MAURITIUS SUGAR INDUSTRY RESEARCH INSTITUTE

ANNUAL REPORT 1962

Mauritius Sugar Industry Research Institute

ANNUAL REPORT 1962

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CORRIGENDUM

Mauritius Sugar Industry Research Institute

Annual Report 1963

Page 138, 6. Chemical Control Notes

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

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SUGAR MANUFACTURE

BY-PRODUCTS

APPENDIX

Photograph on the cover is of the main buildings of the M.S.I.R.I. at Réduit during the XIth Congress of the I.S.S.C.T., September 1962.

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REPORT OF THE CHAIRMAN

EXECUTIVE BOARD 1962

THE Board held 11 meetings during the year, three of which jointly with the Research Advisory Committee. The only changes on the Board were Mr. Pierre de Comarmond who replaced Mr. L. de Chazal, and myself who replaced Mr. Raymond Hein, Q.C., as Chairman.

I should like here to congratulate my predecessor on the excellent work he has accomplished as Chairman of the Board for the past five years, work which has made my task considerably easier.

ESTABLISHMENT

For the first time since the Institute started in 1953, there were no changes or new appointments during the year

Mr. A. Wiehe was re-appointed Consulting Sugar Technologist.

Mr. J. Maurice Paturau, who had been appointed Consulting Sugar Technologist in 1958, assumed his new duties of Minister of Industry, Commerce and External Communications, and had consequently to interrupt his direct association with the Institute. I wish to place on record my sincere congratulations to Mr. Paturau on his new appointment, and extend to him our warmest thanks for the invaluable services he has rendered to this Institute.

AIME DE SORNAY FOUNDATION

The second scholarship awarded by this Foundation, which was created in 1960 to perpetuate the memory of our regretted Plant Breeder, was awarded to Mr. Lim Sow Tin who came out third in the Entrance Examinations of the College of Agriculture.

FINANCE

It had been foreseen in 1958 that the present level of cess would be insufficient to support a fully developed Institute in 1962. The fact that the deficit is comparatively small is due to the strict economy exercised by the Administration throughout the year. If the Institute is to continue to serve the industry without any deterioration in the services previously rendered, a sufficient income must be provided in 1963. A research organization, preoccupied with a shortage of essential finance, cannot be expected to continue to remain at a high level of efficiency. This question has caused considerable concern to the Board during the past year, and an approach will have to be made to the industry in 1963 with a view to putting the finances of the Institute on to a sound basis, unless the industry is prepared to accept a reduction in the services rendered by the Institute and in the efficiency of its research.

I. S. S. C. T.

The XIth Congress of the International Society of Sugar Cane Technologists was held at the Institute from Monday the 24th September to Friday the 5th October 1962. One hundred and eighty five delegates from thirty four overseas territories and about two hundred local members were present in the Bonâme Hall of the Institute on the day of the opening session. Our Director, who was General Chairman of the Congress, had the cumbersome task of its organization. In the opinion of all concerned, the Congress was highly successful. For such a brilliant achievement, I would like to congratulate him, his staff, estate managers, and all those who helped in the organization of this International Conference.

In concluding this report, I wish to express my personal thanks to my colleagues of the Board for their valuable co-operation, and the Board's appreciation of the excellent work done again this year by Dr. Wiehe and his devoted staff.

P. Giraud

Chairman

31st. January, 1963.

REVENUE AND EXPENDITURE ACCOUNT

YEAR ENDED 31st DECEMBER, 1962

Running & Administrative Expenses ...	1,482,271.71	Cess on sugar exported	1,612,322.22
Herbarium Expenses	1,043.12	Miscellaneous receipts	103,010.66
Interest paid	21,458.21	Excess of Expenditure over Revenue for the year, deducted from Accumulated Funds ...	13,757.88
Leave and Missions Fund	100,000.—		
Depreciation	124,317.72		
Rs.	1,729,090.76	Rs.	1,729,090.76

BALANCE SHEET

AS AT 31st DECEMBER, 1962

ACCUMULATED FUNDS	1,473,033.53	FIXED ASSETS (at cost less depreciation and amounts written off)		
REVENUE FUNDS	84,577.93	Land & Buildings ...	1,695,034.86	
SPECIAL STUDIES FUND	4,630.67	Equipment & Furniture :		
AIMÉ DE SORNAY FOUNDATION ...	25,000.—	Laboratories, Houses & Offices	49,469.18	
GROUND WATER RESEARCH FUND ...	360,548.12	Agricultural Machinery & Vehicles	36,247.—	1,780,751.04
LOAN FROM ANGLO MAURITIUS ASSURANCE SOCIETY LTD. ...	357,916.—	CURRENT ASSETS		
GOVERNMENT OF MAURITIUS (Purchase of Buildings)	153,263.40	Sundry Debtors ...	46,424.97	
		Aimé de Sornay Foundation Account	25,000.—	
		Aimé de Sornay Scholarship ...	19.50	
		Cash at Bank & in hand (*Ground Water Research Fund Account*) ...	360,548.12	
		Cash at Banks & in hand ...	246,226.02	
				678,218.61
Rs.	2,458,969.65		Rs.	2,458,969.65

(sd) Ph. ESPITALIER-NOEL
(sd) G. ROUILLARD } *Board Members*

(sd) P. O. WIEHE *Director.*

AUDITORS' REPORT

We have examined the Books and Accounts of the Institute for the year ended 31st December 1962, 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 1962, according to the best of our information and the explanations given to us and as shown by the Books and Accounts of the Institute.

Port Louis,
Mauritius,
February, 1963.

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

p.p. de CHAZAL, DU MÉE & Co.
Chartered Accountants.

INTRODUCTION

THE cover of this 10th Annual Report commemorates an event of outstanding importance in the annals of the Sugar Industry Research Institute. Mauritius acted as host country to the International Society of Sugar Cane Technologists for its XIth Congress which was held at the Institute from 24th September to 5th October.

In co-operation with many personalities outside the Institute, all members of the staff took an active part in the various aspects of organizing this conference. An exacting task, which found its rewards through the many valuable and stimulating discussions, the free interchange of technical information and opinions, and through professional contacts firmly established at a personal level.

Mr. F. C. Bawden, M.A., F.R.S., Director of Rothamsted Experimental Station, was guest of honour on this occasion. In a remarkable address on *the role of research in the development of modern agriculture*, he emphasized the importance of the application of research, well illustrated in the following quotation :

> «...No industry can advance without research, but research alone, however good, will not automatically benefit an industry; research is of use only when practitioners are willing and able to act on its results...».

THE 1962 SUGAR CROP

For the third year in succession, Mauritius produced a sub-normal sugar crop in 1962 because of adverse climatic conditions. These were in order of importance : two major cyclones *Beryl* in December and *Jenny* in February; a wet grinding season from September to November, 3.4" of rain in excess of the average; and sub-normal temperatures during four months of the growing season, January, April, May and June. In addition, arrowing was especially heavy for Mauritius conditions and probably had a detrimental effect on yields towards the end of the crop.

The main production statistics, comparing the 1962 harvest with that of the preceding year, are given below :

	1962	*1961*
Area harvested, arpents	192,900	187,800
Weight of cane, met. tons	4,624,500	4,945,000
Tons cane per arpent :		
Island	24.0	26.4
Estates	28.0	32.2
Planters	19.8	20.5
Sugar manufactured % cane	11.52	11.18
Tons sugar per arpent (98.6 pol.) :		
Island	2.76	2.95
Estates	3.22	3.60
Planters	2.28	2.29
Sugar production met. tons (98.6)	532,640	553,260

The general pattern of rainfall and temperature distribution is shown in fig. 1, and the influence of climatic factors on production is analysed in greater detail in chapter VI. Exceptionally heavy rains in December undoubtedly caused serious losses of surface soil and nutritive elements through leaching and run off, but it is difficult to assess quantitatively the effect of this factor. Sub-normal temperatures prevailed during four months of the growing season reducing cane yields by 0.8 tons par arpent, equivalent to 154,000 tons of cane, or 16,600 tons of sugar for the island as a whole. Losses brought about by excessive rainfall between September and November reduced sucrose content of the cane by 0.85 units, thus accounting for 39,000 tons of sugar on the weight of

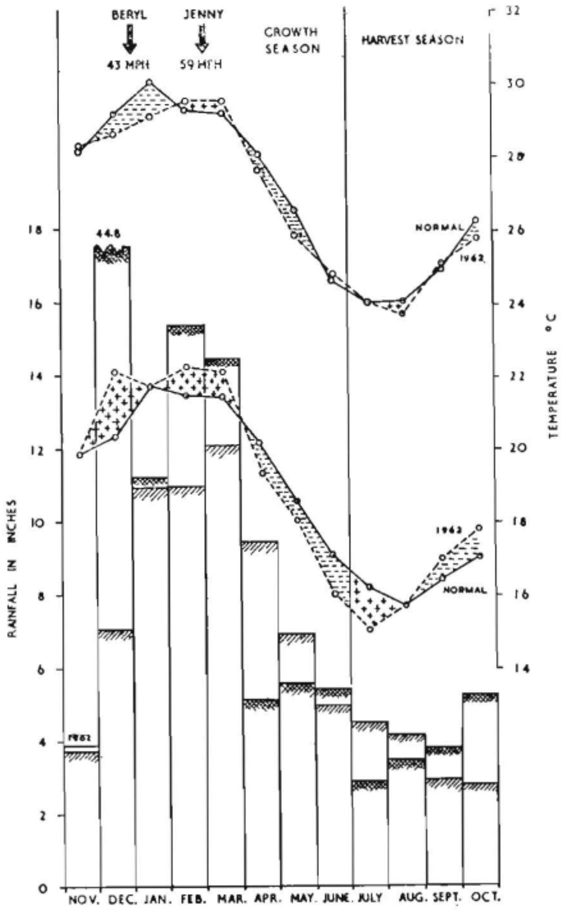

Fig. 1. Rainfall and temperatures (max. & min.) compared to normal during growing and harvest seasons of 1961–1962. The beneficial or deleterious effects on growth and maturity are indicated by + or — signs.

cane reaped. Finally, cyclones have caused an estimated reduction of 60,000 tons of sugar.

These adverse factors were more marked in the central plateau and upper regions of the eastern and southern sectors. This is reflected in fig. 2, in which yields of cane and sugar in different sectors are shown for 1962. The high cane yields registered in the North emphasize the importance of the temperature factor when rainfall is not limiting. Cane yields in successive ratoons is shown in fig. 3. Virgin canes suffered less than ratoons, possibly because of the larger proportion of short-season canes which were not so vulnerable to cyclonic winds.

The harvest season started on the 4th July and was completed on the 22nd December. The average duration of harvest, including Sundays and public holidays, extended over 138 days varying, in individual factories, from 99 to 158 days. The course of ripening of the cane is shown in fig. 4 which clearly indicates the disastrous effect of heavy rains, in September and October, on sucrose content. Sugar production in the 23 factories of the island ranged from 11,400 to 55,500 metric tons. Approximately 3.5% plantation white sugar was produced for local consumption.

The more important data relative to factory performance are summarized below in comparison with those of the previous crop. Chemical control data are given in detail in tables (i) to (v) of Appendix XVII.

	1962	*1961*
Harvest started	4th July	26th June
Harvest ended	22nd. Dec.	29th. Dec.
Tons cane per hour	91.0 (52.0 to 212.3)	92.8 (51.8 to 222.4)
Sucrose % cane	13.19	12.81
Fibre % cane	13.85	12.61
Molasses % cane (95° Brix)	2.67	2.80
Purity mixed juice	85.9	85.2
Reduced mill extraction	95.8	95.8
Sucrose % bagasse	2.18	2.09
Reduced boiling house recovery	89.7	89.7
Reduced overall recovery	85.9	85.9
Total losses sucrose % cane	1.83	1.78

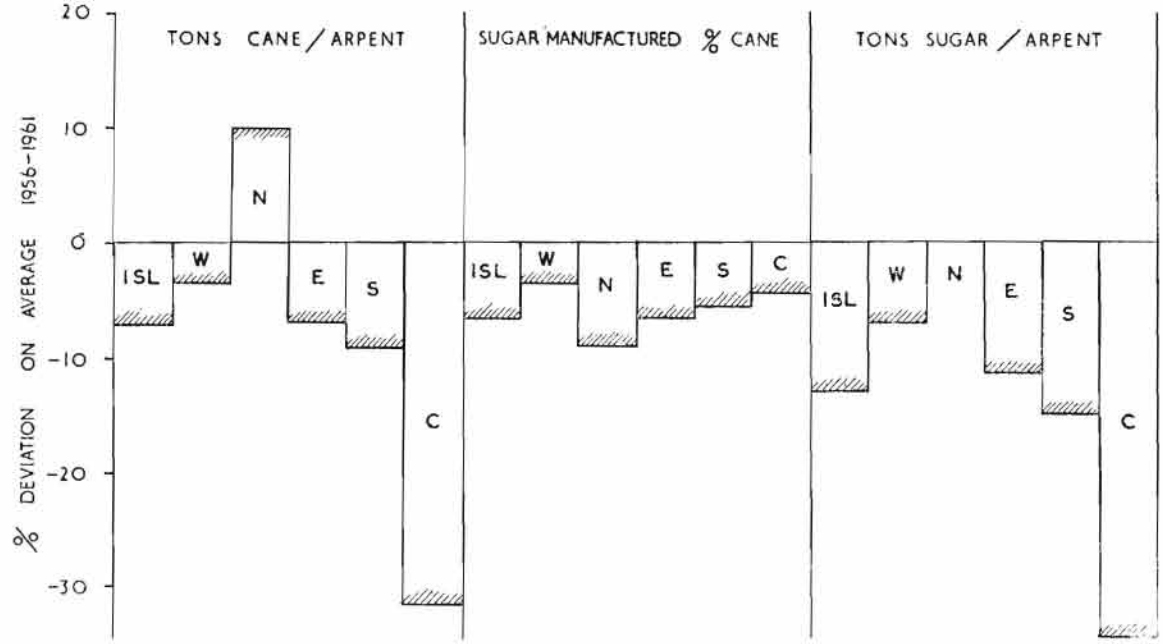

Fig. 2. Deviations in cane and sugar yields in 1962 in different sectors of the island, in relation to the average during 1956–1961 (1960 included).

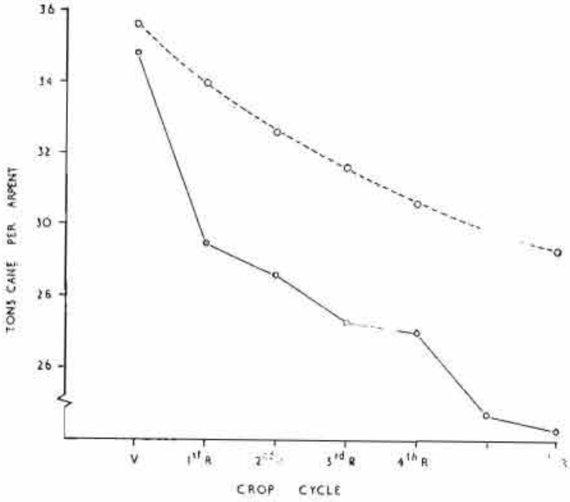

Fig. 3. Average yields of virgins and ratoon canes on estates. Plain line: 1962; broken line: average 1956–1961 (1960 excluded).

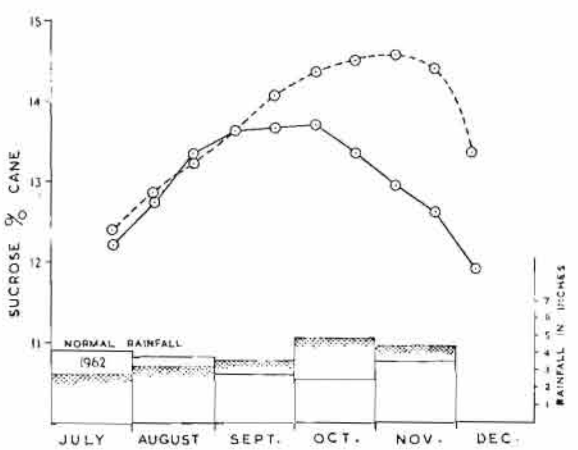

Fig. 4. Maturation curves, island average. Plain line: 1962; broken line: average 1956–1961 (1960 excluded). Monthly rainfall shown in columns.

CANE VARIETIES

The area cultivated under different varieties by estates shows the following changes over 1961 (c.f. Appendix X): M.134/32 and Ebène 1/37 decreased by 6% and 2% respectively, while there was an increase of 4% for M.147/44, 2% for M.93/48 and 1% for each of M.202/46 and Ebène 50/47. The area under M.31/45, M.253/48 and the three Barbados varieties remained the same. As regards the varietal composition of the crop crushed, M.147/44 accounted for nearly 31% of the 2.75 million tons of cane produced by estates. Ebène 1/37 followed with 17.7%, M.134/32 and B.37172 each represented 13.5% of the total.

These data are more clearly shown by means of histograms in fig. 5 for the different sectors of the island. They illustrate the important place occupied by M.147/44 in most sectors except the central plateau where Ebène 1/37 was still the leading variety in 1962. Of the 3 Barbados varieties cultivated commercially, B.37172 was generally the most important, B. 3337 retaining its place under inferior environmental conditions in the wetter parts of the South and Centre, while B.34104 formed an important fraction of the crop in the West.

The areas planted in 1962 are given in detailed form in Appendix XI and illustrated in fig. 6. The dominant variety for the island as a whole was M.147/44 which occupied nearly 29% of plantations. Varieties each representing over 10% of the area were in order of importance : M.93/48, M.202/46 and Ebène 50/47. The trend in varieties in different sectors follows the course indicated in previous years, and is diagrammatically summarized in fig. 7.

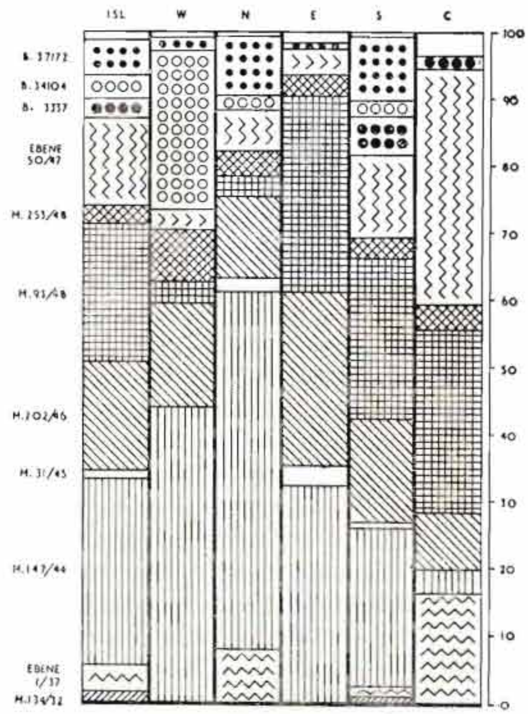

Fig. 6. Varietal composition of plantations made in 1962 on estates.

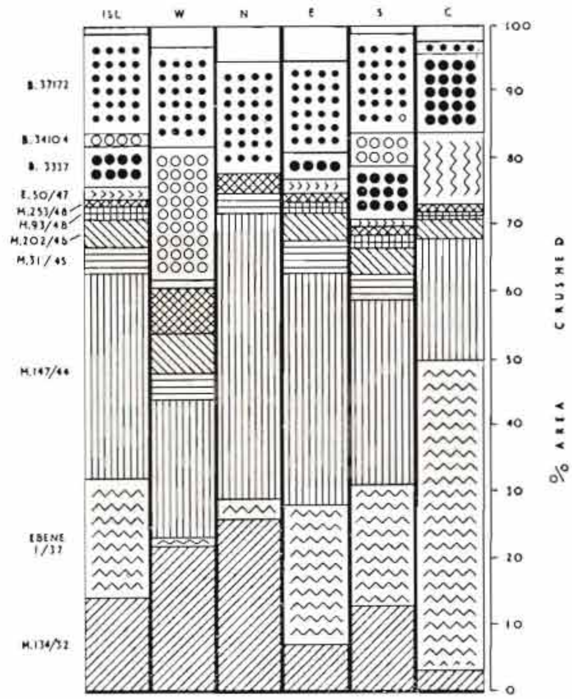

Fig. 5. Varietal composition of 1962 crop in different sectors.

The average yield of different varieties for all estates of the island were as follows :

(*a*) *Varieties released before 1959*

M.147/44	33.7 T.C.A.	(120)
B.37172	32.5	(116)
B. 34104	30.0	(107)
M. 134/32	27.4	(98)
M. 31/45	25.8	(92)
B. 3337	21.9	(78)
Ebène 1/37	21.6	(77)

(*b*) *Varieties released after 1959*

M. 253/48	37.0	(132)
M. 202/46	32.5	(116)
M. 93/48	28.2	(101)
Ebène 50/47	25.6	(91)

Weighted Average 28.0 = 100

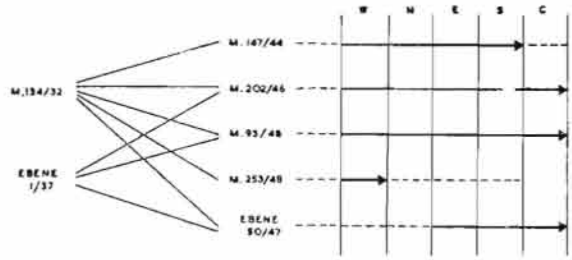

Fig. 7. Trend in cane varieties in different sectors.

Deviations from average yields are illustrated in fig. 8. Varieties released after 1959 are shown in a separate group because they occupied only a small fraction of the total and were mostly in the early stages of the crop cycle. It is difficult to evaluate the relative merits of commercial varieties from these results since, on the one hand, they are not uniformly distributed in different sectors, while on the other hand, climatic conditions were more detrimental to growth in some sectors than others.

An analysis of cane yields in different parts of the island, however, shows the following points of general interest :

(a) M.147/44 has given the best results, partly because of its outstanding resistance to cyclones.

(b) M.31/45 has produced yields below average in all sectors.

(c) Both Ebène 1/37 and B.3337 were much affected by high winds.

(d) B.37172 performed exceedingly well in all sectors, except the Centre.

(e) Of the more recently released varieties, M.253/48 gave very high yields under irrigated conditions. Both M.202/46 and M.93/48 have produced above average yields, although those of the latter were influenced by the fact that a large proportion of short season virgin canes were harvested. Ebène 50/47 performed best in the Centre where it outyielded Ebène 1/37 by 9 tons per arpent.

Finally, it is interesting to point out that

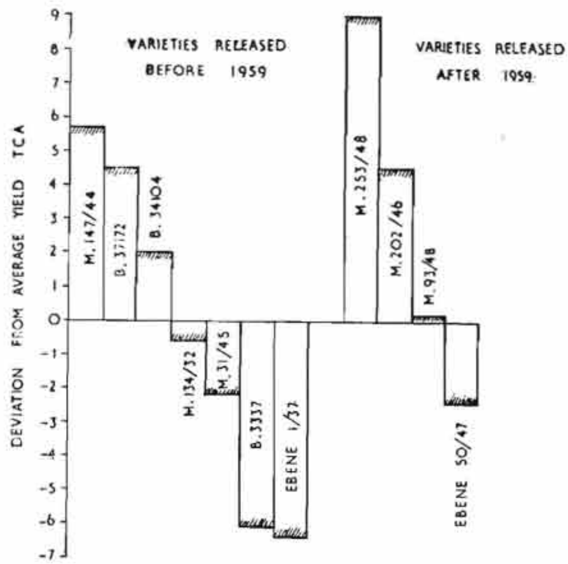

Fig. 8. Yield deviation of commercial cane varieties in 1962. Varieties released after 1959 are shown separately.
Average yield all varieties = 28 tons/arpent.

M.134/32, which still occupies 25% of the area cultivated in the North, produced 9 tons of cane less per arpent than M.147/44 in that region. These results confirm experimental data from one trial situated in a typical locality in the North where the following results were obtained :

Average 4 crops : 1959 (virgins) to 1962 (3rd. R.)

	T.C.A.	*S.M.%C.*	*T.S.A.*
M.134/32	21.7	10.4	2.25*
M.147/44	31.6	10.3	3.25*
M.202/46	27.3	10.8	2.94
M.93/48	27.3	10.4	2.84
B.37172	26.1	10.2	2.66

In view of these data, it is surprising to note that 8% of the 1962 plantations in the North were composed of M.134/32.

