, 1966 crop.

loss of sucrose by inversion. For this purpose, the juice before and after treatment was analysed for sucrose and reducing sugars, sampling being continuous for 1¼ hours. Glucose ratio was also calculated. It is clear from Table 69 that loss of sucrose is no greater than noticed in the course of preliminary industrial experiments performed in 1965.

Table 69. Effect of storage on reducing sugars and glucose ratio in mixed juice

Week ending	*Temperature of juice °C*	*Mixed Juice*		*Treated Juice*	
		Reducing sugars	*Glucose ratio*	*Reducing sugars*	*Glucose ratio*
17/9/66	67	0.42	3.55	0.42	3.62
23/9/66	73	0.35	2.65	0.36	2.78
30/9/66	78	0.35	2.95	0.39	3.12

The mixed and treated juices were also analysed for starch to ascertain the effectiveness of the enzymatic action at different temperatures. Judging from Table 70, it would appear that a temperature close to 73°C should be aimed at for best results when employing enzymatic starch removal (NICHOLSON & HORSELEY 1958; BOYES, 1964). Keeping the heated mixed juice for 8 minutes at temperatures varying from 67°C to 81°C caused 52 per cent of the starch to be destroyed on an average.

Table 70. Effect of juice storage temperature on starch elimination

Date	*Storage temperature* °C	*Starch in mixed juice* p.p.m.	*Starch in treated juice* p.p.m.	*% Starch reduction*
17/9/66	67	141	89	37
20/9/66	76	129	48	63
21/9/66	73	128	39	69
22/9/66	72	120	42	65
23/9/66	72	138	59	57
26/9/66	72	117	58	50
27/9/66	81	131	86	34
28/9/66	80	137	72	47
29/9/66	78	118	68	42
30/9/66	79	109	51	53
Average	75	127	61	52

Results showing magma purity, filterability and starch content of raw sugar for the 1966 crushing season at Rose Belle are assembled in Table 71. Sugar for the first week has an average filterability of 29.5, a figure somewhat low, but to be expected in the early days of the season because of the influence of C-massecuite left over from the previous crop entering the manufacturing process. However, the rise in filterability during the following week calls for an explanation; it is probably due to the fact that a build-up of viscosity due to heavy molasses recycling resulting from the low magma purity had not yet taken place. By the end of the third week, however, filterability drops to 20.0 and remains low for several weeks as a result of poor clarification, heavy molasses recycling and high starch content of the sugar.

Table 71. Average weekly magma purity, filterability and starch in Rose Belle raw sugar.

Week ending	*Enzymatic process*	*Magma purity*	*Raw sugar filterability*	*Starch in raw sugar* p.p.m.
16/ 7/66	—	86.1	29.5	—
23/ 7/66	—	77.7	33.7	—
30/ 7/66	—	77.1	20.0	—
6/ 8/66	—	—	21.1	—
13/ 8/66	—	—	26.0	—
20/ 8/66	—	—	23.7	—
27/ 8/66	—	—	24.0	189
3/ 9/66	—	—	27.0	—
10/ 9/66	+	78.5	33.7	—
17/ 9/66	+	71.8	29.8	—
24/ 9/66	+	75.6	31.0	124
1/10/66	+	79.8	38.0	124
8/10/66	+	86.6	48.0	85
15/10/66	+	89.2	46.7	93
22/10/66	—	88.0	48.1	144
29/10/66	—	85.2	41.3	150
5/11/66	—	85.9	38.3	226
12/11/66	+	85.2	42.2	187
19/11/66	+	85.6	50.4	150
26/11/66	+	—	50.4	—

On 5.9.66 enzymatic removal of starch was put into operation, the factory simultaneously switching from cold liming to liming at the flash tank. The heated unlimed juice at 70-73°C was stored in a tank provided with three outlets, each outlet at a different level so as to enable the storage time to be varied as required. Thus it was possible to obtain storage times of 8, 12 and 14 minutes respectively.

It will be observed from Table 71 that although filterability improved somewhat following the adoption of the enzymatic process and new liming procedure, yet a marked improvement was only achieved when the magma purity was raised above 85, and molasses recycling thus curtailed to a large extent.

When the enzymatic process was stopped, during the weeks ending 22.10.66, 29.10.66 and 5.11.66, filterability gradually declined despite the fact that liming at the flash tank was still taking place whilst the starch in raw sugar gradually increased. The position was reversed as the enzymatic process was renewed towards the end of the season.

Fig. 33, based on the results of Table 71, shows the definite relationship between filterability and starch in raw sugar at Rose Belle.

As in the case of Britannia, the unlimed mixed juice before and after storage was analysed, the analyses being carried out on daily composite samples obtained in the following manner. From each continuous 1¼ hour sample coming into the lab, a portion (100 ml.) was taken and composited. At the end of the day's crushing sucrose, reducing sugars, and starch were determined. The results obtained are given in Table 72.

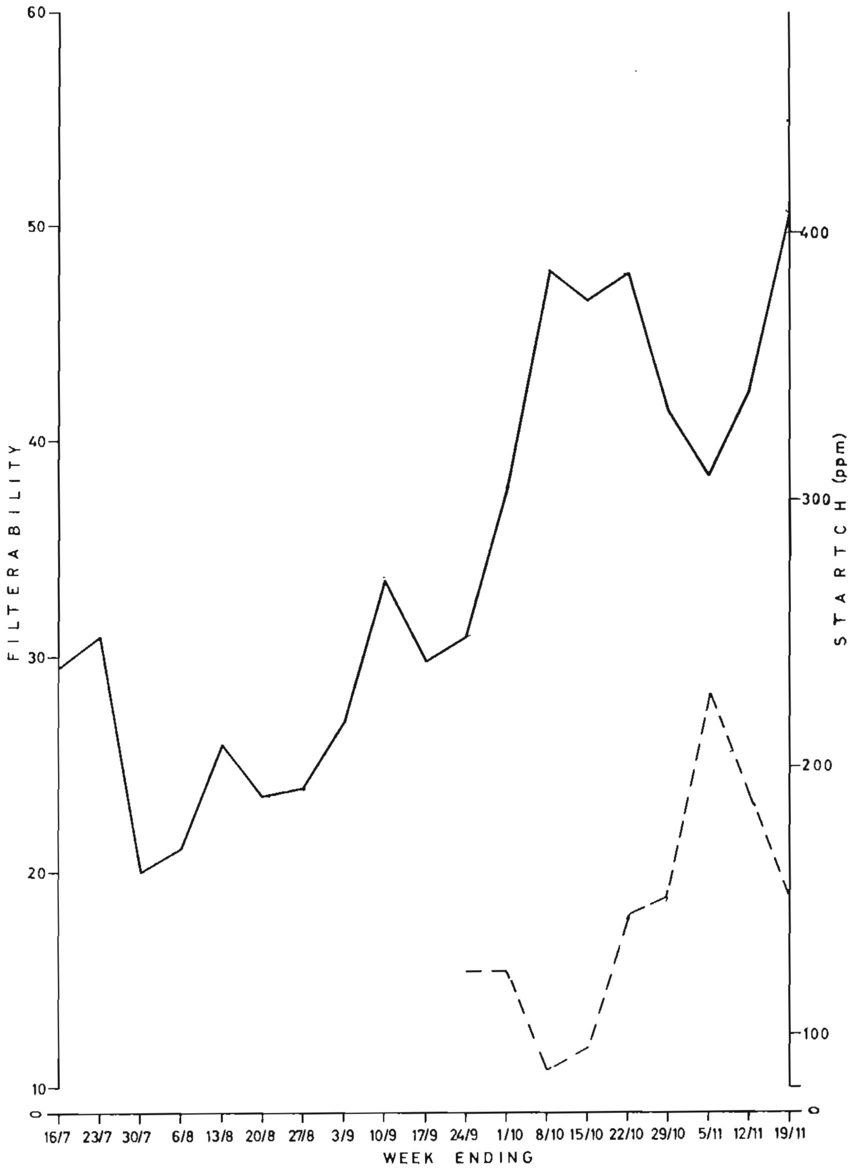

Fig. 33. Filterability and starch content of raw sugar, Rose Belle, 1966 crop.

Table 72. Effect of enzymatic process on reducing sugars, glucose ratio and starch in juice

Week ending	*Storage temperature °C*	*Storage time (mins)*	*Mixed juice* Reducing sugars	*Mixed juice* Glucose ratio	*Mixed juice* Starch p.p.m.	*Treated juice* Reducing sugars	*Treated juice* Glucose ratio	*Treated juice* Starch p.p.m.	*% Starch reduction*
10/ 9/66	71	12	0.26	2.2	109	0.28	2.3	34	70
17/ 9/66	73	12	0.29	2.3	111	0.29	2.3	13	89
Average	*72*	*12*	*0.28*	*2.3*	*110*	*0.29*	*2.3*	*24*	*80*
24/ 9/66	70	14	0.29	2.3	109	0.30	2.4	20	83
1/10/66	72	14	0.31	2.5	158	0.30	2.4	19	87
Average	*71*	*14*	*0.30*	*2.4*	*134*	*0.30*	*2.4*	*20*	*85*
8/10/66	70	8	0.33	2.7	111	0.32	2.6	21	81
15/10/66	70	8	0.30	2.6	123	0.30	2.5	30	75
Average	*70*	*8*	*0.32*	*2.7*	*117*	*0.31*	*2.6*	*26*	*78*

Particularly evident is the substantial destruction of starch. Raw juice kept for 8 minutes lost 78 per cent of its starch. Per cent elimination increased to 80 after 12 minutes and to 85 after 14 minutes. At the same time loss of sucrose by inversion is practically negligible. The same conclusion was arrived at after preliminary investigations in 1965, and is thus confirmed.

Mon Désert - Alma also adopted the enzymatic process of starch removal from juice together with liming at the flash tank throughout the 1966 season except for 5 weeks, as indicated in Table 73.

Table 73. Effect of clarification process on filterability and starch in raw sugar

Week ending	*Enzymatic process*	*Storage time*	*Storage temp. (°C)*	*Liming procedure*	*Raw sugar filterability*	*Starch in raw sugar p.p.m.*
23/ 7/66	—	—	—	Mixing tank	19.8	—
30/ 7/66	+	18	60-70	Flash tank	27.0	163
6/ 8/66	—	—	—	Mixing tank	20.5	224
13/ 8/66	+	18	60-70	Flash tank	24.4	226
20/ 8/66	+	12	60-70	,, ,,	29.3	172
27/ 8/66	—	—	—	Mixing tank	17.0	253
3/ 9/66	—	—	—	,, ,,	13.3	293
10/ 9/66	+	12	70-80	Flash tank	21.7	242
17/ 9/66	+	,,	,,	,, ,,	33.7	153
24/ 9/66	+	,,	,,	,, ,,	38.5	127
1/10/66	+	,,	,,	,, ,,	39.9	173
8/10/66	+	,,	,,	,, ,,	48.3	136
15/10/66	+	,,	,,	,, ,,	44.1	138
22/10/66	+	,,	,,	,, ,,	49.6	115
29/10/66	+	,,	,,	,, ,,	51.9	112
5/11/66	—	—	—	Mixing tank	32.5	157
12/11/66	+	12	70-80	Flash tank	36.5	128

The unlimed heated juice passed through three tanks in series staying for 6 minutes in each tank. All three tanks were in use during the second and fourth weeks of crushing, liming being effected in the mixing tank for the first and third weeks.

As from 15.8.66 one of the storage tanks was put out of circuit; and until the end of the crop storage time was reduced to 12 minutes.

During the early weeks of the season steam shortage limited the temperature of the juice in the storage tank to 60-70°C, which is below the optimum temperature for suitable enzymatic action. This probably accounts for the low efficiency achieved in starch removal during this period.

The enzymatic/flash tank liming process was then discontinued for two weeks. As a result, the filterability fell to 17.0 and 13.3 as an unfortunate sequel of the starch content rising to 253 and 299 p.p.m. respectively.

Following the possibility of storing the juice at 70-80°C for 12 minutes, which occurred during the week ending 10.9.66, there was a gradual improvement in raw sugar filterability. It should be pointed out that the average figures for this first week leave much to be desired. They are due to the recycling of molasses of the previous week and to the level of the muds in the clarifier rising when liming at the flash tank, compelling the Process Superintendent to revert to liming in the mixing tank for much of the week. Such practice had on occasions to be followed in the course of the succeeding weeks, but not as often nor as long as happened during the week ended 10.9.66.

When the average weekly filterability reached 51.9, liming at the flash tank was stopped. As expected the filterability dropped to 32.5, the daily filterability even reaching 23.5 on the last day of the process, and then rose to only 36.5 for the last week of the season, when liming at the flash tank was again resorted to. But it should be pointed out that liquidation sugars are included in those produced during this last week.

The steady improvement in Mon Désert sugars throughout 1966 following the adoption of the enzymatic process of starch removal and flash tank liming process is clearly shown in fig. 34 which follows the same pattern noticed in the case of Britannia and Rose Belle.

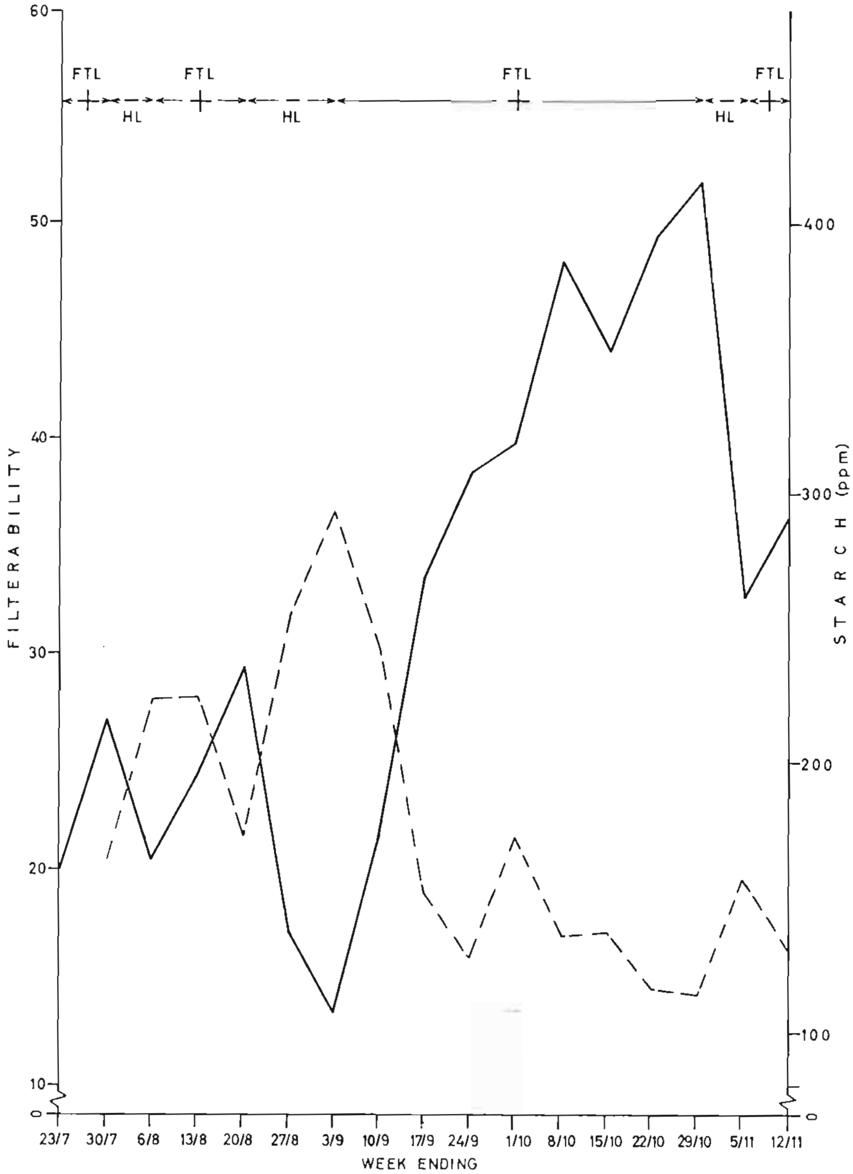

Fig. 34. Filterability and starch content of raw sugar, Mon Désert-Alma, 1966 crop.
HL = hot liming
FTL = liming at flask tank
\+ = enzymatic process in operation
— = no enzymatic process

Ferney is a factory producing defecation raw sugar only during part of the season. The enzymatic process of starch removal from juice was adopted right from the start of raw sugar production and continued until the crop ended. Comparisons can therefore only be made between 1966 raws and those manufactured the previous year.

Table 74. Comparison between 1965 and 1966 sugars at Ferney S.E.

Week ending	*Filterability*	*Week ending*	*Filterability*
23/10/65	36.0	22/10/66	45.3
6/11/65	31.1	29/10/66	42.5
13/11/65	34.0	5/11/66	43.6
27/11/65	30.3	12/11/66	51.8
4/12/65	38.7	19/11/66	52.3
11/12/65	32.8	26/11/66	46.0
		3/12/66	45.8
Average	*33.8*	*Average*	*46.8*

Table 75. Average starch in Ferney raw sugar

Year		*Starch, p.p.m.*
1965	...	213
1966	...	138

It is clear from Table 74 that in 1966 there was a marked improvement in filterability over 1965. How far is this due to the enzymatic process can only be a matter for conjecture. What is obvious is the sharp drop in starch in the average 1966 raws compared to those of 1965. (Table 75). This reduction in starch naturally follows the elimination of 33 per cent starch from the mixed juice by storing it for 6 minutes at 70-72°C, as shown in Table 76.

Table 76. Elimination of starch by enzymatic action

Date	*Starch content p.p.m.* *mixed juice*	*treated juice*	*% reduction in starch*	*Storage temp. °C*
15/10/66	142	99	30	70
24/10/66	132	84	36	72
25/10/66	109	72	34	72
Average			*33*	

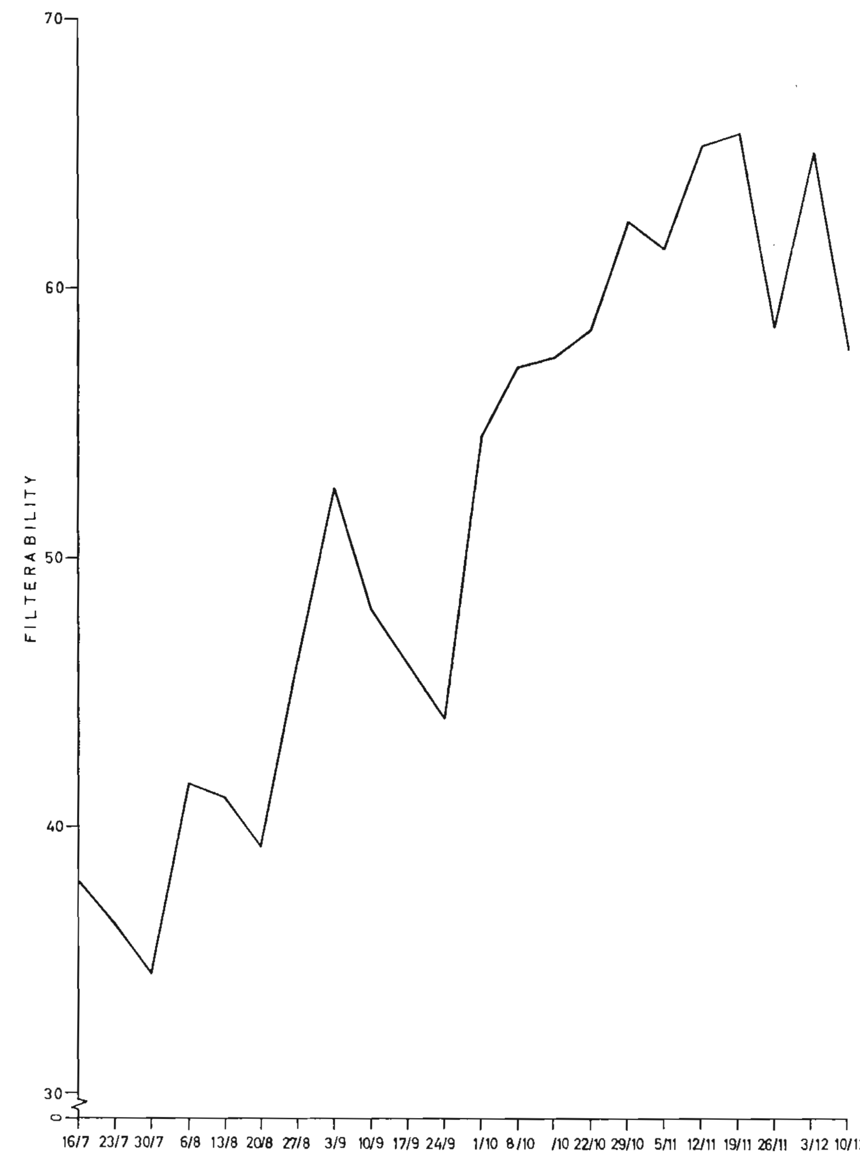

Fig. 35. Filterability of raw sugar, Médine, 1966 crop.

