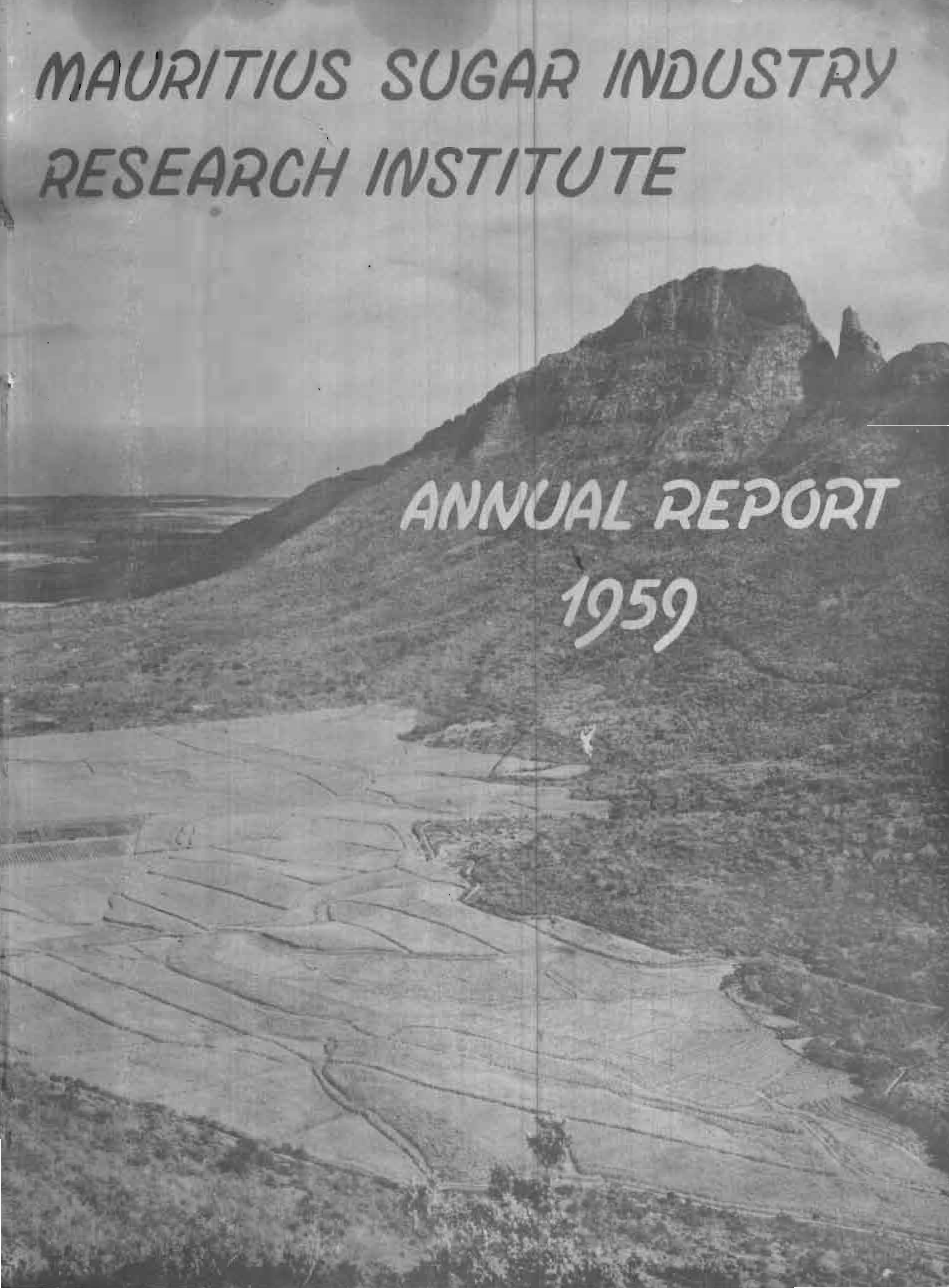
MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE



ANNUAL REPORT 1959

MAURITIUS SUGAR INDUSTRY

RESEARCH INSTITUTE

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The cover photograph shows cane plantations of Magenta at the foot of Montagne du Rempart.

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and the senior staff of the Research Institute.

STAFF LIST

Director	P. O. Wiehe, C.B.E., D.Sc., A.R.C.S., F.L.S.
Agronomist	P. Halais, Dip. Agr.(Maur.)
Botanist	E. Rochecouste, B.Sc., Dip.Agr. (Maur.)
Chemist	D. H. Parish, B.Sc., M.Agr. (Q.U.B.), A.R.I.C.
Senior Asst. Chemist ...	S. M. Feillafé, Dip.Agr. (Maur.)
Plant Breeder	Vacant
Asst. Plant Breeder ...	G. Harvais, B.Sc., (Aberd.)
Geneticist	E. F. George, B.Sc., A R.C.S.
Asst. Geneticist ...	J. A. Lalouette, Dip.Agr. (Maur.), as from 1.1.60
Plant Pathologist ...	R. Antoine, B.Sc., A.R.C.S., Dip.Agr.Sc. (Cantab.), Dip.Agr. (Maur.)
Sugar Technologist ...	J. D. de R. de Saint Antoine, B.S., Dip. Agr. (Maur.)
Associate Sugar Technologist	J. P. Lamusse, B.S.
Associate Chemist (S.T.) ...	C. Vignes, M.Sc., Dip.Agr. (Maur.)
Asst. Chemist (S.T.) ...	Vacant
Asst. Sugar Technologist ...	R. H. de Froberville, Dip.Agr. (Maur.)
Asst. Sugar Technologist ...	Vacant
Entomologist	J. R. Williams, M.Sc., D.I.C.
Chief Agriculturist ...	G. Rouillard, Dip.Agr. (Maur.)
Senior Field Officer ...	G. Mazery, Dip.Agr. (Maur.)
Field Officers :	
Headquarters ...	P. R. Hermelin, Dip.Agr. (Maur.) *i/c Réduit Experiment Station*
...	A. Lagesse, Dip.Agr. (Maur.)
...	M. Mamet, (Dip.Agr. Maur.), as from 1.1.60
North ...	R. Béchet, Dip.Agr. (Maur.) *i/c Pamplemousses Experiment Station*
South ...	F. Mayer, Dip.Agr. (Maur.) *i/c Union Park Experiment Station*
Centre ...	L. P. Noel, Dip.Agr. (Maur.) *i/c Belle Rive Experiment Station*
Laboratory Assistants :	
Botany ...	C. Mongelard
Chemistry ...	L. C. Figon
Soils	L. Ross, Dip.Agr. (Maur.)
Entomology ...	M. A. Rajabalee
Foliar Diagnosis ...	Mrs G. Caine
Pathology ...	C. Ricaud, B.Sc.
Sugar Technology	F. Le Guen B.Sc.
...	M. Randabel, Dip.Agr. (Maur.)
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	Miss L. Kingdon
	Miss D. Le Roy

REPORT OF THE CHAIRMAN

EXECUTIVE BOARD 1959

THIS report must open with a sad note: the Institute in particular, and the Sugar Industry as a whole, have learned with deep regret of the untimely death in Switzerland of Mr. Aimé de Sornay, the Institute's Plant Breeder. After a brillant career in the Government Service, Mr. A. de Sornay had given the Institute the best of his valuable knowledge and experience and his loss is deeply felt by every person associated with the Institute, in whatever capacity. On behalf of the Board and the Staff, I wish to express here to the members of his family our most sincere sympathy.

The Board has held 13 meetings in the course of the year and its composition with one exception has been unchanged. Mr. Lucien de Chazal was appointed by the M.S.P.A. to replace Mr. J. A. Harel. I am personally indebted to Mr. Georges Rouillard for accepting to assume the Chairmanship of the Board during my absence from the Colony from April to September.

ESTABLISHMENT

The following members of the staff went on overseas leave during the year: Messrs. G. Mazery, P. R. Hermelin, J. P. Lamusse, P. Halais and M. M. d'Unienville.

Messrs C. Ricaud, B.Sc., and C. Mongelard were granted study leave: the former to study Plant Pathology at the Imperial College of Science and Technology, London, and the latter to study Botany at the University College, London. Arrangements were also made for Mr. F. Le Guen, B.Sc., to study Electronics and Instrumentation at the Northampton College of Technology. These courses of studies are financed by the Special Studies Fund, referred to in the Annual Report for 1957.

The Director left for the United Kingdom in the month of March and attended the 10th I.S.S.C.T. Congress held in Hawaii with three other members of the staff: Messrs. P. Halais, R. Antoine and J. P. Lamusse. The last two stopped over for a fortnight in Australia after the Congress.

The Director and Secretary also attended the 9th meeting of the «Comité de Collaboration Agricole Maurice - Réunion - Madagascar» which was held this year in Madagascar in the month of October.

Messrs R. Antoine and R. Béchet visited Madagascar in February and again in the month of August to establish and make observations on resistance trials to Fiji Disease of the sugar cane.

Mr. E. C. Vignes, M.Sc., was appointed Associate Chemist, Sugar Technology Division as from the 1st June, Mr. A. Jauffret, Librarian as from the 1st March, Miss D. Le Roy, Lady Typist as from the 1st August.

Mr. M. Mamet, Dip.Agric.(Maur), has been selected to replace Mr. M. Hardy who has resigned his appointment as Field Officer with effect from 31st of December.

Mr. J. A. Lalouette, Dip.Agric.(Maur.), was appointed to the newly created post of Assistant Geneticist in the Division of Plant Breeding and Genetics. This latter appointment is a step in the expansion of this important section of the Institute's activities.

Messrs Adrien Wiehe and Maurice Paturau were re-appointed Consulting Sugar Technologists.

BUILDINGS

The Administration wing of the main building was completed in June, and the Chemistry and Sugar Technology buildings were completed and occupied in the month of October.

Work then started immediately on the former bacteriological laboratory taken over from the Government, which is being converted into a Library-Lecture Hall; it is hoped that this conversion, which is the last main item of the Institute's building programme, will have been completed by the month of May, 1960.

The Board has decided to name this Hall after Philippe Bonâme, Director of the first Sugar Cane Experiment Station, known as the «Station Agronomique», which was created in 1893.

FINANCE

The change in the financial year of the Institute from July-June to January-December has brought to light the variability of the Institute's revenue over the year. In effect, almost all the cess on sugar exported is received between August and January every year; as a consequence, the Institute's finances reach a peak period in December and are at their lowest point in June. With the balance sheet date changed from 30th June to 31st December the financial position of the Institute may appear more favourable than in former years. It should be emphasized, however, that the comparatively larger cash balance shown at the end of December does not actually represent an improvement in the finances of the Institute.

It is to be noted that the building and development programme of the Institute will reach completion in 1960. At the same time, the gradual expansion of the establishment has progressed to the point where the accepted structure has now been reached. In previous years, with a smaller establishment, the Institute's revenue exceeded current expenditure. It was thus possible to finance the large building and development programme partly out of revenue. From now on, it is hoped that the revenue of the Institute from the cess on sugar exported will be sufficient to meet the annual current expenditure, while other revenue, derived mainly from the sale of canes produced at Experimental Stations, will serve for repayment of the loan and normal capital expenditure.

In concluding this Report, I wish to express my personal thanks to my colleagues for their willing and precious cooperation and the Board's satisfaction at the excellent spirit in which all members of the Staff have, in a common effort, achieved the smooth and successful working of the Institute.

Raymond Hein

Chairman.

23rd December, 1959.

REVENUE & EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1959

Running and Administrative Expenses ...	1,358,152.58	Cess on Sugar Exported	1,549,578.52
Interest on Loan	27,482.50	Miscellaneous receipts	99,935.12
Leave and Missions Fund	75,000.—		
Depreciation	204,604.49		1,649,513.64
		Excess of Expenditure over Revenue for the year, carried to Accumulated Funds	15,725.93
Rs.	1,665,239.57	Rs.	1,665,239.57

BALANCE SHEET

AS AT 31st DECEMBER, 1959

ACCUMULATED FUNDS	1,468,549.18	FIXED ASSETS (At cost less depreciation and amounts written off)		
REVENUE FUNDS	59,246.36	Land and Buildings ...	1,476,766.87	
SPECIAL STUDIES FUND ...	19,281.38	Equipment & Furniture (laboratories, houses & offices)	20,199.82	
PALMYRE OVERHEAD IRRIGATION EXPERIMENT FUND	—	Agricultural Machinery & Vehicles ...	36,849.—	
GROUND WATER RESEARCH FUND	262,887.93			1,533,815.69
LOAN FROM ANGLO MAURITIUS ASSURANCE SOCIETY LTD. ...	555,961.—	CURRENT ASSETS		
		Sundry Debtors ...	34,941.39	
GOVERNMENT OF MAURITIUS (Purchase of Buildings)	191,579.25	Cash on Fixed Deposit	125,000.—	
		Cash at Bank (Ground Water Research Fund Account)	262,887.93	
		Cash at Banks and on hand	600,863.09	
				1,023,692.41
Rs.	2,557,508.10	Rs.		2,557,508.10

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December, 1959, 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, 1959, 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) M. N. LUCIE-SMITH
(sd) G. ROUILLARD } *Board Members*
(sd) RAYMOND HEIN *Chairman*

Port Louis,
Mauritius,
6th February, 1960

(sd) P.R.C. Du MÉE
C.A.(S.A.),A.S.A.A.
p.p. DE CHAZAL, DU MÉE & CO.
Chartered Accountants.

IN MEMORIAM

AIMÉ de SORNAY

1906 - 1959

The news that Aimé de Sornay was no more came as a painful shock to all his colleagues at the Research Institute. He had left Mauritius in July to spend several months vacation leave in Europe and died suddenly of heart failure near Lucerne on the 16th of August.

de Sornay was born on the 2nd July 1906. He studied at the Mauritius College of Agriculture (Hons.Diploma, 1927), the Institut d'Agronomie Coloniale, Paris (Ingénieur, 1928) and Cambridge University (B.Sc.Botany, 1941).

Soon after joining the Department of Agriculture in 1928, he was sent to the Imperial Cane Breeding Station, Coimbatore, where he worked for one year under Venkatraman. On his return to Mauritius, he was appointed Cane Breeding Officer to the recently created Sugarcane Research Station, then directed by A. Glendon Hill who was in charge of the programme of genetics and cane breeding. He was appointed Plant Breeder in 1947 and transferred to the Sugar Industry Research Institute in the same capacity in 1954. The whole of his career was thus devoted to the improvement of cane varieties; his contributions to our knowledge in this field were published mostly in «La Revue Agricole de l'Ile Maurice» and in the Proceedings of the I.S.S.C.T.
He will always be remembered in the sugar industry of the island as a member of the research team whose endeavours were largely responsible for the improvement of our sugar yields from 1.7 tons per arpent in the early thirties to 3.0 tons in 1953.

Aimé de Sornay is deeply mourned by all the staff of the Sugar Industry Research Institute not only as a colleague of sound experience but also as a sincere friend.

P. O. W.

INTRODUCTION

THE main results of research carried out at the Sugar Industry Research Institute in 1959 are presented in this seventh Annual Report. The work of the Institute and a survey of the 1959 sugar crop are briefly summarised in the Introduction in the usual manner, followed by a more detailed account of investigations in various fields. Data on the sugar industry of the island are tabulated in the Appendix.

The Chairman of the Board has referred in his report to certain changes which took place in the Establishment. The most important of these was the decision to expand immediately the division of Plant Breeding and Genetics and to include a field officer within its cadre at a later date. The production of new cane varieties has always been regarded as the most important endeavour of the Institute and that which has a more direct bearing on the sugar industry of the island at large. This decision therefore can only be regarded as wise investment for the future. In this connection it is interesting to note that apart from the section of field experimentation and extension, which is the most expensive to operate, the greatest proportion of the annual current expenditure of the Institute is devoted to Plant Breeding and Genetics.

One of the Field Officers, Mr. M. Hardy, who had been in charge of Pamplemousses Experiment Station since early 1954, resigned at the end of the year to take an appointment as Agronomist at St. Antoine S.E. His departure is regretted by all his colleagues. On the other hand, it is felt that the Institute is serving yet another useful purpose, though indirectly, by the training of agriculturists who have a leading role to play in the sugar industry of the island in applying the results of research to field practices.

By arrangement with estate managers, several members of their personnel worked in the factory and field sections of the Institute during the intercrop period. Close cooperation was also maintained during the year between the staff of the Institute and sugar estates and planters. The total number of visits made in this connection was 1873.

It is gratifying to record that the building programme is now nearly completed. The Administration wing was occupied in April while the new Chemistry and Sugar Technology laboratories (illustrated in fig. 13) were taken over in September. Work then began immediately on the conversion of the former Bacteriological laboratory into a Lecture Hall and Library. It has been decided to name this Hall after Philippe Bonâme, who was the pioneer of experimentation on sugar cane in Mauritius, having been the first — and only — Director of the «Station Agronomique» founded by sugar planters in 1893 and taken over by Government to be expanded into a Department of Agriculture in 1913.

Little developmental work was carried out at the Experiment Stations, which are now entirely under cultivation except at Belle Rive where the planting programme will not be completed before two or three years. Cane production sold to neighbouring mills was 419 tons at Réduit Experiment Station, 572 at Pamplemousses Experiment Station, 650 at Belle Rive Experiment Station and 248 at Union Park Experiment Station, making a total of 1889 tons as against 1635 in 1958.

THE 1959 SUGAR CROP

In spite of climatic vagaries in 1959, sugar production reached a record level of 579,841 metric tons at 98.6 pol.* Indeed, the rainfall pattern, as illustrated in fig. 1, was the reverse of normal conditions: dry early and late during the growing period and wet during the latter part of the harvest season. Rainfall during April to July amounted to 12.7", the lowest figure on record since 1875, as against a normal of 26". In October and November 18" of rain fell on the average over the island, this, strangely enough, being the highest figure since 1875 and representing nearly three times the normal of 6.6".

* *Equivalent to 656,623 short tons at 96 pol.*

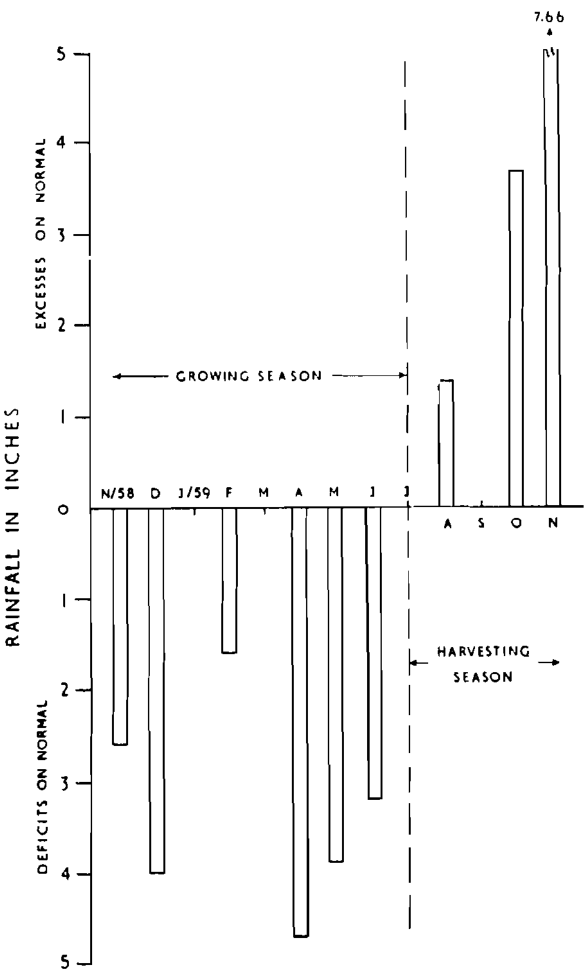

Fig. 1. Rainfall deficits and excesses on normal during the growing and harvesting seasons of the 1959 sugar crop.

The area under cane cultivation increased to 190,000 arpents in 1959 of which 180,000 were reaped (94.7%), producing the largest cane crop, 4,743,285 metric tons, recorded in the island. Cane yields averaged 26.3 tons per arpent i.e. 1.5 tons below the normal which stands now at 27.8 tons. Planters' yields averaged 20.6 tons per arpent and was 11.9 tons below that of estates.

On estate lands the yield of cane in successive ratoons was well over the average (fig. 2). The slightly lower yield of virgin canes in 1959 was probably due to the fact that a greater proportion of such cane is now harvested after 12 months instead of 14 to 16 months.

The drought prevailing from April to July was conducive to high sucrose content. The maturity trend during the early part of the grinding season (fig. 3) indicated that there was the potential for excellent juice quality. Heavy rains in August, however, followed by still heavier precipitations in October and November caused a rapid deterioration in sucrose content. These bad effects were offset, to some extent, by the fact that crushing started earlier than usual, while the wet conditions in October probably enabled a greater weight of cane to be harvested towards the end of the crop. Commercial sugar manufactured % cane averaged 12.22*, a figure very close to that of a normal year. The average yield of sugar per arpent was 3.22 metric tons, ranging from 2.85 in the north to 3.85 in the west. Yields on estates amounted to 3.95 (4.06 tons at 96 Pol.) while those of planters averaged 2.51 tons. Sugar yields obtained on land cultivated by estates are shown diagrammatically in fig. 4. For comparative purposes the amount of sugar per harvested arpent has been converted to a 96 Pol. basis. The highest average yield was 4.83 and the lowest 2.74. It is interesting to note that yields of over 4 tons of sugar were obtained by 14 estates on an aggregate area of 55,000 arpents. The results of

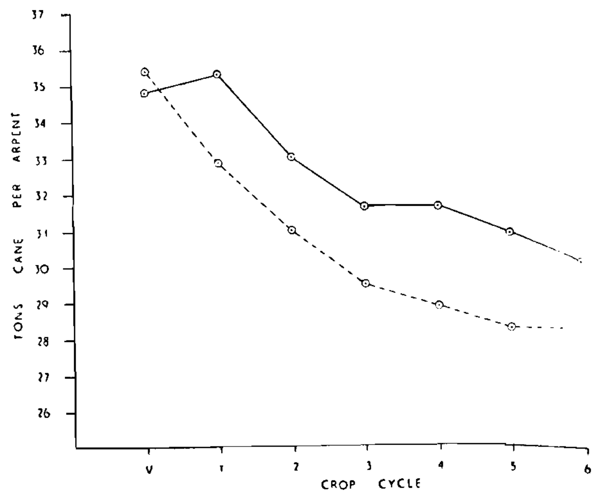

Fig. 2 Yield of cane per arpent (estates) in virgins and succeeding ratoons.
Plain line: 1959; broken line: average 1947-1958.

Equivalent to 8,2 tons of cane per ton sugar.

the 1959 and 1958 crops compared to a normal year are as follows :

	Normal	**1958**	**1959**
Tons cane per arpent	27.8	—2.9	—1.5
Commercial sugar manufactured % cane	12.3	—0.16	—0.08
Tons sugar manufactured per arpent	3.3	—0.18	—0.10

There were 24 factories operating in 1959, canes from Beau Vallon being crushed at Riche en Eau. Grinding began on the 1st July, most factories had closed down by the third week in November, and the last finished crushing on the 17th December. The average number of crushing days was 110, cane crushed per hour 87.7m. tons and cane crushed per day 1797 m. tons. FUEL factory averaged the highest crushing rate, 206 m. tons per hour, ever attained in the island. The steady increase in the capacity of factories, already remarked upon in previous reports, is illustrated in fig. 5 which shows also

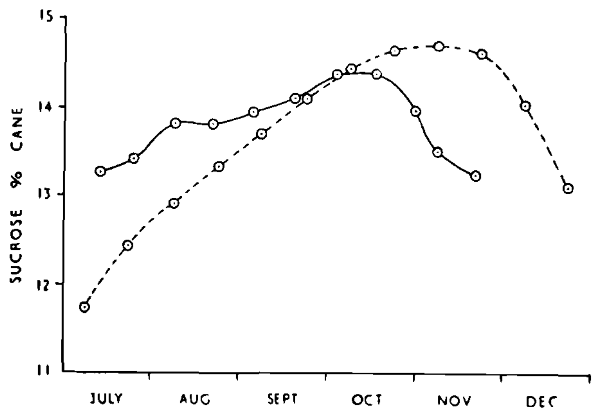

Fig. 3. Maturation curves.
Plain line: 1959; broken line: 1947-1958.

the marked improvement in factory efficiency as revealed by total manufacturing losses % canes. These have passed from 2.21 in 1946 to 2.06 in 1954 and 1.70 in 1959. In this connection it is interesting to note that sucrose % cane was 0.01 below the figure obtained in 1958, yet commer-

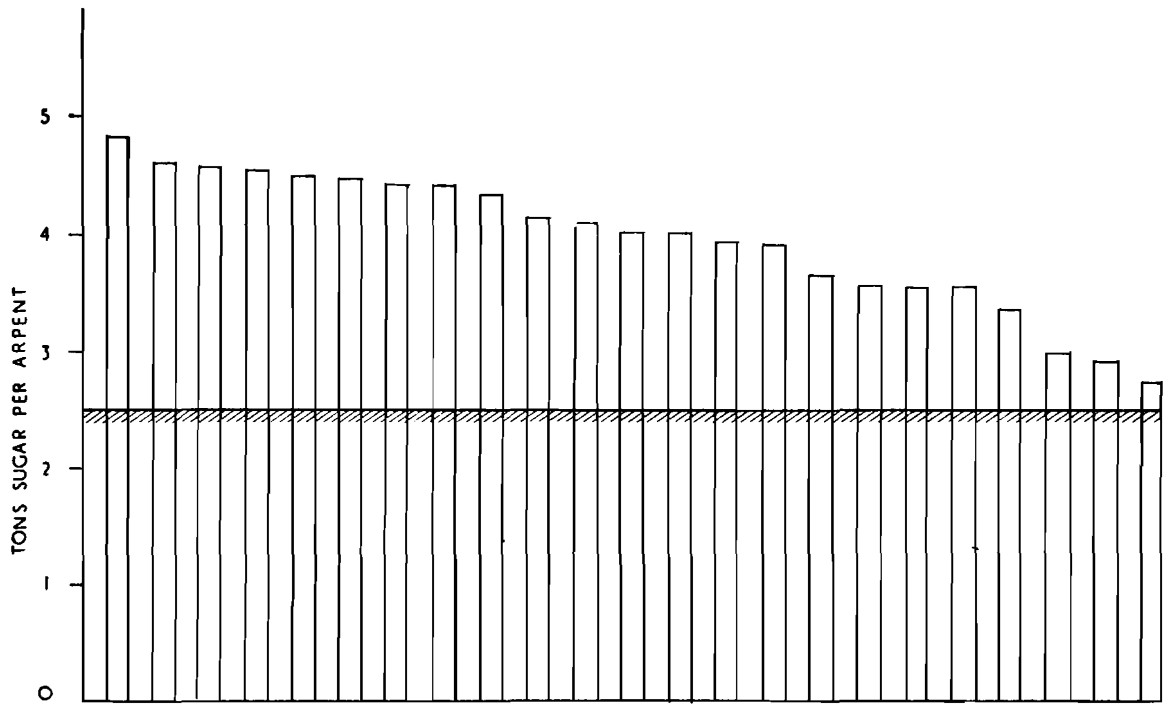

Fig. 4. Yield of sugar (96 pol) in metric tons per arpent on 24 Estates with factories. Average yield on planter's lands shown by horizontal shaded line.

cial sugar manufactured % cane was 0.08 above. This represents a gain of nearly 4,000 tons of sugar which is mostly due to higher factory efficiency resulting from large capital investments as well as improved manufacturing processes and control.

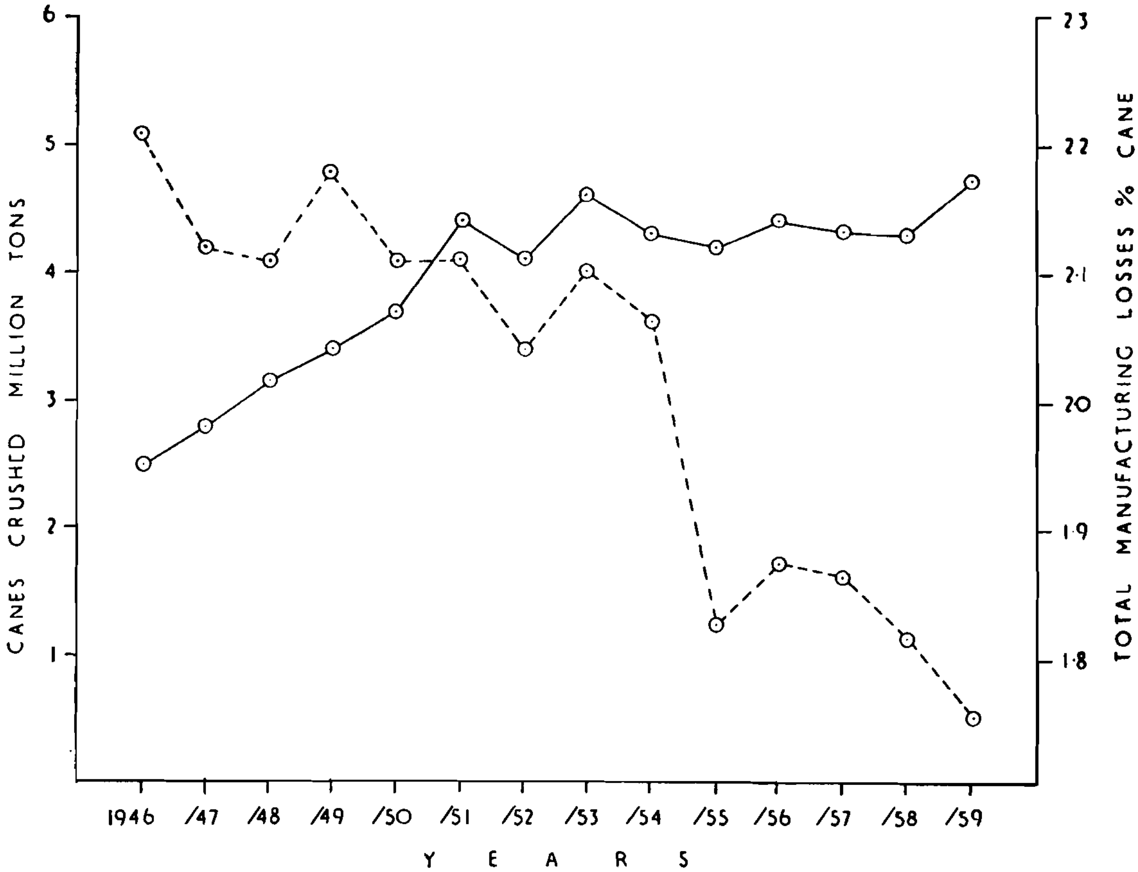

Fig. 5. Canes crushed (plain line) and manufacturing losses 1946 to date.

CANE BREEDING AND SELECTION

Crossing. The year in the division of Plant Breeding and Genetics has been notable in two ways: firstly, crossing inside the greenhouse was commenced on a limited scale and secondly, a more careful approach to the recording of results of selection has been initiated by the adoption of a system of card indexing.

Crossing inside a greenhouse under controlled conditions offers independence from weather fluctuations and the possilibity of employing a wider range of parents than is possible with crossing in the open. The technique, successfully pioneered in South Africa, has recently been used with excellent results in Florida. This year was the first in which the method has been tried in Mauritius, and although many difficulties were encountered, valuable experience was gained. On the basis of what was learnt in 1959, and on advice and comments generously given from abroad, it is intended to expand considerably and improve hybridization under controlled conditions in 1960. Preliminary results from a series of crosses indicated that more seedlings could be obtained inside the greenhouse than from comparable crosses outside.

The total number of individual crossings made this year was 366. The actual number of separate parental combinations which gave rise to a reasonable number of seedlings was in the region of 50, a figure which still invites improvement. A vigourous programme of selection among all promising varieties for new parents, both male and female, is now in progress however, and new crosses have also been made this year utilizing varieties imported since 1955.

The card referencing system mentioned above, together with a method of progeny measurement, is intended to provide data on the performance of progenies of the crosses which are made each year. The progress of each M. variety, through the various stages of selection, is also being separately recorded. By gradual stages, information will be abstracted from the record books concerning breeding and selection in previous years so as to make the index comprehensive.

Selection. The present position in the routine of varietal selection is as follows :

Seedlings raised in 1959 ...	... 40,826
Seedlings planted in 1958 for selection in 1960 ...	... 13,259
Selections from 1957 seedlings made in 1959 (M.—/57 series)	... 506
Selections from propagation plots in 1959.	
M.—/54 series ...	... 6
M.—/55 ,, ...	... 34
M.—/56 ,, ...	... 94
Selections from 1st selection trials in 1959, for inclusion in variety trials in 1960.	
M.—/53 series ...	... 10
M.—/55 ,, ...	... 1
Foreign varieties in propagation plots for testing in variety trials in 1960.	... 10
Varieties in pre-release trials on estates ...	72

Quarantine. Varieties at present in the quarantine greenhouse are not due for release from quarantine until June, 1960. They are C.L. 41 - 70, B.39246, C.P.1, B.45151, H.39 - 7028, N:Co.293, N:Co.334, C.P.29 - 116, H.38 - 2915, Q.61 and *Erianthus* sp. Five varieties undergoing quarantine had to be destroyed in June because of a suspected outbreak of mosaic on B.47258.

Cuttings of several varieties were exported during the year to Australia, the Belgian Congo, Madagascar, South Africa, Trinidad and the U.S.A.

Bunch Planting. Experiments with bunch planting continue. It has been shown with one cross that the percentage of selection from bunch planted seedlings is almost the same as from single plantings. It was also found that selection from the best stalks in bunch planted seedlings gave rise to the best progenies in the subsequent vegetative generation; thus proving once again the general basis of bunch planting to be substantially correct. Other experiments have been laid down to investigate the relative elimination rate of inferior varieties from bunch planted seedlings of several different crosses, and to test the efficiency of selection from bunches in plant cane and in subsequent ratoon generations.

Flower Formation. Investigations into flower formation were continued this year and included several types of photoperiodic experiments. The time of development of the flower primordium of many varieties was established by section cutting while correlated to this, the time and length of the normal photoperiodic stimulation of this flower development has been demonstrated in one variety.

Pre-release trials. There are 72 varieties undergoing testing in 30 pre-release trials established on estates. It will be recalled that these trials are of two types. In the first, six varieties including a standard are replicated at random in four blocks. Promising varieties are further tested in the second type of trial which consists of six randomized blocks of six plots. In order to obtain early information on the maturity behaviour of new varieties, harvesting of blocks in pairs is staggered over the crop period. As a rule, little importance is attached to results obtained in virgins because of the long crop cycle practised in the island. Identical trials are repeated in various parts of the island so as to assess the reaction of varieties to the full range of climatic conditions which prevail locally. In a general way, emphasis is placed on a wider distribution of trials in space rather than on increased replication of plots at one site. Reference was made in an earlier report to the desirability of applying heavy doses of nitrogen to canes undergoing selection. This practice has now been extended to pre-release trials with two main objectives : (a) elimination of varieties with a tendency to lodge and (b) selection of varieties which respond to nitrogen and have therefore a greater production potential.

Among canes being tested, some of the more promising are the following M. seedlings : 305/49, 409/51, 423/51, 658/51, 81/52, 272/52, 225/53, 227/53, 356/53, 117/55 and also Ebène 50/47. It is of interest to record that varieties which are outstanding in other countries, such as N:Co.310 in Natal and many other cane growing areas, B.41227 in the West Indies, Pindar, Trojan and Q.50 in Queensland, have not given promising results so far.

Final Variety Trials. These trials were formerly known as «post-release trials», an unsuitable denomination as they may include varieties not yet released for commercial cultivation. The main purpose of these field experiments is to test the interaction variety/fertilizer/environment. Valuable results, which have enabled practical recommendations to be made, were obtained from the series planted in 1954 comparing M. 134/32 with Ebène 1/37 and four Barbados varieties. The second series planted in 1957 include M.31/45 and M.147/44 in 8 trials reaped in first ratoons in 1959. No conclusions will be drawn until results of the 1960 harvest are available . A third series, including M.202/46, M.93/48, M.253/48 and Ebène 50/47, will be planted early in 1960. Nurseries of these four varieties and two standards have been established at Pamplemousses Experiment Station in order to provide planting material of uniform quality, free from ratoon stunting disease.

THE CANE VARIETY POSITION

The above review of the activities of the Division of Plant Breeding and Genetics has served to give an outline of «work behind the scene» in the development of new varieties. It is now desirable to analyse broadly the present position concerning commercial cane varieties in the island.

The varietal composition of the 1959 crop, as determined by the proportion of estate grown cane crushed at factories was :

M.134/32	...	34%
Ebène 1/37	...	28%
M.147/44	...	13%
B.37172	...	7%
B.3337	...	5%
M.31/45	...	5%
Others*	...	8%

These data when compared to those of the 1958 crop show that M.134/32 has receded by 12% while Ebène 1/37, M. varieties and B. varieties have increased by 3%, 6%, and 3%, respectively. The composition of the crop in different sectors is shown in fig. 6.

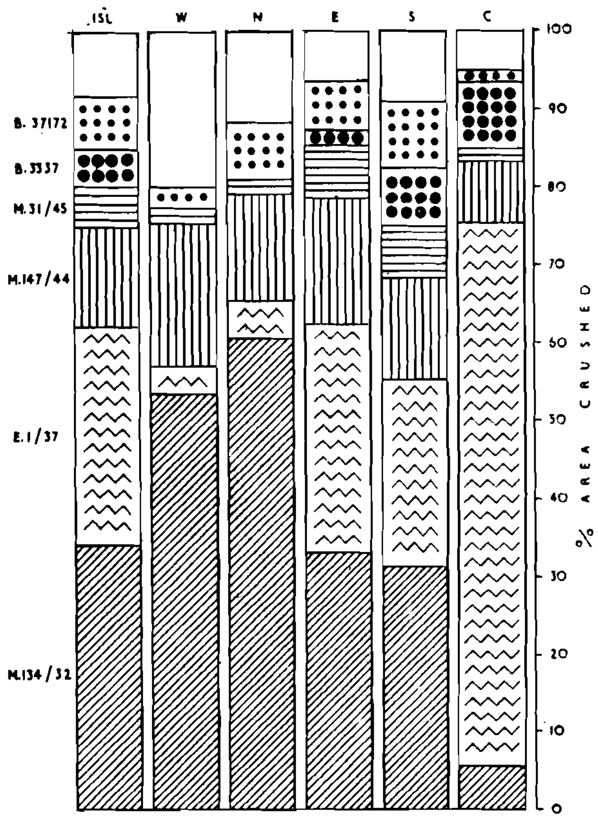

Fig. 6. Varietal composition of 1959 crop in different sectors (estate grown cane).

* *Including M.112/34, B. 34104, B.37161 and unreleased varieties grown on an experemental scale.*

The distribution of dominant varieties over 13,000 arpents of plantations made by Estates in 1959 was :

			(1958)
M.147/44	...	33%	(29%)
Ebène1/37	...	24%	(29%)
B.37172	...	21%	(21%)
B.3337	...	7%	(5%)
M.31/45	...	4%	(8%)
B.34104	...	3%	(3%)

The composition of plantations in different parts of the island is illustrated graphically in fig. 7, while the variety trend since 1954 is shown in fig. 8. Broadly speaking the pattern of varieties planted in different sectors follows closely that of the previous year : M.147/44 and B.37172 being favoured in dry areas and Ebène 1/37 and B.3337 in wet areas. The performance of varieties in different climate zones is briefly discussed hereunder.

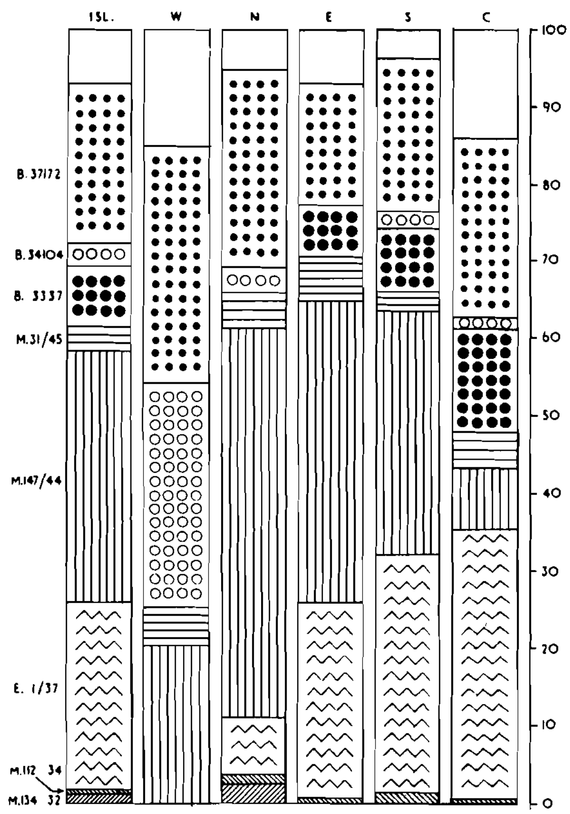

Fig 7 Varietal composition of plantations made in 1959 on estates.

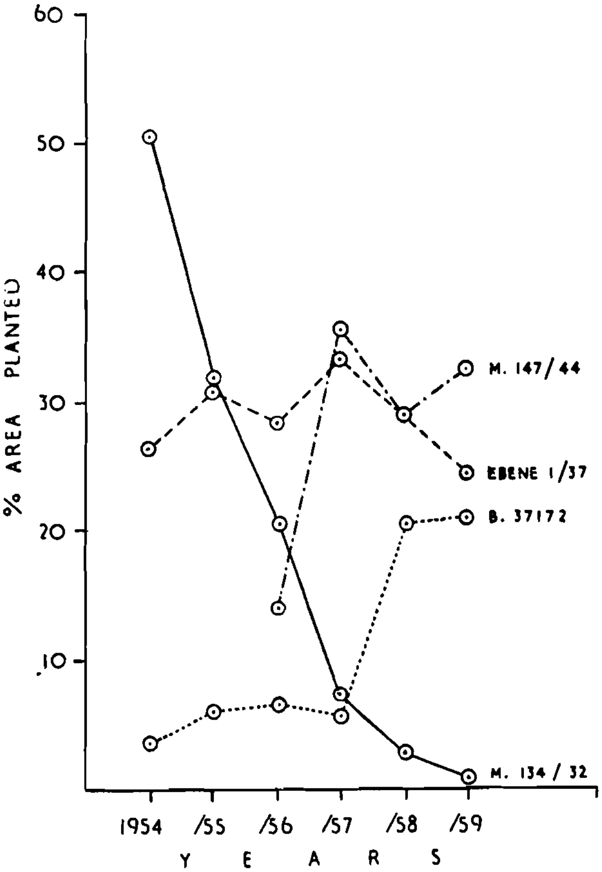

Fig. 8. Variety trend 1954-1959.

Sub-humid Area. This zone comprises cane lands receiving less than 50" of rain annually and where irrigation water is not available. The best varieties under these conditions are M.147/44 and B.37172 which have consistently outyielded M.134/32. The main defects of M.147/44 are its clinging trash and deterioration in juice quality from about October onwards. B.37172 on the other hand is a «clean» cane, easy to work and with high purities even late in the season. These varieties are to some extent complementary to one another. Because of its defects, it would probably be unwise to extend the cultivation of M.147/44 beyond 30%. Other varieties which have performed well in restricted areas of this zone are B.34104 and M.31/45 in fields where the water table is high.

Irrigated Area. The best commercial varieties are M.147/44, B.37172 and B.34104. The advantage of B.37172 under such conditions is that it responds better to nitrogenous fertilizers than M.147/44.

Humid Area. Receiving between 50" and 80" of rain annually. The choice of varieties under these conditions is much wider, including those mentioned above and Ebène 1/37 where rainfall is higher. M.31/45 is well suited to this zone while the quality of M.147/44 has been disappointing although yields of over 6.5 tons of sugar per arpent have been recorded in some fields.

Super-Humid Area. The unchallenged variety in the wet area of Mauritius is Ebène 1/37 which has produced exceptionally high sugar yields in 1959. B.3337 has the merit over Ebène 1/37 of producing economic returns with a high level of nitrogenous fertilization and of being more resistant to wind damage.

Release of new M. Varieties. The Cane Release Committee recommended that the varieties M.202/46 (Co.281 x M.63/39) and M.93/48 (Ebène1/37 x M.63/39) should be released for commercial cultivation in 1960.

M.202/46 is a thick cane, with fairly free trash, ratooning well and with a tendency to arrow heavily. It posesses high sucrose in early and mid season, but juice quality deteriorates rapidly later. It has produced better results (from 6 to 22% more sugar per arpent) than the standard variety in all climatic zones.

M.93/48 is also a thick cane with free trash and a good ratooner, but is a shy arrower. It is extremely vigorous under conditions of high rainfall, and in spite of its lower sucrose than Ebène1/37, it has outyielded that variety in sugar per arpent by a wide margin in trials located in the super-humid zone. Consequently, priority for planting material of M.93/48 will be given to plantations of the wet zone.

Further information of interest on these two varieties is given in the Cane Breeding section of this Report.

The performance of M.93/48 in one trial, reaped during five consecutive years, is shown diagrammatically in fig. 9. The relative benefit obtained, as determined from Hugot's formula* is compared with that derived from B.3337.

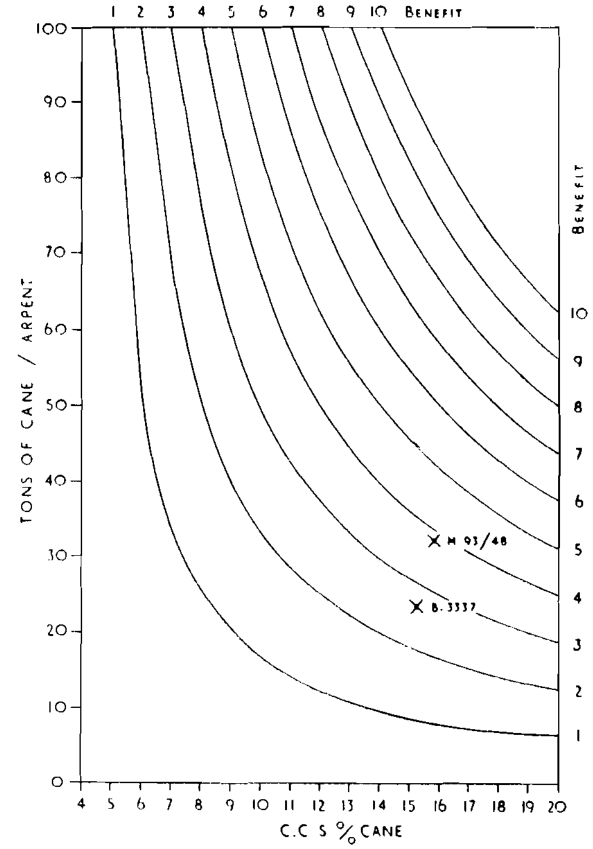

Fig. 9. Curves of relative benefit derived from Hugot's formula at various levels of cane yields and C. C. S. % cane. Average results of M. 94/48 compared to B. 3337 are indicated.

Similar results were obtained in other trials, and both newly released varieties were superior to the standards in all instances.

The merits and defects of another variety, M.253/48 (B.34104 x M.213/40) were considered by the Committee, but it was decided not to advise its release until more information is obtained, particularly concerning its juice quality. However, in view of its excellent performance under irrigated conditions (37% more sugar per arpent than the standard), the Cane Release Committee recommended that the Central Board should authorize the cultivation of this variety under permit on a restricted scale.

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* *Relative benefit* = $\frac{\text{tons cane/arpent (CCS} - 4)}{100}$

NUTRITION AND SOILS

Nitrogen. The standard nitrogenous fertilizer used in Mauritius is ammonium sulphate as per unit of N it has been cheaper than and as efficient as any other form of nitrogen available. In the last few years, however, commercial urea has appeared on the local market in considerable amounts. This newer nitrogenous fertilizer has proved tempting for the cane planters because it is slightly cheaper per unit N than sulphate of ammonia and also, on account of its high nitrogen content, transport costs are lowered. In view of the interest in urea and because no local data on its performance as a nitrogen source for sugar cane were available, a series of experiments were laid down in the various climatic zones of the island in 1956 to compare urea with amonium sulphate. The results of these well replicated trials have now shown conclusively that when urea is applied on the stool in a single dressing, as is the standard practice in Mauritius, then it is inferior to sulphate of ammonia. There is some indication from the results, however, that below a level of 30 kg of Nitrogen per arpent, urea compares more favourably with sulphate of ammonia than at higher levels and experiments are now in progress to test if this is the case. Moreover, application of urea under the trash or covering it with soil should improve its efficiency; this aspect is also under investigation. The losses of cane in the experiments when the urea was used instead of sulphate of ammonia were more than one ton per arpent, a result showing clearly that before any major change is made in fertilizer policy by estates, thorough research, using modern agronomic technique, should be made.

Further information of interest was obtained on the differential response of varieties to Nitrogen. Thus data from 14 final variety/fertilizer trials have shown that varieties bred in Mauritius can be adversely affected by over-fertilization with Nitrogen whereas other varieties such as B. 37172 and more especially B.3337 show little or no deterioration in quality.

Average results available to date are summarized in the table below :

Differences resulting from application of 50 kg instead of 20 kg N per arpent.

Variety	Six Trials Series '54 (1956, 57, 58, 59)		Eight Trials Series '57 (1959)	
	Tons Comm. Sugar/Arp.	Comm. Sugar % Cane	Tons Comm. sugar/arp.	Comm. Sugar % cane
B.3337 ...	+ 0.44	+ 0.12		
B.37172 ...	+ 0.29	— 0.13	+ 0.29	— 0.09
M.147/44 ...			+ 0.26	— 0.41
Ebène1/37 ...	+ 0.18	— 0.37	+ 0.24	— 0.45
M.31/45 ...			+ 0.18	— 0.54
M.134/32 ...	+ 0.17	— 0.37		

Phosphorus. The phosphate status of cane land in Mauritius was, generally speaking, unsatisfactory when this Institute was founded six years ago; priority was therefore given to an intensive study of phosphate fertilization under local conditions. The results obtained from these field trials are discussed in another section of this Report.

As a consequence of the many experiments carried out and frequent discussions with those interested, phosphate fertilization on estates is gradually being placed on a rational basis. The use of dressings of one ton of guano at planting, unheard of five years ago, is now a common practice, while soluble phosphates are playing a smaller but still important role as supplementary fertilizers. This role is of a dual nature: firstly, soluble phosphate when applied at planting meets the requirements of the first harvest; thereafter ratoons derive their requirements principally from the heavier dressing of *guano phosphaté*. Secondly, in those ratoons showing phosphate deficiency, small dressings of soluble phosphate have proved profitable by improving yields whilst ratooning can be carried on for the normal period.

In the Annual Report for 1958 (p. 47), it was recommended that on derocked or subsoiled land known to be deficient in phosphate, and on eroded slopes, higher dressings of guano (up to two tons per arpent), supplemented by soluble phosphate in the furrow, should be applied. This recommendation has, however, not yet been generally practised.

Although there has been a noticeable improvement in the phosphate status of our crops, as indicated by foliar diagnosis, it should be pointed out that deterioration may be expected, particularly on new lands, until such times as the reserve of soil phosphorus has been built up to an adequate level.

Organic matter. Data available on the vegetative composition of the sugar cane crop has been collated.

With an average yield of 30 tons of millable stalks per arpent, trash and tops return approximately six tons of organic matter to the soil annually or the equivalent of the organic matter in fifteen tons of farmyard manure. In a rotation of virgin and six ratoons, the total organic matter returned by sugar cane, excluding the very considerable quantity of roots, is approximetely 42 tons, corresponding to 120 tons of «fumier». With a turnover of this magnitude it is difficult to understand how a dressing of 6 tons of «fumier» in a crop cycle could be expected to play any significant role in the fertility of cane soils. In addition data on the inorganic composition of the cane crop has been collated and is presented along with the vegetative data.

Soil amendments. In view of the interest shown in the use of bagasse, either composted with scums and molasses or applied directly to heavy soils, several trials were laid down during the year to assess the value of the material.

SOIL SURVEY

Work on the pedological characteristics of local soils continued throughout the year, some twenty-five profiles being studied in detail. This work is producing a sound background for the final soil group and family classification of local soils. Concurrently with this work, phase mapping has also been progressing. The phase, possibly more than any other sub-division of a soil survey, is of extreme importance to the practical agriculturist because properties affecting land use, such as slope, depth of soil, rockiness, stoniness and drainage characteristics are mapped. The most striking phases in Mauritius are those of rockiness and stoniness. Rational mapping of these characteristics is now possible as ten different phases have been established. A one inch reconnaissance map of the Pamplemousses and Rivière du Rempart section, showing these phases and their significance as regards irrigation, has been prepared and passed on to the Public Works Department for use as a guide in the planning of a surface irrigation system. Mapping has been extended to cover the whole of Mauritius and a phase map of rockiness has been completed.