A more critical appraisal of recently released varieties can be made from the results of «final variety/fertilizer» trials, 10 of which were harvested in 1st ratoons in the 4 climatic

* There is statistically less than one chance in 100 that this difference could occur by chance.

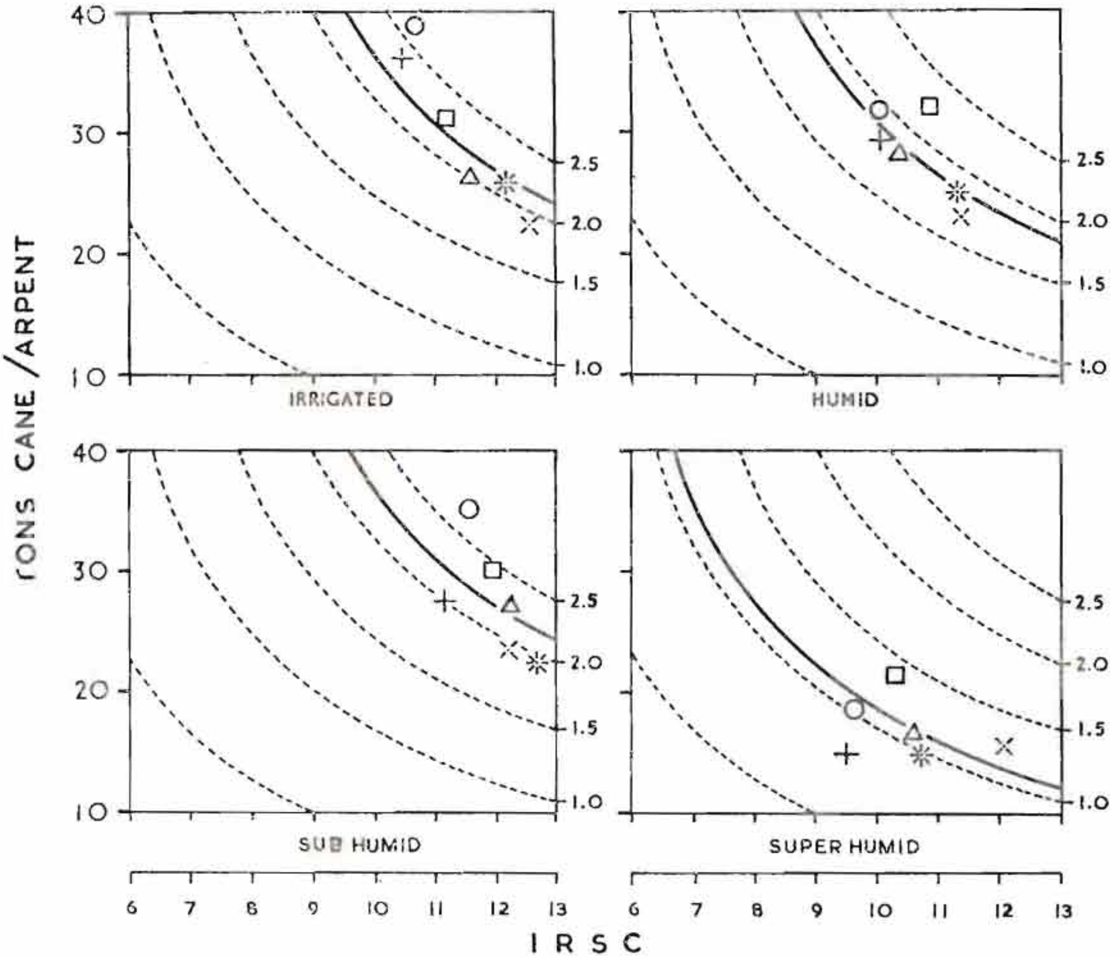

Fig. 9. Benefit curves at levels of 1.0 to 2.5 tons sugar per arpent with corresponding yields of six varieties under four environmental conditions.

Average benefit for the six varieties studied shown as a plain curve.

O = M. 147/44; Δ = M. 202/46; □ = M. 93/48; + = M. 253/48; × = Ebène 1/37; * = Ebène 50/47.

zones. The performance of these varieties, based on Hugot's formula,* in comparison with the two standards M.147/44 and Ebène 1/37, is shown separately for each set of environmental conditions in fig. 9. It will be recalled that low-sucrose varieties are relatively more penalized than high-sucrose varieties when a deduction of 4 is made from the recoverable sugar. The benefit curve for the average of each group of trials is also indicated and permits a rapid assessment of the relative performance of different varieties. These varieties which occur above the average curve are superior, and those below are inferior, in terms of «net» commercial sugar production. The results indicate that, of the 4 varieties tested, M.93/48 is the most adaptable, having performed better, or creditably well, under the 4 environmental conditions. M.202/46 has performed moderately well under both sub-humid and humid conditions. M.253/48 has been outstanding in the irrigated trials. Ebène 50/47 produced its best results under humid conditions. Variations in sucrose content at different periods of the harvest season are shown in fig. 10. In this connection, it is important to refer to the close agreement between the average quality of all varieties as determined in the laboratory ** and the corresponding weekly figures at factories where the trials were situated (fig. 11).

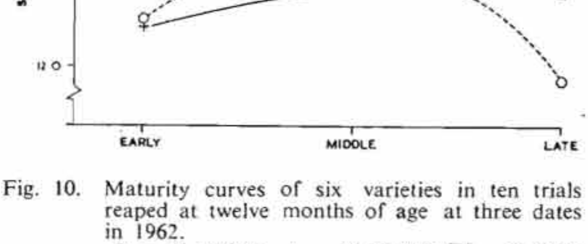

Fig. 10. Maturity curves of six varieties in ten trials reaped at twelve months of age at three dates in 1962.
O = M.147/44; Δ = M.202/46; □ = M.93/48
+ = M.253/48; × = Ebène 1/37; * = Ebène 50/47.

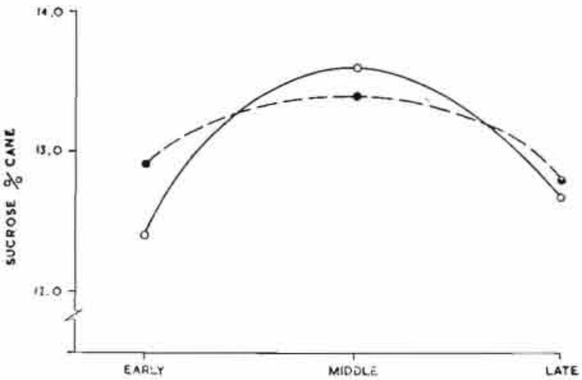

Fig. 11. Seasonal variation in sucrose content of six varieties (plain line) compared to factory data (broken line).

These trials also afforded an excellent opportunity of assessing the resistance of new varieties to cyclones. Broken canes were counted in the 10 experiments under reference immediately after cyclone *Jenny*, observations being made on the number of canes broken at the base, or higher up along the stalks.

The results obtained were as follows :

		% cane	
		broken at base	*above base*
M.147/44	...	1.2	2.8
M.93/48 ...	...	2.5	2.1
M.253/48	...	4.6	4.4
Ebène 50/47	...	1.9	12.8
Ebène 1/37	...	9.2	10.9
M.202/46	...	2.1	27.0

The high resistance of M.147/44 and M.93/48 is clearly demonstrated by these data in the same way as is shown the great vulnerability of M.202/46 to high winds. It is interesting to note that, in spite of the very large number of broken canes, — up to 50% in one trial in the North — M.202/46 has recuperated beyond expectation to produce reasonable yields at harvest. Susceptibility of a variety to cyclones cannot be expressed in terms of its fragility alone, but must take also into account,

* c. f. *Ann. Rep. Sug. Ind. Res. Inst. Mauritius*, 1959 : 16, 42. $\text{Benefit} = \frac{\text{TCA (IRSC-4)}}{100}$

** c. f. *Ann. Rep. Sug. Ind. Res. Inst. Mauritius*, 1960 : 103.

besides the age of the cane, its ability to recover, as the following data indicate :

	Average 10 trials % broken canes February	Yield TCA
M.147/44 ...	4	30
M.93/48 ...	5	27
M.253/48 ...	9	25
Ebène 50/47 ...	15	21
Ebène 1/37 ...	20	21
M.202/46 ...	29	24

In concluding this chapter, it may be opportune to summarize our present knowledge of the agronomic characteristics of the four varieties released since 1959.

M.202/46. A thick-stalked, very vigorous variety, sucrose content higher than M.93/48 and less fibrous, ratoons well, trashes easily, appears to be fairly resistant to drought and more resistant to the stalk borer than M.93/48. Its range of adaptation seems to be more restricted than that of M.93/48, and it is doubtful whether it will perform as well in regions receiving more than 100″ of rain annually. Arrows freely, should not be grown as a *grande saison* cane. Like M.93/48, it should be harvested in plant cane at ages not exceeding 14 to 15 months. The more important defects of M.202/46 are its extreme susceptibility to high winds; the stalks are brittle and the foliage is easily shredded. From experience gained in 1962, it appears to recover quickly from cyclone damage, particularly in warmer areas.

M.93/48. A vigorous variety with a wide range of adaptation to different environmental conditions. Highly resistant to cyclones. Sucrose content : medium ; fibre : high ; ratoons well, trashes easily, is a shy arrower. This variety should play an important role in the super-humid zone. The defects of M.93/48 include slow germination, which can, however, be markedly improved by the short hot-water treatment (52° for 20 mins or 50° for 1/2 hr); a tendency to produce a large number of small shoots from stumps after harvest — hence the importance of ensuring that the stalks are cut as close as possible to the ground; and susceptibility to ratoon stunting disease, a weakness which it shares with the three other varieties released after 1959, but which can be overcome by the establishment of disease-free nurseries.

M.253/48. Probably the highest cane-producing variety which has been released in Mauritius, but with a very restricted range of adaptation. A thick-barrelled cane, which trashes easily and does best under irrigated conditions. Its defects are : low sucrose content and very low fibre, very high susceptibility to chlorotic streak, susceptibility to sour rot if it is harvested after 14 or 15 months of age.

Ebène 50/47. The most important attribute of this variety is its high sucrose content, but it has a restricted range of growing conditions, performing best under humid conditions. Ebène 50/47 is a free arrower, moderately susceptible to cyclones and does not tolerate drought.

CANE BREEDING AND SELECTION

Flowering in 1962 was especially heavy and was conducive to the fulfilment of an interesting and extensive breeding programme. Over 1000 crosses were made during the season both at Pamplemousses and at Réduit, involving the use of 170 parent varieties in different combinations. Crossing at the latter station was made easier by the construction of a new greenhouse especially designed, with 22 – foot headroom to allow the handling of even very tall cane stalks. The house was finished towards the end of the tasselling period so that it will be used to the optimum only in future years.

Fuzz was dried after ripening and stored from three to four months in a deep freezer to be sown during November and December. This innovation permitted the transfer of the work of sowing and potting from the very busy time of selection to a slacker period of the year. Germination of the fuzz was excellent and it is estimated that 120,000 seedlings have been raised. A portion of the fuzz has been stored to insure against a future year of low fertility.

Potting is still in progress. Transplanting in the field is expected to take place in March - April 1963.

Experiments were continued on the isolation of arrows for crossing and improving the reliability of seed setting. Genetical and statistical studies on seedling selection continue especially with regard to bunch planting and selection rates applicable at various stages of selection.

The number of seedlings and varieties in the course of selection is given below. In order to show the great increase in the current programme of variety testing, comparative figures for 1959 are given in brackets.

(i)	Seedlings raised in 1962 for selection in 1964	93,776	(41,000)
	(a) singly planted ...	18,734	
	(b) No. of bunches of 3 seedlings initially ...	75,042	
(ii)	Seedlings planted out in 1961 for selection in 1963, approximately	74,000	(13,000)
(iii)	Seedlings raised in 1959 and 1960 and now in bunch selection plots to be selected in 1963 and 1964	7,495	
(iv)	1957, 1959, 1960 seedlings now in propagation plots ...	2,715	(1,500)
(v)	Varieties (1956 to 1958 series) in first selection trials ...	410	(437)
(vi)	Varieties in multiplication for planting in variety trials in 1963 (1954 to 1957 series)	46	(11)
(vii)	Varieties in variety and pre-release trials on estates		
	(a) M' 46 to '57 series ...	91	(72)
	(b) Ebène varieties ...	6	
	(c) Foreign varieties	7	

A major step forward in variety testing which will considerably speed up the evaluation of promising new canes was initiated in 1962. All varieties selected from first selection trials are multiplied in a propagation plot which will provide sufficient planting material eight months later to establish 16 variety trials, four in each of the climatic zones. Thus a study of each variety in four environments will begin soon after its selection from first selection trials.

Through the generous co-operation of the Manager of Médine Sugar Estate, who kindly placed 2 1/2 arpents at the disposal of the Institute this year, 46 varieties of the 1954-1956 series were planted in a propagation plot in September, and will provide sufficient cuttings for establishing variety trials in May - June 1963.

The main results of variety trials are summarized in another section of the report. The following are the varieties which are worth mentioning here, by virtue of either present or previous promise :

M. 248/48. Because of its good performance in a variety trial on one estate, the potential of this variety and its range of adaption are being studied at various sites.

M. 423/51. This is a rich variety which is still being tested in a series of variety and pre-release trials. Results so far seem to indicate that it is equivalent to Ebène 1/37 both in sugar per arpent and regional adaptation.

M. 442/51. This variety has given extremely promising results in all regions of the island, chiefly on account of high weight of harvested cane. The sugar content is better than that of M. 147/44.

N: Co. 376 has shown early promise in both the super-humid and irrigated regions, but it will be necessary to make a more widespread evaluation of the variety before its value is finally assessed.

N: Co. 310 and **R. 397** have been found to have a restricted application, showing promise in only the irrigated regions of the island. More thorough tests of these two canes will be initiated in 1963.

M. 409/51, **M. 658/51** and **M. 13/53** are all high-sugar varieties which appear to have a future, but which are still in the course of more extensive testing.

The varieties **M. 305/49**, **M. 81/52**, **M. 272/52**, **P. R. 1000** and **B. 41227** have been dropped from the variety testing programme for several reasons, including leaf scald susceptibility (M. 81/52) and poor cane yields (M. 272/52, P.R. 1000, M. 305/49 and B. 41227).

NUTRITION AND SOILS

Nitrogen. This nutrient, on which the sugar industry spends annually about ten million rupees, continues to receive much attention from the point of view of levels of application and form of fertilizer. Investigations are continuing on the effect of nitrogenous fertilization on yield of cane and sugar, as well as on the chemical composition of the cane plant.

Weather conditions prevailing since 1960 have imposed a severe handicap on experimental work, reducing plant analytical and yield data during that period to negligible amounts.

The nitrification rate of the ammonium ion applied as ammonium sulphate to the soil has been studied under field conditions in 1961 and 1962. Nitrification was found to be rapid, being completed in less than three months. In the absence of a cover crop, the nitrate was completely removed from the soil by leaching.

Many nitrate-containing fertilizers are now on the market, and as no price differential between the nitrate and ammoniacal forms exists, planters are interested in these newer materials.

No data are available in the scientific literature, either from overseas or in Mauritius, to show that nitrate nitrogen *per se* is superior to the ammoniacal form as regards yields of sugar.

As has been demonstrated, the transformation of the ammonium ion into nitrate by soil micro-organisms, is fairly rapid and therefore the ammoniacal fertilizers provide both nitrate and ammonium ions to the growing plant.

On the other hand, the nitrification process does increase soil acidity. Close attention, however is being given to base-depletion, particularly in the soils of the super-humid zone, where liming with coral sand is now generally recommended when the pH falls below 5.

Nitrate is extremely mobile in the soil, and theoretically, it is readily leached out of the solum. There is no doubt that it is probably unwise to apply high levels of nitrate to wet soils subject to heavy rains. Such conditions pertain to the super-humid zone, particularly at the end of each year, the peak period for fertilizer applications.

Phosphorus. The high levels of rock phosphate now being used at planting have resulted in a very large increase in the annual consumption of *guano phosphaté* and also in the importation of prepared rock phosphate from overseas.

The total annual imports of *guano phosphaté* into Mauritius in the past eight years (metric tons) is given below :

Year	*Metric Tons*
1953	2,400
1954	4,800
1955	2,500
1956	9,200
1957	10,900
1958	12,800
1959	13,000
1960	12,500
1961	12,500

As a result, there is no doubt that the phosphate status of cane lands will improve markedly with the years, and one of the major factors reducing yields will be eliminated.

Because of the impossibility of sampling leaves for foliar diagnosis during the last three years, it has not been possible to check the phosphate status of ratoon canes which had received a high level of phosphate fertilization at planting, but the original recommendation that ratoons suspected of being phosphate deficient should be dressed with 25 Kgs of soluble phosphate from the fourth ratoon onwards has become a general practice.

The series of field trials on ratoons, using different types and placements of phosphate, is now complete and the results will be published shortly.

Generally, it can be stated from this work that if the ratoon crop is deficient in phosphate, then the annual application of 25 Kgs of phosphate per arpent will bring economically interesting increases in cane yield. Ammonium phosphate appears to be the most suitable choice of carrier; placement of the fertilizer on the stool, or on the trash, gives about equivalent results with this material.

More than half of the estates of Mauritius have now used soil analyses for phosphate as a guide to the basic fertilization at the time of planting.

The analyses are carried out by the estate chemists in the laboratories of the Sugar Research Institute, and apart from the direct value of the analyses made, the system has certainly proved useful in increasing the liaison between estate staff and the workers at the Institute.

Potassium. The control of the degree of fertilization by this nutrient is based entirely on foliar analyses : this means that in the past few years most estates have had to rely for guidance on information obtained before 1960.

With the large amounts of potash removed by the cane crop and the green tops, quite large depletions of the potash status of the soil can occur fairly quickly. For this reason, applications of higher levels of potash than are normally used have been encouraged.

As the industry can be left for several years without nutritional guidance as a result of a series of cyclones or droughts, soil analytical methods for determining the potash status of fields seem to have a rôle to play. To this end, work was initiated during the year on soil potash levels.

The loss of potash by leaching has often been stressed as a factor to be considered when applying potassic fertilizers, and studies on the leaching of potash in the super-humid zone have started.

A new potassic fertilizer, potassium bicarbonate, has also been studied both from the point of view of leaching and as a source of potash for the cane. This fertilizer is alkaline, and therefore would have been useful in preventing soil acidification; unfortunately it is incompatible with ammonium sulphate and must therefore be buried. It is unlikely therefore that potassium bicarbonate will ever have a rôle as a commercial fertilizer in Mauritius.

Calcium, Magnesium and Trace Elements. As deficiencies of potash and phosphate are eliminated and yields continually improve, increasing interest will centre around the secondary elements, calcium and magnesium, and also around the trace elements.

In spite of the fact that the number of field trials is limited, several lime, coral sand and basalt sand experiments were laid down in early 1962. These trials will give information on the nutritional status of the cane crop as regards calcium and magnesium. They will also enable an assessment of the non-calcium nutritional effects of liming, such as the increased availability of molybdenum and the depression of aluminium and manganese levels. Information on the effect of the improved physical conditions on cane growth will also become available.

Studies on the trace element status of cane were also initiated during the year, and areas of potentially low molybdenum have been delineated. Field trials with molybdenum have been laid down in these areas.

Foliar Diagnosis. Following the gap of three years in leaf sampling due to perturbed meteorological conditions in 1960, 1961, and 1962, a reorganization of the control of cane nutrition by means of foliar diagnosis has been initiated to take effect in 1963. Emphasis will henceforth be placed on «permanent sampling units», fully representative of climate, soil groups, and past history of cane fields. About six hundred such sampling units were selected for systematic sampling during the grand period of growth.

The soil map to which reference is made below has been of great help for the selection of sampling units and will permit an extrapolation of foliar diagnosis data in relation to soils within comparable systems of crop management.

The importance of adequate moisture previous to leaf sampling, and correction for age of the cane, to which reference was made last year, give greater accuracy as well as more flexibility to the application of the method in practice.

It should be pointed out that a correction for levels of N P K in different varieties had been adopted in the past. The article which appears in Chapter III on comparative N P K foliar diagnosis values of six commercial varieties at six sites indicates that these variations, though small, are consistent, hence the necessity of applying a correction for this factor.

In addition to the determination of the major elements, leaf sheaths will be sampled for determining the calcium status *per se* and possible toxicity of manganese which may be associated with soil acidity.

Soil Survey. The 1:100,000 soil map of Mauritius was printed during the year, and I take this opportunity to thank the Director of Overseas Surveys and his staff for their invaluable assistance. There is no doubt that the soil survey of Mauritius will prove of considerable importance to both the sugar industry and the island as a whole.

Work on the analytical side of the survey continued throughout the year but will be terminated early in 1963, and the written report on the soil survey will then be produced.

The following table gives the area of the various groups of soils classified :

Area under different soil groups		*Acres*
Low Humic Latosols	...	80,000
Humic Latosols	...	23,000
Humic Ferruginous Latosols	...	56,000
Latosolic Reddish Prairie	...	97,000
Latosolic Brown Forest	...	54,000
Dark Magnesium Clay	...	19,500
Mountain slope complexes	...	25,500
Grey Hydromorphic	...	5,300
Low Humic Gley	...	1,800
Ground Water Laterite	...	2,700
Alluvial soils ...	...	800
Regosols ...	...	7,900
Lithosols ...	...	81,500
Built area not surveyed	...	1,100
Reservoirs ...	...	3,100
Islets not surveyed	...	2,400
		461,500

As mentioned previously, estate chemists made determinations on available phosphate and pH of the soils of their respective estates. Eventually, it will be possible to give basic soil data covering all the estate cane area.

Organic Composition of Cane. Work on this subject has been severely restricted because of cyclones and droughts, and no work on leaf composition has been possible.

Juice has been studied once again from the point of view of starch levels, and the effect of potassium deficiency on these levels examined.

The new varieties are all high in starch, and the South African finding that potash deficiency increases the starch level in juice has been confirmed for our conditions.

Root Systems. Studies on the root systems of the cane variety M. 147/44 growing in «free soils» under overhead and surface irrigation were carried out this year by LEE's method*.

The mean dry weights of roots in the different soil layers from four excavations under each type of irrigation gave the following results :

	Dry wt. roots gm. in 3" depth × 25 sq. ft.	
Soil layers (inches)	*Overhead Irrigation*	*Surface Irrigation*
0 — 3	132.7	75.5
3 — 6	97.4	92.1
6 — 9	119.7	103.8
9 — 12	77.5	96.2
12 — 15	57.7	70.1
15 — 18	24.6	30.0
18 — 21	13.9	22.9
21 — 24	5.7	12.2
24 — 30	9.0	8.9

It will be observed from these data that the mean dry weight of roots in the first 3 in. soil layer under overhead irrigation is nearly twice that under surface irrigation, thus indicating a greater development of roots in that layer. However, the general distribution of the root systems of M. 147/44 below that layer was closely comparable under both conditions of irrigation.

* c.f. *Ann. Rep. Sug. Ind. Res. Inst. Mauritius*, 1961 : 48.

Investigations were also made on the distribution of the root system of the variety B. 3337 at Cascade under conditions of no basalt application, and applications of 180 tons per arpent. Apart from a greater production of roots in the first 3 in. soil layer in the basalt treatment, root development was comparable in both treatments.

Effect of Growth Substances on Cane Germination. Studies on the effect of different growth substances on the germination of the variety M.93/48 were started this year. Gibberellic acid, indole acetic acid, ethylene chlorhydrin and tri-iodobenzoic acid were tested at concentrations varying from 10 to 1000 p.p.m. One-eyed cuttings pre-treated at 52°C for 20 minutes were used. For each treatment, 20 cuttings were taken and immersed for 20 minutes in the respective solution of the growth substances.

From this preliminary work the following observations emerge :

(i) Gibberellic acid promoted germination at concentrations up to 50 p.p.m. above which it exercised an inhibitory effect on bud development.

(ii) Indole acetic acid at all concentrations inhibited germination and there was also a graded effect from lower to higher concentrations.

(iii) Tri-iodobenzoic acid and ethylene chlorhydrin promoted germination only at the 100 p.p.m. treatment.