A number of factories reported improved filterability when liming at the flash tank which in most cases implies a certain amount of enzymatic elimination of starch from the juice. Others employed the enzymatic process without flash tank liming for varying periods. There again, positive results were achieved. The case of Médine, which is illustrated in fig. 35 may be cited as an example.

This factory used the enzymatic removal of starch from the juice throughout the season which can be conveniently divided into three periods according to the temperature at which the raw juice was heated. Thus from 11.7.66 to 20.8.66 the temperature was 45°C; from 22.8. 66, to 24.9.66, 50-55°C; and from 26.9.66 to 3.12.66, 70°C. Flash tank liming was not adopted at Médine. As the figure shows, the gain in filterability is negligible for the first period but greatest during the third period when the gelatinisation temperature of cane starch is attained and enzymatic attack becomes fully effective as the starch is dispersed (NICHOLSON & HORSELEY 1958).

As from 3.10.66 other modifications were brought in; e.g. the pH of the clarified juice was stepped up to 7.3 so as to keep the P_2O_5 content to less than 20 ppm, pan aid was used and the level of mud in the clarifier was kept at a minimum. It is significant, however, that for the week ending 1.10.66 when only the enzymatic process was operating, the gain in filterability was 10.3 points. On the whole, the average filterability at Médine was 10 points higher than during the previous year.

The above survey clearly indicates the deleterious influence exerted by starch on the filterability of local raws.

The adoption of the enzymatic removal of starch from the juice during 1966 has certainly played an important part in the improvement of the quality of Mauritius sugars.

It should be emphasized that the factory which showed the greatest improvement was Britannia which, incidentally, did not lime at the flash tank. Certain other factors, such as the better juice quality in 1966, climatic effect, and modifications to sugar boiling process have undoubtedly helped in this improvement. However, the evidence available points to the enzymatic process as having played a major part in the production of these better raws.

It is highly important in the general interest of the sugar industry that the average filterability of Mauritius sugars should continue to improve. Of all the methods proposed with this goal in view, enzymatic action provides a simple economic way to reduce starch, one of the main causes of refining difficulty.

Factories usually producing sugars of relatively high starch content should therefore make it their duty to adopt the method to ensure better results in the future.

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3. CURING LOW GRADE MASSECUITE IN A BMA K1000 CONTINUOUS CENTRIFUGAL

E. PIAT & M. ABEL

Introduction

Following the installation of a BMA K1000 continuous centrifugal at Britannia factory, it was decided to carry out a series of tests on the curing of C-massecuites in order to evaluate its merits in comparison with the batch centrifugals already in use there.

Description of Machine

The BMA K1000 (fig. 36) is a continuous machine comprising a vertically mounted conical basket spinning at 1750 r.p.m. The angle of the cone is 35°, and the external diameter is 40 inches. The drive is by means of an electric motor mounted behind the centrifuge and

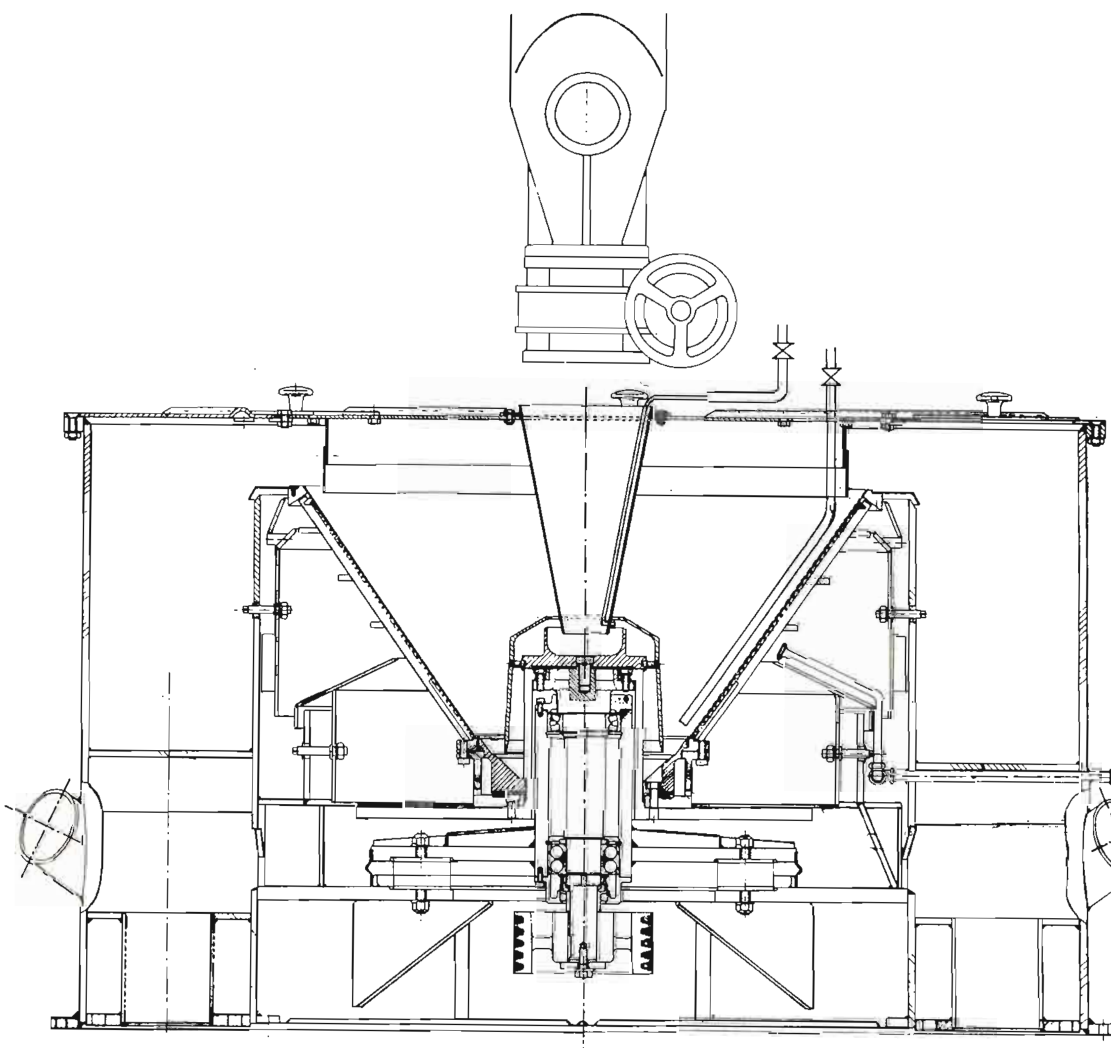

Fig. 36. BMA Continuous Centrifugal.

connected to the basket spindle by means of 5 V-belts. The distribution cone inside the apex of the basket is somewhat elaborate as shown in fig. 36. The type of screen used for the test, and recommended by the manufacturers for the curing of low grade massecuites, had slots 0.06 mm wide and 2.2 mm long. Lubrication of the two main bearings is done by a separate oil pump, which in case of failure switches off a pilot lamp and the main drive. It is of interest to note that below the basket is a flywheel which improves the balance of the basket.

The manufacturers also supplied a massecuite reheater capable of heating 50 cubic feet of massecuite per hour from 23°C to 45°C. The reheater consists of a trough in which rotates a heating element through which hot water is circulated by means of a pump. The temperature of this water is thermostatically controlled, and heat is added, as injected steam, in a separate vessel. Under working conditions massecuite flows at a constant rate and, therefore, control of the final massecuite temperature is obtained by manually setting the desired temperature of the water (60°C). This type of control was found to be quite adequate, the temperature of the massecuite seldom varying more than a few degrees per hour.

Massecuite flow from the reheater is controlled by an automatic diaphragm valve. The controlling impulse comes from the power taken by the drive, which is itself proportional to the feed rate of massecuite. The manufacturers claim that this control is not essential when curing low grade massecuites. This was evident because when the machine was in operation the diaphragm valve remained idle most of the time.

Wash water is added near the apex of the basket, but provision is made for further addition of water higher up the basket. There is also an addition of water inside the distribution cone to prevent the massecuite from adhering to the metal and thus ensure smooth feeding.

Steam injection is provided inside and outside the basket. The latter steam circuit includes a thermostat. It is generally used in order to keep the centrifuge at the same temperature as that of the incoming massecuite. An important point to watch when operating the machine is that the steam injection should be shut off before stopping the machine as otherwise the concentration of heat at one point of the screen can cause permanent damage to the latter.

The batch machine used for the comparisons was a 42 × 24 in. Broadbent spinning at 1500 r.p.m. and fitted with a screen having slots 0.35 mm wide.

The reheater provided by Broadbent works on a principle similar to that of the BMA, but it has a smaller heating surface and thus requires a higher temperature of water in the coils.

Set-up of Experiment

In order to obtain comparative figures for the two machines, the latter were considered to be made up of two separate units each, i.e. the massecuite reheater and the centrifugal proper. Ten one-hour tests were carried out at about one week interval. During the course of each test, massecuite from the same strike was cured simultaneously in the two machines, and meanwhile the following temperatures were recorded and samples taken :

- (i) a sample of massecuite flowing from the crystallizer was taken every fifteen minutes and its temperature noted;
- (ii) massecuite was sampled after the Broadbent reheater and its temperature recorded each time the centrifugal was fed;
- (iii) massecuite was continuously sampled after the BMA reheater and its temperature taken at regular intervals;
- (iv) molasses were automatically sampled at the exit from the two machines;
- (v) sugar from the K1000 was sampled once every five minutes;
- (vi) sugar samples from Broadbent was obtained by boring through the whole thickness of the sugar in the basket before discharge.

The capacity of the Broadbent was determined from the size of the basket, the thickness of massecuite in the basket, and the time taken per cycle. That of the K1000 was obtained by diverting for exactly ten seconds the feed to a weighing bucket. Two weighings were

Table 77. Results of comparative tests between BMA K100 and Broadbent batch machine

		Original Massecuite			*Original Mother Liquor*		*Mother liquor after reheater*			*C-sugar*	*Final Molasses*		*Dilution litres/water cu. ft. massecuite*	*Capactiy cu. ft. MC/hr.*
		Brix	*App. Pty*	*Temp. °C*	*Brix*	*App. Pty.*	*Brix*	*App. Pty.*	*Temp. °C*	*Pty.*	*Brix*	*App. Pty.*		
1	BRO	94.14	60.1	28	89.04	31.6	89.04	31.7	39	86.7	89.46	30.1	—	21
	BMA						88.96	31.9	44	90.4	85.50	30.7	1.3	45
2	BRO	97.02	56.5	25	91.08	34.2	90.48	35.0	45	79.2	92.04	32.7	—	21
	BMA						91.08	34.5	48	86.4	86.34	33.9	1.8	44
3	BRO	92.46	59.4	26	87.48	31.9	88.32	32.6	38	86.3	88.92	31.7	—	21
	BMA						88.08	32.0	45	89.9	84.36	31.6	1.2	50
4	BRO	91.26	58.6	25	86.34	32.3	87.12	32.7	41	91.6	87.48	33.2	—	21
	BMA						86.52	32.3	45	89.4	83.52	34.0	1.4	80
5	BRO	90.84	62.5	25	85.74	31.8	86.10	32.4	47	95.0	85.32	32.5	—	23
	BMA						86.34	31.6	41	89.3	82.74	33.1	0.8	70
6	BRO	91.08	60.9	25	85.74	32.7	86.52	33.7	42	94.0	86.04	33.9	—	23
	BMA						86.34	33.0	43	92.4	84.36	34.9	0.7	61
7	BRO	91.86	64.1	31	85.92	32.7	85.80	31.9	39	93.3	85.74	34.0	—	28
	BMA						85.74	32.0	43	88.7	83.94	33.7	1.0	51
8	BRO	91.94	65.2	23	85.92	35.6	85.74	36.3	40	89.7	86.10	36.3	—	28
	BMA						86.34	36.1	42	88.3	84.36	36.9	1.0	56
9	BRO	91.68	67.0	28	85.50	36.1	84.36	36.8	41	92.3	87.48	37.6	—	28
	BMA						84.72	37.4	43	92.2	84.54	38.9	1.0	51
10	BRO	91.86	64.8	30	86.94	37.6	86.70	36.6	43	89.6	86.94	38.2	—	28
	BMA						85.74	38.1	45	85.6	83.16	39.0	1.1	52
Mean	*BRO*	*92.41*	*61.9*	*27*	*86.97*	*33.6*	*87.02*	*34.0*	*41*	*89.8*	*87.55*	*34.0*	—	*24*
	BMA						*86.99*	*33.9*	*44*	*89.3*	*84.28*	*34.7*	*1.1*	*56*

made : one at the beginning, and the other at the end of each test.

The other data recorded were the amount of wash water used, the power setting of the drive, and the temperature of water in the element of each reheater.

For samples (i), (ii) and (iii), the mother liquor was extracted by means of a laboratory centrifugal in the first three tests and by means of a pressure filter in the other tests. Each sample was analysed for Brix and apparent purity.

Results and Observations

The results of the tests are given in Table 77. Among other observations made, the two following points were noted :

(a) there was a complete absence of vibration in the continuous machine over a wide range of massecuite temperature and wash water settings;

(b) owing to fluctuating water pressure in the factory line, the wash water setting had to be readjusted to the selected value several times during each test. However, this inconvenience should be easily remedied in future by gravity feeding of the water, or through the use of a separate pump.

Discussion of Results

(a) The capacity of the K1000 was on the average more than twice that of the Broadbent, corresponding figures obtained being 56 and 24 cubic feet of massecuite per hour. Maximum and minimum throughputs obtained during the tests with the continuous machine were 80 and 44 cubic feet per hour.

(b) The amount of resolution was approximately the same in both reheaters, although the temperature after the K1000 reheater was about 4°C higher than that of the Broadbent.

(c) The average difference in final molasses purity for all the tests made amounted to 0.7 in favour of the batch machine. It seems that this figure could be somewhat reduced in future as more experience is gained with the K1000, and a constant wash water pressure becomes available. Although the higher molasses purity speaks in favour of the batch machine, other considerations could easily outweigh this advantage, namely :

(i) greater capacity of the continuous machine;

(ii) smaller capital investment for the same capacity;

(iii) lower maintenance and operating costs;

(iv) uniform and low power consumption.

Conclusion

Under the conditions that prevailed at Britannia during the 1966 crop, the BMA K1000 continuous centrifugal cured an average of 55 cubic feet of C-massecuite per hour, yielding molasses 0.7° in purity higher than that of the batch machine. Although each case should be studied according to its own merits, it is hoped that these figures will be helpful to those faced with the task of ordering new equipment for the curing of low grade massecuite.

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4. THE FILTERABILITY OF MAURITIUS RAWS IN 1966

J. D. de R. de SAINT ANTOINE

During the 1966 crop a number of steps were taken in the various factories of the island to improve the filterability of the raws produced for export. The object of the present paper is to review the work done, and to assess the results achieved.

Although it is difficult to compare average filterability indices for one year to those of another, mainly because of differences in juice quality which may result from different climatic conditions, yet it is at this stage pertinent to point out that, in 20 out of 23 factories, sugars of better filtering quality were produced in 1966 as compared to 1965. Average filterability for the island increased by 18 per cent. This figure would have been largely exceeded had it not been for the following facts :

(a) in many factories, and for various reasons, it was only a number of weeks after the crop had started that good results were obtained;

(b) in most factories when success was achieved following a modification of some kind to process, lengthy experiments were carried out with, and without the modification, in order to assess its influence on filterability. And during these periods when the old process was reverted to, filterability dropped and lowered the average figure for the crop.

Although valuable efforts were made in all factories to improve filterability, yet the magnitude of the effort has evidently not been the same everywhere. Thus, in the factories where filterability was already good, it was not necessary to spend as much time and effort on the problem as in those factories where filterability was poor. Matters would have been different if a bonus/penalty system had been in force.

A very important aspect of the results achieved in 1966 is that it is in those factories where the lowest figures prevailed in 1965 that the most spectacular results were obtained. Hence it cannot be said, as certain sceptical persons claimed after the 1965 crop, that the conditions prevailing in certain factory areas are such that good filtering sugars cannot be produced there. Thus average filterability of Britannia, which recorded the lowest figure in 1965, increased by 110 per cent in 1966 in spite of the limitations set out in (a) and (b) above.

The improvement in the filterability of Mauritius raws in 1966 is due mostly to the following causes :

(a) reduction in starch content of sugars by enzymatic process of starch removal;

(b) adoption of more efficient clarification processes and more thorough phosphate precipitation;

(c) adoption of remelting processes;

(d) reduction in the percentage of B-sugar bagged;

(e) initiation of strict quality control on all the raws produced.

Each of these will now be considered in some detail, except for the enzymatic process of starch destruction which is dealt with fully in another chapter of this report.

Clarification

In a number of factories, excellent results were obtained following the adoption of more efficient clarification processes, particularly in relation to the point of liming. It should be pointed out, however, that the clarification processes followed until then in all the factories of the island were rather crude, as they consisted in either straight cold liming or, at the best, hot liming. In the latter case, mixed juice was generally heated to about 60°C, limed, and brought to boiling. The low clarification efficiency of these processes, particularly the former, had very detrimental effects on sugar filterability.

Early during the crop, good results were recorded at Savannah factory when a liming procedure used in Queensland and described by De Froberville (1965) was adopted. The acid raw juice was heated to 103-105°C, and milk of lime added by means of a dosing pump to the juice line just upstream of the flash tank. Simultaneously, the enzymatic process of starch removal was followed, but the reaction time was limited to only about 5 minutes. Clarification efficiency was improved and sugar filterability went up. However, the mixing of lime and juice was not satisfactory; when this was improved, as from the 12th of September, still better results were obtained, as shown in fig. 37. Average filterability for Savannah, by the way, showed an increase of 18 points over 1965, a figure exceeded only by Britannia with 23 points.

Improvements in raw sugar filterability were observed in most factories where liming of the boiling juice was resorted to, best results being obtained where clarification was initially poor. A typical example is Mon Désert-Alma factory as shown in fig. 34 earlier in this report.