The soil survey has now reached the stage where a «mass attack» is possible, a clear picture of all those features affecting final classification of the soils having been obtained. Estates could help considerably in the production of the final survey if an agronomist, who could spend some time with the soil survey workers, were available on each estate. He would obtain during this period sufficient knowledge of the soils of his estate to be able to assist in mapping, sampling and determining simple characteristics such as colour, pH, available phosphate and potash. Estates which can provide such help will obviously obtain a good soil map more quickly than others.

CANE DISEASES

The abnormal growth conditions which prevailed during the year and the rapid changes in the pattern of varieties cultivated in the island, are probably the major factors which have brought about certain modifications in the overall annual disease picture in cane lands.

In spite of the dry conditions, the effects of ratoon stunting disease have been less severe this year. For example, the performance of M.134/32 in the sub-humid area was superior this crop season than the preceding one. The same trend was reflected in the 1959 ratoon stunting trials inasmuch as reductions in yields in diseased plots compared with healthy plots were less than the previous year. Thus, in the sub-humid zone, reductions in yield ranged from 4.0% to 20.3% in first ratoons as compared to 4.7% to 26.0% in virgins, in 1958. In the super-humid area, the reductions varied from 4.1% to 25.5% in first ratoons as compared to 2.4% to 45.0% in virgins, in 1958. Ebène 1/37 showed susceptibility in both trials with a reduction of 13.3% at Pamplemousses Experiment Station and 25.5% at Belle Rive Experiment Station. The reductions in yield between diseased and healthy plots with M.147/44 and B.37172 were 15.3% and 9.6% respectively in the super-humid zone and 6.9% and 4.0% respectively in the sub-humid area. The varieties M.202/46 and M.93/48 have shown susceptibility in a ratoon stunting trial in the super-humid zone.

In spite of the short hot water treatment, chlorotic streak is the important disease of the super-humid zone. The effect of the disease on the highly susceptible Ebène 1/37 results in a weaker ratooning capacity, leading to a progressive reduction of stools per unit area and of canes per stool. It is once more recommended to give the short hot water treatment to all planting material derived from infected areas, whether such material is to be planted in a wet or a dry, apparently disease-free, locality. An extensive research programme on the transmission of this disease is in progress.

Mention should be made of rind disease or sour rot (*Pleocyta sacchari* Mass), a disease hitherto considered of little economic importance attacking almost exclusively overmature, dead or dying canes. This year, however, the disease was found to be widespread in the Northern sector, particularly in the coastal area and in places where the soil is shallow, very rocky, and growth conditions generally poor. The severe drought which prevailed from mid-April to the end of July was probably conducive to the severe, yet local, outbreaks. Several consignments of infected canes produced a mixed juice purity of 73 at one factory where the average figure was 89. It is not believed, however, that varieties now under cultivation show greater susceptibility to the disease. Indeed, the most severe infection was observed in a field of M.134/32, a variety which is, under normal conditions, resistant to the fungus.

Several cases of pokkah-boeng (*Fusarium moniliforme* (Sheld.) Snyd. et Hans) were also reported this year during the period of active growth, from the end of January to the beginning of April, and cases of top rot were observed cn M.147/44 and M.202/46.

Although all commercial varieties cultivated at present in Mauritius are resistant to leaf scald (*Xanthomonas albilineans* (Ashby) Dows), the chronic and acute phases of the disease are still encountered in the variety collection. This year two seedlings were infected under natural conditions and showed high susceptibility to the disease.

No epidemic of red rot (*Physalospora tucumanensis* (Went.) Speg.) occured during the year, but the disease caused damage on occasion to cuttings planted after the long hot water treatment. It is possible that germination failures could be attributed to latent infection of the cuttings and resistance of the fungus to the heat treatment.

Only varieties, locally bred or imported, resistant to gumming disease (*Xanthomonas vasculorum* (Cobb) Dows.) are cultivated in the island. The soundness of such a policy was evident again this year during which weather conditions have been favourable to gummosis. Several «old» varieties were severely affected, showing chlorosis of the foliage (the «maladie blanche» of the middle eighties) with a large number of dead stalks. Two Australian varieties, Q.44 and Q.57, recently released from quarantine, contracted gumming disease naturally in the observation plot.

Red stripe (*Pseudomonas rubrilineans* (Lee *et al.*) Starr et Burkholder) was occasionally encountered in a mild form, as in previous years, on the Barbados varieties during the early part of the year, particularly in the wet areas.

Eye spot (*Helminthosporium sacchari* (Breda de Haan) Butler) was again conspicious during the cooler months, particularly on B.37172. The leaves showed heavy striping, but no cases of top rot were observed and there was no apparent damage to the cane crop.

Only one case of Smut (*Ustilago scitaminea* Syd.) (fig. 22) wasre ported this year in the subhumid western coastal area. The variety affected was B.37161. However, the disease was seen, as usual, during the early part of the year, in the cane collection particularly on P.O.J. varieties.

Leaf burn, a physiological injury to the foliage which usually causes alarm to planters, was again observed during the period of rapid growth, at times when environmental conditions are conducive to excessive transpiration. It should be mentioned once more that such conditions prevail usually for a short time after which the plants rapidly recover.

Snail damage to standing cane was observed in one locality on B.37172. The injury followed an abnormal proliferation of the root band. The snails were attracted to such soft tissue and fed on the proliferations and in many cases on the underlying parenchyma as well. The proliferation of the root band accompanied by stem and knife cut distortions on the internode, although strongly suggestive of herbicide damage, could not apparently be attributed to such cause. It is believed that such damage to standing cane is a first record. Another abnormal growth was observed on a seedling cane, M.256/57: several shoots, otherwise normal, were seen to be completely devoid of buds. On the other hand, stem galls, resulting in an excessive proliferation of buds, led to witch's broom effect on a planted cutting of Ebène 50/47, a variety not yet released. The number of shoots counted at one node was eighty-five.

FIJI DISEASE IN MADAGASCAR

A Fiji Disease resistance trial was established in the highly contaminated Brickaville area, on the East Coast of Madagascar, in co-operation with the French Authorities in July 1959. Twenty-two varieties were planted in the trial, the canes serving as controls being the highly susceptible M.134/32, the tolerant N:Co.310 and the resistant Pindar. M.147/44 and M.31/45, recently released from quarantine, have been included. Six varieties, including M.202/46, M.93/48 and M.253/48, are now in the quarantine greenhouse in Madagascar for inclusion in the resistance trial.

An outbreak of what appears to be an unrecorded disease of the sugar cane occured in commercial plantations on the West Coast of Madagascar and the neighbouring island of Nossi-bé, in October. The characteristic feature was the presence of galls on the lower surface of leaves of sugar cane plants; this is a diagnostic symptom of Fiji Disease but no other single associated Fiji Disease symptom has apparantly been observed. Furthermore, the epidemiology does not seem to have anything in common with Fiji Disease. Morphological and histological studies on preserved leaves, collected during a visit to Madagascar, revealed fundamental differences in galls present on such material and Fiji Disease galls. Although no opinion can be expressed on the nature of the galls, and only precise experimentation will reveal whether the disease is of virus origin, it appears that the material examined was not affected with Fiji Disease.

GUMMING DISEASE IN REUNION

A serious outbreak of gumming disease occuted last year in the neighbouring island of Réunion. (*Vide* Ann. Rep. M.S.I.R.I., 1958, p. 63). Information was obtained this year that the disease had spread considerably, the leading variety R.397 being the most affected, with the result that the cultivation of that variety is being abandoned. M.253/48, a promising variety resistant to gummosis in Mauritius, has also contracted infection naturally.

Although environmental conditions cannot be ignored, the differences in varietal reaction to the disease in the two islands point to the existence of two different strains of the pathogen in Mauritius and Réunion, respectively.

Three varieties D.109, M.147/44 and N:Co. 310 were forwarded to the Botany School, Cambridge University, in order to have their reactions tested to isolates of *Xanthomonas vasculorum* from Mauritius and Réunion. Preliminary results obtained indicate that the three varieties are susceptible to the Réunion strain and that only D.109 is affected by the Mauritian one. This observation is in agreement with field reactions of the three varieties in the two islands.

CANE PESTS

Work on cane pests continued along the lines described in the previous report and particular attention was given to research upon nematodes associated with cane roots.

Widespread and very numerous attacks by the army worm, *Leucania loreyi* Dup., occured in November-December in fields of young ratoon cane and resulted in each instance in the complete defoliation of several arpents of young growth. The appearance of fields after the attacks was remarkable and alarming but, since the caterpillars did not destroy the hearts of the shoots and their attack was not sustained, cane growth was only checked temporarily. The reason for such numerous and widespread outbreaks of this insect are not clear but it is to be remarked that all the attacked fields had been burnt before harvest and adjoining unburnt fields were virtually untouched. It is to be concluded that burning at harvest induced the outbreaks of *Leucania* in the young growth of the subsequent crop.

The sugar cane scale insect, *Aulacaspis tegalensis* Zehnt., was also more abundant than usual and some severe attacks occurred in dry coastal areas, probably as a consequence of the dry weather earlier in the year. Cane stalks encrusted with this insect tend to dry out and growth is suppressed while there is also a remarkable reduction of the sugar content.

A localised attack by another scale insect, *Pulvinaria iceryi* (Sign.) occured in one region and utterly destroyed about two arpents of ratoon cane.

Nematodes. Progress was made with the work of determining the various species which feed upon cane roots and a useful collection of about 700 permanent slide preparations has been formed. The work of elucidating the effect of soil nematodes upon cane growth is difficult and time-consuming and will require much patient investigation, particularly as nematode activity is probably associated with plant pathogens. Soil fumigation experiments are producing interesting results and are being pursued. The improved growth of cane following soil fumigation with ethylene dibromide is very striking on sandy soil but growth responses have been obtained on other soil types as well.

Stalk Borer. The stalk borer, *Proceras sacchariphagus* Boj., continues to be the major cane pest in the island. Efforts to introduce and establish foreign parasites, which will attack the borer, were continued with the assistance of the Commonwealth Institute of Biological Control and liberations of two parasitic species were made. Data were also collected upon the comparative resistance of cane varieties to the borer but, as far as commercial varieties are concerned, there is little to add to the comments made in the report for 1958. The small amount of information available at this stage upon the three promising varieties M.202/46, M.93/48 and M.253/48 indicate that they may be more susceptible than M.147/44 and M.134/32.

White Grubs. Experiments with insecticides against *Clemora smithi* Arr. were continued and, although aldrin and chlordane give good grub control when applied at planting, uncertainty as to the effect of the insecticides upon cane growth necessitate more critical tests than have been made hitherto. Application of these chemicals to cane soils is not at present recommended.

HEAT TREATMENT OF CUTTINGS

Appreciable progress was made during the year in the hot water treatment programme against ratoon stunting disease. The central hot water treatment plant at Belle Rive, administered by the Sugar Producers' Association, worked at full capacity during the first six months of the year. During the crop season, however, the amount of cuttings sent for treatment was well below expectation. On the whole, a creditable effort has been made and, out of a target area of 1315 arpents, a total of 610 arpents of nurseries were established in the various factory areas in 1959.

The varieties treated were, in declining order of importance: M.147/44, B.37172, Ebène 1/37, B.3337, M.31/45 and in addition a small proportion of M.134/32, M.112/34 and B.34104.

Planting material was also treated in the experimental tank of the Institute at Réduit for large and small planters. The former have established their own nurseries, whereas cuttings treated for small planters have been planted in a central nursery administered by the Sugar Planters' Rehabilitation Fund Committee.

It would appear, if the gross results are considered, that the hot water treatment has not been seriously detrimental to the germination of treated setts. Indeed, 84% of the area of nurseries planted were maintained and the average recruiting figure was 24%. However, if these results are analysed, it is observed that germination in the nurseries has been very variable and has ranged from almost complete failures to excellent stands. If the reduction in germination had been uniformly distributed in all plantations, the obvious answer would be to plant the nurseries with a proportionally greater number of treated cuttings. As such is not the case, studies on the effect of heat on the germination of treated setts are being actively pursued.

As far as the varietal effect is concerned, the germination of B.37172 is least affected by the heat treatment. M.147/44 gives erratic results on account of the large number of sprouted eyes encountered on that variety, hence a rigourous selection of cuttings has to be resorted to. The germination of Ebène 1/37 is appreciably reduced by the treatment and M.134/32 does not stand the heat treatment at all well.

Experiments on the addition of anti-oxidants to the hot water bath to improve the germination of treated setts have again given promising results. Further experimentation is being carried out on a field scale.

WEED CONTROL

Substituted Ureas. Experiments started in 1956 in order to assess the effects of CMU and DCMU on cane growth were completed this year. The herbicides, applied at rates varying from 2 to 10 lb per arpent did not produce any adverse effects on cane yield and sucrose content. Of the two chemicals, DCMU proved the more effective, particularly in the super humid localities. Better weed kill was obtained at the higher rates. The repeated application of these weed killers during the years 1956-1959 greatly reduced the stand of annual weeds and checked, to some extent, the spread of perennial broad-leaved weeds. Perennial grasses, however, were in general not affected at the rates of application used.

Studies on Cynodon dactylon. Botanical studies on *C. dactylon* have revealed that 4 clones of this species, consisting of triploid and tetraploid strains, occur in Mauritius. Morphological differences between these races are not so obvious. Investigations on the epidermal structure of their stolons, however, have shown appreciable differences which could be used, in conjunction with other characters, to distinguish them. The identification of these varieties is of considerable practical interest since they have been found to differ in their susceptibility to sodium trichloracetate (TCA) and sodium dichloropropionate (Dowpon). The tetraploids are in general more resistant to those chemicals than the triploids.

Sodium dichloropropionate. The degree of tolerance of sugar cane to *sodium dichloropro-*

pionate (Dowpon) was assessed by spraying the varieties Ebène 1/37 and B.3337. The spray was directed towards the base of 5 month and 8 month old stools. The higher rates of application were found to be detrimental to both varieties and at the lower rates Ebène 1/37 was found to be more tolerant to this weed killer than B.3337.

Other investigations. Experiments on the control of *Paspalidium geminatum* («herbe sifflette») were continued and it was found that a formulation consisting of a substituted urea, preferably DCMU, or simazin with sodium chlorate, could give very satisfactory results. Further trials on *Heliotropium amplexicaule* («herbe bleue») indicate that the above formulations and also one consisting of a substituted urea or simazin with amizol or Dowpon can give satisfactory results, new infestation from seed being greatly reduced. Experiments on the eradication of *Typha javanica* («Voundre»), growing in marshy lands, with Dowpon and low volatile esters of 2,4-D and 2,4,5–T, used alone and in mixed formulations, showed that Dowpon was the most effective herbicide for the control of this weed.

Simazin. Preliminary observations made on the assessment of the herbicidal properties of Simazin, in comparison to the substituted ureas, indicate that the latter chemicals are apparently more effective than simazin in the control of certain weed species. It is, however, too early to draw definite conclusions at this stage of the experimental work. Addition of small quantities of sodium chlorate to the substituted ureas or Simazin increases their efficacy. This was particularly obvious when spraying was carried out just after weed emergence.

Logarithmic sprayer. A Chesterford logarithmic spraying machine was presented to this Institute this year by Messrs. Fisons Pest Control Ltd. of England. This spraying machine will serve an exceedingly useful purpose in the screening of new herbicides.

OVERHEAD IRRIGATION

The irrigation experiments described in the last annual report were continued at Palmyre by courtesy of the manager of Médine S.E.

The main observations made this year are summarized below:

	Free Soil		Gravelly Soil	
Type of irrigation	Overhead	Surface	Overhead	Surface
No. of irrigations per year	11	14	11	14
Water applied per arpent per year (inches)	38	80	36	300
Yield of cane (Tons/arp.)	36.3	38.7*	29.3	30.6*
Cost of irrigation (Rs.) (a) per arpent	200	107	260	194
(b) per ton cane	5.50	2.60	8.90	6.25

* Corrected for initial fertility differences in experimental plots. The actual yields from surface irrigated fields were 40.9 and 31.1 tons/cane per arpent on free and gravelly soils, respectively.

Rainfall during the year was 29 inches and there was a serious shortage of irrigation water for the overhead irrigated plots. The pumping units could not therefore work at full capacity and water was not available for night work. As a result, the overhead irrigated fields received only 36-38 inches instead of the intended 50 inches, while surface irrigated plots did not suffer from the water shortage to the same extent.

Growth measurements (fig. 10) have indicated normal elongation with both types of irrigation and differences in yield in favour of surface irrigation, as shown above, may have been due to the inadequate water supply in the overhead irrigated plots. It will be noticed that on free soils 42 inches of water extra in surface irrigated plots has apparently resulted in 2.4 tons more cane per arpent, while on gravelly soil 264 inches augmented yields by only 1.3 tons per arpent.

In an experiment carried out with overhead irrigation on free soils, the best results were obtained when $2\frac{1}{4}$ inches of water were applied per irrigation. Growth of cane was markedly depressed with application rates of 3 inches and $1\frac{1}{2}$ inches (fig. 11).

Preliminary observations were made on two types of evaporimeters, (a) the Standard tank of the Research Committee, Institute of Civil Engineers, recommended by Penman, and (b) that of the U.S. Weather Bureau. There are indications that the high figures obtained with the latter type do not represent the normal evapo-transpiration of sugar cane.

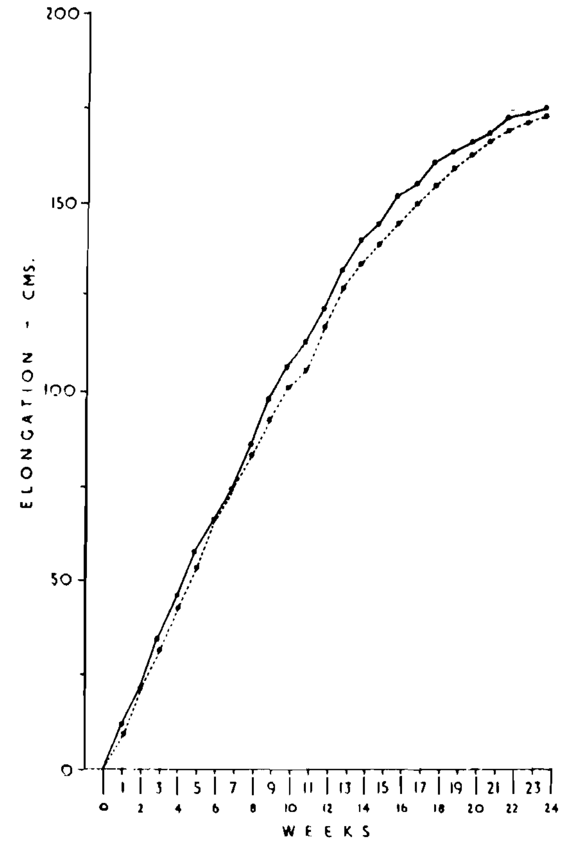


Fig. 10. Elongation, weekly intervals.
Dotted line: overhead irrigation.
Plain line: surface irrigation.

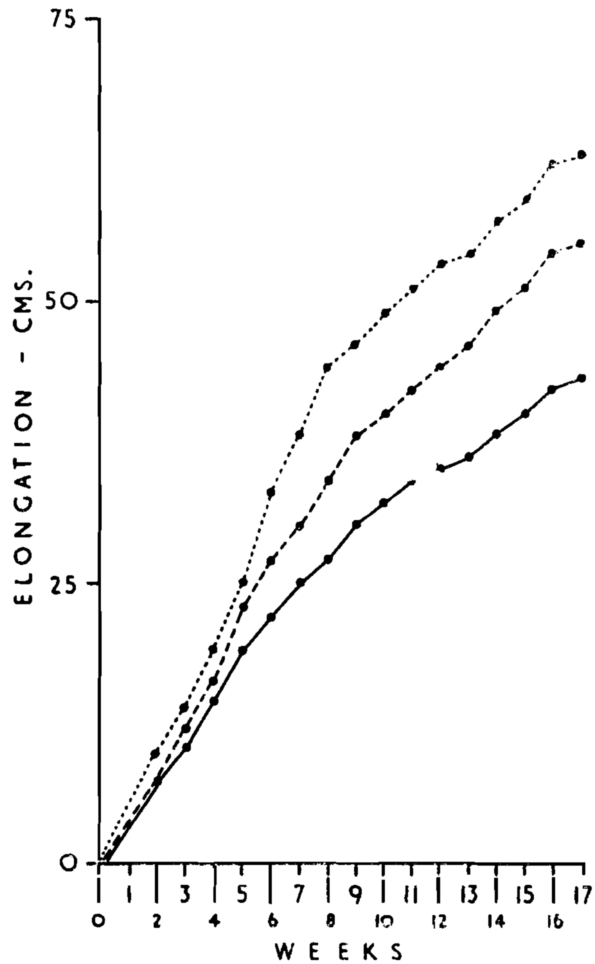


Fig. 11. Relation between elongation and rate of application by overhead irrigation on free soils.
Dotted line: $2\frac{1}{4}$" per irrigation.
Broken line: 3" per irrigation.
Plain line: $1\frac{1}{2}$" per irrigation.

GROUND WATER

The geophysical survey started in 1958 was continued from May to December 1959 by Mr. R. Sentenac of the Compagnie Générale de Geophysique. The whole of the northern sector of the island including Plaine des Roches has now been surveyed. Test borings, to determine the volume of water available at different depths, will be carried out at a number of selected sites in 1960. Messrs. Sir Alexander Gibb & Co. are acting as consulting engineers to the Institute in this connection.

The main conclusions of the 1958 resistivity survey covering the district of Pamplemousses are summarized below from the report submitted by the Compagnie de Géophysique. One of the maps accompanying this report (fig. 12) is reproduced by courtesy of the Chamber of Agriculture. In addition to the economic importance which this project may have for the future development of agriculture in Mauritius, the geological data obtained are of the greatest value for the soil survey now in progress.

The most important feature revealed is that the sub-stratum of older volcanic formation is also permeable, sea water penetrating into the old as well as into the recent formations.

Overlying the salt water, a layer of fresh water extends throughout the tuffs which are crossed by more or less well-defined basaltic lava flows.

Following the results of the electrical soundings, it has been possible to locate the most important lava flows and to trace them back to their original volcanoes. Resistivity charts of three different depths indicate that the volcanic systems of Pamplemousses district may be classified chronologically as follows:

(a) Old lavas from Montagne Longue, extremely weathered on the surface or covered with tuffs.

(b) Younger lavas from Butte aux Papayes and Mont Virer.

(c) More recent flows from Mont Piton and Forbach Hill, superimposed on part of the lavas from Butte aux Papayes and Mont Virer.

The very permeable nature of the fissured basalt formations and their distribution throughout the mass of clayey tuffs has a most important influence on the hydrology of the region. A study of this distribution, in conjunction with the level of the water table, gives an indication of the water potentialities of the different lava flows.

A systematic determination of the characteristics of these lava flows will be the second step of the hydrologic investigation. A certain number of sites, three of which are to be given priority, have been indicated for test observations.

Local conditions will decide whether it would be preferable to drill or sink wells. Whatever method is adopted, detailed data must be collected over long periods in order to account for seasonal variations.

Once a thorough study of the water resources of the different volcanic systems is completed, the site of the permanent pumping stations will depend on specific factors, namely, depth from which the water has to be pumped, altitude and location of the area to be irrigated.

FIELD EXPERIMENTATION

Field experimentation in 1959 included 160 established trials of which 130 were harvested, 45 new trials laid down, and a number of other field experiments such as selection trials, germination and nutritional studies, weed control and disease observation plots, which were not harvested.

The number of trials standing for harvest in 1960, and their nature, is as follows :

Variety trials (one date of harvest) ...	22
Pre-release variety trials (3 dates of harvest)	14
Ratooning capacity	6
Final variety/fertilizer trials (3 dates of harvest)	14
Growing period of cane	2
«Clean» v/s selective cutting ...	6

Fertilization and amendments

(i)	Urea v/s sulphate of ammonia ...	8
(ii)	Nitrogen at high levels	4
(iii)	Levels, forms and placement of phosphate	10
(iv)	High and low fertilization (demonstration)	2
(v)	Balanced and unbalanced fertilization	3
(vi)	Basalt on highly leached soils ...	2
(vii)	Gypsum	2
(viii)	Bagasse amendment	3
(ix)	Organic matter	13
	Ratoon stunting disease	12
	Chlorotic streak	1
	Control of Clemora by insecticides ...	8
	Control of borers by insecticides ...	1
	Control of nematodes by fumigants ...	3
	Weed control	18

The cooperation of sugar estates in the establishment of many of these trials is gratefully acknowledged.

SUGAR MANUFACTURE

The strength of the Sugar Technology division was markedly increased during the year with the appointment of an Associate Chemist, an Assistant Sugar Technologist and an additional Laboratory Assistant. As a consequence, it has been possible to devote time to a greater number of research problems. The activities of the division are briefly reviewed below :

Research : (a) *Cane Analysis.* The analysis of cane from experimental plots of the Institute is based on a method using a Cutex fibrator and a hydraulic press. The method, however, suffers from several disadvantages, in particular from lack of accuracy in fibre determination. A large number of experiments carried out with a cane chipper and a Waring blendor have shown that this new type of equipment suits the purpose much better and yields more accurate results. The new equipment will consequently be adopted in 1960.

(b) *Power consumption of cane knives and shredders.* The power consumption of a number of cane knives and shredders has been measured during the crop with the help of recording and integrating wattmetres. Interesting results have been obtained which will lead to a better utilization of the power available for cane preparation prior to milling.

(c) *The use of Polyelectrolytes in juice clarification.* Whereas during the 1958 crop the effectiveness of «krilium», an anionic polymer, was tested in the clarification of juice, similar tests were carried out in 1959 with «separan», a nonionic polymer. This polyelectrolyte increases the rate of settling of muds in clarifiers and has considerably helped clarification in a few factories where juices have been particularly refractory this crop.

(d) *The washing of raw sugar in centrifugals.* Experiments carried out to compare saturated steam with superheated water have shown the superiority of the latter. Tests have also been made on the most appropriate time of application of superheated water in centrifugals. It would appear that best results are obtained when the superheated water is applied late in the cycle.

(e) *Dirt correction.* A number of determinations made during the crop on mixed juice samples from various factories have shown that these juices contain, on the average, 0.5 per cent. by weight of extraneous matter, commonly called dirt. This is made up mostly of soil particles and of bagacillo. It is suggested that a «dirt correction» be applied in future to the weight of mixed juice, so as to assess sucrose in mixed juice, and hence sucrose in cane, more correctly.

(f) *Cooling and reheating of final massecuites.* Comparisons made between a new type of crystallizer and the standard Fletcher Blanchard crystallizer have shown that the former is less effective than the latter for the cooling as well as for the reheating of final massecuites.

(g) *Filterability of raw sugars.* Average raw sugar samples from the 1958 crop have been analysed for starch and silica. A number of filterability tests with the Nicholson test filter have also been made, but it has not been possible to complete this study.

(h) *Starch content of juices.* In collaboration with the Chemistry Division, the starch

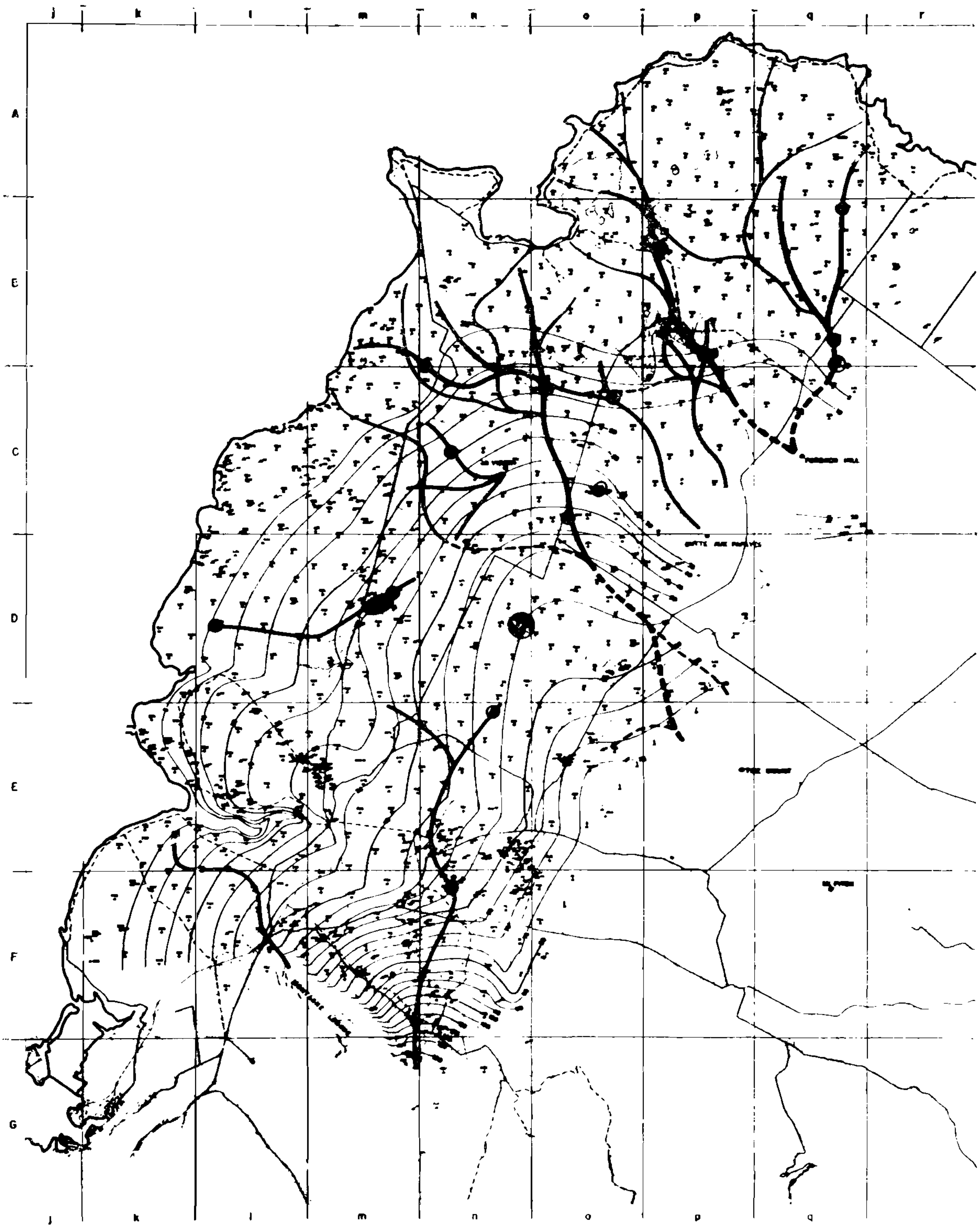


Fig. 12. Map showing results of electrical resistivity survey in the Pamplemousses district. General water table (contour lines) and more important lava flows (heavy lines) are indicated.

content of juices was determined in different varieties. The results of the analyses, which are presented in detail elsewhere in this Report, show that there are marked varietal fluctuations; thus, M.134/32 is uniformly low, Ebène 1/37 is moderately high and M.147/44 is high. The technological significance of this finding is unknown and much has to be learnt locally about the influence of starch level in juice on sugar quality.

Advisory. In addition to advice given to factorychemists on many occasions, relative to chemicalcontrol, the more important questions studied were :

(a) Weight and polarization changes of raw sugars exported to the United Kingdom. This study was carried out at the request of the Sugar Syndicate in order to determine the factor responsible for changes in weight and polarization of raw sugars exported to the U.K. during the past few years.

(b) At the request of the Central Board, the problem of cane analysis as affecting cane payment in Mauritius was studied and recommendations made thereon.

(c) A complete steam balance was calculated for one factory.

(d) Advice was given to another factory concerning the liming system to be adopted there in 1960.

(e) As a result of the poor settling qualities of juices, much time was devoted to clarification problems at a number of factories.

(f) In order to reduce the moisture content of manufactured sugar, one factory successfully followed recommendations on the use of superheated steam in the centrifugals.

(g) By-products Committee. This Committee held a number of meetings during the year and devoted a considerable amount of time to the study of a better utilization of the by-products of the Sugar Industry. A report will be issued early in 1960.

Routine. Routine work included :

(a) The analysis of about 3000 cane samples from experimental plots.

(b) The analysis of 30 samples of raw sugar for pol. and moisture.

(c) In September, one of the laboratory assistants worked in the laboratories of the Sugar Syndicate, to determine the Dilution Indicator of sugars at the time of their arrival in town. As a result of this control measure, factories have manufactured sugars with low Dilution Indicators.

(d) The analysis of 168 cane samples for reducing sugars.

(e) The standardization of 101 hydrometers, the setting of six thermoregulators, the checking of one pH meter and the dilution and distribution of hydrochloric acid to laboratories.

THE HERBARIUM

During the year, work continued on the reorganization and classification of the plant collections following the amalgamation of the three main sources of material, namely those of the Mauritius Institute, the Department of Agriculture and the M.S.I.R.I. It is expected that this work will be completed early in 1960, when regulations governing the use of the herbarium and guides to the collections will be issued.

Several overseas visitors studied at the herbarium.

A small library on Mascarene botany has been formed and will constitute a valuable adjunct to the herbarium. Dr. R. E. Vaughan has again devoted much time to the plant collection and the help so generously given is much appreciated.

The first leaflets of the series the Institute proposes to publish on the weed flora of the island were issued during the year. The three leaflets comprising this first issue describe the botany, ecology and distribution of the following weeds: *Bidens pilosa*, *Cassia occidentalis*, *Oxalis latifolia*, *Oxalis debilis* and *Oxalis repens*, together with notes on their control and on the diseases and insects affecting them.

GENERAL

10th Congress I.S.S.C.T. The Director and three members of the staff attended the 10th Congress of the ISSCT in Hawaii, in May, in company with 11 other delegates from Mauritius. Officers of the Institute contributed 9 papers which are listed elsewhere in this Report. In addition to the interest offered by the technical sessions, much information of great value was obtained on the sugar industry of Hawaii, which enjoys such a high reputation. Foreign delegates were unanimous in praising the organisation of this Congress which will be remembered as one of the best of the Society.

11th Congress I.S.S.C.T. Mauritius was selected as the host country for the 11th Congress which will be held towards the end of September, 1962. The Administrative-Executive Committee elected at the last formal meeting of the 10th Congress is composed of: General Chairman, Dr. P. O. Wiehe; General Vice-Chairman, Mr. R. Follett-Smith; General Secretary-Treasurer, Mr. J. M. Patureau. Planning of the next Congress has already begun and much of the organization will devolve on the Institute. At a meeting of local members held in November, Mr. M. de Nanclas was elected Regional Vice-Chairman for the Mauritius Section.

Meetings. The Research Advisory Committee met three times during the year; once, jointly with the Board, to visit the Experiment Station at Pamplemousses.

Two meetings were held at Belle Rive Experiment Station in July, when Mr. R. Antoine reviewed recent progress in the campaign against Ratoon Stunting Disease.

In September, a joint meeting was arranged with the Mauritius Sugar Syndicate when problems related to sugar quality were discussed with the managers and engineers of sugar estates

Regional meetings were held at Union Park, Belle Rive and Pamplemousses, in October, at which Messrs. Parish and Feillafé presented and discussed results obtained with urea as a nitrogenous fertilizer.

Dr. R. E. Vaughan gave a lecture on the organization and function of a Herbarium at a joint meeting with the Royal Society of Arts and Sciences which took place at the Institute in June.

Comité de Collaboration Agricole Maurice - Réunion - Madagascar. The Director and Secretary attended the 9th Conference of this Committee held in October, in Madagascar. Visits included sugar plantations at Nossi-Bé and Sosumav in the West and Brickaville in the East. Field observations on the new cane disease, which has appeared recently on the West Coast of Madagascar, were of particular interest as also were discussions on the present status of Fiji Disease on the East Coast.

Under the auspices of the «Comité», Messrs P. Baudin, plant pathologist, and B. Sigwalt, entomologist, both attached to the *Institut de la Recherche Agronomique* in Madagascar, spent about two weeks at the Institute in October and November, respectively.

Lecturing at the College of Agriculture. Since April 1959, the Sugar Technology Division has been responsible for the courses of Sugar Manufacture and Sugar Engineering at the College of Agriculture. Mr. G. Rouillard also gave a course of lectures on agriculture of the sugar cane while Mr. R. Antoine had charge of lectures in Plant Pathology and Botany of the sugar cane.

PUBLICATIONS, REPORTS AND CIRCULARS

Annual Report for 1958. An abridged French version was also issued.

Bulletin No. 11. Antoine, R., 1959, Progrès dans la lutte contre la maladie du rabougrissement des repousses à l'Ile Maurice. (Extracted from *Revue Agricole et Sucrière de l'Ile Maurice.* 38 (5) pp. 214-221.)

Occasional Paper No. 3. Williams, J. R., 1959, Studies on the nematode soil fauna of sugar cane fields in Mauritius. (3) Dorylaimidae (*Dorylaimoidea, Enoplida*).

Private Circulation Report No. 14. Delegates ISSCT. Report of delegates to the 10th Congress ISSCT. Hawaii, May 1959. Mimeo 151 pp., 20 figs., 7 tables 1 map, Oct. 1959.

Technical Circular No. 11. Lamusse, J. P. The cooling and curing of C Massecuites. Mimeo 13 pp., 8 figs., 4 tables, May 1959.

Technical Circular No. 12. Saint Antoine, J. D. de R. de. Weight and Polarization changes of raw sugars exported to the United Kingdom. Mimeo 20 pp., 13 tables, 1 fig., July 1959.

Articles in «Revue Agricole et Sucrière de l'Ile Maurice». Parish D. H. & Feillafé S. M., 1959, Preliminary notes on the soil survey of Mauritius. 38, 287-291.

Papers Presented at the 10th ISSCT Congress

Antoine, R. Studies on Chlorotic Streak disease of sugar cane.

Antoine, R. Notes on the tetrazolium test for diagnosing ratoon stunting disease.

George, E. F. Effect of the environment on components of yield in seedlings from five *Saccharum* crosses.

Halais, P. The determination of nitrogenous fertilizer requirements of sugar cane crops by foliar diagnisis.

Parish, D. H. The organic acid composition of some commercial cane varieties grown in Mauritius.

Parish, D. H. & Feillafé, S. M. Phosphate studies on some latosols of Mauritius.

Rochecouste, E. Evaluating herbicides in sugar cane cultivation.

Saint Antoine, J. D. de R. de. Cane payment in Mauritius.

Sornay, A. de & Davidsen, O. Relationship between growth of sugar cane and yield of cane at harvest.

Wiehe, P. O. Organisation of cane quarantine in Mauritius.

Miscellaneous.

Antoine, R., 1959, Gumming disease in Réunion. *Commonwealth Phytopathological News*, V, 28-29.

STAFF MOVEMENTS

The Director spent six weeks in the U.K. before attending the 11th Congress of the ISSCT in Hawaii.

Mr. P. Halais, Agronomist, went on overseas leave in January and also attended the ISSCT 10th Congress.

Mr. J. P. Lamusse, Associate Sugar Technologist, went on overseas leave during the same period. In England he visited the Tate & Lyle Research Laboratory and one of their refineries and the National Physical Laboratory. He attended the ISSCT 10th Congress in Hawaii and returned via Australia where he visited several sugar factories in Queensland, the Colonial Sugar Refining Co. in Sydney, the Sugar Research Institute in Mackay and the Bureau of Sugar Experiment Stations in Brisbane.

Mr. R. Antoine, Pathologist, accompanied by Mr. R. Béchet, Field Officer, went to Madagascar in February to lay down trials in connection with the Fiji Disease campaign. Mr. Béchet went again to Madagascar in August to make observations on these trials. Mr Antoine was also absent from April to June. He visited various research centres in the U.K. On his way to Hawaii, to attend the 10th Congress of

ISSCT, he stopped in California and visited the Earhart Plant Research Laboratory of the Californian Institute of Technology at Passadena. He also had valuable discussions with members of the Plant Pathology Department of University of Berkeley. After attending the Congress, he stopped for two weeks in Australia and spent most of his time with the pathologists of the Queensland Bureau of Sugar Experiment Stations.

Mr. G. Mazery, Senior Field Officer, left the island on leave, in April. He returned in October after having visited several Irrigation Research Centres in France. He also spent three weeks in Jamaica where he received valuable assistance from the Research Department of the Jamaica Sugar Producer's Association.

Mr. P. R. Hermelin, Field Officer in charge of Réduit Experiment Station, was absent from March to September on overseas leave. He visited several Research Centres in the U.K., especially the West of Scotland Agricultural College, at Auchincruive.

Mr. M. M. d'Unienville, Assistant Secretary, went on overseas leave from April to July.

Messrs. C. Ricaud and C. Mongelard, Laboratory Assistants in the Pathology and Botany Divisions, respectively, left for London in October on study leave. The former is following a post graduate course in Plant Pathology at the Imperial College of Science and Technology and the latter is studying Botany at the University College, London.

It is a pleasure to record my appreciation of the help so freely given by research organizations abroad in the course of visits by officers of the Institute.

In concluding this survey of the activities of the Sugar Industry Research Institute in 1959, I should like to thank once more all members of the staff for their loyal support during the year.

Director.

4th January, 1960.

Fig. 13. Chemistry and Sugar Technology building (for comparison with fig. 7, Ann. Rep. 1955).

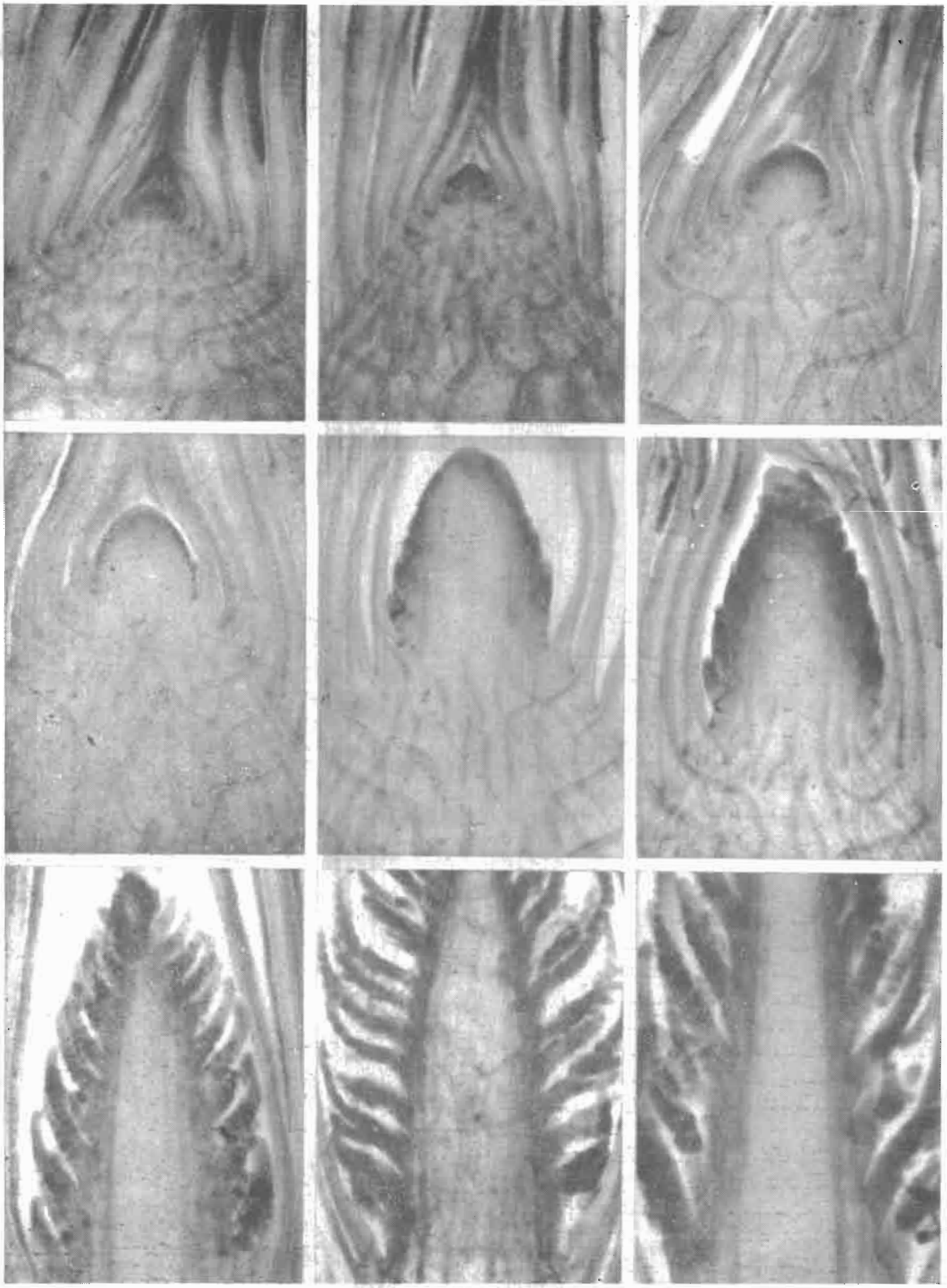


Fig. 14. Consecutive stages in the early development of the young flower primordium.

CANE BREEDING

E. F. GEORGE

1. ARROWING

(i) Conditions in 1959.

THE questionnaire sent out to estates each year, to determine the intensity of arrowing in the various sectors of the island, was even more conscientiously returned than in previous years. Thanks are due to all those who contributed towards the counting of practically half a million canes all over the island.

The results of this work given in table 1 show that the cane flowered little this year, and on the average just slightly more than in 1958. It is also clearly illustrated that, during any one year, favourable arrowing conditions may occur in one sector but not others. In the south of the island, arrowing was this year almost twice as intense as in the previous year, while over the rest of the island flowering was less.

Data on varieties which are not widely planted is necessarily scanty; nevertheless, figures showing the flowering intensity of these canes are included in table 1 to make it complete, but are placed in brackets to indicate that they are not entirely accurate.

More information is accumulating on the variety M.147/44 and it is clear that this variety is not a heavy flowerer. It gave this year a percentage less than half that for M.134/32 or Ebène 1/37.

Graphs showing the relation between age of ratoon cane and flowering intensity in varieties M.134/32, Ebène 1/37 and M.147/44 are illustrated in fig. 15. The curve for the variety Ebène 1/37 follows the same pattern as observed in previous years and the curious reduction in flowering percentage in canes cut during the previous July is once again clearly confirmed. In the variety M. 134/32 this reduction was not found this year, there being a roughly linear relationship between percentage of flowering and date of previous harvest over the whole period July-December. Totals of four years data still show the reduced trend of the July-cut canes.

The curve for the variety M.147/44 based on counts of 67,000 canes is calculated for the first time this year. As this variety gains in popularity, figures become more readily available. It seems that M.147/44 differs from Ebène 1/37 and M.134/32 in the correlation between date of harvest and percentage flowering, but a better picture will emerge after several further years of study.

Table 1. Average percentage arrowing in 1959.

Variety	*North*	*South*	*East*	*West*	*Centre*	*Average*
M.134/32	3.76	10.02	6.72	7.47	0.74	6.94
Ebène1/37	—	9.67	5.61	2.26	3.38	6.43
M.147/44	1.56	4.12	(3.54)	1.08	0.66	2.95
M.31/45	(0.48)	1.58	0.20	(0.41)	—	1.42
B.3337	—	1.39	—	—	(1.89)	1.45
B.37161	(1.97)	4.73	(7.99)	(1.04)	(0)	3.64
B.37172	0.34	2.71	1.24	—	(1.22)	1.86
M.112/34	1.11	(3.94)	(7.04)	(1.68)	—	2.66

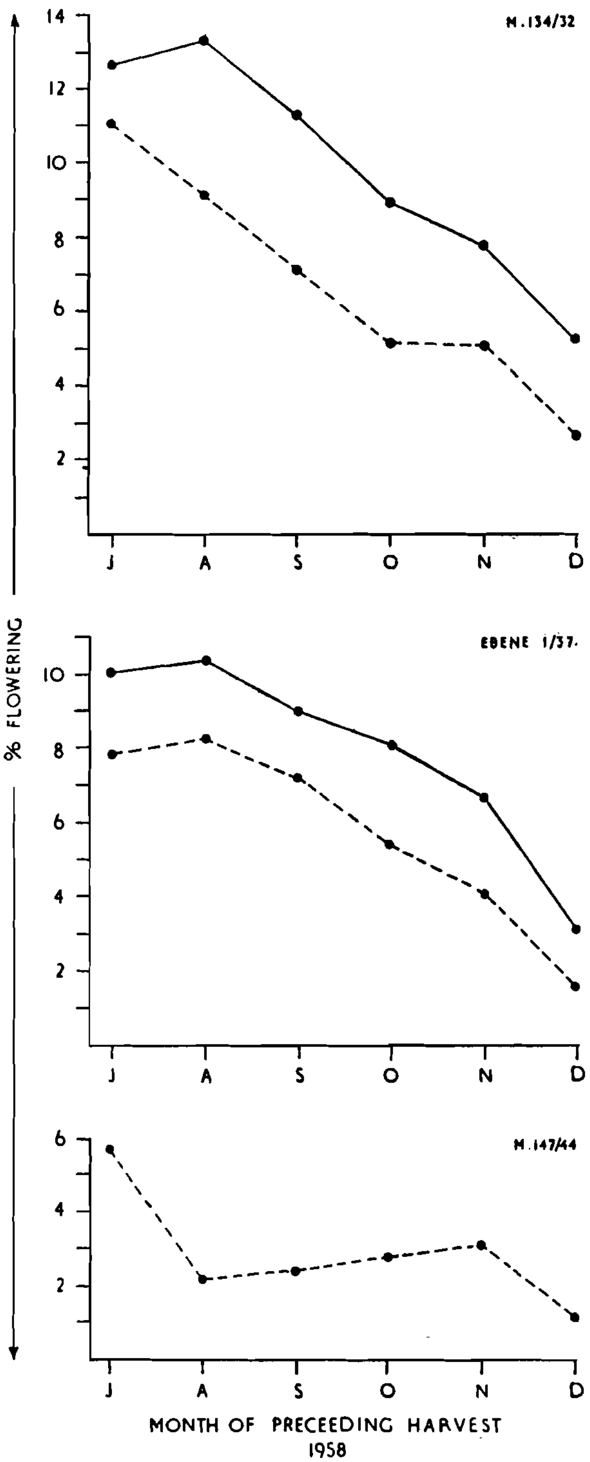


Fig. 15. The relationhip between date of previous harvest and percentage of flowering in the varieties M. 134/32, Ebène 1/37 and M. 147/44.
Plain line; average of 4 years' data 1956-1959.
Broken line; result of 1959 census.

(ii) **Flower initiation**

The time of formation of flower primordia of many varieties was investigated during the earlier part of the year. Sections of the apices of canes were cut using a bench microtome.

The early development of the flower primordium was followed in several varieties and is illustrated by photographs in figure 14.

Purely for the sake of convenience, various arbitrary stages were designated, in this early development, which were as follows:

Undifferentiated apex	Stage 0	Size 0.1—0.2 mm.
First recognisable stage in differentiation	Stage 1	Size 0.3 mm.
followed by	Stage 2	Size 0.6 mm.
	Stage 3	Size 1.0 mm.
	Stage 4	Size 2.0 mm.
	Stage 5	Size 3.0 mm.

The explanation of fig. 14 viewing from top left to bottom right is as follows :

	Variety	Size of apex	Stage
(i)	P.R.1000	0.16 mm.	0
(ii)	U.S.48-34	0.18 mm.	0-1
(iii)	U.S.48-34	0.4 mm.	1-2
(iv)	M.241/40	0.6 mm.	2
(v)	C.P.36-13	1.5 mm.	3-4
(vi)	C.P.36-13	1.9 mm.	4
(vii)	B.34104	3.0 mm.	5
(viii)	U.S.48-34	4.4 mm.	(over 5)
(ix)	B.34104	6.7 mm.	(over 5)

The first signs of arrow formation appeared at the beginning of March. In general, differentiation of the rudimentary inflorescence began a little later than in the previous year.

Arrow initiation in different varieties took place within a period of one month and confirmed, as was found last year, that varieties showing early initiation were those which arrow most freely.

The leaf cutting experiment performed last year was repeated this year, with certain modifications, on the varieties C.P.36-13 and M.241/40. The results were in close agreement with last year's findings. Only the very youngest leaves have any significant effect in stimulating flowering: in C.P.36-13 the young leaves of the spindle and the next youngest leaf were effective, while in M.241/40 only the leaves of the spindle were found operative.

Five photoperiodic experiments were conducted during the year investigating different aspects of flowering and its control.