CANE DISEASES

In spite of the cyclonic conditions which prevailed at the beginning of the growing season, no outbreak of any of the major bacterial or fungal diseases occurred in commercial plantations. Environmental conditions, however, were favourable to leaf scald and gummosis, and several susceptible varieties were severely affected in the variety collection. It follows that continued vigilance should be exercised in testing the disease reaction of seedling cane during selection, and of promising imported varieties. To that end, the experimental procedure in leaf scald testing has been modified with positive results.

Preliminary investigations on strain variation in the gumming disease pathogen had indicated that isolates from five different sources could be separated into two groups on the basis of their morphological and physiological characters. Thus the isolates from Réunion and Mauritius could be placed in one group, and those from Natal, Southern Rhodesia, and Madagascar in another. Further work on strain differentiation, using bacteriophage, conducted at the Commonwealth Mycological Institute, has shown that the phage active against *Xanthomonas vasculorum*, obtained from diseased material collected in Southern Rhodesia, lysed the isolates from Southern Rhodesia and Natal but not those from Madagascar, Réunion and Mauritius. The work is continuing at the Commonwealth Mycological Institute on bacteriophage reciprocal sensitivity testing.

Ratoon stunting disease and chlorotic streak, however, continued to take their toll during the year. All varieties cultivated at present in the island are susceptible to the two virus diseases. The results of ratoon stunting trials harvesting this year have shown average reductions in yield after four ratoons, varying from 9% in Ebène 1/37 to 17% in B. 37161, in the sub-humid area.

Although the trials in the super-humid zone were once more severely affected by the cyclones, and the results obtained were rather erratic, the average reactions in all trials of the commercial varieties released after 1959 confirmed the ratings already given. The reductions in yield were : Ebène 50/47 : 20%, M. 202/46 : 16%, M. 93/48 : 10%, and M. 253/48 : 7%. The last variety again showed low susceptibility to the disease. M. 93/48 is not more susceptible than the other varieties released after 1959. Although the disease has been responsible for erratic growth in certain fields, in others the poor performance of that variety is due much more to the unfavourable environmental conditions, both climatic and edaphic, prevailing in certain marginal areas where M. 93/48 has been planted. The vigorous, homogeneous stand observed in fields planted with cuttings derived from nurseries, emphasizes once more the importance of planting that variety as well as the other newly released canes with disease-free material.

The long hot-water treatment installation at the M.S.P.A. Station at Belle Rive worked below its capacity, and approximately 950 tons of cuttings were treated. Of these, 163 tons served to plant 48 arpents at the «central nursery». The project for the establishment of such a nursery, from which healthy planting material would be available for secondary nurseries on estates, has materialized and is now well under way.

Nurseries established on estates totalled 133 arpents. On an average, 6 tons of treated cane were needed to establish one arpent of nursery. Plantations made during the year with material obtained from A and B nurseries amounted to 1410 arpents out of 13,280 arpents planted, or 10.6%.

In 1963, clean planting material will be available from 61 arpents at the central nursery and will serve to establish approximately 540 arpents of B nurseries on estates. The target in 1964 is set at 145 arpents which should plant about 1,300 arpents of B nurseries in the various factory areas. The material available will meet the total planting requirements in 1965.

The implementation of the «central nursery» scheme resulted in a much smaller requirement in treated cuttings. In order to have the plant at Belle Rive working at full capacity, it was decided to carry out treatments against chlorotic streak as well for neighbouring estates. During the year, 510 tons were treated. The treatment given is 50°C for 30 minutes. With the high efficiency obtained in the treatment tanks, the virus is inactivated in the cutting after 20 minutes in water at 50°C. It is planned to treat 3000 tons of cuttings against chlorotic streak in 1963.

Observations on the reactions of commercial canes and promising varieties are continuing in the Fiji disease resistance trial in the Brickaville area of Madagascar with the co-operation of the *Institut de la Recherche Agronomique de Madagascar*. Eight varieties were sent to Madagascar this year for inclusion in the trial after the quarantine period. The eradication campaign against the disease on the East Coast of Madagascar has been very successful in the sugar producing area. In the small plantations, scattered over the whole province, although good work has been done under difficult conditions, the Plant Protection Services have to contend with several factors, mainly human, which still hamper progress in their task.

The prohibition concerning the entry and sale of canes in the town of Tamatave was lifted in March after the setting up of a control organization in the town and port area of Tamatave. The expenses involved are met by the Governments of Mauritius and Réunion. Replacement of susceptible canes by the resistant Pindar is likely to be completed by mid-1963. Furthermore, on a few occasions, sugar cane sticks were seized on persons going into the port area. The control in the port area of Tamatave will have to continue at least for another year.

CANE QUARANTINE

The cane quarantine greenhouse continued to be administered, managed, and maintained by the Research Institute, the officer in charge being the Plant Pathologist. The 1960-62 quarantine came to an end in March. Out of 50 varieties received, two did not germinate, one showed an unidentified leaf striping and was destroyed, and another suffered severely from Pokkah-boeng resulting in top rot. The 46 varieties released from quarantine were : C.P. 47-193, C.P. 48-103, C.P. 53-18, P.R. 980, 28 NG 101, 51 NG 2, *S. spontaneum* (Krakatau), *S. spontaneum* (Mandalay), H. 44-3098, 51 NG 11, Mol. 5801, Mol. 5904, H. 50-7209, H. 49-5, Luna, Q. 67, Q. 68, Q. 70, Kassoer, G. 362, 51 NG 63, 51 NG 140, 57 NG 208, M. 1900 S, N. 10 (Saccharine), N. 52-219 (Salute), N. 50-211 (Salvo), N. 55-176, Co. 331, N : Co. 382, C.B. 45-6, C.B. 41-35, B.45151, H. 39-7028, B. 49119, B. 52298, B.47225, B. 39246, B. 41211, B. 5650, Co. 1202, Co. 1208, Co. 1230, Co. 1177, Co. 1186 and Co. 1190.

The 1962-64 quarantine started in September. Through the kind co-operation of the U.S.D.A., Queensland Bureau of Sugar Experiment Stations, Colonial Sugar Refining Co. Ltd., H.S.P.A. Experimental Station, B.W.I. Central Breeding Station, South African S.A. Experiment Station, Cane Breeding Institute of Coimbatore, Taiwan Sugar Experiment Station, and the Agricultural Experiment Station of the University of Puerto Rico, 55 varieties were imported. Unfortunately, after rejecting and destroying two varieties because of inadequate space, five varieties had to be destroyed in the examination room. Later, a severe attack of leaf scald was detected on one of the imported varieties and all the canes in that compartment, twelve in all, originating from two sources, had to be destroyed. The canes from one source could fortunately be obtained once more. Out of the original 48 canes planted in the greenhouse, there are thus 39 varieties left. These are : Co. 475, Triton, Q. 58B38, I.216, Q.54N7103, H. 41-3340, H. 47-4991, H. 48-3166, H. 49-104, H. 49-134, H. 49-3533, H. 51-5064, H. 53-5064, H. 53-263, H. 32-8560, P.R. 975, P.R. 999, P.R. 1016, P.R. 1048, B. 42231, B. 46364, B. 47419, B. 52107, B. 51129, B. 39254, B. 4906, B. 5037, B. 5041, B. 50215, B. 5336, Saraband, Sabre, Samson, Cl. 41-223, C.P.50-28, C.P. 52-68, S. 17, Co. 853, Co. 975 and Cl.41-42.

Cuttings of several varieties were exported to Barbados, Taiwan and Madagascar, and fuzz was sent to Tanganyika.

CANE PESTS

The year 1962 was characterized by the abundance of several cane pests which are normally inconspicuous.

The thrips, *Fulmekiola serrata*, which feeds and develops from egg to adult in the leaf spindle, was exceptionally abundant during November-December, and the foliar injury it causes was conspicuous in many fields of young cane.

The leafhopper, *Perkinsiella saccharicida*, normally innocuous but potentially important owing to its ability to transmit the Fiji disease virus, occurred in such large numbers in one field in the North that the canes were adversely affected. The leafhopper, as a rule, lays its eggs in the leaf midribs, but even the stalks on this occasion had been utilized. This freak outbreak, localized even within the field where it occurred, is the only known instance of leafhopper injury to cane in Mauritius.

Outbreaks of the red locust, *Nomadacris septemfasciata*, also occurred in various localities causing severe defoliation in many fields. New attacks were being reported at the end of the year, and insecticidal treatments were being applied to counter the insect.

Apart from the above, the outstanding pests were the stalk borer, *Proceras sacchariphagus*, and the scale insect, *Aulacaspis tegalensis*, and research work during the year was centred on these.

Efforts to breed *Diatraeophaga striatalis*, the cane borer parasite introduced from Java in 1961, were continued, but the laboratory culture was lost in March when the adults of the sixth artificially reared generation failed to mate. Searches in the field also did not reveal the presence of the parasite in the area where it had been released in 1961, and it must be concluded that the insect has not become established. A full account of the work on *Diatraeophaga* was presented at the XIth I.S.S.C.T. Congress.

Other work on the stalk borer, comprising a study of its adult biology, was also presented in full as a paper at the XIth I.S.S.C.T. Congress. This described the reproductive habits and capacity of the insect, and is the first of a series of planned studies to elucidate the relationship of the insect to its host-plant.

Several infestations of cane stalks by the scale insect, *Aulacaspis tegalensis*, occurred in the drier parts of the island, and many fields were severely attacked. This pest is controlled to a large extent by natural enemies, particularly Coccinellid beetles, but intense scale populations nevertheless occur in some fields nearly every year. The major effect of the scale is a pronounced lowering of the sucrose content of the stalks it infests, caused by the chemical action of its saliva during feeding. Studies are in progress to assess the nature and extent of the losses now caused by the insect, and the relation of field practices, such as early or late cropping, to its abundance and to the severity of the loss of sugar % cane caused by its presence.

Little time was available during the year to continue investigations upon the interesting, but still obscure, subject of soil nematodes. A reniform nematode, *Rotylenchulus parvus*, was recorded from cane roots, and some data were acquired on the incidence of various parasitic forms in the soil around cane roots.

It is appropriate to conclude this brief summary of cane pests by drawing the attention of cane growers to the continuing need for the propagation and maintenance of flowering shrubs around fields to supply food for the parasitic wasps which attack the white grub, *Clemora smithi*. Suitable plants are *Eupatorium pallescens* and «Queue de Rat». There has been a progressive and perturbing disappearance of such plants in recent years which might lead eventually to a recrudescence of the white grub.

WEED CONTROL

It will be observed from Appendix XX that the sugar industry has spent over 4 million rupees on herbicides in 1962, a sum exceeding that of the previous year by approximately Rs. 500,000. The major differences have been in an increased importation of herbicides of low solubility, such as substituted ureas and triazine, the use of which is now integrated in normal agricultural practice of the super-humid zone.

As a result of more intensive application of these compounds in pre-emergence, the use of hormone-type weedkillers, TCA and sodium chlorate has decreased, continuing the trend started in 1960.

The improvement in cane agriculture which has resulted from the use of herbicides in Mauritius is now established beyond doubt. But it must be emphasized that chemicals are often a dangerous tool. The use of herbicides implies a thorough knowledge of the products themselves, dosage, time of application, stage of growth, spraying techniques, besides other agronomic factors.

Cynodon Dactylon. New facts have been disclosed which shed light on the conflicting results reported on the control of *C. dactylon* by TCA and Dalapon. Studies on the biology of this weed have revealed the existence of different clones which show different tolerances to herbicides, and have demonstrated that the most important phases in rhizome development coincide with the time of the year at which TCA and Dalapon are more effective.

New Herbicides. Of the new herbicides tested this year in pre-emergence of both crop and weeds, *Hyvar* gave excellent weed control while *Lorox* (U.S. trade name), *Afalon* (German trade name), proved slightly less effective than *DCMU* at equivalent dosage rates. Of the seven other herbicides tested, *Fenac* was the most effective, but at rates of application higher than 1.5 to 2.0 lb/arpent, it affected cane growth. *Aresin* gave somewhat unsatisfactory results, while *Thiuron*, at all dosage rates experimented (2.0 — 8.0 lb/arpent), proved ineffective.

Phytotoxic effects of Herbicides. Experiments laid down this year in ratoon canes to determine the effects of Dalapon on cane growth and sucrose content are in progress. Preliminary observations have demonstrated that this chemical may cause severe cane injury, producing malformations of various kinds.

Cane varieties were found to differ in their tolerance to the chemical. Varieties such as Ebène 50/47, M. 147/44, and B. 3337 were affected at rates of application as low as 4 lb per arpent, whereas Ebène 1/37 at this dosage seemed more tolerant.

The extensive use of DCMU in the super-humid area since 1960 has indicated that this chemical may cause severe injury to plant canes in pre-emergence application under the following conditions : in poorly drained areas, in localized areas where the subsoil has been brought to the surface during ploughing operations, and in areas where there is phosphorus deficiency. Cases of cane injury caused by bad application of the herbicide have also been recorded.

IRRIGATION

The experiment started in 1957 to compare spray irrigation with furrow irrigation, on different soil types, was concluded at the end of the year. Results obtained in 1962 on low humic latosols —«free soils»— confirmed those of the previous year. The experiment with 100% portable equipment on latosolic reddish prairie soils —«gravelly soils»— was discontinued in 1962. A semi-permanent spraying system has now been installed by the estate, covering the original experimental area and extending over 450 arpents of new land which was previously uncultivated on account of its excessive permeability and high water requirements when using surface irrigation. This development speaks for itself as far as the value of spray irrigation on this type of soil is concerned.

The full results of these experiments will be reviewed in a special publication which is in preparation.

With the kind co-operation of the Manager of Médine S. E., another series of experiments, using the equipment available in conjunction with lysimeters, has been initiated for further investigations on water retention capacity of soils, and on the consumptive use of water by the cane plant under Mauritius conditions.

Observations on water distribution of different types of rainers : «boom-o-rain», low pressure (20 lbs per sq. in.), intermediate pressure (70 lbs per sq. in.), are reviewed elsewhere in this report. Two other contributions relate to the measurement of evaporation for assessing irrigation needs and the evaluation of evapotranspiration in different parts of the island, based on net radiation calculated from meteorological elements according to Turc's formula.

GROUND WATER

The ground water survey initiated in 1958 with funds subscribed by the Government and the Sugar Industry Reserve Fund was completed at the end of the year, except for observations on the water level at 130 sites which will be continued until the end of March 1963. Mr. R. Sentenac, of the *Compagnie de Géophysique*, who was in charge of these investigations, left the island in December. It is a pleasure to record here the invaluable services he has rendered in connection with that important research project.

The results of the ground water survey will be embodied in four papers, the first of which appeared in July 1962.

Core drilling and borings in 1962 were entrusted to Messrs. Doger de Spéville & Co. Ltd., the Institute having retained Sir Alexander Gibb & Partners as Consultant Engineers. The programme of work realised included 6 cores at an average depth of 217′, and 7 pumping tests of which 4 gave positive results.

The major results of this investigation indicate that large scale exploitation of ground water could probably be made in the following areas :

(a) **North.** The Mount system flowing westwards. Escalier - Plaine des Roches systems flowing north eastwards.
(b) **Flacq.** Camp de Masque - La Caroline.
(c) **Grand Port.** Rose Belle - Mare d'Albert.
(d) **Plaines Wilhems.** Holyrood.
(e) **Black River.** Palma.

In addition, local utilization of ground water could be made in the following regions :

(1) Along the Piton and Forbach lava flows in the North;
(2) Camp de Masque - La Caroline, and Rivière du Poste - Queen Victoria systems at Flacq;
(3) Rose Belle - New Grove, and Mare d'Albert - Union Vale systems in Grand Port;

(4) Seven sites in Plaines Wilhems - Black River, including Beard (already being utilized by Réunion S.E.), La Marie, Pierrefonds (already in utilization by Médine S. E.), Palmyre, La Chaumière, Bambous and Chebel.

The approximate locations of the sites mentioned above are indicated in fig. 12.

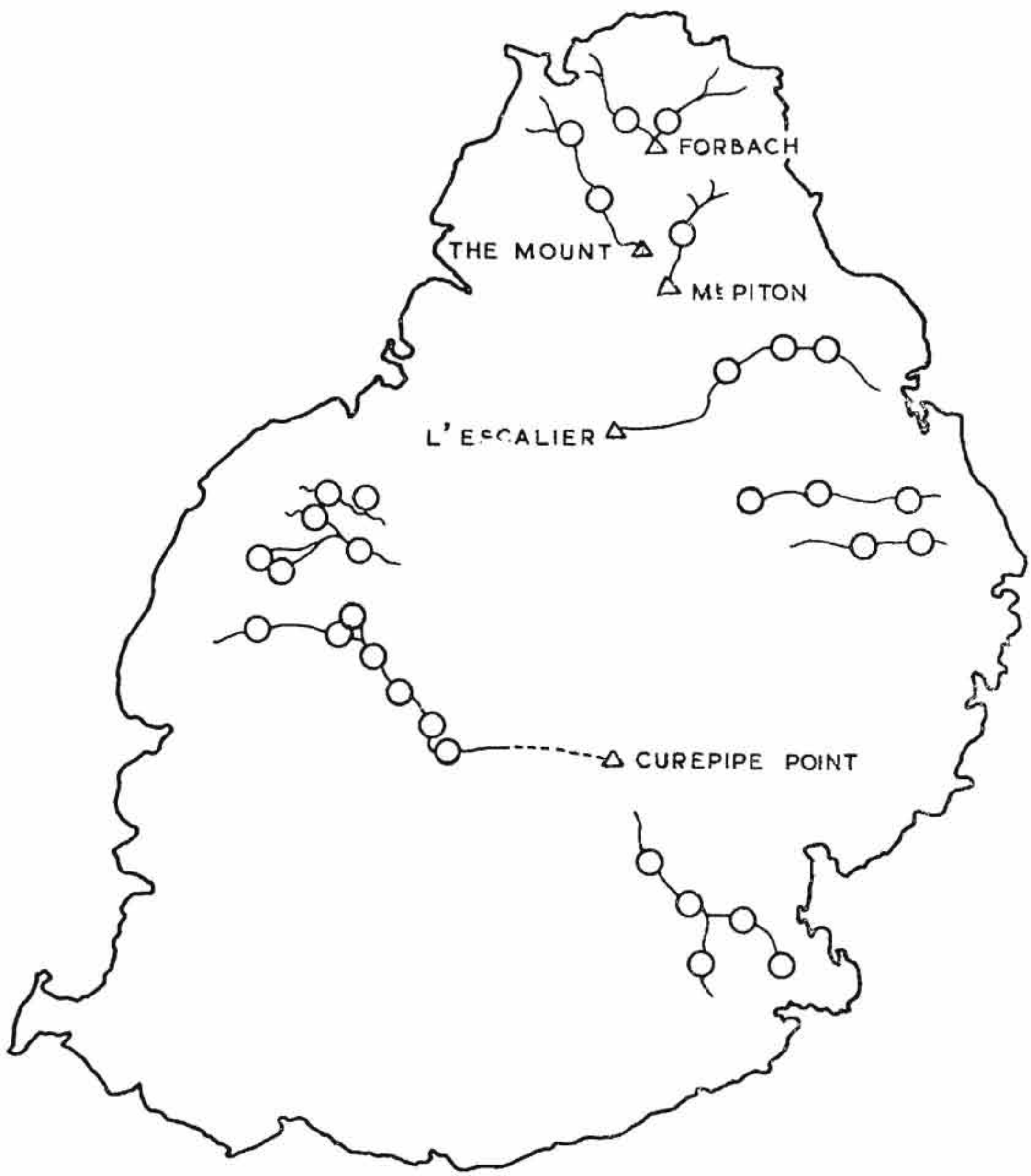

Fig. 12. Map of Mauritius showing recent lava flows of some of the volcanic systems explored. Circles indicate more promising sites for utilisation of ground water. The position of craters is shown by triangles.

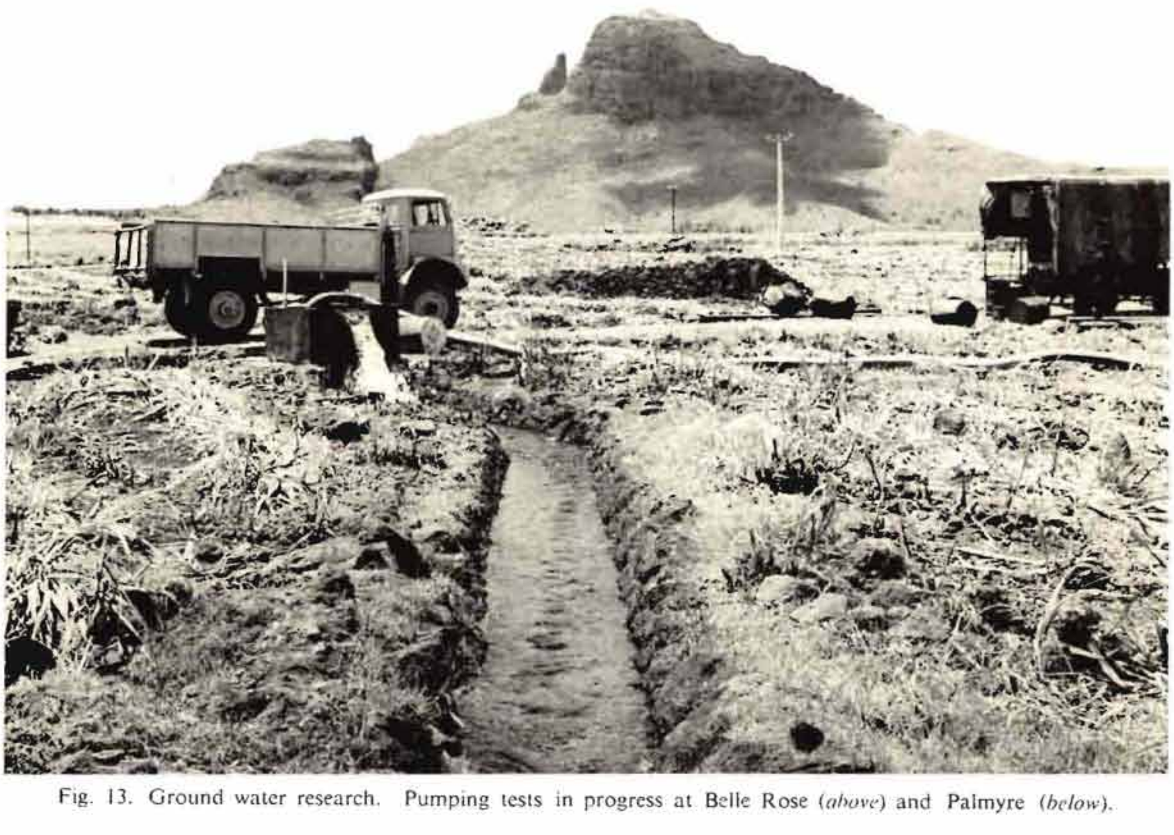

Fig. 13. Ground water research. Pumping tests in progress at Belle Rose (*above*) and Palmyre (*below*).

Fig. 14. Pumping ground water from bore hole at La Marie (*above*). Pumping test at Palmyre (*below*) showing measuring tank, mobile generating plant, and bore hole rig.

FIELD EXPERIMENTATION

The co-operation of estates in assisting the Institute to carry out its programme of field experimentation is gratefully acknowledged. In addition to the 134 trials which were harvested during the year, several estates kindly made available a sufficient area of land for seedling selection, multiplication plots, irrigation experiments, and root system studies. This programme could not have been carried out on land available at experimental stations which are used primarily for breeding plots, early stages of selection, ratooning capacity trials, investigations on diseases, weed control, and fertilizer demonstration plots.

It is unfortunate, however, that the results from 8 experiments were invalidated through varying causes, including harvesting by mistake, applying fertilizers to control plots in fertilizer trials, recruiting with another variety than that planted, spot spraying with herbicides in experimental plots.

Field experiments for 1963 stood as follows at the end of the year :

Variety :		
(i)	1st selection trials	18
(ii)	Variety trials	49
(iii)	Final variety/fertilizer trials ...	18
(iv)	Ratooning capacity	4
Cultivation :		
(i)	Clean v/s selective cutting ...	12
(ii)	Spacing trials	8
(iii)	Germination	6
(iv)	Irrigation	2
(v)	Herbicides on cane growth ...	9
Fertilization and amendments :		
(i)	Nitrogen	15
(ii)	Phosphate	7
(iii)	Calcium & phosphate ...	6
(iv)	Potassium	4
(v)	Molybdenum	8
(vi)	Bagasse	3
(vii)	Organic matter	9
(viii)	Basalt	6
(ix)	Diseases	15
(x)	Pests	16

SUGAR MANUFACTURE

Research. The main subjects of investigation during the year were concerned with protein recovery from cane juices, discussed under the heading *By-products.* In addition, work continued on various other topics, several of which form the subject of special contributions in this report.