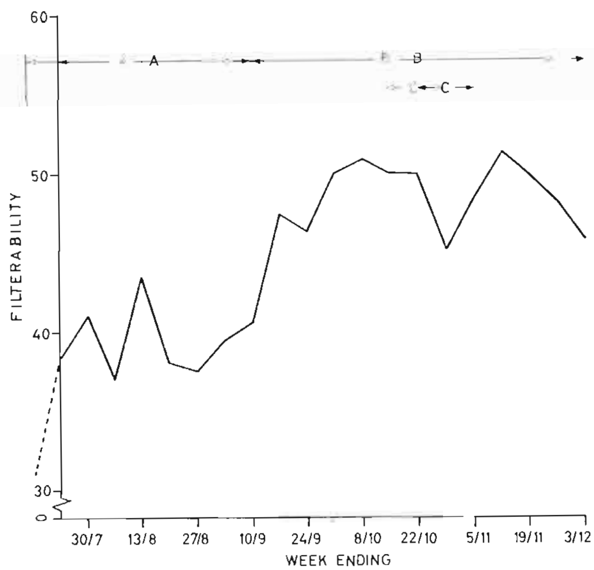

Fig. 37. — Weekly filterability indices, Savannah, 1966.
A — Flash tank liming, incomplete mixing
B — Flash tank liming, mixing improved
C — Milk of lime dosing pump out of order and double curing of C-Sugar stopped.

When liming boiling juices the clarified juice is much less turbid, but the precipitate formed is lighter and settles more slowly. As a result, clarifier capacity is inadequate in certain factories and the process cannot be followed continuously. The addition of polyelectrolytes may however bring the situation back to normal by increasing the settling rate. Thus, at Mon Désert-Alma, where Separan AP 30 is normally used at the rate of 2 ppm in juice, mud levels gradually went up in the clarifier as soon as liming of boiling juices was followed, so that after some twelve hours, ordinary hot liming had to be resorted to until the mud level went down. However, when the polyelectrolyte addition was increased to 4 ppm, liming of boiling juices could be practised for periods of 24-30 hours.

But polyelectrolytes do not always work, or may prove too expensive above certain concentrations. In such cases, it would be advisable to lime the hot juice partially and to complete the liming at the boiling temperature. It is pertinent to point out here that the clarifier capacity necessary in Queensland when liming at boiling temperature is practised is 700-750 imperial gallons per T.C.H. In Mauritius, only seven factories have equivalent capacities, whereas in seven others it is less than 500. If the capacities are expressed in sq. ft of settling area per T.C.H., figures for Mauritius vary between 15 and 35 sq. ft., whereas Hugot recommends 33-35 sq. ft.

Mention should also be made here of the diameter of the flash tank vent pipe. If it is not of adequate size, air will not be eliminated from bagasse particles which, therefore, will not settle rapidly and completely. Flashing may even take place in the clarifier, accompanied by surging of the juice. And, as pointed out by JENSEN (1957) «*if the flash is inadequate, scum accummulates in the flow channels, and when much bagacillo is present in the juice, the flow around the (Bach) subsider is checked or even blocked and short circuiting of the juice must then occur*». Dorr-Oliver now recommend a vent pipe of 16 in. diam. for a factory crushing 100 T.C.H. A survey carried out last crop has indicated that in most factories this dimension, or its equivalent, is not respected.

It must be stressed that liming at boiling temperature is not a panacea, but must be supplemented with adequate mixing of juice and milk of lime or saccharate, with accurate pH control and with proper phosphate precipitation. Unfortunately, several factories are not yet equipped with pH controllers; in other cases, the controllers are there but do not operate correctly and it is only in a few factories that good control is achieved. Measures are being taken to remedy the situation for the 1967 crop.

Concerning phosphates, it has been observed that in many cases the soluble phosphate content of the clarified juice is too high and adversely affects sugar filterability. The figure recommended by JENKINS (1966) is 8-12 p.p.m. as P, which is equivalent to 18-27 p.p.m. as P_2O_5. Such low values cannot usually be obtained unless the pH of the clarified juice is about 7.5. Although it is not possible to recommend this value for all factories, yet there is no doubt that in many cases better results could be achieved by liming to higher pH's. As a matter of fact, the improvement in filterability observed in 1966 over the previous year was certainly partly due to more thorough phosphate precipitation. Thus, whereas in 1965 only 8 factories registered clarified juice pH values of 7.2 or more, the figure rose to 15 in 1966.

Boiling House

As pointed out earlier, the main changes effected in boiling house work in 1966 which helped to improve filterability are the adoption of remelt processes and the bagging of less B sugar.

In all the factories except two, remelting of all the C-sugar was practised, and double-curing of the final massecuite was followed in 6 of the 20 factories that produce only raws. There is no doubt that remelting of C-sugar is a sound practice which is bound to yield better filtering raws than those produced when the C-sugar is used as footing for the shipment strikes, particularly when this sugar is single-cured and yields a comparatively low purity magma. No experiments were carried out last crop to compare the influence on the filterability of the final product of double versus single-curing of C-sugar in a process where this sugar is remelted and not used as footing. It is believed that double-curing offers a small advantage, but the economics of the process have not been worked out. The most important aspect of the question, however, is to ascertain that the fore-curing operation is effectively carried out, whether double-curing is resorted to or not; and the single-cured C-sugar should have a purity of at least 85.

A typical example of the adverse effects of low purity C-sugar on the filterability of the shipment raws is to be found in the results obtained at Rose Belle factory — where the C-sugar was remelted throughout the crop — and reported earlier in this report (*vide* p. 130). As mentioned there, «*although filterability improved somewhat following the adoption of the enzymatic process and new liming procedure, yet a marked improvement was only achieved when the magma purity was raised above 85 and molasses recycling thus curtailed to a large extent*».

In several factories experiments were carried out to ascertain the influence of the remelting of B sugar on the filterability of the bagged product. The results obtained at Saint Antoine and Beau Champ factories will be reviewed briefly.

During most of the crop, Saint Antoine factory produced plantation white sugar by remelting about 75 per cent of its A sugar followed by phospho-defecation and recrystallization. The raw sugar bagged during the early part of the season, except the 1st week during which no white sugar was produced, was made up of unmelted A sugar plus all the B sugar, and its filterability averaged only 29. From then on, and during the ten additional weeks during which white sugar was produced, about 80 per cent of the B sugar was remelted and recrystallized. The filterability index of the bagged sugar immediately went up and averaged 38 for the four weeks immediately following the period when the B sugar was not remelted. Henceforth, filterability went up still higher to average 50 during the six following weeks, but this further increase cannot be attributed to remelting only because of various factors that have come into play during that period.

The results obtained at Beau Champ factory are shown in fig. 38, an examination of which will reveal the following salient points. During the first five weeks when hot liming was followed and B sugar remelted to the extent of 82 per cent, the filterability index averaged 46. During

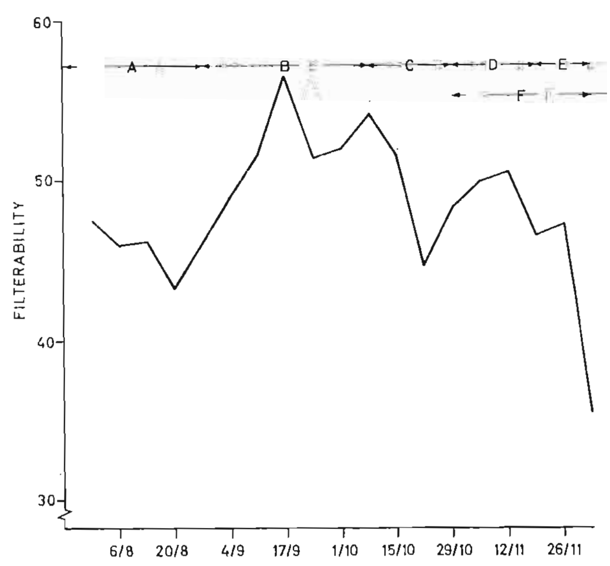

Fig. 38. Weekly filterability indices, Beau Champ, 1966.
A — Liming 65°C, 82% B sugar remelted, av. filt. 46
B — Liming flask tank, 78% B remelt, av. filt. 53
C — Liming flask tank, no B remelt, av. filt. 48
D — Liming flask tank, no B remelt, av. filt. 49
E — Liming at 65°C, no B remelt, av. filt. 41
F — Enzymatic process for 8 mins at 65. 70°C.

the following six weeks, B sugar was remelted to about the same extent, but liming of the boiling juice was resorted to. The increase in filterability from 46 to 53 may therefore be attributed mostly to better clarification. During the ensuing period of three weeks, liming of the boiling juice was maintained but no B sugar was remelted and filterability immediately dropped. Finally, the experiments carried out during the last two periods (D) and (E) show that when liming at the flash tank was discontinued filterability dropped again. The enzymatic process of starch removal was also followed during the last five weeks of the crop, but was of too short duration to allow any definite conclusion to be drawn.

The filterability index of B sugars is usually much smaller than that of A sugars for the same factory. In the majority of cases, the difference is considerable, A sugars having indices about twice those of B sugars. DOUWES DEKKER (1962) has observed the same relationship for Natal raws for which, following the analyses of a large number of samples, average A sugar filterability indices amounted to 49.4, whilst B sugars averaged only 25.4. Things being so, one simple method of improving the filterability of shipment sugars is to produce as little B massecuite as possible, whilst increasing the percentage of A massecuite.

Statistical Table XVIII (iv) contains all the data relative to massecuite production in the various factories of the island, and it will be observed that the figure B massecuite per cent total massecuite varies sometimes widely from one factory to another in spite of the fact that purity figures for the various products are just about the same in both cases. This may be the result of variations within the same boiling process, variations which may seem quite small at first sight but which are sufficiently important to affect massecuite percentages markedly, and hence shipment sugar filterability indices. The following boiling diagrams will illustrate the point (fig. 39). The diagram on the left shows the boiling process followed in a local factory last crop. It will be observed that for every 100 solids by weight in syrup, 65.8 are used to build the 1st massecuite, whilst 27.1 and 7.1 are sent to the 2nd and 3rd massecuites respectively. Solids in massecuite and massecuite percentages by weight are indicated in Table 78.

Table 78. Massecuite solids and percentages of unmodified process

Mcte		*Solids in mcte. % solids in syrup*	*Per cent by weight*
A	...	83.6	48.0
B	...	57.1	32.7
C	...	33.7	19.3

Now, without changing massecuite and molasses purities, the above process may be slightly modified with the object of producing less B massecuite. This may be achieved by using as much A molasses as possible for building up the C massecuite — hence there will be

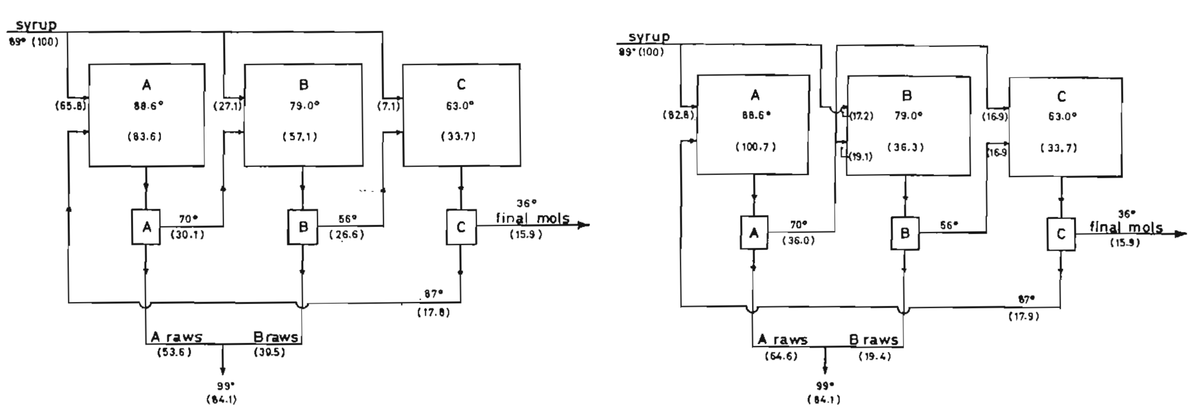

Fig. 39. Improvement in boiling process.
Left — Actual boiling process followed. *Right* — Modified boiling process

less left for the B massecuite — and by using as much syrup as possible for the A massecuite, the difference being fed to the B massecuite only. This is shown in the diagram on the right in fig. 39, from which it will be observed that for every 100 solids in syrup 82.8 are used to build the 1st massecuite and 17.2 in the 2nd massecuite. Solids and percentage figures in this case are given in Table 79.

Table 79. Massecuite solids and percentage of modified process

Mcte		*Solids in mcte. % solids in suryp*	*Per cent by weight*
A	...	98.7	58.5
B	...	36.3	21.5
C	...	33.7	20.0

By comparing Tables 78 and 79 it will be seen that the small modifications brought to the boiling process have decreased the amount of B massecuite by 11.2 per cent, and increased the percentage of A massecuite by 10.5 per cent.

It would appear, from the results obtained in several factories, that the production of finer grain sugar has improved average filterability, but no reliable data are available to prove this point. It is well known that the filterability of a raw sugar will be governed mostly by the purity of the medium from which it was crystallised, the higher the purity the better the filterability. Hence so far as this is concerned, for a massecuite of a given purity, yielding molasses also of a given purity, the filterability of the sugar produced should not be influenced by the size of the crystals since in both cases the mother liquor is exhausted to the same final figure. However, it is possible that in practice the amount of impurities occluded in coarser crystals, which take longer to grow, should be larger than in smaller crystals, and this would explain the higher filterability of the latter. Should that be the case, vacuum pans fitted with mechanical circulators, and thus having fast boiling characteristics, should yield better filtering raws than ordinary and slower pans. A number of comparisons were made last crop in one factory equipped with both types of pans and the results, which are shown in Table 80, were kindly communicated to this Institute.

Table 80. Filterability indices of sugars boiled in forced circulation and in natural circulation calandria pans

	Filterability index *Forced circulation*	*Natural circulation*
	'A' SUGAR	
	46	47
	46	44
	48	30
	41	55
	44	41
	50	45
	50	43
Average	*46*	*44*
	'B' SUGAR	
	34	40
	48	44
	41	38
	41	13
	45	34
	36	38
Average	*41*	*35*

It is unfortunately not possible to draw a conclusion from the above figures because of the wide variations observed in the results. This is most probably due to the fact that in industrial practice it is often impossible to keep conditions sufficiently constant long enough to enable fair comparisons to be made.

It is intended to study further, mostly on a laboratoty scale, the influence of grain size on filterability, and it is hoped that, as a result, some light will be thrown on this aspect of the problem.

Quality Control

It is not necessary to enlarge on the fact that the good results obtained last crop would not have been achieved if strict quality control had not been exercised by the individual chemist during production, and by the central laboratory of the Sugar Syndicate on samples collected both on arrival of the sugars at the docks and at the time of their shipment.

Conclusion

It has been very gratifying to note that, for the first time last crop, all the raw sugar producers of the island have made a sustained effort to improve the filterability of their product. As a result, average filterability of

Mauritius raws has improved over the previous year, and there is no doubt that, with the experience gained, still better results will be achieved in 1967.

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5. AN UNIDENTIFIED YEAST-LIKE MICRO-ORGANISM CAUSING TROUBLE IN A MIXED-JUICE TANK

C. RICAUD

In one factory, where the enzymatic process of juice clarification was tried in conjunction with the elimination of impurities by air flotation in an attempt to improve raw sugar filterability, serious trouble was encountered following profuse development of an unidentified micro-organism in the flotation tanks. Removal by means of sieves did not work owing to the very rapid growth, which resulted in the accumulation of up to 5 tons of the organism in one week-end, the factory processing about 130 tons of juice per hour. The process had to be abandoned. It is believed that such a problem has never before been encountered in cane sugar manufacture.

The process involved heating the mixed juice up to 70°C in juice heaters, from where the juice passed in succession through two tanks fitted with stirrers and in which air was bubbled from the bottom. The organism developed in these tanks at the end of each week when the temperature dropped to 45°-50°C owing to decreased efficiency of the juice heaters. The pH was about 6.2. From these tanks the juice was pumped through another set of juice heaters and trouble was encountered through blocking of pipes by the organism.

The micro-organism had a fibrous texture (Plate XII, *top*) and could be mistaken for an accumulation of bagasse particles. However, microscopic examination of the fibres revealed that these consisted mainly of strands of closely-growing, parallel fungal hyphae (Plate XII, *bottom*). These hyphae were aseptate, branched, and occasionally formed oval yeast-like bodies at their tips. Samples were sent to the Centraal Bureau voor Schimmelcultures in Delft, Holland, for identification. The yeast *Saccharomyces cerevisiae* and the fungus *Chaetomium globosum* were found; both organisms are thought to be contaminants rather than the one observed. The micro-organism could be either a fungus belonging to the order Phycomycetae, but no typical sporangia were found, or a fission yeast which, under the conditions of growth, had given rise to a true mycelium which formed closely-packed aggregates.

APPENDIX

THE MAURITIUS HERBARIUM

R. E. VAUGHAN

Accessions. During the year under review over six hundred specimens have been incorporated in the Herbarium. From Réunion a further collection of 44 species was received from Mr. T. Cadet; these were confined mainly to three families, grasses, sedges and orchids. Duplicates of this material have been sent to the Herbarium, Royal Botanic Gardens, Kew, for examination, and a report on the grasses indicates that some of these are endemic montane species including *Agrostis salaziensis* C. Cordem. and *Festuca borbonica* Spr.

From Mt. Cocotte, that treasure-house of rare indigenous animals and plants, comes an important new record for Mauritius, the peculiar and primitive fern *Cheiroglossa palmata* Pr. *var malgassica* C. Chr. in the family *Ophioglossaceae*. A further report from Dr. G. Cufodontis, Botanical Institute of Vienna, on indigenous species of *Pittosporum* confirms the presence in Mauritius of the wide-ranging species *Pittosporum ferrugineum* Ait. forma *ovatifolium* (Ferd. v. Muller) Cuf. which occurs in many Pacific islands, N. E. Australia, Indonesia, but not in continental Asia. Good material of this species has now been added to the Herbarium.

Other Mauritius specimens of particular interest acquired during the year were species of the difficult and elusive orchid genera of *Angraecum, Jumellea*, and *Bulbophyllum*. Some fine specimens in flower and fruit of the *Lomatophyllum* sp. confined to the northern islets of Mauritius were obtained from Round Island. An apparently new species of the Mascarene palm genus *Acanthophœnix* from Crown Land Declerc near Grand Bassin was brought to our notice by the lessee, Mr. Marc d'Unienville; good material and photographs of this plant have now been obtained for further study. Five species of indigenous plants collected by Forest Ranger C. P. Appassamy have been received from Rodrigues.

An important addition to the Map Collection has been the recently published *Carte Internationale du Tapis Végétal, Madagascar*, in three sheets. In addition to the main map, each sheet has insets showing Divisions Administratives et Hypsométrie, Géologie et Lithologie, Sols, Bioclimats, Types de Végétation et Agriculture.

Distribution to Institutes and Herbaria. At the request of the Tropical Products Institute, London, two large consignments of dried leaves and twigs of two indigenous species of Diospyros, *D. leucomelas* and *D. tesselaria,* were sent for chemical studies at Aberdeen University.

Seeds of *Argyreia nervosa* (Convolvulaceae), a naturalised climbing plant common in the Mascarenes, were sent to Professor Dr. Stopp, Institute of Pharmacognosy, University of Mainz, for research in progress on the chemical constituents of this plant.

Additional material of the interesting weed *Coronopus serratus* was sent to the Herbarium, Royal Botanic Gardens, Kew. Seeds of the indigenous *Hibiscus liliiflorus* from Rodriguez were sent to the Cytogeneticist, U.S. National Arboretum, in connection with a research project on this genus.