Morphological examinations described above have now been conducted for several years and the actual time of formation of floral primordia has been ascertained. Little is known, however, about the length of the normal preceding photoperiod which is necessary to bring about this differentiation. Such knowledge would be useful in devising artificial regimes of lighting to induce flowering. Experiment 1 was planned to investigate this problem.

Experiment 1: Induction was interrupted by a series of treatments with artificial lighting at night. Each treatment while it lasted was prohibitive to flower induction and, by giving such treatments over varying periods of time, practically the whole of the presumed stimulatory period was covered. One indication from the results of this experiment is that the rate of stimulation of flowering commences slowly at the beginning of February, rises to a maximum in the first weeks of March and subsequently diminishes rapidly, so that stimulation no longer takes place after the end of March (fig. 16). It is intended to give more details of these results at a later date, together with results of **Experiments 2 and 3** in which the relative efficiency of various periods of artificial lighting given at night were investigated from the point of view of delaying arrowing in early flowering varieties for crossing purposes.

Experiment 4. It is a common observation that cane varieties which do not flower abundantly produce more flowers in border rows than elsewhere. It was thought that one of the many possible causes of this effect might be a greater light intensity acting on the spindle, where light is a limiting factor in hormone production. An experiment was therefore devised in which canes of varieties which do not normally flower freely were grown in drums and given an increased light intensity by placing ordinary tungsten bulbs near to the spindle. The experiment was completely negative, not one flower was produced in any treated cane or in the controls. The varieties use were P.O.J.2940, Ebène 1/37, M.134/32, D.109 and B.H.10/12.

Experiment 5. An attempt was made to induce flowering in canes of varieties which do not normally flower freely, by subjecting them to a period of short days. Treated canes were marcotted and transferred to drums which were placed in a dark room for the necessary period

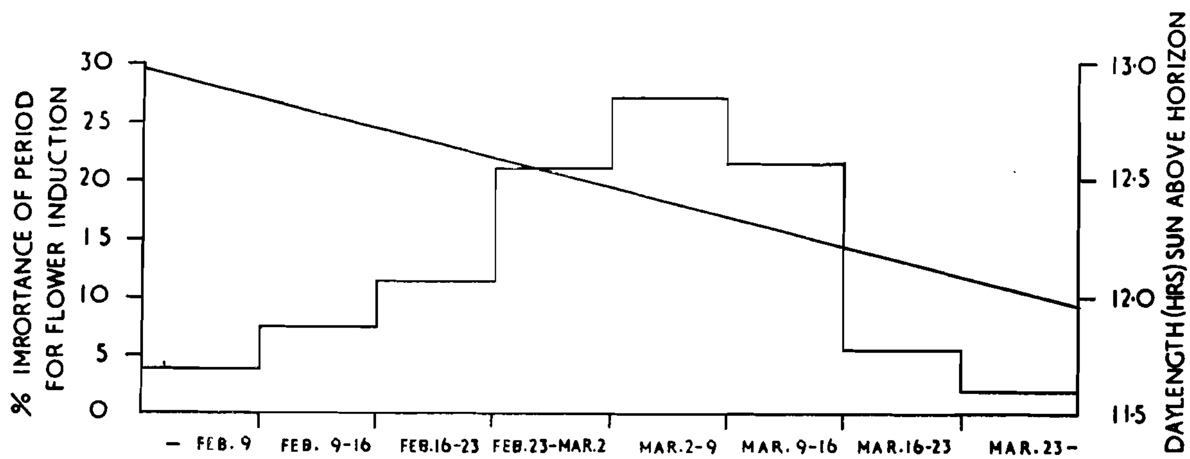


Fig. 16. The relative importance of various weeks in 1959 for the induction of flowering in the variety C. P. 36-13 as suggested by the results of Experiment 1. The day length during the corresponding periods is shown by the straight line (with reference to the right hand scale).

each day, to subject the canes to 4 hours of extra darkness daily. No flowers were induced by this treatment in any of the varieties used, which were again P.O.J.2940, Ebène 1/37, M.134/32, D.109 and B.H.10/12. This method has been described as giving excellent results by Vijayasaradhy (1957) at Coimbatore, India.

2. CROSSING

(i) Crossing Programme.

Flowering at Réduit and Pamplemousses was not heavy in 1959 and curtailed the possible number of parental combinations which could be made.

A proportion of crosses was made inside the greenhouse for the first time this year. The minimum temperature inside the greenhouse was not allowed to fall below 23°C, this being achieved by thermostatic control.

Firstly, to try to improve the male fertility of many varieties and to induce it in others normally male sterile, young inflorescences were placed inside the greenhouse in a warmer environment. The method used successfully by P.G. Brett in South Africa was employed. Cane showing the first signs of flowering were cut in the fields and transported to the greenhouse where they were preserved in SO_2 and phosphoric acid solution. Soil marcottes enclosed in polythene sheeting were applied to the cut canes. When roots developed in the marcotte, the cut cane was removed from solution and it was attempted to keep the cane alive by means of the roots in the marcotte. Although many canes of many varieties were brought into the greenhouse, in no case was successful arrow emergence induced.

With the failure thus to induce male fertility, emphasis was turned towards making crosses inside the greenhouse employing male and female arrows which had opened naturally in the field. Two procedures were adopted. A soil marcotte enclosed in polythene film was placed around canes intended as females. These were then cut and transported to the greenhouse where they were preserved in solution. Crosses were made with arrows enclosed in light linen lanterns, the skirts of which were tied to avoid pollen contamination. Male arrows used for pollination were preserved simply in solution and were changed as they ceased to be useful. At the completion of each cross, female arrows were removed from the greenhouse and the marcotted portion, which by this time had developed roots, was planted in the soil against a rack to which the canes were tied and where a light muslin bag was fixed for collecting fuzz.

The second procedure adopted differed only in so far as a few female arrows were air-layered in the field several weeks before transportation to the greenhouse, so that when cut they were already self sufficient on their own root systems. The few results obtained by the use of this method were encouraging and although marcotting at an early stage in the field presents difficulties, it is nevertheless intended to concentrate on this method during the coming crossing season. The method has been employed with eminent success by Danckleman (1958) and his co-workers at Canal Point, Florida.

Table 2. The numbers of seedlings obtained from comparable pairs of crosses inside and outside the greenhouse during the 1959 crossing season at Réduit.

Cross		*No. of seedlings obtained from crosses made*	
		Inside	*Outside*
B.37161	x M.147/44	0	8
Co.281	x M.63/39	0	5
Co.421	x 47 R.2777	500	350
Ebène1/37	x M.147/44	100	550
,,	x M.147/44	160	600
,,	x M.213/40	180	150
M.134/32	x Vesta	280	50
N:Co.310	x M.63/39	118	0
,,	x M.213/40	80	0
,,	x M.213/40	50	0
,,	x M.147/44	500	0
,,	x 36 MQ.2717	80	0
,,	x 47 R.2777	170	400
N:Co.376	x M.213/40	280	70
P.O.J.2878	x 47 R.2777	1,000	70
36 MQ.2717	x M.147/44	13	15
	Totals	3,511	2,268

Several pairs of crosses were made during the crossing season commencing at the same time. One cross was made outside the green-house using the time-honoured method with large glass lanterns, the other made inside under the conditions described above. The results shown in table 2 indicate an over-all superiority in fertility of crosses made inside. The results of the crosses of Ebène 1/37 x M.147/44, which appear as exceptions to this general rule, can be put down to the difficulty of preserving stalks of Ebène1/37 in solution without wilting taking place. It is to be expected that arrows of this variety suffered in consequence.

work commenced last year, mainly to test the effect of hot water on female fertility.

Arrows of the variety M.147/44 were treated at various time/temperature combinations some of which were sufficient, and others insufficient, to promote emasculation of the anthers. These treated arrows were crossed with 47 R.2777 used as a male. The results of these crosses are shown in table 4. Where emasculation was effective, it also appears that stigmas and ovaries were adversely affected as no seedlings were obtained from the treated arrows.

The experiment will be continued next year as time permits.

Table 3. A summary of the breeding work carried out in 1959.

Experiment	*No. of crosses made*		*No. of seedlings obtained*		*Total*	*No. of Seedlings transplanted*
Station	*Inside*	*Outside*	*Inside*	*Outside*		
Réduit	150	116	13,701	16,647	30,348	6,905
Pamplemousses	—	100	—	10,478	10.478	12,934
Belle Rive	—	—	—	—	—	10,988
Union Park	—	—	—	—	—	5,560
	150	216	13,701	27,125		
	366		40,826		40,826	36,387

The range of parents used increased during the year. It was possible to use for the first time newly imported varieties as both male and female parents. P.T.43-52 and 47 R.2777 were used as very successful male parents with a wide range of females. Active selection for possible breeding canes is now carried out in all normal selection plots at the time of selection and varieties chosen are planted in trial breeding plots for a period of years while their usefulness as parents is investigated.

Transplanting of seedlings to the fields was expedited by exceptionally favourable weather conditions prevailing during the month of December. A summary of the breeding work is given in table 3 and a list of crosses in table XIII of the Appendix.

(ii) Experiments on the male and female fertility of flowers.

Effect of hot water. A small experiment was carried out this year, in continuance of the

Table 4. The number of seedlings obtained when arrows of M.147/44 treated in hot water at different temperatures for varying times of treatment were pollinated with 47 R.2777.

Treatment of arrows of M.147/44 in Water		*No. of seedlings obtained*	*Remarks*
50°C.	10 mins.	0	Emasculation effective
	6 mins.	0	
	4 mins.	0	
No treatment Control		18	Emasculation not effective. Some selfing could have occured in these crosses.
45°C.	30 mins.	0	
	20 mins.	43	
	10 mins.	15	
22°C.	18 hrs, Control	155	

3. STUDIES ON SEEDLING POPULATIONS

(i) Effect of the environment.

The studies commenced last year, on seedlings of different crosses grown under contrasting environmental conditions, gave many interesting results which were summarized in a paper presented to the 10th Congress of the ISSCT. Although this work was unfortunately not able to be satisfactorily continued during the year, some observations were made on Brix distributions. As seedling growth had been extremely erratic at Belle Rive, it was only possible to study the following crosses at Réduit, Pamplemousses and Union Park.

M.241/40	x M.147/44
Ebènel/37	x M.147/44
Co.421	x M.147/44
B.34104	x M.147/44
131P.	x M.147/44

deviation of the Brix distribution may be predicted. The greatest standard deviations occurred in progenies grown in the super-humid regions of the island, which, bearing in mind the apparent fixed relationship of standard deviation and mean, suggests that selection for Brix should be more efficient under such conditions. Although the performance of a clone under such varying conditions is not yet clear, it should be more easy to select superior varieties falling at the extreme end of the curve, when the spread of a distribution curve for any given character is wide.

Figure 18 gives the correlation obtained with last year's data between the means of yield distributions of the same crosses and the respective standard deviations. In this case the correlation is positive and exhibits practically no within-crosses or within-environments tendencies.

Table 5. Correlations between mean and Standard deviation and the regression of Standard deviation on mean within each cross.

Cross		*Correlation between mean & S.D.*	*Regression S.D. on mean (Y =)*
M.241/40	x M.147/44	—0.99	$1.17 - 0.43\,(x - \bar{x})$
Ebènel/37	x M.147/44	—1.00	$1.46 - 0.33\,(x - \bar{x})$
Co.421	x M.147/44	—0.97	$1.11 - 0.22\,(x - \bar{x})$
B.34104	x M.147/44	—0.97	$1.28 - 0.12\,(x - \bar{x})$
131P.	x M.147/44	—0.99	$1.53 - 0.45\,(x - \bar{x})$

Within each cross at each Experiment Station, Brix readings were taken in a random sample of 60 seedlings in single stools. From a study of the frequency distributions of these figures, it has been found that populations of the same cross, planted in contrasted environments, give a high negative correlation between the mean Brix and the standard deviation.

This result is shown graphically in figure 17.

Although the results could possibly differ from one year to another, it at present appears that the regression of mean on standard deviation will be a genetic constant of each cross. The regressions in the crosses studied are given in table 5. From the mean, Brix of a population of seedlings from one such cross, the standard

Maximum spread of the yield distribution curve is obtained under the most favourable growth conditions, which is apparently where the most efficient selection for yield should be obtained. This is the reverse of what is suggested in the case of Brix selection.

As these observations have a bearing on the whole policy of seedling selection, as carried out at present, experiments are being continued.

(ii) Bunch Planting Experiments.

The breeding policy, as followed at present, is to plant about 30,000 seedlings each year in single spacing, which is a convenient number to be accomodated at the experimental stations. Seedlings in excess of this are planted in bunches.

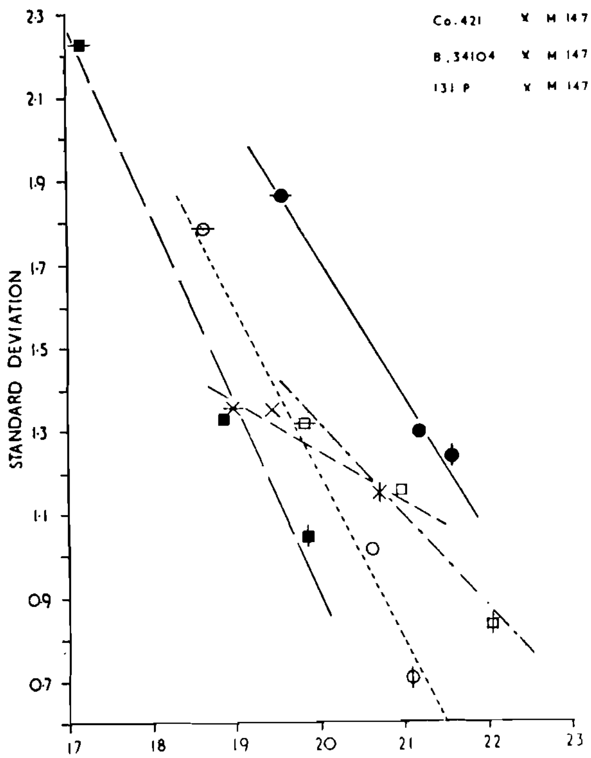


Fig. 17. The correlation within each cross between the mean and standard deviation of Brix distributions of populations grown in different environments.

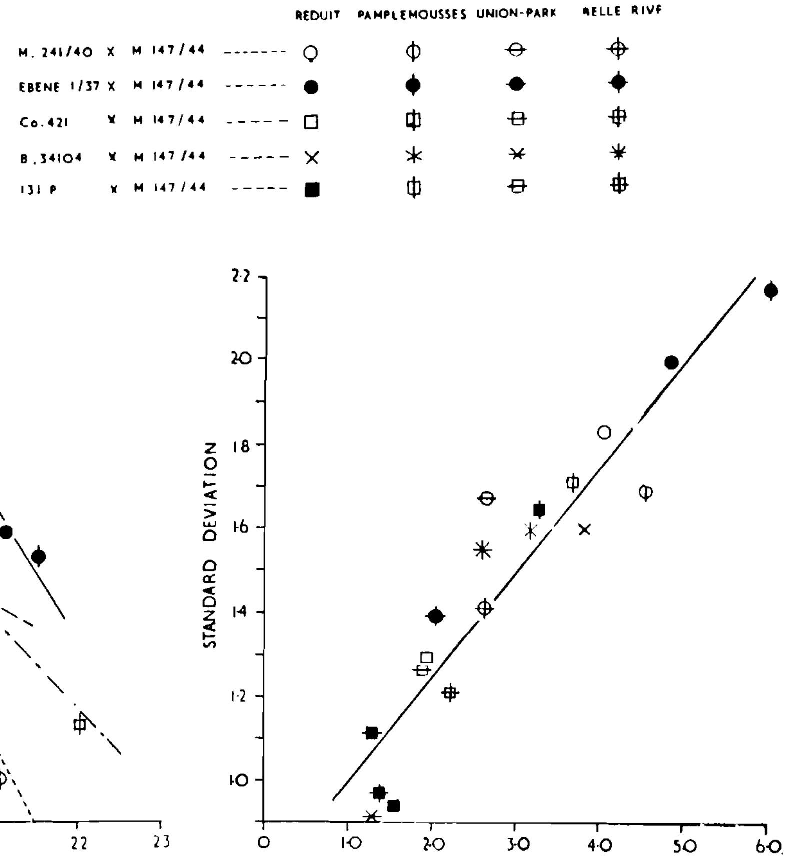


Fig. 18. The correlation obtained with data gathered in 1958 between the means of yield distributions and the respective standard deviations.

As it is desired to increase the number of seedlings raised annually, the selection from bunch planted seedlings will become increasingly important. The results of several experiments, either completed or in progress, on this method of selection will therefore be of importance.

The experiment mentioned in last year's annual report, which was devised to compare selection from seedlings bunch planted according to two methods with selection from the usual space planted seedlings, has now been finished.

At the time of writing, many results have yet to be calculated. It is already clear that by selecting the best stalks from bunch planted seedlings with the cross in question, there was the highest probalibity of selecting the best varieties present. Although the initial percentage of selection from bunch planted seedlings must necessarily be high, subsequent selection from the first vegetative generation compares very closely with the selection percentage from seedlings planted singly. This result is a further vindication of the bunch planting method.

A proportion of the seedlings raised this year has been planted in bunches and selections from these will be made in plant cane, in the first ratoon and perhaps even the following year, in an attempt to follow the elimination of certain seedlings by competition which occurs when the bunches of seedlings are grown in ratoon.

Another experiment has been planted this year to compare the percentage elimination of inferior varieties in several crosses which had been bunch planted. A sample of varieties, selected at random from each of these crosses, will be tested for superiority to a random sample of varieties from each of the same crosses planted singly.

4. FIRST SELECTION TRIALS

One hundred and thirty four varieties were planted in first selection trials this year on the results of selections of propagation plots. The policy, so far, has been to select from propagation plots in plant cane. Whenever possible this year varieties in propagation plots standing in first and second ratoons were reselected and many which had not been selected previously in virgin cane were discovered. This result has cast doubts on the previous efficiency of selection in virgin canes and so it is intended that in future all propagation plots shall be re-examined in ratoons for good varieties which might possibly have escaped detection.

The present first selection trial consists of three replicates. Results have shown that a plot size of two lines of 15 feet introduced during recent years has reduced interaction between varieties and decreased the variability within the trial.

The actual size of each trial has also been increased recently. Instead of one trial consisting of a number of separate sub-trials, each testing six or seven varieties with a standard, up to 20 or 30 varieties are now tested between themselves and one or two standard varieties at the same time. It is not yet possible to draw definite conclusions as to whether this practice is superior, but early results show that there is not a great loss of accuracy in using the larger trial, while it offers the definite advantage of testing many varieties together at the same time.

The number of varieties at present planted in first selection trials undergoing selection is 437 there being 143 planted in trials at Réduit, 112 at Pamplemousses, 103 at Belle Rive and 79 at Union Park.

Only one trial was in second ratoon and at the stage of selection this year. This trial was at Belle Rive where the following canes of the M—/53 series were selected for planting in variety trials next year. It should be borne in mind that these are only the first results for these varieties which must be given further testing.

M.223/53. Semi-erect: medium thickness; average germination. Outyielded Ebène1/37 by 41% over the three years in which the trial was run. Has a high CCS and a fairly high fibre.

M.255/53. Erect or semi-erect: average thickness: germination fair. High yielding and with high CCS. This is another very promising variety for high rainfall conditions.

M.230/53. Erect: medium thicknesss. Germination and early growth extremely good. Yield and CCS on a par with Ebène1/37, but is worth further testing.

M.273/53. Semi-erect: tendency to lodge: medium thickness; germination fair. A high yielding cane with unfortunately a low purity and CCS.

M.334/53. Semi-erect but tends to lodge. Eyes tending to protrude, trash free, arrowing a little; germination fair. A higher yielder than Ebène1/37 but its CCS is slightly less. Fiber high.

M.355/53. Erect to semi-erect: eyes tend to protrude, medium to thick cane with reasonably good germination. Gives slightly higher yields but lower purity and CCS than the standard.

M.356/53. Erect, of medium thickness with eyes tending to sprout. Germination average. Outyielded Ebène1/37 by 16% and possessed a higher CCS. It has a low fibre content.

M.359/53. This cane is erect to semi-erect and of medium thickness. Germination reasonably good. It gave a yield significantly higher than Ebène1/37 during the three years of the trial, with an equivalent CCS.

M.361/53. Erect with eyes tending to protrude; medium thickness; germination fair. High yielding but of low purity and subsequently low CCS. If this is confirmed in later tests it will be a bad point against this variety.

M.366/53. A fairly thin cane of semi-erect habit. Germination good. Yields slightly better than Ebène1/37, though its low CCS may prejudice it against commercial cultivation.

The following variety has been selected for testing in advance of the normal routine:

M.117/55. Has excellent germination and growth potential. It has been selected from a first selection trial at Réduit on account of the extremely high yields it has given in plant cane (137% of M.147/44 and 210% of Ebène1/37) even though its brix was a little low this year. It is a thick cane which arrows sparsely but has a tendency to lodge. Trashing is rather difficult.

5. PRE-RELEASE VARIETY TRIALS

Seven variety trials each of four replications and four pre-release variety trials each consisting of six replicates were planted during the year. The total number of variety trials with varieties still undergoing selection was 23 at the end of the year, while the total of pre-release trials was 7.

Promising varieties undergoing test in these pre-release trials are:

M.253/48, M.305/49, M.423/51, M.81/52, M.272/52 and R.397. The varieties M.202/46 and M.93/48 which are now to be released are not considered here.

M.253/48. Results for this variety in the humid and super-humid regions of the island have so far been poor. Under irrigated conditions, however, it continues to give outstanding results compared to M.134/32. This year's results of the trial which was in 4th ratoon, are shown below:

	Tons cane/arp.	*CCS % cane*	*Tons sugar/arp.*
M.253/48	55.5	14.7	8.16
M.134/32	35.2	13.9	4.89

M.305/49. Recent results for this variety in a trial in the humid region were disappointing. The results so far obtained in this trial are as follows:

	M.305/49	**Ebène1/37**
Virgins	6.52 tons sugar/arp.	6.75 tons sugar/arp.
1st ratoon	6.86 „	5.86 „
2nd „	5.26 „	4.83 „
3rd „	4.55 „	4.95 „

The results of this variety in first and second ratoons certainly warrant its trial in other regions of the island.

M.423/51. This is a rich cane with high yielding qualities. In a trial in the super-humid region it has been particularly successful, as shown by the following results:

	Tons cane/arp.	*CCS % cane*	*Tons sugar/arp.*
M.423/51	44.3	14.8	6.56
M.442/51	51.9	10.5	5.44
Ebène1/37	40.6	12.7	5.16

In another trial compared to M.134/32 results were not so promising, as follows:

	Tons cane/arp.	*CCS % cane*	*Tons sugar/arp.*
M.423/51	27.3	15.9	4.34
M.253/48	30.5	14.2	4.33
M.134/32	27.7	15.3	4.24
M.653/51	27.6	14.0	3.86
M.699/51	28.5	13.4	3.82
M.691/51	27.0	13.5	3.65

M.81/52. There are as yet no results from variety trials for this variety. In first a selection trial compared to M.134/32 it gave very good results and its appearance in subsequent propagation plots has appeared very promising. It is for this reason that it has been included prematurely in two pre-release trials.

M.272/52. One result has been obtained so far for this variety in the super-humid region and this has been disappointing. Germination and early growth are really excellent, so that early in the season the cane stands out amongst its competitors. Later, however, the canes tend to lodge very badly and are often eaten by rats.

	Tons cane/arp.	*CCS % cane*	*Tons sugar/arp.*
M.272/52	30.6	13.5	4.13
M.93/48	44.3	12.8	5.67
M.19/51	39.0	11.8	4.60
M.277/51	36.5	12.6	4.60
Ebène1/37	32.5	13.8	4.49
M.253/48	37.6	11.6	4.36

The good performance of M.93/48 in this trial should be noted, while the inferior performance of M.253/48 suggests its unsuitability for cultivation under conditions of high rainfall.

R.397. This variety has continued to give good results in a trial in the humid region whereas those obtained in sub-humid conditions have not been good.

Humid Region

	Tons cane/arp.	*CCS % cane*	*Tons sugar/arp.*
R.397	44.4	15.6	6.93
M.134/32	29.5	15.5	4.57

Sub-humid Region

R.397	26.0	15.1	3.93
M.483/50	26.0	16.9	4.39
B.41227	26.4	15.4	4.07
M.134/32	22.2	15.4	3.42

Defects of this cane are its very heavy arrowing (often up to 75%) and the heavy side shooting which follows. The newer series of pre-release trials in which it has been placed will enable a comparison to be made between R.397, M.147/44 and the varieties shortly to be released.

Varieties which have shown promise this year in early variety trials, and which will be included in pre-release trials, are especially:

M.658/51. In a trial in the humid region this variety outyielded M.134/32 by a wide margin.

	Tons cane/arp.	*CCS%cane*	*Tons sugar/arp.*
M.658/51	49.0	14.8	7.25
M.134/32	40.8	15.0	6.12
M.659/51	43.4	13.7	5.95

M.409/51. A rich cane which for this reason gave superior sugar per arpent than M.147/44 in a trial in the humid region.

	Tons cane/arp.	*CCS/%cane*	*Tons sugar/arp.*
M.409/51	31.6	15.8	4.99
M.147/44	33.8	14.0	4.73
M.350/51	31.9	13.7	4.37
M.399/51	28.3	14.4	4.08

The variety Ebène 50/47, which has gained popularity in experimental plantations on several estates, is included in three variety trials. In addition, it is now intended to plant this variety in the forthcoming series of Final Variety Trials in comparison with M.202/46, M.93/48, M.253/48 and standard varieties, in order to gain an accurate indication of its performance in all the sectors of the island as soon as possible.

The varieties Ebène1/44, B.41227 and N:Co.310, although not out of the running, have not lived up to their early promise and now stand little chance of eventual release.

6. THE RELEASE OF THE VARIETIES M.202/46 AND M.93/48

At a recent meeting, the Cane Release Committee recommended that the varieties M.202/46 and M.93/48 should be released during 1960 for commercial cultivation. The Committee decided that there was at present an insufficient body of results to justify the release of M.253/48. As preliminary results for this variety showed that in irrigated regions, if not elsewhere, it was capable of outyielding the standard cane by a wide margin in CCS/arpent, its limited cultivation in these regions might be recommended by the Central Board pending a decision on its release in one or two year's time.

M.202/46. This variety was first selected in November 1947 at Réduit. Derived from the cross Co.281 x M.63/39 it has the same parentage as the variety M.147/44. In its early trials it did not surpass the standard M.134/32 by a large margin, but in subsequent variety trials it has been consistently successful under quite a wide range of environmental conditions. Although in few of the trials in which this variety has been tested, has it been compared to M.147/44, it is felt that although in some conditions it will not be superior in yielding qualities to that variety, better trashing and cultivation qualities will establish it as a more useful alternative.

M.202/46 is a thick cane with fairly free trash. Its ratooning capacity is very good. Habit immediately after germination is prostrate, but changes to semi-erect in later stages of growth. There is generally little side-shooting except after flowering. Flowering is usually quite heavy, about 20%, although occasionally it may be as high as 40%.

Reaction to pests and diseases may be summarized as follows :

a) Resistant to gummosis
b) Susceptible to ratoon stunting disease.
c) Susceptible to chlorotic streak.
d) Apparently more susceptible to the spotted borer than M. 134/32 and M.147/44.

Fibre generally high, about 20% more than Ebène1/37. Juice quality is good early and mid-season but sucrose content falls off rapidly late in the season, rendering the cane probably unsuitable for harvesting at this time of the year. Purity is good.

The performance of M.202/46 in the pre-release trials where it has been tested is given in table 6.

A summary of the results of M.93/48 in pre-release trials is presented in table 7.

Table 6. M.202/46. Percentage superiority over the standard variety in pre-release trials. The actual results of the Standard are given in brackets.

Average Results — 5 trials reaped in Ratoons only.

Trial	11/56, 12/57	8/52	10/56	19/56
Locality	Alma, Riche en Eau	Bagatelle	St. Antoine	Beau Plan
Zone	Super-humid	Humid	Sub-humid	Irrigated
Standard	Ebène1/37	Ebène1/37	M.134/32	M.134/32
No. of Ratoons	2 and 1	6	2	2
TCA	121% (24.3)	102% (30.2)	120% (30.8)	127% (34.2)
CCS	95% (14.9)	104% (15.0)	102% (15.3)	96% (16.5)
TSA	115% (3.62)	106% (4.53)	122% (4.71)	122% (5.64)
Purity	100% (92.5)	99% (92.3)	100% (90.6)	98% (93.8)
Fibre	113% (9.5)	120% (10.0)	110% (9.0)	112% (9.8)
Arrowing	6%	25%	1%	1%

Maturity Behaviour

Early	103
Mid.	111
Late	96

Frequency of Superiority on Control

TCA	85%
CCS	54%
TSA	100%

M.93/48 (Ebène1/37 x M.63/39). Selected under the environmental conditions of the super-humid region at the old Hermitage Experimental Station in August 1950, M.93/48 has always shown extreme promise for this region. In its early trials it was compared with M.134/32 which it surpassed by a very wide margin, but in subsequent variety trials it has proved better than Ebène1/37 and B.3337.

Canes of this variety are thick and present no trashing difficulties. There is some tendency for sprouting of the eyes to take place, but generally this is not severe. In habit the canes may be described as semi-erect. Arrowing is never heavy. The ratooning capacity of M.93/48 is fair and although not so good as M.202/46 is better than Ebène 1/37.

Reactions to pests and diseases are the same as for M.202/46.

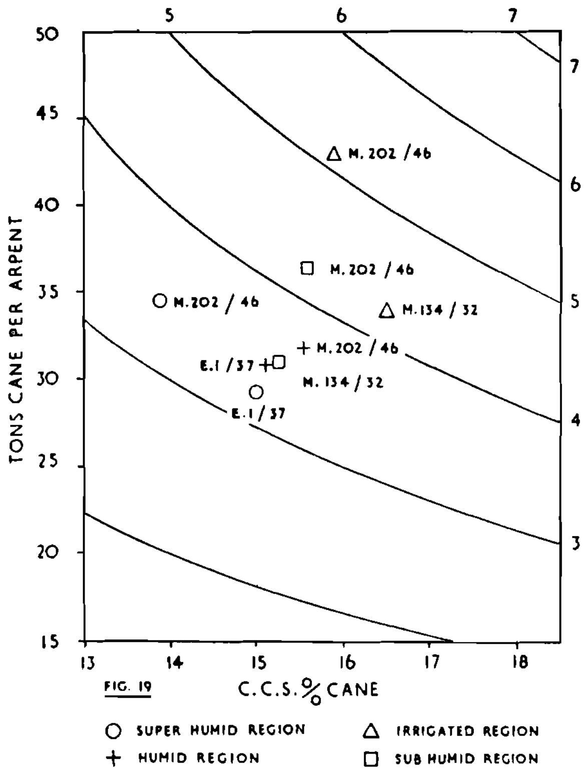
Fibre is quite high in this variety but less than in B.3337. Sucrose % cane is generally inferior to Ebène1/37, purity being normal.

Table 7. M.93/48. Percentage superiority over the standard variety in pre-release trials. The actual results of the Standard are given in brackets.

Trial	35/54	10/57
Locality	Britannia	Alma
Zone	Super-humid	
Standard	B.3337	Ebène1/37
No. of ratoons	4	1
TCA	132% (23.6)	136% (32.5)
CCS	104% (15.3)	93% (13.8)
TSA	137% (3.61)	127% (4.48)
Purity	100% (94.1)	99% (92.0)
Fibre	92% (13.3)	121% (8.5)
Maturity Behaviour		
Early	103	92
Mid.	106	100
Late	102	85

Frequency of Superiority on Control

TCA	95%
CCS	85%
TSA	84%



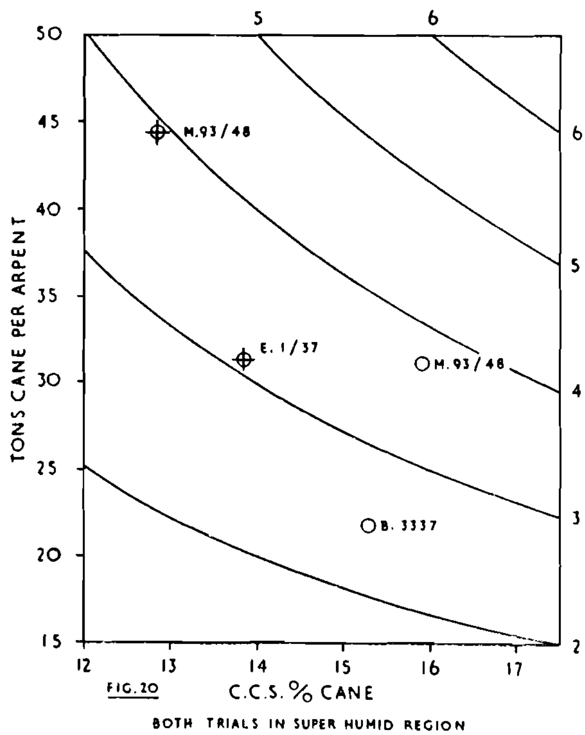


Fig. 19 & 20 A comparison of levels of "benefit" or net profit as given by Hugot's formula, for M. 202/46 and M. 93/48 in the variety trials in which these canes have been tested. In each case the variety is compared with its standard in the same trial.

Hugot (1958) discussed the difficulties of assessing the merits of different varieties of sugar cane. The usual criterion in judging two varieties has been the weight of sugar obtained per unit area. He, however, thought that the expenditure incurred in raising the crop and obtaining the sugar should be taken into account. He therefore devised a formula by means of which the net profit from different varieties could be compared. The essence of this formula is that the relative benefit of any variety is given thus:

$$\textit{Relative benefit} = \frac{\text{tons cane per arpent (CCS-4)}}{100}$$

Curves at various levels of benefit were drawn for the appropriate tons cane/arpent and CCS levels. The results of M.202/46 and M.93/48 have been fitted into these diagrams showing that in every case a superior profit could be expected from the cultivation of these two canes. Magnified portions of the general curve, which is presented in the introduction (fig.9) are given here in figures 19 and 20 showing the results of the two new varieties as compared to the control varieties in the respective trials in which tests were made.

In these diagrams it is only possible to contrast the results of a variety to the standard within that trial. It is not a fair comparison, for example, to relate the performance of the standard in one trial with the performance of the standard in another.

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7. INFLUENCE OF NITROGEN FERTILIZATION IN VARIETY TRIALS

P. HALAIS

The two series of widely spread variety-fertilizer Final Trials, started in virgins in 1954 and 1957, have been reaped as 12 month old ratoon crops, early, medium and late in the harvesting season. The results from the fourteen trials comprising the two series have brought a most unexpected conclusion concerning the interaction variety-nitrogen fertilization as shown in table 8, which compares the tons of Commercial Sugar per arpent and the Commercial Sugar % Cane responses of ratoons to high nitrogen (50 kg N arp.) against low nitrogen (20 kg N arp.) both applied as a single dressing of sulphate of ammonia in the month following the reaping of the previous cane crop.

Table 8. Responses to High over Low Nitrogen Fertilization.

Variety	*Six Trials* Series '54 (1956, 57, 58, 59)		*Eight Trials* Series '57 (1959)	
	Tons Com. Sugar/Arp.	*Com. Sugar % Cane*	*Tons Com. Sugar/Arp.*	*Com. Sugar % Cane*
B.3337	+ 0.44	+ 0.12		
B.37172	+ 0.29	— 0.13	+ 0.29	— 0.09
M.147/44			+ 0.26	— 0.41
Ebène1/37	+ 0.18	— 0.37	+ 0.24	— 0.45
M.31/45			+ 0.18	— 0.54
M.134/32	+ 0.17	— 0.37		

Table 8 shows that two varieties, namely B.3337 and B.37172, respond much better to Nitrogen, with very little or no deterioration in cane quality, than the four commercial Mauritian bred varieties M.134/32, Ebène1/37, M.147/44 and M.31/45. The latter are all unable to make the best use of this powerful nutritional growth factor as deterioration of cane quality sets in at a high level of nitrogen fertilization. If early dressings to the above mentioned Mauritian varieties give rise to lowering of cane quality at harvest time, it is to be expected that fragmented and later applications would give rise to even poorer responses. On the other hand, additional applications made late in December or January would probably work well with the two Barbados varieties B.3337 and B.37172.

This observation calls for a new orientation of the cultural operations followed when conducting the early selection of cane varieties in Mauritius: all field trials carried out for this purpose should henceforth get high Nitrogen applications (not less than 50 kg N per arpent) in order that it may be possible to discard at an early stage those varieties showing the defect of restricted response to Nitrogen through lodging or otherwise. It is also more probable that the varieties selected under these conditions will show stronger stalks, more resistant to wind damage but associated, however, with relatively high fibre contents.

Probably these findings will throw some light on why levels of Nitrogen fertilization lower than those normally used in some other sugar producing countries, such as Puerto Rico or the Hawaiian Islands, are favoured in Mauritius.

NUTRITION AND SOILS

1. THE COMPOSITION OF CANE JUICE

IV. Starch

J. D. de R. de SAINT ANTOINE & D. H. PARISH

IN 1957 one of the authors of this paper (J. D. de R. de Saint Antoine) had the opportunity of visiting a large London refinery and discussing the problem of raw sugar filterability with its Chief Chemist. According to the latter, the refining qualities of Mauritius raws had gradually deteriorated during the past few years, mostly as a result of increasing starch content. From the results of analyses carried out at the refinery, the starch content of Mauritius raws then averaged 200 p.p.m. It was also pointed out that when raw sugars contain more than about 150 p.p.m. of starch, processing difficulties are experienced in the refinery, particularly at the filter station where filtration is slowed down.

Following this visit it was decided to determine the starch content of average crop samples of raw sugars as well as that of the juices of the major commercial cane varieties harvested yearly. These latter analyses were initiated as it was believed that increasing starch content of raw sugars was most probably a varietal effect and resulted from the milling, during the past few years, of an increasing proportion of the varieties Ebène 1/37, B.37172, B.3337 and, more recently, M.147/44. Thus, whereas prior to 1955, M.134/32 had occupied for many years approximetely 85 per cent. of the cane lands, the present percentage stands at less than half that figure.

Average 1958 crop samples of raw sugars from twenty-one factories were analysed for starch. The method employed is that used by Balch (1953) but modified by Alexander (1954), and reads as follows :

« 100 gm. of sugar are dissolved in 100 ml. of water and to the solution is added 20 ml. N HCl and 300 ml. of alcohol. After standing for at least an hour the precipitated gums are filtered off, using a total of 3gm. kieselguhr for filter aid. The cake is washed with water, followed by 70 per cent. alcohol, hot absolute alcohol and hot benzol. The cake is transferred to a 250 ml. breaker with 40 ml. of $CaCl_2$ solution (S.G. 1.3) and mixed thoroughly. The mixture is covered and kept boiling gently for 18 minutes to extract the starch. The contents of the beaker are cooled to room temperature, transferred quantitatively to a 100 ml. volumetric flask and made up to volume. In addition, 1.7 ml. of water is added to the flask to compensate for the volume occupied by the kieselguhr. The mixed contents from the flask are then centrifuged until a clear supernatant solution is obtained. An aliquot of the clear solution containing 0.5 to 3 mg of starch is transferred to a 100 ml. volumetric flask and made up to approximately 50 ml. The following reagents are then added in sequence : 5 ml. 2N acetic acid, 1 ml. 10 per cent. KI and 10 ml. 0.01 N KIO_3. The volume is made up to mark and the optical density measured at 600 *mu* in a 1 cm. cell. The amount of starch in the aliqout taken is then read off from a graph obtained by analysis of known amounts of starch, conducted in a similar manner.»

The weighted average of the results obtained yielded 234 p.p.m. of starch. If this figure is compared with those given below (Akira, 1956), it will be observed that Mauritius raws contain much less starch than those of Formosa, Australia and South Africa.

Table 9. Starch Content of Raw Sugars, p.p.m.

Formosa	600 — 1230
Australia	700
South Africa	430
Réunion	240
Peru	210
Brazil	180
Philippines	170
Indonesia	80
Cuba	50

The method of analysis described above was also used to determine the starch content of the juices from the important varieties being studied in final selection trials, which were harvested in 1957 and 1959. These trials, which were formerly called Post Release trials, have been described elsewhere (Parish, 1956). Briefly, the trials cover the various climatic zones of the island and are composed of six varieties which are reaped early, mid-way and late in the crushing season. The varieties studied received nitrogen fertilizer at a level of 40 kgs N per arpent, whilst P and K fertilization was maintained at an optimum level in all the plots. The cane samples received from the experimental plots were shredded in a Queensland fibrator (Cutex) and the juice expressed from the shredded mass by pressing at 25 kgs/sq.cm. in a hydraulic press.

The results of analyses are tabulated below.

Table 10. Starch content (p.p.m.) of juices of different varieties from 1954 series F.S. trials harvested in second ratoon in 1957

	Humid region				*Super-humid region*			
Variety	*Early*	*Mid*	*Late*	*Average*	*Early*	*Mid*	*Late*	*Average*
M.134/32	135	120	135	130	170	195	180	182
B.37172	170	180	160	170	145	210	235	197
Ebène 1/37	180	160	170	170	175	290	365	277
B.3337	340	315	450	368	175	365	450	330

Table 11. Starch content (p.p.m.) of juices of different varieties from 1954 series F.S. trials harvested in fourth ratoon in 1959

	Humid region				*Super-humid region*			
Variety	*Early*	*Mid*	*Late*	*Average*	*Early*	*Mid*	*Late*	*Average*
M.134/32	364	168	255	262	130	190	230	183
B.37172	546	220	535	434	184	185	305	225
Ebène 1/37	706	320	569	532	192	270	220	227

Table 12. Starch content (p.p.m.) of juices of different varieties from 1957 series F.S. trials harvested in first ratoon in 1959

	Humid region				*Irrigated region*			
Variety	*Early*	*Mid*	*Late*	*Average*	*Early*	*Mid*	*Late*	*Average*
B.37172	155	185	240	193	133	180	340	218
Ebène 1/37	165	285	270	240	245	325	255	275
M.147/44	454	550	400	468	300	550	960	603

Table 13. Average starch content (p.p.m.) of juices of different varieties from F.S. trials harvested in 1st, 2nd and 4th ratoons

Variety	*1957 Series 1st Ratoon*	*1954 Series 2nd Ratoon*	*1954 Series 4th Ratoon*	*Average*
M.134/32	—	156	222	189
B.37172	205	184	329	239
Ebène 1/37	257	224	379	287
B.3337	—	349	—	349
M.147/44	535	—	—	535

The data available are unfortunately insufficient to correlate changes in starch level with such factors as date of harvest, site or season. However, it will be observed from the results that the starch contents of the more recently released cane varieties are all higher than that of M.134/32. Ebène 1/37, which is the variety best suited to the superhumid areas of the island, contains about 50 per cent. more starch than M.134/32 whilst M.147/44, the variety which is being most propagated at present, contains about three times as much starch as M.134/32.

It may thus be concluded that the increase in starch content observed by refiners results from the processing of varieties which contain more starch than M.134/32.

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2. CHEMICAL FERTILIZATION

D. H. PARISH & S. M. FEILLAFÉ

Nitrogen

The sugar industry of Mauritius is now spending annually about nine million rupees on nitrogenous fertilizers and an expenditure of this order should obviously be made rationally.

In the past only three nitrogenous fertilizers have found common acceptance in Mauritius: in historical sequence they are sodium nitrate, ammonium sulphate and urea. Many exotically named and packaged proprietary nitrogenous mixtures have been and still are imported, though only in small quantities.

Sodium nitrate imports fell rapidly after the introduction of cheap ammonium sulphate, but the fertilizer is still used on many estates as a « booster» or «starter» for the cane.

The advice formerly given to planters was that they should purchase only the cheapest form of nitrogen, and from this advice sprang the habit of costing the nitrogen on a unit price basis only.

There is some evidence in the scientific agricultural literature (Carey & Robinson, 1953) to show that sodium nitrate is not as good as ammonium sulphate as a nitrogen source for sugar cane; the reason for the poorer performance of sodium nitrate lying presumably in the mobility of the nitrate ion. This factor has, however, never been stressed in Mauritius and has not been taken into account in the evaluation of this form of nitrogen.

Some three years ago commercial urea became available and sales of this material increased rapidly so that for the first time sulphate of ammonia began to lose popularity.

The change from ammonium sulphate to urea was being made as a result of considering the price for unit nitrogen only, which was lower for the latter when savings on local transport were taken into account.

No local data, and indeed in 1956 almost no foreign data, were available which would allow the efficiency of urea as a nitrogen source for sugar cane to be assessed. It was essential that this information should be obtained in order to see whether the change to urea was justified or not. Ten experiments were therefore laid down in various climatic zones of the island to compare urea with sulphate of ammonia as a nitrogen source for sugar cane. The levels of nitrogen used in the experiments were 0, 15, 30 and 45 kg. per arpent applied on the stool in one dressing.

The final results which were obtained from four virgin and seventeen ratoon harvests are given in table 14.

Table 14. Effect of levels and form of nitrogen on yield and vegetative characteristics.

	Control	*Sulphate of Ammonia*			*Urea*		
Kgs Nitrogen per arpent	**0**	**15**	**30**	**45**	**15**	**30**	**45**
Tons cane per arpent	23.2	26.8	28.5	30.2	25.6	27.5	27.4
Cane Yield Index	100	116	123	130	110	119	118
Vegetative Index	100	108	113	115	106	111	112
Foliar Diagnosis Index	100	107	111	116	106	110	110

These results show clearly that urea is not as efficient a source of nitrogen for sugar cane, under the conditions of the experiments, as is ammonium sulphate.

There are many scientific reasons which could account for the poor performance of urea but two stand out as being particularly probable.

Firstly, Soubies, Gadet and Lenain (1955) have shown that urea can lose ammonia by volatilization. The urea in our experiments was applied on the stool, as is the standard practice in Mauritius, and it has been observed that urea applied in this manner may still be lying on the soil surface three months after application. In view of the high temperatures occurring during the day at the soil surface and the length of time the urea is exposed, volatilization losses of ammonia, if they do occur in this manner, would be heavy.

Secondly, Soubies *et al* (*l.c.*) have demonstrated that on acid soils nitrification of the ammonium ion liberated from the urea is rapid. Again therefore, if this condition holds in our soils then urea is placed at a disadvantage as the heavy spring rains will cause leaching losses of the nitrate ion.

Whatever the reason for the relatively poor performance of urea there is, however, no doubt that the method used in Mauritius of applying the urea on the surface of the soil in one heavy dressing is not the best for this particular fertilizer.

The experimental results show that at a level of 30 kg. per arpent or less urea compares much more favourably with ammonium sulphate than it does when dressings of the order of 45 kg per arpent are used. Moreover, application of the urea under the trash or covering the fertilizer with soil should improve its performance and experiments are under way to test these various points.

If the performance of urea can be improved by using the methods suggested or if its cost should fall appreciably then this material may well prove to be an economic source of nitrogen.

For the present, however, taking into consideration both the price and efficiency of urea nitrogen, it cannot be considered as a desirable alternative to sulphate of ammonia.

Apart from urea, one other nitrogenous fertilizer, aqua ammonia, is of potential interest to Mauritius. This material, which is a 20% aqueous solution of ammonia, is now used widely in the Hawaiian Islands. The change from solid nitrogen carriers to aqua ammonia has saved the sugar industry there more than Rs. 5,000,000 annually, due firstly to the cheapness of aqua ammonia solution and secondly, to the efficiency of its transport, storage and distribution.

The saving to the national economy of Mauritius would be almost Rs. 1,000,000 at current prices if one-third of the nitrogen used were imported as aqua ammonia.

The problems which would be associated with such a course are manifold and before aqua ammonia can be considered seriously much experimentation, on methods of application and its efficiency compared with sulphate of ammonia, will have to be carried out. A start has already been made, but factual information will not be available before two or three years.

Phosphorus

Phosphate nutrition has received much attention in Mauritius over the past few years owing to the widespread deficiencies, as diagnosed by foliar analyses, occurring in the cane growing areas.

There are several reasons for the development of this unsatisfactory state of affairs although one is particularly important. With the advent of heavy agricultural machinery many new lands which are extremely deficient in phosphate have been planted. In addition, deep cultivation such as de-rocking and subsoiling are now common practices and, whilst this work is to be encouraged, the extreme poverty of our subsoils in phosphorus and their admixture with topsoils have often caused a deterioration in the phosphate status of the fields so treated.

All the factors have worked together to result in the present position and one of the first efforts of the Institute was to obtain, through field experimentation, information which would aid in the development of a rational and economic phosphate fertilization programme.

The factors which govern efficiency of phosphate fertilization are type of fertilizer, quantity, crop requirements and placement. Elsewhere in the world soluble phosphates such as super, triple super and ammonium phosphate have been used more widely than the cheap insoluble forms such as rock phosphate because of their greater efficiency in supplying plant needs, but no data on their relative performances when compared with the guano-phosphaté used locally were available.

The first series of experiments was therefore designed to compare the different types of phosphate fertilizer when applied in the furrow at planting. The results showed clearly that for the virgin crop the soluble forms of phosphate were superior to guano phosphate when used in this manner. With the following ratoon crops, however, guano phosphate equalled the soluble forms. (Parish & Feillafé, 1959).

These results can be explained by the fact that the virgin crop has a poor feeding power whilst the ratoon crop, due to the greater ramifications of the root system, can extract phosphate from a greater volume of the soil and so mitigate the effects of a shortage of this nutrient.

Foliar analyses of the control plots, i.e. the plots receiving no phosphate, showed marked deficiencies in the virgins but much greater uptake in the ratoons, proving that the effect is not due to poor residual values.

Experiments on the best methods of placing soluble phosphate are of interest only in ratoon crops, placement in the furrow at planting being the standard practice for virgins. In passing, however, note should be made of the fact that insoluble phosphates, and guano phosphaté falls into this class, are usually worked thoroughly into the soil. This is particularly important when deep cultivation is being practised as, although the physical structure of the subsoil is improved by this operation, root proliferation in the subsoil will not take place unless the horizon is adequately supplied with phosphate. This has been elegantly illustrated by work in Hawaii and is something which should be borne in mind whenever land with phosphate deficient subsoil is being worked.

Humbert (1953) and Hartt (1955) as a result of their work with radio-active phosphorus concluded that with ratoon crops phosphate applied in the rooting zone is utilized but surface applied phosphate under dry conditions is not absorbed although in wet districts, and particularly where there is a trash blanket, surface applied phosphate is useful.

The results of the experiments carried out in Mauritius so far have shown that when the ratoon crop is deficient in phosphate then surface applied phosphate is utilized and that soluble forms are superior to insoluble forms. There is some doubt as to the best site of placement, i.e. on the stool or on the trash and therefore until more data becomes available placement should be on the stool, particularly as the cheapest form of soluble phosphate available is ammonium phosphate and this is easily applied with the nitrogenous fertilizer.

The results so far obtained have shown clearly that soluble phosphates are superior to the guano-phosphate used in Mauritius, but the application of this finding to estate practice requires first that a philosophy of fertilization should be developed.

The following factors are operative in Mauritius :—

a) Insoluble phosphates are considerably cheaper than the soluble forms and they are well utilized even on the low humic latosols which have pHs around 6.0.

b) Soluble phosphates when applied in small amounts are superior to the insoluble forms.

c) Virgin crops are more sensitive to phosphate deficiency than ratoon crops.

d) Of all the nutrients, phosphate alone when applied to the soil is never lost, it may be fixed or «revert» but provided that there is no erosion, it is not lost.

e) Many cane growing soils no longer respond to phosphate, due to the heavy dressings of phosphate fertilizer given to these lands in the past.

f) Correction of phosphate deficiency in ratoons, unless the ratooning period is long as in Mauritius, will not be worth while as the virgin crop will have suffered the biggest loss.

Bearing these facts in mind, then it would seem that the wisest course would be to build up the phosphate reserves of the soil by applying the largest possible dressing of cheap phosphate during the ploughing out.

Dressings of guano should be at a level of one ton on land which is known to be deficient and, on eroded slopes and land being deeply worked for the first time, 1,500 or even 2,000 kilos cannot be considered excessive. With these heavier dressings, the bulk of the guano should be mixed thoroughly with the soil and the remainder scattered in the furrow.

Scums should be used at a dressing of about 5 tons in the furrow at planting and if scums are not available soluble phosphate (50 kg P_2O_5/arpent) should be used.

One point which is worth the attention of those estates where the scums come from filter presses, is that kibbling of the scums would improve handling and distribution in the furrow.

Where deficiencies continue to exist in the ratoons then soluble phosphate should be used at 25 — 50 kgs P_2O_5 per arpent.