Special mention should be made here of :

(a) **Osmophilic Yeasts in raw sugars.** The preliminary investigations which started in October 1961 were continued during the year. The studies involved analyses of raw sugar samples from each factory in order to determine their osmophilic yeast content (this included fermentation tests and plate counts on osmophilic agar), identification of the yeasts encountered, determination of the stage during the manufacturing process at which the sugar product is contaminated by the yeasts recovered in the sugar, effect of the yeasts on the keeping qualities of raw sugars, and the use of germicides in the control of osmophilic yeasts in sugar products.

Eight species were isolated from raw sugars and identified with the assistance of the *Centraalbureau voor Schimmelcultures* in Delft. These are : *Schizosaccharomyces pombe, Saccharomyces rouxii, S. rosei, Torulopsis etchellsii, T. versatilis, Endomycopsis ohmeri, Candida tropicalis* and *Dekkeromyces* sp. The yeast populations present in sugar products in the early stages of manufacture are destroyed by the normal boiling processes. However, it was found that there is contamination of the massecuite in the crystallizer and that the yeasts present are recovered after centrifuging in the raw sugar and molasses. The yeasts are capable of considerable activity and, given favourable conditions, will multiply and decompose the raw sugar rapidly. The germicide Weladyne, containing 1.75% available iodine, gave effective control of the yeasts at concentrations as low as 10 p.p.m. available iodine after 15 minutes, even in highly concentrated sugar solutions.

(b) **Mill sanitation.** During the 1962 campaign, a new type of organic sulphur bactericide, Busan 881, was tested. The value of this compound in micro-organism control was assessed by observing the effect on (a) the drop in purity and (b) the increase in glucose ratio, on passing from crusher juice to mixed juice. Data obtained at two factories show that differences were not significant. In the light of these results, it would appear that the use of Busan for mill sanitation is not warranted under local conditions.

(c) **Screening of mixed juice.** During the 1961-1962 intercrop, Mon Loisir factory installed a static juice screen of Dorr-Oliver make (Dorr-Oliver D. S. M. Screen). Tests were therefore carried out with a view of assessing the performance of that screen and comparing its efficiency with that of a conventional vibrating screen.

Analysis of the results arrived at showed that, for a mixed juice throughput of 65 tons/hr and under the conditions prevailing at Mon Loisir, the D.S.M. screen separates twice as much bagacillo from mixed juice as the vibrating screen does.

Advisory work. The advice of the Institute was sought on a number of occasions either by individual factories or by corporate bodies. The following subjects should be mentioned in particular :

1. A study on the mud filtration operation at one factory, with the object of determining the performance of their rotary drum vacuum filter.
2. A study of the chemical control of one factory with a view of determining whether this control was being properly carried out.
3. A study of the crystallizer and centrifugal departments of one factory, as a result of which several recommendations were made.
4. Tests were carried out to determine the efficiency of two new types of crystallizer cooling elements installed at two factories.
5. At the request of the Mauritius Sugar Syndicate, the economics of manufacturing low pol sugar for sale to Japan were studied, and recommendations made on the premium to be paid to the factories producing such sugars.
6. On a number of occasions, advice on various aspects of processing work and on chemical control was given.

Instrumentation. The Instrument Engineer was called upon throughout the crop for a number of duties dealing with instrumentation work. For those who are not well aware of the services that this Institute can render through its Instrument Engineer, it is worthwhile giving a list of the major duties performed during the crop :

(a) Installation and commissioning of automatic controls on a high pressure boiler at Britannia.

(b) Installation and commissioning of the S.M.R.I. lift integrator on the top roller of the last mill at Savannah factory.

(c) Advice given and commissioning carried out at several factories where difficulties were being experienced with pH controllers.

(d) Mr. Le Guen was also called upon for various other duties, such as calibration of thermo regulators, industrial thermometers, CO_2 recorders, flow meters, cuitometers, and also of laboratory equipment, namely refractometers, polarimeters and analytical balances.

BY-PRODUCTS

As a result of the work on the protein content of cane juice, much interest has arisen in the preparation of a high protein heat coagulate from cane juice and also in the direct feeding of filter muds to animals.

The extraction process adopted in 1961 was slightly modified with the object of improving the protein content and reducing the fats and wax content of the coagulate. To this end, the juice was first centrifuged in the cold, prior to coagulating the protein by heat and recentrifuging. The cake obtained showed a slight improvement over that separated in 1961 as it contained on the average 25.6% of protein and 22.0% of fats and wax, comparative figures for 1961 being 22.8 and 25.0 respectively.

Feeding trials were carried out on laying hens with coagulate prepared in 1961 and in 1962. In view of the high temperature at which drying had to be effected, it was possible to

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THE MAURITIUS HERBARIUM

At the beginning of the year it was gratifying to learn that the Herbarium had at last received official recognition, and that a grant from the Ministry of Agriculture and Natural Resources had been approved towards meeting the running expenses of the Herbarium. This, together with financial aid and accommodation afforded by the Mauritius Sugar Industry Research Institute, has permitted the appointment of a Curator and an Assistant, and provided the necessary funds for travelling and purchase of essential equipment. In consequence, it has been possible for the organization and work of the Herbarium to be placed on a secure and permanent basis, so that the essential task of building up the collections, library, and bibliographical index can go forward with much greater speed and efficiency.

During the year, 338 specimens were laid in, among which were some very rare indigenous plants and a number of cultivated species not hitherto represented in the Herbarium. Special attention has been given to a study of the plants in the Royal Botanic Gardens, Pamplemousses. In recent years, the unprecedented cluster of cyclones have radically changed the physiognomy and floristic composition of the Gardens. As a result, an attempt is now being made to compile a new census and survey of plants in the Gardens and, with the help of experts in overseas institutions, to determine those species which are still unknown. Among interesting accessions to the Herbarium may be mentioned a collection of eighty specimens made by the Director while on a visit to Agaléga, the Farquhar group of islands, and the Seychelles. The Forestry Department has kindly presented the Herbarium with a representative collection of timber specimens of indigenous trees comprising 12 hand specimens and 33 larger examples suitable for exhibition purposes, a duplicate set of these has been handed over to the Department of Agriculture for exhibition at the Pamplemousses Botanic Gardens.

Work has continued on the Weed Flora of Mauritius and the next leaflet in the series, on *Ambrosia psilostachya* (Herbe Solférino), is in the press.

Cases of live-stock poisoning by a species of yam (*Dioscorea sansibarensis*) have occurred recently and, as a result of enquiries made by the Ministry of Agriculture and Natural Resources, a report was prepared on some of the common poisonous plants of the island which was subsequently published in the local press.

Mention may be made here of some overseas visitors who made use of the Herbarium, or who were guided by the Herbarium staff in collecting or field studies. Dr. Jean D. Le Roy, Sous-Directeur of the *Museum Mational d'Histoire Naturelle*, *Paris*, explored Madagascar and the Mascarenes for twelve weeks searching for species of wild coffee. He was in Mauritius in early June, and made critical studiés in the field and the Herbarium of Mascarene species of Coffea. He has recently published a preliminary report on his mission (1962). In September, Professor Robert Scagel, University of Columbia, spent three days in Mauritius collecting marine algae. His visit was part of a scientific mission sponsored by the Indian Ocean Scientific Year, which took him to the Mascarenes and Madagascar and on an extended tour down the East African Coast. In the same month, Mr. & Mrs. Goodale Moir were here for a few days, collecting orchids for the Botanic Gardens, Hawaii.

A delegate to the XIth Congress of the I.S.S.C.T., Mr. Gillis Een, visited Mauritius on two occasions, during which he made comprehensive collections of mosses and hepatics both in Mauritius and Réunion. After examination of these by specialists overseas, it is expected that the Mauritius Herbarium will obtain a named duplicate set of this valuable material.

Requests from abroad for information and specimens were met with, so far as our resources permitted. Material sent overseas ranged from living orchids to Heidelberg University, palm seeds to Japan, and herbarium specimens on loan, or donated to various institutions. Many local enquiries were received concerning the identification of plants. For common weeds or indigenous plants, this may be a fairly simple matter, provided an authentic herbarium specimen is available. In the case of rare cultivated plants, however, recourse may have to be made to large national herbaria maintaining world collections.

An important addition to the Herbarium Library has been a rare report by Dupont on a visit to the Seychelles and neighbouring islands. P. R. Dupont (1870-1938) was a dedicated student of natural history, and his critical observations and comments in his reports are a mine of valuable information on the flora and fauna of the many islets he visited.

Some recent original papers and reports of interest are given hereunder :

EDGERLEY, L. E. (1962). The Conifers in Mauritius. *Proc. R. Soc. Arts Sci. Mauritius*, **2** : 190-202.

FORESTRY DEPARTMENT, MAURITIUS (1961). Progress Report 1955-60, prepared for the, British Commonwealth Forestry Conference 1962. Port Louis.

HEIBY, E. (1961). Notes sur le Somorona-Lycopode des forêts tropicales employé par certaines populations de Madagascar comme drogue héroïque. *Bull. Acad. malgache*, **38** : 97-101. Refers to the Mascarene species *Lycopodium phlegmaria*.

KEINER, A. (1961). Note sur l'Aponogeton fenestralis. *Bull. Acad. malgache*, **38** : 34-39. The form of this species in Mauritius is noted.

LE ROY, JEAN F. (1962). Prospection des Caféiers sauvages. Rapport préliminaire sur une mission scientifique à Madagascar et aux Iles Mascareignes (27 avril - 15 juillet 1962). *J. Agric. trop.*, **9** : 211-244.

PIGGOTT, C. J. (1961). Notes on some of the Seychelles Islands, Indian Ocean. *Atoll Res. Bull.*, no. 83. Pacific Science Board, Washington, D.C.

SAUER, JONATHAN D. (1962). Effects of recent Tropical Cyclones on the Coastal Vegetation of Mauritius. *J. Ecol.* **50** : 275-290.

SKOTTSBERG C. (1960). Astelia on Mauritius. *Svensk bot. Tidskr.*, **54** : 477-482.

WOOD'S HOLE OCEANOGRAPHIC INSTITUTION (1962). A Partial Bibliography of the Indian Ocean. Massachusetts, U.S.A.

PUBLICATIONS

Annual Report for 1961. 109, xxxiv p.; 33 figs. An abridged French version was also issued. (Reprint from *Rev. agric. sucr. Maurice,* **41** (2) 1962 : 55-86).

Index to the Proceedings of the International Society of Sugar Cane Technologists, v. I-X (1924-1959). viii, 100 p.; map.

Occasional Papers

Nos. 10 and 11 ROCHECOUSTE, E. Studies on the biotypes of *Cynodon Dactylon* (L) Pers.
- I. Botanical investigations.
- II. Growth response to trichloroacetic and 2,2-dichloropropionic acids.

(Reprint from *Weed Res.* **2** (1, 2) 1962 : 1-23; 136-145).

No. 12 SENTENAC, R. Recherches d'eau souterraine à l'Ile Maurice.
- I. Généralités. 27 p.; 12 figs..

No. 13 HAYWARD, A. C. Studies on bacterial pathogens of sugar cane.
- I. Differentiation of isolates of *Xanthomonas vasculorum*, with notes on an undescribed *Xanthomonas* sp. from sugar cane in Natal and Trinidad.
- II. Differentiation, taxonomy and nomenclature of the bacteria causing red stripe and mottled stripe diseases. 27 p.; 4 plates.

No. 14 WILLIAMS, J. R. A new genus and species of Nygolaimidae (Enoplida).
(Reprint from *Nematologica* **8**, 1962 : 225-228).

Leaflet

No. 6 ROCHECOUSTE, E. *and* VAUGHAN R.E. Weeds of Mauritius. 8. *Ambrosia Psilostachya* DC. (Herbe Solférino). 3 p.; 1 plate.

Technical Circular

No. 19 HALAIS, PIERRE. Short notes on the practice and use of foliar diagnosis of sugar cane crops. 3 p.

Private Circulation Report

No. 16 VIGNES, E. CLÉMENT. Report on a tour of various factories, refineries and sugar research organizations in the Commonwealth of Australia. 21 p.

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

SAINT ANTOINE, J. D. DE R. *and* VIGNES, E. CLÉMENT. The extraction of cane juice protein and the assessment of its value as a feeding stuff. **41**(1) 1962 : 25-30.

PARISH, D. H. Sugar cane as a source of animal foodstuff. **41**(6) 1962 : 308-311.

Papers Prepared for XIth Congress, I.S.S.C.T., September 1962. (To be published in **Proceedings**).

ANTOINE, ROBERT, FROBERVILLE, R. DE *and* RICAUD, C. Preliminary investigations on the presence of osmophilic yeasts in Mauritius raw sugars.

ANTOINE, ROBERT *and* HAYWARD, A. C. The gumming disease problem in the Western Indian Ocean area.

BAUDIN, P. *and* ANTOINE, ROBERT. Fiji disease in Madagascar.

DE GROOT, W. *and* GEORGE, E. F. Breeding of sugar cane varieties in Mauritius.

GEORGE, E. F. A further study of *Saccharum* progenies in contrasting environments.

GEORGE, E. F. Applications of a grade score in determining the potential of sugar cane crosses.

GEORGE, E. F. *and* DE GROOT, W. Inherent defects of seedlings in Mauritius.

GEORGE, E. F. *and* LALOUETTE, J. A. Photoperiodic experiments on the sugar cane variety C.P. 36-13.

GHANI, M. A. *and* WILLIAMS, J. R. An attempt to establish the Javanese fly, *Diatraeophaga striatalis* Towns., in Mauritius for the control of the cane moth-borer, *Proceras sacchariphagus* Boj., with notes upon parasites of cane moth-borer in Java.

HALAIS, PIERRE. The detection of N P K deficiency trends in sugar cane crops by means of foliar diagnosis run from year to year on a follow-up basis.

LAMUSSE J.P., WIEHE, H.F. *and* RANDABEL, M. The use of crystallizers for the cooling of high-grade strikes in raw sugar manufacture.

LE GUEN, F. Practical methods of finding optimum settings for automatic controllers.

MONGELARD, CYRIL. Mathematical treatment of data upon root systems of sugar cane.

PARISH, D. H. Fertilizers and the sugar industry of Mauritius.

ROCHECOUSTE, E. New aspects in the control of rhizomatous grasses with special reference to *Cynodon Dactylon* (L) Pers.

ROCHECOUSTE, E. *and* MONGELARD, C. The response of root primordia to pruning treatments of sugar cane sett roots.

SAINT ANTOINE, J. D. DE R. *and* WIEHE, H. F. Results of experiments on the curing of low-grade massecuites in high-speed centrifugals.

WIEHE, P. O. Presidential Address : The role of the I.S.S.C.T. in promoting our knowledge of the sugar cane plant.

WIEHE, P. O. The control of sugar cane diseases in Mauritius.

WILLIAMS, J. R. Investigations in Mauritius on the soil-inhabiting nematodes associated with sugar cane.

WILLIAMS, J. R. The reproduction and fecundity of the sugar cane stalk borer, *Proceras sacchariphagus* Bojer (Lep., Crambidae).

GENERAL

1. **Meetings.** The Research Advisory Committee met on the 24th March, 16th June and 17th November for visits and discussions of research work in progress.

A list of the meetings held in the Bonâme Hall, and subjects presented, is given below :

**6th January, 1962* — D. H. PARISH. Post-cyclone fertilizer practice in sugar cane plantations.

10th January, 1962 — L. BUSCARLET. L'usage de la sonde à neutrons pour la détermination de l'humidité et la densité des sols.

Mr. Buscarlet who is attached to the *Département de Biologie au Commissariat de l'Energie Atomique, Saclay, France,* had kindly accepted to spend several days in Mauritius to discuss various research projects, while he was on a mission to Réunion Island.

**16th February, 1962* — D. H. PARISH. General fertilizer practices.

**16th March, 1962* — D. H. PARISH. Foliar diagnosis.

S. M. FEILLAFÉ. Soil classification in Mauritius.

**27th April, 1962* — E. F. GEORGE *and* W. DE GROOT. Cane varieties.

**18th May, 1962* — ROBERT ANTOINE. Sugar cane diseases.

31st May, 1962 — P. O. WIEHE. A review of the work of the M.S.I.R.I. in 1961.

7th June, 1962 — J. D. DE R. DE ST. ANTOINE. A review of investigations in sugar manufacture in 1961.

**15th June, 1962* — J. R. WILLIAMS. Sugar cane insect pests.

***20th June, 1962* — ROBERT ANTOINE. Le rôle des levures osmophiles dans la détermination des sucres roux.

†3rd July, 1962 — P. O. WIEHE. A visit to the «Oil Islands» and the Seychelles.

** 20th July, 1962* — E. ROCHECOUSTE. Chemical weed control in sugar cane plantations.

***6th December, 1962* — ROBERT ANTOINE. Certains aspects de l'industrie sucrière au Natal.

27th December, 1962 — P. HALAIS. Le diagnostic foliaire.

2. **Staff movements.** The following officers were granted overseas leave in 1962 : Messrs. L. P. Noël, E. C. Vignes, M. Randabel, M. A. Rajabalee, L. Ross and W. de Groot. Mr. Robert Antoine attended a meeting of the Pathology Sub-Committee of the *Comité de Collaboration Agricole Maurice-Réunion-Madagascar* held in Madagascar from the 28th March to 6th April, and in Réunion from the 6th to 14th April. He also attended, as a representative of the *Société de Technologie Agricole et Sucrière de l'Ile Maurice*, the tour of the South African Sugar Industry which was organized for delegates attending the XIth I.S.S.C.T. Congress. The Sugar Technologist, the Botanist, and the Director, also attended this tour and were away from 6th October to 1st November.

3. **Miscellaneous.** Close liaision was maintained with sugar estates and cane planters generally. In this connection, 1340 visits were made by members of the staff to estates.

Co-operation with the Department of Agriculture was maintained on the basis established in previous years. Thus, at least seven members of the staff were responsible for courses of lectures at the College of Agriculture, the Pathologist and the Entomologist sat on a plant importation committee of the Department of Agriculture, while Mr. J. R. Williams supervised the entomological work during the absence, on study leave, of the Entomologist of the Department of Agriculture.

At the request of the Chairman of the Economic Commission, the Director prepared several memoranda on various technical aspects of the sugar industry.

* Talks specially prepared for Extension Officers of the Department of Agriculture.

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

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

Additions made during the year to the buildings of the Institute included two greenhouses specially designed for cane breeding and for pathological investigations, which are already proving to be of considerable help in the current programme of research.

Cane production at the four stations of the Institute totalled 1,400 tons: Réduit 300; Pamplemousses 650; Belle Rive 300; Union Park 150.

In concluding this broad review of the activities of the Sugar Industry Research Institute during 1962, I should like to record my deep appreciation to all members of the staff for their ready response and for the high spirit with which they accepted the additional calls made upon them by the Organizing Committee of the XIth Congress of the I.S.S.C.T.

Director

31st January, 1963.

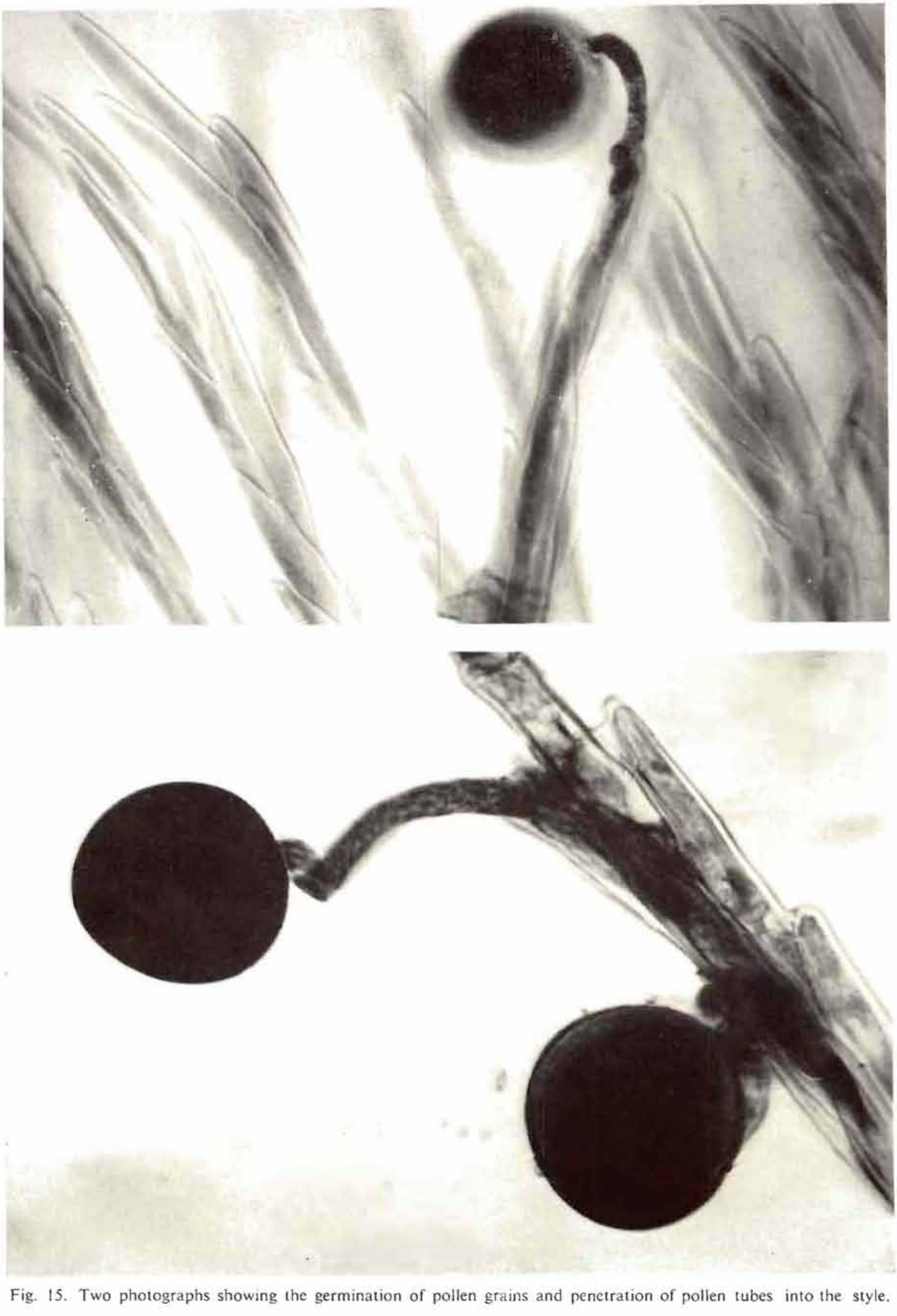

Fig. 15. Two photographs showing the germination of pollen grains and penetration of pollen tubes into the style.

CANE BREEDING

E. F. GEORGE & W. de GROOT

1. ARROWING

(i) Conditions in 1962.

ARROWING was much more heavy in 1962 than has been the case during recent years. A similar intensity occurred in 1956.

It is known that size of the cane, water status within the plant and temperature have an important influence on flower induction, but it has not been possible so far to apply this knowledge in a prediction of flowering intensity based on the results of annual flowering counts.

The percentage of flowers in commercial varieties grown in different sectors is given in Table 1. Thanks are again due to estate managers for arranging the sample counts of arrowing stalks. A total of over 640 thousand canes was examined this year.

The influence of date of previous harvest on flowering is shown in fig. 16 for the two varieties M.147/44 and Ebène 1/37. Figures averaged over recent years emphasize the increased flowering intensity during 1962.

(ii) Control of flowering.

Leaf lopping, as used in Australia, was employed successfully for retarding the flowering of some early flowering varieties needed for crossing. As is found when using other treatments to delay flowering, the percentage of arrows was also reduced.