Visitors. It has been a busy year for visitors from overseas coming to Mauritius to collect material and study the vegetation of the Mascarenes at first hand. In August, Prof. B. Lloyd Binns, visiting Professor of Botany at the University of Malawi, came here with the two-fold intention of seeing the montane vegetation and studying herbarium organization with a view to extending the herbarium which she is now building up at the new university.

Professor Dr. G. Erdtman, Director of the Palynological Laboratory, Stockholm, Sweden, came to Mauritius in September for the purpose of furthering his investigations on pollen taxonomy. This field of research has been pioneered by Dr. Erdtman, and it may be truly said that he is the world authority on this comparatively recent and fascinating discipline which has illumined, though not without controversy, many obscure problems in plant systematics. During his stay in Mauritius, Dr. Erdtman obtained much useful material from living endemic plants which he supplemented by samples of pollen from herbarium specimens. With Dr. Erdtman was Dr. John Rowley, of Massachusetts University, who fixed fresh pollen material for subsequent examination by the electron microscope. At the conclusion of their visit, Dr. Erdtman gave a conference on «Pollen grains and spores and their significance in Taxonomy, Palœbotany and Genetics». Dr. Rowley then showed, with comments, some of his remarkable electron microphotographs illustrating features of pollen cytology and the structure of pollen grain walls.

In October, Mr. H. J. Schlieben, Senior Technical Assistant in the Botanical Research Institute, National Herbarium, Pretoria, spent some weeks in Mauritius and Réunion with the object of securing a general collection of plants for the National Herbarium. He obtained in all about 200 species, and a duplicate set of his Réunion material will be presented to the Mauritius Herbarium.

Dr. Jean F. Leroy, Curator, Laboratoire d'Agronomie Tropicale, Paris, who came to the Mascarene Islands a few years ago in connection with a research project on *Coffea* spp., returned to Mauritius early in November to make a further field study of local species of *Coffea* for a monograph he is preparing on the indigenous species of this genus in Madagascar and the Mascarenes.

Nature Reserves. The fifth plenary meeting of A.E.T.F.A.T. (Association pour l'Étude Taxonomique de la Flore d'Afrique Tropicale) took place in Uppsala from 12th to 15th September. During the meeting a symposium was held on the conservation of vegetation and its constituent species in Africa south of the Sahara. The writer contributed a paper to the symposium on «Nature Conservation in Mauritius and Rodriguez»; this is in the press and will appear in the Proceedings of the Association in the near future. On the occasion of the anniversary meeting of the Royal Society of Arts and Sciences in August, Mr. France Staub exhibited a colour film vividly illustrating some features of wild life on the Nature Reserves of Round Island and Ile aux Aigrettes. The film was preceded by a talk given by the writer on Nature Reserves, with special reference to Ile aux Aigrettes and the significance and distribution of the vegetation thereon.

Weed Flora. Work continued on the Weed Flora during the year and Leaflet No. 11 appeared when this report was in the press. This leaflet comprised two common species of *Setaria*, *S. pallide-fusca* and *S. barbata*, and also included a key for the identification of all the members of this genus occurring in the Mascarene Islands.

General. There has been a welcome increase in the interest shown by schools and other institutions in the work of the Herbarium and some hundreds of inquiries and determinations of specimens have been handled during the course of the year.

Thanks are due to the Conservator of Forests and his staff for the provision of guides, location and collection of material, and co-operation in many ways. Gratefully acknowledged also is the assistance given by voluntary helpers in obtaining specimens for the Herbarium, many of these from remote areas of the island difficult of access. This work is an indispensable contribution to the progress of our knowledge of the local flora.

Some of the more important publications received by the Herbarium Library are given below :

DICKSON, J. H. 1965. Biology of the Tristan da Cunha Islands – Part I. General Introduction. *Phil. Trans. R. Soc.* Series B. **249** : 259-271. Part IV. The Effects of the Eruption of 1961 on the Vegetation of Tristan da Cunha. *Ibid.* **249** :403-424

HUMBERT T. H. *et* COURS DARNE, G. 1964-1965. *Carte Internationale du Tapis Végétal. Madagascar* (1 : 1,000,000). (i) Cap St. André — Lac Alaotra (ii) Mangoky — Cap Ste Marie, (iii) Baie d'Ampasindara. Pondichéry.
1965. *Notice de la carte de Madagascar.* Pondichéry.

HUTCHINSON J. 1964 — *The Genera of Flowering Plants; Dicotyledones.* Volume I Oxford.

Ten volumes are envisaged in this monumental work which provides keys and descriptions of all known genera of flowering plants with notes on distribution, economic uses, and references to original sources.

ROCHECOUSTE, *and* PILOT, J. 1966. The control of weeds in tea by Herbicides in Mauritius. *Weed Res.* **6** : 50-57.

Lists the common species invading tea plantations.

WACE, N. M. *and* DICKSON, J. H. 1965 — Biology of the Tristan da Cunha Islands — Part II. The Terrestrial Botany of the Tristan da Cunha Islands. *Phil. Trans. R. Soc.* Series B. **249** : 273-360.

Of much interest in this and in the paper by Dickson, cited above, is the account of the *Phylica-Blechnum* community; resemblance to similar montane communites in the Mascarenes is noteworthy.

WATT, J. M. *and* BREYER-BRANDWIJK, M. G. 1962. *Medicinal and Poisonous Plants of Southern and Eastern Africa.* 2nd ed. Edinburgh & London.

Contains references to, and descriptions of many plants occurring also in the Mascarene Islands.

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XXIV. List of approved cane varieties

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* *Grateful acknowledgment is made to the Secretary, Mauritius Chamber of Agriculture, for providing the necessary data to compile Tables II to VI.*

Table I. General description of sugar cane sectors of Mauritius

SECTORS	WEST	NORTH	EAST	SOUTH	CENTRE
DISTRICT	Black River	Pamplemousses & Rivière du Rempart	Flacq	Grand Port & Savanne	Plaines Wilhems & Moka
ORIENTATION	Leeward	—	Windward	Windward	—
PHYSIOGRAPHY	Lowlands and Slopes	Lowlands	Lowlands and Slopes	Lowlands and Slopes	Plateau
GEOLOGY	Late lava — Pleistocene				
PETROLOGY	Compact or vesicular doleritic basalts and subordinate tuffs				
ALTITUDE	Sea level - 900 ft.	Sea level - 600 ft.	Sea level — 1,200 ft.	Sea level - 1,200 ft.	900 - 1,800 ft.
HUMIDITY PROVINCE	Sub-humid	Sub-humid to humid	Humid to super-humid		
ANNUAL RAINFALL, inches. Range and mean	(30 - 60) 44	(40 - 75) 55	(60 - 125) 94	(60 - 125) 90	(60 - 150) 90
MONTHS RECEIVING LESS THAN TWO INCHES RAIN	June to October	September to October	None		
AVERAGE TEMPERATURE °C — JAN.	27.0°	26.5°	25.5°	25.0°	23.5°
AVERAGE TEMPERATURE °C — JUL.	21.0°	20.5°	19.5°	19.0°	17.5°
CYCLONIC WINDS, greater than 30m.p.h. during 1 hour	December to May				
PEDOLOGY Great Soil Groups	Soil Families				
Low Humic Latosol	« Richelieu »	« Richelieu » « Réduit »	« Réduit » « Bonne Mère »	« Réduit »	« Réduit » « Ebène »
Humic Latosol	—	« Rosalie »	—	« Riche Bois »	« Riche Bois »
Humic Ferruginous Latosol	—	—	« Sans Souci »	« Belle Rive » « Sans Souci » « Midlands » « Chamarel »	« Belle Rive » « Sans Souci » « Midlands »
Latosolic Reddish Prairie	« Médine »	« Labourdonnais » « Mont Choisy »	« Mont Choisy »	« Labourdonnais » « Mont Choisy »	« Médine »
Latosolic Brown forest	—	—	« Rose Belle »	« Rose Belle » « Bois Chéri »	« Rose Belle » « Bois Chéri »
Dark Magnesium Clay	« Lauzun » « Magenta »	« Lauzun »	—	—	—
Grey Hydromorphic	« Balaclava »	« Balaclava » « St. André »	« Balaclava »	—	—
Low Humic Gley	—	—	« Valetta »	—	« Valetta » « Petrin »
Lithosol	—	« Melleville »	« Pl. des Roches » « Melleville »	« Melleville »	—
IRRIGATION	Common	Some	Rare		
APPROXIMATE AREA 1000 arpents — Sector	56	91	72	160	63
APPROXIMATE AREA 1000 arpents — Cane	12	54	47	65	27
CANE PRODUCTION 1000 metric tons (1966)	397	1105	1090	1673	579
SUGAR PRODUCTION 1000 metric tons (1966)	48	130	126	192	66
SUGAR FACTORIES Production in 1000 metric tons (1966)	Médine 48	Mon Loisir 26 Belle Vue 25 St. Antoine 21 Solitude 20 Beau Plan 20 The Mount 18	Union Flacq 71 Beau Champ 29 Constance 26	Savannah 30 Mon Trésor 25 Riche en Eau 22 Rose Belle 21 Union 20 Britannia 17 Bel Ombre 16 Bénarès 14 St. Félix 13 Ferney 13	Mon Désert 30 Réunion 19 Highlands 17

Table II. Area under sugar cane in thousand arpents (1), 1958 - 1966

Year	Area under cane Island	Area reaped					
		Island	West	North	East	South	Centre
1958	189.22	176.69	9.20	49.14	38.78	56.62	22.95
1959	195.31	183.12	9.62	50.37	40.93	58.77	23.43
1960	201.61	188.36	10.22	51.50	42.15	60.34	24.14
1961	201.17	187.29	10.33	50.71	41.98	60.29	23.98
1962	204.97	193.77	11.07	52.60	42.61	62.41	25.08
1963	204.20	194.08	11.63	51.17	43.61	62.67	25.00
1964	206.94	195.41	11.79	52.70	42.23	62.45	25.24
1965	205.56	194.92	12.02	51.80	43.08	62.74	25.28
1966 (2)	206.00	195.74	12.26	51.44	43.62	62.95	25.47

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), 1958 - 1966

Crop Year	No. of factories operating	Av. Pol.	Island	West	North	East	South	Centre
1958	25	98.5	525.8	31.80	137.17	106.07	178.80	72.01
1959	24	98.6	580.4	35.22	141.95	123.76	195.86	83.59
1960	23	98.0	235.8	18.06	75.22	50.02	72.24	20.24
1961	23	98.8	553.3	32.62	140.05	111.92	183.77	84.90
1962	23	98.6	532.8	35.09	154.51	109.25	176.74	56.87
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(2)	23	98.7	561.8	48.4	130.0	125.8	191.7	65.9

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), 1958 - 1966

SECTORS	1958	1959	1960	1961	1962	1963	1964	1965	1966(2)
ISLAND									
Millers ...	30.5	32.5	15.3	32.2	28.0	35.1	26.2	35.7	29.5
Planters	19.1	19.7	10.2	20.5	19.5	23.7	18.5	25.3	19.7
Average ...	24.5	25.9	12.7	26.4	23.9	29.6	22.4	30.7	24.7
WEST									
Millers ...	32.4	34.4	21.3	35.3	31.8	37.8	32.3	43.5	35.9
Planters	25.2	26.4	13.5	23.4	22.7	27.8	25.0	34.7	28.9
Average ...	28.0	29.3	16.2	27.8	26.2	32.1	28.1	38.9	32.3
NORTH									
Millers ...	29.5	30.0	19.2	29.2	31.1	35.0	29.0	35.5	28.6
Planters	17.5	17.1	11.4	20.6	21.4	24.0	19.2	24.4	17.8
Average ...	21.6	21.5	14.1	23.5	24.7	27.8	22.5	28.2	21.5
EAST									
Millers ...	31.5	33.0	16.3	32.7	29.0	37.6	28.0	39.0	31.1
Planters	16.8	19.2	9.3	17.9	17.1	21.3	16.0	23.5	19.1
Average ...	22.4	24.8	12.2	24.4	22.5	28.9	21.5	30.9	25.0
SOUTH									
Millers ...	30.3	32.3	14.6	31.7	27.8	33.4	24.5	33.2	29.2
Planters	22.5	21.4	9.4	20.8	20.1	24.6	18.7	25.7	21.5
Average ...	27.4	28.6	12.9	28.3	25.5	30.7	22.7	30.9	26.6
CENTRE									
Millers ...	30.6	34.9	9.7	36.7	22.1	36.2	23.3	35.7	26.4
Planters ...	19.9	22.0	7.6	23.7	15.8	24.1	16.9	25.5	18.2
Average ...	25.9	29.1	8.8	30.8	19.3	30.8	20.5	31.2	22.7

NOTE : (*1*) *To convert in metric tons/acre, multiply by 0.959*
„ „ „ long tons/acre, „ „ 0.945
„ „ „ short tons/acre, „ „ 1.058
„ „ „ metric tons/hectare, „ „ 2.370

(*2*) *Provisional figures*

Table V. Average sugar manufactured % cane(1), 1957 - 1966

Crop Year	Island	West	North	East	South	Centre
1957	12.94	13.07	13.86	12.64	12.49	12.88
1958	12.14	12.36	12.95	12.22	11.53	12.12
1959	12.24	12.48	13.08	12.22	11.64	12.27
1960	9.84	10.94	10.34	9.73	9.29	9.56
1961	11.19	11.40	11.76	10.94	10.78	11.47
1962	11.52	12.07	11.90	11.38	11.12	11.76
1963	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 (2)	11.60	12.20	11.77	11.53	11.47	11.39

NOTE : (1) To convert into tons cane per ton sugar manufactured : divide 100 by above percentage
(2) Provisional figures

Table VI. Tons sugar manufactured per arpent reaped, 1957 - 1966

Crop Year	Island	West	North	East	South	Centre
1957	3.31	4.02	2.92	2.89	3.66	3.68
1958	2.98	3.46	2.79	2.74	3.16	3.14
1959	3.17	3.66	2.81	3.03	3.33	3.57
1960	1.26	1.96	1.49	1.19	1.20	0.84
1961	2.95	3.16	2.76	2.67	3.05	3.54
1962	2.75	3.16	2.94	2.56	2.84	2.27
1963	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 (1)	2.87	3.94	2.53	2.88	3.05	2.59

NOTE : (1) Provisional figures

Table VII. Monthly rainfall in inches, 1951 - 1966. Average over whole sugar cane area of Mauritius

Crop year	GROWTH PERIOD (deficient months in italics)								NOV-JUNE (sum of monthly deficits)	MATURATION PERIOD (excess months in italics)				JULY-OCT. (sum of monthly excesses)
	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE		JULY	AUG.	SEPT.	OCT.	
Normals 1875-1949	3.77	7.09	11.04	11.06	12.09	9.50	6.91	4.96	15.00	4.59	4.15	2.90	2.81	2.50
Extremes to date	0.52 13.18	1.74 44.81	2.69 32.46	2.59 36.04	3.35 38.98	1.45 27.60	1.62 21.41	0.97 16.49	2.20 29.20	1.62 10.23	0.60 12.52	0.69 8.06	0.76 9.83	0.00 14.12
1951	*3.15*	*5.86*	11.65	*8.20*	*10.89*	*7.98*	7.00	7.26	7.43	*4.91*	*5.41*	*4.16*	*3.84*	3.87
1952	4.08	*2.22*	*5.26*	11.17	16.88	10.11	*5.69*	*4.86*	12.31	*8.22*	*5.20*	*3.47*	*3.13*	5.61
1953	6.06	18.05	*11.65*	*6.59*	*10.57*	*8.35*	11.95	12.75	7.14	*10.10*	*4.72*	*3.07*	2.68	6.25
1954	*3.76*	11.47	*5.00*	*7.96*	14.89	*6.20*	*6.49*	6.06	12.88	*6.44*	*5.04*	*4.11*	1.53	3.76
1955	4.81	*5.19*	*4.50*	23.28	19.60	10.97	8.83	7.73	8.44	*4.66*	3.85	*3.68*	1.12	0.85
1956	*3.03*	7.70	12.02	13.59	*10.60*	*4.14*	*5.93*	*4.90*	8.63	2.94	2.82	1.68	1.40	0.00
1957	*2.08*	8.11	*7.80*	*6.98*	*8.93*	10.66	*6.14*	*3.66*	14.24	3.55	2.54	*3.32*	0.96	0.42
1958	*2.09*	10.26	13.49	13.28	29.54	13.29	*4.95*	*2.20*	6.40	*8.22*	*4.51*	1.50	2.47	3.99
1959	*1.18*	*3.06*	13.64	*9.48*	13.93	*4.81*	*3.04*	*1.80*	19.91	3.07	*6.01*	2.67	*6.53*	5.59
1960	11.43	*6.58*	23.46	18.29	16.97	*1.73*	*3.23*	5.06	11.96	3.57	2.29	*8.06*	1.49	5.16
1961	*2.48*	*3.13*	*4.31*	*2.59*	*7.96*	*7.58*	*4.70*	7.13	28.71	*7.84*	*5.65*	2.05	2.26	4.75
1962	3.89	44.81	11.17	15.42	14.47	*5.12*	*5.62*	5.49	5.67	2.89	3.50	*3.79*	*5.28*	3.36
1963	4.68	*5.26*	*8.41*	11.46	*5.02*	*9.49*	*5.41*	*4.09*	13.91	*6.13*	0.82	1.76	*3.50*	2.23
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*	14.12
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

NOTE: To convert into millimetres, multiply by 25.4

Table VIII. Monthly maximum and minimum air temperatures, 1951 - 1966. Average over whole sugar cane area of Mauritius