In the case of local peasant cane growers, it is unlikely that they will be prepared to invest large amounts of money in phosphate fertilization at planting and for them the best course would probably be to use only soluble forms of phosphate in small frequent doses.

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3. THE VEGETATIVE AND MINERAL COMPOSITION OF THE CANE CROP

P. HALAIS, D. H. PARISH & S. M. FEILLAFÉ

Although the practice of returning to a field an amount of nutrient equivalent to the amount removed at harvest is an out-moded way of supplying fertilizer needs, yet information on the nutrient distribution within a crop and on the organic matter produced is interesting in that it gives a quantitative idea of the changes involved during growth.

By abstracting the sugar literature of Mauritius accumulated during the past 30 years the authors have been able to calculate the organic and mineral distribution of a fairly typical estate crop, viz, a crop of 35 tons well supplied with nitrogen, phosphate and potash. The data is given in table 15.

Table 15. Quantitative Composition of one year's growth of sugar cane per arpent.

	Cane Stalks	Green Tops	Trash	Roots
Tons *Fresh Matter* ...	35	10	5	4
Tons *Dry Matter* ...	9.0	2.5	3.7	1.0
Kg. *N* ...	25	20	17	
Kg. P_2O_5 ...	12	10	8	
Kg. K_2O ...	50	40	35	
Disposal : ...	Brought to factory	Most often removed for fodder	Left in the field although trash may occasionally be burnt	

Table 16. Distribution of the nutrients from 35 tons of cane after crushing (Kgs.)

	N	P_2O_5	K_2O	*Disposal*
Molasses	6	2	36	Usually exported
Press-Cake	8	8	2	Returned to fields
Bagasse	11	2	12	Burnt in factory though a surplus may be left.

The nutrients contained in the 35 tons of sugar cane are, after crushing, distributed as shown in table 16.

The amount of potash removed from a field with the cane and the green tops is about 90 kgs. The fact that many estate fields do not respond to potash fertilization despite this heavy removal of potassium reflects the massive quantities of molasses and potash salts which have been applied in the past.

Table 17. Distribution of dry matter produced during a crop cycle.

Crop Residues	*Tons of dry matter*
Green tops, trash roots	50
Trash & roots	33
Roots	7

As the bulk of the organic matter removed from an area as millable cane is not returned, the amount of organic matter added to the soil within a crop cycle of one virgin and six ratoon crops is as shown in Table 17.

When it is considered that one ton of farmyard manure contains about 400 kgs of organic matter then the roots and trash during a crop cycle return organic matter equivalent to some 80 tons of farmyard manure. In the case of a field where the green tops are not removed, organic matter equivalent to about 120 tons of farmyard manure is returned to the soil.

The question as to whether the organic matter is humified or not is un-important as no response to organic matter *per se* has been recorded in Mauritius.

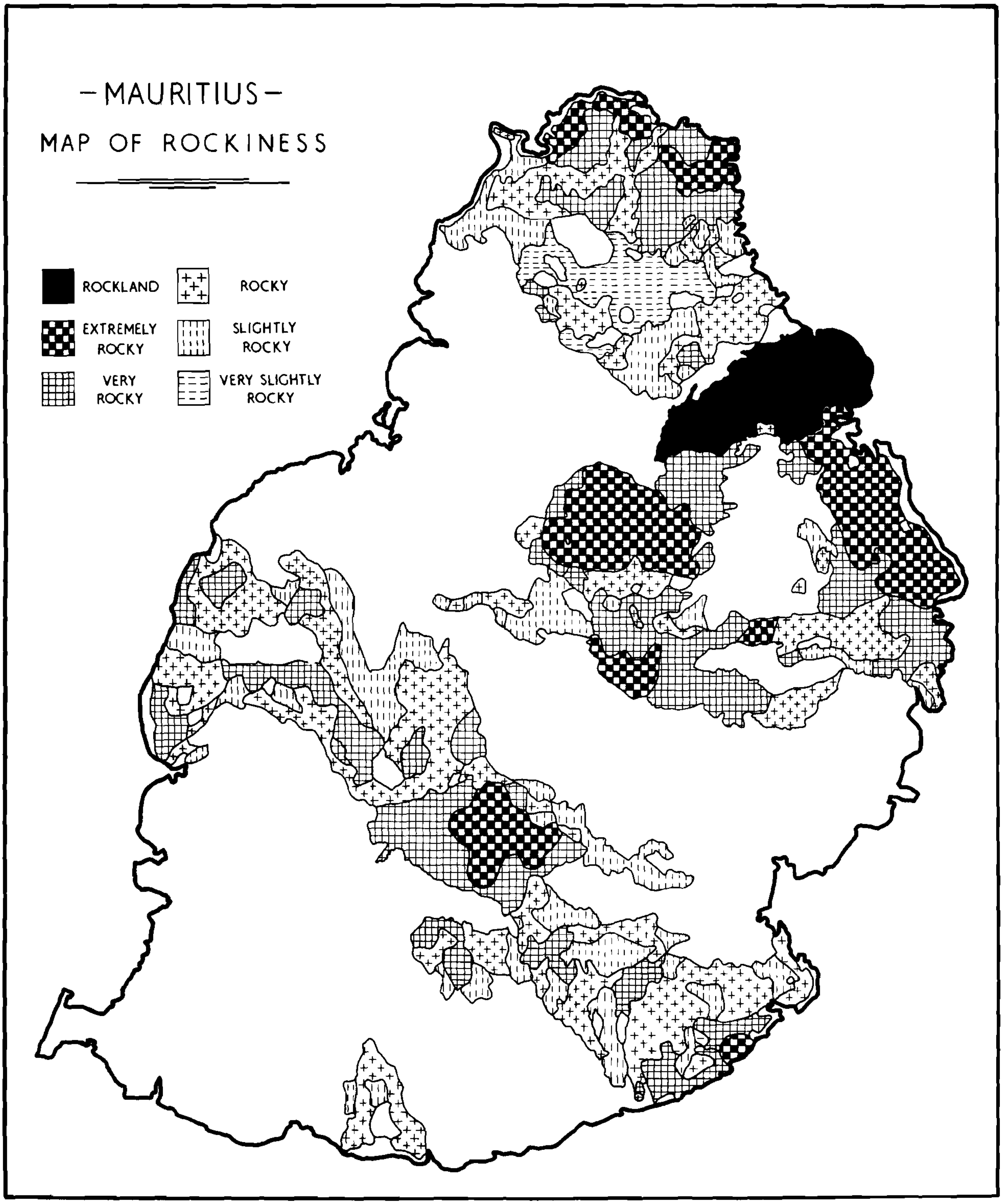
4. SOIL SURVEY

D. H. PARISH & S. M. FEILLAFÉ

« Phase map of rockiness »

Phase mapping, that is the classification of soils according to such factors as slope, erodibility, drainage, rockiness, etc. is usually the final step in a soil survey.

However, in Mauritius one of the most important differences between soils, agriculturally speaking, is the degree of rockiness as this factor is intimately related with the exploitation and potential of the land. It was felt therefore that classification of rockiness and stoniness



— MAURITIUS —
MAP OF ROCKINESS
ROCKLAND
ROCKY
EXTREMELY ROCKY
SLIGHTLY ROCKY
VERY ROCKY
VERY SLIGHTLY ROCKY

Fig. 21.

should receive early attention in the soil survey and the opportunity is taken here to describe the « rockiness » map (scale 1: 25,000) which has now been produced and which is available for consultation at this Institute.

The classification used was obtained from the U.S.D.A. Soil Manual although modifications were necessary to suit local conditions.

Before any rational use can be made of the map, a reduced copy of which is given as figure 21, it is essential to understand the terms which have been employed.

The classification of Halais (1946) is widely known in Mauritius and so one hears of «mature bouldery clays» and «immature gravelly loams». However, bouldery is a very specific description whilst the term «gravelly» employed by the above worker implies a textural characteristic and gives no indication of the gross physical features which any one looking at our «gravelly» soils can see immediately.

The most important factor affecting agriculture is the distribution of rocky masses and the terms «rockiness» and «stoniness» have therefore precise meanings for soil surveyors.

Rockiness is the relative proportion of bed rock or fixed rock exposure, either rock outcrops or patches of soil too thin over bedrock for use in a given soil area. In other words, under Mauritian conditions it means the proportion of an area occupied by exposed lava beds.

Stoniness is the relative proportion of loose fragments of rock occurring on or in the soil mass. Stoniness is itself subdivided into various classes.

A significant proportion of fragments coarser than very coarse sand and yet small enough to be worked with the soil influence markedly the moisture storage, infiltration and runoff characteristics of the soil. They influence root growth, especially through their dilution of the mass of active soil, they protect the fine particles from erosion, and they are moved with the soil mass in tillage. Small stones less than 3 inches in diameter are called gravels, and those between 3 - 10 inches are called cobbles. The terms « gravelly » and « cobbly » are regarded as textural descriptions.

Stones larger than 10 inches in diameter are not defined by soil textural classes but they are nevertheless important agriculturally as they interfere with tillage unless removed. When piled, the heaps may cover an appreciable area of land.

A further distinction is made by classifying rocks above twenty-four inches in diameter as boulders.

The bouldery soils of Halais have been shown to contain no significant amount of bedrock. They are therefore stony soils, the stones being of boulder size.

The « gravelly soils » contain significant amounts of bed-rock exposures and therefore they are primarily rocky soils. As a secondary feature of these soils it may be stated they are gravelly.

Geologically, the rocky phases are composed principally of highly vesiculated, highly fissured lava and the topography is hummocky, whilst the non-rocky phases contain relatively vesicule free basalt and the topography is flat or smoothly rounded unless erosion has occured.

These factors are extremely important as regards agricultural land values because, as the degree of rockiness increases, so does the difficulty of exploiting the land. In addition, as a result of the fissured and hummocky nature of the lava, normal irrigation methods become impossible. This latter factor is of fundamental importance in the dry North which contains a large area of extremely rocky soils.

Five degrees of rockiness have been established and the areas covered by these phases have been mapped (fig. 21). Although the term rockiness implies the amounts of fixed rock, nevertheless, in view of the highly fractured state of the lava there is obviously a correlation between the amount of fixed rock and physically detached rock. In other words, the more rocky a soil the more is the amount of loose rock.

Measurements of the volumes of the rock walls on cultivated land of varying degrees of rockiness have been made and the following distribution has been found to hold generally.

Phase	Very slightly rocky	Slightly rocky	Rocky	Very rocky	Extremely rocky
Vol. in 1000 cubic feet of piled rock per arpent	< 5	5 — 15	15 — 25	25 — 35	> 35

One other classification unit has been used for the Plaine des Roches which is unique in Mauritius. This has been called «Rockland». (Feillafé and Parish 1957).

The phase map of stoniness is in preparation and when finished, together with the phase map of rockiness, will provide for the first time a rational picture of one of the factors of basic importance in land use and development.

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CANE DISEASES

ROBERT ANTOINE

1. RATOON STUNTING DISEASE

TWO trials to assess the reactions of present commercial cane varieties to the ratoon stunting virus were harvested this year in first ratoons. The trials, one in the sub-humid zone and the other in the super-humid zone, were planted late in 1957 and the cuttings established in the disease-free plots were taken from nurseries free from ratoon stunting disease and were not heat treated. The adverse effects of heat treatment upon germination and establishment were thus avoided and a uniform stand obtained in the disease-free plots. The cuttings planted in the disease plots were obtained from infected stools and were pressure-inoculated with contaminated juice.

Nine varieties were included in the trials. Each plot consisted of 4 rows, with 24 stools per row and there were 3 replications.

Results obtained in virgins and first ratoons are summarized in tables 18 and 19.

Table 18. Effect of ratoon stunting disease on the yield of cane and sugar in a sub-humid locality.

	Virgins (12 months) Reduction in yield			*1st Ratoons Reduction in yield*		
Variety	*Cane/ arpent (Tons)*	%	*Sugar/ arpent (Tons)*	*Cane/ arpent (Tons)*	%	*Sugar/ arpent (Tons)*
M.134/32 ...	5.4	22.3	1.19	2.7	9.3	0.51
M.112/34 ...	1.2	4.7	0.25	7.5	20.3	1.41
M.147/44 ...	4.4	13.0	0.87	2.7	6.9	0.12
M.31/45 ...	5.8	16.9	0.96	4.4	11.1	0.86
Ebène 1/37 ...	2.6	10.8	0.84	4.6	13.3	0.69
B.3337 ...	4.0	13.4	0.74	3.3	8.8	0.84
B.34104 ...	2.6	9.3	0.51	2.5	7.8	0.53
B.37161 ...	6.0	26.0	1.15	3.4	11.4	0.48
B.37172 ...	3.5	11.0	0.60	1.5	4.0	0.38

Table 19. Effect of ratoon stunting disease on the yield of cane and sugar in a super-humid locality.

	Virgins (12 months) Reduction in yield		*1st Ratoons Reduction in yield*		
Variety	*Cane/ arpent (Tons)*	%	*Cane/ arpent (Tons)*	%	*Sugar/ arpent (Tons)*
M.134/32	2.3	45.0	2.3	6.8	0.17
M.112/34	2.3	36.5	—	—	—
M.147/44	0.4	2.4	5.1	15.3	0.56
M.31/45	1.0	13.7	1.6	4.7	0.07
Ebène 1/37	6.8	39.3	8.8	25.5	1.12
B.3337	4.9	34.0	2.2	5.0	0.15
B.34104	4.6	41.4	1.3	4.1	0.13
B.37172	3.7	25.9	2.7	9.6	0.22

B.37161 is not included in table 19 on account of erratic growth in all plots and M.112/34, a variety suited to sub-humid irrigated areas, did not perform normally.

An analysis of the results obtained in the sub-humid zone shows that the effects of ratoon stunting disease were less severe this year than in 1958 in spite of the fact that the trials were harvested in 1st ratoons. It should be mentioned that the same observation was made during the 1959 crop. Thus the performance of M.134/32 a variety now infected on a large scale was this season superior to the last one.

The relatively low reductions in yield obtained in the super-humid zone are not a reflection of environmental conditions only. It was mentioned in last year's report that the harvested canes were immature and that sugar determinations could not be carried out. Indeed, canes in the diseased plots had made such a slow start that a large number of immature stalks were left standing at harvest. This no doubt accounts in a large measure for the apparent relatively high yield in such plots. The practice of leaving «water shoots» or immature stalks standing at harvest in the super-humid zone was too rigidly followed.

It will be observed that reductions in cane yields in the sub-humid area ranged from 4.0% to 20.3% in 1st ratoons as compared to 4.7% to 26.0% in virgins in 1958. In the super-humid zone, the reductions varied from 4.1% to 25.5% in 1st ratoons as compared to 2.4% to 45.0% in virgins in 1958. It should be noted once more that all the varieties grown commercially at present are susceptible to the disease. The effects of chlorotic streak on Ebène 1/37 in the super-humid region cannot be disregarded as reductions in yield of 25.5% and of 1 ton of sugar per arpent are significant.

All diseased canes showed a higher sucrose content than healthy ones in the super-humid zone. Erratic results, however, were obtained in the dry locality. In spite of the environmental conditions which, apparently, were not conducive to the worst effects of ratoon stunting disease, reductions ranging between half a ton and one ton of sugar per arpent should not be overlooked. Hence the importance of planting only healthy cuttings derived from disease-free nurseries.

The promising varieties, M.202/46, M.93/48 and M.253/48, the first two of which were recently released for commercial plantings, have shown susceptibility in a ratoon stunting trial in the super-humid zone. Their reactions to the disease in a dry locality are being studied. Planters should establish their propagation plots with heat-treated cuttings or cuttings derived from disease-free nurseries.

Investigations on poor growth of Co.419 have shown its susceptibility to ratoon stunting disease. It is interesting to note that reductions in yield in a trial which was reaped during three consecutive years increased from 6% in virgins to 21% in 1st ratoons and then dropped to 18% in 2nd ratoons in 1959.

2. HEAT TREATMENT OF CUTTINGS

(a) Hot water treatment programme against ratoon stunting disease.

The central hot water treatment plant at Belle Rive, administered by the Sugar Producers' Association, worked at full capacity during the first six months of the year. In addition, planting material was treated for small and large planters in the hot water tank of the Institute at Réduit. A creditable effort has been made on the whole and, in spite of the slackness shown during the crop season and the unco-operative attitude which prevailed in some quarters, appreciable progress was made during the year in the hot water treatment programme against ratoon stunting disease.

Out of a target of 1315 arpents of nurseries a total of 611 arpents were planted in the various factory areas in 1959. Recruitings amounted to 28% and 522 arpents or 85% of the planted area was maintained. The weight of cuttings treated for estates, including the amount for recruiting was 2,300 tons. Since the beginning of the campaign in June 1958, a total of 3,515 tons of cuttings have been treated at Belle Rive for estates and 961 arpents of nurseries esta-

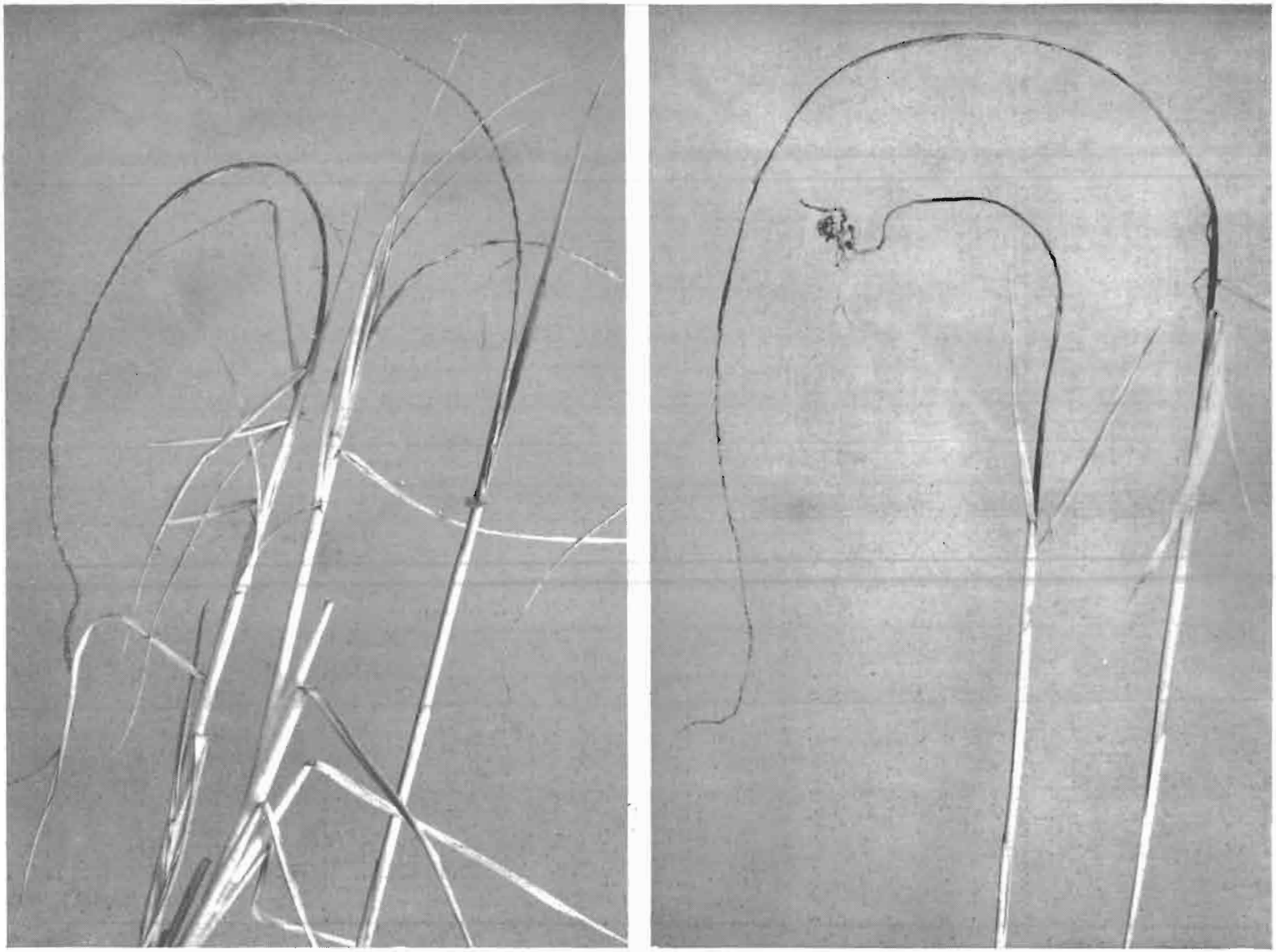

Fig. 22. Smut Disease of Sugar Cane.

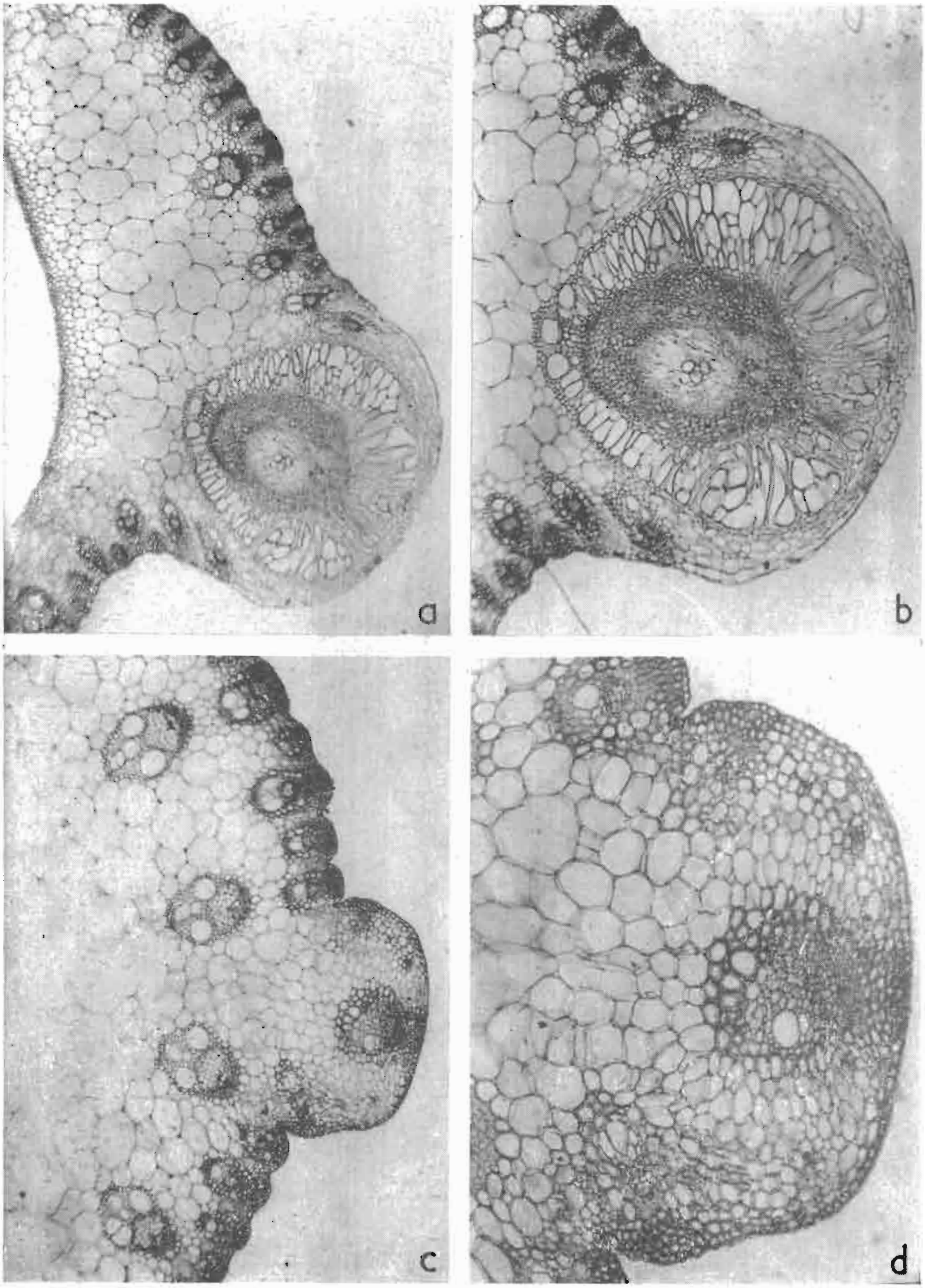

Fig. 23. Transverse sections of midribs of sugar cane leaves attacked by Fiji disease and Pseudo-Fiji disease. (a) Fiji disease gall on M.134/32, x 44. (b) Same, x 100. (c) Pseudo-Fiji disease gall on Pindar x 44. (d) Same, x 100.

blished, of which 803 arpents or 84% have been maintained. Recruitings amounted to 24%.

If these gross results are considered, namely, that 84% of the area of nurseries planted were maintained with 24% recruiting, it would appear that the hot water treatment has not been, on the whole, seriously detrimental to the germination of the treated setts.

Table 20. Varieties established in nurseries in 1958 and 1959 on estates.

	1958			**1959**			**To-date**	
Variety	*Area planted (arpents)*	*Area maintained (arpents)*	*Recruiting %*	*Area planted (arpents)*	*Area maintained (arpents)*	*Recruiting %*	*Area planted (arpents)*	*Area maintained (arpents)*
M.147/44	85	70	18	319	268	31	404	338
B.37172	113	104	11	150	147	17	263	251
Ebène 1/37	90	61	22	71	52	30	161	113
B.3337	20	16	5	33	21	31	53	37
M.31/45	20	13	4	14	12	31	34	25
Other varieties	22	17	27	24	22	30	46	39
Total	350	281	18	611	522	28	961	803

Table 20, which gives details of varieties established in nurseries, shows that, apart from B.37172 which was comparatively little affected, the drop in germination of setts of commercial varieties, following heat treatment, averaged 30% in 1959. If such reduction had been uniformly distributed in all nurseries, a proportional increase in the number of treated setts planted would be the obvious answer. However, this is not the case as germination in the nurseries was very variable and ranged from almost complete failures to excellent stands. Studies on the nature of the planting material as affecting the germination subsequent to the heat treatment were actively pursued.

The varieties treated, in declining order of importance, were M.147/44, B.37172, Ebène 1/37, B.3337, M.31/45 and in addition a small proportion of M.134/32, M.112/34 and B.34104. As far as the effect on the more important commercial varieties is concerned, B. 37172, as already mentioned, is least affected by the heat treatment. With M.147/44, a rigorous selection of cuttings should be carried out, if erratic results are to be avoided, on account of the large number of sprouted eyes encountered on this variety. Of the two varieties well adapted to the super-humid zone, germination of Ebène 1/37 is appreciably reduced by the heat treatment whereas, on the whole, better results are obtained with B.3337. The once popular M.134/32 is seriously affected and complete failures have been observed on occasion, particularly if cuttings are taken during the period of active growth.

Table 21 gives an indication of nurseries established and of plantations made with disease-free stock in the various sectors of the island in 1959. It will be seen that 17% of the total plantings were made with cuttings, directly heat treated or derived from nurseries. The total area planted was only six times the area of the nurseries which provided the cuttings. At least 25% of the total area planted in 1959 would have been established with disease-free stock had the nurseries been better utilized.

The treatment of planting material for large planters, who have established individual nurseries, was carried out in the tank of the Institute. Out of a target of 700 tons of cuttings, 240 tons were treated in 1959. With regard to small planters, the Sugar Planters' Rehabilitation Fund Committee is responsible for the establishment of a central nursery with material treated at Réduit. The start made in 1958 was pursued this year and the area of nurseries increased.

Table 21. Disease-free plantations established in 1959.

Sector	Nurseries established in 1959 (arpents)	Plantations established with cuttings derived from 1958 nurseries (arpents)	Total area planted with treated cane (arpents)	% total area planted in 1959
West	18	76	94	18
North	171	638	809	31
East	140	273	413	16
South	262	593	855	15
Centre	20	80	100	5
Island	611	1,660	2,271	17

(b) **Studies on the germination of heat treated setts.**

The experiments were concentrated on M.147/44 and Ebène 1/37, the two important commercial varieties which give erratic germination after the heat treatment.

(i) **Addition of anti-oxidants to the hot water bath.**

Experiments on the addition of anti-oxidants to the hot water bath to improve the germination of treated setts were pursued during the year. The results are given in table 22.

Table 22. Effect of anti-oxidants on the germination of treated setts.

Treatment	*Concentration %*	*No. of germinated eyes %*
Control (treated in hot water)	—	4
Control (treated in cold water)	—	53
Urea	0.25	34
Potassium cyanide	0.005	17
Potassium cyanide	0.02	19
Sodium sulphite	0.10	19

It will be observed that an addition of urea at 0.25% to the treatment bath resulted in a germination of 34% of the eyes as compared to 53% in the case of untreated cuttings and 4% for cuttings treated in hot water without anti-oxidants. The other anti-oxidants also improve the germination of treated setts but their effect was not as marked as that of urea. In view of the promising results obtained, further experimentation is being carried out on a field scale.

(ii) **Time of trashing.**

Owing to contradictory statements having been made as to the effect of trashing on the development of side buds in M.147/44, an experiment was initiated to determine the best trashing practice in connection with the subsequent hot water treatment of the cane stalks. The results are given in table 23.

It appears that it is preferable to trash the cane at least a week before the preparation of cuttings for treatment. The germination of buds increased from 55% to 77% when treatment was progressively delayed from 1 to 17 days after trashing. However, after the sixth day the percentage germination was practically constant.

Table 23. Effect of time of trashing on the germination of heat treated setts.

Days between trashing and treatment	*Germinated eyes %*
1	55
3	44
6	73
8	74
10	88
13	69
15	72
17	77

(iii) **Time lag between preparation of setts and treatment.**

An experiment was conducted in order to determine whether any undue delay in the despatch of cuttings to the treatment plant could be detrimental to the subsequent germination of the heat treated setts. Three varieties, with different reactions to the heat treatment, were included : B.37172, M.147/44 and M.134/32. Cuttings were treated one to nine days after their preparation. Results obtained with the three varieties were on the whole similar and showed that a delay of up to nine days did not affect the germination of heat treated setts.

(iv) **Virgins v/s ratoons.**

Three cuttings were taken from individual canes in 10 months old virgins and ratoons of M.147/44 after first removing the immature top and basal portions. The cuttings were planted after treatment in hot water at 50°C for 2 hours. Experimental results are given in table 24. It appears that it is better to treat 10 month old M.147/44 in ratoons rather than in virgins and that an inferior performance is obtained with top cuttings. It should be mentioned that the two batches of cuttings did not originate from the same locality.

(v) **Packing of baskets.**

An investigation to determine the effect upon germination of different methods of packing cuttings in baskets for immersion gave no conclusive results. The two methods used were loose packing with the cuttings lying criss-cross and tight packing with all the cuttings lying in one direction.

(vi) **Fertilization.**

An experiment was carried out in order to determine whether potassic fertilization at the rate of 100 lbs. KCl per arpent, applied to virgins of M.147/44 one month before taking cuttings for the hot water treatment, had an effect on the germination of the treated setts.

Results indicate that the effect of potassic fertilization on the germination of both heat treated and untreated setts is slight. The percentage of buds which germinated on HWT setts was increased only from 18.0 to 22.9 and on untreated setts from 51.3 to 57.8.

(vii) **Age of virgin cane.**

Severe germination failures have been encountered on occasions after the hot water treatment of cuttings of Ebène 1/37. An investigation was carried out in order to determine the best age at which that variety should be used to provide cuttings for heat treatment.

Table 24. Effect of hot water treatment on the germination of cuttings taken from virgins and ratoons of M.147/44.

	Cane	*Cutting*	*Germinated eyes %*
Pamplemousses	virgin	top	31
		middle	53
		bottom	50
Réduit	ratoon	top	78
		middle	85
		bottom	100

From the results given in table 25 it appears that cuttings derived from old plant cane withstand the heat treatment better than cuttings from younger planting material.

Table 25. Effect of the hot water treatment on the germination of cuttings from virgins of Ebène 1/37 of different ages.

Age (months)	*Germinated eyes %*	
	Hot water treated	*Untreated*
9	10.0	23.9
11	20.2	24.0
15	27.4	19.6

3. MISCELLANEOUS DISEASES

The overall disease picture in cane lands during the year has been summarized in the Director's introduction to this report. The more important pathological aspects are discussed in this chapter.

(a) **Rind disease.**

A severe, yet local, outbreak of rind disease or sour rot, (*Pleocyta sacchari* Mass) occurred during the year. The disease had hitherto been considered of insignificant economic importance and the fungus as a weak parasite attacking only overmature, dead or dying canes. This year, however, exceptionally low mixed juice purities were recorded at one factory at the beginning of the crop season on several consignments of cane and the stalks sent for milling were found to be infected with sour rot. A survey revealed that the disease prevailed in the northern coastal area, particulariy where the soil is shallow or exceedingly rocky and growth conditions generally poor. The conducive factor to the outbreak was probably the severe drought which prevailed from mid-April to the end of July. The variety most severely affected was M.134/32. The two other varieties grown in the area, M.147/44 and B.37172, suffered less. It should be mentioned that the severity of the disease was related more to poor soil conditions than to the cane variety. It is not believed that the newer varieties now under cultivation are more susceptible to the disease. In fact, the former main variety, M.134/32, which under normal conditions shows resistance to the fungus, was the most affected.

(b) **Chlorotic streak.**

In view of the high number of ratoons grown in Mauritius, chlorotic streak, in spite of the short hot water treatment, is the important disease of the super-humid zone. The short hot water treatment will not prevent the subsequent re-infection of stools derived from treated setts but it reduces considerably the ill-effects of the disease. On a highly susceptible variety, such as Ebène 1/37, the disease results in a weaker ratooning capacity leading to a progressive reduction of stools per unit area and of canes per stool.

The two newly released varieties, M.202/46 and M.93/48, are susceptible to chlorotic streak. Planters are therefore again advised to give the short hot water treatment to all planting material obtained from infected localities, whether such material is to be planted in a disease-free area or not. At peak periods in the planting programme cuttings could be planted without heat treatment if such material is derived from the lower, sub-humid part of an estate.

In view of the economic importance of chlorotic streak in the island, extensive research on the transmission of this disease is in progress.

(c) **Gumming disease.**

The reactions to gummosis of all promising varieties, locally bred or imported, are tested as a routine practice and only those showing high resistance to the disease are eventually released for commercial plantings. The soundness of such a policy, adopted because the gumming disease pathogen is harboured in several alternate hosts, was evident again this year. Weather conditions were favourable to the disease and several susceptible varieties in the cane collection have been severely affected, showing a large number of dead stalks and exhibiting, in some cases, severe chlorosis of the foliage. Two Australian varieties, Q.44 and Q.57, recently released from quarantine, have contracted gumming disease naturally in the observation plot.

The epidemic of gumming disease in Réunion island, mentioned in last year's report, was severe in 1959. Inoculation experiments carried out at the Botany School of Cambridge University indicate that the Réunion strain of *Xanthomonas vasculorum* is different from that in Mauritius.

Snail damage.

In early April, approximately half an arpent of cane, growing in a depression in a field under 8 months old B.37172 virgins, was seen to be damaged by snails. There had been a bad infestation of the weed *Setaria barbata* in the hollow and the attack was discovered after hand weeding had been carried out. An intensive proliferation of tissues in the region of the root band was observed and the snails, attracted to such soft tissues, fed on the proliferations and in many cases on the underlying parenchyma as well, with the result that the cane stems were weakened and generally broke at these points. The production of these outgrowths or galls was accompanied by a distortion of the stem and knife-cut effects on the internode.

At the same time, herbicide damage to standing M.134/32 was observed on another estate. The damage was local and on cane stools growing in the immediate vicinity of the spot where the herbicidal mixture had been prepared. The effect of the weedicide on the cane was the production of abnormalities very similar to those observed on B.37172 and described above, namely, abundant proliferation particularly of the root band area with stem distortion and knife-cut effects. Snail damage, however, was not observed on this occasion. The symptoms on B.37172 and M.134/32 are illustrated in fig 24.

In July, all snail damage had disappeared from the attacked field of B.37172 and the cane had recovered and looked normal. Although the symptoms strongly suggested that herbicidal damage was the primary cause, the trouble could not be definitely attributed to such factor. It is believed that such snail damage to standing cane is a first record.

4. FIJI DISEASE IN MADAGASCAR

With the co-operation of the French authorities a Fiji disease resistance trial was laid down in July in the highly contaminated Brickaville area on the east coast of Madagascar. It should be mentioned that the trial was not laid down along lines generally adopted for testing the reactions of cane varieties to the virus. A flat homogeneous area was selected in a highly contaminated M.134/32 field. One row out of every four was selected for planting the varieties to be tested. Each varietal plot, 18 feet long, was, after removal of the M.134/32 stools, planted with 25 cuttings and was separated from the next plot in line by a row of five feet of standing M.134/32 cane. There were four replications for each of the twenty-two varieties to be tested. In addition, border rows of infected M.134/32 were left surrounding the trial. The M.134/32 canes were thinned wherever necessary to enable planting and establishment of the varieties to be tested. Soon after germination, the rows of infected canes on both sides of each line containing varieties under test were harvested. When the trial was well established, the five foot rows of M.134/32 left between the ends of the varietal plots and the remaining M.134/32 rows were also harvested. The object of the procedure was to force the infected leafhoppers to migrate on the young actively growing varieties under test. The standard varieties included are the highly susceptible M.134/32, the tolerant N:Co.310 and the resistant Pindar. Varieties of special interest to Mauritian planters which have been included in the trial are M.147/44 and M.31/45. In addition, M.202/46, M.93/48 and M.253/48 are now undergoing quarantine in Madagascar and will be tested enventually for reaction to Fiji disease.

An outbreak of what has been tentatively called «Pseudo-Fiji» disease of the sugar cane occurred in commercial plantations on the west coast of Madagascar and the neighbouring island of Nossi-Bé, in October 1959. The characteristic symptom, the presence of galls on the lower surface of the leaves, led at first to the belief that Fiji disease had reached the west coast. However, no other symptom has been observed and as the epidemiology does not seem to have anything in common with Fiji disease it is difficult to establish the true nature of the malady. Furthermore, galls were also observed on *Pennisetum purpureum* growing in an affected area.

A detailed morphological and histological study of preserved infected sugar cane leaves obtained from Madagascar has revealed fundamental differences between the type of galls present on the west coast of Madagascar and the true Fiji disease galls. The differences are illustrated in fig. 23 and summarized in table 26.

Information has been obtained recently from Madagascar that cuttings taken from infected plants and grown in the greenhouse gave rise to apparently healthy plants. There is therefore no cause for alarm at present and no special protective measures are contemplated concerning our importations from the West and North of Madagascar.

Table 26. Morphological and histological observations on Fiji and « pseudo-Fiji » galls.

	Fiji galls	*« Pseudo-Fiji » galls*
(a)	Present on lower surface of leaf.	Present on lower surface of leaf.
(b)	Run in direction of veins.	Run in direction of veins.
(c)	White or pale yellow to green, may turn brownish with age and become ruptured.	In preserved material, white to pale yellow with necrotic spotting.
(d)	Rectilinear, smooth in outline.	Beaded, may cause distortion of veins.
(e)	Isolated or may coalesce end to end.	Isolated or may coalesce end to end.
(f)	Fibro-vascular bundles affected.	Mesophyll affected.
(g)	Proliferation of phloem and of sclerenchymatous sheath.	Proliferation of parenchyma, sclerenchymatous sheath may be affected and wound response observed. No proliferation of phloem cells.
(h)	Sharp line of demarcation between normal and abnormal tissue.	Merging of normal and abnormal tissue.
(i)	Galls in affected stems under growing point.	Undetermined.
(j)	Galls on roots (?)	Undetermined.
(k)	Not recorded outside genus *Saccharum*.	Present on *Pennisetum purpureum*.

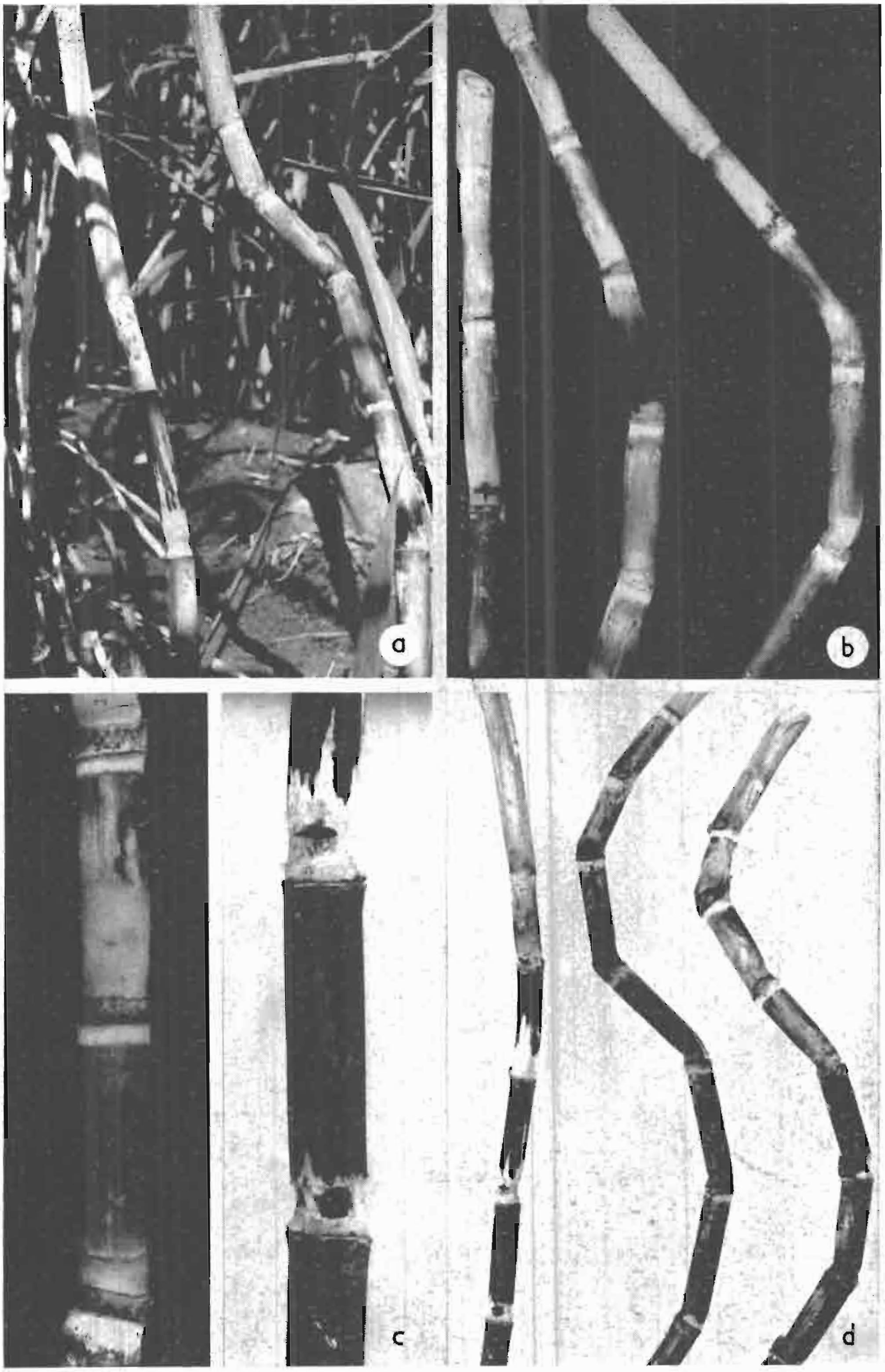

Fig. 24. Snail damage and herbicide injury to sugarcane. (a) Snail damage following proliferation of the root bands on B.37172. (b) Proliferation of root bands, distortion and knife-cut effect on M.134/32 due to herbicides. (c) left : herbicide damage on M.134/32, note proliferation of root band; right: snail damage following proliferation of root bands on B.37172. (d) Snail damage on B.37172, note distortion and knife-cut effect.

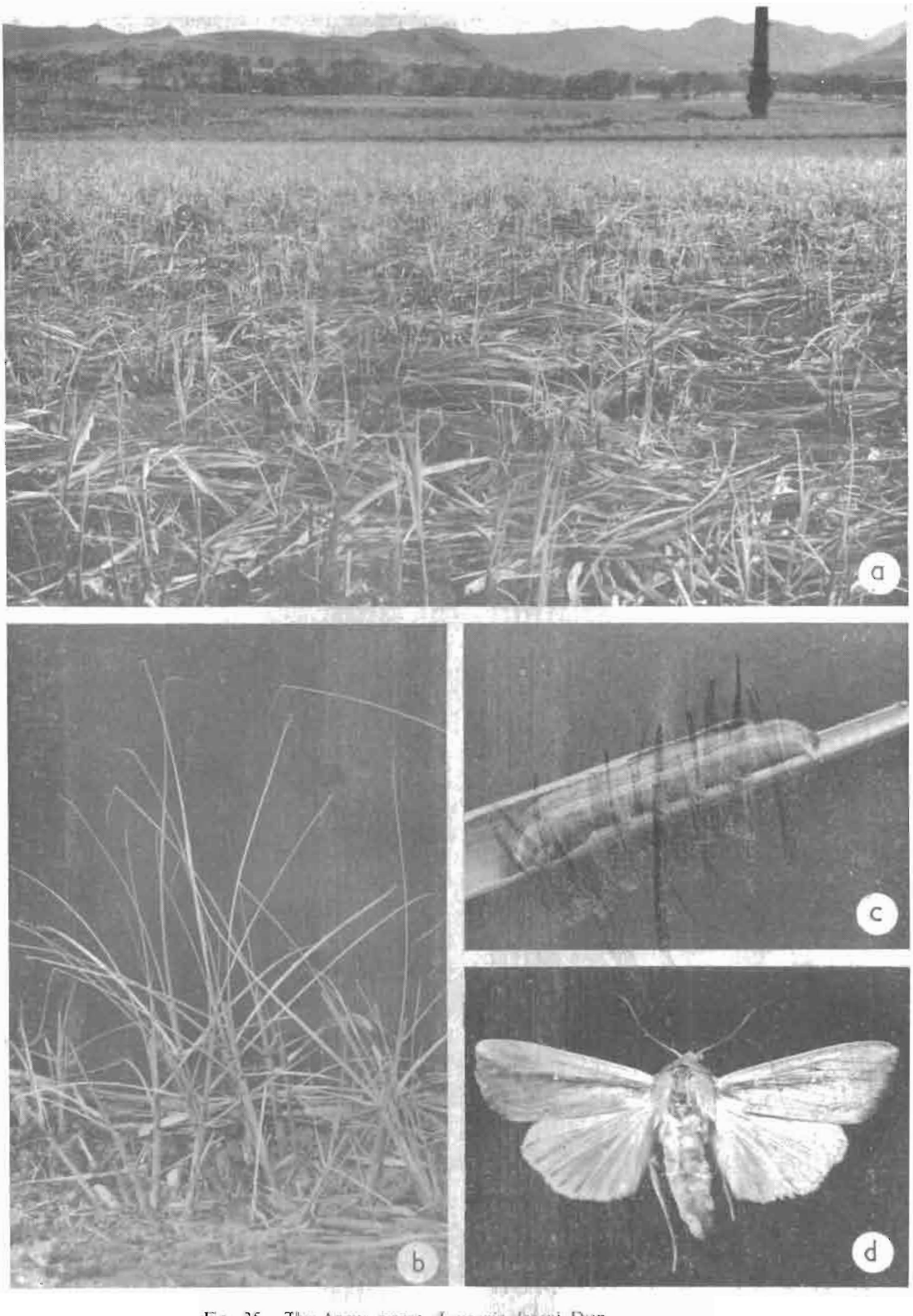

Fig. 25. The Army worm. *Leucania loreyi* Dup.
(a) Aspect of field of young ratoon cane after attack.
(b) Defoliated shoots, only the midribs remain.
(c) Caterpillar. (d) Adult.

CANE PESTS

J. R. WILLIAMS

1. NEMATODE INVESTIGATIONS

COLLECTION and identification of nematodes associated with cane roots was continued and two papers were published dealing with Dorylaimoid and Tylenchoid nematodes, respectively. * A reference collection comprising nearly seven hundred permanent slide mounts of nematodes obtained from cane roots and cane soils has now been built up. Among the species of phytophagous nematodes which have been recorded in or around cane roots, those most worthy of mention are the root-knot nematodes *Meloidogyne javanica* (Treub) and *M. incognita acrita* Chitwood, the lesion nematodes *Pratylenchus zeae* Graham and *P.brachyurus* (Godfrey), the burrowing nematode *Radopholus similis* (Cobb), the spiral nematodes *Helicotylenchus* spp. and *Scutellonema* sp., the pin nematode *Paratylenchus* sp., as well as species of *Tylenchorhynchus*, *Hemicycliophora*, *Xiphinema*, *Longidorus*, and *Trichodorus*. All of these species were found on occasions in large numbers but their occurrence seems to be sporadic or localised. Systematic sampling of cane soils and cane roots has yet to be done but it appears from the sampling methods which have been used to date that the composition of the nematode fauna varies very considerably not only in different localities and in different soil types but often from field to field in any one locality and often in different parts of the same field. The most ubiquitous of the species named appear to be *P. zeae* and *Helicotylenchus* spp. while *Paratylenchus* sp. and *Hemicycliophora* sp. are forms which though less common occur around cane roots in enormous numbers on occasion.

The root-knot nematodes, *Meloidogyne javanica* and *M.incognita acrita*, were given particular attention as the injury which they cause to roots is more obvious than that which results from the activities of other species. A survey to assess their incidence in different cane varieties and in different localities was begun but is still very incomplete. It does not seem, however, that these species are generally important for root infection appears to be infrequent and usually slight when present. This statement does not apply to the small area of cane (a little more than 100 arpents) grown on sandy coral soil where root infection is frequently severe and appears to be an important factor limiting growth. The cane variety which has given the best results on sandy soil is M.147/44, a fact which may indicate a greater resistance to root-knot nematodes than the other varieties which have been tried, namely M.134/32, B.37172 and B.37161.

Experiments with the soil fumigant EDB (ethylene dibromide) were pursued with some interesting results. In 1958, six simple preliminary experiments were made in different localities, each consisting of small plots in which the soil was treated with EDB before planting using hand injector guns. Treatments were not replicated, there being usually two treated plots with an untreated plot between them. The results were assessed by vigour of early growth and by yield of cane at harvest. In all but one of the experiments tillering and early growth of shoots was considerably better in the treated plots and yield of cane was increased by the equivalent of several tons of cane per arpent as shown in Table 27. The greatest response was obtained on sandy soil. These results, though obtained from crude experiments involving an expensive and difficult soil treatment, are of sufficient interest to justify further work with EDB and

* M.S.I.R.I. Occasional Papers No. 3 and 4.

during the year three trials with adequate replications were laid down. Two of these are on sandy soil and one on gravelly soil and an effort is being made to follow not only differences of cane growth after treatment but also changes which occur in the nematode soil fauna. Early data from one of the trials on sandy soil indicate that the population of free-living Tylenchoid nematodes is reduced for a period of months after soil treatment and is accompanied by an increase in the numbers of certain «saprophagous» forms.

Table 27. Cane yields (tons/arp.) following pre-planting soil fumigation with ethylene dibromide.

	Untreated	*Treated*	*% Increase*
Mont Choisy (sandy soil)	14.2	19.0	34
,, ,,	17.9	23.3	30
Union Park	32.0	36.8	15
,, ,,	21.3	25.6	20
Bel Etang	30.0	35.1	17
Belle Rive	26.4	25.2	—

2. THE STALK BORER

Numerous consignments of parasitic insects were received during the year from the Indian station of the Commonwealth Institute of Biological Control for trial against the stalk or spotted borer, *Proceras sacchariphagus.* A large proportion arrived with the contents in bad condition but sufficient material of two species, *Tetrastichus israeli* (Mani & Kurian) and *Stenobracon nicevillei* (Bingh.), was obtained to enable liberations in the field. About 20,000 adults of the former species, a pupal parasite, were received from India and the number was augmented by breeding so that a total of 42,500 were released. Very few of the latter species arrived in good state and only a small number were released.

Observations upon the comparative resistance of cane varieties to the stalk borer were continued with particular reference to the promising varieties M.202/46, M.93/48, and M.253/48. The data obtained to date from pre-release trials seems to indicate that these canes are more susceptible to the borer than M.147/44 and M.134/32.

One trial was laid down to determine the effect of foliar application of Endrin against the stalk borer.

3. INSECTICIDAL EXPERIMENTS AGAINST WHITE GRUBS

The white grub, *Clemora smithi,* has not in recent years been a pest of considerable importance and, although the reasons for its decline from its former pre-eminent status as a cane pest are not altogether clear, the several introduced species of Scoliid wasps are partly if not largely responsible. Experiments with insecticides, the progress of which has been described in earlier reports, have the object of finding a simple and cheap method of preventing infestation in places where the insect continues to be of concern.