A photoperiod experiment conducted during the year gave rise to some stimulating results which will be further investigated. The light treatment which was used to prolong normal daylengths, when given at certain

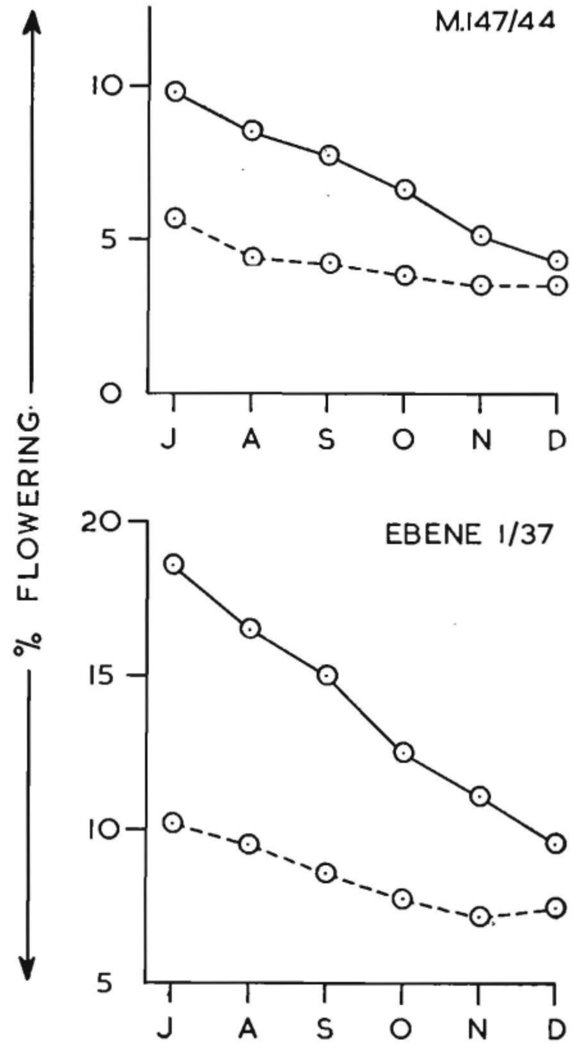

Fig. 16. The relationship between date of previous harvest and percentage of flowering in the varieties Ebène 1/37 and M.147/44.
Plain line : Results of 1962 census.
Broken line : Averages of the data during several years (1960 omitted).

Table 1. Average percentage arrowing in 1962 *

Variety	*North*	*South*	*East*	*West*	*Centre*	*Average*
M.134/32	9.8	17.3	—	7.8	—	10.5
Ebène 1/37	11.2	12.3	17.2	—	13.2	13.6
M.147/44	3.9	7.3	14.5	4.6	9.0	7.5
M.31/45	1.1	2.1	13.2	—	—	5.0
M.202/46	11.0	(7.7)	(25.8)	12.3	—	12.4
Ebène 50/47 ...	—	—	(31.6)	—	16.3	19.3
M.93/48	—	12.1	—	—	—	12.1
M.253/48	—	—	—	1.6	—	1.6
B.3337	—	0.1	—	—	0.7	0.3
B.34104	—	—	—	4.3	—	4.3
B.37172	1.2	3.2	9.6	1.8	—	3.6
Average	5.1	6.7	14.6	4.9	10.3	7.6

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

periods, gave rise to an increase in flowering percentage. This result is shown in fig. 17. It will be noted that in those treatments where increased flowering was obtained, the rate of emergence of the inflorescences was higher. Conversely a retardation of flowering resulted in a reduced total emergence and a slower rate of protrusion.

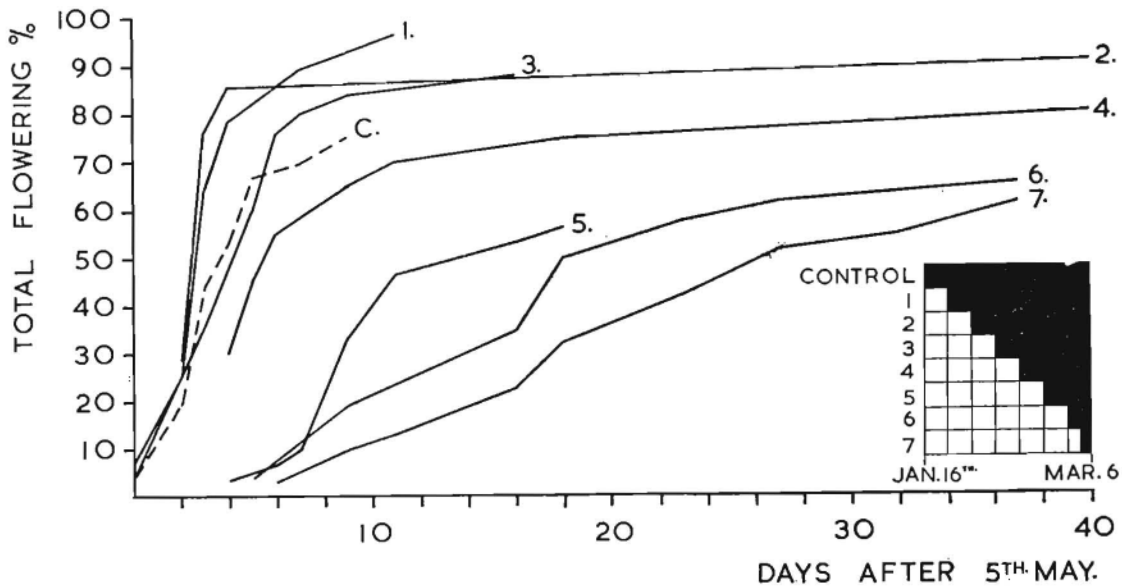

Fig. 17. The emergence of inflorescences in a photoperiod experiment. The duration in weeks of the lighting treatments giving these results is shown by white squares in the diagram, bottom right.

2. CROSSING

(i) Programme.

A highly successful crossing programme was executed, using techniques evolved over the past few years. The increased flowering percentages in all varieties enabled many new and interesting combinations to be made.

The total number of crosses made was 948, of which 208 were made in the open. A summary of the crossing work is given in Table 2, while the list of crosses is given in Appendix XXI.

For the crossing programme 600 marcottes were placed in the field early in the season. From this number, 325 which had given inflorescences were used in crossing. Another 375 unmarcotted canes were cut in the field as the flowers emerged and kept in preservative solution with a marcotte on the stalk. This latter method usually gives fairly good results at the beginning of the season although later on the percentage of stalks dying increases.

An experiment was conducted on establishing cut canes without first putting marcottes and without preservative solution, using a mist propagator. Some of the stalks employed had inflorescences about to emerge while others showed no sign of flowering. Although most of the stalks were successfully rooted, the inflorescences did not tolerate the high humidity and most, although not all, died. There seems to be no future for mist propagation in this connection because for marcotting non-flowering stalks the normal methods used in the field are less troublesome.

Table 2. Summary of Crossing Work in 1962

	Number of crosses made			*Number of seedlings obtained*		
	In Green-house	*Outside*	*Total*	*In Green-house*	*Outside*	*Total*
Réduit	577	163	740	36,601	9,003	45,602
Pamplemousses ...		208	208		48,172	48,172
			*948		57,175	**93,776

* From this number, 50 crosses were stored.

** This number does not include a good number of seedlings which were discarded before potting.

(ii) Seed setting.

Because seed setting in crosses currently made is variable, some observations were made during the year to find out whether inadequate pollination, or failure of pollen to germinate, was the reason for this irregularity.

The work progressed only so far as evolving a satisfactory technique for observing the growth of the pollen tube in the style.

The first method which was employed consisted in clearing the natural red pigment of the style by gently heating in lacto-phenol. Staining was then carried out, using methylene blue or cotton blue in lacto-phenol. Photographs of two preparations made by this method are shown in fig. 15.

Subsequently the method described by Martin (1959) was employed with certain modifications. Styles were fixed in lacto-phenol and subsequently cleared by warming therein. The lacto-phenol was removed by careful washing in water and staining was accomplished in 0.1% aniline blue dissolved in 0.1 Molar K_3PO_4. The tissue was mounted on a slide in the stain and the coverglass ringed to prevent evaporation.

Observations were made with ultraviolet light under which pollen tubes fluoresce a bright yellow-green contrasting sharply with the surrounding tissue.

(iii) Transplantation of seedlings.

Sowing fuzz, seedling raising and transplantation have been carried out in the past immediately after crossing had finished, and at the same time as selection was in progress. With the present increased scale of selection, it has been necessary to redistribute work more evenly throughout the year. Fuzz was therefore dried at the completion of a cross and stored with silica gel in a deep freeze. Sowing took place in December, and potting will proceed in January and February. Germination of the stored fuzz was excellent, and the growth of the seedlings very satisfactory at this warmer period of the year. Due to the high fertility, a portion of the fuzz has been stored until next year.

It has been thought advisable to reduce the number of seedlings planted per bunch because it now seems that selection is mainly effective from the bunch–planted seedlings surviving in the field at selection time. Consequently, bunches of 3 seedlings each are being planted. It has so far been noticeable that the percentage survival in the pots is much higher than previously.

3. SELECTION

None of the stages in the selection scheme were severely affected by cyclone Jenny, and selection proceeded smoothly according to the methods described in recent reports. A small part of the programme was postponed until 1963 because of time devoted to the International Congress.

Bunch selection plots were established at Réduit S.E.S. and at F.U.E.L. and Britannia S.E. Propagation plots were planted at the four experiment stations, and for the first time at F.U.E.L. sub-station. 4 first selection trials were planted and 15 harvested. From among the 46 varieties selected from first selection trials, the following are among the more interesting :

M.17/55 (M.311/41 × M.423/41). This variety was included by chance in two first selection trials at Réduit. It was selected from the first trial last year and from the second this year where it has again given a weight of cane much exceeding that of M.147/44. Sugar content is unfortunately rather low, but the cane is free trashing and of a high diameter.

M.67/55 (B.34104 × M.63/39) was also selected at Réduit with a yield of cane superior to that of M.147/44.

M.89/57 (B.34104 × M.213/40). The results obtained from this variety are interesting because they justify the current procedure of testing all selected seedlings in two environments. Compared to M.147/44 at Réduit, the yields of this variety have not been very satisfactory, but it has outyielded Ebène 1/37 by a wide margin over two years at Belle Rive. It is a semi-erect variety, thin, but with a high number of canes. Disadvantages are a high percentage flowering and a somewhat tight trash.

Table 3. Summary of Selection Work in 1962

Station	*No. of stalks planted in B.S.P.*	*No. of varieties planted in Prop. Plots*	*No. of selections made in Prop. Plots*	*No. of selections made in 1st Sel. Trials*
Réduit	590	28	11	23
Pamplemousses	—	210	20	8
Belle Rive	—	34	11	11
Union Park	—	238	20	4
F. U. E. L.	1,775	129	—	—
Britannia	1,576	—	—	—
Total	3,941	639	62	46

Note: (1) From the 639 varieties planted in Propagation Plots, there are only 401 different, as the 238 planted at Union Park are replicates of those planted at Réduit and Pamplemousses.

(2) From the 62 varieties planted in 1st Selection Trial, only 55 are unique, as 7 are replicated in two different environments.

4. VARIETY AND PRE-RELEASE TRIALS

During the year, 12 new variety trials and 5 new pre-release trials were planted. Results from 96 varieties planted in 29 variety trials and 13 pre-release trials were obtained during the harvesting season. A total of 102 varieties is being carried forward for further study in 1963. The following is a summary of the performance of the most promising varieties.

M. 442/51 (B.37172 × M.213/40). This is the most promising of the varieties in the last stages of selection. Eight results in ratoons from two trials in humid regions and two trials in irrigated regions are now available, and in every case the variety has outyielded either Ebène 1/37 or M.147/44 in sugar per arpent. Virgin results from other trials in other regions are equally encouraging.

Canes of this variety are of a medium thickness which is very regular. Trashing is easy and the habit erect. The variety seems to be slightly better in sucrose content than M.147/44 and it yields more cane per arpent. A summary of the results of 9 harvests compared to M.147/44 is given on page 40.

Table 4. Distribution of Trials

Year of planting	*Sub-humid*	*Humid*	*Super-humid*	*Irrigated*	*Total*
1957	—	1	—	—	1
1958	1	1	1	1	4
1959	1	2	3	2	8
1960	—	2	2	2	6
1961	2	5	4	2	13
1962	6	6	2	3	17
Total	10	17	12	10	49

	T.C.A.	I.R.S.C.	T.S.A.
M.442/51	35.28	10.19	3.60
M.147/44	34.03	9.73	3.30

N:Co. 310 and **R. 397**, both heavy flowering varieties, have been found, after extensive tests, to have a possible future only in the irrigated regions of the island. Furthermore detailed tests are being conducted in order to assess the real value of these varieties under irrigated conditions.

In view of the fact that R. 397 has been planted fairly widely by some estates in localities other than the sub-humid-irrigated, it is necessary to emphasize that the results of variety trials support a more cautious approach. A summary of the results of R. 397 compared to M.147/44 in one trial in the humid region, and another in the sub-humid region, during 3 years illustrates the relative inferiority of the former variety.

	T.C.A.	I.R.S.C.	T.S.A.
R.397 ...	28.14	10.43	2.94
M.147/44 ...	36.39	10.30	3.75

M.423/51. This variety which has a high richesse (better than Ebène 1/37) has given conflicting results from variety and pre-release trials on account of variable cane tonnage. It seems to give slightly more sugar per arpent than Ebène 1/37 in those regions where Ebène 1/37 is a standard variety, but is unfortunately equally susceptible to damage from cyclones. M.93/48 has given better results in those trials where comparisons have been made. Testing continues.

N:Co. 376. gave encouraging results in two trials this year. In the irrigated region the results were as follows :

	T.C.A.	I.R.S.C.	T.S.A.
N:Co.376 ...	53.0	10.6	5.61
M.147/44 ...	46.5	8.7	4.07
M.253/48 ...	46.8	9.1	4.25

In the super-humid region the figures obtained were equally good :

	T.C.A.	I.R.S.C.	T.S.A.
N:Co.376 ...	27.9	11.7	3.27
Ebène 1/37	14.1	11.5	1.63
M.93/48 ...	22.3	10.7	2.38

More extensive trials with this variety are planned for 1963.

The present distribution of variety and pre-release trials throughout the island is shown in Table 4.

Until now, varieties selected from first selection trials have been propagated in small plots on the Experiment Stations. These plots have given sufficient material to plant one trial the following year. It has been decided that a much more rapid and accurate assessment of new varieties will be possible by planting four trials, one in each of the major climatic regions, right from the start of the variety trial stage. With the generous co-operation of the Manager of Médine S.E., 46 new varieties selected from First Selection Trials were planted in a large multiplication plot. Growth of these canes has been excellent and there will be ample planting material for establishing 4 trials of each variety in 1963.

5. STUDIES ON SEEDLING POPULATIONS

E. F. GEORGE

(i) Optimum Selection Rates from Seedlings.

(a) *Response to selection and heritability.*

First results were obtained during the year from an experiment designed to test the efficiency of selection in singly planted seedlings and in single stools in bunch selection plots. Analysis of variance has showed that selection gave rise to groups of varieties which were significantly superior to groups of varieties chosen at random with no regard to apparent merit.

Both random samples and selected varieties were taken from the single stool stage (either seedlings or B.S.P.) and planted in the usual propagation plots in which a standard variety is placed after every 5 varieties. There is no replication and the plot size is 15 feet. The expected efficiency of selection or heritability from the experimental plot was 0.76.

The response to selection in one experimental cross (M.134/32 $\times$ M.147/44) was as follows :

		Random	Selected
Mean	...	29.55 kgs.	37.10 kgs.
S. D.	...	11.87 kgs.	

$$\text{Response to selection, } R, = 37.10 - 29.55\text{kgs.} = 7.55 \text{ kgs.}$$

In terms of the cross phenotypic standard deviation, s_P

$$\frac{R}{s_P} = 0.64$$

The original singly planted seedlings of this cross were selected at the rate of 3.99%. This is found from tables to be equal to an intensity of selection, i, of 2.06.

The heritability, h^2, between the seedling and propagation plot stages can be calculated from the formula

$$\underset{Prop.\ plot}{\frac{R}{\sigma_P}} = i = \underset{Seedlings}{\frac{S}{\sigma_P}} \cdot h^2 \qquad (1)$$

where S is the selection differential.

$$\text{Then } h^2 = \frac{0.64}{2.06} = 0.31$$

The expected heritability in singly planted seedlings is generally about 0.5 with this type of cross and at this location. The product of the *expected* (subscript e) heritability in seedlings and propagation plot should be equivalent to the *realised* (subscript r) heritability between these two stages

$$h^2_r : h^2_{e\,Seedlings} \cdot h^2_{e\,Prop.\ plot} \qquad (2)$$

$$h^2_r = 0.76 \times 0.5$$

$$= 0.38$$

It will be seen that this is quite close to the heritability calculated from the response to selection. This latter would tend to be higher if the random samples were not truly random due to the difficulty of propagating low yielding individuals of the original population.

These results strongly suggest that what has been described as the "non-maintenance of seedling characters" is mainly explicable in terms of environmental variation. The response to selection found in practice being what would be expected from formulas (1) and (2). This subject is in the course of further study in other experiments.

Formula (1) shows that the response to selection measured in the propagation plot can be improved (a) by increasing the selection differential; that is to say diminishing the selected proportion of the seedling population, (b) by increasing the realised heritabillty.

Something can be done to improve the heritability by attention to field practices, but the first measure suggested above is not practical due to the effects of environmental variation on the probability of selecting superior clones. A study of this subject has been stimulated by the above results and is reported below.

(b) *The probability of selection of superior clones.*

Fixed population statistics were used for the greater part of the calculations which were made. These were based on experimental measurements having practical significance, and were as follows :

Genetic mean grade $\bar{x}_G = 5.0$

Minimum genotypic grade for selection 8.5

Genotypic variance, $s^2_G = 1.28$.

From these figures was derived the probability of missing a variety with a potential of the genetic minimum at various expected heritabilities and selection percentages. The result is shown in fig. 18.

The expected heritability of grade in plots of singly planted seedlings is found in regions of good growth in Mauritius to be between 0.4

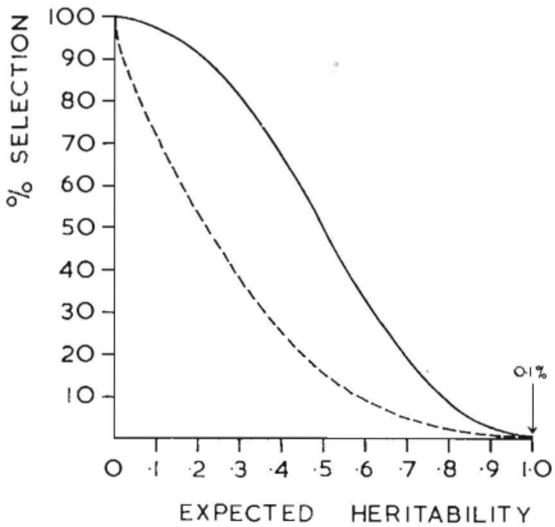

Fig. 18. The chances at different expected heritabilities of missing a variety of genetic grade 8.5 when different selection percentages are adopted. Based on the genetic grade distribution :

$\bar{x}_G = 5.0 \quad \sigma^2_G = 1.28$

Dotted line $P = 0.05$
Plain line $P = 0.001$

and 0.6. The selection percentage which should be adopted to be sure of not missing a good variety ($P = 0.05$) is between 8.9 and 24.8 (average about 15%). At a higher probability ($P = 0.001$) the percentage lies between 33.0 and 67.0 (average about 50%).

These selection percentages are much higher than those used up to the present in Mauritius, when little more than that proportion of the seedling population phenotypically the same, or better than the standard variety, was selected. The probability of selecting a good variety under these conditions is indicated in fig. 19. The calculations on which this graph is based assume that there is a maximum genetic grade of 9.4 in the theoretical population. The maximum could in fact be less than this and alter the shape of the curve, but there is still a greater than 50% chance of including a variety genetically above the minimum when the phenotypically acceptable part of the population is selected.

It should be noted how in seedling populations with the same mean and genetic variance, the phenotypic proportion apparently above the minimum grade increases as the expected heritability decreases. The proportion of the population genetically above the minimum level is constant (potentially 0.1% in the present example). If the phenotypically acceptable seedlings from this population were selected at an expected heritability of 0.3, then 4.5% would be taken. Only $\frac{0.1}{4.5} = 2.2\%$ of these selections will be genetically equivalent or superior to the minimum grade so that it is easy to see why, if selection is made when the environmental variability is large, the majority of the selected seedlings will appear inferior in the next generation.

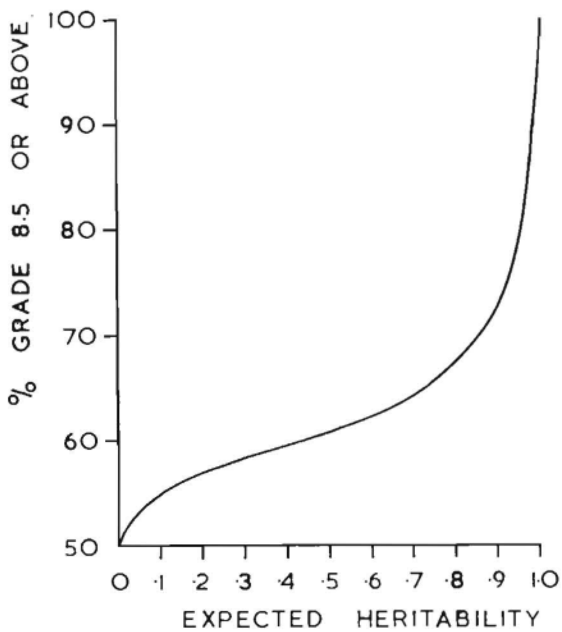

Fig. 19. The chances at different expected heritabilities of selecting all the varieties equal to or above genetic grade 8.5 when that part of the progeny phenotypically better than this grade is selected. The following assumptions were made : Genetic grade distribution defined by $\bar{x}_G = 5.0$, $\sigma^2_G = 1.28$. Maximum genetic grade = 9.4

(ii) Progenies in contrasting environments.

Calculations were finished and a paper presented[2] during the year on a further study of samples of the same progenies grown in contrasting environments. The main conclusions can be summarized as follows :

Environment, and the genetic individuality of the crosses significantly influenced the means, standard deviations and coefficients of variation relating to the distributions of many characters. Significant adaptation to the environments of Réduit, Pamplemousses, Union Park, or Belle Rive, was shown by the progeny means in 12 characters. Preferential adaptation was shown most especially in the super-humid regions, and here differences between family means were often estimated with sufficient reliability to permit the confident choice of the family with highest mean expression.

Although it was possible to pick out with some precision the families with the highest mean expression in the super-humid region, the selection of individual varieties was predicted to be imprecise. For this reason, it has been thought better to select all original seedlings firstly in the humid region where the efficiency of selection is higher. Provided the initial selection is liberal, the varieties so selected should still retain adaptation to regions other than humid.

(iii) The value of certain crosses.

A score to represent the selectors' opinion of a variety is used frequently now in experimental work to assess the value of seedling populations. Assuming that the scores allotted in any particular progeny are normally distributed, it is possible to calculate the number of seedlings which must be examined to find a commercial variety with a given probability.

This method was applied to seedlings derived from several different crosses showing that only some of the crosses give any chance of yielding a variety of commercial standards, but that in a good cross a commercial variety may be found 63 times out of a hundred when 1000 or less seedlings are examined. With the probability of finding a variety of the required grade, 95 times out of 100, between 2000 and 3000 seedlings would have to be screened.

Records of the selection of commercial varieties in Mauritius were examined to see if the above estimates are correct. The result is shown in Table 5.

Table 5. The derivation of commercial varieties bred in Mauritius.