YEAR	NOV.		DEC.		JAN.		FEB.		MAR.		APR.		MAY		JUNE		JULY		AUG.		SEPT.		OCT.	
	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m	M	m
Normals 1950-65	27.9	18.7	29.2	20.6	29.7	21.7	29.4	21.8	29.1	21.5	27.9	20.2	26.4	18.6	24.8	17.1	24.0	16.4	23.8	16.0	24.8	16.5	26.1	17.4
1951	28.1	18.1	29.2	21.0	29.9	22.2	28.7	22.0	29.1	21.7	28.4	19.1	26.8	18.3	24.6	17.5	24.5	16.9	24.0	16.3	24.9	16.2	26.1	17.7
1952	27.7	19.3	29.8	21.0	30.8	22.3	29.6	21.9	28.8	22.2	28.0	21.2	26.9	20.0	23.8	17.3	24.0	16.8	23.8	15.6	25.0	17.2	25.9	16.7
1953	27.7	18.6	28.7	19.7	29.2	21.5	29.6	21.5	30.4	21.2	28.6	20.2	27.1	19.9	26.0	19.1	24.1	17.2	23.7	16.1	24.7	16.6	25.9	17.5
1954	28.1	19.0	28.8	21.1	29.8	21.7	30.4	22.3	29.8	21.4	27.9	21.0	26.6	20.0	24.9	17.3	24.1	17.4	24.2	17.0	24.6	17.4	26.5	17.3
1955	27.4	19.2	29.1	20.2	30.9	21.6	29.4	21.3	29.1	22.1	28.1	20.4	26.6	18.9	24.7	17.6	24.0	16.8	23.4	15.9	24.9	16.4	25.8	16.5
1956	28.4	18.7	28.4	20.4	29.4	21.7	28.4	21.6	28.6	21.3	27.5	19.4	26.2	19.2	24.5	16.4	24.0	15.0	24.7	15.5	25.8	16.6	27.2	17.6
1957	29.2	17.8	29.8	20.3	30.4	21.6	28.8	21.1	29.4	21.3	27.4	19.2	26.7	18.4	24.6	16.7	24.9	16.2	24.4	16.0	25.6	16.5	27.6	17.4
1958	29.2	17.8	30.5	21.3	29.9	21.9	29.6	21.8	29.6	22.4	28.8	22.1	26.0	17.7	24.4	16.3	24.2	15.6	24.4	16.7	25.9	16.2	26.1	17.3
1959	28.4	17.9	30.1	19.9	30.1	21.1	29.8	21.7	28.7	22.5	28.1	20.0	26.6	17.6	25.0	15.8	23.5	15.6	23.7	15.9	24.8	16.2	25.8	17.8
1960	27.3	20.5	28.9	20.9	28.8	22.0	29.1	22.4	28.7	21.5	27.8	19.1	26.8	18.6	24.7	17.7	23.4	16.2	24.0	17.0	24.3	17.5	25.7	17.5
1961	26.6	18.6	29.2	20.6	29.8	21.9	30.8	21.2	29.8	21.8	29.4	21.1	28.3	19.6	26.4	18.3	25.5	18.4	24.3	16.8	25.4	16.5	26.7	18.0
1962	28.3	19.9	28.6	22.1	29.2	21.7	29.5	22.2	29.5	22.1	27.6	19.3	25.8	18.0	24.7	16.0	24.0	15.1	23.6	15.7	25.1	17.0	25.7	17.8
1963	27.3	18.4	29.1	20.8	29.1	21.3	29.3	21.6	28.7	20.7	28.6	20.8	25.8	17.8	25.2	17.4	23.8	16.3	23.6	14.4	24.3	15.4	25.9	16.7
1964	27.1	18.9	29.0	20.0	29.2	21.1	29.1	23.1	28.9	22.7	26.1	19.8	24.8	18.1	24.1	16.5	22.7	14.9	22.9	15.4	23.7	15.9	25.2	16.9
1965	27.3	18.2	28.8	20.4	28.3	21.4	29.2	21.8	28.0	20.5	27.1	20.8	25.2	18.7	24.4	16.1	24.1	17.5	22.9	16.6	24.2	17.3	25.3	18.1
1966	26.8	19.1	28.2	19.9	28.5	21.3	29.2	22.1	27.9	21.5	27.8	20.3	27.2	18.1	24.7	17.4	23.9	17.0	23.7	16.5	25.4	16.9	26.0	17.2

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

Crop Year	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966
November	24	18	18	14	16	12	13	13	19	16	18	15	17	15	17
December	21	15	16	15	17	13	13	14	15	15	*43*(2)	24	18	17	15
January	22	18	28	13	20	20	14	17	*53*(2)	16	20	26	*60*(2)	19	*45*(2)
February	25	15	15	*34*(2)	16	19	18	17	*74*(2)	13	*59*(2)	16	*34*(2)	15	14
March	25	15	15	29	19	18	*33*(2)	18	15	13	18	17	24	21	25
April	22	20	16	16	17	16	28	17	15	12	21	16	18	21	15
May	24	22	22	19	18	15	14	16	17	13	20	20	22	24	13
June	25	23	20	22	17	13	14	17	17	19	17	18	20	17	16
July	20	24	16	17	15	12	11	16	15	19	19	17	20	20	18
August	25	24	23	20	14	17	20	18	16	20	22	15	20	18	20
September	21	20	19	19	17	17	17	17	20	21	18	17	20	17	14
October	20	19	20	14	18	15	17	18	18	19	22	16	17	18	20

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
February 1955	—	30	—	37	35
March 1958	34	29	22	35	31
January 1960 *Alix*	60	48	43	60	—
February 1960 *Carol*	83	82	78	74	55
December 1961 *Beryl*	49	45	33	51	40
February 1962 *Jenny*	64	74	49	58	54
January 1964 *Danielle*	48	61	55	81	53
February 1964 *Gisele*	37	33	26	42	32
January 1966 *Denise*	53	52	35	44	40

Table XI. Variety trend in Mauritius, 1952 - 1966

% Area cultivated (Estate lands)

YEAR	M. 134/32	M. 147/44	M. 31/45	M. 202/46	M. 93/48	M. 99/48	M. 253/48	M. 442/51	Other M. seedlings	Ebène 1/37	Ebène 50/47	B. 3337	B. 34104	B. 37161	B. 37172	Others
1952	90	—	—	—	—	—	—	—	3	4	—	—	—	—	—	1
1953	86	—	—	—	—	—	—	—	3	8	—	—	—	—	—	1
1954	83	—	—	—	—	—	—	—	3	9	—	1	—	1	—	1
1955	74	—	—	—	—	—	—	—	2	15	—	3	—	2	1	1
1956	66	1	1	—	—	—	—	—	3	17	—	4	—	3	2	1
1957	55	6	3	—	—	—	—	—	1	21	—	4	1	3	3	1
1958	43	10	4	—	—	—	—	—	2	24	—	5	1	3	5	1
1959	33	15	5	—	—	—	—	—	1	25	—	5	2	3	8	1
1960	25	19	5	—	—	—	—	—	1	26	—	6	2	3	10	1
1961	19	23	5	2	1	—	1	—	—	24	1	7	2	2	11	1
1962	13	26	4	4	3	—	1	—	—	21	3	7	3	2	11	1
1963	9	29	4	6	5	—	2	—	—	18	4	6	3	2	11	1
1964	6	31	3	8	9	—	2	—	1	15	5	6	2	—	11	1
1965	5	29	4	11	12	—	2	2	1	11	6	5	2	—	9	1
1966	3	26	4	13	16	1	2	5	—	9	6	4	2	—	8	1

Table XII. Percentage annual plantations under different cane varieties on sugar estates, 1962 to 1966

Years / Varieties	Island					West					North					East					South					Centre				
	1962	1963	1964	1965	1966	1962	1963	1964	1965	1966	1962	1963	1964	1965	1966	1962	1963	1964	1965	1966	1962	1963	1964	1965	1966	1962	1963	1964	1965	1966
M.134/32 ...	1.7	—	0.6	1.3	—	—	—	0.9	1.4	—	8.0	0.6	1.8	3.2	—	—	—	0.5	1.2	—	1.0	—	0.4	1.0	—	—	—	—	—	—
M.147/44 ...	28.9	31.0	22.5	3.6	2.5	44.1	55.1	40.1	13.1	10.3	53.3	68.1	56.8	13.4	0.7	32.5	30.9	22.0	1.6	6.1	23.6	23.1	14.9	—	0.8	3.6	1.0	0.4	—	—
M.31/45 ...	1.2	1.7	6.2	9.4	9.4	—	—	1.3	6.2	11.6	1.9	1.0	2.4	7.5	3.6	2.7	6.1	14.9	22.3	12.6	0.8	1.0	5.5	7.9	13.1	1.0	—	—	0.6	2.1
M.202/46 ...	16.1	14.8	21.3	21.1	16.2	15.6	23.9	28.4	29.2	30.9	12.1	12.4	22.0	23.7	15.9	26.3	19.3	23.0	23.3	13.8	15.7	15.8	25.1	24.8	19.8	8.1	7.8	4.0	0.6	3.7
M.93/48 ...	20.4	24.4	25.5	26.3	22.7	3.3	1.8	—	0.9	—	3.1	9.3	12.3	18.8	12.7	28.6	16.4	20.6	19.1	32.2	24.0	28.7	23.4	22.9	16.0	27.4	46.6	62.7	67.9	50.5
M.99/48 ...	—	0.1	0.4	3.4	3.6	—	—	0.2	1.1	4.8	—	—	—	0.6	—	—	0.3	0.6	5.7	4.9	—	0.1	0.5	4.4	4.8	—	—	0.2	1.8	3.1
M.253/48 ...	3.7	1.7	1.4	2.7	0.5	7.4	2.4	10.9	20.6	0.3	3.7	3.3	0.3	1.6	0.3	3.3	1.3	1.3	0.9	0.7	3.1	1.9	1.2	1.5	0.8	3.6	—	—	—	0.2
M.409/51 ...	—	—	0.1	0.9	5.9	—	—	—	—	1.5	—	—	—	0.8	1.5	—	—	—	—	6.7	—	—	—	—	9.8	—	—	—	—	3.4
M.442/51 ...	—	—	4.2	18.8	24.1	—	—	7.0	23.8	29.2	—	—	1.8	26.6	55.3	—	—	5.0	18.4	19.1	—	—	5.4	20.9	17.9	—	—	1.0	1.8	1.3
M.13/53 ...	—	—	—	—	2.5	—	—	—	—	6.3	—	—	—	—	5.3	—	—	—	—	1.0	—	—	—	—	1.9	—	—	—	—	0.2
M.13/56 ...	—	—	—	—	1.1	—	—	—	—	3.0	—	—	—	—	1.9	—	—	—	—	0.1	—	—	—	—	1.3	—	—	—	—	0.2
Ebène 1/37 ...	3.0	4.5	1.7	1.7	3.4	—	—	—	—	—	—	—	—	—	—	—	4.1	—	—	—	1.2	3.6	3.6	3.4	3.9	16.4	13.5	1.3	1.5	13.3
Ebène 50/47...	12.6	9.7	7.6	4.4	2.1	2.9	0.7	—	—	—	6.3	4.0	2.1	1.4	1.2	4.4	3.5	3.5	2.4	1.5	12.5	9.2	8.6	7.1	3.8	35.5	26.0	20.4	5.5	1.0
B.3337 ...	2.4	5.8	3.1	—	—	—	—	—	—	—	—	—	—	—	—	0.1	14.8	4.9	—	—	5.4	7.6	4.7	—	—	1.7	—	—	—	12.9
B.34104 ...	3.5	1.2	0.2	—	—	24.5	9.0	3.2	—	—	2.2	—	—	—	—	0.9	—	—	—	—	2.5	1.9	—	—	—	0.6	—	—	—	0.6
B.37172 ...	5.4	2.4	1.5	0.4	—	1.3	4.9	3.2	0.2	0.1	8.6	—	0.5	0.4	—	0.6	—	—	—	—	9.4	5.1	3.1	0.7	—	0.2	—	—	—	0.6
Other varieties	1.1	2.8	4.2	6.9	6.0	0.9	2.2	5.0	3.5	2.0	0.8	0.7	—	2.8	1.6	0.6	3.6	4.3	5.1	1.3	0.8	2.1	4.1	5.4	6.1	2.9	5.1	10.2	20.3	21.0
Total area arpents	13,406	12,290	13,755	13,400	11,021	1,203	531	741	1,045	804	2,251	2,445	2,176	2,255	2,212	2,800	2,274	3,164	2,554	2,281	5,225	4,902	5,696	5,593	4,090	2,077	2,127	1,978	1,953	1,634

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

Year	Island	West	North	East	South	Centre
1953	87.8	85.9	87.7	88.1	88.5	85.4
1954	88.0	83.8	86.8	89.6	89.4	85.3
1955	87.1	86.7	88.6	87.7	86.4	86.1
1956	84.5	87.5	86.4	84.9	83.8	82.9
1957	85.0	79.0	86.9	83.6	85.7	83.7
1958	82.9	77.9	86.3	77.5	83.1	85.5
1959	86.1	87.8	85.9	82.1	87.2	87.8
1960	81.9	82.2	82.7	78.3	75.2	84.8
1961	85.4	78.5	84.4	85.1	86.3	86.7
1962	82.9	72.8	83.3	82.1	84.6	82.1
1963	86.2	77.8	86.2	84.6	88.3	85.8
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

NOTE: The weight of cane produced on estates in 1966 was: virgins 399,972 tons; ratoons 2,607,030

Table XIV. Average yields of virgin and ratoon canes on estates
Tons per arpent. A : 1962 - 1965 B : 1966

Crop Cycle	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	35.8	34.6	43.7	43.6	36.5	35.3	39.2	36.2	33.4	32.6	33.5	32.2
1st Ratoon	33.4	31.4	36.4	37.0	34.3	31.9	35.3	32.9	32.0	31.3	32.6	26.9
2nd ,,	32.0	29.5	36.1	36.3	32.3	28.3	34.5	32.1	30.4	29.7	31.1	25.7
3rd ,,	30.4	29.5	33.7	33.5	31.4	28.0	32.9	33.7	29.6	28.9	30.0	25.4
4th ,,	30.0	28.0	31.8	32.4	30.7	27.2	32.0	28.9	28.9	27.8	29.3	25.2
5th ,,	29.8	27.0	31.1	32.8	30.3	26.3	31.7	28.1	28.5	26.7	29.6	24.0
6th ,,	29.2	27.7	30.7	31.5	29.7	26.3	30.5	28.7	28.3	27.4	29.4	23.7

Table XV. Evolution of 1966 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
	23rd July						*30th July*						*6th August*						*13th August*					
Cane crushed (1000 m. tons)	399	34	10	122	188	45	652	53	61	178	277	84	922	72	117	236	373	124	1,210	90	192	296	468	164
Sugar manufactured % cane	10.29	10.98	10.35	10.34	10.13	10.21	10.38	10.95	10.29	10.53	10.21	10.26	10.52	11.08	10.43	10.69	10.35	10.44	10.65	11.23	10.52	10.84	10.49	10.65
Sugar manufactured (1000 m. tons)	41.1	3.8	1.1	12.7	18.9	4.6	67.6	5.8	6.1	18.8	28.3	8.6	97.0	8.0	12.2	25.3	38.5	13.0	128.9	10.3	20.1	32.0	49.1	17.4
	20th August						*27th August*						*3rd September*						*10th September*					
Cane crushed (1000 m. tons)	1,437	107	252	341	540	197	1,715	126	326	397	630	236	1,969	143	394	446	714	272	2,194	159	455	492	790	298
Sugar manufactured % cane	10.75	11.34	10.63	10.93	10.57	10.81	10.88	11.45	10.78	11.03	10.70	10.94	10.98	11.53	10.89	11.11	10.69	11.04	11.06	11.62	10.98	11.18	10.90	11.12
Sugar manufactured (1000 m. tons)	154.5	12.1	26.8	37.2	57.1	21.3	186.6	14.4	35.1	43.8	67.5	25.8	216.2	16.5	42.9	49.7	77.0	30.1	242.7	18.5	50.0	55.0	86.1	33.1
	17th September						*24th September*						*1st October*						*8th October*					
Cane crushed (1000 m. tons)	2,479	177	526	552	880	344	2,711	192	589	598	955	377	2,975	212	659	651	1,039	414	3,233	230	731	704	1,117	451
Sugar manufactured % cane	11.13	11.67	11.07	11.26	10.98	11.18	11.19	11.73	11.18	11.30	11.03	11.22	11.28	11.80	11.28	11.39	11.11	11.27	11.34	11.86	11.38	11.41	11.18	11.30
Sugar manufactured (1000 m. tons)	275.8	20.6	58.0	62.1	96.6	38.5	303.2	22.5	65.7	67.5	105.2	42.3	335.7	25.0	74.4	74.2	115.4	46.7	366.4	27.3	83.2	80.5	124.4	51.0
	15th October						*22nd October*						*29th October*						*5th November*					
Cane crushed (1000 m. tons)	3,485	248	800	754	1,193	490	3,737	268	869	806	1,277	517	3,982	289	936	856	1,358	542	4,144	304	979	890	1,412	559
Sugar manufactured % cane	11.40	11.92	11.47	11.48	11.20	11.35	11.45	11.98	11.55	11.51	11.25	11.35	11.47	12.05	11.60	11.52	11.28	11.37	11.52	12.10	11.65	11.54	11.34	11.38
Sugar manufactured (1000 m. tons)	397.2	29.6	91.9	86.5	133.6	55.6	427.8	32.2	100.4	92.8	143.7	58.7	456.6	34.8	108.5	98.5	153.2	61.6	477.3	36.7	114.0	102.8	160.2	63.6
	12th November						*19th November*						*26th November*						*Total crop production (preliminary figs.)*					
Cane crushed (1000 m. tons)	4,309	318	1,019	929	1,470	573	4,512	338	1,066	981	1,548	579	4,672	357	1,096	1,027	1,613	579	4,844	397	1,105	1,090	1,673	579
Sugar manufactured % cane	11.54	12.14	11.70	11.55	11.39	11.40	11.56	12.18	11.74	11.57	11.41	11.39	11.59	12.20	11.76	11.56	11.46	11.39	11.60	12.20	11.77	11.53	11.47	11.39
Sugar manufactured (1000 m. tons)	497.3	38.6	118.7	107.3	167.4	65.3	522.0	41.2	125.1	113.3	176.5	65.9	541.5	43.4	128.8	118.6	184.8	65.9	561.8	48.4	130.0	125.6	191.9	65.9

Table XVI. Evolution of cane quality during 1966 sugar crop

Week Ending	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
16th July	—	10.28	12.93	11.06	—	—	11.83	10.20	11.90	10.15	11.78	10.21
23rd „	11.97	10.35	12.65	10.90	11.92	10.35	12.12	10.54	11.82	10.07	11.70	10.47
30th „	12.17	10.51	12.47	10.90	11.93	10.26	12.38	10.92	12.15	10.41	12.11	10.35
6th August	12.42	10.87	12.94	11.43	12.21	10.56	12.60	11.20	12.35	10.77	12.42	10.81
13th „	12.59	11.05	13.21	11.79	12.37	10.67	12.72	11.39	12.53	10.90	12.80	10.96
20th „	12.85	11.35	13.29	11.99	12.69	11.04	12.93	11.61	12.75	11.19	12.97	11.64
27th „	13.04	11.51	13.49	12.07	12.86	11.26	12.99	11.63	13.12	11.48	13.05	11.74
3rd Sptember	13.04	11.57	13.45	12.10	12.98	11.37	13.03	11.69	13.05	11.53	13.05	11.66
10th „	13.22	11.73	13.74	12.49	13.15	11.53	13.19	11.81	13.22	11.65	13.16	11.83
17th „	13.30	11.77	13.55	12.14	13.45	11.76	13.24	11.84	13.26	11.68	13.06	11.62
25th „	13.51	11.95	13.78	12.42	13.81	12.08	13.45	12.05	13.46	11.81	13.06	11.67
1st October	13.64	12.06	13.85	12.41	13.93	12.15	13.65	12.18	13.58	11.95	13.10	11.75
8th „	13.74	12.07	14.08	12.65	14.10	12.25	13.65	12.11	13.71	11.97	13.02	11.60
15th „	13.66	12.05	14.00	12.63	14.12	12.32	13.53	12.06	13.55	11.90	12.98	11.60
22nd „	13.76	12.03	14.35	12.76	14.15	12.53	13.57	11.93	13.63	11.91	13.07	11.52
29th „	13.82	12.16	14.34	12.67	14.38	12.47	13.51	11.84	13.60	12.04	13.27	11.71
5th November	14.00	12.24	14.60	13.14	14.62	12.65	13.73	11.88	13.74	12.04	13.49	11.93
12th „	14.05	12.30	14.46	13.00	14.80	12.90	13.82	11.90	13.77	12.08	13.20	11.60
19th „	14.00	12.18	14.34	12.82	14.71	12.66	13.63	11.76	13.90	12.13	12.36	10.76
26th „	13.85	12.40	14.15	12.53	14.26	12.46	13.10	11.43	14.10	12.60	—	—

NOTE A = Sucrose % cane

B = Sugar manufactured % cane

Table XVII. Duration of harvest in days (A) and weekly crushing rates of factories in 1000 metric tons (B) in different sectors of the island, 1948 - 1966