Chlordane and aldrin have proved to be highly efficacious against *Clemora* and additional data obtained in 1959 serve only to supplement those given in the Annual Report for 1958. In brief, chlordane at 2-8 lb/arp. and aldrin at 2-4 lb/arp. distributed in the furrows at planting in liquid or dust formulations give good grub control for 2-3 years. When applied to the soil surface adjacent to rows of ratoon cane, grub control is less and is erratic at the lower dosage rates.

The efficacy of the insecticides against the grub when applied to the furrows is considered to have been amply demonstrated but yield responses have been inconsistent and difficult to interpret. When applied to ratoon cane, however, it is now concluded that even the lower dose sof emulsions depress growth. Furthermore, a trial made in 1958 with aldrin in powder form applied at 1, 2, and 4 lb/arp. along rows of ratoon cane and earthed over resulted in significant yield reductions of several tons of cane per arpent from each treatment.

Cane yields following application of insecti-

Table 28. Estimated tons cane/arp. following insecticide treatments at planting.

Locality	*Cane Variety*	*Stage of Growth*	*Grubs/arp. Untreated Plots*	*Insecticide & Dose, lb/arp.* 0	2 *Chl*	2 *Ald*	4 *Chl*	4 *Ald*	8 *Chl*	
St. Julien	E. 1/37	Virgin	7,100	40.4	43.6	41.1	42.5	39.5		Insecticide Emulsions
		1st Rat.	7,300	27.9	29.2	23.8	26.0	25.1		
		2nd Rat.	21,800	43.5	43.8	43.5	40.3	43.9		
L'Etoile	E. 1/37	Virgin	3,600	35.4		36.7	37.4	31.7	33.9	
		1st Rat.	21,100	38.0		39.8	42.0*	40.3	38.4	
Riche en Eau	B. 3337	Virgin	14,500	29.9		31.8	29.0	27.7	31.9	
		1st Rat.	2,400	24.8		23.6	24.1	22.2	23.2	
		2nd Rat.	0	18.8		18.8	17.2	18.9	18.0	
Riche en Eau	E. 1/37	Virgin	5,300	29.0		28.9	28.2	27.6	26.7	Insecticide Dusts
		1st Rat.	11,100	26.7		26.0	23.7	23.8	24.0	
Bel Etang	E. 1/37	Virgin	0	22.8		23.2	19.3	19.5	23.3	
		1st Rat.	6,300	35.4		36.4	32.2	35.1	34.5	
Riche en Eau	E. 1/37	Virgin	0	17.5		18.2	19.7*	15.2*	18.2	

cide to the furrows at planting, the method which gives best grub control, are given in Table 28 and the grub infestation in the untreated plots is included. Grub infestation in all trials was too low to noticeably affect growth. It should also be mentioned that the high doses of 4 lb aldrin and 8 lb chlordane were included in trials only to assess phytotoxicity. The figures show significant yield increases on two occasions after application of 4 lb chlordane to the furrows but yield responses generally were neither significant nor consistent. In view of the depressed growth following application of similar doses to ratoon cane, yields which are lower than the controls must be regarded with attention and it is concluded that the use of these insecticides in a manner which is both effective and safe has still to be demonstrated and it is advisable for planters to refrain from use of these chemicals pending final results from experiments. Two new trials with a larger plot size than previously used were laid down during the year and test applications are to be made in estate plantings on different soil types and climatic areas.

Chlordane and aldrin have been used experimently as soil insecticides in several cane growing countries following reports from the U.S.A. that the former increased yields when applied at planting even in the absence of known pests. It is of interest to briefly review this work abroad.

In Louisiana, yields of plant and first ratoon cane on heavy soils were considerably increased even in the absence of recognised soil pests when chlordane dusts and emulsions were applied at 2-5 lb/acre on the seed pieces at planting (2,5,6,7,); aldrin at 4 lb/acre as a dust appeared too heavy a dose and decreased yield of plant cane (7). In Florida, when chlordane at 2-6 lb/acre and aldrin at 1-6 lb/acre were applied as emulsions on the seed pieces at planting against wireworms, aldrin at 3 lb and chlordane at 6 lb appeared to be the best treatments; yields were not depressed by any of the treatments (6). In India, chlordane dust in the furrows at planting to control termites significantly increased yield of plant cane when used at $\frac{3}{4}$ lb and 5 lb /acre and appeared to stimulate plant growth (8); aldrin as a dust or emulsion also greatly increased yield at doses of $\frac{1}{2}$ - $1\frac{1}{2}$ lb/acre (4,9). In Queensland, aldrin at 1, 2 and 3 lb/acre did not affect yield of plant and first ratoon cane in the absence of insect attack (10) while 2 - 4 lb/acre increased yield of first ratoon cane by controlling white grubs (10) and funnel ants (11); no yield responses followed application of either aldrin or chlordane to the furrows at planting in the absence of recognised pests. In British Guiana, chlordane applied at

* *Significant difference*

or soon after planting on heavy clay soil at unspecified doses significantly reduced yield, aldrin left yield unchanged (1); other data (3) shows inconsistent yield responses from application of 2 and 4 lb/acre chlordane.

In general, the difficulty being experienced in evolving a safe treatment against white grubs is disappointing and results obtained elsewhere do not seem entirely applicable to local conditions, probably due to soil and climatic factors.

4. THE SUGARCANE SCALE INSECT

Outbreaks of the sugarcane scale insect, *Aulacaspis tegalensis* Zehnt., occured in several localities of the subhumid zone during the year, being reported from Constance, Tamarin, Medine, and Mon Loisir. The attacks were often severe and yields from many fields were considerably reduced. The scale occurs chiefly on the cane stalks and to a lesser extent on the leaves and leaf sheaths. The cane stalks become encrusted with the massed bodies of the young stages and the adult females (fig. 26) which feed upon the cane juices through slender mouth parts inserted in the cane tissues. The foliage of attacked stalks tends to dry out and a reduced yield results from suppression of growth and also from the death of stalks. There is also a striking reduction in the sugar content of badly attacked stalks. This was demonstrated by choosing at random 50 heavily attacked and 50 healthy or slightly attacked stalks from a field of M.147/44 in August. The top and bottom halves were taken alternately from each stalk to make five samples of attacked and unattacked cane, respectively, each sample consisting of five top and five bottom half-stalks. The samples were shredded and 300 gm of shredded cane taken from each for juice analysis. The results are given in Table 29 and show a reduction of sugar content amounting to rather more than 40%.

Table 29. Loss of sugar in cane attacked by *Aulacaspis*. Results from 5 samples of attacked and healthy canes respectively.

	Healthy Canes	*Attacked Canes*	*% Loss*
Brix % Cane	15.8 ± 0.9	11.0 ± 0.9	30.4
Pol % Cane	13.4 ± 0.5	7.6 ± 0.6	43.3
CCS % Cane	12.2 ± 1.0	6.6 ± 1.7	45.9

Aulacaspis is favoured by dry conditions and is a rare insect in all regions except the coastal belt to which its sporadic attacks are virtually confined. Its relative abundance during the 1958-59 crop may be associated with the dry conditions which prevailed for several months.

The severe effect of the scale upon yield is best mitigated by harvesting early while to minimise reinfestation the stalks should be cut as close to the ground as possible and all «babas» or water-shoots removed. Unfortunately, the presence of a heavy attack tends to be overlooked until the insects are exposed by trashing preparatory to harvest. It is therefore advisable in droughty areas to examine fields closely when the presence of the insect has been noted.

5. ARMY WORMS

Many outbreaks of the army worm, *Leucania loreyi* Dup. (fig. 25), occured in various parts of the island in November - December. All were in fields of early ratoon cane which had been burnt before harvest and were characterised by the sudden appearance of extremely large numbers of caterpillars which stripped the foliage from the young shoots, frequently leaving only the hard midribs of the older leaves. A total of about forty fields are known to have been attacked in this manner. In each instance, defoliation became apparent 20 - 30 days after burning and was obviously the result of the feeding of a single brood initiated by eggs laid at about the time of burning. The attacks subsided with the pupation of the caterpillars and, as only the foliage of the shoots had been destroyed and the growing points remained unharmed, cane growth suffered only a temporary check. Cane in fields adjacent to the attacked fields and which had not been burnt was uninjured.

Caterpillars of *Simplicia* sp. accompanied those of *Leucania* in many of the affected fields, the two species sometimes being equally abundant. The caterpillars of *Simplicia*, however, fed only upon the cane debris heaped in the interlines but to a casual observer it appeared that *Leucania*, having consumed virtually all the available green foliage, was resorting to dead and decaying vegetable matter.

Leucania loreyi is a nocturnal insect. The moths fly at night when they seek the sweet liquids upon which they feed. The caterpillars also feed actively only at night and hide under trash or in sheltered places on their food-plant during the day. Pupation occurs in the soil or under trash. The association of the attacks with burning at harvest seems, as noted on occasions with *L. unipuncta* Haw. in Hawaii, to result from the attraction of the moths to the sugary liquids forced out of the cane stalks by heat when the trash is burned off. Consequently, the moths concentrate in a field after burning and a large number of eggs are laid in a relatively small area while the caterpillars which emerge develop more or less in unison so that defoliation is sudden and severe, occuring some weeks later on the new cane growth. The disappearance of the insect when the brood has completed development can be attributed to the dispersion of the newly emerging moths which have no cause to congregate as did their parent moths. It is not clear, however, why attacks of this insect have been absent in previous years, the last reported outbreak being in 1950 and it affected only a small area in one locality. Burning to facilitate harvest was practised more in 1959 than before, partly owing to the increased cultivation of M.147/44 with its hairy and clinging trash, but a certain amount of cane is burned every year.

6. THE COTTONY SCALE

A severe but localised attack of the cottony scale insect, *Pulvinaria iceryi* (Sign.), developed early in the year at Trois Ilots and resulted in the complete destruction of about two arpents of ratoon cane, the attacked variety being M.112/34. The attack began on the young ratoon growth and spread gradually to cover about five arpents, the cane around the peripehry of the decimated area showing stunting to various degrees. It was the first outbreak of this insect to occur since 1955.

The scale, distinctive owing to the white pocket-like egg sac which develops on the female (hence the vernacular name of «Pou à poche blanche»), has a most drastic effect on the cane which it attacks. The leaves show yellowish and purplish discolourations before drying up and, depending upon the number of insects present, subsequent growth of attacked shoots is stunted or completely inhibited and is often followed by death not only of the shoots but of the whole stool. The effect of the insect strongly suggests that its saliva, which enters the tissues during feeding, is toxic to the plant. Large numbers of ants, particularly *Anoplolepis longipes* Jerd., which feed upon honeydew, accompanied the *Pulvinaria* and led to the appearance of frequent colonies of the cane aphid *Longiunguis sacchari* Zehnt., and the Aleyrodid *Neomaskellia bergii* Sign.

7. THE SUGARCANE LEAFHOPPER

Tytthus mundulus (Bredd.), the natural enemy of *Perkinsiella saccharicida* which was introduced in 1956 - 57, was observed during the year in localities far from the original colonisation centres and it is concluded that the insect has now dispersed over the whole island.

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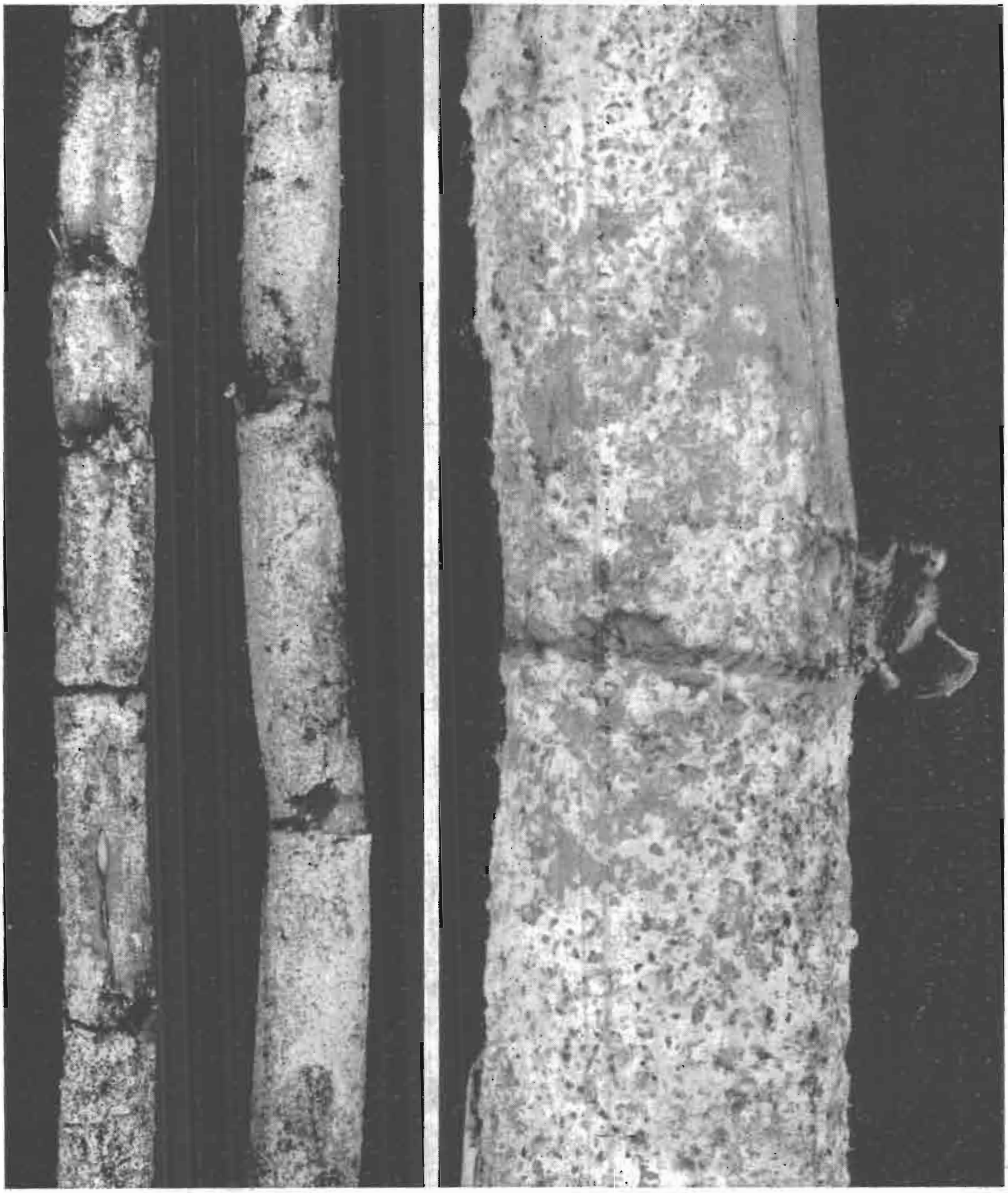

Fig. 26. Cane stalks attacked by the sugarcane scale insect, *Aulacaspis tegalensis* Zehnt.

Fig. *27*. Control of *Paspalidium geminatum*. Above ; experimental plot in December, 1959, three months after treatment with DCMU (20 lb) and Sodium chlorate (400 lb) per arpent.
Below ; experimental plot in Aug., 1959, 8 months after treatment with Simazin (20 lb) and Sodium chlorate (400 lb) per arpent. DCMU and Sodium chlorate gave similar results.

WEED CONTROL

E. ROCHECOUSTE

1. INVESTIGATIONS ON THE SUBSTITUTED UREAS

THE series of trials started in 1956 for evaluating the effects of CMU-N-(4-chlorophenyl)-N^1,N^1-dimethyl urea and DCMU-N-(3,4-dichlorophenyl)-N^1, N^1-dimethyl urea on cane yield and sucrose content was completed this year. As previously reported (M.S.I.R.I. Ann. Reports 1956-1958) these experiments consisted of five trials laid down in different localities of the island in which CMU and DCMU were applied at rates 2,3,4,5,6,8 and 10 lbs per arpent. Treatments 4, 6 and 8 consisted of two series: one in single application and the other in which half of these rates were used in two applications at two months' intervals. Herbicide application was made before weed emergence.

In plant canes two weed surveys were made, two and four months after herbicide application. Oniy one weed survey could be made in ratoon canes because at the time a second weed survey became due the canes had closed in.

Effects on Weeds. Throughout these trials DCMU proved more effective than CMU, particularly in the super-humid localities of Rose Belle and Valetta. It also gave a better control of certain weed species such as *Kyllinga polyphylla*, *Oxalis repens*, *Digitaria timorensis*, *Pycreus ferrugineus* and a few other annuals. At the higher rates of application both chemicals gave, in general, more satisfactory results. It must be pointed out, however, that when rates higher than 5-6 lbs per arpent were applied the benefit derived with regard to greater efficacy was not always appreciable. The split application gave, in general, a more lasting effect than the single application, this was observed particularly in plant canes when the second weed survey was made.

The repeated application of these weed killers during the years 1956 - 1959 has greatly reduced the stand of annual weeds and checked to some extent the spread of perennial broad-leaved weeds. There has been a shift in the annual weed population in favour of species more resistant to these chemicals. It was observed, for example, that annuals such as *Ageratum conyzoides*, *Sonchus asper*, *Bidens pilosa*, *Siegesbeckia orientalis* and *Crepis japonica* have been gradually displaced from the population by other more tolerant species such as *Lobelia cliffortiana*, *Euphorbia hirta* and *Phyllanthus* spp. In general both chemicals gave a fairly good control of some of our troublesome annual grasses: *Digitaria timorensis*, *Setaria barbata*, *Setaria pallide-fusca* and *Paspalum paniculatum*. It is interesting to note that at the higher rates the growth and spread of several broad-leaved perennials have been appreciably reduced and of these *Oxalis latifolia* and *Oxalis debilis* deserve special mention. Perennial grasses, however, were in general not affected by these chemicals at the rates of application used in these trials.

Effects on yield and sucrose content. The trials were harvested in second ratoon this year and again it was found that neither cane yield nor sucrose content were adversely affected by DCMU and CMU at the rates of application used. Results obtained during the three year crop cycle have been summarized in tables 30 and 31. From these data it will be observed that, under conditions prevailing in Mauritius, no harmful effect on cane yield and sucrose content resulted from use of these substituted ureas at rates of application varying from 2-10 lbs per arpent.

General Conclusions. Experimental work carried out with DCMU and CMU since 1956 have established that these chemicals are potent weed killers that can effectively control a wide range of annual weeds in sugar cane plantations without affecting that crop. Their persistence in the soil owing to their low solubility make them particularly suitable to the super-humid localities and to the irrigated areas of the island. It is recommended that on economic grounds the rate of application should not exceed 4-6 lbs per arpent.

Table 30. Effects of CMU and DCMU on Cane Yield expressed in tons per arpent. Averages for the years 1957 - 1959.

Herbicide in lbs. per arpent	*CMU* Plant Canes						*DCMU* Plant Canes					
	Valetta	Rose-Belle	Benares	Magenta	Solitude	Mean	Valetta	Rose Belle	Benares	Magenta	Solitude	Mean
2	33.9	25.6	35.7	23.1	38.8	30.2	34.2	24.5	36.6	26.5	37.6	31.9
2/2	34.7	22.4	38.5	24.9	34.4	30.9	34.9	25.3	41.2	26.5	36.1	32.8
3/3	35.5	23.4	36.5	25.7	36.3	31.5	34.1	25.9	40.8	27.3	38.9	33.4
4	36.1	25.6	37.8	26.6	34.9	32.2	34.9	26.3	40.8	26.9	37.4	33.3
4/4	35.2	26.3	39.3	23.3	39.7	32.8	34.7	26.6	40.1	23.6	33.7	31.7
5	34.2	25.4	35.6	25.5	36.8	31.5	33.7	25.8	40.6	27.3	32.4	31.9
6	31.6	24.5	35.8	26.4	31.6	30.0	36.9	24.4	37.7	27.9	35.4	32.5
8	32.9	23.8	42.3	29.5	37.5	33.2	34.6	25.3	38.7	29.3	33.0	32.2
10	34.1	23.8	40.4	24.5	37.3	32.0	34.3	25.7	37.8	27.8	35.0	32.1
Control	33.1	23.6	34.5	25.3	39.0	31.1	34.2	26.3	38.4	26.7	36.9	32.5

Table 31. Effects of CMU and DCMU on Sucrose Content expressed in terms of CCS % cane. Averages for the years 1957 - 1959.

Herbicide in lbs. per arpent	*CMU* Plant Canes						*DCMU* Plant Canes					
	Valetta	Rose-Belle	Benares	Magenta	Solitude	Mean	Valetta	Rose Belle	Benares	Magenta	Solitude	Mean
2	15.99	17.04	13.66	15.14	15.50	15.47	15.53	17.09	12.52	15.35	15.12	15.12
2/2	15.77	16.25	12.78	13.92	15.37	14.82	15.47	17.17	12.49	15.13	15.33	15.12
3/3	15.87	16.98	13.22	15.41	15.14	15.32	15.93	16.86	13.99	14.74	15.10	15.32
4	15.83	16.83	12.98	15.22	15.39	15.32	15.84	17.33	12.76	15.58	15.47	15.40
4/4	15.37	17.13	12.76	14.88	15.01	15.03	15.98	17.12	13.04	15.11	14.82	15.21
5	16.26	17.14	13.47	15.55	15.29	15.54	15.49	17.23	13.33	15.18	15.67	15.38
6	15.32	17.00	12.65	15.59	15.25	15.18	15.37	17.01	12.97	15.12	15.51	15.20
8	15.81	16.97	12.68	15.36	14.01	14.97	15.98	17.36	13.14	15.09	14.94	15.30
10	15.17	16.43	13.31	15.17	14.76	14.97	15.67	17.09	13.59	15.33	14.76	15.29
Control	15.98	17.19	13.02	15.00	14.97	15.23	15.97	16.28	12.95	15.39	15.23	15.16

2. EFFECT OF DOWPON ON CANE GROWTH

Dowpon (sodium 2,2 dichloropropionate) is particularly effective against graminaceous weeds and has been used in other countries for the control of grasses in sugar cane plantations. Rates of application per acre at which it has been applied vary from 2-10 lbs and it has also been reported that some cane varieties are fairly susceptible to its toxic effects. The object of these experiments was to determine the tolerance of two cane varieties to this chemical and to assess whether Dowpon could effectively and economically replace TCA for the control of *Cynodon dactylon* in plant canes. It will be recalled that TCA is used in cane fields in Mauritius to control this grass at rates of up to 125 lbs per arpent without any adverse effect on cane growth.

Experimental. Dowpon at rates of 10, 20, 40 and 80 lbs per arpent in 100 gallons of water was sprayed in plant canes of Ebène 1/37 and B.3337 at two growth stages, namely 5 and 8 months. The herbicidal spray was directed towards the base of the stools, as is the usual practice when *C. dactylon* is controlled in cane fields, thus avoiding wetting the foliage.

Results and conclusions. Observations made on the effects of Dowpon on the growth of these two cane varieties may be briefly summarized thus :

(i) **10 lb Treatment.** Ebène 1/37 was slightly affected and showed only a temporary yellowing of the foliage. In B.3337 that effect was more pronounced; apical and marginal blight of the young leaves occurred and growth was checked. In both varieties the 5-month old canes were more affected.

(ii) **20 lb Treatment.** Ebène 1/37 was moderately affected and B.3337 showed stunted growth. In the latter variety occasional death of young stalks occurred and the blight effect on the young leaves was pronounced.

(iii) **40 lb Treatment.** B.3337 was severely affected, showing a fairly high proportion of dead stalks. Growth abnormalities were frequent and were characterised by tangle tops, abortion of blades and production of side shoots Ebène 1/37 was in general less affected. It is interesting to note that the effect of the chemical was to stimulate the production of young tillers which looked apparently normal; this stimulation was much less in the case of Ebène 1/37.

(iv) **80 lb Treatment.** Both varieties were very severely affected. In Ebène 1/37, many stalks were killed and the others lodged, subsequently producing a large number of side shoots. Growth malformations described for the 40 lb treatment were more pronounced and in B.3337 the tops of many stalks developed a fan like appearance. Production of tillers was well marked in B.3337 which indicates that the stools had not been killed by the treatments. The 5 month old canes were still severely affected.

From the results described above it will be observed that Dowpon is fairly toxic to cane growth and that cane varieties differ in their tolerance to this chemical, B.3337 being more susceptible than Ebène 1/37 at all rates of application used. It must be emphasized, however, that cane stools survive the treatments and that the chemical stimulated the production of tillers. It appears from the results of these experiments and from those reported previously (M.S.I.R.I. Ann. Report 1957) that it would be safer to continue using TCA for the control of grasses in sugar cane plantations until more is known about the tolerance of local cane varieties to this chemical.

3. STUDIES ON CYNODON DACTYLON AND ON ITS CONTROL

Cynodon dactylon, locally known as «chiendent», is a drought resisting perennial grass and is one of the most troublesome weeds of the island. It grows in all soils in the different localities and is particularly tenacious in the humid and sub-humid zones. TCA has been widely used in Mauritius for its eradication and although satisfactory results have been obtained in certain areas, disappointing results have also been recorded. Dowpon has recently been introduced and experiments on the effects of this chemical on C. *dactylon* were started in 1957. Since varying results have been obtained on its control in Mauritius and in other countries where this grass is a pest, it was felt that fundamental studies on the botany of this species were needed in order to obtain a better understanding of the various aspects of its control by these chemicals. Accordingly, detailed morphological investigations were begun on representative samples of this grass collected from the various localities of the island, in order to establish whether different clones of *C. dactylon* exist in Mauritius and to confirm whether these strains differ in their susceptibility to TCA and Dowpon. The studies that are being carried out are not yet complete. Consequently, only a brief summary of the results obtained so far is given below.

Botanical studies on *C. dactylon* have revealed that 4 clones of this species consisting of triploid and tetraploid races occur in Mauritius (fig. 29). These are tentatively described below.

(i) **Constance Type. 2n=40.** A robust variety with fairly thick stolons and rhizomes and with a rather tufted habit of growth. It is of localized distribution in agricultural lands and is very resistant to TCA and Dowpon.

(ii) **Réduit Type. 2n=40.** A prostrate variety with shorter leaves prevailing along roadsides and occasional in agricultural lands. Apparently fairly resistant to TCA and Dowpon.

(iii) **Beau Champ Type. 2n=30.** A vigorous variety with well developed rhizomes and stolons which spread rapidly in the field. Very common in agricultural lands. Moderately resistant to TCA and Dowpon.

(iv) **Bel Ombre Type. 2n=30.** Closelh related to Beau Champ type in habit of growty but apparently less resistant to TCA and Dowpon; fairly common in agricultural lands.

Morphological differences between these strains are not stricking, particularly with regard to the Beau Champ and Bel Ombre races. Investigations on the epidermal structure of their stolons, however, have shown appreciable differences which could be used in conjunction with other characters to distinguish them (fig. 28). In brief, it may be said that the Constance type is characterized by a great variation in the arrangement and shape of the cork-cells while in the Réduit type the pattern is more regular and the cork-cells are predominantly barrel-shaped. The Bel Ombre type is mainly distinguished by a large number of its cork-cells being flattened transversely or obliquely and in the Beau Champ type there is conspicuous stellation of the silica cells.

The identification of these varieties is of considerable practical interest since these races have been found to differ in their susceptibility to TCA (sodium trichloroacetate) and to Dowpon (sodium 2,2 dichloropropionate), the tetraploids being in general more resistant to these chemicals than the triploids.

From these preliminary observations it may be inferred that varying results obtained in the control of *Cynodon dactylon* by TCA and Dowpon in Mauritius, and possibly in other countries, might be primarily due to different varietal tolerances to these herbicides.

4. OTHER INVESTIGATIONS

(a) **Herbe Sifflette** (*Paspalidium geminatum*). During the year 1958, large scale trials on the control of this grass were conducted using the formulation 100 lbs TCA plus 40 lbs Dowpon per arpent. It must be pointed out that this formulation had been tentatively recommended for its control on the basis of experimental work carried out in 1957. Owing to very unsatisfactory results obtained in these field trials, methods of control were reinvestigated.

A series of trials were laid down in the marshy lands of two localities, Magenta and Bel Ombre, where the grass had developed into a pure sward. The following herbicides were used alone and in various combinations at the rates indicated below in 100 gallons of water per arpent: CMU, DCMU, Simazin (10 and 20 lbs), Dowpon (10, 20, 40 and 80 lbs), Sodium chlorate (200 and 400 lbs), Amizol (5 and 10 lbs), TCA (20, 40 and 100 lbs). Time of application on the efficacy of the treatments was studied by repeating the trials at 4 seasons of the year:

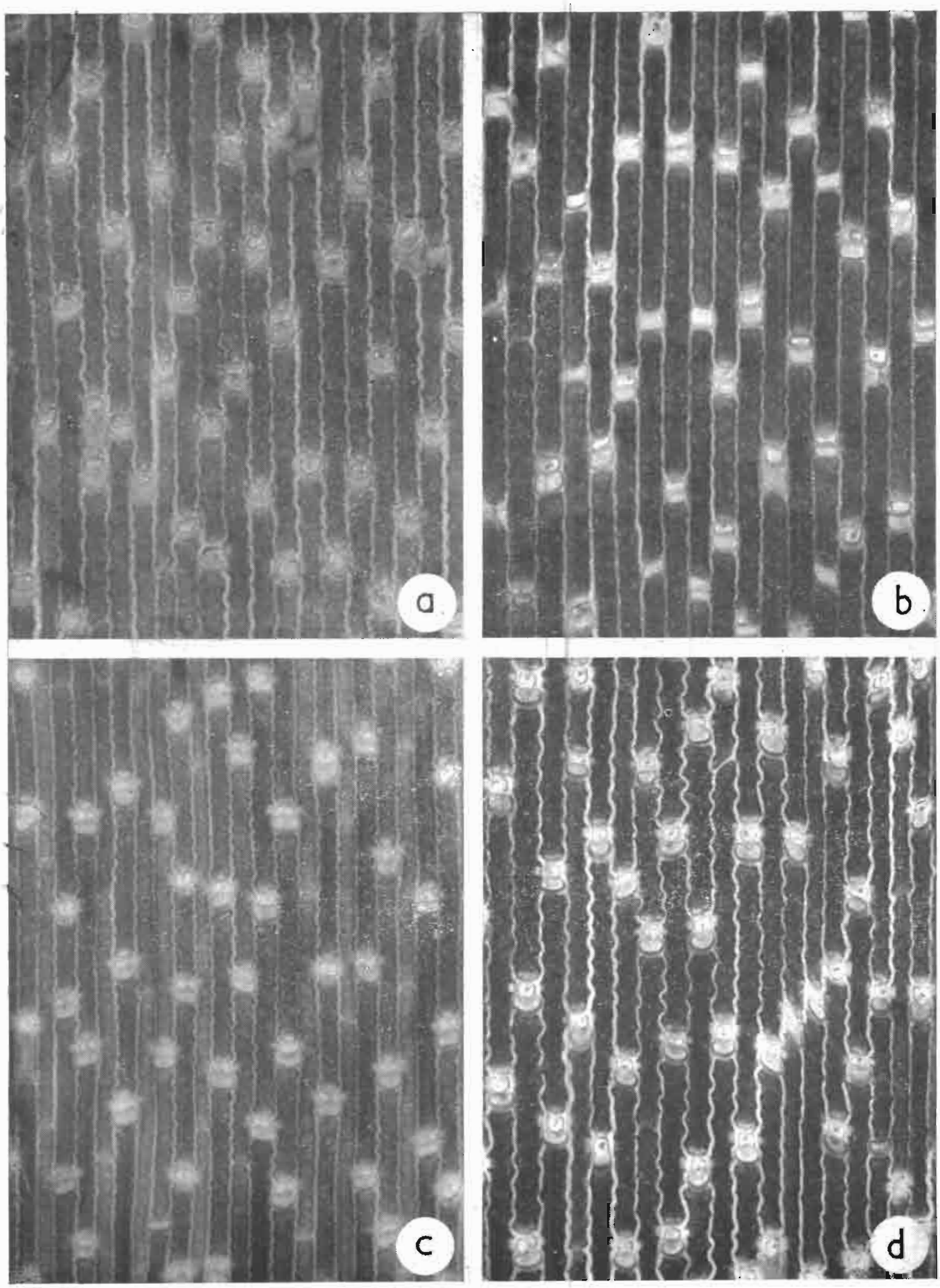

Fig. 28. Epidermal pattern of stolons of probable biotypes of *Cynodon dactylon* (x 900).
(a) Constance, (b) Réduit (c) Bel Ombre (d) Beau Champ.

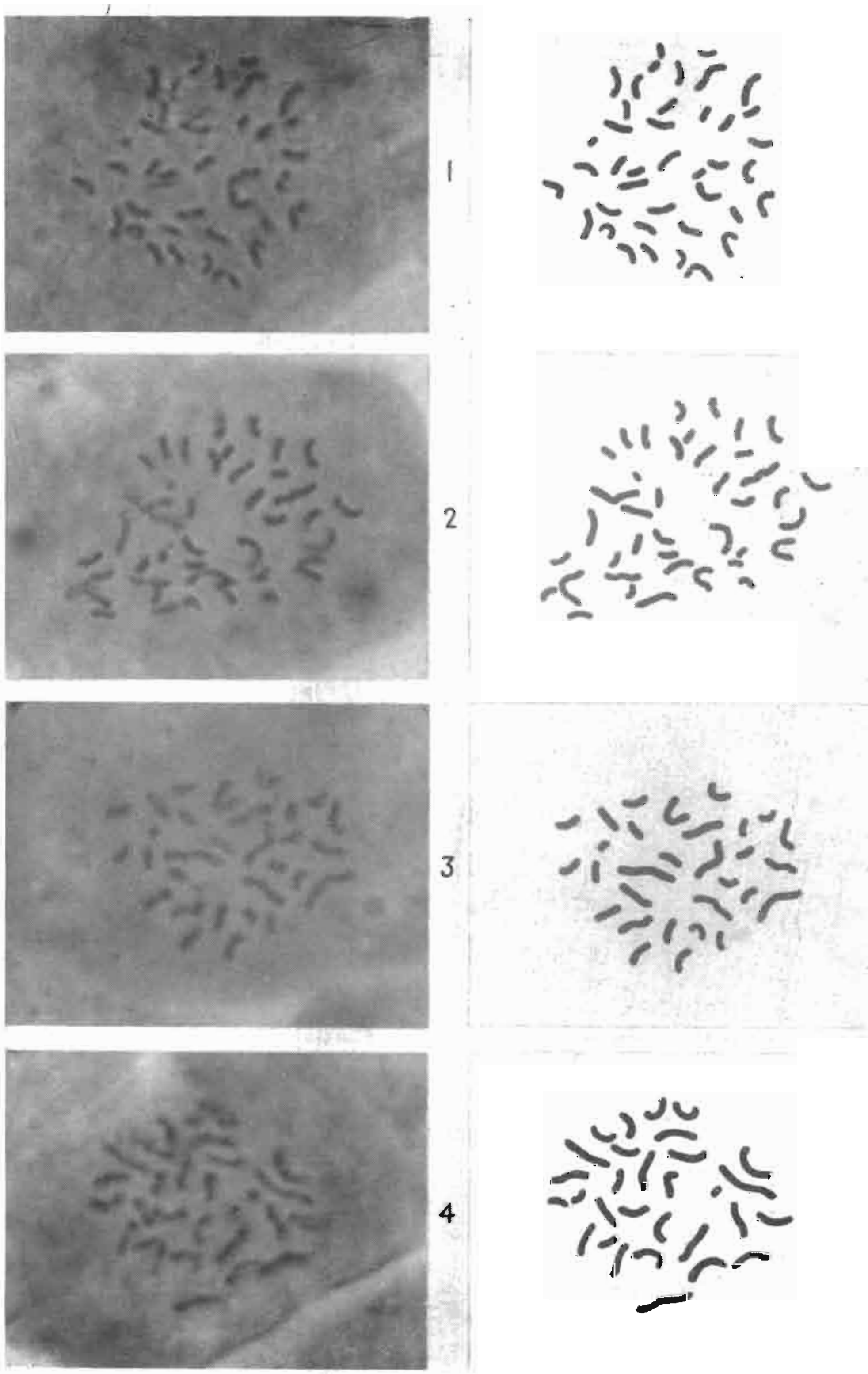

Fig. 29. Photomicrographs and *camera lucida* drawings of somatic chromosomes from root tip smears of probable biotypes of *Cynodon dactylon* (x. 2000).
(1) Réduit 2n=40, (2) Constance 2n=40, (3) Bel Ombre 2n=30, (4) Beau Champ 2n=30.

February - March; April - May; June - July; September - October. The treatments were repeated in any one trial when regrowth exceeded 10 per cent.

The best treatments were mixtures consisting of DCMU or Simazin (20 lbs) plus sodium chlorate (400 lbs). Dowpon used alone at rates of 10, 20, 40 and 80 lbs gave unsatisfactory results even when the treatment was repeated thrice in any one trial at any one season. In general, the May applications proved the best and showed greatest persistence in the soil. Large scale trials with these formulations will be carried out in 1960 in order to determine whether this method should be adopted for the eradication of the grass.

(b) **Herbe Bleue** (*Heliotropium amplexicaule*). Experimental work carried out during the years 1957 - 1959 on the eradication of this weed showed that sodium chlorate at the rate of 100 - 200 lbs in 100 gallons of water could give satisfactory control. It was observed, however, that although established plants could be controlled, this treatment did not check satisfactorily re-infestation from seeds. Since the plant has generally a heavy output of fertile seeds, better methods of control had to be investigated. The experiments carried out this year on this weed are reported below.

The following treatments were applied to 400 sq. ft. plots in a field heavily infested with this plant and two series were laid down, one in February and the other in May. The rates given below are in lbs per arpent.

(i) Simazin (10 and 20 lbs) with Amizol (10 lbs)

(ii) DCMU (10 and 20 lbs) with Amizol (10 lbs)

(iii) Simazin (10 and 20 lbs) with Dowpon (20 lbs)

(iv) DCMU (10 and 20 lbs) with Dowpon (20 lbs)

(v) Simazin (10 and 20 lbs) with Sodium chlorate (200 and 400 lbs)

(vi) DCMU (10 and 20 lbs) with Sodium chlorate (200 and 400 lbs)

The best results were obtained with treatments (ii) to (vi) when mixtures with the higher rates were used. Few established plants survived the treaments by producing new shoots from the basal underground parts of the stems. Re-infestation from seeds, however, was checked satisfactorily. Definite recommendations on the eradication of this weed cannot be made at this stage and further experimental work is needed to determine the most economic and effective method of control.

(c) **Voundre** (*Typha javanica*). At the request of the Entomologist of the Medical and Health Department an experiment was carried out on the eradication of this weed growing along drains in marshy lands. The following treatments were used and the rates applied were in lb per arpent.

(i) Dowpon at 10 and 20 lbs

(ii) U46 special (2,4-D and 2,4,5-T butyl glycol ester) at 2 and 4 lb a.e.

(iii) U46 special at 2 lb a.e. plus Dowpon 5 lbs.

The best treatments were obtained with Dowpon when used alone. The 20 lb treatment was as effective as the 10 lb one. In the other treatments satisfactory control was obtained for about 3 months then the plants regenerated from underground buds.

CULTIVATION, IRRIGATION, CLIMATE

1. FURTHER STUDIES ON THE EFFECT OF RAINFALL ON SUGAR PRODUCTION

P. HALAIS.

THE influence of meteorological factors on local sugar production is being better understood through the use of appropriate simple or multiple regressions worked out for a long series of undisturbed observations, covering 13 years from 1947 to 1959, on each of the five sugar sectors of the island.

Perusal of the annual reports of the Institute since 1954 allows one to follow the progress achieved in this connection. The subject is now sufficiently advanced for certain definite conclusions to be made concerning the two main aspects of sugar production: cane tonnage and cane quality.

Cane tonnage. The sum of monthly rainfall deficits for the growth period is by far the dominant factor involved under Mauritian conditions during cyclone-free years.

An attempt to improve the known relationship was made by using in a multiple regression, the deficits of October, November and December (early growth months) separately from those of the rest of the period from January to June. For the 13 years (1947 to 1959) under consideration, the following equation, as applied to the North sector, is given as an example:

(a) A difference of 3.2 tons of cane in 1955. This can be explained by the fact that rains were only resumed towards the end of February after a comparatively dry December and January, thus accounting for less rainfall deficits than there was really, and

(b) A difference of 3.6 tons of cane in 1958, a result undoubtedly associated with the two mild cyclones which affected that sector during March and April of that year.

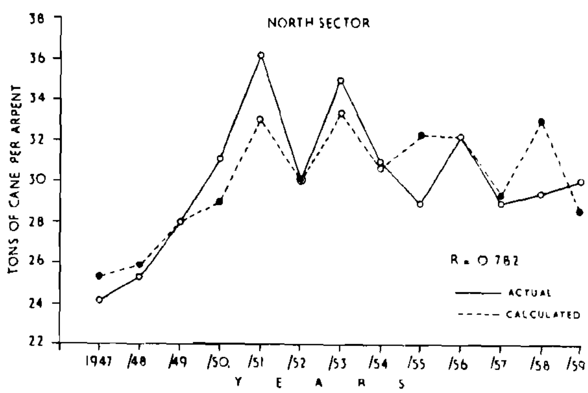

Fig. 30. Relation between sum of monthly rainfall deficits and tons of cane per arpent for estates of north sector.

$$Y = 30.1 - 0.463\ (X_1 - 2.84) - 0.518\ (X_2 - 10.92) \quad R = 0.782$$

where Y corresponds to the tons of cane per arpent for estates

X_1 „ „ sum of monthly rainfall deficits in inches for 3 months, Oct., Nov., & Dec.

X_2 „ „ sum of monthly rainfall deficits in inches for 6 months, Jan., Feb., Mar., Apr., May & June.

The multiple correlation between observed (actual), and calculated tons of cane per arpent works out to $R = 0.782$ which, of course, is highly significant. The two major discrepancies seen in fig. 30 are :

A further conclusion is that for the North sector, which as a whole suffers from lack of moisture, an increase of 7 tons of cane per arpent (25%) is to be expected over present average or normal production if moisture were brought to its optimum level by proper irrigation.

Apart from its use — with the obvious restrictions mentioned above — for the early prediction of the standing crop, the equation can serve a useful purpose for adjusting cane yields to long range normal meteorological conditions. It is now definitely proved that, under local circumstances, averages of cane yields over three years or more, may be quite misleading if meteorological conditions which prevailed are being ignored. Only adjusted figures should therefore be kept for economic planning.

However, the earlier simple regressions published in the 1956 annual report of the Institute featuring November to June rainfall deficits can, taken as a whole, be used quite safely.

Cane quality. The sum of monthly rainfall excesses and mean daily range of temperatures (Max — Min) are the two dominant influences which govern cane ripening during the maturation period. Multiple regressions have been worked out for the three sugar sectors where temperature data are available from 1947 to 1959 through the courtesy of the Government Meteorological Service: the North sector, at Pamplemousses Observatory, the South at Plaisance Air Field and the Centre at Vacoas Observatory.

The observed (actual) and calculated sugar manufactured % cane are shown graphically in figs. 31, 32 and 33.

The accuracy of the relationship is considerable for such a large number of consecutive years (1947 to 1959), especially for the North and South sectors as shown by the high multiple correlations 0.950 and 0.854, respectively.

The marked fluctuations in cane quality are well illustrated in figures 31 - 33, particularly for the northern sector where extremes of 8.9 and 12.8 were recorded in 1953 and 1957, respectively.

Sugar sector	*Multiple regression*	*Multiple Correlation*
North	$Y = 11.20 - 0.219\,(X_1 - 1.29) + 1.013\,(X_2 - 9.23)$	$R = 0.950$
South	$Y = 10.43 - 0.107\,(X_1 - 3.33) + 0.317\,(X_2 - 6.57)$	$R = 0.854$
Centre	$Y = 11.18 - 0.074\,(X_1 - 3.51) + 0.870\,(X_2 - 5.79)$	$R = 0.728$

where Y corresponds to average sugar manufactured % cane up to 15th of August

X_1 „ the sum of monthly rainfall excesses in inches during June and July.

X_2 „ average daily range of temperature °C (Max-Min) during June and July.

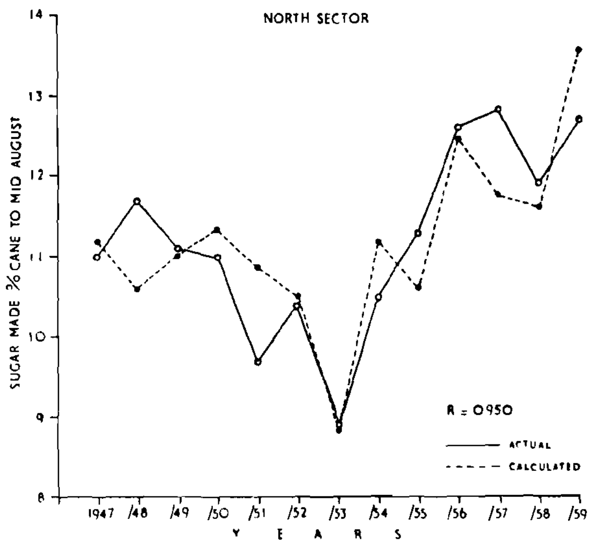

Fig. 31. Influence of sum of monthly rainfall excesses and daily range of temperature on cane quality for north sector.

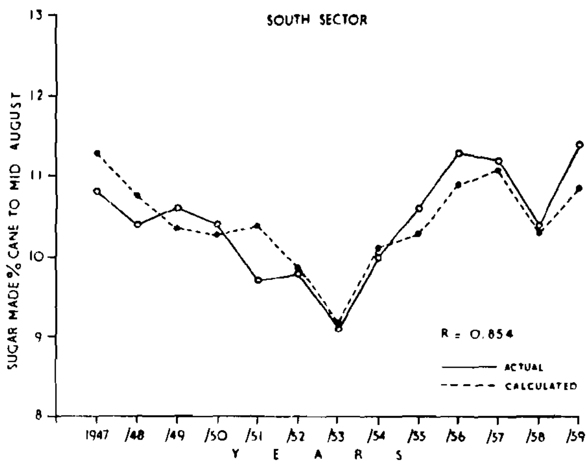

Fig. 32. Influence of sum of monthly rainfall excesses and daily range of temperature on cane quality for south sector.

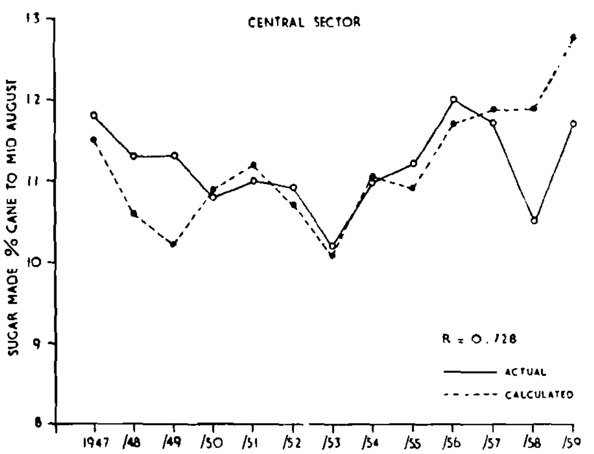

Fig. 33. Influence of sum of monthly rainfall excesses and daily range of temperature on cane quality for central sector.

These variations can all be ascribed to prevailing meteorological conditions.

It follows that, even more than cane tonnage, cane quality has to be adjusted to long range normal meteorological conditions, if averages of three years or even longer are being used for planning or other purposes.

An interesting observation shown on the graph for the South (fig. 32) is that the 1958 cyclones had no influence on cane quality whereas for the Centre, the graph (fig. 33) indicates that the actual Sugar manufactured % cane was about 1.4 lower than expected due to the March and April cyclones.

A further useful application of the multiple regressions for cane quality is to be found as a guide to the early start of the factories by calculating each year the cane quality, (a) at the beginning of July, on the meteorological data for May and June, (b) on the 15th of July and (c) on the 1st of August in a similar manner.

Such calculations will constitute a reliable substitute to early laboratory tests for cane quality made under artificial conditions.

If such an interpretation had been available in 1959, it is quite probable that earlier crushing would have been decided upon by individual factories in several instances.

2. REVIEW OF FIELD EXPERIMENTS IN PROGRESS

GUY ROUILLARD

The object of this account is to give a broad outline of field experiments and other field work in progress at the Institute.

The programme of field work carried out in 1959 included 147 experiments and variety trials (fig. 34) of which 104 were harvested during the crop season. Leaf samples were taken for foliar diagnosis and involved 3643 analyses for nitrogen, 2993 for phosphorus and potassium respectively, while 2703 sugar analyses were made from cane sampled during the crop. Routine selection of varieties was effected and 40,826 seedlings were planted. The number of 1957 seedlings selected and planted for further testing was 506 while 134 varieties were placed in new first selection trials.

Thirty-nine new experiments and variety trials were laid down during the year for the various divisions of the Institute.

Details of the experimental programme may be summarized as follows:

Pre-release variety trials. Twenty eight pre-release trials were reaped in 1959, nine in both the super-humid and humid zones, five in the sub-humid zone and five on irrigated land. The harvesting of thirteen of these trials was staggered over the crop period to evaluate the maturity behaviour of the varieties concerned. Among the best varieties in the pre-release trials were M.202/46 and M.93/48, which have now been released for cultivation, while M.253/48 also shows promise as a variety of commercial value. Other promissing varieties in pre-release trials are M.305/49, M.423/51, M.81/52 and R.397. Eleven new pre-release trials were laid down during the year, six of them in the super-humid zone.

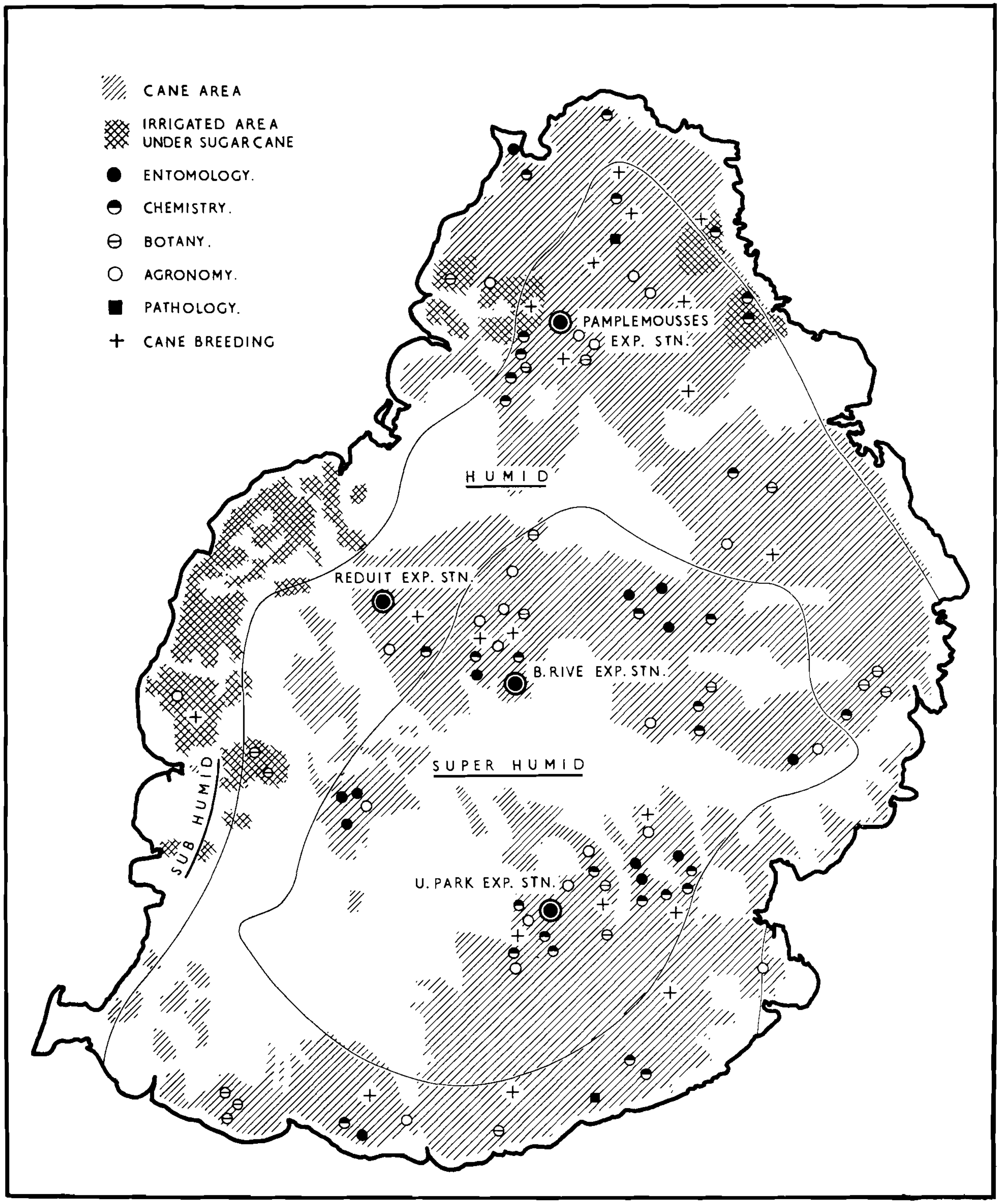

Fig. 34. Location of Field Experiments on Estates.