Cross	*Years cross made prior to that giving commercial variety*	*Commercial variety*	*No. of seedlings examined before variety selected*
R.P.6 × M.27/16 ...	—	M.171/30	231
P.O.J.2878 × M.35/17 ...	—	M. 72/31	313
P.O.J.2878 × M.109/26 ...	—	M. 73/31	82
P.O.J.2878 × D.109 ...	1	M.134/32	259
R.P.8 × P.O.J.2878 ...	—	M.112/34	404
M.134/32 × M.196/31 ...	—	M.165/38	306
M.134/32 × M.99/34 ...	—	M.63/39	1063
	—	M.76/39	
	2	M.423/41	2251
	6	M. 31/45	5416
Co.281 × M.63/39 ...	—	M.147/44	491
	1	M.202/46	1781
Ebène 1/37 × M.63/39 ...	—	M. 93/48	1084
B.34104 × M.213/40 ...	—	M.253/48	614

This shows that, of all the crosses made between 1930 and 1948, only 7 yielded commercial canes. A variety of merit was obtained in nearly all cases in the first "or second year" that the particular combination was made. This appears to emphasize that once a good combination of parents is found, a commercial variety is readily forthcoming. There is therefore some reason to think that more rapid advance may come from testing new parental combinations than from the wearied repetition of 'proven' crosses, even though they are known to give a high proportion of selectable seedlings.

(iv) Bunch planting.

Experiments on bunch planting continue, but from discussions at the ISSCT Congress and from experience still being gathered, it has seemed advisable to reduce the size of the bunches planted in the field. It is certainly true that selection from the survivors of bunch planted seedlings is effective. This is further shown from the results of one experimental bunch selection plot examined in 1961 and 1962, which contained 676 selections from the same cross (Ebène 1/37 × M. 147/44).

Virgins 1961

	Seedlings	Standards	Difference
Mean grade ...	5.431	7.347	1.916
Variance ...	2.916	1.530	
Genetic variance ...			1.386
Genetic standard deviation ...			1.177
Mean difference in terms of s_G			1.628

A normal deviate of 1.63 is exceeded 5.16% of time in random sampling.

Ratoons 1962

	Seedlings	Standards	Difference
Mean grade ...	5.495	7.714	2.219
Variance ...	3.070	0.811	
Genetic variance ...			2.159
Genetic standard deviation ...			1.469
Mean difference in terms of s_G			1.511

A normal deviate of 1.51 is exceeded 6.55% of time in random sampling.

These genetic percent selection expectations are higher than have been found in any unselected seedlings examined so far in Mauritius, and concur with previous findings (George 1962) and with Hawaiian experience, that selections from bunch planting are found to be considerably above average.

With 6.55% of the population superior to the standard, 676 stools would yield 44 varieties with a mean grade better than the standard. With six as the estimated number of surviving seedlings per bunch at the time of field planting, 7408 seedlings were originally planted in the experiment. The worth of this cross is such that about 2% of unselected singly planted seedlings might appear genetically superior in grade to the same standard. The number of selections from 7408 single seedlings would then be 148. Bunch planting as practised has been 44/148 (= 0.3) times as efficient as single planting in this case. The efficiency is less still if it is remembered that 9 or 10 seedlings were placed in each bunch at potting.

Reduction of the size of the bunches while retaining the same selection rate per bunch in the field, will still economise ground and can be expected to restore the efficiency of bunch planting to a figure very close to that of single planting.

(v) Elimination of varieties caused by bunch planting.

Some results have been calculated from the bunch planting experiment planted in 1959 in which a comparison was made between varieties taken at random from 5 crosses which were both singly planted and bunch planted. Single stalks were taken from random stools in the single planting, and also at random from bunches of seedlings. As in the single planting it was not possible to take planting material from very poor stools, the samples may be expected to be slightly better than random. Some selection had already been practised in the bunch planted seedlings when the samples were taken, and so here they could be expected to be slightly worse than from truly random sampling.

It is realised that the reliance placed on the results of this experiment depends entirely on the randomness of the samples which were taken. The choice of the original planting material was made in as unbiassed a fashion as possible.

It was found that the stools grown from random stalks from bunch planting were significantly better than stools derived from single planting in the means of the characters grade, diameter, and top. There was no significant difference between samples in brix, length or number of canes. In only one cross (P.O.J. 2878 $\times$ Co. 213) was there any significant difference in weight between the samples from bunch and single planting, and here the mean of the bunch sample was significantly ($P = 0.05$) better.

However, the advances in the means of the characters mentioned which were caused by bunch planting, were not always sufficient to compensate for a reduction in the variance of the distribution. Thus, calculating the percentage of varieties expected to have a performance genetically equal or better than the standard, in each of these characters, shows that the unselected singly planted seedlings often had a higher expectation of producing varieties above the minimum requirement.

On extending the method of analysis to other characters, it was found that in the expected selection rates there were significant interactions between method of planting (bunch or single,) and the cross involved, and also between method of planting and the character considered.

The largest significant difference between the means of the varieties derived from bunch and single planting was in the character top, which was a score allotted to record the condition of the top foliage and where large healthy leaves and the absence of flowers were given the most credit. Selection expectations also tended to confirm that improved tops were to be found in the varieties chosen at random from the bunch plantings. Thus it appears that the area, and possibly also photosynthetic efficiency of the leaves, is a factor determining to a marked degree the survival of varieties when planted in bunches.

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NUTRITION AND SOILS

1. THE COMPOSITION OF CANE JUICE

V. THE STARCH CONTENT OF JUICE FROM DIFFERENT VARIETIES

D. H. PARISH

Introduction

BECAUSE starch solutions are viscous, it is reasonable to suppose that high levels of solubilized or partially solubilized starch grains in a liquid undergoing filtration on an industrial scale are undesirable.

DE SAINT ANTOINE and PARISH (1959), following suggestions from refiners that Mauritian raws were becoming increasingly refractory owing to higher starch levels, studied the starch levels of the juice from various varieties. It was concluded that as the variety M.134/32, a variety giving juices very low in starch, went out of cultivation and was replaced by varieties with juices containing high levels of starch, the overall effect would be that the starch levels of Mauritian raw sugars would increase.

WOOD (1962) has shown that the starch is concentrated in the top of the cane, and presumably therefore cyclonic years in Mauritius should tend to give higher starch levels than usual in the juice, owing to the regrowth of broken canes and the generally higher proportion of short cane than would occur in normal years.

WOOD, *loc. cit.*, has also shown that nutritional potassium stress causes an increase in the starch levels of juice, a factor which could be of importance in Mauritius as many planters' lands are deficient in potassium.

Taking into account the fact that since 1959 many new varieties have come into general cultivation, that 1962 was a cyclonic year and that no local information on the effect of potassium on the starch levels of juice was available, it was felt that a study of the starch level of the juices was worth while.

Analytical

The juices were taken from the mid-crushing-season harvests of the final variety trials; the sites sampled covered a wide range of local climatic zones.

The juices were prepared using a cane chipper and the juice from a sub-sample of chips pressed out with a hydraulic press.

Starch was determined by the method of BALCH (1953) as modified by ALEXENDER (1954), and the figures given are the averages of at least six different juice samples.

Results

The results of the analyses are presented in Table 6 which gives the range of starch content of juices from seven different varieties, Table 7 which shows the effect of low potassium fertilization on starch levels and Table 8 which compares the data of de SAINT ANTOINE and PARISH, *loc. cit.*, with the results obtained for the cyclone year of 1962.

Table 6. The starch content (ppm) of juices from different varieties harvested in 1962.

Variety	*Lowest level*	*Mean*	*Highest level*
M.147/44	480	1171	2,000
M.31/45	900	1205	1,390
M.202/46	370	672	1,190
M.93/48	370	708	1,040
M.253/48	165	478	785
Ebène 1/37	320	543	870
Ebène 50/47	220	400	740

Table 7. The effect of potassium nutrition on the level of starch (ppm) in the juice from different varieties.

Variety	*Normal Potassium*	*Low Potassium*
M.147/44	1160	1205
M.31/45	1105	1305
M.202/46	835	825
M.93/48	788	825
M.253/48	535	578
Ebène 1/37	660	648
Ebène 50/47	410	553

Table 8. Average starch content (ppm) of the juice of two varieties in a normal year (1959) and a cyclonic year (1962).

Variety	1959	1962
M.147/44	550	1170
Ebène 1/37	275	543

Discussion

From the literature available, it is not at all clear whether in fact high starch levels in cane juice, or in raw sugar solutions, are associated with poor filterability.

Boyes (1958) regards starch as the principal cause of the poor filterability of South African cane juices, and this opinion is apparently generally held in South Africa.

Nicholson (1959), discussing Australian experience, is inclined to consider the effect of starch on filterability as being of relatively minor importance, whilst in Mauritius, Vignes (1962) found a significant positive correlation between increasing starch content and poorer filterability.

In any event, in view of the current attitude of the refiners of Mauritian raw sugars, it is essential that factors which lead to high starch levels in juices should be thoroughly understood.

Table 6 shows the starch levels occurring in the juice of seven varieties currently grown on a wide scale in Mauritius.

The most popular variety M.147/44 is widely planted because of its excellent resistance to cyclone damage, but there is no doubt that it gives juices with very high starch levels.

M.31/45 is not a popular variety, but it, too, is very high in starch.

The varieties M.202/46 and M.93/48 give medium levels of starch in the juices, whilst M.253/48, Ebène 1/37 and Ebène 50/47 give relatively low levels of starch.

Table 7 shows the effect of potassium deficiency on the starch levels of the juices studied.

There is no doubt that the effect of a shortage of potassium has been to increase starch levels, thus confirming South African findings; the importance of this effect of faulty potassium nutrition is however insignificant compared with varietal differences.

Table 8 shows the effect of a cyclonic year (1962) and a normal year (1959) on the starch levels in the juices of the two widely cultivated varieties M.147/44 and Ebène 1/37.

The doubling of starch level in a cyclonic year is certainly significant and can almost certainly be accounted for by the higher ratio of top internodes to total internodes, as WOOD, *loc. cit.*, has shown that most of the starch is in the top 2–3 ft. of the cane.

Taking the information so far obtained on the starch levels of Mauritian cane juices, it is seen that the varietal effect is supreme and that cyclonic years will increase the starch levels. Nutritional effects compared with these two factors are unimportant.

Summary

The starch levels of the juices from seven varieties have been determined.

Varietal effects are dominant, the varieties M.147/44 and M.31/45 giving particularly high levels of starch.

Potassium deficiency increases the starch content of juices, but this is of only minor importance.

1962, a cyclonic year, gave juices with twice as much starch as 1959, a cyclone free year.

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2. A FIELD STUDY OF THE NITRIFICATION RATE OF AMMONIUM SULPHATE AND THE SUBSEQUENT LOSS OF NITRATE

D. H. PARISH, L. C. FIGON, & L. P. ROSS

Introduction

The sugar industry of Mauritius has an annual expenditure of about Rs. 14,000,000 on imported nitrogenous fertilizers.

Ammonium sulphate is the standard nitrogenous fertilizer used in Mauritius, but fertilizers containing cheap synthetic nitrate are appearing on the market in increasing quantities.

Little information on the nitrification rate of ammonium sulphate and the subsequent movement of the nitrate ion under field conditions is available for tropical soils, particularly for the conditions occurring in Mauritius, where heavy dressings of nitrogenous fertilizers are applied on the soil surface before the start of the heavy summer rains.

Experimental

The average annual dressing of sulphate of ammonia in Mauritius is about 250 Kg/acre and as the dressing is banded along the cane row the actual intensity of application, taking surface area covered into account, is about 500 Kg/acre; the fertilized plots therefore received this level of fertilization.

Two experimental sites were chosen, one site at Réduit on a low-humic latosol with an annual rainfall of 61″, the other at Belle Rive on a humic ferruginous latosol and a mean annual rainfall of 157″.

The sites were in flat fields which had just been cleared after having been under cane for several years.

Four small plots were marked out, two receiving 500 Kg. of ammonium sulphate/acre, the other two plots being used as controls.

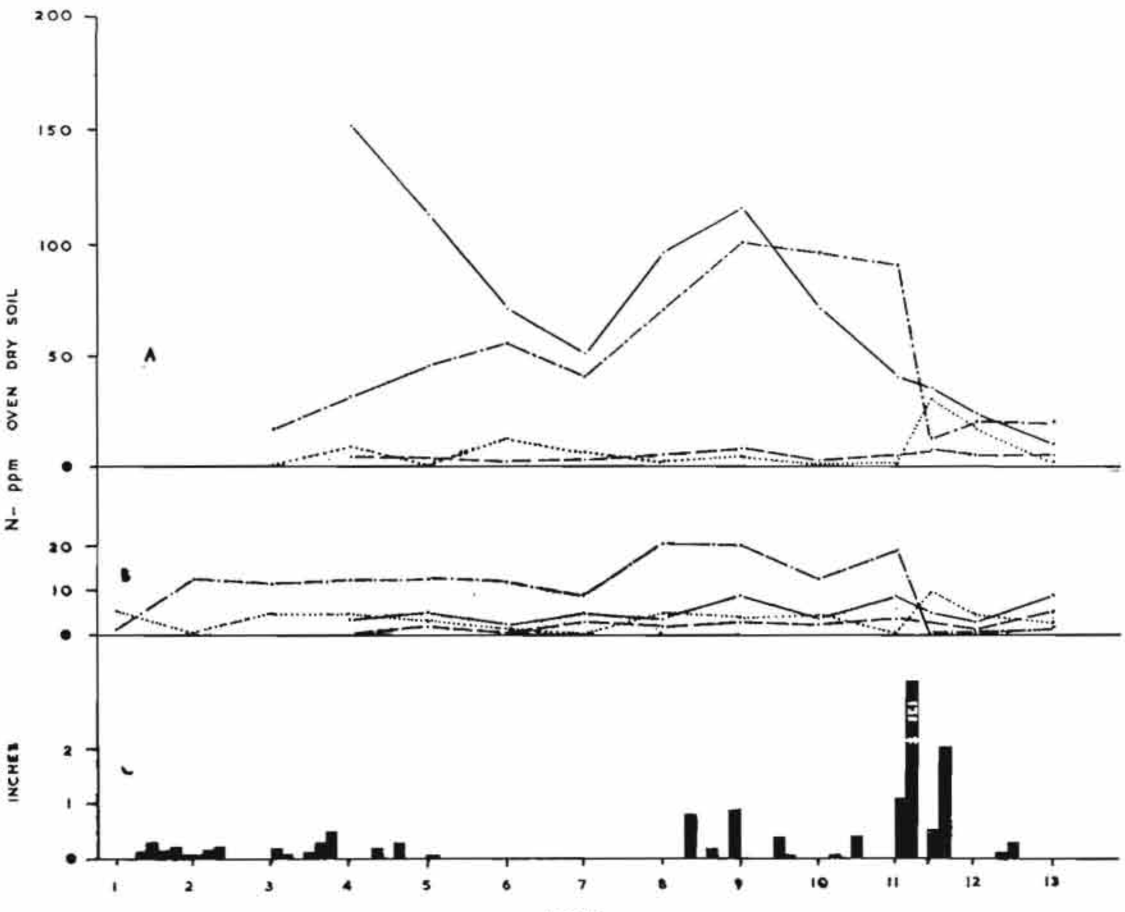

Fig. 22. The changes in the levels of NH_4^+-N and NO_3^--N at Réduit.

A. Fertilized plots. B. Control plots. C. Rainfall.

Plain line : NH^+-N in 0-9″ layer

Broken line : NH_4^+-N in 9-18″ "

Dashes and dots : NO_3^--N in 0-9″ layer

Dots : NO_3^--N in 9-18″ layer

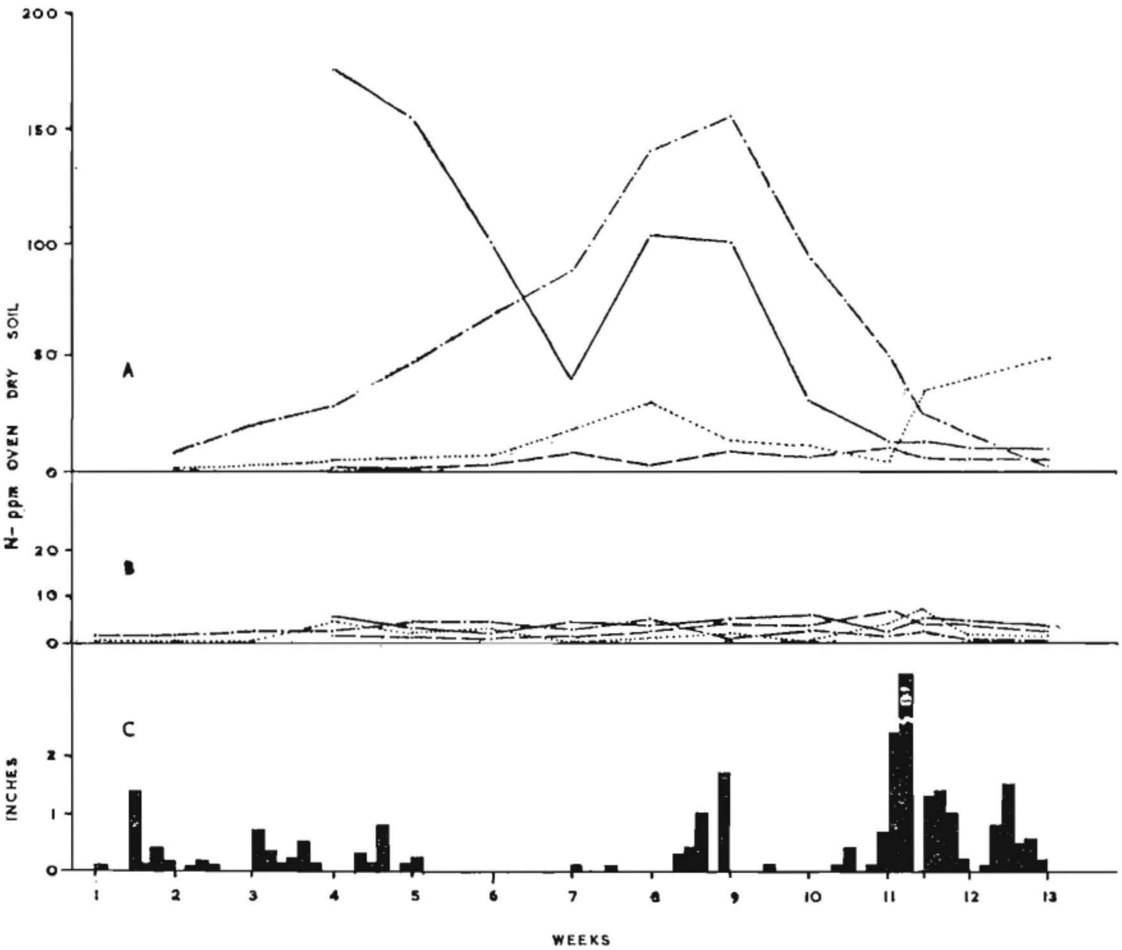

Fig. 23. The changes in the levels of NH_4^+ -N and NO_3^- -N at Belle Rive.

A. Fertilized plots. B. Control plots. C. Rainfall.

Plain line : NH_4^+ -N in 0–9″ layer

Broken line : NH_4^+ -N in 9–18″ layer

Dashes and dots . NO_3 -N in 0–9″ layer

Dots : NO_3^- -N in 9–18″ layer

The plots were surrounded by small ditches to prevent contamination of the surfaces by soil wash; the area being kept free from weeds by hand weeding.

Three samples of soil from the surface 0 - 9″ layer and the 9 - 18″ layer were taken weekly from each plot, using a Jarrett post-hole auger, the samples for each treatment being bulked. Care was taken with the 9 - 18″ samples to prevent contamination by soil from the surface layer; the holes when sampling was completed were refilled and marked.

The soil samples were analysed almost immediately for ammonia by the method of HARPER (1924), and nitrate by an adaptation of the method of EASTOE and POLLARD (1950), the colour being read at 430 mμ on a Beckman D.U. spectrophotometer. The pH and Kjeldahl nitrogen of the samples were also determined weekly.

The results for both NH_4^+– and NO_3^-– nitrogen are expressed as ppm of N in the soil dried at 105°C.

The nitrification rate of sulphate of ammonia when mixed with the two soils was determined in the laboratory using moist soil (about 50% of the moisture holding capacity), sub-samples being taken for analysis twice weekly.

The whole experimental procedure was based on the work of CUNNINGHAM & COOKE (1958).

Results

The levels of NO_3^-– and NH_4^+– nitrogen in the surface 0 - 9″ and the lower 9 - 18″ layers of the soil from the control and fertilized plots, together with the daily rainfall, are given in fig. 22 for the Réduit site, and fig. 23 for the Belle Rive site.

Fig. 24 shows the soil moistures of the two layers of soil at both sites.

The nitrification rate of sulphate of ammonia added to the two soils is shown in fig. 25, together with the changes occurring in the control samples.

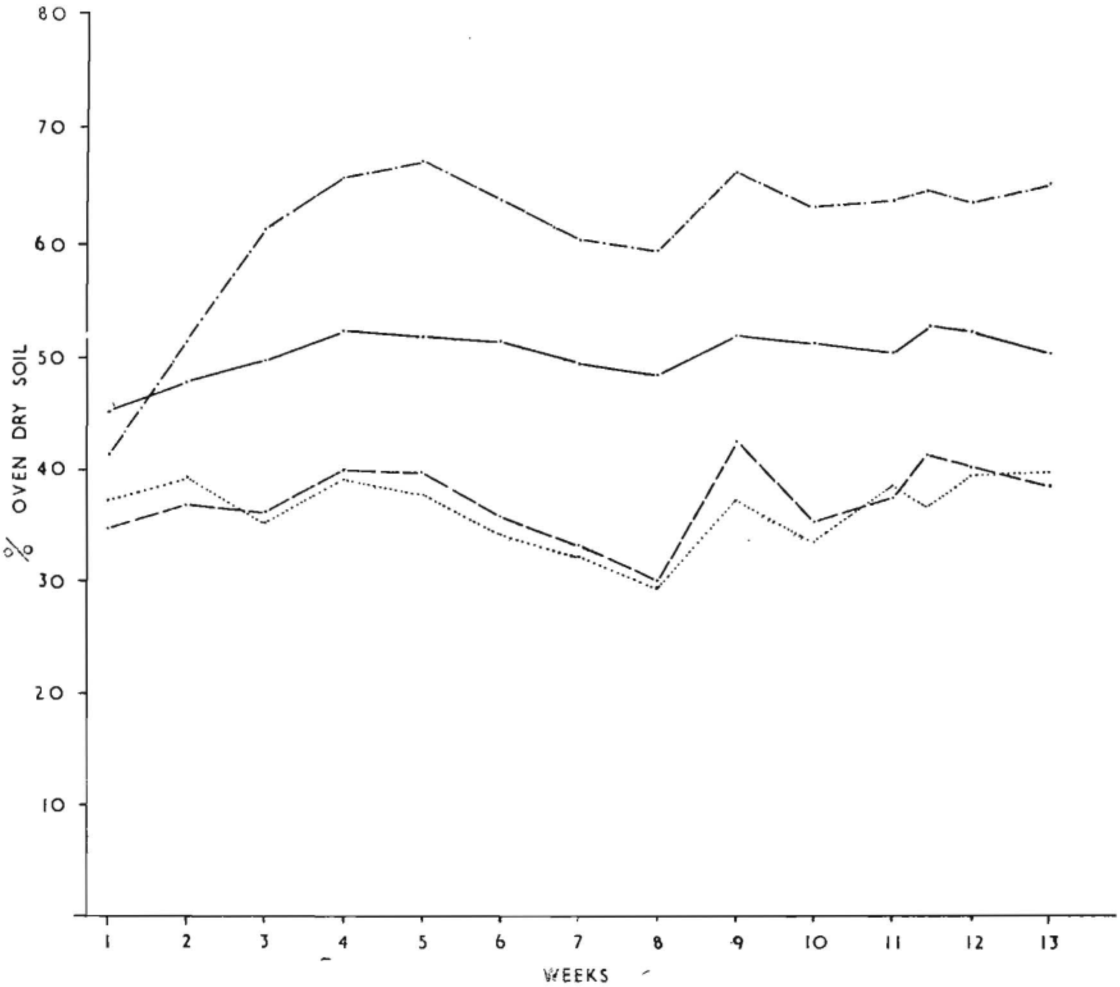

Fig. 24. Soil moisture of the 0–9″ and 9″ to 18″ layers at Réduit and Belle Rive from the 22nd Sept. 1961 to 13th Dec. 1961. (gm. water/100 gm oven dried soil.)