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1948	132	167.6	140	7.3	122	42.1	136	33.6	140	60.0	125	24.6
1949	133	176.5	142	7.7	128	44.0	129	37.0	140	62.4	127	25.4
1950	141	184.6	130	10.1	140	47.9	145	35.1	144	65.0	135	26.5
1951	154	197.8	150	10.3	169	52.0	159	40.3	140	65.8	132	29.4
1952	149	192.4	151	9.9	149	50.5	155	40.2	154	63.4	131	28.4
1953	158	205.7	162	11.8	167	57.7	161	42.5	153	66.0	145	27.7
1954	140	214.1	142	11.7	137	60.5	138	42.9	147	68.7	134	30.3
1955	133	222.6	134	12.8	122	64.2	140	41.5	140	71.6	127	32.5
1956	136	227.3	129	12.7	137	62.7	138	43.4	138	76.2	128	32.3
1957	128	237.5	144	13.3	104	68.2	133	42.9	141	78.6	129	34.5
1958	131	232.2	131	13.7	109	68.2	142	42.9	142	76.4	135	30.9
1959	134	248.4	127	15.5	106	71.8	152	46.7	148	79.4	136	35.1
1960	113	148.3	110	10.5	116	43.9	123	29.5	118	46.2	81	18.2
1961	150	230.2	147	13.6	126	66.2	160	44.6	165	72.2	154	33.6
1962	140	231.4	158	12.9	136	66.9	159	42.2	141	78.8	111	30.6
1963	153	263.3	160	16.3	132	75.4	174	50.6	156	86.0	154	34.9
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

Table XV. Evolution of 1966 crop — Production data at weekly intervals

	Island	West	North	East	South	Centre
	23rd July					
Cane crushed (1000 m. tons)	399	34	10	122	188	45
Sugar manufactured % cane	10.29	10.98	10.35	10.34	10.13	10.21
Sugar manufactured (1000 m. tons)	41.1	3.8	1.1	12.7	18.9	4.6
	20th August					
Cane crushed (1000 m. tons)	1,437	107	252	341	540	197
Sugar manufactured % cane	10.75	11.34	10.63	10.93	10.57	10.81
Sugar manufactured (1000 m. tons)	154.5	12.1	26.8	37.2	57.1	21.3
	17th September					
Cane crushed (1000 m. tons)	2,479	177	526	552	880	344
Sugar manufactured % cane	11.13	11.67	11.07	11.26	10.98	11.18
Sugar manufactured (1000 m. tons)	275.8	20.6	58.0	62.1	96.6	38.5
	15th October					
Cane crushed (1000 m. tons)	3,485	248	800	754	1,193	490
Sugar manufactured % cane	11.40	11.92	11.47	11.48	11.20	11.35
Sugar manufactured (1000 m. tons)	397.2	29.6	91.9	86.5	133.6	55.6
	12th November					
Cane crushed (1000 m. tons)	4,309	318	1,019	929	1,470	573
Sugar manufactured % cane	11.54	12.14	11.70	11.55	11.39	11.40
Sugar manufactured (1000 m. tons)	497.3	38.6	118.7	107.3	167.4	65.3

	Island	West	North	East	South	Centre
	30th July					
Cane crushed (1000 m. tons)	652	53	61	178	277	84
Sugar manufactured % cane	10.38	10.95	10.29	10.53	10.21	10.26
Sugar manufactured (1000 m. tons)	67.6	5.8	6.1	18.8	28.3	8.6
	27th August					
Cane crushed (1000 m. tons)	1,715	126	326	397	630	236
Sugar manufactured % cane	10.88	11.45	10.78	11.03	10.70	10.94
Sugar manufactured (1000 m. tons)	186.6	14.4	35.1	43.8	67.5	25.8
	24th September					
Cane crushed (1000 m. tons)	2,711	192	589	598	955	377
Sugar manufactured % cane	11.19	11.73	11.18	11.30	11.03	11.22
Sugar manufactured (1000 m. tons)	303.2	22.5	65.7	67.5	105.2	42.3
	22nd October					
Cane crushed (1000 m. tons)	3,737	268	869	806	1,277	517
Sugar manufactured % cane	11.45	11.98	11.55	11.51	11.25	11.35
Sugar manufactured (1000 m. tons)	427.8	32.2	100.4	92.8	143.7	58.7
	19th November					
Cane crushed (1000 m. tons)	4,512	338	1,066	981	1,548	579
Sugar manufactured % cane	11.56	12.18	11.74	11.57	11.41	11.39
Sugar manufactured (1000 m. tons)	522.0	41.2	125.1	113.3	176.5	65.9

	Island	West	North	East	South	Centre
	6th August					
Cane crushed (1000 m. tons)	922	72	117	236	373	124
Sugar manufactured % cane	10.52	11.08	10.43	10.69	10.35	10.44
Sugar manufactured (1000 m. tons)	97.0	8.0	12.2	25.3	38.5	13.0
	3rd September					
Cane crushed (1000 m. tons)	1,969	143	394	446	714	272
Sugar manufactured % cane	10.98	11.53	10.89	11.11	10.69	11.04
Sugar manufactured (1000 m. tons)	216.2	16.5	42.9	49.7	77.0	30.1
	1st October					
Cane crushed (1000 m. tons)	2,975	212	659	651	1,039	414
Sugar manufactured % cane	11.28	11.80	11.28	11.39	11.11	11.27
Sugar manufactured (1000 m. tons)	335.7	25.0	74.4	74.2	115.4	46.7
	29th October					
Cane crushed (1000 m. tons)	3,982	289	936	856	1,358	542
Sugar manufactured % cane	11.47	12.05	11.60	11.52	11.28	11.37
Sugar manufactured (1000 m. tons)	456.6	34.8	108.5	98.5	153.2	61.6
	26th November					
Cane crushed (1000 m. tons)	4,672	357	1,096	1,027	1,613	579
Sugar manufactured % cane	11.59	12.20	11.76	11.56	11.46	11.39
Sugar manufactured (1000 m. tons)	541.5	43.4	128.8	118.6	184.8	65.9

	Island	West	North	East	South	Centre
	13th August					
Cane crushed (1000 m. tons)	1,210	90	192	296	468	164
Sugar manufactured % cane	10.65	11.23	10.52	10.84	10.49	10.65
Sugar manufactured (1000 m. tons)	128.9	10.3	20.1	32.0	49.1	17.4
	10th September					
Cane crushed (1000 m. tons)	2,194	159	455	492	790	298
Sugar manufactured % cane	11.06	11.62	10.98	11.18	10.90	11.12
Sugar manufactured (1000 m. tons)	242.7	18.5	50.0	55.0	86.1	33.1
	8th October					
Cane crushed (1000 m. tons)	3,233	230	731	704	1,117	451
Sugar manufactured % cane	11.34	11.86	11.38	11.41	11.18	11.30
Sugar manufactured (1000 m. tons)	366.4	27.3	83.2	80.5	124.4	51.0
	5th November					
Cane crushed (1000 m. tons)	4,144	304	979	890	1,412	559
Sugar manufactured % cane	11.52	12.10	11.65	11.54	11.34	11.38
Sugar manufactured (1000 m. tons)	477.3	36.7	114.0	102.8	160.2	63.6
	Total crop production (preliminary figs.)					
Cane crushed (1000 m. tons)	4,844	397	1,105	1,090	1,673	579
Sugar manufactured % cane	11.60	12.20	11.77	11.53	11.47	11.39
Sugar manufactured (1000 m. tons)	561.8	48.4	130.0	125.6	191.9	65.9

Table XVIII. Summary of chemical control data 1966

(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	9/7	22/7	22/7	15/7	22/7	30/7	5/8	14/7	6/7	6/7	7/7
	To	12/12	23/11	10/11	9/11	22/11	26/11	2/12	6/12	9/12	2/12	6/12
	No. of crushing days	128	100	90	93	97	95	95	118	128	122	124
	No. of crushing hours per day	22.15	21.30	23.42	21.06	20.06	20.08	20.78	19.70	20.11	18.70	16.08
	Hours stoppage per day	0.66	0.74	0.31	1.10	0.84	0.73	1.08	0.55	0.43	0.16	0.46
	Overall time Efficiency	97.0	96.7	98.7	95.1	96.0	96.5	95.2	97.3	97.9	98.2	97.2
CANE CRUSHED (Metric Tons)	Factory	215.971	43.556	52.174	100.378	102.001	85.108	128.782	105.711	396.862	173.999	67.335
	Planters	180.610	130.472	114.189	53.113	112.474	96.324	86.087	117.395	211.961	83.971	50.913
	Total	396.581	174.028	166.363	153.491	214.475	181.432	214.869	223.106	608.823	257.970	118.248
	Factory % Total	54.4	25.0	30.4	68.4	43.4	37.3	58.3	47.4	65.1	67.4	56.9
	Per day	3,098	1,740	1,843	1,650	2,211	1,910	2,262	1,891	4,756	2,115	0,954
	Per hour actual crushing	139.2	81.7	78.7	78.4	110.2	95.1	108.9	96.0	235.7	113.0	60.6
VARIETIES CRUSHED (Factory)	M.134/32 per cent	3.2	2.5	3.5	0.6	15.8	—	10.8	—	0.6	0.1	—
	M.147/44 per cent	31.3	27.8	52.4	35.5	51.6	60.2	64.5	52.2	19.9	33.9	26.2
	M.31/45 per cent	1.8	0.1	4.3	6.5	1.4	3.9	4.3	7.6	8.7	12.9	5.7
	M.202/46 per cent	18.7	40.5	19.7	15.1	9.3	5.6	3.4	17.7	17.1	15.2	14.2
	M.93/48 per cent	1.2	3.3	5.2	19.7	2.5	2.7	6.8	2.1	19.0	9.2	11.0
	M.253/48 per cent	12.5	5.7	1.3	2.1	2.2	0.3	0.3	1.1	—	2.8	—
	Ebène 1/37 per cent	—	—	—	2.4	0.6	—	—	0.8	11.0	6.5	2.2
	Ebène 50/47 per cent	1.0	3.7	1.6	4.2	1.7	—	0.9	3.4	3.9	3.0	4.3
	B.3337 per cent	—	—	—	—	—	—	—	0.1	7.0	0.8	5.0
	B.37172 per cent	10.1	14.6	5.4	7.3	8.2	24.6	5.9	6.6	3.3	12.4	8.2
	B.34104 per cent	12.8	—	3.3	0.2	0.8	—	—	—	—	1.0	8.8
	M.442/51 per cent	4.0	1.8	1.4	6.0	3.5	2.4	2.1	8.2	2.4	1.7	11.5
	Other varieties per cent	3.4	—	1.9	0.4	2.4	0.2	1.0	0.2	7.1	0.5	2.9
SUGAR PRODUCED (Metric Tons)	Raw Sugar	48,395	20,016	19,745	17,855	25,416	13,125	26,281	25,918	70,701	29,151	5,048
	White Sugar	—	—	—	—	—	7,568	—	—	—	—	7,696
	Total Sugar	48,395	20,016	19,745	17,855	25,416	20,693	26,281	25,918	70,701	29,151	12,744
	Tons Sugar at 96° Pol.	49,836	20,556	20,326	18,367	26,202	21,342	27,008	26,698	72,579	30.001	13,173

		Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CRUSHING PERIOD	From	6/7	6/7	7/7	8/7	7/7	14/7	8/7	11/7	12/7	8/7	16/7	24/6	—
	To	28/11	2/12	30/11	19/11	26/11	20/12	10/12	24/11	28/11	18/11	17/10	10/11	—
	No. of crushing days	117	122	119	106	115	130	127	111	114	108	77	98	111
	No. of crushing hours per day	15.56	17.45	20.50	20.94	18.45	17.01	17.14	21.70	18.25	16.60	20.14	20.69	19.57
	Hours stoppage per day	0.24	1.21	0.20	0.35	0.39	0.23	0.76	0.89	1.38	0.25	0.70	0.86	0.62
	Overall time Efficiency	98.5	93.5	98.4	97.3	97.9	98.7	95.8	95.9	92.4	98.5	96.6	96.0	96.9
CANE CRUSHED (Metric Tons)	Factory	167.995	171,672	181,465	131,066	123,027	124,040	167,231	47,409	59,594	102,985	89,662	179,971	3,017,994
	Planters	28.885	37,588	63,168	54,338	22,642	1,795	10,903	72.792	88,994	71,186	50,559	84,563	1,824,922
	Total	196.880	209,260	244,633	185,404	145,669	125,835	178,134	120,201	148,588	174,171	140,221	264,534	4,842,916
	Factory % Total	85.3	82.0	74.2	70.7	84.5	98.6	93.8	39.4	40.1	59.1	63.9	68.0	62.3
	Per day	1.683	1,715	2,056	1,741	1,266	0,968	1,403	1,083	1,303	1,613	1,821	2,699	1,904
	Per hour actual crushing	108.1	98.3	98.7	83.1	71.2	56.9	81.8	52.0	71.4	97.3	90.4	130,4	97.3
VARIETIES CRUSHED (Factory)	M.134/32 per cent	0.4	2.0	11.7	—	—	4.7	12.7	4.0	9.5	1.9	—	—	3.5
	M.147/44 per cent	44.5	30.9	14.3	0.2	12.4	12.2	18.2	35.2	36.4	15.8	0.3	4.5	26.8
	M.31/45 per cent	1.7	6.5	3.2	0.4	1.8	6.3	4.3	6.1	2.8	2.5	—	—	4.5
	M.202/46 per cent	11.5	14.3	16.9	23.2	7.6	14.7	10.4	7.6	13.8	12.6	1.9	3.6	13.6
	M.93/48 per cent	7.3	7.3	9.8	35.9	38.7	8.2	14.2	7.6	2.8	24.1	15.7	43.9	14.6
	M.253/48 per cent	—	—	—	—	—	2.1	1.6	—	0.3	2.8	—	—	1.7
	Ebène 1/37 per cent	3.5	8.2	10.0	19.4	15.7	2.4	8.0	7.3	0.6	16.4	12.1	33.0	8.4
	Ebène 50/47 per cent	3.4	6.7	5.1	4.7	1.0	6.7	12.3	4.3	4.0	9.4	51.1	8.7	5.9
	B.3337 per cent	10.5	0.5	2.0	14.6	12.0	—	2.8	2.4	—	4.6	1.3	1.5	3.4
	B.37172 per cent	11.2	8.4	16.0	—	—	35.9	8.4	13.2	15.8	2.4	—	—	8.6
	B.34104 per cent	0.4	3.6	0.4	—	—	—	—	3.1	0.2	2.0	—	—	1.6
	M.442/51 per cent	2.2	1.8	3.6	0.5	4.4	4.0	3.4	5.2	8.4	1.1	—	0.8	3.1
	Other varieties per cent	3.4	10.0	7.0	1.1	6.4	2.8	3.7	3.9	5.4	4.4	17.6	4.0	4.3
SUGAR PRODUCED (Metric Tons)	Raw Sugar	22,388	25,494	29,638	21,462	16,695	6,559	20,183	13,166	16,122	19,111	16,804	30,033	539,306
	White Sugar	—	—	—	—	—	7,529	—	—	—	—	—	—	**22,793**
	Total Sugar	22,388	25,494	29,638	21,462	16,695	14,088	20,183	13,166	16,122	19,111	16,804	30,033	**562,099**
	Tons Sugar at 96° Pol.	23,088	26,294	30,515	22,086	17,203	14,549	20,797	13,530	16,612	19,689	17,306	30,920	578,677

Table XVIII. Summary of chemical control data 1966

(ii) CANE, BAGASSE, AND JUICES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE/SUGAR RATIO	Tons cane per ton sugar made	8.2	8.7	8.4	8.6	8.4	8.8	8.2	8.6	8.6	8.9	9.3	8.8	8.2	8.3	8.6	8.7	8.9	8.8	9.1	9.2	9.1	8.4	8.8	8.6
	„ „ „ „ „ @ 96° Pol.	8.0	8.5	8.2	8.5	8.2	8.5	8.0	8.4	8.4	8.6	8.9	8.5	8.0	8.0	8.4	8.5	8.6	8.6	8.8	8.9	8.9	8.1	8.7	8.4
	Sucrose per cent	13.68	13.45	13.40	13.05	13.72	13.55	13.80	13.48	12.98	12.89	12.62	12.69	13.82	13.65	12.97	12.97	13.49	12.89	12.58	12.76	12.45	13.15	12.93	13.20
	Fibre per cent	13.66	13.27	14.17	13.45	14.51	14.87	13.91	15.08	12.92	13.38	15.00	13.88	13.05	13.20	12.50	13.12	13.89	12.05	14.11	14.38	13.01	12.03	11.97	13.46
BAGASSE	Pol. per cent	1.94	2.16	1.88	1.80	2.08	2.45	2.14	2.03	1.88	1.63	2.15	1.68	2.56	2.36	2.13	2.41	2.74	1.93	1.91	2.04	2.07	1.63	2.03	2.05
	Moisture per cent	50.3	49.4	47.9	46.8	48.0	50.2	49.2	46.1	50.0	47.0	49.0	48.8	48.8	48.5	49.4	49.3	45.1	49.4	45.5	49.2	49.5	50.2	48.0	48.7
	Fibre per cent	47.01	47.64	49.38	50.83	49.22	46.38	47.76	51.04	47.50	50.74	48.06	48.99	47.97	48.40	47.69	47.54	51.40	48.00	51.95	48.10	47.70	47.60	49.32	48.49
	Weight per cent cane	29.1	27.9	28.7	26.5	29.5	32.1	29.1	29.6	27.2	26.4	31.2	28.3	27.2	27.3	26.2	27.6	27.0	25.1	27.2	29.9	27.3	25.3	24.3	27.73
1st EXPRESSED	Brix (B_1)*	19.22	19.62	19.53	18.35	19.88	17.87	19.68	19.47	18.10	18.60	17.97	18.03	19.30	18.81	17.75	17.90	18.68	17.56	17.17	16.98	17.65	17.53	17.57	18.40
JUICE	Gravity Purity	88.8	88.0	88.8	90.9	89.8	89.0	89.9	88.7	90.2	89.4	87.8	89.9	90.3	90.1	90.1	91.5	89.9	90.5	88.8	90.5	90.4	90.8	90.1	89.7
	Reducing sugar/sucrose ratio	3.1	2.9	3.1	3.1	2.5	2.5	2.5	3.6	2.8	2.6	3.2	2.6	2.0	1.9	2.5	2.7	2.1	3.6	2.3	3.0	2.4	3.0	2.7	2.7
LAST EXPRESSED	Brix*	2.43	3.27	2.44	1.48	3.35	3.92	2.79	2.33	3.59	2.85	2.71	3.22	3.61	2.78	2.97	2.95	4.04	2.42	2.30	2.20	2.64	2.09	2.89	2.84
JUICE	Apparent Purity	72.3	74.9	70.1	74.5	74.3	70.9	70.0	70.8	75.5	72.3	73.0	77.0	78.1	76.2	73.1	76.3	78.5	74.8	75.2	74.5	76.0	76.4	76.7	74.4
MIXED JUICE	Brix*	14.97	15.20	14.56	13.60	13.66	14.64	13.99	14.39	14.17	13.66	13.13	13.03	14.32	14.27	13.44	13.63	14.46	13.15	12.36	12.12	13.03	13.79	14.44	13.94
	Gravity Purity	87.5	85.9	86.3	87.6	87.4	86.5	88.0	86.7	88.3	87.6	86.3	87.9	88.1	88.1	88.5	89.1	89.0	88.5	86.7	88.2	88.6	89.2	88.5	87.7
	Reducing sugar/sucrose ratio	3.7	3.8	3.8	3.9	3.1	3.1	3.5	4.6	3.4	3.4	3.9	3.3	2.5	2.5	2.9	3.3	2.6	4.3	2.9	3.5	2.8	3.3	3.2	3.4
	Gty. Pty. drop from 1st expressed juice	1.3	2.1	2.5	3.3	2.4	2.5	1.9	2.0	1.9	1.8	1.5	2.0	2.2	2.0	1.6	2.4	0.9	2.0	2.1	2.3	1.8	1.6	1.6	2.0
ABSOLUTE JUICE	Brix (B_A)	18.27	18.18	18.26	17.32	18.51	18.62	18.43	18.49	17.00	17.11	17.37	16.84	18.15	17.98	16.90	16.90	17.72	16.67	16.98	17.05	16.28	16.85	16.70	17.52
	B_A/B_1	0.951	0.927	0.935	0.944	0.931	0.924	0.936	0.950	0.939	0.920	0.960	0.933	0.941	0.956	0.950	0.944	0.949	0.949	0.980	1.004	0.922	0.961	0.950	0.952
	Gravity Purity	86.8	85.3	85.5	87.1	86.7	85.4	87.0	85.8	87.7	87.0	85.5	87.5	87.5	87.4	87.7	88.4	88.4	87.9	86.2	87.4	87.9	88.7	88.0	87.1
CLARIFIED JUICE	Brix*	14.94	14.77	13.90	13.63	13.70	14.03	13.21	13.46	14.25	13.66	12.66	12.72	14.04	13.93	12.69	13.87	14.50	13.07	12.40	12.20	13.00	13.75	14.27	13.59
	Gravity Purity	—	86.8	86.7	88.3	87.8	86.4	—	86.6	88.4	87.6	86.6	89.5	88.8	88.6	—	90.7	88.1	—	87.5	88.0	89.2	89.5	89.1	88.1
	Reducing Sugar/sucrose ratio	3.7	3.7	4.3	3.8	3.1	3.3	—	4.4	3.4	3.0	3.7	2.8	2.4	2.6	2.9	3.5	2.8	—	2.7	3.3	2.7	3.3	3.1	3.3