Ratooning capacity. The results obtained from five variety trials designed to assess ratooning capacity have shown that M.202/46 is a particularly good ratooner. M.93/48 was satisfactory in this respect only in super-humid localities.

Final Variety Trials. Fourteen Final Variety Trials, formerly called « Post-Release Trials», were harvested. Five were located in the superhumid zone, six in the humid zone, one in the subhumid zone and two on irrigated lands. The results show the overwhelming superiority of E.1/37 over all other varieties in localities where rainfall is over 80 inches per annum. The other variety which performed well in such localities was B.3337. In areas receiving less than 80 inches of rain annually M.147/44 was the best variety with regard to yield of sugar per arpent. However, M.147/44 has two defects: poor sucrose content during the second half of the crop period and a clinging trash which adds to the labour of harvesting. B.37172 has shown itself to be a useful cane for late harvesting in areas receiving less than 80 inches of rain annually. In the absence of stalk borer, M.31/45 have given excellent results in the humid zone. The performance of both B.3337 and B.37172 is improved with heavy dressings of nitrogen whereas locally bred varieties have a tendency to lodge and sucrose content is lowered when high doses of nitrogen are applied.

Fertilization. Eight experiments were laid down in 1956 to compare urea with sulphate of ammonia and they have given results which prove the superiority of the latter particularly at the heavier rates of application, split doses have therefore been tried for the higher levels to test if this technique will improve the performance of urea.

Some varieties have responded so well to applications of 60 kg of nitrogen per arpent that the necessity was felt of studying the effect of even higher doses of this nutrient. Four experiments, including treatments of 150 kg. N per arpent, were accordingly laid down this year.

Twenty one trials to compare different forms of phosphate fertilizers were harvested in 1959. Seven of the experiments were laid down at planting and fourteen were made on ratoons. These experiments have shown that guano phosphaté when used in heavy applications at planting is an efficient and cheap phosphatic fertilizer. However, soluble forms have proved to be superior for plant canes and on ratoons that are deficient in phosphate, so these soluble forms of phosphate can play a useful role in our fertilizer programme.

Demonstration plots. Four plots comparing high and low, balanced and unbalanced fertilization were harvested this year and another laid down; one of these experiments, initiated in 1936, is now in the 6th rotation. The experiments serve a useful purpose by illustrating the benefit which may be derived by rational use of mineral fertilizers.

Soil Amendments. To compare farmyard manure, molasses and scums to mineral fertilizers, the permanent experiments on the four stations were burnt and harvested as usual and results were also obtained from six trials in 2nd ratoons located on estates of the superhumid zone. The results, interpreted on an economic basis, are definitely in favour of mineral fertilization.

Three new experiments were laid down to study the fertilizing effect of composted bagasse and factory residues while three other trials were initiated on different soil types to assess the effect of mixing 50 tons of bagasse per arpent thoroughly into the soil.

Two experiments laid down in 1959 showed that better yields can sometimes be obtained by application of calcium to the soil. Large amounts of calcium have been applied in the form of guano phosphate for many decades but the importance of the calcium contained in the fertilizer was never stressed. Soil and plant analyses from the experimental plots will enable the critical limits of this element for cane growth to be assessed.

Two trials with basalt are in progress, one of which was started in 1947. They show that yields are consistently increased following massive application of basaltic dust to the free soils of the super-humid regions. The practicability of applying basaltic dust should be examined in view of the large amounts of the material which will become available as a result of the intensive road and building development works in progress in the island.

Control of Clemora by Insecticides. Fourteen experiments to study the effect of insecticides in the form of Aldrin and Chlordane for the control of Clemora were harvested. Five were laid down at planting, while three were made on young virgin canes and six on ratoons. The results show that although aldrin and chlordane give good grub control when applied at planting, uncertainty as to the effect of the insecticides upon cane growth necessitate more critical tests than have been made hitherto. The use of these insecticides is not recommended on a field scale.

Nematodes. Several preliminary experiments were harvested to test the effect of soil fumigants on nematodes and cane growth. The improved growth of cane following soil fumigation with ethylene dibromide is very striking on sandy calcareous soils, but growth responses have also been obtained on other types of soils.

The Stalk borer. Apart from the active campaign of biological control, the chemical control of borer is being studied.

Weed Control. Five experiments started in 1956 with a view to evaluating the effects of CMU and DCMU on cane growth were completed this year. The herbicides applied at rates varying from 2 - 10 lb per arpent did not affect cane yields but their repeated application during three years greatly reduced the stand of annual weeds and checked to some extent the spread of perennial broad-leaved weeds. Perennial grasses however, were in general not affected at the rates of application used.

During the year four experiments were laid down to assess the effect of repeated applications of Dowpon, CMU, and DCMU and Simazin on cane growth. At this stage no data are available. Three experiments on the control of *Paspalidium geminatum* and *Heliotropium amplexicaule* using a mixture of either sodium chlorate and DCMU or sodium chlorate and Simazin have given encouraging results.

Also laid down in 1959 was a series of ten experiments to study the effects of TCA and Dowpon on growth of «Chiendent» at different periods of the year. The problem is complicated by the fact that different varieties of «chiendent» have been found to exist and that they differ in their degree of resistance to these herbicides.

Ratoon Stunting Disease. Twelve trials were harvested in the different climatic zones to assess the effect of the disease on yield of commercial cane varieties. It appears that all varieties are susceptible to the disease, as plots planted with cuttings free from ratoon stunting disease gave superior results in all cases. One trial to determine the susceptibility of newly released varieties was laid down in the sub-humid zone.

One large trial was laid down to assess the resistance to ratoon stunting disease of 154 varieties ranging from canes formerly cultivated in the island to promissing varieties from selection trials. The object is to try to determine whether resistance is conferred along specific blood lines.

Two trials which include a large number of replications have been laid down to study the effect of long hot water treatment on germination. Planting is to be done at various times of the year.

Chlorotic Streak. Five experiments situated in most varied conditions are under way to assess the effect of environment on chlorotic streak. The disease does not seem to exist in the sub-humid zone except under particular soil conditions.

Gumming disease. Routine testing of 43 promising and imported varieties is in progress.

Leaf Scald. Three experiments to determine the reaction of B.34104 to the disease have proved the resistance of the variety to the local strain of the pathogen.

Irrigation. Sixty five acres of land situated in the sub-humid western part of the island are devoted to an experiment comparing overhead with surface irrigation. The experiment is still at the exploratory stage but it already shows the great economy of water enabled by the overhead system, particularly on gravelly soils.

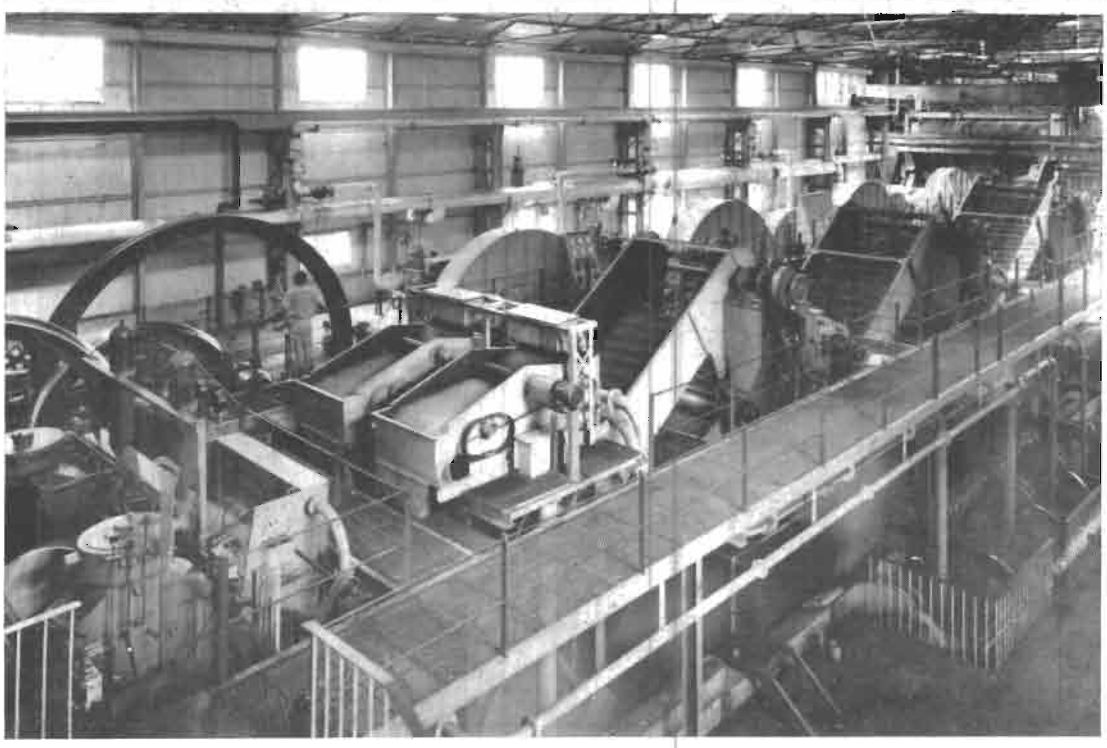

Fig. 35 Above · Pump house of Bel Ombre factory which uses sea water for its condensing plant.
Below . Crushing plant of Riche en Eau factory.

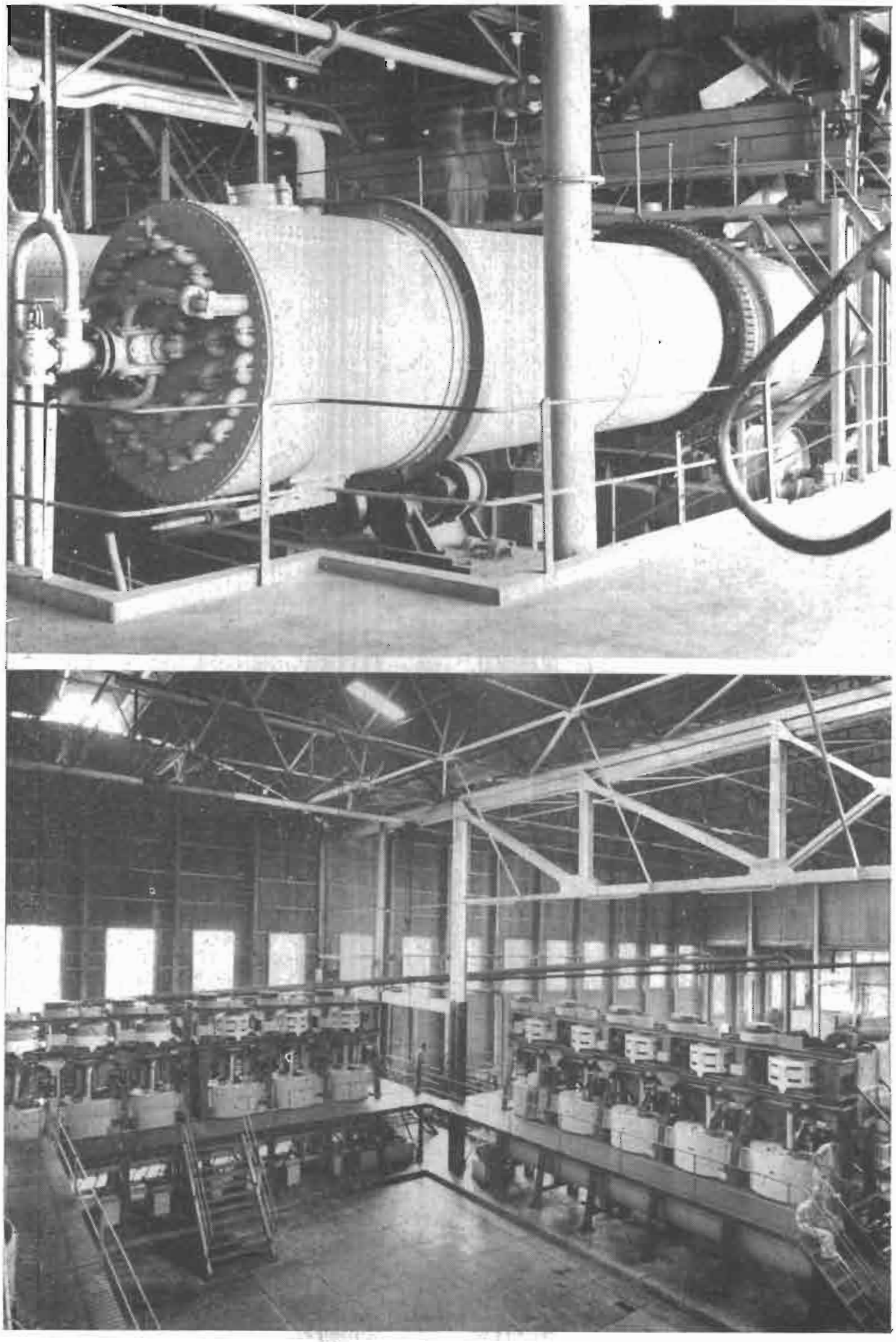

Fig. 36. Above : Lafeuille crystallizer, Mon Désert - Alma factory.
Below : New centrifugal station, Médine factory.

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1959.

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

WITH the closing down of Beau Vallon, only 24 factories were in operation in 1959. A synopsis of the chemical control figures of these factories is given in tables XVII (i) - (v) of the Appendix.

Cane and Sugar production. The crop under review was a record one both for tonnage of cane harvested and amount of sugar manufactured. Table 32 gives the area harvested, cane crushed and sugar production figures for the past four years.

Table 32. Area harvested (thousand arpents) cane crushed and sugar produced (thousand metric tons).

	1956	1957	1958	1959
Area harvested	167.9	169.6	174.0	180.0
Cane crushed	4,421.2	4,343.8	4,329.0	4,743.3
Sugar produced, 98.5 Pol. ...	572.3	561.3	525.6	580.7*

Cane Quality. As mentioned in the introduction to this Annual Report, a severe drought prevailed during the maturing period, rainfall amounting to only 12.7″ for the period April through July, as against a normal figure of 26″. Consequently sucrose per cent cane was about 1.5 units higher than the 1947 - 1958 average when the crop started in early July (Vide fig. 3, page 11). Had the dry season persisted, average sucrose per cent cane would have been much higher than the figure recorded, namely 13.76. This relatively low figure was the result of heavy rain during the grinding season, particularly in October and November. Thus by the 15th of November sucrose per cent cane was about 1.4 units below the average figure for 1947 - 1958.

Table 33 gives sucrose per cent cane for the various sectors of the island during the past four years.

Average fibre per cent cane and mixed juice purity for the same period are given in table 34. As may be seen, fibre per cent cane, which had been steadily increasing during the past few years, dropped slightly in 1959. This decrease is doubtless due to the rainy season which prevailed during the latter part of the crushing period. There is every reason to believe, however, that as a result of the increasing cultivation of high fibre varieties such as B.37172 and, in particular, M.147/44, fibre per cent cane will be appreciably higher in forthcoming years, should less abnormal climatic conditions than in 1959 prevail.

Table 33. Sucrose per cent cane, 1956 - 1959.

	Island	*West*	*North*	*East*	*South*	*Centre*
1956	14.26	15.06	15.19	14.51	14.20	14.35
1957	14.59	14.87	15.53	14.33	14.16	14.33
1958	13.77	13.99	14.53	13.76	13.25	13.62
1959	13.76	14.09	14.67	13.66	13.23	13.66

* Provisional figure.

Table 34. Fibre per cent cane and mixed juice gravity purity, 1956-1959.

	Fibre per cent cane	*Mixed juice Gravity Purity*
1956	11.67	87.5
1957	11.86	87.8
1958	12.21	87.2
1959	11.96	87 3

Average mixed juice purity has been on a par with that recorded in previous years. St. Antoine factory, however, which lies in a low rainfall area, crushed several cane consignments which yielded mixed juice purities as low as 73. As pointed out in the introduction to this report, these low purities resulted from a local outbreak of rind disease following the severe drought which prevailed from April through July.

Milling. A synopsis of crushing data and milling figures for the period 1956 to 1959 is given in table 35.

It is gratifying to note that, in spite of the rainy season which prevailed during the latter part of the crop, the average number of net crushing hours per day has slightly increased from 19.50 in 1958 to 20.32 in 1959. It should however be again stressed that, had the 'cane supply been such that all the factories had been able to crush day-in and day-out, Sundays excepted, the average duration of the crop would have been only 96 days instead of 110, on the assumption that time lost due to mechanical difficulties were to remain the same. As also pointed out in the Annual Report for 1958, that would have meant more sugar in the bags, lower production costs and greater benefit derived from the capital expenditure incurred to increase factory capacity.

In connection with the duration of the crop, it will be observed from the figures given in table 36 that the factories of the south of the island are those that are most handicapped by cane shortage due to insufficient labour for cane harvesting and loading.

Table 35. Milling results, 1956 - 1959.

	1956	**1957**	**1958**	**1959**
No. of factories	26	26	25	24
No. of crushing days	109	105	108	110
No. of net crushing hours/day ...	20.87	20.89	19.50	20.32
Hours of stoppages/day* ...	0.97	0.80	0.89	0.82
Time efficiency	95.6	96.3	95.6	96.1
Tons cane/hour	74.7	76.1	82.5	87.7
Tons fibre/hour	8.72	9.03	10.07	10.49
Imbibition % fibre	222	231	217	230
Sucrose % bagasse	2.63	2.63	2.50	2.32
Moisture % bagasse	47.8	47.5	48.2	48.3
Reduced Mill Extraction ...	95.4	95.3	95.3	95.7
Extraction Ratio	36.8	37.1	38.5	34.1

Table 36. Number of net crushing hours/day, 1956 - 1959.

	Island	*West*	*North*	*East*	*South*	*Centre*
1956	20.87	21.43	22.30	21.83	19.37	21.60
1957	20.87	21.45	22.16	20.76	19.67	21.75
1958	19.50	20.23	21.07	20.20	17.80	21.13
1959	20.27	21.92	21.83	20.51	18.65	21.23

* Exclusive of stoppages due to shortage of cane.

With the closing down of Beau Vallon and the harvesting of a record cane crop, the average tonnage of cane ground per hour has again increased and has reached 87.7 metric tons in 1959. Minimum and maximum hourly rates were 46.2 (St. Félix) and 206.4 (Union Flacq). This latter figure is equivalent to 227.4 short tons of cane per hour. It should be pointed out that Union Flacq has only one tandem of seven mills (one 3 RC 38" x 75", 4 M 34" x 71", 2 M 38" x 71"). That this factory should have crushed such a high tonnage of cane per hour and yet obtained an average reduced mill extraction of 95.8 is quite an achievement.

The average reduced mill extraction of all the factories was 95.7 last crop as against 95.3 in 1958. Eight factories, as against only two in 1958, recorded average figures of 96.0 or more, Mon Loisir again ranking first with 96.6 There has thus been a marked progress in milling efficiency from one year to the next, and it would appear that Mauritius is nowadays one of the leading countries of the world for milling efficiency, as shown in table 37.

days when, following the temperature reduction at the final juice heater practiced in certain factories for about two hours prior to the long week-end shut-down, appreciable amounts of bagacillo were separated.

Screening of clarified juice is an excellent practice which is strongly recommended, even for those factories where clarification usually presents no difficulty, as some bagacillo, even under good operating conditions, is bound to find its way into the clarified juice at some time or other, on Monday mornings for example. Amongst other advantages, elimination of bagacillo will yield sugars of better keeping quality. Vibrating screens, which are not very expensive, would be preferable to stationary screens for this purpose.

Clarification. In spite of the fact that average mixed juice purity was as good in 1959 as in 1958, several factories had to deal with refractory juices, either for a few weeks only, or, as was the case at Mon Désert-Alma, for the major part of the crop. At this factory clarification threatened to become a bottleneck

Table 37. Reduced Mill Extractions of various countries.

Country	Taiwan	Mauritius	Mauritius	Queensland	Jamaica	S. Africa	Trinidad	Hawaii	Java	B. Guiana	Philippines
Crop	**1955-56**	**1956**	**1959**	**1956**	**1956**	**1957**	**1957**	**1956**	**1956**	**1956**	**1955-56**
R.M.E.	96.2	95.4	95.7	95.3	95.0	94.8	94.3	94.1	93.5	93.2	91.9

Juice Straining. The vibrating screens installed at Riche-en-Eau in 1958 having proved a success, several other factories followed suit in 1959. The trend will no doubt persist in 1960 in view of the numerous advantages of vibrating screens over drag-type strainers.

The juices from the clarifiers of two factories were screened over stationary screens during the crop. In one case where clarification was rather poor, large amounts of bagacillo were thus removed daily. In the other case, where clarification was good, only small amounts of bagacillo were removed daily, except on Mon-

and, had the polyelectrolyte separan not been available for increasing the settling rate in the clarifier, processing would have been considerably slowed down, as reported elsewhere in this report*. Clarification difficulties were also encountered at several other factories e.g. Labourdonnais, Mon Loisir, St. Antoine and St. Félix, but did not last more than two to three weeks in each case.

Five other factories have adopted the liming process in which the secondary juice is heated to 80-100°C, mixed with the cold primary juice, weighed, limed and brought to boiling before

* The use of polyelectrolytes in cane juice clarification, p. 85.

being sent to the clarifier. It would appear, however, for reasons explained further in this report*, that heating of secondary juice prior to weighing leads to an inflated sucrose per cent mixed juice and hence sucrose per cent cane figure. Under these circumstances heating of secondary juice prior to weighing cannot be advocated.

The first two Rapi-Dorr clarifiers installed in Mauritius functioned satisfactorily at Constance and Mon Désert factories during the crop.

Filtration. As shown in table 38, filtration results of clarifier muds were just about the same in 1959 as in 1958.

tion of rotary vacuum filters in several other factories, and that should pay dividends next year.

In general, filter operation in Mauritius factories suffers badly from lack of control, with the result that the filtrate sent back to the mixed juice carries a high proportion of minute mud solids into a closed circuit. These mud solids thus tend to build up in the clarifier and may be the cause of clarification difficulties which are wrongly attributed to juice refractoriness. Most of the filter stations suffer from an inadequate supply of bagacillo, and this bagacillo is generally too coarse. Conclusive experiments carried out in Queensland (1954) have shown that for

Table 38. Filtration results, 1956 - 1959.

	1956		1957		1958		1959	
	Filter Presses	Rotary Filters	Filter Presses	Rotary Filters	Filter Presses	Rotary Filters	Filter Presses	Rotary Filters
No. of factories	16	10	15	11	12	13	11	13
Pol. % Cake	7.92	3.30	7.80	2.55	6.99	2.02	7.33	2.13
Av. Pol. % Cake	6.14		5.57		3.48		3.57	
Cake % Cane	2.15		2.12		2.37		2.38	
Pol. in cake % Cane ...	0.13		0.12		0.08		0.08	

It is however interesting to point out that Riche-en-Eau factory has increased the purity of its clear filtrate from 73.0 to 80.0, without any appreciable increase in pol. % cake or cake % cane, through better control of the clarifier and filter operations, special attention being paid to the proportion of bagacillo and mud solids in the feed of the Oliver filter. This improvement has led to an awakening of interest in the operaproper filter operation a factory crushing 100 tons of cane per hour should have a supply of about 450 kgs. of bagacillo per hour, for which 40 sq. ft. of screen area (8 mesh) are necessary — figures much higher than those obtaining in Mauritius.

Evaporation. The first quintuple effect evaporator to operate in recent years in Mauritius functioned this crop at Union Flacq. It was

Table 39. Syrup, massecuites and molasses, 1956 - 1959.

	1956	1957	1958	1959
Syrup purity	87.8	88.2	87.3	87.9
A Massecuite purity	79.6	79.6	81.0	81.7
Purity drop, A Massecuite ...	20.4	20.7	20.8	20.1
,, ,, B ,, ...	20.9	21.1	20.8	21.1
,, ,, C ,, ...	21.6	22.3	22.7	23.6
Brix C Massecuite	99.1	98.9	98.8	100.1
Crystal % Brix in C Massecuite	32.5	33.4	34.1	35.3

* Chemical control notes: heating of secondary juices, p. 93

made by adding a 13,000 sq. ft. first body to the existing 47,000 sq. ft. quadruple effect.

Boiling House Work. There has been no marked differences in purity drops between the figures obtained this crop and those of preceding years, as shown in table 39.

As may be seen above, the difference between syrup and A massecuite purity was very much the same in 1959 as in 1958, indicating the same amount of boiling back. However the purity drop between C Massecuite and final molasses has gradually increased from 21.6 in 1956 to 23.6 in 1959. During the same period the Brix of the C Massecuite has increased from 99.1 to 100.1 and the crystal content per cent Brix from 32.5 to 35.3 indicating that, with the new equipment available, heavier massecuites are boiled.

Inspection of the following figures (table 40) shows that there has been a steady, if unspectacular, improvement in boiling house work over the past four years. In spite of the processing difficulties encountered in several factories due to refractory juices, sucrose lost in final molasses per cent cane dropped by 0.05 from 1958 to 1959. Industrial losses have also dropped slightly during the same period, whilst losses in filter cake were the same. Reduced boiling house recovery increased from 89.3 to 89.6.

ted mostly from the installation of new equipment and from better process control.

The trend towards larger vacuum pans has been confirmed this year, all the pans installed in 1959 being of 40 - 60 ton capacity. Mon Désert Alma factory has departed from the usual Mauritian practice of having a central condenser for all the vacuum pans and has erected a 50-ton calandria pan fitted with a separate barometric condenser and vacuum pump, whilst St. Antoine factory has used a jet condenser with a small pan used for white sugar boiling.

This crop has seen the introduction of the first boiling point elevation instruments for vacuum pan control in Mauritius. Two of these have been placed on pans used for graining at Mon Trésor and Union — St. Aubin, whilst Riche-en-Eau used the instrument to control boiling of the B strike. Mon Trésor has also installed on its graining pan a Kelso feed controller which works on the same principle as the cuitometer.

The improvement of the crystallizer stations of most factories has continued and is bringing dividends as shown by the steady improvement in low grade work discussed above.

Two new centrifugal batteries were installed in 1959. One at Médine for A,B and C massecuites and one at Rose Belle for C massecuites. Final molasses gravity purities at these two factories dropped respectively from 38.3 and 40.4 in 1958 to 34.4 and 36.5 in 1959. Several other factories have also added centrifugal units to existing batteries, and the first Ward-Leonard

Table 40. Final molasses, losses and recovery.

		1956	1957	1958	1959
Final Molasses :	Gravity Purity	37.2	37.7	37.9	36.7
	Red. Sugars % Brix ...	15.8	16.2	15.8	14.6
	Total Sugars % Brix ...	52.9	53.9	63.7	51.3
	Wt. % @ 95° Brix ...	2.62	2.45	2.59	2.53
Sucrose lost in final molasses % cane ...		0.90	0.92	0.93	0.88
Undetermined losses % cane		0.19	0.23	0.17	0.16
Industrial losses % cane		1.24	1.22	1.18	1.13
Reduced Boiling House Recovery		89.0	89.0	89.3	89.6

As a result of increased boiling house recovery and higher milling efficiency, total sucrose losses per cent cane have dropped from 1.81 in 1958 to 1.70 in 1959.

New Boiling House Installations. The higher boiling house recovery recorded in 1959 resuldrive machine to be installed in Mauritius operated successfully on B massecuite at Mon Loisir.

Sugar Drying. During the 1959 crop the Mauritius Sugar Producers' Association requested millers to exercise stricter control on raw sugars with a view to increasing the keeping qualities of the product. To this end Solitude and Bénarès used banks of infra-red lamps over the sugar conveyor. Figures available from the latter factory show that it was thus possible to reduce the moisture content of the sugar from 0.43 to 0.29 per cent. Highlands also succeeded in reducing the moisture content of its sugars from 0.60 to 0.40 per cent. by using superheated instead of saturated steam wash in the centrifugals.

White Sugar Production. Plantation white sugar production has increased from 19,124 in 1958 to 21,196 metric tons in 1959. Prior to 1959 all this sugar was produced by juice sulphitation, but this year Bénarès and Ferney have started syrup sulphitation whilst St. Antoine used phospho-defecation of raw remelt to produce its quota of white sugar.

Electricity from Bagasse. Four factories, St. Antoine, Union-Flacq, Savinia and Médine now have additional turbo-alternators to produce electricity which is sold to the Central Electricity Board. The total elctricity thus sold in 1959 amounted to 8,700,000 KWH.

Steam Accumulators. The first steam accumulators to be used in Mauritius operated this crop at Union-Flacq and it is reported that fluctuations in live and exhaust steam pressures were appreciably reduced.

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2. POWER CONSUMPTION OF CANE KNIVES AND SHREDDERS.

R. de FROBERVILLE & J. D. de R. de SAINT ANTOINE

The objects of the study, the results of which are briefly presented in this paper, were:

(a) To determine the actual HP consumption of cane knives at these factories where the two sets of knives are independently motor driven,

(b) to make recommendations, if any, with a view to deriving greater benefit from the HP available,

(c) to measure the HP consumption of the motor driven shredders installed in 1959 at two factories.

A recording wattmeter coupled to an integrator was used for the tests, each of which lasted about twenty-four hours. The readings of the integrator at the beginning and end of each test enabled the calculation of the average power input. Sections of each chart obtained are presented in the accompanying figures, and show motor power inputs for periods of two to four hours. All the charts relating to cane knives were taken at a chart speed of 60 mm/hour whilst the shredder charts ran at 120 mm/hour, the maximum speed available with the instrument. The horizontal power scale which is given in KW, and in approximate HP for convenience, is constant as the same current transformer was used throughout the tests.

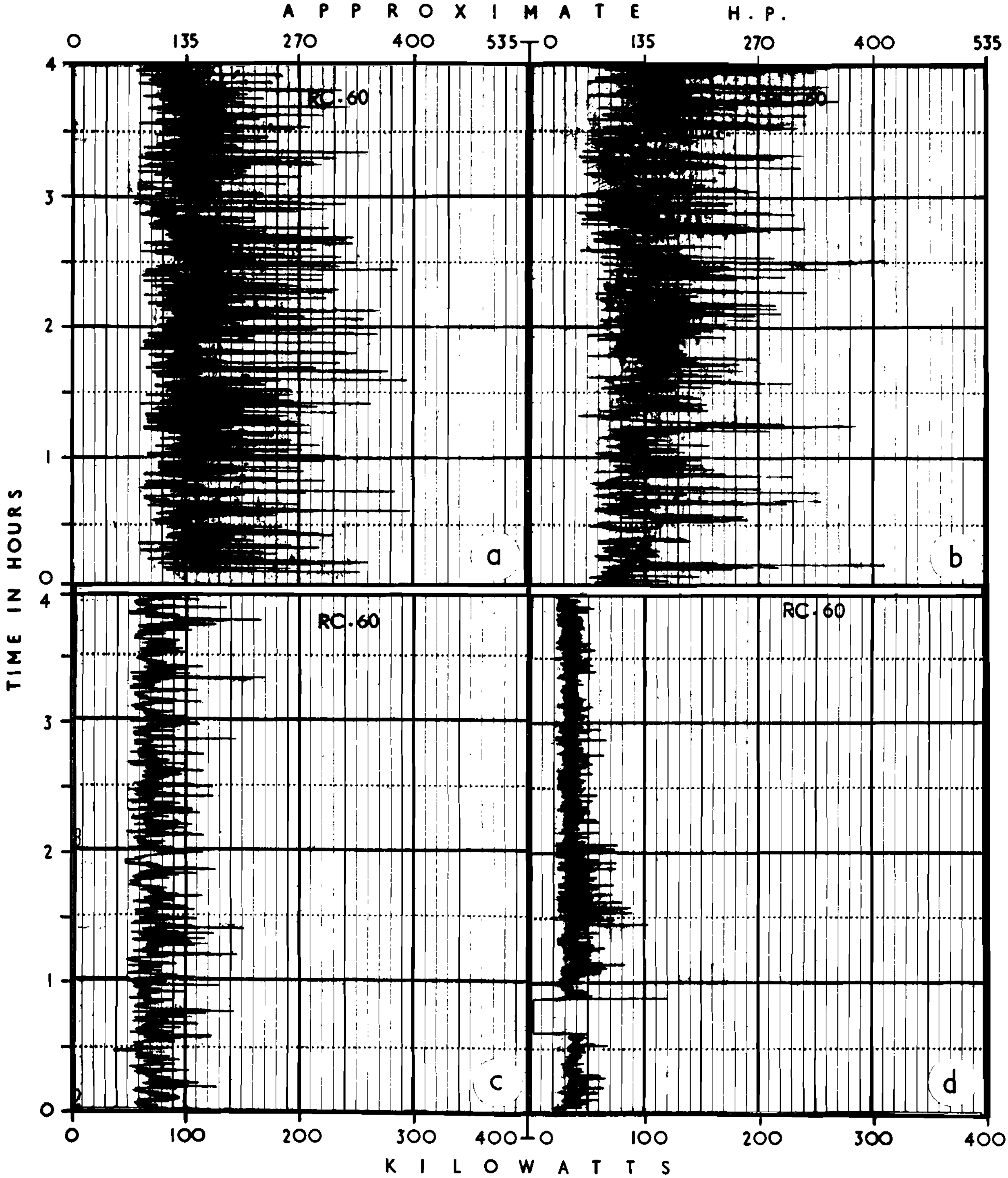

Fig. 37. Fluctuations in Power Consumption of Cane Knives.
(a) Factory A - 1st set, knives at 7" from carrier.
(b) Factory A - 1st set, knives at 9" from carrier.
(c) Factory A - 2nd set, knives at ½" from carrier.
(d) Factory B - knives placed at head of cane carrier.

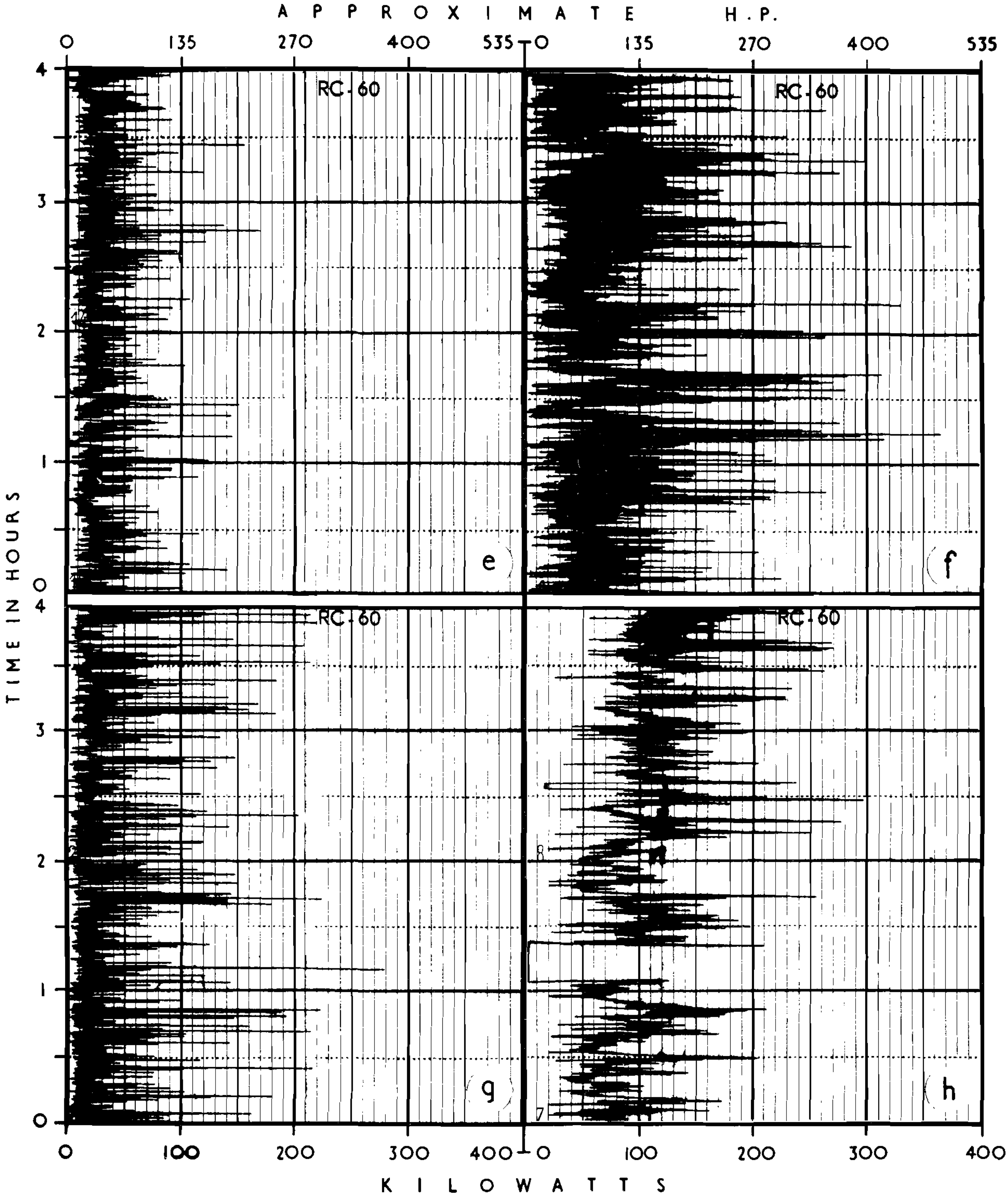

Fig. 38. Fluctuations in Power Consumption of Cane Knives.
(e) Factory C - 1st set, knives at 14" from carrier.
(f) Factory C - 2nd set, knives at 5/8" from carrier.
(g) Factory D - 1st set, knives at 14" from carrier.
(h) Factory D - 2nd set, knives at 1½" from carrier.

Cane Knives. The results obtained with cane knives are given in table 41, whilst corresponding chart sections are shown in fig. 37 and 38.

Table 41. Power consumption of cane knives.

Factory	*A*			*B*	*C*		*D*	
	1*st set*	1*st set*	2*nd set*		1*st set*	2*nd set*	1*st set*	2*nd set*
Rated HP of motor ...	250	250	135	200	125	250	200	300
R.P.M.	730	730	470	585	490	490	585	585
No. of knives	36	36	36	30	32	36	34	34
Knife clearance, ins. ...	7	9	½	8	14	5/8	14	1½
Tons fibre/hour	9.6	9.6	9.5	10.9	12.4	12.3	14.8	14.8
Av. KW consumption ...	120	108	71	54	43	83	33	108
Av. HP consumption ...	161	145	95	72	58	111	44	145
Av. HP consumed/ton fibre/hr	16.8	15.1	10.0	6.6	4.7	9.0	3.0	9.8
Rated HP/ton fibre ...	26.0	26.0	14.2	18.3	10.1	20.2	13.5	20.3

An examination of the above figures and of the corresponding charts indicates the following interesting points:

(a) Rated HP per ton of fibre varies considerably from factory to factory as exemplified by factories C and A which have figures of 10.1 and 26.0 respectively on their first set of knives. This can be understood, to a certain extent at least, since engineers themselves do not agree on the figure. Thus Hugot (1950) recommends 12-15 HP per ton of fibre, whilst Tromp (1946) and the Mirrlees Watson Co. (1957) are in favour of 16-21 HP. Also, an electric motor has less capacity to resist stalling than a reciprocating engine, so that there is often a tendency to use more powerful motors than necessary to overcome peak loads. No great harm ensues so long as the power factor is not appreciably reduced and the generating plant can take care of this extra loading.

(b) Once a motor of a given rated power has been installed, however, the important point is to get the most out of it. A glance at the above results and corresponding charts will show that such is not the case for many of the installations investigated. Thus at factory B only about a third of the rated horsepower is consumed and, as may be seen from fig. 37(d), the power consumption chart is fairly even and shows no prolonged peak loads. It should be pointed out, however, that the knife installation of this factory differs from those of the other factories listed in that the knives are situated at the top end of the cane carrier in such a position that they only cut through when the canes have started tilting over the carrier to fall into the closed chute of the shredder. Under these circumstances, power consumption is bound to be smaller than in standard installations, but nevertheless full advantage is not being derived from the power available.

In the case of the first set of knives of factory D, the position is still worse, actual average consumption being only about 22 per cent of the rated power available. However, a few sustained peak loads do occur and the consumption then rises almost to the rated power of the motor (fig. 38 g) so that it would be difficult to derive fuller benefit from the power available unless cane feeding to the knives was made more regular. Also as a result of this irregular feeding a few severe peaks are registered at the second set of knives (fig. 38 h) whose motor, however, consumes on the average less than 50 per cent of the rated horsepower available.

The situation looks better at factory C, but it would appear that the clearance of the first set of knives could be reduced since the average power consumption is less than half of the rated power and since the chart (fig. 38 e) shows no severe peaks.

The results obtained at factory A are interesting from several aspects. As may be seen from table 41, it was possible at that factory to decrease the clearance of the 1st set of knives from 9" to 7" without increasing much the average horsepower consumption, corresponding figures being 145 and 161 HP. For a motor rated at 250 HP, actual average consumption represents 58.0 and 64.4 per cent of the rated power available, figures higher than those obtaining in all the other cases studied. In spite of these high figures, no sustained peaks are registered, as may be seen from fig. 37 (b) and (a).

It will also be observed that at factory A the second set of knives is driven by a smaller motor (135 HP) than the first (250 HP). The powerful motor of this first set allows a clearance of only 7", so that the canes leaving the first set have already been fairly well prepared and the second set is left with a relatively lighter job. The power available at the second set, whose clearance is only ½ inch, is then profitably made use of, average power consumption per cent rated capacity amounting to 70.4. Further, as may be seen from fig. 37 (c), the power consumption chart is very smooth, only a few instantaneous overloads being recorded every hour.

It would appear that the knife installation of factory A, with the more powerful motor on the 1st set and with the relatively small clearance at this set is to be preferred to the standard installation found in all the other factories of the island, where two sets of knives are used and where the more powerful motor drives the second set. Nowadays, with the use of lateral feed carriers which, in many cases, are fitted with cane levellers, feeding of the main carrier is more regular than it was in the past. This allows for a smaller clearance at the 1st set of knives but also calls for a powerful engine. The feed to the 2nd set is greatly regularised, so that this set can be driven by a less powerful motor and yet work at a clearance of only ½ inch to ensure good preparation.

Shredders. The power consumption figures given in table 42 are those relating to the only two factories of the island with motor driven shredders.

It will be observed from the above figures that the power consumption at both factories is high, averaging 19.0 and 15.1 HP per ton of fibre per hour. Further, as may be seen from fig. 39 (i) and (j) sustained overloads were frequently recorded which often caused the motors to switch off. This applies in particular to factory B, and doubtless results from irregular feeding of the shredder and insufficient preparation of the material fed. Factory B, as explained earlier, has only one set of knives placed at the top end of the carrier.

Table 42. Power consumption of shredders.

Factory	E	B
Make of shredder ...	Cail	Gruendler
Rated HP of motor ...	350	375
RPM	1000	960
No. of hammers ...	81	78
Initial setting, in. ...	½	5/8
Tons fibre/hour	12.4	10.2
Av. Kw. consumption ...	175	115
Av. HP consumption ...	235	154
Av. HP consumed/ton fibre/hr.	19.0	15.1

From unpublished sections of charts it was observed that whereas the motor of factory B consumed about 50 HP when the shredder ran empty, that of factory E consumed about 110 HP under the same circumstances for reasons which have not yet been fully investigated. It should also be pointed out, however, that when the charts were taken at factory E towards the end of the crop the clearance between the hammers and the anvil bar was smaller than that obtaining at the beginning of the crop. This is due to the wear which occured in the bearing surfaces of the free hammers on their supporting shafts.

Finally, it is hoped that this study has shown how useful a recording wattmeter can be around a factory, not only for determining the power consumption of the various motors, but also, in many instances, for deriving greater advantage from the available horsepower.

The authors would like to express their gratitude to Mr. P. Caboche. of Solitude S. E., for kindly placing a recording wattmeter at their disposal as well as for the advice he has given and keen interest he has shown throughout the tests.

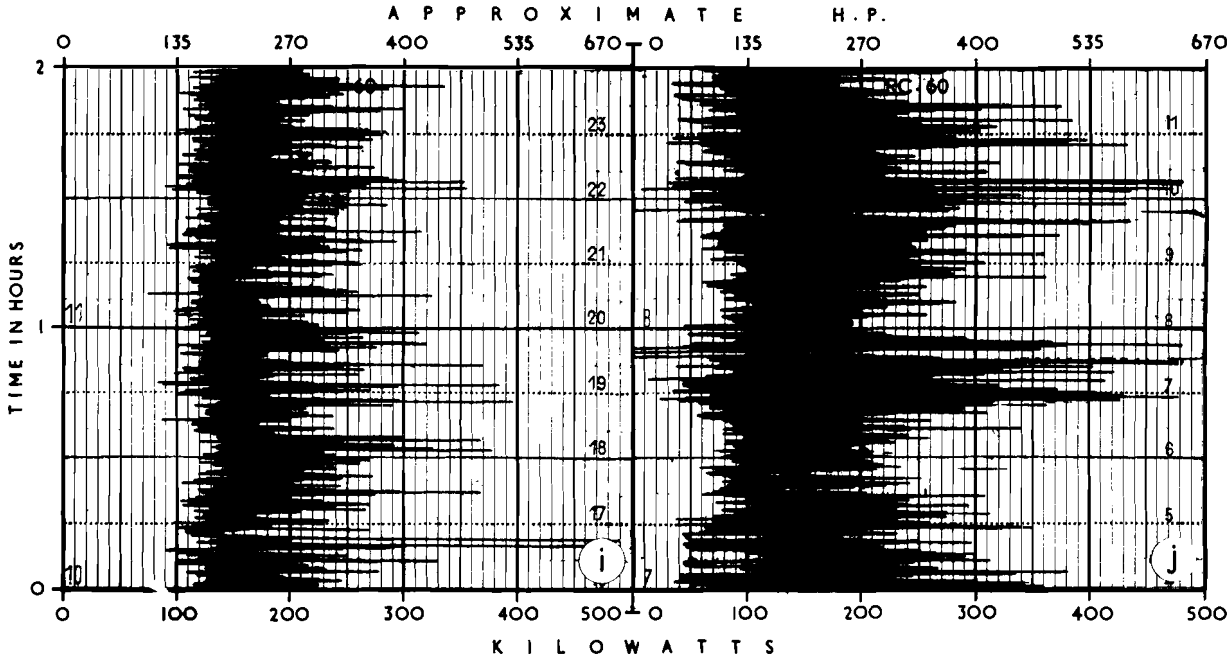

Fig. 39. Fluctuation in Power Consumption of Shredders.
(i) Factory E - Shredder placed after two sets of knives.
(j) Factory B - Shredder placed after one set of knives.

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3. THE USE OF POLYELECTROLYTES IN CANE JUICE CLARIFICATION

E. C. VIGNES & R. de FROBERVILLE

Introduction. In recent years a number of investigations on the effectiveness of synthetic polyelectrolytes for cane juice clarification have been reported. Following the studies of B. Bonneville (1953) with lytron in Louisiana and those of Ching-an-Lee (1953) with krilium in Formosa, polyelectrolytes have been tested by many workers in different parts of the sugar world. In general it has been shown that these flocculating agents promote faster settling of muds and yield clearer juices, the degree of success obtained depending on the characteristics of the juice tested. One interesting feature, derived from these studies, is the extremely low concentrations at which the polyelectrolytes were claimed to be effective.

Moron and Keller (1959) report that laboratory tests of ten flocculants were carried out during the 1957 crushing season in Louisiana, in order to assess their efficacity in juice clarification. As a result of that work separan AP 30 was selected as the most promising clarifying agent and was tested on a plant scale during the 1957 crop. Very favourable claims were then formulated about that compound. Amongst other things, it was found that at the rate of only 1.25 p.p.m., separan caused settling rates to increase by 250 per cent, muds to be more compact and sucrose in filter cake to be substantially reduced.

In this country, krilium and lytron have been used in some factories to meet clarification difficulties during the past few years. However, experiments carried out by the Sugar Technology division of this Institute (1958) showed that the addition of krilium at the rate of only 1-2 p.p.m. on mixed juice did not prove beneficial in 1958 in the 3 factories where tests were made.

Both krilium and lytron are anionic polymers which bear the same negative charge as most of the particles found in cane juice. Hence, as pointed out by Payne (1956) it would be expected that cationic polymers would be more effective in the clarification of juices — a claim which was substantiated by laboratory testing in Hawaii.

In spite of enquiries made locally, it was not possible to obtain any cationic polymer for testing during the crop. However, the local representatives of the Dow Chemical Company kindly placed at the disposal of this Institute the required quantity of the non-ionic polymer separan AP 30 for plant scale testing in two factories during the 1959 crop.

Unfortunately, the polyelectrolyte was not available as from the beginning of the crop so that it was not possible to test it at St. Antoine factory which lies in a dry region and where serious clarification difficulties were encountered early during the crop. The two factories finally chosen for the tests were Mon Desert-Alma and Riche en Eau, both situated in a high rainfall area. The former factory is equipped with only one Rapi-Dorr clarifier of 150 tons capacity and had to deal with refractory juices. Riche en Eau factory has two Bach clarifiers, and juice quality was normal during the crop.

Procedure. Separan was added at the flash tank to the hot limed juice in very dilute solution (0.025%). All tests were carried out in exactly the same way in both factories. At Mon Desert-Alma, owing to the low mineral P_2O_5 content of the raw juice, a little phosphoric acid is added to bring the level of P_2O_5 in the mixed juice to about 125 p.p.m. During the 1959 season the quality of the juice was very poor at that factory and after many expedients had been tried out without success, separan was added at the rate of 1.5 p.p.m. for the remainder of the crop to promote clarification and speed up processing.

At Riche en Eau, it is not the practice to add either phosphoric acid or any polyelectrolyte to the mixed juice. Both factories employ the same liming process: the secondary juice is heated to 80-100°C, mixed with the primary juice, limed to pH 8.0 — 8.4; the mixed juice is then brought to boiling and sent to the clarifiers.

For all the tests, the following information was collected at hourly intervals: refractometric brix on mixed and clarified juices, pH of clarified juice, settling time, i.e. the number of minutes taken for 500 mls of limed juice to deposit a given volume of mud, mud volume per cent after 20 minutes settling and turbidity by means of a Hellige turbidimeter. The average mineral P_2O_5 content of mixed juice, pH of limed juice and pol. per cent filter cake were also determined daily, and the average flow of mixed juice/hour was noted.

Results. Two series of comparisons were made at Riche en Eau. During the first, the polyelectrolyte was added at the rate of 2.5 p.p.m on mixed juice to clarifier No. 1, no addition being made to clarifier No. 2. For the first half of the second series the polyelectrolyte was added to clarifier No. 1 at the rate of 1.25 p.p.m., addition being switched to clarifier No. 2 during the second half.

Since at Mon Desert-Alma there is only one clarifier, the polyelectrolyte was added on alternate days, as far as possible, care being taken to stop the addition several hours prior to gathering data on untreated juices. Two series of comparisons were also made at that factory, both with 1.5 p.p.m. of separan, one with heating of the secondary juice and the other with cold liming.

The results obtained at the two factories are given in tables 43 to 49.