Broken line : Réduit 0–9″ layer
Plain line : Réduit 9–18″ layer
Dots : Belle Rive 0–9″ layer
Dashes and Dots : Belle Rive - 9–18″ layer

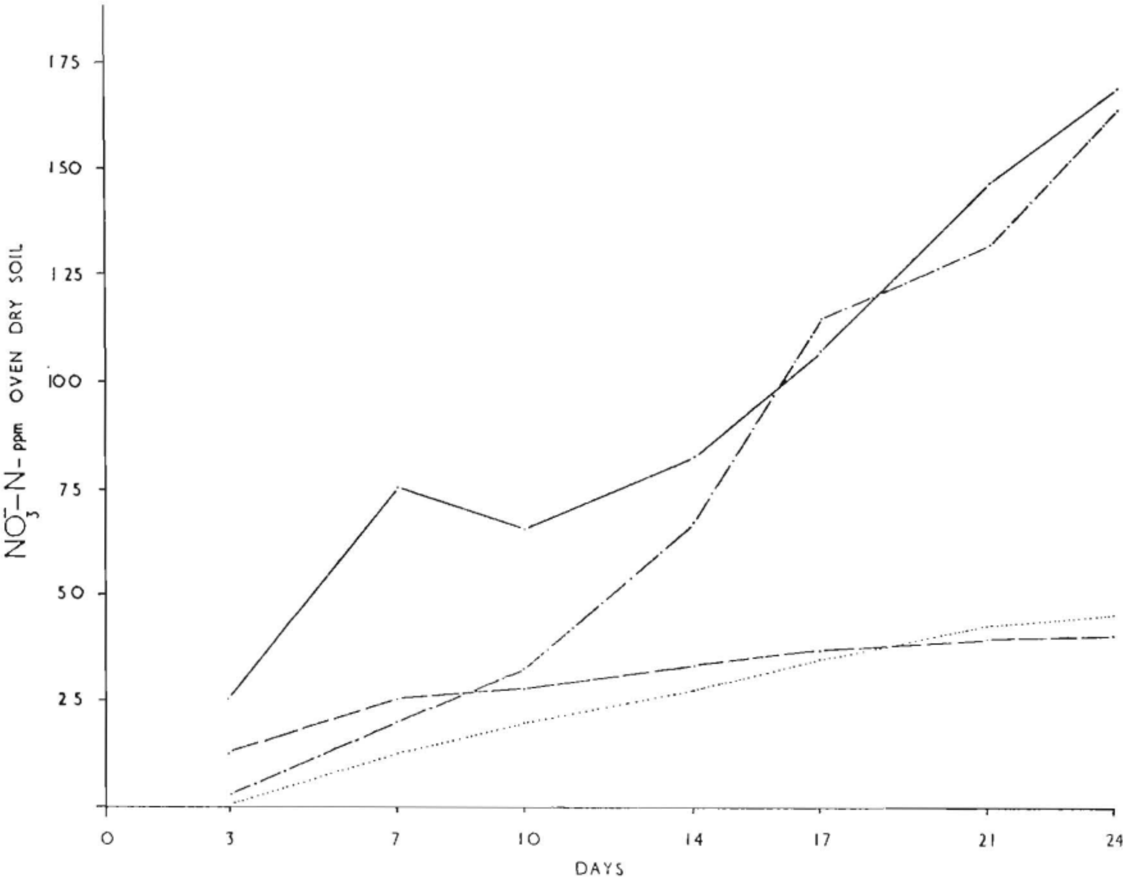

Fig. 25. Nitrification rate of sulphate of ammonia mixed with moist top soil from Réduit and Belle Rive.

Plain line : Réduit Treated — Dashes and dots : Belle Rive Treated

Broken line : Réduit Control — Dots : Belle Rive Control

Discussion

Changes in ammonium and nitrate levels in unfertilized, uncropped soil.

The NH_4^+– and NO_3^-– nitrogen levels in the surface 0 - 9″ and the lower 9 - 18″ layers of the unfertilized bare soil are shown in parts B of figs. 22 and 23.

At both sites, unfertilized plot changes in NH_4^+– nitrogen, in both the surface and lower layers, are negligible and the NO_3^-– nitrogen in the 9 - 18″ layer also changes but slightly.

The changes of NO_3^-– N in the surface layer however are quite marked in the Réduit plots and are parallelled, but in a much less significant way, by the Belle Rive plots.

In the first seven weeks of sampling, the NO_3^-– N in the surface layer of the Réduit plots is fairly constant, at a level of around 10 ppm. After the seventh week, the level rises to about 20 ppm and finally drops to negligible amounts after the heavy rains of the 1st and 2nd of December.

The increase in the nitrate content of the 0 - 9″ layer started with the period at which the soil moisture was lowest, and it is natural to assume that the increase was due to an upward movement of soil water carrying with it nitrate ions from the subsoil.

Many investigators [HARDY (1946), MEIKLEJOHN (1953), JONES (1957)] in the tropics report high nitrate contents in the topsoil during the dry period of the year and various reasons have given to account for this.

DHAR *et. al.* (1933) proposed a photonitrification process, and some circumstantial evidence that photooxidation of ammonium does in fact occur have been forthcoming from various countries. WETSELAAR (1961) suggests however, as a result of his work, that in fact the nitrate accumulation in the surface layer of the soil is due to capillary transport of nitrate under drying conditions.

Changes in ammonium and nitrate levels in the fertilized plots.

The changes in the NH_4^+– and NO_3^-– nitrogen of the 0 - 9″ and 9 - 18″ layers of the fertilized plots are shown in parts A of figs. 22 and 23.

The overall results for the surface 0″ - 9″ layers at both Réduit and Belle Rive are similar; a general decrease in NH_4^+– N, and an increase in NO_3^-– N up to around the tenth week, and then a decline. At the end of the sampling period, both NH_4^+– N and NO_3^-– N were at low levels.

This general picture shows that the NH_4^+– nitrogen, applied as ammonium sulphate to the surface of the soil, is completely nitrified in about twelve weeks, and that the nitrate formed is lost completely from the bare soil in the same period.

As regards the changes occurring in the 9 - 18″ layers, the generalizations which seem valid are, that the NH_4^+– N in this layer is not augmented by NH_4^+– N from the surface layer and that after sustained heavy rains the NO_3^-– N in this layer shows a marked increase.

When the details of the graphs are studied, several points arise which need explanation.

The level of NH_4^+– N of the surface layers of both Réduit and Belle Rive declines up to the seventh week, and then suddenly rises to a peak, and falls thereafter to negligible amounts.

This flush of ammonium ions occurred towards the end of the dry period and must have been due to a change in the susceptibility of the NH_4^+– N in the soil to be liberated by the particular extractant and alkali used in the determination of the soil ammonium ions. It is accepted that methods like HARPER's give only an indication of the readily extractable and easily hydrolysable ammonium nitrogen.

Whether this temporary fixation of ammonium nitrogen was physical or biological is unknown, and this point is certainly worthy of further study.

The changes in NO_3^-– N in the surface layers of the Réduit site and the Belle Rive site are quite different, the Réduit samples showing dramatically the loss of nitrate through leaching due to the deluge of the 2nd December, whilst the Belle Rive nitrate falls in a regular fashion from the ninth week onwards.

The 9 - 18″ layers of both experimental sites, however, show accumulation of nitrate after the heavy rains.

Conditions at the beginning of December were so abnormal that the Belle Rive soil became waterlogged, which fact accounts for the high values of NO_3^-– N in the 9 - 18″ layer from the twelth week onwards.

The Réduit site did not become waterlogged and so the NO_3^-–N in the 9 - 18″ layer eventually fell to negligible amounts.

The loss of nitrogen by the fertilized plots at Réduit from the 9th to the 11th week would appear to have been quite high, as about 50 ppm of NH_4^+– N were lost, and yet, no increase in nitrate occurred.

For the Belle Rive site NH_4^+– N fell by almost 100 ppm and the NO_3^-– N fell by about the same amount.

As the period from the ninth to the eleventh week of sampling was a dry period, soil moistures at both sites fell; it seems difficult therefore to count the loss of NO_3^-– as a leaching phenomenon, particularly as the 9 - 18″ layers showed no increase in NO_3^-– as would be expected if nitrates were being washed down the profile.

Loss of nitrate by leaching is not a simple elution, as COOKE & CUNNINGHAM, *loc. cit.*, have shown. These workers found that nitrate ions present in the structural units of the soil were not washed out of the soil by a single heavy rain, as drainage occurred around the structural units rather than through them.

The converse of this could conceivably

occur, whereby percolating rainfall, rich in the nitrates of the surface layer, drains through channels in the subsoil and has little effect on the level of the subsoil nitrate.

Be this as it may, it seems that some other explanation for the large loss of nitrogen from the ninth to the eleventh week is needed.

The total nitrogen figures determined by the KJELDAHL method showed that the soil nitrogen levels of the fertilized plots fell to the same level as the control plots by the thirteenth week, and therefore the loss of nitrogen was almost certainly a real loss.

These results can be interpreted therefore by assuming that some of the losses were due to denitrification, which is apparently a more active cause of nitrogen loss than was suspected. The surface layers of the soils studied are of good structure and are well drained, but MEIKLEJOHN (1940) has shown that denitrification can occur even under well aerated conditions; it could be also that the chemical reaction of nitrite with $-NH_2-$ N is an important factor in nitrogen loss with the acid latosols and high soil surface temperatures.

Nitrification of ammonium sulphate mixed with the moist top soil.

Fig. 25 shows the nitrifying power of the soil from both experimental sites.

The results for both soil types are very similar as regards the nitrification rate of the added sulphate of ammonia and the mineralization and oxidation of native soil nitrogen.

Conclusions

Ammonium sulphate is nitrified fairly quickly when applied to the surface of the soil and the nitrate or nitrite formed is lost by denitrification and leaching. The losses found in these experiments would of course have been considerably reduced in the presence of a growing cane crop.

The ammonia form of nitrogen was held by the soil, as even the rains of December 1st and 2nd did not affect the NH_4^+- nitrogen levels. The leaching of nitrogen from sulphate of ammonia found to occur by SHERMAN (1955) apparently did not hold under the conditions of this experiment.

The rains of the 1st and 2nd December were exceptional and it is probable that on a field scale, loss of nitrate by leaching was of minor importance compared to general erosion losses. However, heavy rains are common in November and December, and as many soils in Mauritius are very shallow and rocky, the use of heavy dressings of nitrate at this period of the year is theoretically not without some risk.

Results available from Mauritius and many other countries show no difference in the efficacy of nitrate nitrogen and of ammonium nitrogen applied as fertilizers to sugar cane. It could be that losses of nitrate by leaching on a practical scale are unimportant or counterbalanced by nitrogen losses from sulphate of ammonia.

Work is, however, being repeated on the comparison of nitrate and ammonia as sources of nitrogen for sugar cane, and when these results are obtained, it will be possible to be more categorical about the relative merits of the two forms.

Summary

Ammonium sulphate applied to the soil surface was almost completely nitrified in 13 weeks, and the nitrogen it contained (100 kg./acre) was completely lost from the bare soil in the same period.

Denitrification on uncropped soils is probably a cause of steady nitrogen loss, whilst leaching by heavy rains can reduce soil nitrate levels dramatically.

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3. COMPARATIVE NPK FOLIAR DIAGNOSIS VALUES OF SIX CANE VARIETIES AT SIX LOCATIONS

P. HALAIS

Two corrections must be made to N P K levels obtained from chemical analysis when foliar diagnosis is to be run year after year as a follow-up procedure of the mode of nutrition of the crops. Permanent sampling units, of fairly large size, carefully selected, with the co-operation of estates, are now used to represent the general conditions of climate, soil group, and management, prevailing on the different sectors of the sugar plantations. Some 600 such units have been already selected to cover the needs of the 23 sugar estates.

An age correction is introduced for adjusting all leaf contents to the standard age of 5 months for ratoon crops though the actual leaf sampling extends from 3 to 7 months. (HALAIS, 1962). In doing so, the sampling, otherwise restricted by meteorological conditions which are binding, acquires much more flexibility in actual practice.

A variety correction is also needed to bring all leaf contents in line with average figures obtaining for cane varieties at large. This correction constitutes a further refinement of the follow-up scheme now in force and aims at disclosing the evolution of the N P K nutritional trends from observations collected on the same permanent sampling units, which will have to be replanted with different varieties in the years to come.

New experimental evidence on this variety correction, which had been recognized early in the development of the method of foliar diagnosis and actually applied in routine foliar diagnosis in Mauritius, will be given below.

The comprehensive series of final variety-fertilizer trials (started at some two to three year's interval) is well suited for finding the foliar diagnosis variety correction to be adopted for the new cane varieties recommended. The example given covers the series Agro. '54 representing six varieties compared at six locations during three years. Each individual deviation given in the Tables 9, 10, 11 is derived from 108 determinations conducted on virgin canes (1955), 1st ratoons (1956), and 2nd ratoons (1957). Such extensive repetitions in time and space is the surest means of reaching sound conclusions.

These tables show for each nutrient separately expressed in terms of N, P_2O_5 and K_2O % d.m. of the 3rd leaf blade (central portion, midrib excluded) and for each variety, the deviation of the observed contents against the average content of the six varieties in competition in each location.

The deviations calculated are consistent for each of the three major nutrients tested. In other words, there is no variety-location interaction at play, and consequently, a variety correction is fully justified by facts and represents a characteristic of each variety allowing the leaf contents of different varieties to be brought to a common average denominator. It will be found that a positive deviation from the average of the six varieties tested, entails the adoption of a negative correction to be subtracted from the analytical figures obtained and vice versa.

In conclusion, corrections derived from the first group of six varieties, some of which are now under commercial cultivation, are summarized in Table 12. The corrections for the newer varieties, M.147/44 and M.93/48, for instance, are fairly well known but final values will be published in due course owing to the unavoidable delay resulting from the abnormal climatic conditions which prevailed during the last three consecutive sugar campaigns and which prevented leaf sampling from being undertaken without interruption on the existing final variety-fertilizer trials. However, there is no need to delay leaf sampling on the field units planted with new varieties for which the variety correction is not known with accuracy. The required correction will be made later on when available, and this detracts in no way the follow-up procedure involved.

Table 9. N % d.m. (deviations from Foliar Diagnosis location means)

Location	*The Mount*	*Bon Espoir*	*Beau Vallon*	*Eau Bleue*	*Union Flacq*	*Bonne Veine*	*F.D. Variety Means*	*Variety Corrections*
Agro.	7/54	8/54	5/54	10/54	6/54	9/54	—	—
B.37172 ...	+ 0.11	+ 0.10	+ 0.09	+ 0.11	+ 0.10	+ 0.12	2.03	— 0.10
B.37161 ...	+ 0.08	+ 0.03	+ 0.05	+ 0.10	+ 0.06	+ 0.06	1.99	— 0.06
M.134/32 ...	— 0.01	— 0.01	+ 0.04	+ 0.03	+ 0.08	+ 0.07	1.96	— 0.03
M.34104	+ 0.01	+ 0.01	0.00	— 0.01	— 0.02	— 0.03	1.92	+ 0.01
Ebène 1/37	— 0.06	— 0.05	— 0.06	— 0.07	— 0.11	— 0.11	1.85	+ 0.08
B. 3337 ...	— 0.10	— 0.10	— 0.12	— 0.16	— 0.08	— 0.13	1.81	+ 0.12
Foliar Diagnosis *Location Means*	*1.81*	*1.83*	*1.87*	*1.94*	*1.98*	*2.13*	*1.93*	

Table 10. P_2O_5 % d.m. (deviations from Foliar Diagnosis location means).

Location	*Beau Vallon*	*Union Flacq*	*Eau Bleue*	*Bon Espoir*	*Bonne Veine*	*The Mount*	*F.D. Variety Means*	*Variety Corrections*
Agro. ...	5/54	6/54	10/54	8/54	9/54	7/54	—	—
M.134/32 ...	+ 0.031	+ 0.033	+ 0.022	+ 0.046	+ 0.028	+ 0.054	0.497	— 0.035
B.34104 ...	+ 0.026	+ 0.017	+ 0.034	+ 0.020	+ 0.023	+ 0.021	0.486	— 0.024
B.37172 ...	+ 0.004	+ 0.011	+ 0.012	— 0.006	+ 0.031	— 0.019	0.468	— 0.006
B.37161 ...	— 0.031	— 0.013	— 0.015	— 0.030	— 0.003	— 0.024	0.443	+ 0.019
Ebène 1/37	— 0.010	— 0.017	— 0.018	— 0.023	— 0.034	— 0.027	0.441	+ 0.021
B.3337 ...	— 0.023	— 0.028	— 0.034	+ 0.009	— 0.049	— 0.005	0.438	+ 0.024
Foliar Diagnosis *Location Means*	*0.425*	*0.440*	*0.462*	*0.475*	*0.487*	*0.489*	*0.462*	

Table 11. K_2O % d.m. (deviations from Foliar Diagnosis location means)

Location	*Bonne Veine*	*Beau Vallon*	*Eau Bleue*	*Bon Espoir*	*Union Flacq*	*The Mount*	*F.D. Variety Means*	*Variety Corrections*
Agro. ...	9/54	5/54	10/54	8/54	6/54	7/54	—	—
Ebène 1/37	+ 0.07	+ 0.08	+ 0.13	+ 0.11	+ 0.11	+ 0.13	1.55	— 0.11
M.134/32 ...	+ 0.16	+ 0.08	+ 0.08	+ 0.02	+ 0.07	+ 0.13	1.53	— 0.09
B.37172 ...	0.00	0.00	0.00	+ 0.02	0.00	— 0.10	1.43	+ 0.01
B.37161 ...	— 0.02	— 0.09	— 0.05	— 0.06	— 0.07	— 0.07	1.38	+ 0.06
B.3337 ...	— 0.10	— 0.04	— 0.11	— 0.05	— 0.04	— 0.02	1.38	+ 0.06
B.34104 ...	— 0.10	— 0.04	— 0.06	— 0.05	— 0.09	— 0.11	1.37	+ 0.07
Foliar Diagnosis *Location Means*	*1.34*	*1.37*	*1.41*	*1.42*	*1.43*	*1.68*	*1.44*	

Table 12. Foliar Diagnosis variety correction % d.m.

	N	*P_2O_5*	*K_2O*
M.134/32	— 0.03	— 0.035	— 0.09
Ebène 1/37	+ 0.08	+ 0.021	— 0.11
B.37172	— 0.10	— 0.006	+ 0.01
B.3337	+ 0.12	+ 0.024	+ 0.06
B.34104	+ 0.01	— 0.024	+ 0.07
B.37161	— 0.06	+ 0.019	+ 0.06

These corrections are not numerically large, nevertheless the principle involved in their use is fully justified. Of course, there is no rational explanation at hand why one variety shows leaves higher or lower in N, P_2O_5 and K_2O contents than the average varieties at large. This is simply an observation substantiated by experimental evidence of a precise nature.

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4. TRACE ELEMENTS

D. H. PARISH

No response by sugar cane to trace element applications to the normal basalt-derived soils of Mauritius, nor, so far as is known, to the normal basalt-derived soils of Hawaii has been reported.

Usually, trace element deficiencies in a crop show dramatically, but even in the absence of symptoms, potential losses of yield due to low soil reserves and sudden changes in availability due to abnormal conditions are possible.

In January 1955 replicated experiments were carried out on the effect of spray applications of boron, molybdenum, copper and zinc, to cane growing in fields typical of large areas of Mauritius. No effect from any of these spray treatments was obtained.

In view of the yield responses obtained with basalt dust on the humic ferruginous soils of the super-humid zone, experiments with fritted trace elements under low and high fertility were laid down at the planting of the crop, and harvests taken for two years. No response to the trace element treatment was obtained on these soils.

Responses to liming over and above responses to calcium as a nutrient have been reported by D'HOTMAN (1947) and FEILLAFÉ (1954) in Mauritius, and more recently CLEMENTS (1961) has reported similar non-calcium effects from Hawaii.

It is well known that increasing the pH of a soil increases the availability of molybdenum, but the responses to these heavy limings have been attributed to major physical or chemical changes in the soil, such as improved crystallization of the clay colloids, or reduction in the levels of manganese and/or aluminium.

Molybdenum uptake by a plant is antagonized by manganese in solution and synergized by good phosphate nutrition. As manganese levels are generally high and phosphate levels low in the acid latosols, then molybdenum deficiency is a possibility in these soils.

Latosolic brown forest soils and humic ferruginous latosols from the high rainfall regions of Mauritius give molybdenum deficiency symptoms in sensitive plants like cauliflower. Eight field trials with sugar cane, using sodium molybdate foliar sprays, were laid down in 1962 and preliminary results will therefore be available in 1963.

The first molybdenum deficiency to be described in sugar cane was found by EVANS (1956), but it was an extremely complex deficiency, due apparently to a combination of unusual physical and nutrient deficiency conditions.

Apart from molybdenum, zinc, copper and boron are the trace elements of most practical importance, and their levels have been determined in the T.V.D. laminae of the variety M.134/32 in fifth ratoons, each of 4 - 5 months age, growing in four sites typical of large areas of cane land in Mauritius.

The results are presented in Table 13 together with the minimum levels for sound nutrition suggested by EVANS (1959).

It can be seen from Table 13 that copper is low and zinc has only a small margin of safety, whilst the boron levels are apparently completely adequate. It is interesting that site variations in zinc content are so small, as the available zinc levels in the soils from these sites vary widely, PARISH *et al* (1956).

The accurate determination of trace elements, particularly at deficiency levels, is difficult, and it could be that some of the lower critical levels which have been established are not particularly accurate. From these results, however, it certainly appears that further work on trace elements and cane growth is needed.

Table 13. Levels of Zn, Cu and B (ppm dry tissue) in T.V.D. leaf lamina of the variety M.134/32, 5th ratoons, 4-5 months old.

Site	ZINC		COPPER		BORON	
	Found	Lower Limit	Found	Lower Limit	Found	Lower Limit
Pamplemousses	13.2	<10	3.8	<4	9	1
Réduit	11.2	<10	4.3	<4	7	1
Belle Rive	13.2	<10	3.9	<4	12	1
Union Park	13.2	<10	3.6	<4	12	1

Fig. 20. A low humic latosol formed from transported material overlying a low humic latosol formed *in situ* at Pailles. (Phot. S. M. Feillafé).

Fig. 21. A shallow phase of a low humic latosol illustrating concentric weathering of basalt at Réduit. (Phot. S. M. Feillafé).

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Fig. 26. Acute stage of leaf scald on a seedling cane.

Fig. 27. Inoculation of leaf scald pathogen above growing point (not in stumps). Note pads of cotton wool soaked in bacterial suspension and placed on cut surfaces after inoculation.

CANE DISEASES

R. ANTOINE & C. RICAUD

1. GENERAL CONSIDERATIONS

THE cyclonic conditions which prevailed at the beginning of the growing season would, no doubt, have been conducive to major epidemics of gummosis and leaf scald had it not been for the policy of releasing for cultivation only varieties immune, or highly resistant, to the two bacterial diseases. In an island regularly struck by cyclones, environmental conditions may be extremely favourable to the spread of diseases, as is shown by the reactions of canes in the variety collections. It follows that sustained vigilance should be exercised in the testing of disease reaction and that, unless resistant varieties are not available as is the case with chlorotic streak and ratoon stunting, the release of the so-called susceptible-tolerant variety should not be contemplated.

On two occasions, in February and March, lightning injury to standing cane caused concern to planters, particularly in the first case where forked lightning caused damage to a large patch and several smaller ones. Such damage occurs almost annually during the early months of the year and may at times seem alarming. A short description of the characteristic symptoms would help planters to diagnose, without much difficulty, the cause of the trouble, which is of minor significance if any. In cane fields struck by lightning, the affected areas are generally circular but of varying diameter. Damage is more severe in the centre of the spot, decreasing towards the outside. From a distance, the change in colour of the leaves from green to yellow, brown or purple, is a charateristic feature. Killed stalks develop a top rot associated with a very foul smell. There is a shrinking of the internodes of the stalk which become sometimes strongly bi-concave. Inside, the parenchyma may be completely decomposed with the fibres standing out. Shredding of the leaves or of the entire top which are often seen hanging down, is another typical feature. An abundant production of aerial roots is also generally observed.

Pokkah-bœng (*Gibberella moniliformis* (Sheldon) Wineland) was again conspicuous during the period of active growth on the variety Ebène 50/47. The attacks, although spectacular, were not apparently damaging to the cane.

In a field of M. 112/34 attacked by sheath rot caused by *Cytospora sacchari* Butler, large orange-red spots bearing the typical fructifications were observed on the blade of one of the leaves.