* *Refractometric Brix*

Table XVIII. Summary of chemical control data 1966

(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	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Sucrose per cent	0.92	1.10	1.66	2.19	1.38	1.16	1.05	1.70	0.75	1.30	0.45	0.67	2.09	1.41	2.60	2.59	2.86	1.50	8.00	6.90	7.10	2.71	2.85	1.80
	Weight per cent cane	3.0	3.4	5.1	3.4	4.5	5.1	3.1	2.9	3.8	3.4	3.8	4.8	4.9	1.9	2.3	2.8	2.3	2.2	1.9	2.5	1.8	2.4	4.6	3.4
SYRUP	Brix*	59.7	54.7	56.6	61.3	57.2	63.9	58.2	58.5	61.6	58.2	61.4	68.3	59.6	60.5	67.8	62.4	58.1	59.4	55.2	57.2	54.8	59.0	63.8	59.9
	Gravity Purity	—	85.2	86.3	88.4	87.9	86.9	—	87.2	88.3	87.7	87.9	88.9	89.1	88.4	—	90.2	87.6	—	87.4	87.4	88.7	89.3	88.9	88.0
	Reducing sugar/sucrose ratio	3.8	3.6	4.4	4.0	3.2	3.5	—	4.5	3.8	2.5	3.5	2.8	2.7	1.4	2.9	3.9	—	—	2.6	3.1	3.0	3.3	3.1	3.3
pH VALUES	Limed juice	7.7	—	8.1	8.2	—	7.8	—	8.7	8.2	8.3	—	8.1	7.8	7.7	—	7.9	8.1	8.3	—	7.6	8.3	8.1	7.8	8.0
	Clarified juice	7.3	7.2	7.1	7.0	7.2	7.2	7.2	6.9	7.4	7.1	7.1	7.3	7.4	7.5	7.2	7.2	6.8	7.3	6.9	7.0	7.2	7.4	7.2	7.2
	Filter Press juice	—	—	9.0	8.0	7.2	8.4	8.0	6.9	9.0	7.5	—	8.7	7.2	7.6	7.9	—	—	6.6	—	—	6.7	7.6	7.8	7.8
	Syrup	—	—	6.8	6.4	6.4	6.6	—	6.6	7.0	6.9	7.1	7.1	6.8	7.3	—	—	5.8	6.8	—	7.0	7.0	7.2	7.1	6.8
FINAL MOLASSES	Brix**	88.6	90.5	90.5	89.5	89.4	88.9	90.0	87.0	87.0	89.5	86.0	90.3	88.0	91.5	91.2	86.4	88.4	89.4	90.0	88.6	85.5	86.7	89.3	88.9
	Sucrose per cent	34.12	35.65	32.28	33.99	35.72	34.63	35.64	32.86	35.60	34.81	32.48	33.60	32.70	34.40	35.70	32.10	39.40	36.26	35.00	34.77	34.49	34.10	36.57	34.72
	Reducing sugar per cent	16.72	12.91	17.87	13.70	12.29	13.17	12.04	16.54	10.50	13.59	13.98	11.56	13.00	12.40	13.91	15.30	10.80	11.68	11.70	12.90	11.80	14.00	13.38	13.25
	Total sugars per cent	50.84	48.56	50.15	47.69	48.01	47.80	47.68	49.40	46.10	48.40	46.46	45.16	45.70	46.80	49.61	47.40	50.20	47.94	46.70	47.67	46.29	48.10	49.95	47.97
	Gravity Purity	38.5	39.4	35.7	38.1	40.0	39.0	39.6	37.8	40.5	38.9	37.8	37.2	37.1	37.6	39.1	37.2	44.5	40.5	38.9	39.2	40.3	39.3	41.0	39.1
	Reducing sugar/sucrose ratio	49.0	36.2	55.4	40.3	34.4	38.0	33.8	50.3	29.4	39.0	—	34.4	39.8	36.0	39.0	47.7	27.4	32.2	33.4	37.0	34.2	41.0	36.6	38.2
	Weight per cent cane at 85° Brix	2.85	3.71	3.27	2.78	3.27	3.66	3.05	3.31	2.74	3.04	2.89	2.75	2.66	2.54	2.39	2.36	3.02	2.72	2.78	3.15	2.44	2.35	2.59	2.88
SUGAR MADE	White sugar recovered per cent cane	—	—	—	—	—	4.17	—	—	—	—	6.51	—	—	—	—	—	6.04	—	—	—	—	—	—	0.47
	Raw " " " " "	12.20	11.50	11.87	11.65	11.85	7.24	12.23	11.62	11.61	11.30	4.27	11.37	12.18	12.12	11.58	11.46	5.16	11.29	10.95	10.85	10.97	11.98	11.35	11.14
	Total " " " " "	12.20	11.50	11.87	11.65	11.85	11.41	12.23	11.62	11.61	11.30	10.78	11.37	12.18	12.12	11.58	11.46	11.20	11.29	10.95	10.85	10.97	11.98	11.35	11.61
	Average Pol. of sugars	98.86	98.59	98.82	98.75	98.97	99.01	98.66	98.89	98.55	98.80	99.23	99.00	99.01	98.84	98.79	98.92	99.18	98.92	98.66	98.98	98.90	98.86	98.83	98.83
	Total sucrose recovered per cent cane	12.06	11.34	11.73	11.49	11.73	11.29	12.07	11.49	11.44	11.16	10.69	11.26	12.06	11.97	11.44	11.34	11.10	11.21	10.81	10.73	10.85	11.84	11.22	11.47
	Moisture content of raw sugar per cent	0.27	0.28	0.26	0.35	0.34	0.29	0.28	0.28	0.32	0.34	0.36	0.27	0.25	0.32	0.33	0.34	0.55	0.32	0.37	0.32	0.27	0.31	0.29	0.31
	Dilution indicator	31.0	28.5	29.7	41.3	49.2	42.4	26.4	33.4	28.6	36.7	41.9	37.4	34.0	38.1	37.5	45.9	—	41.8	37.4	41.8	32.8	37.3	34.2	36.0

* *Refractometric Brix 1 : 5 w/w*
** *" " 1 : 6 w/w*

Table XVIII. Summary of chemical control data 1966

(iv) MASSECUITES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MAGMA	Apparent Purity	82.0	88.3	85.8	84.5	94.3	82.8	83.0	85.6	83.4	85.5	92.4	92.4	87.9	92.7	77.7	92.5	—	87.4	85.5	90.7	84.4	86.7	88.0	87.0
A—MASSECUITE	Brix	90.2	92.2	91.4	91.2	91.3	90.6	92.4	94.6	91.8	91.7	90.2	91.0	91.3	92.5	92.2	90.5	89.9	91.0	92.1	91.3	90.5	91.7	91.1	91.2
	Apparent Purity	86.5	85.8	85.7	85.7	85.9	85.5	81.9	78.6	85.8	87.9	86.9	89.8	88.8	84.1	87.2	89.6	88.0	88.6	86.3	85.6	85.9	89.1	85.9	86.0
	„ „ of A—Molasses	71.3	65.0	65.9	66.7	65.8	66.8	63.9	56.6	67.8	66.3	69.4	70.5	67.7	65.0	65.3	71.5	75.6	72.2	67.2	69.1	70.4	70.4	68.7	67.6
	Drop in Purity	15.2	20.8	19.8	19.0	20.1	18.7	18.0	22.0	18.0	21.6	17.5	19.2	21.1	19.1	21.9	18.1	12.4	16.4	19.1	16.5	15.5	18.7	17.2	18.4
	Crystal per cent Brix in massecuite	53.0	59.4	58.1	57.1	58.8	56.3	49.8	50.7	55.9	64.1	53.4	65.2	65.3	54.6	63.1	63.5	50.9	59.0	58.2	53.4	52.4	63.2	55.0	56.8
	Cubic feet per ton Brix in Mixed Juice	30.0	25.9	25.8	31.6	25.0	37.3	34.0	30.0	29.1	31.6	27.3	28.9	24.9	35.1	32.4	26.0	34.4	33.4	26.7	38.9	25.8	26.2	40.0	30.6
	A—Massecuite per cent total massecuite	58.8	54.2	55.1	69.1	58.7	62.1	60.8	60.9	65.8	60.6	43.8	57.2	53.8	63.7	60.2	51.9	51.5	55.8	52.0	61.8	59.1	56.1	70.2	59.6
B—MASSECUITE	Brix	91.3	91.5	90.9	92.2	92.6	92.6	92.2	96.2	92.7	91.8	90.2	92.0	92.4	93.4	92.8	91.7	90.4	92.5	91.5	93.5	91.7	91.7	92.4	92.2
	Apparent Purity	74.6	74.3	72.4	72.7	75.5	74.3	73.2	69.8	73.6	71.9	77.1	78.8	74.9	75.6	75.6	78.6	80.2	78.4	74.3	76.4	78.1	79.2	75.6	75.2
	„ „ of B—Molasses	54.7	52.1	50.5	53.0	54.1	53.4	54.4	49.4	59.1	49.9	62.2	56.8	50.6	57.6	49.5	55.0	66.8	58.0	53.1	54.3	57.0	56.1	56.9	55.2
	Drop in Purity	19.9	22.2	21.9	19.7	21.4	20.9	18.8	20.4	14.5	22.0	14.9	22.0	24.3	18.0	26.1	23.6	13.3	20.4	21.2	21.1	21.1	23.1	18.7	20.0
	Crystal per cent Brix in massecuite	43.9	46.3	44.2	41.9	46.6	44.8	41.2	40.3	35.5	43.9	65.1	50.9	49.2	42.5	51.7	52.4	40.2	48.6	45.2	46.2	49.1	52.6	43.4	44.6
	Cubic feet per ton Brix in Mixed Juice	13.2	10.5	12.5	6.4	8.2	11.3	13.1	11.5	8.3	10.7	21.9	10.6	13.2	12.0	11.7	13.0	17.6	16.6	14.7	14.4	10.8	12.0	9.6	11.7
	B—Massecuite per cent total Massecuite	25.8	22.1	26.8	14.0	19.4	18.8	23.5	23.5	18.4	20.5	35.1	21.1	28.6	21.8	21.8	26.1	26.4	27.7	28.7	22.9	24.9	25.7	16.8	22.8
	Kg. Sugar per cubic foot of A & B Massecuite	18.8	21.1	20.6	21.4	23.8	15.9	17.7	18.8	21.6	18.8	15.8	20.7	21.4	17.4	18.7	21.3	15.0	16.1	18.9	14.7	22.3	22.0	—	19.0
C—MASSECUITE	Brix	92.1	93.3	92.8	94.4	95.7	94.9	94.0	99.1	94.7	94.4	93.2	94.6	94.4	97.5	94.8	92.5	93.1	95.8	94.0	94.3	94.2	93.7	97.6	94.6
	Apparent Purity	60.2	61.3	56.7	59.7	60.9	60.1	59.7	55.7	61.7	57.5	63.3	63.5	60.7	61.6	60.8	64.2	67.7	62.7	61.3	61.2	60.5	63.4	61.3	61.1
	„ „ of final Molasses	34.8	36.5	29.1	35.9	37.6	37.1	39.1	32.0	37.9	35.4	34.3	34.2	34.0	34.2	34.9	37.2	40.5	36.9	35.1	36.3	37.1	35.1	39.2	35.9
	Drop in Purity	25.4	24.8	27.6	23.8	23.3	23.0	20.1	23.7	23.8	22.1	29.0	29.3	26.7	27.4	25.9	27.0	27.1	25.8	26.2	24.9	23.4	28.3	22.1	25.2
	Crystal per cent Brix in massecuite	39.0	39.1	41.0	37.1	37.3	36.6	33.3	34.8	38.3	34.2	44.1	44.5	40.5	41.6	39.8	43.0	45.6	40.9	40.3	39.1	37.2	43.6	36.3	39.3
	Cubic feet per ton Brix in Mixed Juice	7.8	11.3	8.5	9.2	9.3	11.5	8.8	7.5	7.1	9.9	13.2	11.0	8.2	8.0	9.7	11.0	14.7	9.9	9.9	9.7	7.1	8.5	7.4	8.9
	C—Massecuite per cent total massecuite	15.4	23.7	18.1	16.9	21.9	19.1	15.8	15.6	15.8	18.9	21.2	21.7	17.6	14.5	18.0	22.0	22.1	16.5	19.3	15.3	16.3	18.2	13.0	17.6
TOTAL	Cubic feet per ton Brix in Mixed Juice	51.1	47.8	46.8	45.7	42.5	60.1	56.0	49.1	45.2	52.2	62.1	50.5	46.2	55.1	53.8	50.0	68.9	59.9	51.4	63.1	43.7	46.6	56.9	51.4
MASSECUITE	„ „ „ „ sugar made	62.7	62.1	58.8	56.3	53.8	77.8	67.0	62.8	54.9	65.7	80.1	61.6	56.5	67.1	65.2	60.3	85.3	74.4	65.2	80.0	53.6	55.5	70.5	63.7

Table XVIII. Summary of chemical control data 1966

(v) MILLING WORK, SUCROSE LOSSES AND BALANCE RECOVERIES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MILLING WORK	Imbibition water % cane	29.2	26.3	31.1	32.0	39.3	32.8	36.1	32.8	26.9	30.5	36.6	34.9	31.1	30.7	30.5	28.9	26.1	31.7	39.6	43.6	30.2	28.8	21.6	31.0
	„ „ % fibre	214	198	219	238	271	221	260	217	208	228	244	251	238	233	244	221	188	263	282	303	233	239	181	230
	Extraction ratio	30.0	33.8	28.4	27.1	30.8	38.9	32.5	29.8	30.2	25.0	35.3	27.1	38.7	36.4	34.6	38.9	39.5	31.2	29.3	33.4	34.9	26.1	31.8	31.9
	Mill extraction	95.9	95.5	96.0	96.4	95.5	94.2	95.5	95.5	96.1	96.7	94.7	96.2	95.0	95.2	95.7	94.9	94.5	96.2	95.9	95.2	95.5	96.9	96.2	95.7
	Reduced mill extraction	96.3	95.8	96.5	96.7	96.2	95.3	96.0	96.4	96.2	96.9	95.7	96.7	95.2	95.5	95.7	95.2	95.1	96.1	96.4	95.9	95.7	96.7	96.0	96.1
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.56	0.60	0.54	0.48	0.61	0.79	0.62	0.60	0.51	0.43	0.67	0.48	0.70	0.65	0.56	0.66	0.74	0.48	0.52	0.61	0.57	0.41	0.49	0.57
	„ „ in filter cake % cane	0.03	0.04	0.08	0.08	0.06	0.06	0.03	0.05	0.03	0.04	0.02	0.03	0.10	0.03	0.06	0.07	0.07	0.03	0.15	0.17	0.13	0.06	0.13	0.06
	„ „ in molasses % cane	0.94	1.24	0.99	0.90	1.11	1.21	1.03	1.06	0.94	1.01	0.95	0.87	0.84	0.81	0.79	0.75	1.15	0.94	0.92	1.05	0.84	0.79	0.90	0.95
	Undetermined losses % cane	0.09	0.23	0.06	0.10	0.21	0.21	0.05	0.28	0.06	0.25	0.29	0.05	0.12	0.19	0.11	0.15	0.43	0.23	0.18	0.20	0.06	0.05	0.19	0.15
	Industrial losses % cane	1.06	1.51	1.13	1.08	1.38	1.48	1.11	1.39	1.03	1.30	1.26	0.95	1.06	1.03	0.96	0.97	1.65	1.20	1.25	1.42	1.03	0.90	1.22	1.16
	Total losses % cane	1.62	2.11	1.67	1.56	1.99	2.26	1.73	1.99	1.54	1.73	1.93	1.43	1.76	1.68	1.52	1.63	2.39	1.68	1.77	2.03	1.60	1.31	1.71	1.73
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	4.09	4.47	4.03	3.68	4.45	5.79	4.52	4.45	3.95	3.34	5.30	3.78	5.07	4.76	4.32	5.09	5.49	3.72	4.13	4.78	4.54	3.12	3.79	4.30
	„ „ filter cake % sucrose in cane	0.22	0.30	0.60	0.61	0.44	0.44	0.23	0.37	0.22	0.31	0.13	0.24	0.72	0.22	0.46	0.54	0.52	0.23	1.19	1.33	1.02	0.45	1.01	0.46
	„ „ molasses % sucrose in cane	6.87	9.22	7.39	6.90	8.09	8.93	7.44	7.86	7.26	7.84	7.51	6.86	6.08	5.93	6.09	5.78	8.52	7.29	7.31	8.23	6.73	6.01	6.96	7.23
	Undetermined losses % sucrose in cane	0.66	1.72	0.45	0.77	1.53	1.55	0.36	2.08	0.42	1.93	2.33	0.39	0.87	1.39	0.85	1.16	3.19	1.78	1.43	1.57	0.53	0.38	1.47	1.13
	Industrial losses % sucrose in cane	7.75	11.24	8.43	8.28	10.06	10.92	8.03	10.31	7.90	10.08	9.98	7.49	7.67	7.55	7.40	7.48	12.23	9.31	9.94	11.13	8.28	6.84	9.44	8.82
	Total losses % sucrose in cane	11.84	15.71	12.46	11.95	14.50	16.71	12.55	14.76	11.85	13.42	15.29	11.27	12.74	12.31	11.72	12.57	17.72	13.03	14.07	15.91	12.82	9.96	13.23	13.13
RECOVERIES	Boiling house recovery	92.0	88.2	91.2	91.3	89.4	88.4	91.6	89.2	91.8	89.6	89.5	92.2	91.9	92.1	92.3	92.1	87.1	90.3	89.6	88.3	91.3	93.1	90.2	90.8
	Reduced boiling house recovery (Pty. M.J.85°)	90.1	87.4	90.2	89.2	87.0	86.9	89.1	87.5	89.1	86.9	88.3	90.0	89.4	89.7	89.3	88.6	81.6	86.8	88.0	84.4	87.8	89.9	86.7	88.4
	Overall recovery	88.2	84.3	87.5	88.0	85.4	83.3	87.4	85.3	88.2	86.6	84.7	88.7	87.2	87.8	88.3	87.4	82.3	87.0	85.9	84.1	87.2	90.1	86.8	86.9
	Reduced overall recovery (Pty.M.J. 85°, F % C 12.5)	86.8	83.7	87.1	86.3	83.7	82.8	85.6	87.5	85.7	84.2	84.5	87.0	85.1	85.7	85.5	84.3	77.6	83.4	84.9	80.9	84.0	86.9	83.8	85.0
	Boiling house efficiency	100.4	98.1	99.5	99.4	98.4	97.6	99.9	97.9	100.0	97.9	98.7	99.9	99.5	99.8	99.9	98.9	96.2	98.5	98.6	96.2	99.4	100.4	98.6	99.2