Discussion. A study of the results reveals several interesting features, the most outstanding of which is the considerable increase in settling rate resulting from the use of separan, especially at Mon Desert-Alma where the polyelectrolyte caused an increase in settling rate of about 600 per cent. At Riche en Eau, the percentage increase was much smaller — namely 144 per cent with 2.5 p.p.m. separan and 115 — 120 per cent with 1.25 p.p.m. — but it must be pointed out that the juices of Riche en Eau actually presented no serious clarification problem whereas those of Mon Desert-Alma were very refractory. There is no doubt that processing would have slowed down considerably at Mon Desert-Alma if separan had not been available to

Table 43. Riche en Eau — Clarification with 2.5 p.p.m. Separan

	Mixed juice			Clarified juice with Separan					Clarified juice without Separan					Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH
23/9	99.1	88.1	150	7.4	88.0	323	17.5	22.4	7.4	88.5	395	20.4	25.8	8.2
24/9	98.8	86.2	160	7.4	87.8	347	17.0	16.4	7.5	87.1	438	19.4	42.0	8.3
25/9	99.9	89.0	164	7.5	88.8	315	17.0	16.4	7.5	88.9	388	20.0	31.3	7.8
28/9	97.9	86.9	140	6.7	85.2	268	20.2	31.3	6.7	85.0	394	21.8	42.1	7.7
29/9	97.5	87.3	148	7.0	88.3	263	22.6	57.0	6.9	88.6	190	23.6	66.0	7.9
Average	98.6	87.5	152	7.2	87.6	303	18.9	28.7	7.2	87.6	361	21.0	41.4	8.0

Table 44. Riche en Eau — Clarification with 1.25 p.p.m. Separan (added to clarifier No. 1)

	Mixed juice			Clarified juice with Separan					Clarified juice without Separan					Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH
27/10	92.5	86.5	128	6.7	87.2	162	26.0	14.3	6.7	87.4	162	27.0	16.0	8.2
28/10	89.1	88.5	130	6.7	89.7	200	33.6	13.5	6.7	88.5	555	32.2	19.2	8.3
29/10	88.6	88.5	120	7.3	90.6	173	22.0	16.8	7.3	90.0	240	22.7	17.4	8.5
3/11	91.1	86.8	170	7.5	89.4	206	22.4	6.0	7.5	90.0	210	23.6	7.4	8.5
Average	90.3	87.6	137	7.0	89.2	185	26.0	12.6	7.0	89.0	292	26.4	15.0	8.4

Table 45. Riche en Eau — Clarification with 1.25 p.p.m. (added to clarifier No. 2)

	Mixed juice			Clarified juice with Separan					Clarified juice without Separan					Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	pH
4/11	94.6	87.1	150	7.3	87.9	233	21.6	7.0	7.3	89.2	237	24.8	10.5	8.4
5/11	92.8	88.4	148	7.3	90.5	243	17.5	7.6	7.3	90.4	263	18.2	9.3	8.4
6/11	90.2	88.5	150	7.3	91.1	263	13.7	5.7	7.1	91.7	292	16.0	11.1	8.4
9/11	95.0	87.7	146	7.1	90.0	227	19.7	4.9	7.1	90.3	227	20.2	7.1	8.4
Average	93.1	87.9	148	7.2	89.8	241	18.1	6.3	7.2	90.4	255	19.8	9.5	8.4

Table 46. Mon Desert-Alma — Clarification with heating of secondary juice and addition of 1.5 p.p.m. Separan.

	Mixed juice			Clarified juice with Separan					Muds	Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	Pol. %	pH
7/10	139.8	89.8	133	6.8	90.4	555	12.2	2.5	1.9	8.2
8/10	139.7	88.7	126	6.9	90.9	502	12.6	2.9	2.5	8.3
12/10	125.4	89.6	126	6.9	90.0	494	11.8	2.6	2.5	8.2
15/10	115.2	89.9	112	6.8	91.0	501	11.4	1.2	1.1	8.2
Average	130.0	89.5	124	6.8	90.6	513	12.0	2.3	2.0	8.2

† *Mud volume per cent after 20 mins settling time.*
* *No. of minutes taken by 500 mls of juice to deposit 150 mls mud.*

Table 47. Mon Desert-Alma — Clarification with heating of secondary juice and no addition of Separan.

	Mixed juice			Clarified juice without Separan					Muds	Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	Pol. %	pH
9/10	141.9	85.9	119	6.9	90.0	485	16.8	16.6	2.1	8.4
13/10	142.0	90.0	133	6.9	91.8	493	14.4	17.6	2.7	8.2
14/10	118.1	89.1	133	6.8	91.0	444	16.0	12.8	1.9	8.2
22/10	134.6	90.0	143	6.8	91.6	508	15.0	12.0	2.5	8.0
Average	134.1	88.7	132	6.8	91.1	482	15.5	14.7	2.3	8.1

Table 48. Mon Desert-Alma — Clarification without heating of secondary juice and addition of 1.5 p.p.m. Separan.

	Mixed juice			Clarified juice with Separan					Muds	Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	Pol. %	pH
19/10	142.2	90.8	103	7.3	90.6	512	10.6	2.3	2.3	8.3
21/10	137.0	89.8	—	6.9	91.2	500	11.0	3.2	2.1	8.2
Avearge	139.6	90.3	103	7.1	90.9	506	10.8	2.8	2.2	8.2

Table 49. Mon Désert-Alma — Clarification without heating of secondary juice and no addition of Separan.

	Mixed juice			Clarified juice without Separan					Muds	Limed juice
Date	Tons per hour	Purity	P_2O_5 mg/litre	pH	Purity	Turbidity	Mud† Vol. %	Settling Time*	Pol. %	pH
20/10	144.3	90.6	103	7.0	89.9	507	10.7	13.0	2.9	8.2
23/10	131.7	89.7	143	6.7	92.0	542	13.2	17.1	2.3	8.4
Average	138.0	90.1	123	6.8	90.9	524	11.9	15.0	2.6	8.3

† *Mud volume per cent after 20 mins.*
* *No. of minutes taken by 500 mls of juice to deposit 75 mls mud.*

speed up settling rate.

Another advantage resulting from the use of separan is the increased mud density. This was noticed by measuring the mud volume per cent juice after a given settling time. As may be seen from the tables, the mud volume per cent was always smaller with separan, indicating a higher mud density. This was also revealed by visual examination of the flocs which were larger with the polyelectrolyte.

As may be seen from the results of Mon Desert-Alma, pol. per cent muds was smaller by about 15 per cent when separan was used, probably as a result of the higher mud density obtained with the polyelectrolyte. No comparative figures could be obtained at Riche en Eau where the muds from both clarifiers were treated simultaneously in the Oliver filter.

In spite of the considerably higher settling rate resulting from the use of separan at Mon Desert-Alma, the chemical did not affect the turbidity of the clarified juice to any significant degree. It must be pointed out, however, that the separan-clarified juice was still so turbid that turbidity measurement was difficult and probably not very accurate. At Riche en Eau, on the other hand, the clarity of both treated and untreated juices was usually very good. Turbidity measurements were consequently easier at that factory, where the untreated juices showed, on the average, slightly more turbidity than the treated ones. It should be pointed out, however, that Riche en Eau was processing only about 95 tons of juice/hour for a total clarifier capacity of 150 tons. Hence settling time in the clarifier was not a limiting factor.

Conclusion. It is difficult to draw definite conclusions from results of tests carried out in a particular year in only two factories, both of which unfortunately lie in the high rainfall area of the island. But in view of the excellent results obtained at Mon Desert-Alma, it can be said with confidence that under certain circumstances, separan AP 30 can be of considerable help to solve clarification difficulties resulting from the processing of refractory juices such as were encountered at Mon Desert-Alma during the 1959 crop. The polyelectrolyte should be of particular value for factories in which clarifier capacity becomes the limiting factor whenever juices of a refractory nature have to be processed.

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4. THE WASHING OF COMMERCIAL SUGAR IN CENTRIFUGALS

J. P. LAMUSSE & M. RANDABEL

The problem of sugar washing in centrifugals in Mauritius is complicated by the fact that most factories do not have sugar driers. The washing process must therefore be such that it will not only yield a sugar of the right polarisation with minimum purity of runnings but also that the moisture content of the sugar will be acceptable.

The general practice is to wash with saturated steam or with both saturated steam and hot water. A few factories however have tried superheated steam while several factories have been using superheated water. A series of experiments was therefore started to find out which system is best suited to our conditions.

Procedure. All the experiments were carried out with industrial centrifugals in factories. It was therefore impossible to control all variables and a large number of tests had to be done to obtain average results. Moreover, because of limitations to the modifications which could be brought to the factory installations, only two series of comparisons were completed.

(a) Use of saturated steam compared with that of superheated water, and

(b) Time of application of superheated water wash.

(a) **Satured steam v/s superheated water.**

This experiment was carried out on a battery of three Broadbent 42 x 24, 1,500 RPM semi-automatic electric centrifugals working on B massecuite. The experiment was originally planned as a comparison of superheated steam (piped directly from the boilers) and superheated water produced in a special heater. It was found, however, that in spite of the pipe lagging and the bleeding of condensate, the steam reaching the centrifugals was saturated or very slightly superheated (Average 8°F. superheat).

Each run in this experiment consisted of five complete cycles. Steam was applied in one of the centrifugals and superheated water in another. Both centrifugals were identical, had the same type of linings and the same cycle controlled automatically. Runnings from both fugals was sampled continuously throughout the run while a sample of sugar was taken at the end of each cycle by boring through the sugar layer in the basket with a 1½" borer. Care was taken to take the sugar sample at about the same height in the basket every time to eliminate errors due to unevenness in washing. The sugar was immediately placed in a tightly covered metal container. After mixing, the sugar was analysed for polarisation and moisture content and the runnings for apparent purity. The amount of wash water and steam was varied in each run in order to obtain sugar polarisations ranging from 96 to 99. In all cases both the water and the steam were applied at the start of the high speed cycle. In order to eliminate any influence due to a particular machine, the centrifuge in which steam washing was used in one run received superheated water wash in the next run.

(b) **Time of application of superheated water wash.**

These tests were carried out on a battery of 6 semi-automatic 48 x 24, 1,000 RPM Broadbent electric centrifugals working on A massecuite. These centrifugals were fitted with superheated water only for washing. The procedure followed was exactly the same as for experiment (a), with 5 complete cycles to make a run. Throughout the experiment the amount of water used for washing was kept constant (10 secs). In each run one of the centrifugals was set with washing during the first 10 seconds of the spin at high speed while the moment at which washing was started varied in the other centrifugal.

Discussion. Examination of the results tabulated (table 50) shows that for a given polarisation both washing by means of saturated steam and using superheated water yield a sugar of the same moisture content (0.65 and 0.66 respectively) and runnings of about the same purity. For a sugar polarisation of 97.86 the apparent purity of the B molasses was 50.2 when superheated water was used for washing and 49.5 when steam was used. This slight difference in favour of steam cannot be considered to be significant.

These results might be taken to indicate that there is a slight advantage in favour of saturated steam, but in practice the use of superheated water is preferred for the following reasons:

(1) Steam has a tendency to wash the surface of the sugar layer and does not seem to penetrate the layer as evenly as superheated water. This results not only in uneven washing of the sugar in depth but also in caking of the surface of the sugar. Under the conditions of the experiments, to obtain a B sugar polarising about 98.5, over 20 seconds of steam injection was necessary. It was found that washing with steam for more than 18 seconds resulted in caking to such an extent that the plough could not penetrate the sugar layer without manual assistance. The time lost in ploughing reduced appreciably the capacity of the centrifugals. Moreover, the sugar discharged from the centrifugals contained an excessive proportion of large lumps.

Experiment (a)

Details of cycle timer for all runs

Low speed to medium speed	15 secs
Medium „ „ high „	30 „
High „	100 „
High „ „ medium „	15 „
Medium „ „ low „	15 „
Mechanical braking	5 „

Table 50. Washing with superheated water compared with satured steam on B massecuite.

Run No.	Temp. of Mcuite °C	Water: Time of Application Secs.†	Water: Purity Runnings	Water: Sugar Pol.	Water: Moisture % Sugar	Steam: Time of Application Secs.*	Steam: Purity Runnings	Steam: Sugar Pol.	Steam: Moisture % Sugar
1	58	5	50.3	98.80	0.20	15	48.4	98.05	0.36
2	58	7	50.8	98.86	0.27	20	48.2	98.00	0.48
3	60	8	54.2	99.05	0.22	19	51.7	98.58	0.29
4	60	6	52.1	99.04	0.26	16	51.3	98.34	0.38
5	—	10	53.5	99.16	0.37	16	52.2	98.65	0.42
6	56	6	57.1	98.65	0.49	24	55.4	98.95	0.25
7	42	2	49.3	97.40	0.78	25	49.7	98.00	0.78
8	42	1	49.2	97.40	0.88	30	50.1	98.49	0.51
9	50	1	49.7	97.23	0.81	15	49.0	97.15	0.86
10	50	2	48.6	97.41	0.77	18	47.0	96.62	1.06
11	55	1	45.1	95.39	1.25	30	46.1	96.38	1.23
12	55	1	44.9	95.18	1.46	30	46.2	96.68	1.00
13	56	7	47.9	98.06	0.76	20	48.2	98.17	0.68
14	56	7	49.6	98.46	0.66	20	49.0	97.97	0.75
Av.	54	5	50.2	97.86	0.66	21	49.5	97.86	0.65

† Average pressure of water: 95 psig.
" temperature of " : 142° C.
@ 80 psig, Vol. of water delivered = 1 litre/sec.
* Average Steam pressure: 139 psig.
„ „ temp. : 178°C. (352°F.)

(2) With B massecuite, even with long periods of washing with steam, it is impossible to obtain the required polarisation if the massecuite is viscous or of poor quality. Thus in runs 11 and 12 a washing time of 30 seconds yielded sugars of only 96.38 and 96.68 pol.

As mentioned earlier, it was impossible to obtain superheated steam at the centrifugals for comparison with superheated water. If superheated steam is to be used at the centrifugals, a large diameter pipe, well lagged and provided with steam traps should be used to bring the steam from the boilers. Moreover, it is essential to have a thermometer and pressure gauge on the steam line at the centrifugals to be able to check the quality of the steam.

In part (b) of the experiment examination of the results (table 51) shows that there is no difference in polarisation when the same amount of wash water is applied during the first 10 seconds of the spin at high speed or when it is applied from the 10th to the 20th second. The

Experiment (b)

Details of cycle timer for all runs

Low speed to medium speed	15 secs.
Medium " " high "	15 "
High "	120 "
High " " medium "	30 "
Medium " " low "	30 "
Mechanical braking	5 "

Table 51. Effect of varying moment of application of superheated water wash on sugar quality and molasses purity.

	0 - 10 secs.			10 - 20 secs.					
	A	B	C	D	E	F			
Run No.	*Pol. Sugar*	*Moisture %*	*Purity Runnings*	*Pol. Sugar*	*Moisture %*	*Purity Runnings*	*D—A*	*E—B*	*F—C*
1	98.39	0.71	57.1	99.08	0.54	59.3	+0.69	—0.17	+2.1
2	98.88	0.58	59.5	98.18	0.53	60.6	—0.70	—0.05	+1.1
3	98.99	0.47	58.7	99.20	0.53	59.5	+0.21	+0.06	+0.8
4	99.08	0.36	56.7	98.89	0.65	60.6	—0.19	+0.29	+3.9
Av.	98.84	0.53	58.0	98.84	0.56	60.0	+0.01	+0.03	+2.0
	0 - 10 secs.			20 - 30 secs.					
1	98.29	0.64	57.3	98.89	0.58	58.2	+0.60	—0.06	+0.9
2	98.70	0.54	60.2	99.08	0.46	60.4	+0.38	—0.08	+0.2
3	98.98	0.44	60.1	99.17	0.37	58.6	+0.19	—0.07	—1.5
4	99.18	0.30	61.3	99.18	0.34	60.4	+0.00	+0.04	—0.09
5	99.18	0.26	61.1	99.38	0.27	62.7	+0.20	+0.01	+1.6
6	99.18	0.26	61.0	99.17	0.28	60.0	—0.01	+0.02	—1.0
Av.	98.92	0.41	60.2	99.15	0.38	60.1	+0.23	—0.03	—0.1
	0 - 10 secs.			30 - 40 secs.					
1	98.98	0.53	59.5	99.26	0.39	61.8	+0.28	—0.14	+2.3
2	98.52	0.47	59.2	99.26	0.48	57.9	+0.74	+0.01	—1.3
3	98.57	0.47	56.4	98.98	0.43	61.8	+0.41	—0.04	+5.4
4	98.78	0.48	55.5	99.18	0.48	58.9	+0.40	0.00	+3.4
5	98.51	0.59	57.0	99.10	0.42	56.8	+0.59	—0.17	—0.2
6	97.81	0.74	57.5	99.11	0.42	57.0	+1.30	—0.32	—0.5
7	98.30	0.57	60.8	99.10	0.50	59.2	+0.80	—0.07	—1.6
8	98.81	0.50	59.2	99.21	0.42	59.1	+0.40	—0.08	—0.1
Av.	98.54	0.54	58.1	99.15	0.44	59.1	+0.61	—0.10	+1.0

sugar polarisation however increases when the wash is applied later in the cycle, the difference in polarisation being +0.23 when wash is applied from the 20th to the 30th second and +0.61 when it is applied from the 30th to the 40th second. There is no appreciable difference in the moisture content of the sugar and the purity of the runnings are erratic and do not follow any particular trend.

These results may open interesting possibilities when B massecuite is centrifuged in automatic machines. The wash can be applied late in the cycle when the greater part of the runnings has already been removed and as soon as the wash is applied a flap in the discharge gutter can be automatically operated to separate the higher purity runnings obtained during washing from the low purity product obtained at the beginning of the cycle.

Conclusion. For the same sugar polarisation, washing with saturated steam or superheated water yields sugars of the same moisture content and runnings of about the same purity. Superheated water is preferred as more even washing is obtained and no caking of the sugar results.

It appears that when superheated water is used, the later the wash is applied in the cycle, the higher the sugar polarisation. The moisture content of the sugar does not seem to be affected by the moment at which the wash is applied.

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5. CHEMICAL CONTROL NOTES

J. D. de R. de SAINT ANTOINE

(a) **The application of a «dirt» correction factor to the weight of mixed juice.**

During the past few years the author had observed that certain factories, in spite of a strict chemical control, reported undetermined losses which seemed to be abnormally high. After scrutinizing all the causes that could lead to these high losses, it was felt that they probably resulted from an inflated weight of mixed juice due to the presence therein of a significant amount of «dirt». «Dirt» is the name commonly given to insoluble impurities such as soil and bagacillo which are invariably present in mixed juice.

The basic equation of mill control: cane + imbibition water = mixed juice + bagasse, becomes unreliable as soon as the mixed juice contains a significant amount of «dirt».

It was therefore decided to determine the percentage of dirt in the mixed juices of a number of factories during the 1959 crop. The analytical procedure adopted was as follows: a filter paper whose dry weight is known is placed in a large Buchner funnel connected to a filtering flask. The paper must be larger than the funnel by about one inch so that it may have a rim about half an inch high. The paper is humidified with a few drops of water. Ten grams of dry filter aid, Dicalite Speed Plus, are mixed with water and poured over the paper. The vacuum is connected, excess water removed and a cake of filter aid left over the paper. One kilo of mixed juice to which 40 grams of filter aid have been added are then well stirred and gently poured over the cake. Filtration is carried out at 20″ vacuum. After all the juice has filtered off, the cake is thoroughly washed with about 1000 mls. of distilled water. The filter paper and its contents are then removed, dried in an oven at 100 - 105°C for 3 hours, allowed to cool in a dessicator and weighed.

A number of «dirt» determinations were thus carried out during the crop, and the following results were obtained.

strainers of 196 openings per sq.in. have not been replaced by finer screens. Thus when two sets of knives and a shredder were used for the first time in 1958 at Mon Loisir factory, so much bagacillo was present in the mixed juice that none had to be added to the clarifier muds for filtration by the rotary vacuum filter.

It would thus appear that under present day

Table 52. «Dirt» per cent mixed juice.

								Average
Bel Ombre ...	.770	.320	.295	.275	.245	—	—	.381
Labourdonnais ...	1.474	.730	.615	.415	.495	.495	—	.704
Mon Désert ...	.590	.472	.460	—	—	—	—	.507
Mon Loisir ...	.460	.610	.472	—	—	—	—	.514
Réunion ...	.510	1.045	.975	.482	.235	.725	.445	.631
Solitude ...	.378	.888	.540	.405	.360	.580	.500	.522
St. Antoine ...	.456	.742	.668	.770	.536	.395	—	.595
St. Félix ...	.325	.568	.465	.460	.465	.390	.280	.422
					General Average			.535

As may be seen above, the mixed juices analysed contained, on the average, about one-half per cent of extraneous matter. It must be pointed out, however, that the majority of analyses were made during a spell of dry weather and that, on rainy days, a higher proportion of dirt finds its way into the juice.

A limited number of analyses were also carried out to determine the percentage of bagacillo present in the «dirt» which is retained on a 100 - mesh sieve, and the following results were obtained.

Table 53. Percentage of bagacillo in «dirt».

	Dirt %	*Bagacillo* %	*Bagacillo* % *«dirt»*
Labourdonnais	.235	0.09	38.3
,,	.415	0.21	50.6
Réunion	.495	0.17	34.3
St. Félix	.465	0.17	36.6

The above figures show that about 40 per cent of the dirt is made up of bagacillo. Although comparative figures are not available, it is presumable that with the use of intermesh rollers and, especially, of shredders more bagacillo nowadays finds its way into the mixed juices of many factories in which the drag-type

conditions the amount of «dirt» that finds its way into the mixed juice is of sufficient quantity to necessitate that an allowance be made to arrive at a more accurate sucrose per cent-cane figure. For a factory whose average sucrose per cent cane is 14.00 and whose mixed juice contains one-half per cent of «dirt», a reduction of the weight of mixed juice by one-half per cent would yield a sucrose per cent cane figure of 13.93. However the removal of the dirt would at the same time depress the Brix of the juice by about 0.2 units (Anderson et al, 1959). As may be seen from Schmidt's Table, that would bring in a positive correction of 0.01, so that the corrected sucrose per cent cane figure would read 13.94. Thus, for the example chosen, sucrose per cent cane would be lowered by 0.06 and undetermined losses would go down by the same figure.

However, since the amount of «dirt» in mixed juice may vary from factory to factory according to the climatic conditions prevailing during harvest, equipment available and varieties grown, a «dirt» correction can only be applied if the percentage of dirt is determined daily in each factory. The adoption of such a measure would no doubt lead to a more accurate chemical control.

(b) **Heating of Secondary Juices.**

In 1959 five more factories have used the liming process in which the secondary juice is heated to 80 - 100°C., mixed with the cold primary juice prior to weighing, limed and brought to boiling before being sent to the clarifier. From the experience gained at those factories where the process has been in operation for several years, it would appear that better clarification results from its use than from the cold liming process generally followed in Mauritius.

During the 1959 crop, however, the chemist of a sugar factory where the process was being tried for the first time observed that heating of the secondary juice caused an appreciable increase of purity of that juice. As a result of this observation, the Sugar Technology division requested the chemists of six factories where heating of secondary juice is practised to carry out series of Brix and Sucrose determinations before and after heating with a view to finding out whether the increase in purity obtained in all cases.

The results kindly forwarded by these chemists are given in table 54.

Table 54. Purity of secondary juice before & after heating.

Name of Factory	*Final Temp: °C*	*Before Reheating* Brix	*Before Reheating* Sucrose	*Before Reheating* Purity	*After Reheating* Brix	*After Reheating* Sucrose	*After Reheating* Purity	*Diff. in Purity*
Constance	90	9.97	8.35	83.8	10.04	8.40	83.7	—0.1
,,	,,	9.74	8.08	83.0	9.58	7.96	83.1	+0.1
,,	,,	9.26	7.39	79.8	9.39	7.85	83.6	+3.6
,,	,,	9.22	7.58	82.2	9.34	7.74	82.9	+0.7
,,	,,	9.24	7.78	84.2	9.34	7.89	84.5	+0.3
,,	,,	9.22	7.49	81.2	9.46	7.86	83.1	+0.9
,,	,,	9.70	8.19	84.4	9.77	8.30	85.0	+0.6
,,	,,	9.62	8.10	84.2	9.84	8.57	87.1	+2.9
Average	90	9.50	7.87	82.8	9.60	8.07	84.1	+1.3
Labourdonnais	100	8.78	7.03	80.1	8.90	7.23	81.2	+1.1
,,	,,	8.15	6.76	82.9	8.29	6.96	84.0	+1.1
Average	100	8.47	6.90	81.5	8.60	7.10	82.6	+1.1
Mon Désert	100	10.42	8.86	85.0	10.61	9.11	85.9	+0.9
,,	,,	9.28	7.95	85.7	9.45	8.11	85.8	+0.1
,,	,,	10.04	8.54	85.1	10.14	8.70	85.8	+0.7
,,	,,	10.55	8.87	84.1	10.42	8.96	86.0	+1.9
Average	100	10.07	8.56	85.0	10.15	8.72	85.9	+0.9
Mon Désert	60 - 70	10.33	8.78	85.0	10.23	8.74	85.4	+0.4
	,,	10.14	8.70	85.8	10.11	8.78	86.8	+1.0
	,,	10.19	8.99	88.2	10.19	9.26	90.9	+2.7
	,,	9.51	8.42	88.5	9.49	8.50	89.6	+1.1
	,,	9.81	8.13	82.9	9.89	8.30	83.9	+1.0
Average	60 - 70	10.00	8.60	86.0	9.98	8.72	87.4	+1.4

Table 54. Purity of secondary juice before & after heating. (cont.

Name of Factory	*Final Temp : °C*	*Before Reheating*			*After Reheating*			*Diff. in Purity*
		Brix	*Sucrose*	*Purity*	*Brix*	*Sucrose*	*Purity*	
Riche en Eau	100	9.00	7.56	84.0	9.15	7.77	84.9	+0.9
,,	,,	8.80	7.30	83.0	8.90	7.45	83.7	+0.7
,,	,,	8.74	7.39	84.6	8.88	7.55	85.0	+0.4
,,	,,	10.79	9.13	84.6	11.08	9.50	85.7	+1.1
,,	,,	11.10	9.40	84.7	11.10	9.60	86.5	+1.8
,,	,,	10.45	8.81	84.3	11.00	9.32	84.7	+0.4
,,	,,	10.74	9.11	84.8	10.81	9.23	85.4	+0.6
,,	,,	10.07	8.54	84.8	10.21	8.79	86.1	+1.3
,,	,,	10.67	9.08	85.1	11.31	8.84	87.0	+1.9
,,	,,	9.82	8.36	85.1	10.14	8.77	86.5	+1.4
Average	100	10.02	8.47	84.5	10.26	8.78	85.6	+1.1
St. Antoine	90	11.39	9.41	82.6	11.67	9.64	82.6	Nil
,,	,,	11.55	9.67	83.7	11.65	9.86	84.6	+0.9
,,	,,	12.30	10.43	84.8	12.42	10.70	86.2	+1.4
,,	,,	12.03	10.18	84.6	12.18	10.40	85.4	+0.8
,,	,,	11.89	9.69	81.5	12.32	10.34	83.9	+2.4
Average	90	11.83	9.88	83.5	12.05	10.19	84.6	+1.1
Union Flacq	60—70	13.22	11.22	84.9	13.34	11.46	85.9	+1.0
,,	,,	13.69	11.78	86.0	13.81	11.89	86.1	+0.1
,,	,,	12.47	10.61	85.1	12.37	10.64	86.0	+0.9
,,	,,	13.88	11.96	86.2	13.77	11.90	86.4	+0.2
,,	,,	12.85	11.11	86.5	12.97	11.26	86.8	+0.3
,,	,,	11.00	9.02	82.0	10.93	9.23	84.4	+2.4
Average	60—70	12.85	10.95	85.2	12.87	11.06	85.9	+0.7
Union Flacq	90	9.65	7.98	82.7	9.74	8.10	83.2	+0.5
,,	,,	11.17	9.53	85.3	11.12	9.65	86.8	+1.5
Average	90	10.41	8.76	84.1	10.43	8.88	85.1	+1.0
General Average	85—90	10.49	8.84	84.3	10.60	9.05	85.4	+1.1

As may be seen above, of the 42 results obtained all but two show positive differences in purity on heating the secondary juice. This increase in purity results from the coagulating effect of heat on some of the juice constituents, the nitrogen containing non-sugars in particular, and to a lesser degree the lipids, sesquioxides and silicic acids (Honig, 1953). Starch is also gelatinized at temperatures of 50 - 60°C. and, according to Bennett and Schmidt (1959), this gelatinization is responsible for the flocculation observed when certain juices are heated above 60°C.

It will also be observed from the results that heating to 61 - 70°C. instead of 90 - 100°C. does not on the average cause a smaller increase in purity as the former temperature is still high enough for causing coagulation and precipitation.

An important aspect of the question is its influence on the chemical control of the factory, in particular on the sucrose per cent mixed juice and hence on the sucrose per cent cane figure. The results obtained show an average increase of 0.21 in the sucrose content of the secondary juice. If it is assumed that mixed juice is made up of 60 per cent of primary juice and 40 per cent of secondary juice, an increase of 0.21 in the sucrose content of the latter will correspond to an increase of about 0.08 in the sucrose per cent cane figure.

Hence in those factories where heating of secondary juice is practised prior to mixing with primary juice and weighing, it would be necessary to determine daily the increase in sucrose per cent of the secondary juice in order to arrive at a correct sucrose per cent cane figure.

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6. QUALITY DETERMINATION OF CANE FROM EXPERIMENTAL PLOTS

J. D. de R. de SAINT ANTOINE & F. LE GUEN

A large number of cane samples from the various experimental plots of the Institute are analysed yearly by the Sugar Technology Division. Thus some 3000 analyses were carried out during the 1959 crop.

The methods of sampling, and of analysis after shredding the cane sections in a Queensland fibrator (Cutex) and extracting the juice in a hydraulic press, which have been used at this Institute since 1954 have been previously described by Halais (1955).

The method of calculation, in which it is assumed that the composition of the juice extracted by the press is equivalent to that of the absolute juice, is as follows:

$$\text{Juice purity} \ldots = \frac{\text{Pol \% Juice}}{\text{Brix \% Juice}} \times 100$$

$$\text{Moisture \% Absolute Juice} = 100 - \text{Brix \% Absolute Juice}$$

$$\text{Absolute Juice \% Cane} = \frac{\text{Moisture \% Cane}}{\text{Moisture \% Absolute Juice}} \times 100$$

$$\text{Fibre \% Cane} \ldots = 100 - \text{Absolute Juice \% Cane}$$

$$\text{Brix \% Cane} \ldots = \text{Brix \% Absolute Juice} \times \text{Absolute Juice \% Cane} \div 100$$

$$\text{Pol \% Cane} \ldots = \text{Pol \% Absolute Juice} \times \text{Absolute Juice \% Cane} \div 100$$

$$\text{Juice Impurities \% Cane} = \text{Brix \% Cane} - \text{Pol \% Cane}$$

$$\text{C.C.S. \% Cane} \ldots = \text{Pol \% Cane} - \tfrac{1}{2}\ \text{Juice Impurities \% Cane.}$$

Accuracy of the method. From the large number of results obtained over the past few years, it has been observed that this method has a tendency to yield high pol % cane figures and erratic fibre values. These inaccuracies are the result of a number of factors, the most important of which are:

(a) During shredding there is inevitably a certain amount of juice which is splashed on to the trash bar and the hood of the fibrator. This juice falls back in droplets on the shredded material, but only in localized spots where the shredded cane becomes soaked with juice. With these localized spots of high juice content it is impossible in practice to homogenize the shredded material before sub-sampling. An error is consequently introduced into the moisture per cent cane figure and hence in the calculation of absolute juice per cent cane. The value of this last figure is in the range of 85 - 92 and since fibre is calculated from the formula: Fibre % Cane = 100 — Absolute Juice % Cane, an error of 1 in 90 for the absolute juice % cane leads to an error of about 1 in 10 for the fibre % cane.

(b) Moisture per cent cane is determined by drying 200 gms. of the shredded material overnight at 100 - 105°C. At this temperature, a certain amount of destruction of sucrose by caramelisation is bound to occur, as evidenced by the brown colour of the sample when it is removed from the oven.

(c) The assumption that the expressed juice does represent the absolute juice is not quite correct as shown by Atherton (1954). Moreover, the pressure used in practice for extraction of the juice is relatively small and is not constant.

(d) The shredded material consists of a mixture of long fibres and pith tissue and is exceedingly difficult to sub-sample correctly.

Since correct interpretation of most of the field trials laid by the various divisions of the Institute depends on the accuracy of the sampling and analysis of the cane samples collected from these trials, it was decided several years ago to investigate other methods of analysis which would offer greater reliability than the one in use. The method adopted, however, would have to be rapid enough to allow the analysis of at least fifty samples daily during the peak period of the harvesting season.

The various methods investigated were:

(a) A modified Cutex fibrator with small pitch, cross-cut blades. It was soon discarded as the blades quickly became choked with shredded cane which made feeding difficult and time consuming.

(b) An «Aguirre-type» saw which cuts transverse sections of tissues at regular intervals along the cane. This equipment, however, leaves a piece of unchipped cane on the far end of the section, introducing thereby an error in the analysis.

(c) In 1955, Halais investigated two new methods of cane analysis. In the first he used a circular saw similar to that advocated by Evans in British Guiana (1954), but reached the conclusion that longitudinal sawing of cane stalks does not produce saw dust representative of the whole stalk and yields high pol. and low fibre per cent cane results, especially with high fibre varieties. In the other method the canes were disintegrated in three successive steps by means of a cane cutter, a Waddell hammer mill and a Waring blender. The method yielded interesting results, but was not adopted as the cane chipper was not satisfactory and as it was thought preferable to reduce the number of steps in the desintegration from three to two by using a machine that could chip the cane stalks finely enough for use directly in a high speed mixer.

It was finally decided to try a cane chipper similar to that manufactured by Scott and Sevin of Baton Rouge for the Sugar School of Louisiana State University. This chipper, shown in fig. 40, consists of a rotor into which four blades are fitted at an angle. The canes are fed into the chipper and are cut into small pieces by the revolving blades. The rotor is eleven inches in diameter and rotates at 600 R.P.M.; it is belt driven by a 5 H.P. motor.

Cutex runs. Before attempting to compare a new method of cane analysis with a standard one, two conditions must be fulfilled:

(a) Each pair of samples must be similar in composition, within certain limits,

(b) the standard method must be reproducible.

In order to obtain similar samples, lots of 30 canes were sampled according to the usual method in such a way that each batch of canes yielded three equivalent samples, each of which should be representative of the original 30 canes if the sampling procedure is correct. Each of these equivalent samples was then analysed by the Cutex method, the procedure being repeated for four lots of 30 canes. Average differences of .54 in pol. % cane were found between the samples, and in one case a difference as high as 1.41 was obtained. Such variations were too high to enable comparisons to be made between two methods and it was decided to investigate into the causes of these variations. The latter could be due either to the method of preparing the samples or to analytical errors.

The first possible cause to be eliminated was that of variation in the pressure used to extract the juice. The experiments were repeated with six lots of 30 canes, care being taken each time to use the same pressure of 30 kg/cm^2 for extracting the juice. Average differences of 0.49 in pol % cane being still found, it was concluded that the differences in pressure were not the cause of the discrepancy. Nevertheless in all subsequent analyses, a constant pressure of 30 kg/cm^2 was used.

It was unlikely that such random errors could arise from the analysis of the extracted juice but they could possibly result from the sub-sampling of the shredded material sent to the hydraulic press. It was therefore decided to take two sub-samples of shredded material and to analyse separately the juice extracted from each so that any error arising from incorrect sub-sampling at this stage would show in the results.

The results are summarized in table 55.

Table 55. Average differences in pol. per cent cane.

Series	*No. of duplicate tests*	*Av. diff. in pol. % cane between duplicate sub-samples*	*Av. diff. in pol. % cane between equivalent samples*
1	12	.11	.20
2	12	.24	.53
3	12	.19	.22
Average	—	.18	.32

From these results it appears that the error due to sub-sampling is about half that due to differences between equivalent samples. Since the analyses were carried out during the inter-crop period with immature cane in which there are greater variations in sucrose content from top to bottom of the stalk, another series of determinations was carried out, using stalks in which 18 inch portions had been removed from the top and bottom before dividing the canes into thirds.

This procedure was followed for the analysis of seven lots of thirty canes and the results obtained showed that the average differences in pol. per cent cane were reduced from 0.18 to 0.10 for duplicate sub-samples and from 0.32 to 0.17 for equivalent samples. It was therefore decided that by following this procedure the difference was small enough to enable comparisons to be made between two methods as to their pol. per cent cane results.

In all the analyses reported above, the fibre was also determined by two methods: the indirect one which has been already described and a direct one in which about 250 gms of shredded material are weighed into a tared calico cloth and tied into a small bundle. The bundle is placed in cold water, squeezed by hand several times and left in running water overnight. It is then placed in boiling water for one hour, rinsed in cold water, squeezed several times and placed in an oven to dry to constant weight.

A number of comparisons were made and the following average results were obtained.

Table 56. Fibre per cent by indirect and direct methods.

No. of comparisons	*Fibre % cane Indirect Method*	*Fibre % cane Direct Method*
91	11.46	12.43

Thus on the average the direct method yielded results higher than the indirect one by almost one unit of fibre, a highly significant difference. It was also decided to find out which of the two methods was more reproducible, and to this end a number of samples of cane were shredded in the Cutex and four sub-samples of shredded cane taken from each. Two of them were analysed by the indirect method, and the two others by the direct method. The results obtained are shown in table 57.

These results confirm the previous finding that the direct method yields higher results than the indirect one, but also show that both methods, yield erratic figures. The lack of reproducibility arises mainly from the fact that it is impossible to homogenize the shredded material properly before sub-sampling.

Table 57. Reproducibility of indirect and direct methods of fibre determinaton.

	Indirect Method	*Direct Method*
No. of comparisons ...	17	17
Fibre % cane ...	11.10	11.97
Av. diff. between duplicates ...	0.42	0.42
Maximum diff. between duplicates ...	1.48	1.25

Cane chipper runs. Before trying to compare the cane chipper with the Cutex for cane analysis it was necessary to determine the reproducibility of the results obtained with the former just as had been done with the latter. To this end the same method of preparing equivalent samples was adopted as for the Cutex runs, eighteen inch portions being cut from the top and bottom of each cane before sub-sampling.

The analytical procedure adopted was as follows: 300 g of chipped material are weighed and placed in a Waring blender together with one litre of water and 10 mls. of a 5% sodium carbonate solution. The blender is allowed to run at 8000 R.P.M. for ten minutes.

The contents of the blender are then filtered over a tared calico cloth, part of the filtrate being collected for refractometric brix and for pol determination. All the fibre particles adhering to the blender cup are washed into the cloth, which is then tied up into a bundle. The bundle is left overnight in cold running water and soaked in boiling water for one hour the next morning, prior to rinsing and drying in the oven at 105°C to constant weight. From the result obtained, pol % cane, fibre % cane and purity are calculated.

Twenty duplicate samples obtained from seven lots of 30 canes were analysed to check the reproducibility of the method, and the following results were obtained.

Table 58. Reproducibility of Cane chipper method.

	Pol % cane	*Fibre % cane*
Av. diff. between dupli- sub-samples ...	0.12	0.14
Av. diff. between equivalent samples ...	0.24	0.18

As may be seen from the above results, average differences between duplicate sub-samples of chipped material have amounted to 0.12, and those between equivalent samples to 0.24. These figures are of the same magnitude as those obtained with the Cutex, namely 0.10 and 0.17. However, fibre determination of chipped material gives more reproducible results than that of shredded cane, average differences of 0.14 between duplicate sub-samples having been obtained with the cane chipper whilst the corresponding Cutex figure was as high as 0.42.

A series of comparisons was then made between the Cutex and the cane chipper. The cane sampling and sub-sampling procedure adopted was as follows: canes harvested from a small plot in a field were sent daily to the laboratory and subdivided at random into an even number of 30 cane lots. Say four such lots were obtained; two were labelled A_{cu} and B_{cu} for shredding in the Cutex and two were tagged A_{ch} and B_{ch} for use in the cane chipper. Eighteen inch top and bottom portions were then cut off the canes of each lot, and the remaining portion subdivided into three parts. Thus three sub-samples were obtained from each original lot of 30 canes. In every case the shredded or chipped material was analysed in duplicate and the average results obtained are shown in table 59.

It will be observed from these results that pol. per cent cane and fibre per cent cane values obtained with the chipper are on the

Table 59. Comparison between Cutex and Chipper Results.

No. of duplicate tests	*Cutex*			*Chipper*		
	Pol % cane	*Fibre % cane*	*Purity cane*	*Pol %*	*Fibre % cane*	*Purity*
18	12.44	11.52	84.2	12.17	10.76	85.3

average smaller than those obtained with the Cutex by 0.27 and 0.76 respectively. Purity, on the other hand, was higher by 1.1, mainly as a result of the high dilution used in the Waring blender.

During the 1959 crop a new series of comparisons was made between the Cutex and chipper methods on a number of samples received daily from the experimental plots of the Institute for routine analysis by the former method. In this method one half of each of the 30 portions of cane constituting a sample was shredded, the other portion being used as a handle and discarded. For the purpose of the comparisons the major part of each of these 30 discarded portions was immediately fed to the chipper and the analysis of the chipped material carried out as described earlier.

The following results were obtained.

Table 60. Comparison between Cutex and Chipper results.

No. of tests	*Cutex*			*Chipper*		
	Pol % cane	*Fibre % cane*	*Purity*	*Pol % cane*	*Fibre % cane*	*Purity*
55	15.34	12.18	91.8	~~14.64~~ 14.70	11.64	92.7

The above results confirm those of the previous series, namely that the chipper yields lower pol. and fibre per cent cane values, but a higher purity than the Cutex.

It was mentioned earlier that in the methods of calculation employed for the «Cutex» runs it is assumed that the composition of the juice extracted by the press is equivalent to that of the absolute juice. As already pointed out, this assumption is not correct, and there mainly lies the main reason for the higher pol. per cent cane figure obtained with the «Cutex». If the Brix and pol. values of the extracted juice were corrected to bring them in line with those of the absolute juice, pol. per cent cane obtained by the «Cutex» method would closely approximate that of the chipper method. But it is not possible to determine correctly the values of the corrections to be applied. This is a further reason why the chipper method, in which no such corrections are necessary, is to be preferred to the «Cutex» method for the analysis of cane from experimental plots.

Simplified method of fibre determination. The procedure adopted for determining fibre in the cane chipper method was found to be time-consuming and a simpler procedure, based on Hawaiian experience was tried. In this method, the contents of the Waring blender, after disintegration, are filtered through a cylindrical copper funnel six inches in diameter and two inches high fitted at the bottom with a 100-mesh screen. Four gallons of cold water are then allowed to shower through the filter. The wet mat of fibre is loosened with a glass rod, and the filter placed in the oven at 100-105°C for overnight drying to constant weight.

From a series of 18 comparisons carried out on duplicate samples of chipped material between the calico cloth method and the filter method, the latter was found to give reproducible results and yielded an average value of 11.45 as against 11.26 for the former. The small positive difference is probably due to incomplete washing of the fibre and could probably be reduced by using hot instead of cold water.

Conclusion. In the light of the experiments reported in this paper, it has been decided to adopt the cane chipper-Waring blender method for quality determination of cane from the experimental plots of the Institute as from the 1960 harvesting season.

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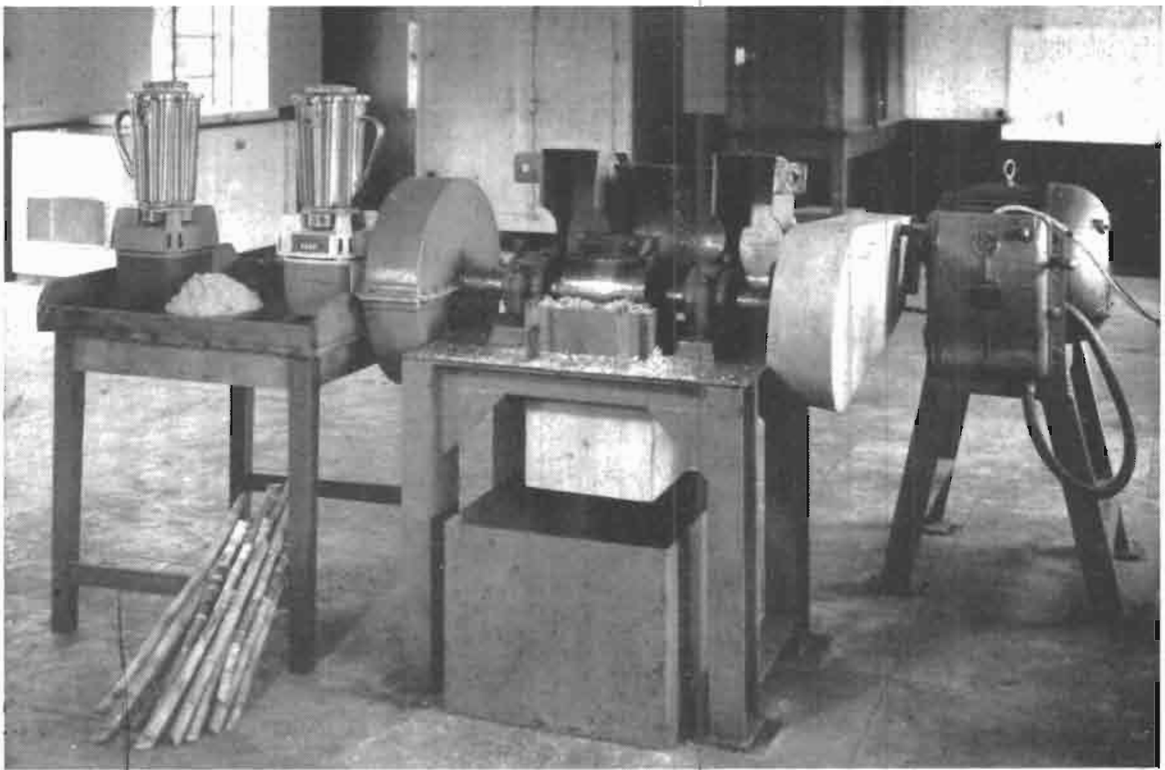

Fig. 40. Above : Cane chipper and Waring blenders, used for cane analysis from experimental plots.
Below : Close-up of cane chipper (hood removed) showing chipped cane.

APPENDIX *

I. Description of cane sectors.

II. Area under sugarcane.

III. Sugar production.

IV. Yield of cane.

V. Sugar manufactured % cane.

VI. Sugar manufactured per arpent.

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IX. Variety trend 1930 - 1958.

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- (ii) Cane, bagasse and juice.
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- (v) Milling work, sucrose losses and balance, recoveries.

XVIII. Molasses production.

XIX. Sales of herbicides.

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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 sugarcane 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	Slopes	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—150) 90	(60—150) 90
MONTHS RECEIVING LESS THAN TWO INCHES RAIN		June to October	September to October	None		
AVERAGE TEMPERATURE °C	JAN.	27.0°	26.5°	25.5°	25.0°	23.5°
	JUL.	21.0°	20.5°	19.5°	19.0°	17.5°
CYCLONIC WINDS, greater than 30m p.h. during 1 hour		December to May				
PEDOLOGY Soil Groups:(*) A. Low Humic Latosol		« Richelieu » bouldery clay (12,000 arpents)		—		
B. Humic Latosol		—	«Réduit» bouldery clay (60,000 arpents)			
			—	«Sans Souci» bouldery clay (20,000 arpents)		
C. Lithosol		«Mapou» stony and gravelly clay (19,000 arpents)		—		
(*) Other unclassified groups occur chiefly in the West and North (2000 arpents)			«Plaisance» stony and gravelly clay (53,000 arpents)			
			—	«Rose Belle» stony and gravelly clay (26,000 arpents)		
IRRIGATION		Common	Some	Rare		
APPROXIMATE AREA 1000 arpents	Sector	56	91	72	160	63
	Cane	10	53	41	61	25
CANE PRODUCTION 1000 metric tons Average 1957 - 59		272	1,053	899	1,608	638
SUGAR PRODUCTION 1000 metric tons Average 1957 - 59		34	141	111	192	79
SUGAR FACTORIES Production in 1000 metric tons Average 1957 - 59		Médine 34	Mon Loisir 28 St. Antoine 20 Solitude 21 The Mount 21 Beau Plan 19 Labourdonnais 17 Belle Vue 15	Union Flacq 60 Beau Champ 29 Constance 22	Savinia 30 Mon Trésor 25 Riche en Eau 23 Union 22 Britannia 20 Rose Belle 20 Benarès 15 Bel Ombre 14 Ferney 12 St. Félix 11	Mon Désert 35 Highlands 23 Réunion 21

Table II. Area under sugar cane in thousands arpents(1), 1955 - 1959.

Year	Area under cane Island	Area reaped					
		Island	West	North	East	South	Centre
1955	180.05	168.59	8.82	47.80	36.90	52.78	21.86
1956	181.21	167.90	8.74	48.16	35.95	53.17	21.88
1957	182.67	169.58	8.95	48.27	35.72	54.25	22.29
1958	189.22	176.69	9.20	49.14	38.78	56.62	22.95
1959(2)	190.00	180.08	9.15	49.65	40.00	58.09	23.19

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), 1955 - 1959.

Crop Year	No. of factories operating	Av. Pol.	Island	West	North	East	South	Centre
1955	26	98.6	533.3	31.52	148.39	103.40	173.96	76.07
1956	26	98.6	572.5	31.06	167.14	110.22	187.60	76.47
1957	26	98.5	562.0	36.05	141.28	103.31	198.86	82.50
1958	25	98.5	525.8	31.80	137.17	106.07	178.80	72.01
1959(2)	24	98.6	579.9	35.21	141.61	123.66	195.83	83.57

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), 1955 - 1959.

	1955	1956	1957	1958	1959(2)
ISLAND					
Millers	31.0	32.0	32.2	30.5	32.4
Planters	19.7	21.0	19.1	19.1	20.5
Average	25.1	26.3	25.6	24.5	26.3
WEST					
Millers	34.3	32.2	35.9	32.4	34.4
Planters	24.3	24.1	27.8	25.2	28.7
Average	27.8	27.0	30.8	28.0	30.8
NORTH					
Millers	29.0	32.2	29.0	29.5	30.1
Planters	20.5	22.2	16.9	17.5	17.5
Average	23.5	25.5	21.1	21.6	21.9
EAST					
Millers	31.8	31.6	31.5	31.5	33.0
Planters	17.3	19.2	17.2	16.8	20.0
Average	22.5	23.9	22.9	22.4	25.3
SOUTH					
Millers	30.7	31.7	32.8	30.3	32.2
Planters	19.7	20.9	22.0	22.5	22.8
Average	27.2	28.3	29.3	27.4	28.9
CENTRE					
Millers	32.4	32.7	34.1	30.6	34.9
Planters	19.7	19.0	20.4	19.9	22.5
Average	27.1	27.1	28.6	25.9	29.4

NOTE: (1) *To convert in metric tons/acre multiply by 0.959*
" " " long tons/acre " " 0.945
" " " short tons/acre " " 1.058
" " " metric tons/hectare " " 2.370

(2) ***Provisional figures.***

Table V. Average sugar manufactured % cane (1), 1955 - 1959.

Crop year	Island	West	North	East	South	Centre
1955	12.61	12.85	13.22	12.43	12.11	12.83
1956	12.95	13.17	13.59	12.84	12.47	12.89
1957	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(2)	12.22	12.48	13.07	12.20	11.63	12.26

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, 1955 - 1959.

	Island	West	North	East	South	Centre
1955	3.17	3.57	3.10	2.80	3.30	3.48
1956	3.41	3.56	3.47	3.07	3.53	3.49
1957	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 (1)	3.22	3.85	2.85	3.09	3.37	3.60

NOTE: (*1*) *Provisional figures.*

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

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

NOTE: To convert into millimetres, multiply by 2.54.

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

Crop Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959
NOVEMBER	—	21	17	24	18	18	14	16	12	13	13
DECEMBER	18	16	24	21	15	16	15	17	13	13	14
JANUARY	27	26	21	22	18	28	13	20	20	14	17
FEBRUARY	20	24	20	25	15	15	*34*(2)	16	19	18	17
MARCH	20	17	18	25	15	15	29	19	18	*33*(2)	18
APRIL	18	21	17	22	20	16	16	17	16	28	17
MAY	20	19	20	24	22	22	19	18	15	14	16
JUNE	24	20	23	25	23	20	22	17	13	14	17
JULY	21	23	21	20	24	16	17	15	12	11	16
AUGUST	18	19	24	25	24	23	20	14	17	20	18
SEPTEMBER	20	21	21	21	20	19	19	17	17	18	17
OCTOBER	18	19	20	20	19	20	14	18	15	17	18

NOTE: (*1*) *To convert into knots, multiply by 0.87.*

,, ,, ,, *kilometres/hr. multiply by 1.61.*

,, ,, ,, *metres/sec. multiply by 0.45.*

(*2*) *Cyclonic wind above 30 miles per hour.*

Table IX. Variety trend in Mauritius 1930 - 1958.

% Area Cultivated.

	Tannas	M. P. seedlings 55 and 131	Demerara seedlings DK/74, D 109 D 130, RP/6 RP/8	POJ. 2878	BH. 10/12	M. 134/32	Other M. seedlings	Ebène 1/37	B. 3337, B. 34104, B. 37161, B. 37172
1930	57	10	16	—	2	—	—	—	—
1935	48	7	16	1	15	—	—	—	—
1940	29	1	1	5	40	2	5	—	—
1944	5	—	—	2	27	37	7	—	—
1950	—	—	—	—	—	91	6	—	—
1953	—	—	—	—	—	83	5	8	—
1954	—	—	—	—	—	83	5	10	2
1955	—	—	—	—	—	74	5	15	6
1956	—	—	—	—	—	66	8	17	9
1957	—	—	—	—	—	55	12	21	12
1958	—	—	—	—	—	43	17	25	15

Table X. Percentage annual plantations under different cane varieties on sugar estates, 1955 to 1959

Years / varieties	Island					West					North					East					South					Centre				
	1955	1956	1957	1958	1959	1955	1956	1957	1958	1959	1955	1956	1957	1958	1959	1955	1956	1957	1958	1959	1955	1956	1957	1958	1959	1955	1956	1957	1958	1959
M.134/32	28.5	16.3	4.2	2.0	0.9	3.9	—	—	—	—	76.3	49.4	12.6	6.9	2.7	20.0	7.4	1.7	0.5	0.1	24.3	14.7	4.3	1.1	0.7	8.5	1.7	—	0.4	0.4
M.134/32(white)	3.4	4.3	3.3	1.0	0.3	47.5	20.6	23.8	6.2	—	0.3	3.4	5.2	1.2	—	8.0	9.6	—	—	0.1	1.2	2.5	3.6	1.9	0.8	1.0	—	—	—	—
M.112/34	5.0	2.2	2.1	0.8	0.5	6.0	—	9.4	2.8	—	3.7	4.3	3.5	2.4	1.1	2.2	1.4	0.8	0.2	0.6	7.1	1.8	2.0	0.3	0.3	3.9	2.6	1.1	0.6	0.1
M.147/44	—	14.0	35.6	28.9	32.7	—	40.8	46.4	25.2	20.5	—	6.8	47.3	35.3	50.4	—	16.6	32.1	34.8	39.0	—	11.5	39.6	25.1	31.2	—	16.1	13.5	22.0	8.0
M.31/45	—	9.0	9.1	8.0	3.8	—	—	6.9	13.1	4.8	—	1.4	5.8	4.8	4.9	—	8.4	10.1	15.7	5.7	—	13.6	12.6	7.3	2.4	—	8.0	1.0	2.8	3.3
Ebène 1/37	31.4	28.5	33.2	28.9	24.3	19.7	7.6	—	—	—	5.3	8.6	6.6	5.2	7.2	49.5	35.4	43.1	27.5	25.2	26.4	22.0	24.7	30.5	30.2	55.2	61.4	81.2	57.5	35.2
B.3337	10.7	7.4	1.8	4.8	6.9	—	—	—	—	—	0.2	0.6	—	—	—	3.2	2.9	1.0	1.7	6.4	11.1	12.2	—	7.6	8.3	22.9	8.6	1.8	8.4	14.7
B.34104	—	2.9	2.2	2.9	2.8	—	11.5	7.8	32.0	29.6	—	0.8	1.6	5.6	2.9	—	0.5	0.5	0.1	—	—	4.7	3.3	3.2	2.1	—	—	0.3	2.7	1.2
B.37161	7.1	8.4	2.1	0.9	—	4.4	16.6	1.1	1.1	—	6.6	14.7	4.6	4.4	—	8.1	7.6	2.7	—	—	9.7	8.6	1.6	—	—	2.0	0.8	—	—	—
B.37172	6.0	6.4	5.7	20.6	21.0	—	2.4	3.9	13.3	30.9	4.1	8.4	11.6	32.3	25.7	5.3	9.3	7.3	18.8	15.9	10.0	7.6	4.8	22.3	19.8	0.5	0.5	0.1	3.0	23.0
Other varieties	7.9	0.6	0.7	1.2	6.8	18.5	0.5	0.7	6.3	14.2	3.5	1.6	1.2	1.9	5.1	3.7	0.4	0.7	0.7	7.0	9.2	0.8	0.5	0.7	4.2	6.0	0.3	1.0	2.6	14.1
Total area, arpents	12726	12706	13948	13011	13203	364	678	536	403	512	2176	2169	2105	2573	2579	1927	2029	3076	2964	2620	5522	5438	6224	5536	5565	2527	2392	2007	1939	1927

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

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

NOTE: *The weight of cane produced on estates in 1959 was : virgins 396,765 tons ; ratoons 2,456,195 tons.*

Table XII. Average yields of virgin and ratoon canes on estates.
Tons per arpent. A : 1947 - 1958 ; B : 1959.

	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	35.4	34.8	41.4	42.7	34.7	31.6	39.2	38.4	34.0	33.6	34.9	35.8
1st Ratoon	32.9	35.3	35.1	39.0	33.1	33.8	34.1	36.9	32.3	34.2	32.8	36.6
2nd ,,	31.0	33.0	33.3	32.6	30.0	31.3	33.1	34.6	30.6	32.3	30.4	34.6
3rd ,,	29.5	31.6	31.7	34.4	29.1	29.4	30.9	33.8	28.9	30.7	29.5	33.6
4th ,,	28.9	31.6	30.4	34.4	27.9	29.2	29.8	31.7	29.2	31.3	28.3	34.3
5th ,,	28.2	31.0	30.4	32.2	27.5	29.2	27.6	30.1	28.8	30.9	28.0	34.2
6th ,,	28.2	30.3	30.5	29.0	27.2	28.0	27.8	30.3	28.9	30.1	27.6	34.9

Table XIII. List of Crosses made in 1959.

CROSS		Number of crosses made	Number of seedlings obtained	CROSS		Number of crosses made	Number of seedlings obtained
B.3337	x Ebène 1/37	3	0	Co.421	x P.O.J.2940	2	0
B.34104	x Ebène 1/37	2	80	,,	x P.O.J.3016	1	0
,,	x M.63/39	6	333	,,	x Q.58	1	0
,,	x M.147/44	1	56	,,	x R.397	2	7
,,	x M.202/46	1	1	,,	x 47 R. 2777	2	588
,,	x P.O.J.2878	1	0	D.109	x self	2	0
,,	x P.O.J.2940	2	0	Ebène 1/37	x Co.419	2	3
,,	x Q.58	1	0	,,	x D.109	2	0
,,	x 47 R. 2777	1	272	,,	x self	3	0
B.37161	x Ebène 1/37	4	2	,,	x M.99/34	4	470
,,	x M.147/44	6	189	,,	x M.63/39	10	1786
,,	x M.202/46	1	1	,,	x M.213/40	2	420
B.37172	x Ebène 1/37	8	22	,,	x M.147/44	32	7552
,,	x M.147/44	2	700	,,	x M.202/46	1	6
,,	x M.202/46	1	38	,,	x M.81/52	1	365
B.41227	x Ebène 1/37	1	0	,,	x P.T.43-52	2	533
B.4362	x M.63/39	1	0	,,	x Q.58	2	0
,,	x M.147/44	1	184	,,	x 47 R. 2777	6	1744
C.B.38-22	x M.147/44	1	18	,,	x 47 R. 4066	6	0
Co.281	x D.109	1	0	,,	x 40 S.N. 5819	1	0
,,	x Ebène 1/37	5	14	,,	x Vesta	2	0
,,	x M.63/39	6	209	Ebène 1/44	x Ebène 1/37 †	1	0
,,	x M.147/44 †	3	384	,,	x M.99/34	3	4
,,	x M.202/46 †	2	33	,,	x M.147/44	3	56
,,	x P.O.J.3016	1	0	,,	x M.202/46	2	0
Co.421	x Ebène 1/37	2	0	Ebène 1/44	x R. 397	1	0
,,	x M.202/46	2	150	,,	x 47 R. 2777	1	12

† *Denotes backcrosses.*
* *Denotes sib-crosses.*

CROSS		Number of crosses made	Number of seedlings obtained
H.37-1933	x Ebène 1/37	4	0
"	x 47 R. 2777	1	0
M.23/16	x M.147/44	1	88
M.134/32	x Ebène 1/37	4	14
"	x M.147/44	12	1903
"	x M.202/46	2	9
"	x P.O.J.3016	1	0
"	x P.T.43-52	1	123
"	x 47 R. 2777	4	135
"	x 47 R. 4066	4	0
"	x Vesta	2	433
M.134/32 white	x M.147/44	1	287
"	x 47 R. 2777	1	16
M.112/34	x Ebène 1/37	2	15
"	x M.147/44	7	1221
"	x M.202/46	2	55
"	x R. 397	2	0
"	x 47 R. 2777	2	104
"	x 47 R. 4066	2	0
"	x Vesta	1	11
M.76/39	x M.63/39*	1	0
M.241/40	x Ebène 1/37	3	5
"	x M.147/44	3	2223
"	x M.202/46	2	59
"	x P.O.J.3016	1	0
"	x 47 R. 2777	1	128

CROSS		Number of crosses made	Number of seedlings obtained
M.377/41	x M.147/44	3	18
"	x M.81/52	2	0
"	x P.O.J.3016	1	0
"	x Q.58	1	0
"	x 47 R. 2777	1	0
M.147/44	x self	7	4
"	x M.202/46*	1	25
"	x 47 R. 2777	8	231
M.31/45	x M.147/44	2	676
M.202/46	x M.147/44*	1	0
"	x P.T.43-52	1	0
M.93/48	x Ebène 1/37 †	1	0
M.99/48	x 36 M.Q. 2717	1	0
"	x P.T.43-52	1	0
"	x 47 R. 2777	1	530
M.381/51	x Ebène 1/37	1	0
"	x M.99/34	1	0
"	x M.147/44	1	0
M.232/52	x M.147/44	1	12
M.272/52	x Q.58	1	0
M.97/53	x M.147/44	1	56
M.98/53	x M.147/44	1	5
M.41/55	x Ebène 1/37 †	1	0
M.361/56	x Ebène 1/37	1	521
"	x P.T.43-52	1	1960
M.221/57	x Ebène 1/37	1	0
"	x M.147/44	1	32

CROSS		Number of crosses made	Number of seedlings obtained
M.222/57	x Ebène 1/37	1	0
,,	x M.147/44	1	0
36 M.Q. 2717	x M.63/39	1	0
,,	x M.147/44	2	42
39 M.Q. 832	x M.147/44	1	328
39 M.Q. 841	x Ebène 1/37	1	0
,,	x M.213/40	1	12
,,	x M.147/44	2	474
N:Co.310	x B.41227	2	17
,,	x Ebène 1/37	2	0
,,	x M.99/34	3	299
,,	x M.63/39	3	112
,,	x M.213/40	4	638
,,	x M.147/44	6	1499
,,	x M.202/46	1	0
,,	x M.81/52	1	0
,,	x 36 M.Q. 2717	2	397
,,	x P.O.J.2878	2	0
,,	x P.O.J.2940	2	0
,,	x 47 R. 2777	2	926
N:Co.376	x M.213/40	2	362
Pindar	x Ebène 1/37	1	0
,,	x M.147/44	1	0
P.O.J.2878	x Co.213	1	1
,,	x Self	1	0
,,	x 47 R. 2777	4	2741
,,	x Uba Marot	2	718

CROSS		Number of crosses made	Number of seedlings obtained
P.R.1000	x Ebène 1/37	4	107
,,	x M.63/39	4	12
,,	x M.213/40	6	704
,,	x M.147/44	10	2068
,,	x P.O.J.3016	1	30
POLYCROSSES			
P.R.1000	x Ebène 1/37 x M.63/39 x M.213/40 x M.147/44 x 47 R. 2777	5	1414
Ebène 1/37	x M.63/39 x M.213/40 x 40 S.N. 5819 x Vesta	5	783
BACKCROSSES (*see also* †)			
Seedling (Ebène 1/37 x M.147/44)	x Ebène 1/37	1	0
Seedling (Ebène 1/37 x M.147/44)	x M.147/44	1	9
SIB CROSSES (*see* *)			
SECOND SIBBING			
Seedling (M.112/34 x M.147/44)x (M.112/34 x M.147/44) x Seedling (M.112/34 x M.147/44)x (M.112/34 x M.147/44)		1	2
SELFING OF SIBS			
Seedling (M.112/34 x M.147/44)x (M.112/34 x M.147/44) x Self		2	0
Grand totals		366	40826

Table XIV. Evolution of 1959 sugar 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
	25th July 1959						*1st August 1959*						*8th August 1959*						*15th August 1959*					
Cane crushed (1000 m. tons)	431	47	56	106	189	33	674	63	116	156	273	66	938	79	184	207	366	100	1166	93	245	252	444	130
Sugar manufactured % cane	11.39	11.23	12.61	11.37	11.07	11.51	11.56	11.44	12.49	11.61	11.20	11.51	11.74	11.61	12.59	11.82	11.31	11.63	11.86	11.73	12.66	11.99	11.39	11.73
Sugar manufactured (1000 m. tons)	49.1	5.3	7.1	11.9	20.9	3.9	77.9	7.2	14.5	18.0	30.6	7.6	110.2	9.2	23.2	24.5	41.4	11.7	138.3	10.9	31.0	30.2	50.6	15.4
	22nd August 1959						*29th August 1959*						*5th September 1959*						*12th September 1959*					
Cane crushed (1000 m. tons)	1410	110	316	299	521	164	1691	126	395	353	615	200	1934	139	463	398	698	236	2209	154	543	451	786	275
Sugar manufactured % cane	11.89	11.81	12.67	12.08	11.11	11.78	11.98	11.92	12.72	12.17	11.49	11.84	12.07	12.00	12.76	12.22	11.57	11.90	12.14	12.10	12.81	12.28	11.65	11.98
Sugar manufactured (1000 m. tons)	168.0	13.0	40.0	36.2	59.5	19.3	202.8	15.1	50.2	43.0	70.7	23.8	233.3	16.7	59.1	48.7	80.7	28.1	268.2	18.7	69.5	55.4	91.6	33.0
	19th September 1959						*26th September 1959*						*3rd October 1959*						*10th October 1959*					
Cane crushed (1000 m. tons)	2472	169	623	502	868	310	2738	185	701	552	948	350	3006	198	782	603	1034	389	3267	213	859	654	1113	427
Sugar manufactured % cane	12.19	12.21	12.85	12.33	11.69	12.05	12.25	12.28	12.89	12.37	11.73	12.13	12.30	12.37	12.94	12.43	11.77	12.19	12.37	12.43	13.02	12.48	11.83	12.23
Sugar manufactured (1000 m. tons)	301.4	20.6	80.0	61.8	101.4	37.4	335.4	22.7	90.5	68.3	111.3	42.6	369.7	24.5	101.2	74.9	121.7	47.2	404.0	26.5	111.8	81.6	131.6	52.1
	17th October 1959						*24th October 1959*						*31st October 1959*						*7th November 1959*					
Cane crushed (1000 m. tons)	3489	227	934	697	1173	458	3736	241	1005	743	1252	495	3964	256	1052	791	1333	532	4174	269	1079	842	1416	567
Sugar manufactured % cane	12.39	12.46	13.05	12.51	11.84	12.29	12.40	12.48	13.04	12.51	11.86	12.32	12.40	12.49	13.05	12.49	11.86	12.33	12.38	12.48	13.06	12.45	11.83	12.34
Sugar manufactured (1000 m. tons)	423.5	28.3	121.8	87.2	138.9	56.3	463.3	30.0	131.0	92.8	148.5	61.0	491.5	32.0	137.2	98.8	158.0	65.5	516.9	33.6	141.0	104.7	167.6	70.0
	14th November 1959						*21st November 1959*						*28th November 1959*						*Total Crop Production (Preliminary figures)*					
Cane crushed (1000 m. tons)	4349	282	1085	888	1493	601	4509	282	1085	935	1570	637	4622	282	1085	978	1623	654	4743	282	1085	1013	1682	681
Sugar manufactured % cane	12.35	12.46	13.06	12.39	11.79	12.33	12.31	12.48	13.05	12.33	11.77	12.32	12.27	12.48	13.05	12.28	11.70	12.29	12.22	12.48	13.05	1221.	11.64	12.26
Sugar manufactured (1000 m. tons)	537.1	35.2	141.7	110.0	176.1	74.1	555.3	35.2	141.6	115.2	184.8	78.5	567.2	35.2	141.6	120.1	189.9	80.4	579.9	35.2	141.6	123.7	195.8	83.6

Table XV. Evolution of cane quality during 1959 sugar crop.

Week Ending	ISLAND		WEST		NORTH		EAST		SOUTH		CENTRE	
	A	B	A	B	A	B	A	B	A	B	A	B
25th July	13.43	11.61	13.35	11.86	14.53	12.62	13.50	11.66	13.11	11.18	13.11	11.56
1st August	13.70	11.89	13.62	12.07	14.36	12.36	13.78	12.09	13.36	11.47	13.25	11.70
8th ,,	13.83	12.15	13.65	12.26	14.61	12.74	13.96	12.46	13.38	11.63	13.37	11.89
15th ,,	13.91	12.34	13.83	12.41	14.55	12.85	14.20	12.81	13.43	11.75	13.40	12.09
22nd ,,	13.77	12.22	13.93	12.31	14.36	12.68	13.91	12.50	13.30	11.70	13.21	11.90
29th ,,	13.90	12.38	14.18	12.59	14.54	12.89	14.12	12.69	13.39	11.83	13.47	12.21
5th Sept.	13.95	12.50	14.34	12.85	14.54	13.05	14.07	12.64	13.54	12.07	13.50	12.23
12th ,,	14.02	12.60	14.48	12.98	14.51	13.07	14.19	12.78	13.51	12.05	13.74	12.46
19th ,,	14.10	12.65	14.92	13.35	14.55	13.10	14.17	12.74	13.52	12.04	13.91	12.58
26th ,,	14.11	12.79	14.55	13.11	14.65	13.22	14.12	12.80	13.61	12.12	13.87	12.44
3rd October	14.39	12.93	15.14	13.48	14.98	13.52	14.38	13.00	13.83	12.34	14.12	12.73
10th ,,	14.59	13.11	14.93	13.26	15.15	13.72	14.55	13.13	14.02	12.53	14.29	12.83
17th ,,	14.39	12.92	14.60	12.99	15.04	13.54	14.24	12.87	13.74	12.21	14.23	12.89
24th ,,	14.10	12.48	14.36	12.75	14.86	12.90	14.03	12.52	13.45	11.90	14.03	12.72
30th ,,	13.98	12.41	14.37	12.61	14.70	13.10	13.68	12.19	13.50	11.92	14.22	12.80
7th November	13.55	12.00	13.98	12.33	—	—	13.29	11.82	13.12	11.56	13.76	12.35
14th ,,	12.96	11.47	13.58	11.94	—	—	12.85	11.43	12.64	11.03	13.61	12.16
21st ,,	13.28	11.10	—	—	—	—	12.75	11.21	13.87	10.68	13.14	11.79

NOTE: *A = Sucrose % cane.*
B = Commercial Sugar manufactured % cane.

Table XVI. Total duration of harvest in days (A) and weekly crushing rates of factories in 1000 metric tons (B) in different sectors of the island, 1947 - 1959.

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1947	129	152.1	128	6.6	130	36.4	125	30.4	130	55.7	133	23.0
1948	132	167.6	140	7.3	122	42.1	136	33.6	140	60.0	125	24.6
1949	133	176.5	142	7.7	128	44.0	129	37.0	140	62.4	127	25.4
1950	141	184.6	130	10.1	140	47.9	145	35.1	144	65.0	135	26.5
1951	154	197.8	150	10.3	169	52.0	159	40.3	140	65.8	132	29.4
1952	149	192.4	151	9.9	149	50.5	155	40.2	154	63.4	131	28.4
1953	158	205.7	162	11.8	167	57.7	161	42.5	153	66.0	145	27.7
1954	140	214.1	142	11.7	137	60.5	138	42.9	147	68.7	134	30.3
1955	133	222.6	134	12.8	122	64.2	140	41.5	140	71.6	127	32.5
1956	136	227.3	129	12.7	137	62.7	138	43.4	138	76.2	128	32.3
1957	128	237.5	144	13.3	104	68.2	133	42.9	141	78.6	129	34.5
1958	130	233.0	128	14.3	106	69.9	137	44.4	141	77.0	133	31.3
1959	135	238.0	133	14.4	102	73.3	149	47.8	147	81.2	133	35.7

Table XVII. Summary of chemical control data 1959.

(i) CANE CRUSHED AND SUGAR PRODUCED.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	Labourdonnais	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savinia	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CRUSHING PERIOD	From	3/7	22/7	24/7	13/7	11/7	8/7	25/7	3/8	20/7	3/7	3/7	13/7	2/7	30/6	3/7	7/7	1/7	16/7	16/7	16/7	30/7	27/7	10/7	20/7	—
	To	14/11	30/10	24/10	6/11	31/10	30/10	28/10	11/11	21/11	9/12	2/12	5/12	2/12	20/11	27/11	12/12	20/11	10/12	5/12	21/11	17/12	21/11	21/11	10/12	—
	No. of crushing days	113	85	77	96	94	97	81	86	105	133	127	123	127	122	124	134	121	123	117	107	115	98	112	123	110
	No. of crushing hours per day	21.55	22.50	22.80	20.75	21.58	22.40	22.00	20.73	21.17	20.32	19.87	15.60	17.20	18.71	20.43	20.78	18.33	18.15	19.48	19.19	18.42	20.21	22.42	21.07	20.32
	Hours stoppage per day	0.76	0.35	0.43	0.85	1.16	1.21	1.25	0.67	1.06	2.08	0.41	0.54	0.76	0.36	0.14	0.87	1.34	0.33	0.47	0.42	1.34	1.80	0.22	0.95	0.82
	Overall time Efficiency	96.6	98.4	98.1	96.1	94.9	94.9	94.6	96.9	87 9	90.8	98.0	96.7	95.8	98.6	99.3	96.0	92.0	98.2	97.7	97.9	93.2	91.8	99.0	95.7	96.1
CANE CRUSHED (Metric Tons)	Factory	120,142	40,154	49,812	107,737	69,231	67,347	54,362	125,331	70,483	316,678	155,907	60,804	162,472	161,337	196,417	122,232	155,148	100,053	184,899	33,991	47,301	103,172	127,492	220,018	2,852,521
	Planters	161,972	124,882	84,357	59,999	34,736	60,385	115,712	90,792	130,709	246,813	92,473	50,143	52,339	38,763	66,514	57,522	22,684	29,297	437	61,065	78,678	65,806	75,017	89,669	1,890,764
	Total	282,114	165,036	134,169	167,736	103,967	127,732	170,074	216,123	201,192	563,492	248,380	110,947	214,811	200,100	262,931	179,754	177,832	129,350	185,336	95,056	125,979	168,978	202,509	309,687	4,743,285
	Factory % Total	42.6	24.3	37.1	64.2	66.6	52.7	32.0	58.0	35.0	56.2	62.8	54.8	75.6	80.6	74.7	68.0	87.2	77.4	99.8	35.7	37.5	61.1	63.0	71.0	60.1
	Per day	2,496	1,942	1,742	1,747	1,106	1,317	2,100	2,513	1,916	4,237	1,956	902	1,691	1,640	2,120	1,341	1,469	1,051	1,584	888	1,095	1,724	1,808	2,518	1,797
	Per hour actual crushing	113.9	86.3	76.4	84.2	51.3	58.7	95.4	121.2	90.4	206.4	98.4	57.8	98.3	87.7	102.3	64.6	80.2	57.9	81.3	46.2	59.4	85.3	80.6	119.5	87.7
VARIETIES CRUSHED (Factory)	M.134/32 per cent	53.4	57.0	65.5	53.9	73.3	68.3	41.8	61.6	43.5	27.0	41.1	21.4	11.1	34 1	54.2	12.7	24.3	27.2	41.6	23.6	54.3	13.5	0.4	5.3	33.8
	Ebène 1/37 per cent	3.6	1.2	3.5	11.2	—	12.4	0.7	3.1	8.8	39.0	18.4	24.7	29.7	34.4	10.7	49.8	25.4	10.7	20.6	12.2	4.1	49.2	72.5	77.4	28.0
	M.147/44 per cent	18.3	23.3	8.2	10.7	10.4	9.5	17.6	16.0	26.6	17.0	10.4	12.5	19.6	5.2	12.0	7.3	15.4	12.1	16.1	25.5	6.1	18.1	4.5	4.9	13.0
	M.31/45 per cent	2.6	2.2	0.6	3.2	0.5	1.3	3.2	1.8	7.2	9.0	1.9	11.1	7.5	2.4	5.1	6.8	12.4	6.4	5.9	8.3	4.1	2.2	0.7	2.1	4.9
	B.37172 per cent	2.5	7.0	4.0	5.5	6.0	2.6	19.5	8.4	11.8	3.0	12.0	12.4	17.1	8.2	9.4	1.2	1.2	21.0	2.9	14.8	12.1	2.4	0.1	0.4	6.6
	B.3337 per cent	—	—	—	0.5	—	—	—	—	—	1.0	2.7	5.9	8.2	2.7	0.8	18.8	17.6	2.2	5.3	4 .6	2.3	3.5	17.2	9.3	5.0
	Other varieties	19.6	9.3	18.2	15.0	9.8	5.9	17.2	9.1	2.1	4.0	13.5	12.0	6.8	13.0	7.8	3.4	3.7	20.4	7.6	11.0	17.0	11.1	4.6	0.6	8.7
SUGAR PRODUCED (Metric tons)	Raw Sugar	35,208	20,464	17,469	21,942	14,114	17,607	16,300	28,555	24,866	68,920	29,876	1,816	24,152	25,524	32,341	20,920	20,510	8,073	21,371	10,785	14,305	20,225	25,007	38,300	558,645
	White Sugar	—	—	—	—	—	—	5,157	—	—	—	—	10,145	—	—	—	—	—	5,893	—	—	—	—	—	—	21,196
	Total	35,208	20,464	17,469	21,942	14,114	17,607	21,457	28,555	24,866	68,920	29,876	11,961	24,152	25,524	32,341	20,920	20,510	13,966	21,371	10,785	14,305	20,225	25,007	38,300	579,841
	Tons Sugar 96° Pol.	36,209	21,049	17,900	22,533	14,423	18,057	22,139	29,304	25,569	70,794	30,698	12,359	24,811	26,191	33,252	21,502	21,098	14,430	21,976	11,083	14,683	20,793	25,669	39,342	595,864
CANE/SUGAR RATIO	Tons cane per ton sugar made	8.01	8.06	7.68	7.60	7.37	7.25	7.93	7.60	8.00	8.18	8.31	9.28	8.89	7.84	8.13	8.60	8.67	9.26	8.67	8.81	8.81	8.35	8.10	8.09	8.18
	,, ,, ,, ,, ,, of 96° Pol.	7.79	7.85	7.50	7.40	7.20	7.07	7.69	7.40	7.87	7.96	8.09	8.98	8.66	7.60	7.92	8.40	8.43	9.56	8.43	8.50	8.58	8.10	7.90	7.87	7.96

Table XVII. Summary of chemical] control data for 1959.

(ii) CANE, BAGASSE AND JUICES.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	Labourdonnais	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savinia	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE	Sucrose per cent	14.09	14.15	14.59	14.60	15.08	15.40	14.62	14.56	13.96	13.62	13.50	13.03	12.69	14.16	13.95	13.10	12.80	12.74	12.96	13.06	13.11	13.39	13.73	13.76	13.76
	Fibre per cent	12.60	11.33	11.32	11.60	12.93	12.37	13.24	12.68	13.26	11.13	12.55	12.85	12.17	11.66	12.52	12.91	12.03	13.92	11.38	12.29	11.81	12.01	10.35	10.21	11.96
BAGASSE	Sucrose per cent	2.46	2.40	2.65	2.05	2.56	2.75	2.24	1.93	2.42	2.15	1.90	2.24	1.77	2.58	2.61	2.85	2.08	2.27	1.88	3.01	2.16	2.00	2.43	2.23	2.32
	Moisture per cent	49.64	51.20	48.15	46.54	47.24	48.56	49.58	48.72	46.90	49.70	46.90	45.10	48.77	48.61	48.60	49.47	46.28	46.18	48.30	48.00	47.80	49.75	49.80	50.00	48.32
	Fibre per cent	46.98	45.72	48.13	50.57	49.32	48.01	47.43	48.75	49.84	47.50	50.28	51.74	48.91	47.80	48.00	49.02	50.87	50.67	49.00	48.08	49.30	47.46	46.82	47.08	48.64
	Weight per cent cane	26.8	24.8	23.5	22.9	26.2	25.8	27.9	26.0	26.6	23.4	24.9	24.8	24.9	24.4	26.1	25.9	23.7	27.5	23.2	25.6	23.9	25.3	22.1	21.7	24.7
1st EXPRESSED JUICE	Brix (B_1)	19.82	20.01	20.32	19.83	20.85	21.10	20.87	20.13	19.35	18.66	18.99	18.19	18.02	19.57	19.13	17.93	17.68	18.32	18.08	17.77	18.33	18.65	18.30	18.34	19.09
	Gravity Purity	88.3	88.0	88.1	90.8	89.6	90.6	89.0	90.4	89.5	89.8	89.5	87.5	89.9	89.6	90.8	90.0	91.4	87.7	88.6	89.6	89.1	89.8	91.3	91.2	89.6
	Reducing sugar/sucrose ratio	3.3	3.4	2.6	2.5	2.4	2.1	3.0	2.2	3.5	2.6	2.8	3.5	2.6	2.6	3.2	2.7	2.3	3.0	3.5	2.5	2.7	2.1	2.8	2.1	2.8
LAST EXPRESSED JUICE	Brix	3.68	3.56	3.09	1.88	2.69	3.84	4.51	2.81	3.76	3.68	2.78	3.78	3.36	3.62	4.24	5.38	2.66	3.45	2.39	4.34	4.00	3.05	2.34	2.83	3.41
	Apparent Purity	72.8	77.5	71.1	71.8	74.6	80.3	75.0	76.4	73.6	76.7	66.9	71.7	76.1	71.9	76.4	81.3	72.9	73.8	69.1	77.8	76.4	71.9	71.4	76.2	74.3
MIXED JUICE	Brix	15.01	15.13	15.25	15.57	15.61	16.50	17.21	14.55	14.84	15.22	13.98	13.64	14.44	14.60	14.63	14.14	13.61	14,30	13.57	13.84	13.40	14.65	14.47	13.91	14.67
	Gravity Purity	86.4	85.2	86.4	88.4	87.7	89.1	86.4	88.2	87.6	87.8	86.7	85.5	87.3	87.5	89.2	87.5	88.9	85.6	86.3	87.2	85.7	87.6	88.9	88.9	87.3
	Reducing sugar/sucrose ratio	3.7	3.9	3.4	3.1	2.7	2.5	3.4	2.6	3.8	2.9	3.5	3.9	3.3	2.9	4.3	3.3	2.6	3.3	4.3	3.6	3.3	2.5	3.1	2.6	3.3
	Gty. Pty. drop from 1st expressed juice	1.9	2.8	1.7	2.4	2.0	1.5	2.6	2.2	1.9	2.0	2.8	2.0	2.6	2.1	1 6	2.5	2.5	2.1	2.3	2.4	3.4	2.2	2.4	2.3	2.3
ABSOLUTE JUICE	Brix (BA)	18.83	18.81	19.22	18.84	19.91	19.81	19.63	19.00	18.55	17.56	17.98	17.62	16.52	18.49	18.02	17.12	16.51	17.41	17.10	17.17	17.43	17.52	17.40	17.34	18.05
	$BA/(B_1)$	0.950	0.940	0.946	0.950	0.955	0.939	0.940	0.944	0.960	0.941	0.947	0.970	0.916	0.945	0.942	0.955	0.934	0.950	0.946	0.960	0.951	0.939	0.951	0.945	0.947
	Gravity Purity	85.6	84.8	85.6	87.7	87.0	88.7	85.9	83.9	86.8	87.3	85.9	84.8	87.4	86.7	88.5	87.1	88.1	85.0	85.5	86.7	85.3	86.8	88.0	88.4	86.6
CLARIFIED JUICE	Brix	15.48	15.01	15.20	15.62	16.02	16.84	17.17	14.56	14.81	15.24	14.28	13.42	14.47	14.63	14.96	14.28	14.35	14.27	13.55	13.82	13.68	14.74	14.70	14.12	14.80
	Gravity Purity	—	—	86.4	88.5	87.1	89.2	—	—	—	—	87.0	84.7	87.6	87.8	89.1	—	89.1	85.8	87.1	87.6	86.1	88.3	89.4	89.2	87.7
	Reducing sugar/sucrose ratio	3.7	3.7	3.4	3.0	2.9	2.4	3.3	—	3.7	3.1	3.5	3.9	3.2	2.7	4.2	3.3	3.0	3.3	3.6	3.1	2.9	2.6	3.3	2.6	3.2

Table XVII. Summary of chemical control data for 1959.

(iii) FILTER CAKE, SYRUP, pH, FINAL MOLASSES, SUGAR.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	Labourdonnais	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savinia	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Sucrose per cent	8.30	1.79	2.67	2.77	6.50	2.54	8.76	1.87	2.10	2.00	1.40	7.80	2.10	8.10	2.40	6.20	6.50	2.51	1.10	7.00	6.30	7.71	6.00	2.74	3.57
	Weight per cent cane	1.6	3.2	2.7	2.2	2.0	3.2	1.9	3.2	2.5	3.0	2.3	2.3	3.4	1.8	2.2	1.2	1.8	2.5	2.2	1.5	1.4	1.7	1.8	3.3	2.4
SYRUP	Brix	63.4	55.0	62.8	60.9	56.8	59.8	70.8	61.3	62.9	58.2	58.8	57.9	61.9	69.3	57.3	63.1	69.4	61.7	58.5	58.0	58.9	61.4	63.9	66.3	61.3
	Gravity Purity	—	—	85.1	88.0	—	88.8	—	—	87.3	88.5	87.0	84.6	87.6	88.0	89.3	—	89.5	86.3	88.1	87.8	86.6	88.2	89.1	89.3	87.9
	Reducing sugar/sucrose ratio	3.8	3.7	1.4	2.8	2.7	2.4	3.2	—	3.4	2.9	3.3	4.1	3.2	2.8	4.0	3.1	3.5	3.3	3.4	2.9	4.8	2.6	3.2	2.5	3.3
pH. VALUES	Limed juice	7.5	—	—	8.0	—	—	—	—	7.5	8.5	8.0	8.3	8.2	8.4	8.3	7.4	8.1	8.8	7.6	—	—	8.3	8.7	8.4	8.1
	Clarified juice	6.9	7.2	7.3	6.9	6.9	7.3	7.0	7.1	7.4	7.0	7.1	6.8	7.0	7.1	7.0	6.9	7.2	6.9	7.0	7.1	7.2	7.2	7.1	6.9	7.1
	Filter press juice	—	—	7.0	—	6.2	—	—	—	6.9	6.3	—	—	7.2	7.9	—	7.0	—	—	6.6	—	—	7.4	7.4	6.6	7.0
	Syrup	—	7.0	7.0	—	6.7	—	—	—	7.0	6.8	6.9	6.1	6.8	6.6	—	—	—	5.7	6.8	—	7.1	7.0	7.1	6.8	6.8
FINAL MOLASSES	Brix	98.6	96.7	94.0	93.2	97.7	95.4	94.5	92.7	94.2	94.2	97.3	92.8	95.1	91.8	95.6	92.1	93.7	97.2	96.5	92.3	96.7	92.9	92.1	95.5	94.7
	Sucrose per cent	33.9	36.0	36.1	36.9	34.4	37.0	35.4	35.6	32.0	35.7	34.6	35.3	33.6	32.9	35.5	33.6	34.1	36.9	36.9	34.8	36.3	36.5	34.1	35.6	34.8
	Reducing sugar per cent	16.2	13.8	15.0	14.2	12.7	11.5	11.8	13.5	15.0	11.7	16.6	13.6	12.7	15.2	15.4	16.0	16.7	14.0	12.2	—	9.9	13.2	13.2	12.7	13.8
	Total Sugars *	50.1	49.8	51.1	51.1	47.1	47.5	47.2	49.1	47.0	47.4	51.2	48.9	46.3	48.1	50.9	49.6	50.8	50.9	49.1	—	48.1	49.7	47.3	48.3	48.6
	Gravity Purity	34.4	37.2	38.4	39.6	35.2	37.7	37.5	38.4	34.0	37.9	35.5	38.0	35.3	35.8	37.1	36.5	36.4	38.0	38.2	37.7	37.5	39.3	37.1	37.3	36.7
	Reducing sugar/sucrose ratio	47.8	38.3	41.6	38.4	36.9	32.1	33.3	38.0	46.8	32.8	47.9	38.5	37.8	46.1	43.4	47.5	48.9	38.0	33.1	—	32.5	36.3	38.6	35.5	39.7
	Weight per cent cane at 95° Brix	2.34	3.08	3.00	2.60	2.63	2.48	3.26	2.59	2.79	—	2.63	2.82	2.68	2.49	2.52	2.06	2.34	2.97	2.38	—	—	2.51	2.40	2.10	2.53
SUGAR MADE †	White sugar recovered per cent cane	—	—	—	—	—	—	3.03	—	—	—	—	9.14	—	—	—	—	—	4.56	—	—	—	—	—	—	0.45
	Raw " " " "	12.48	12.40	13.02	13.08	13.58	13.78	9.59	13.21	12.36	12.23	12.03	1.64	11.24	12.76	12.30	11.64	11.53	6.24	11.53	11.34	11.35	11.97	12.35	12.37	11.77
	Total " " " "	12.48	12.40	13.02	13.08	13.58	13.78	12.62	13.21	12.36	12.23	12.03	10.78	11.24	12.76	12.30	11.64	11.53	6.24	11.53	11.34	11.35	11.97	12.35	12.37	12.22
	Average Pol. of sugars	98.73	98.74	98.37	98.59	98.32	98.45	99.05	98.52	98.71	98.61	98.64	99.20	98.62	98.51	98.70	98.67	98.75	99.19	98.72	98.65	98.54	98.69	98.54	98.61	98.65
	Total sucrose recovered	12.32	12.24	12.81	12.90	13.32	13.57	12.50	13.02	12.20	12.06	11.87	10.69	11.08	12.57	12.14	11.38	11.39	10.71	11.38	11.18	11.19	11.81	12.17	12.20	12.06
	Moisture content of raw sugar per cent	0.22	0.31	0.42	0.46	0.41	0.40	0.38	0.40	0.41	0.37	0.35	—	0.38	0.40	0.33	0.37	0.23	0.47	0.24	0.42	0.27	0.44	0.47	0.47	0.37
	Dilution indicator	21.3	32.6	34.7	48.5	32.3	34.8	47.0	37.0	46.6	36.3	34.6	—	37.7	36.7	34.0	38.5	22.9	62.0	23.9	45.3	22.7	50.1	47.5	51.0	37.8

* *Sucrose % + Reducing Sugars %.*

† *Provisional figures.*

Table XVII. Summary of chemical control data for 1959.

(iv) MASSECUITES.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	Labourdonnais	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savinia	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
A—MASSECUITE	Brix	95.4	93.9	95.0	94.4	96.1	93.6	94.7	95.3	95.6	94.6	96.7	95.0	93.6	94.9	93.5	92.8	95.0	94.2	93.2	94.3	95.2	94.4	94.6	94.0	94.6
	Apparent Purity	84.0	85.2	80.1	85.4	81.7	78.0	82.7	81.7	78.7	80.2	80.0	81.4	85.4	83.9	81.6	86.2	77.5	84.1	86.0	77.4	77.9	79.3	80.3	82.3	81.7
	„ „ of A—Molasses	63.5	64.9	58.5	65.7	59.4	57.8	58.5	58.9	53.8	60.5	55.0	65.8	66.5	61.4	60.8	67.0	55.0	67.9	67.1	57.3	62.1	60.0	58.3	63.8	61.6
	Drop in Purity	20.5	20.3	21.6	19.7	22.3	20.2	24.2	22.9	24.9	19.7	25.0	15.6	18.9	22.5	20.8	19.2	22.5	16.2	18.9	20.1	15.8	19.3	22.0	18.5	20.1
	Crystal per cent Brix in massecuite	56.2	57.8	52.0	57.4	54.9	47.9	58.3	55.7	53.8	49.9	55.5	44.3	56.4	58.3	53.1	58.2	50.0	50.5	57.4	47.1	41.7	48.3	52.8	51.1	52.3
	Cubic feet per ton Brix in Mixed Juice	28.5	23.6	31.0	29.9	30.0	37.2	35.0	37.0	24.7	31.0	28.9	26.7	25.6	28.9	31.5	32.2	35.4	27.3	27.0	30.3	28.8	32.0	27.2	35.0	30.3
	A—Massecuite per cent total massecuite	54.2	50.2	57.5	64.3	63.9	70.7	70.8	71.8	54.2	67.7	57.4	50.5	52.8	63.1	61.7	60.9	63.5	49.3	50.9	63.6	66.2	66.8	60.2	68.7	61.5
B—MASSECUITE	Brix	97.0	96.9	97.0	96.1	97.3	95.5	96.7	96.8	97.0	96.0	97.5	96.6	95.0	97.2	94.1	93.7	95.0	96.2	95.0	93.6	97.1	95.9	96.1	95.5	95.9
	Apparent Purity	70.0	71.0	68.6	73.0	67.7	68.9	71.8	69.7	69.7	69.9	67.8	72.4	72.1	66.3	71.7	75.1	63.8	74.4	74.9	67.5	70.3	71.6	69.2	72.6	70.6
	„ „ of B—Molasses	48.4	50.9	48.3	46.4	47.1	49.6	48.3	47.6	47.2	49.0	43.8	59.5	51.0	44.9	51.5	51.8	43.1	56.1	55.2	49.1	47.1	53.3	44.0	51.9	49.5
	Drop in purity	21.6	20.1	20.3	26.6	20.6	19.3	23.5	22.1	22.5	20.9	24.0	12.9	21.1	21.4	20.2	23.3	20.7	18.3	19.7	18.4	23.2	18.3	25.2	20.7	21.1
	Crystal per cent Brix in massecuite	41.9	40.9	39.3	49.6	38.9	38.3	45.5	42.2	42.6	41.0	42.7	31.9	43.1	38.8	41.6	48.3	36.4	41.6	44.0	36.4	41.7	39.2	45.0	43.0	41.7
	Cubic feet per ton Brix in Mixed Juice	14.8	13.9	13.4	10.3	9.8	9.2	4.7	8.1	14.3	7.3	12.6	14.4	15.1	10.4	11.8	12.1	12.4	16.3	17.0	10.1	5.6	9.4	11.4	9.6	11.1
	B—Massecuite per cent total Massecuite	28.0	29.6	25.7	22.1	20.8	17.6	9.6	15.7	31.2	16.1	25.0	27.3	31.1	22.6	23.1	22.9	23.6	29.5	32.2	21.2	12.8	19.5	25.3	18.8	22.6
	Kgs. Sugar per cubic foot of A & B Massecuites	18.5	20.7	18.3	20.3	20.8	18.0	19.7	18.4	20.8	21.3	19.3	15.2	19.7	21.0	19.1	18.6	18.2	17.5	18.0	16.9	22.5	19.6	21.5	18.6	19.6
C—MASSECUITE	Brix	100.0	99.4	100.3	98.9	102.5	99.4	98.3	99.1	99.5	98.5	100.1	99.9	98.6	100.8	98.6	97.0	98.6	100.6	99.5	97.5	100.0	97.5	98.6	101.3	100.1
	Apparent Purity	56.4	57.5	56.9	56.4	55.9	57.0	59.2	55.3	54.4	56.8	55.6	58.9	55.5	56.1	56.6	58.1	51.6	57.2	55.9	57.4	60.4	59.1	57.5	56.4	56.7
	„ „ of final molasses	29.2	35.4	33.6	36.8	33.9	33.7	34.1	35.1	29.7	34.7	30.7	38.0	32.1	29.6	31.4	31.0	31.5	33.2	38.2	34.7	36.3	35.8	32.1	33.4	33.1
	Drop in Purity	27.2	23.1	23.3	19.6	22.0	23.3	25.1	20.2	24.7	22.1	24.9	20.9	23.4	26.5	25.2	27.1	20.1	23.9	17.7	22.7	24.1	23.3	25.4	23.0	23.6
	Crystal per cent Brix in massecuite	37.4	34.2	35.1	31.0	33.3	35.1	38.0	31.1	35.1	33.8	35.9	33.7	34.5	37.6	36.7	39.3	29.3	35.9	28.6	34.8	37.8	36.2	37.4	34.5	35.3
	Cubic feet per ton Brix in Mixed Juice	9.4	9.5	8.8	6.4	7.2	6.2	9.7	6.3	6.6	7.4	8.8	11.8	7.7	6.6	7.7	8.6	6.8	11.7	8.9	7.1	9.2	6.6	6.6	6.4	7.8
	C—Massecuite per cent total massecuite	17.8	20.1	16.8	13.6	15.3	11.7	19.6	12.4	14.6	16.2	17.6	22.2	16.1	14.3	15.2	16.2	12.9	21.2	16.9	15.2	21.0	13.7	14.5	12.5	15.9
TOTAL MASSECUITE	Cubic feet per ton Brix in Mixed Juice	52.7	47.0	52.3	46.5	46.9	52.6	49.4	51.4	45.6	45.8	50.2	52.9	48.4	45.9	51.1	52.9	52.5	55.2	53.0	47.5	43.5	48.0	45.2	51.0	49.3
	„ „ „ sugar made	65.6	60.4	64.9	56.9	56.8	62.8	63.4	61.9	56.1	56.0	62.7	71.6	60.2	55.6	61.8	64.2	63.1	78.3	66.7	58.9	56.3	59.0	54.3	61.5	60.8

Table XVII. Summary of chemical control data for 1959.

(v) MILLING WORK, SUCROSE LOSSES & BALANCE, RECOVERIES.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	Labourdonnais	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ
MILLING WORK	Imbibition water % cane	30.4	29.9	29.6	25.7	31.5	25.6	22.0	35.5	28.8	21.6	32.4
	,, ,, % fibre	241	264	261	221	243	207	166	280	217	194	258
	Extraction ratio	37.3	37.2	37.7	27.8	34.3	37.2	32.0	27.2	34.7	33.2	27.9
	Mill extraction	95.30	95.79	95.73	96.78	95.56	95.40	95.80	96.55	95.40	96.30	96.50
	Reduced mill extraction	95.34	95.29	95.23	96.49	95.72	95.35	96.00	96.61	95.70	95.80	96.52
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.66	0.60	0.62	0.47	0.67	0.71	0.62	0.50	0.64	0.50	0.47
	,, ,, in filter cake % cane	0.14	0.06	0.07	0.06	0.13	0.08	0.17	0.06	0.05	0.06	0.03
	,, ,, in molasses % cane	0.83	1.11	1.07	0.94	0.90	0.89	1.15	0.91	0.89	0.84	0.93
	Undetermined losses % cane	0.15	0.14	0.02	0.23	0.06	0.15	0.18	0.07	0.18	0.16	0.20
	Industrial losses % cane	1.11	1.31	1.16	1.23	1.09	1.12	1.50	1.04	1.12	1.06	1.16
	Total losses % cane	1.77	1.91	1.78	1.70	1.76	1.83	2.12	1.54	1.76	1.56	1.63
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	4.68	4.21	4.27	3.22	4.44	4.60	4.24	3.43	4.58	3.67	3.48
	,, ,, filter cake % sucrose in cane	0.96	0.40	0.50	0.41	0.86	0.53	1.16	0.41	0.36	0.44	0.22
	,, ,, molasses % sucrose in cane	5.88	7.84	7.34	6.45	5.97	5.78	7.87	6.25	6.37	6.17	6.89
	Undetermined losses % sucrose in cane	1.04	0.99	0.12	1.58	~~0.04~~ 0.40	0.99	1.23	0.51	1.29	1.17	1.48
	Industrial losses % sucrose in cane	7.88	9.27	7.96	8.44	7.23	7.30	10.26	7.17	8.02	7.78	8.59
	Total losses % sucrose in cane	12.56	13.49	12.23	11.66	11.67	11.90	14.50	10.60	12.60	11.45	12.07
RECOVERIES	Boiling house recovery	91.8	90.3	91.7	91.3	92.4	92.4	89.3	92.6	91.6	91.9	91.1
	Reduced boiling house recovery (Pty. M.J.85°)	91.2	90.2	90.7	88.1	90.5	88.6	88.0	90.2	91.3	88.4	89.7
	Overall recovery	87.5	86.5	87.8	88.3	88.3	88.1	85.5	89.4	87.4	88.5	87.9
	Reduced overall revocery (Pty. M.J.85°, F% C12.5)	87.0	85.9	86.4	85.0	86.7	84.5	84.5	87.1	87.4	84.7	86.5
	Boiling house efficiency	99.5	100.1	100.9	99.2	99.5	99.1	98.1	100.3	100.0	99.9	98.7

		Ferney	Riche en Eau	Mon Trésor	Savinia	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MILLING WORK	Imbibition water % cane	31.7	21.5	30.2	27.7	25.8	25.4	26.5	30.2	27.3	33.6	25.7	24.7	29.0	27.5
	,, ,, % fibre	247	177	260	222	212	211	190	266	222	284	214	239	285	230
	Extraction ratio	33.5	28.7	38.1	39.2	46.4	31.9	35.1	29.6	48.0	33.8	31.5	37.7	34.4	34.1
	Mill extraction	95.70	96.50	95.56	95.10	94.35	96.16	95.11	96.63	94.10	96.00	96.20	96.10	96.49	95.92
	Reduced mill extraction	95.90	96.40	95.20	95.10	94.19	95.99	95.67	96.25	94.00	95.60	96.00	95.18	95.58	95.70
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.56	0.45	0.63	0.68	0.74	0.49	0.62	0.44	0.77	0.52	0.51	0.53	0.48	0.57
	,, ,, in filter cake % cane	0.18	0.07	0.15	0.05	0.07	0.12	0.06	0.02	0.10	0.09	0.13	0.11	0.09	0.09
	,, ,, in molasses % cane	0.97	1.02	0.79	0.90	0.69	0.79	1.07	0.88	—	0.98	0.90	0.82	0.75	0.88
	Undetermined losses % cane	0.62	0.07	0.02	0.18	0.12	0.01	0.27	0.24	—	0.33	0.04	0.10	0.24	0.16
	Industrial losses % cane	1.77	1.20	0.96	1.13	0.88	0.92	1.40	1.14	1.11	1.40	1.07	1.03	1.08	1.13
	Total losses % cane	2.33	1.60	1.59	1.81	1.62	1.41	2.03	1.58	1.88	1.92	1.58	1.56	1.57	1.70
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	4.30	3.50	4.45	4.87	5.65	3.84	4.89	3.37	5.90	4.65	3.97	3.86	3.51	4.14
	,, ,, filter cake % sucrose in cane	1.38	0.58	1.06	0.36	0.53	0.93	0.49	0.19	0.77	0.78	0.98	0.80	0.65	0.65
	,, ,, molasses % sucrose in cane	7.44	8.02	5.58	6.45	5.27	6.14	8.41	6.76	—	8.75	6.67	5.97	5.44	6.40
	Undetermined losses % sucrose in cane	4.76	0.55	0.14	1.29	0.92	0.09	2.14	1.85	—	2.98	0.32	0.73	1.77	1.16
	Industrial losses % sucrose in cane	13.58	9.14	6.78	8.10	6.72	7.16	11.04	8.80	8.50	12.51	7.97	7.50	7.86	8.21
	Total losses % sucrose in cane	17.88	12.69	11.23	12.97	12.37	11.00	15.93	12.17	14.40	17.16	11.76	11.36	11.37	12.35
RECOVERIES	Boiling house recovery	85.8	90.5	92.9	91.5	92.9	92.6	88.4	90.9	90.9	88.8	91.7	92.2	91.9	91.4
	Reduced boiling house recovery (Pty. M.J.85°)	85.2	88.4	91.2	87.6	91.1	89.5	88.4	89.9	89.1	88.3	89.6	88.9	88.5	89.6
	Overall recovery	82.1	87.3	88.8	87.0	87.6	89.0	84.1	87.8	85.6	85.2	88.2	88.6	88.6	87.6
	Reduced overall revocery (Pty. M.J.85°, F% C12.5)	81.7	85.2	86.9	83.3	85.8	85.9	84.6	86.5	83.7	84.4	86.0	84.7	84.6	85.7
	Boiling house efficiency	95.2	97.5	100.3	98.0	100.6	99.3	97.9	100.0	99.2	97.8	100.4	98.9	98.6	99.3

Table XVIII. Production and Utilisation of Molasses.

Year	Production M. tons	Exports M. tons	Used for production of alcohol M. tons	Available as fertilizer M. tons	N.P.K. equivalent in molasses available as fertilizer M. tons		
					N	P_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