Table XIX. Production and utilisation of molasses, 1948 - 1966

Year	Product-ion M. tons	Exports M. tons	Used for product-ion of alcohol M. tons	Other domestic uses M. tons	Available as fertilizer M. tons	N.P.K. equivalent in molasses available as fertilizer M. tons		
						N	P_2O_5	K_2O
1948	85,308	—	42,640	—	42,768	222	107	2,198
1949	96,670	1,867	41,728	—	53,075	276	133	2,728
1950	98,496	79	25,754	—	72,643	378	182	3,734
1951	125,819	3,601	44,896	—	77,322	402	193	3,974
1952	113,756	40,537	29,878	—	43,339	225	108	2,228
1953	141,449	67,848	16,037	—	57,564	299	144	2,958
1954	120,495	89,912	8,300	—	22,383	116	56	1,145
1955	106,839	53,957	9,005	—	43,877	228	110	2,255
1956	118,716	52,694	8,661	—	57,361	298	143	2,948
1957	110,471	72,539	7,796	—	30,136	157	75	1,549
1958	113,811	59,158	8,435	—	46,218	240	116	2,376
1959	118,056	59,985	9,632	—	48,439	252	121	2,490
1960	72,991	45,180	8,871	—	18,940	98	47	970
1961	139,234	64,633	7,357	—	67,244	350	168	3,456
1962	122,890	76,800	7,750	—	38,340	199	96	1,955
1963	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	112,290	6,653	484	13,835	72	36	706

Table XX. Importation of inorganic fertilizers, in metric tons, 1951 - 1966

YEAR	N	P_2O_5	K_2O
1951	5,710	1,020	4,080
1952	5,800	1,140	2,960
1953	5,080	560	2,380
1954	4,170	1,110	3,340
1955	5,620	570	3,110
1956	8,870	2,170	3,940
1957	6,900	2,770	4,390
1958	6,210	3,020	4,690
1959	8,500	2,740	5,310
1960	8,170	4,382	5,765
1961	7,462	4,769	4,569
1962	9,467	5,377	6,373
1963	9,762	5,079	6,952
1964	10,095	5,698	8,838
1965	9,520	7,236	6,222
1966	8,070	4,596	7,515

Table XXI. Sales of herbicides 1964 - 1966

HERBICIDES	1964		1965			1966		
	Quantity		Quantity		Acid equivalent lb	Quantity		Acid equivalent lb
	Imperial gallons	Kg.	Imperial gallons	Kg.		Imperial gallons	Kg.	
MCPA — Metallic salt	9,859		9,072		36,288	9,402		37,608
2,4-D amines	27,361		23,172		116,915	15,909		83,671
2,4-D esters	11,029		7,335		37,245	6,380		38,155
2,4-D and 2,4-5-T esters			6,734		3,612	6,679		29,795
Pentachlorophenol	595		100		300	261		783
Sodium chlorate		398,053		272,823			261,774	
Sodium trichloroacetate (TCA)		389,449		309,746			314,625	
Sodium 2,2-dichloro-proprionate (Dalapon, Basfapon, Unipon)		6,670		2,261			931	
Substituted ureas (Herban, DCMU, Linuron)		35,312		38,922			53,611	
Substituted triazines (Simazine Atrazine)		15,097 22,507		9,338 33,305			262 30,233	
Unclassified	602	425	450	544			874	

Table XXII. Importation of Major Herbicides, 1956 - 1966

YEAR	Inorganic chemicals		Hormone type		Aliphatic acid derivatives		Substituted phenols	Substituted ureas	Substituted triazines	
	Sodium Chlorate Kg.	Sodium Arsenite Kg.	2,4-D; 2,4,5-T MCPA		T C A Kg.	Dalapon Kg.	P. C. P. Imp. Gall.	Linuron D.C.M.U. Herban Kg.	Simazine Kg.	Atrazine Kg.
			Imp. Gall.	Kg.						
1956	92,780	124	48,333	6,125	181,700	—	3,460	—	—	—
1957	107,961	80	36,142	645	163,278	—	1,824	—	—	—
1958	128,835	4,000	43,150	565	167,096	—	3,528	—	—	—
1959	173,383	—	60,261	72	264,389	—	1,534	—	—	—
1960	304,851	7,050	76,629	—	377,063	400	2,641	12,500	568	—
1961	214,301	6,000	59,272	—	363,716	9,553	1,403	30,000	1,812	—
1962	272,937	8,000	54,507	—	335,595	21,933	1,010	38,279	21,432	—
1963	276,502	—	45,825	—	339,981	5,070	969	39,915	26,833	2,377
1964	398,053	—	48,249	—	389,449	6,670	595	35,312	15,097	22,507
1965	272,823	—	45,330	—	309,746	2,261	100	38,922	9,338	33,305
1966	261,774	—	38,370	—	314,625	931	261	53,611	262	30,233

Table XXIII. List of combinations sown in 1966

(i). Early nobilisations of *S. spontaneum* and *S. robustum*

Reference Cross No.	PARENTAL COMBINATIONS Female	Male	No. of germinated crosses	No. of Pots*	No. of non-germinated Crosses
2302	Chalain	x Sdlg. (55-1182 x 57 N.G. 208)	7	581*	0
2575	M.29/16	x Sdlg. (M.47/38 x Mol. 5904)	1	43	1
2431	M.26/20	x ,, ,, ,,	4	25	2
406	M.143/41	x *S. spont.* Self No. 1	1	20	1
486	,,	x U.S 48-34	2	2	2
1231	M.377/41	x *S. spont.* Kletak	3	18	0
642	,,	x *S. spont.* Ma dalay	4	17	0
647	,,	x Mol. 5904	4	60	2
644	,,	x 51 N.G. 2	3	5	0
646	,,	x 28 N.G. 101	1	1*	0
1100	M.81/52	x *S. spont.* Mandalay	1	5	0
1214	,,	x Mol. 5904	1	60	0
416	Mapou Perlée	x *S. spont.* Self No. 1	1	210	1
2290	M.P. 131	x 57 N.G. 208	3	708*	2
2560	,,	x Sdlg. (55-1182 x 57 N.G. 208)	1	6	0
2494	,,	x Sdlg. (M.47/38 x Mol. 5904)	1	26	2
411	*S. spont.* self No. 2	x N. 55-176	2	11	1
2002	S.W. 499	x 51 N.G. 140	3	19	1
2004	,,	x Self	2	7	1
427	U.S. 48-34	x B. 34104	8	280	1
2558	,,	x D. 109	1	1	0
668	,,	x Ebène 50/47	5	2	0
742	,,	x M. 69/56	2	14	2
456	,,	x M. 220/56	4	164	0
Total	24		65	2285	19

* *All seedlings potted singly, except for Reference Cross Nos. 2302, 646, and 2290 which have been potted 3 sdlgs/pot.*

Table XXIII. List of combinations sown in 1966

(ii)[1]. (a) Combinations having produced more than 300 pots of 3 seedlings

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of Pots[2]	No. of non-germinated crosses
466	B.41227	x	M.134/57	9	396	0
548	Co.1186	x	M.69/56	5	320	0
759	C.P.48-103	x	M.134/57	4	396	0
2368	Ebène 1/37	x	M.69/56	6	429	1
1156	Ebène 88/56	x	C.B.41-35	3	900	1
1360	,,	x	M.147/44	9	438	0
1182	,,	x	P.T.43-52	8	336	2
56	Eros	x	M.147/44	5	2059	0
542	M.202/46	x	M.69/56	6	1064	0
1091	,,	x	P.T.43-52	6	351	0
1509	M.93/48	x	C.B.41-35	3	334	0
1283	M.81/52	x	M.69/56	8	974	0
610	M.85/53	x	M.69/56	5	390	0
578	,,	x	M.134/57	5	550	0
597	M.258/55	x	M.220/56	2	330	0
1044	M.212/56	x	M69/56	12	1193	0
520	M.30/57	x	M.220/56	4	498	0
417	M.35/57	x	M.147/44	4	647	0
462	,,	x	M.220/56	4	438	0
419	,,	x	M.134/57	7	507	1
85	N.50-211	x	M.147/44	8	1017	0
568	,,	x	M.220/56	5	303	0
563	N:Co.310	x	M.220/56	5	340	0
573	,,	x	M.134/57	4	434	0
21	N:Co.376	x	M.69/56	5	908	0
492	,,	x	M.220/56	4	1233	0
500	,,	x	M.134/57	4	873	0
28	Q.68	x	R.47/2777	5	1365	0
1529	Q.70	x	M.361/56	5	764	0
Total		29		160	19787	5

(*1*) *For convenience of tabulation, the following code has been adopted: Re for Réunion; Ma for Mayaguez; R 47/2777 for 47 R 2777 and M.Q.39/832 for 39M.Q. 832.*

(*2*) *Planted in the fields 3 pots/hole, end February 1967.*

Table XXIII. List of combinations sown in 1966

(ii)*1*. (b) Combinations having produced between 16 and 300 pots of 3 seedlings

Reference Cross No.	PARENTAL COMBINATIONS Female Parent		Male Parent	No. of germinated crosses	No. of Pots2	No. of non-germinated crosses
1516	B.3337	x	M.99/34	2	16	2
1495	,,	x	M.13/53	4	256	0
1485	,,	x	M.69/56	5	230	0
1407	B.4362	x	M.99/34	4	121	3
817	B.41227	x	M.147/44	6	24	0
695	,,	x	M.202/46	3	16	2
813	,,	x	M.220/56	4	51	0
1021	,,	x	P.T. 43-52	2	26	0
1	C.B. 38-22	x	B.34104	6	47	3
77	,,	x	M.147/44	2	30	0
19	,,	x	M.69/56	3	79	0
897	,,	x	M.356/56	4	146	0
537	Co. 1186	x	B.34104	5	75	3
1351	,,	x	M 202/46	4	37	0
1347	Co. 1208	x	M.202/46	4	38	0
57	C.P. 34-120	x	M.147/44	3	120	1
841	C.P. 48-103	x	B.34104	4	60	0
765	,,	x	M.69/56	4	191	1
2233	Ebène 1/44	x	Q.58	4	56	4
1234	Ebène 88/56	x	B.34104	7	66	1
1376	,,	x	Ebène 50/47	4	58	0
1080	,,	x	M.202/46	1	19	0
1176	,,	x	M69/56.	4	175	0
2030	Eros	x	B.34104	2	25	4
1209	,,	x	M.202/46	5	195	0
1273	M.134/32	x	C.B. 41-35	4	75	1
2355	,,	x	D.109	2	26	7
2274	,,	x	M.69/56	8	43	0
829	M.99/34	x	B.34104	4	23	1
834	,,	x	M.69/56	5	105	0
2008	M.241/40	x	B.34104	15	82	1
24	,,	x	C.B. 41-35	1	114	0
1057	,,	x	M.356/56	3	130	0
476	M.143/41	x	M.202/46	4	41	0
603	,,	x	M.69/56	3	117	1
460	,,	x	M.220/56	4	112	0
660	M.377/41	x	M.220/56	4	17	0
789	M.112/42	x	M.220/56	3	16	0
532	M.202/46	x	B.34104	5	160	0
1530	M.93/48	x	R.47/2777	3	40	4
1250	M.253/48	x	M.147/44	1	94	0
613	M.85/53	x	B.34104	5	96	0
13	,,	x	C.P. 48-103	2	19	2
618	,,	x	M.220/56	5	86	0

(*1*) *For convenience of tabulation, the following code has been adopted : Re for Réunion; Ma for Mayaguez; R. 47/2777 for 47 R. 2777 and M.Q. 39/832 for M.Q. 832.*

(2) *Planted in the fields 3 pots/hole, end February 1967.*

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of Pots[2]	No. of non-germinated crosses
483	M.85/53	x	M.180/58	5	199	0
623	,,	x	N.55-176	5	103	0
1432	M.97/53	x	B.34104	9	112	1
593	M.258/55	x	B.34104	4	60	0
440	M.69/56	x	B.34104	1	36	0
1440	M.360/56	x	M.147/44	2	200	0
444	M.30/57	x	B.34104	2	58	0
524	,,	x	M.86/57	4	46	0
454	M.35/57	x	B.34104	2	21	0
446	,,	x	M.69/56	4	299	0
450	,,	x	M.180/58	4	105	0
507	,,	x	N.55-176	4	75	0
1433	M.136/57	x	P.T. 43-52	4	57	0
588	M.347/57	x	M.220/56	5	97	0
1436	M.435/59	x	M.147/44	2	98	0
1301	M.625/59	x	M.147/44	3	60	0
1152	,,	x	M.69/56	5	128	0
1007	,,	x	M.220/56	3	30	0
1462	M.Q. 39/832	x	B.34104	11	43	4
632	N.10	x	B.34104	5	34	0
637	,,	x	M.69/56	4	115	0
745	,,	x	M.220/56	5	96	0
709	N.50-211	x	M.69/56	5	54	0
41	N.52-219	x	M.147/44	2	23	0
553	N:Co.310	x	B.34104	5	27	0
779	,,	x	M.357/56	3	260	0
867	,,	x	P.T. 43-52	4	124	0
628	N:Co.376	x	M.180/58	4	286	0
528	,,	x	N.55-176	4	147	0
2517	Q.50	x	M.147/44	2	106	2
693	Q.58	x	Ebène 50/47	6	106	0
Total		75		305	6758	48

Table XXIII. List of combinations sown in 1966

(ii)/. (c) Combinations having produced less than 16 pots of 3 seedlings

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of Pots	No. of non-germinated crosses
1355	B.3337	x	Ebène 88/56	2	1	0
1500	,,	x	M.220/56	4	10	0
2392	B.4362	x	Ebène 50/47	5	9	2
1093	,,	x	M.356/56	2	1	4
904	,,	x	Q.58	2	1	3
1452	B.5650	x	M.147/44	1	4	0
1127	B.37161	x	Ebène 50/47	3	6	2
727	B.41227	x	B.34104	4	1	1
1408	,,	x	C.B.41-35	2	3	0
1141	,,	x	M.13/53	2	2	2
704	,,	x	M.69/56	5	3	0
732	,,	x	M.180/58	2	2	3
1198	B.49119	x	M.147/44	1	9	3
1210	,,	x	M.220/56	2	1	0
1418	C.B.45-6	x	M.69/56	1	1	4
7	C.B.38-22	x	C.P.48-103	3	3	2
25	Co.290	x	R.47/2777	2	1	0
26	Co.331	x	B.34104	6	2	1
1370	,,	x	P.R.905	1	1	0
1387	C.P.36-13	x	D.109	2	1	0
52	C.P.48-103	x	Co.290	4	1	0
894	,,	x	M.147/44	3	15	0
858	,,	x	Q.58	3	5	0
2306	Ebène 1/37	x	P.T. 43-52	4	10	4
2325	,,	x	Q.58	1	1	4
1113	Ebène 1/44	x	M.202/46	4	2	3
801	Luna	x	B.34104	2	2	2
792	,,	x	Ebène 50/47	2	1	2
29	,,	x	M.147/44	7	6	0
1246	,,	x	M.13/53	2	2	2
809	,,	x	M.69/56	4	1	0
921	,,	x	N:Co.382	1	1	0
805	,,	x	P.T.43-52	4	6	0
1255	M.134/32	x	Ebène 88/56	4	5	0
1260	,,	x	M.99/34	2	2	3
966	,,	x	M202/46	5	7	0
1442	,,	x	M.220/56	2	3	1
831	M.99/34	x	Ebène 50/47	2	3	6
1028	,,	x	M.147/44	2	6	0
1107	M.241/40	x	Ebène 50/47	4	2	6
1061	,,	x	M.69/56	1	5	1
1357	,,	x	M.438/59	3	6	0
479	M.377/41	x	B.34104	4	12	0
665	,,	x	Ebène 50/47	1	1	3
987	,,	x	M.13/53	2	1	2

(*1*) *For convenience of tabulation, the following code has been adopted: Re for Réunion; Ma for Mayaguez; R.47/2777 for 47 R2777 and M.Q. 39/832 for 39 M.Q.832.*

Reference Cross No.	PARENTAL COMBINATIONS Female		Male	No. of germinated crosses	No. of Pots	No. of non-germinated crosses
649	M.377/41	x	M.69/56	5	4	0
655	,,	x	M.134/57	1	1	2
656	,,	x	M.180/58	4	3	0
1291	M.112/42	x	M.69/56	1	3	2
786	,,	x	N:Co.382	3	1	0
1133	M.197/46	x	Ebène 50/47	6	5	0
997	M.127/52	x	Q.58	2	1	2
1288	M.272/52	x	B.34104	2	1	0
37	M.85/53	x	C.P.36-13	2	3	2
680	,,	x	Ebène 50/47	1	1	4
1438	M.210/54	x	C.P.36-13	2	3	0
1532	M.403/54	x	Q.58	2	1	0
1118	M.461/54	x	B.34104	3	1	2
1455	M.516/54	x	M.202/46	1	11	0
1421	M.17/55	x	M.220/56	1	1	0
1195	M.258/55	x	M.147/44	1	3	2
1427	M.212/56	x	B.34104	4	9	0
1217	,,	x	M.147/44	5	9	0
1222	,,	x	Q.58	4	9	0
518	M.30/57	x	M.134/57	2	5	0
752	M.35/57	x	Ebène 50/47	2	1	2
516	,,	x	M.86/57	2	5	0
1001	M.111/57	x	Q.58	2	1	1
584	M.347/57	x	B.34104	3	4	3
1015	,,	x	P.T.43-52	3	3	0
1295	M.240/59	x	M.84/35	1	12	0
1140	M.463/59	x	Ebène 50/47	1	1	0
1011	,,	x	M.220/56	2	1	2
1299	M.625/59	x	Q.58	2	2	2
1423	Ma. 336	x	B.34104	2	2	0
1373	M.Q. 39/832	x	Re.366	1	1	0
558	N.50-211	x	B.34104	3	11	2
9	N:Co.310	x	C.P.48-103	2	5	2
685	,,	x	Ebène 50/47	2	2	2
871	,,	x	M.202/46	3	4	0
864	,,	x	M.180/58	4	2	0
837	N:Co.376	x	B.34104	2	1	2
983	P.O.J.2364	x	M.220/56	6	13	0
27	Q.47	x	R.47/2777	4	7	1
Total	84			224	321	101

Table XXIV. List of Approved Cane Varieties, 1967

M.134/32

M.134/32 white

M.134/32 striped

*M.112/34

*M.423/41

***M.147/44

M.31/45

M.202/46

M.93/48

M.99/48

M.253/48

M.409/51

M.442/51

M.13/53

M.13/56

M.377/56

Ebène 1/37

Ebène 50/47

*B.H.10/12

**B.3337

**B.34104

B.37161

B.37172

N:Co 376

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* *To be uprooted before 31st December, 1969*

** *To be uprooted before 31st December, 1970*

*** *To be uprooted before 31st December, 1973*