Planting material, whether heat-treated or not and originating from nurseries or commercial plantations, should be given the recommended organo-mercurial treatment before planting. However, organo-mercurial fungicides on the market used to contain 3% mercury. Some of the preparations imported at present contain 6%. The recommendation for the preparation of the dip for cuttings at planting time is that the solution should contain between 0.015 and 0.03% mercury. In other words, the single strength preparation (3% Hg.) should be used at $\frac{1}{2}$ to 1% concentration and the double strength fungicide (6% Hg.) at $\frac{1}{4}$ to $\frac{1}{2}$% concentration. The use of too concentrated a solution is not only wasteful but may result in injury to the developing bud. Also, it should be remembered that the handling of the fungicide with bare hands may cause painful burns.

2. RATOON STUNTING DISEASE

(a) Varietal reaction

The resistance trials were again damaged by the cyclones, particularly the one established in the super-humid zone which had already been badly hit by the 1960 cyclones, and had to be replanted the following year. No conclusions could be drawn on the erratic results obtained in that trial, yields in 1st ratoons ranging from 4.4 to 16.4 tons per acre only.

Experimental results were obtained this year for 2nd and 4th ratoons respectively in the two trials at Pamplemousses in the sub-humid zone. Table 14 gives the results for 1st and 2nd ratoons, while Table 15 gives a summary of the results obtained in the resistance trial planted in November 1957. No. data were collected in 1960.

The average reduction in yield of sugar for virgins, 1st, 3rd and 4th ratoons at Pamplemousses ranged from 9% in B.37172 to 18% in B.37161. The varieties released more recently showed reductions in yield of sugar for 1st and 2nd ratoons in the same locality, varying from 3% in M. 253/48 to 26% in M.202/46. The low susceptibility of M.253/48 should once more be noted. M.93/48, with a reduction of sugar per acre of 8%, is not more susceptible than the majority of sugar cane varieties cultivated at present. The poor growth observed in a few fields is attributed to the unfavourable climatic and edaphic factors prevailing in certain marginal areas where the variety has been planted. It is true that ratoon stunting has caused erratic growth in a few fields planted with untreated material, and that shows up still more the vigorous, homogeneous stand in fields planted with cuttings obtained from nurseries. The importance of planting that variety as well as the other newly released ones with disease-free material is once more stressed.

Table 14. Effects of ratoon stunting disease on yields in cane and sugar in 1st and 2nd ratoons at Pamplemousses Experiment Station.

		TONS CANE/ARPENT			TONS SUGAR/ARPENT		
Varieties	*Crop*	*Treated*	*Untreated*	*Reduction %*	*Treated*	*Untreated*	*Reduction %*
M.202/46	1st ratoon ...	30.4	26.8	12	3.89	3.16	19
	2nd ,, ...	28.4	20.7	27	3.35	2.21	34
	Average ...	29.4	23.8	19	3.62	2.69	26
M.93/48	1st ratoon ...	29.3	26.1	11	3.72	3.42	8
	2nd ,, ...	40.7	34.9	14	4.44	4.12	7
	Average ...	35.0	30.5	13	4.08	3.77	8
M.253/48	1st ratoon ...	36.0	34.0	6	4.46	4.25	5
	2nd ,, ...	32.4	37.8	—17	3.53	3.48	1
	Average ...	34.2	35.9	—5	4.00	3.87	3

Table 15. Summary of results obtained in a ratoon stunting trial laid down at Pamplemousses in 1957.

		TONS CANE/ARPENT			TONS SUGAR/ARPENT		
Varieties	*Crop*	*Treated*	*Untreated*	*Reduction %*	*Treated*	*Untreated*	*Reduction %*
M.134/32	Virgin ...	24.5	19.1	23	4.73	3.54	25
	1st ratoon ...	20.5	26.7	9	4.84	3.33	11
	3rd ,, ...	25.7	21.2	18	3.44	2.73	21
	4th ,, ...	27.5	24.3	9	2.67	2.62	2
	Average ...	26.8	22.8	15	3.94	3.31	16
M.112/34	Virgin ...	25.7	24.5	5	4.79	4.54	5
	1st ratoon ...	36.9	29.4	20	5.90	4.49	24
	3rd ,, ...	26.7	25.4	5	3.39	3.23	5
	4th ,, ...	30.2	26.3	13	3.41	2.63	23
	Average ...	29.9	26.4	12	4.37	3.72	15
M.147/44	Virgin ...	33.7	29.3	13	6.26	5.39	14
	1st ratoon ...	38.6	35.9	7	5.74	5.62	2
	3rd ,, ...	30.3	24.0	21	3.45	2.54	26
	4th ,, ...	53.3	42.1	21	4.80	3.58	25
	Average ...	39.0	32.8	16	5.06	4.28	15
M.31/45	Virgin ...	34.3	29.5	17	5.91	4.85	16
	1st ratoon ...	39.6	35.2	11	6.41	5.55	13
	3rd ,, ...	27.3	24.1	12	3.22	3.16	2
	4th ,, ...	36.9	32.9	11	4.35	3.82	12
	Average ...	34.5	30.2	12	4.97	4.37	12
Ebène 1/37	Virgin ...	24.5	21.9	11	4.65	3.81	18
	1st ratoon ...	34.2	29.6	13	5.43	4.74	13
	3rd ,, ...	28.4	23.2	18	3.64	3.04	16
	4th ,, ...	23.0	25.4	—10	2.65	3.00	—13
	Average ...	27.5	25.0	9	4.09	3.65	11
B.34104	Virgin ...	27.3	24.7	10	5.14	4.63	10
	1st ratoon ...	31.3	28.8	8	4.98	4.45	11
	3rd ,, ...	28.3	24.4	14	3.45	2.83	18
	4th ,, ...	32.4	29.5	9	3.53	3.01	15
	Average ...	29.8	27.0	9	4.28	3.73	13
B.3337	Virgin ...	30.3	26.3	12	5.49	4.75	14
	1st Ratoon ...	37.5	34.2	9	6.14	5.30	14
	3rd ,, ...	30.1	26.8	11	3.04	3.11	2
	4th ,, ...	38.3	32.9	14	3.64	3.39	7
	Average ...	34.1	30.1	12	4.58	4.14	10
B.37161	Virgin ...	23.1	17.1	26	4.17	3.02	28
	1st ratoon ...	29.5	26.1	12	4.91	4.43	10
	3rd ,, ...	32.2	25.3	21	3.90	2.91	25
	4th ,, ...	39.2	34.4	12	4.35	3.92	10
	Average ...	31.0	25.7	17	4.36	3.57	18
B.37172	Virgin ...	31.5	28.0	11	5.79	5.19	10
	1st ratoon ...	37.0	35.6	4	6.18	5.80	6
	3rd ,, ...	25.7	25.1	2	3.14	3.09	2
	4th ,, ...	42.1	35.6	15	4.63	3.99	14
	Average ...	34.1	31.1	9	4.94	4.52	9

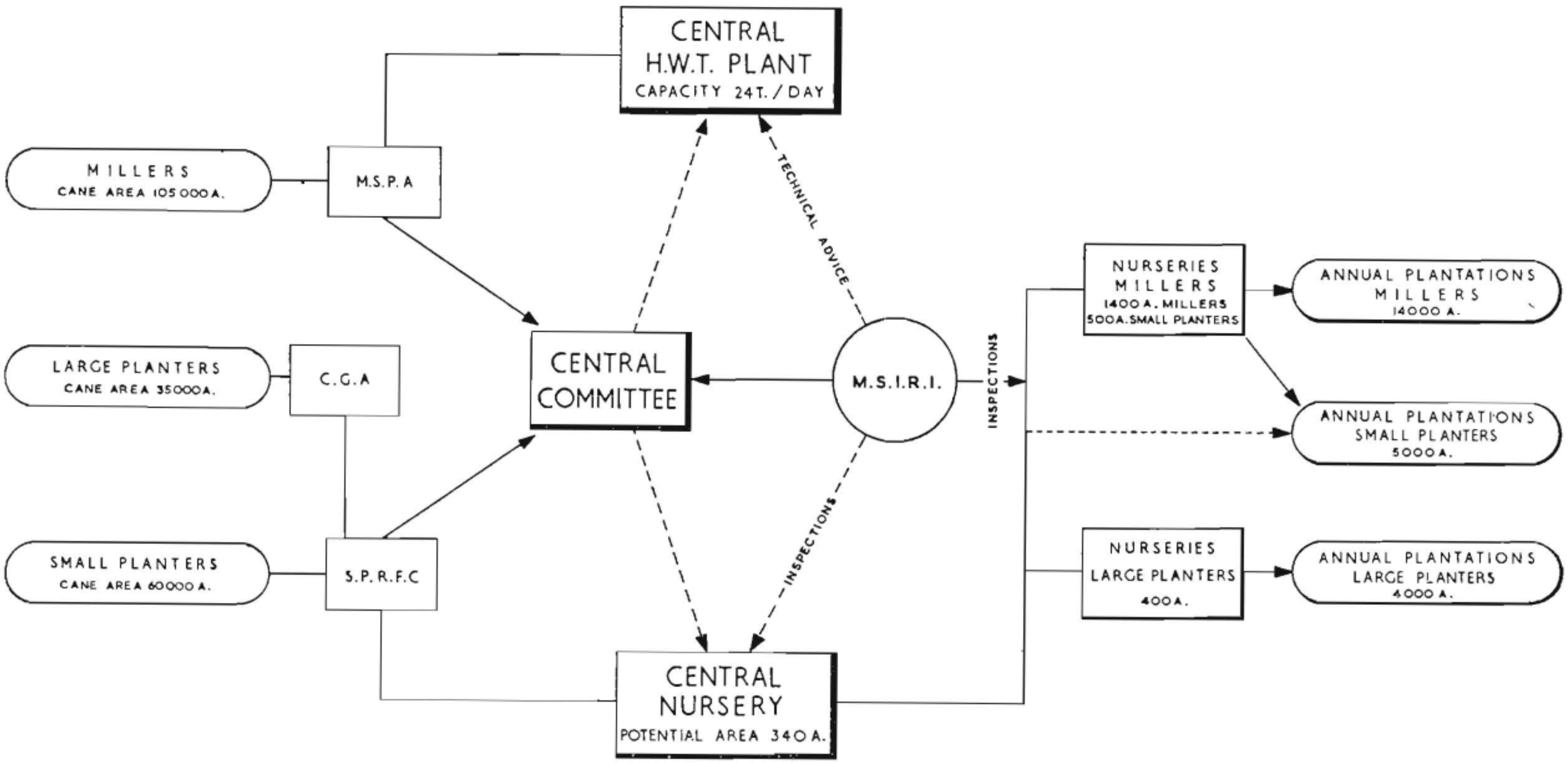

Fig. 28. Scheme for the production of treated planting material for the sugar industry.

(b) Progress in control measures

Since the beginning of the campaign against ratoon stunting disease, in June 1958, to the end of 1962, the weight of cuttings treated at the central hot water treatment plant for estates amounted to approximately 7,000 tons. In 1960, the quality of the planting material was so poor after the two severe cyclones, that only 125 tons were treated and, this year, there is no doubt that the implementation of the central nursery scheme has been in a certain measure responsible for a reduction in the total weight of cuttings treated for individual estates.

The 7,000 tons of treated setts planted approximately 1,200 arpents. It appears therefore that the planting rate, with hot water treated cuttings, on an average for the island, should be reckoned as 6 tons per arpent, i.e. almost twice the normal rate. However, at the central nursery located in the hot, sub-humid area where conditions for growth are excellent, water is not limiting and special care is taken for plant establishment, the requirement in treated setts is hardly above that for normal plantations. Thus, this year, 163 tons of cuttings served to establish 48 arpents.

Individual nurseries established on estates in 1962 totalled 133 arpents and required 790 tons of treated cuttings. Plantations made during the year with material obtained from A and B nurseries amounted to 1410 arpents. This represents 10.6% of the total area (13280 arpents) planted.

The scheme for the establishment of a central nursery from which healthy planting material would be available for secondary nurseries on estates, mentioned in last year's annual report, has materialized through an agreement reached between the Sugar Producer's Association and the Sugar Planter's Rehabilitation Fund Committee and is now well under way. The scheme is detailed in fig. 28 which is self-explanatory.

In 1963, planting material will be available from 61 arpents of virgin A nurseries at the central nursery and will serve to establish approximately 540 arpents of B nurseries on estates. The target in 1964 is set at 145 arpents of virgin and 1st ratoon A nurseries which should plant 1,300 arpents of B nurseries in the various factory areas. The material available should meet the total planting requirements of estates the following year.

A proportion of the B nurseries on individual estates will serve to supply planting material to small planters on a factory area basis. Large planters will obtain their clean cuttings straight from the central nursery and establish their own B nurseries.

3. CHLOROTIC STREAK

Experimental work on chlorotic streak is progressing along the following lines :

(a) Soil transmission of the disease

The studies are conducted on plants grown in concrete containers under insect-proof individual cages. In addition, the erection of a greenhouse made up of three individual compartments was completed towards the end of the year. Further experimentation on disease transmission in soil and nutrient solutions will be carried out in the greenhouse.

(b) Spread of the disease in sugar cane fields

Twenty-five sugar cane fields were selected in the sub-humid irrigated zone in order to include in the area a gradual change from the heavy dark magnesium clay soils to the low humic latosols with free drainage. The spread of the disease in relation to the type of soil and the surface irrigation is being assessed.

(c) Inheritance of resistance

As the evidence on soil transmission of chlorotic streak is building up, the task of controlling the disease appears more difficult. The direct approach to the production of resistant varieties is now contemplated and to that effect the reactions of 34 breeding canes to the disease are being assessed. All varieties grown commercially in Mauritius have proved to be susceptible when grown under conditions favourable to infection. The reactions of several of the breeding canes is still unknown and in fact there is no evidence at present to conclude that there is a resistant variety in Mauritius. Consequently, the breeding canes are being tested in the superhumid zone, under controlled conditions in drums and in a field which had borne a severely infected crop. The variety M.423/51, rated as very highly susceptible, was the first to contract infection within six months.

(d) Miscellaneous

Leaf symptoms resembling those of chlorotic streak had been reported in 1954 on one plant of *Pennisetum purpureum*, strangely enough, in the sub-humid zone. This year, abundant symptoms were observed on the same plant grown as a hedge in the high rainfall area and separated from a heavily infected sugar cane field by a ditch. The symptoms tended to disappear almost completely during the cooler, drier months.

With the implementation of the central nursery scheme, the requirement of the treatment plant against ratoon stunting disease has reduced considerably. In order to keep the plant working at full capacity, it was decided to carry out treatments against chlorotic streak as well for neighbouring estates. In order not to alter the setting of the thermostat the treatment of 50°C for 30 minutes was given. As cuttings are normally treated in Mauritius against chlorotic streak at 52°C for 20 minutes, it was decided to test the efficacy of the new treatment on the virus before embarking on a large scale programme. To that effect, cuttings obtained from plants showing the characteristic leaf symptoms were loaded in baskets and immersed in water at 50°C. Three lots of baskets were removed after 20, 25 and 30 minutes treatment respectively, and the cuttings planted out with a control. Results showed that even the shortest time of treatment had inactivated the virus in the cutting. Infection in the control plot amounted to 36%. Thermocouple readings at the centre of the cuttings during treatment showed that temperatures varying between 44° and 45 °C had been reached after 20 minutes. This confirms the previous finding* that the virus is inactivated *in vivo* at temperatures of 44° to 45°C. During the year, 510 tons were treated against chlorotic streak at the central plant. It is planned to treat 3,000 tons of cuttings in 1963 for neighbouring estates. The total weight of canes treated annually against chlorotic streak in Mauritius amounts to 19,500 tons.

4. LEAF SCALD

The new method for inoculating the leaf scald pathogen outlined in the 1961 report has proved very successful in the resistance trials. A high level of infection was maintained in the inoculated rows planted with the following susceptible varieties : White Tana, Sealey's Seedling, M.81/52 and M.112/34. The varieties under test failed to contract infection although the two controls M.81/52 and M.112/34 both reacted as susceptible, which is in agreement with their rating. Furthermore, both B.34104 and B.3337, rated as resistant in Mauritius, did not contract the disease in the trial.

The method of testing varieties has been modified in order to obtain concurrently the reactions of varieties to natural and artificial methods of infection.

The promising variety M.81/52, in view of its high susceptibility, is not to be released. Planters are advised to uproot their observation plots as soon as possible.

5. GUMMING DISEASE

Eighty-nine varieties were tested in the resistance trial during the year. Conditions were very favourable to the disease, the susceptible control getting the top rating. Of the varieties under test, one proved to be highly susceptible, one susceptible, and two slightly susceptible.

Preliminary investigations on strain varia-

* c.f. *Ann. Rep. Sug. Ind. Res. Inst. Mauritius,* 1957 : 62.

tion in the gumming disease pathogen conducted by Dr. A. C. Hayward at the Commonwealth Mycological Institute had indicated that such variation did exist. Thus, isolates from five different sources : Mauritius, Réunion, Madagascar, Natal and Southern Rhodesia could be separated into two groups on the basis of their morphological and physiological characters; the isolates from Réunion and Mauritius being placed in one group, and the remainder in another. Furthermore, the isolates from Réunion and Mauritius could be differentaitcd by host reaction. Other work on strain differentation using bacteriophage is being conducted at the Commonwealth Mycological Institute. Preliminary results have shown that the isolate from Madagascar could be differentiated from those obtained in Southern Rhodesia and Natal which appear to be identical. Thus the phage against *Xanthomonas vasculorum* obtained from diseased leaves collected in Southern Rhodesia lysed the isolates from Southern Rhodesia and Natal but not those from Madagascar, Réunion and Mauritius. The work on bacteriophage reciprocal sensitivity testing is continuing and it is intended to send to the Commonwealth Mycological Institute diseased leaves of *Thysanolaena maxima* in order to include this bacterial pathogen in the studies.

6. FIJI DISEASE IN MADAGASCAR

The assessment of the reactions of canes grown commercially in Mauritius and of promising varieties is continuing in the Fiji disease resistance trials with the co-operation of the *Institut de la Recherche Agronomique à Madagascar*. Such trials are established annually in a highly contaminated area in the Brickaville district on the East Coast of Madagascar. Several varieties are thus either under test or undergoing their quarantine period before being included in a trial. The following promising varieties : M.99/48, M.39/49, M.409/51, M.442/51 M.658/51, M.225/53, M.117/55 and Ebène 88/56 were sent to Madagascar this year for the same purpose.

The eradication campaign against the disease on the East Coast of Madagascar has been very successful in the sugar producing area. Thus the resistant Pindar has replaced the susceptible varieties. The other highly resistant canes now available are : Q.57, S.17, M.31/45, Ragnar and Trojan. Of these S.17 appears to be particularly well adapted to the conditions prevailing in that sugar cane area. In the small plantations, scattered all over the province, and in which the cane is grown for chewing purposes, for the production of fermented cane juice or of alcohol, although the good work done, under difficult conditions, has yielded some positive results, eradication is not yet in sight. Progress in the task of the Plant Protection Service is being hampered by several factors, mainly human, in a province where cultivation of the sugar cane is of secondary importance and where a large proportion of the fields are not cultivated for the production of sugar.

It follows, therefore, that continued vigilance has to be exercised in order to prevent an accidental entry of the disease into Mauritius, the more so that one of the measures which aimed at the protection of Mauritius, mainly the prohibition concerning the entry and sale of canes in the town of Tamatave, was lifted in March. However, a control organization has been set up in the town and port area of Tamatave and, during the year, sugar cane pieces were seized, on a few occasions, on persons going into the port area. The expenses involved in the control work are being met by the Governments of Mauritius and Réunion proportionately to the sugar production of the two islands. Replacement of susceptible canes by the resistant Pindar in the small plantations around the town of Tamatave is likely to be completed by mid-1963. A large number of cane fields after uprooting have been converted to banana plantations.

The understanding and unfailing co-operation of the Minister for Agriculture in Madagascar is once more gratefully acknowledged.

Fig. 29. Young stages (hoppers) of the red locusts, *Nomadacris septemfasciata* (Serv.)

Fig. 30. Cane field (M.147/44) partly defoliated by the red locust.

CANE PESTS

J. R. WILLIAMS

1. GENERAL

INSECT pests were on the whole more conspicuous on sugar cane in 1962 than they have been for many years and outbreaks occurred of several species which are normally innocuous.

The thrips, *Fulmekiola serrata*

Foliar injury by thrips, characterized by irregular chlorotic patches and streaks mainly on the terminal half of the leaf blade, became very conspicuous in November-December in many regions. The insect lives in colonies in the rolled leaves of the spindle and it scarifies the surface tissues of the unexpanded leaves : the damaged tissues become chlorotic and often dessicated, while the leaf tips may dry out and die before separation from the spindle so that they remain tied together in a characteristic manner. Thrips injury is evident to some extent every year but is seldom of consequence. It is, however, accentuated when conditions are dry, and growth of young canes, which suffer most, may receive a temporary check. Varietal susceptibility is marked.

The red locust, *Nomadacris septemfasciata*

Outbreaks of the red locust occurred in December and others were being reported at the end of the year. High populations of the young stages (hoppers) were present in the attacked fields, causing severe defoliation. Insecticidal treatment of fields in the attacked areas was being initiated at the end of the year. It may be noted that the last outbreak of this locust occurred in 1933 when many fields were reported to have been severely damaged.

The leafhopper, *Perkinsiella saccharicida*

A circumscribed, intense attack was reported in one field in the North, the canes being stunted and the sugary excretion of the insects resulting in a black growth of mould over the leaves. This is the only known instance of the leafhopper causing obvious suppression of cane growth in Mauritius.

Other insects

Other pests during the year were the scale insect, which is discussed below, *Clemora smithi*, which attacked a few fields in the North, and the cane moth borers, particularly *Sesamia* and *Proceras*. In connection with *Clemora*, it is to be remarked that the maintainance around cane fields of food-plants for its Scoliid parasites has been sadly neglected in recent years. The use of chemical weedicides in cane fields and the absence of *Clemora* attacks for some years are no doubt the reasons, but it is to be emphasized that the planting and care of *Eupatorium* and *Stachytarpheta* (Queue de Rat) around or near cane fields is a sound precautionary measure against *Clemora* which should not be neglected.

Research

Recent work on the stalk moth borer, *Proceras sacchariphagus*, has been reported fully in two papers presented at the 11th ISSCT Congress*. One of these relates the attempt to establish in Mauritius the Javanese fly, *Diatraeophaga striatalis*, a parasite of the borer. Liberations of the fly made in June-July 1961, have apparently not resulted in its establishment while a laboratory culture, started in July 1961, expired in March after six generations were reared. It is intended to make another effort to introduce and establish this parasite.

Little time could be devoted to the study of soil nematodes during the year. *Rotylenchulus parvus*, a reniform nematode, was recorded from cane roots, this being the first time a nematode of this genus has been found in sugar cane. Otherwise, a new species of Nygolaimid was described from soil around cane roots*. A summary of work in Mauritius on nematodes associated with sugar cane was presented at the 11th ISSCT Congress*.

Investigations were also made on the scale insect which attacked many fields in the Black River District. These are described below.

2. THE SUGAR CANE SCALE INSECT

A study was begun on the scale insect, *Aulacaspis tegalensis*, to acquire more data upon its incidence, the losses it causes, the development of infestations in relation to cultural practices, and the activity of its natural enemies.

Incidence in the field

Infestation of cane fields is restricted to low-lying, dry regions, namely the Northern Plain, the Black River District, and the coastal strip in the east and south. The insect may well exist in other parts of the island, but only in the areas mentioned does it become so numerous as to encrust cane stalks and to assume any importance. Irrigated and non-irrigated fields are equally liable to infestation and it seems possible that low rainfall favours the insect directly by permitting greater survival of the young (crawler) stage, although an indirect effect, such as one upon natural enemies, may also be operative.

Field infestation is characteristically heavy over a more-or-less well defined area, which may comprise part of a field, adjacent parts of contiguous fields, or a block of fields. A road or field track may sharply demarcate an infestation, even though the fields on each side are comparable as to cane variety etc. The picture thus gained is of infestation extending slowly from a focus or from several foci. This is consistent with the idea that the minute «crawlers» hatching from the eggs have to rely upon their own exertions to find suitable tissue on which to fix themselves, though their dispersion by wind, upon the clothing of labourers, and during transport of cut canes to the factory no doubt results at times in new foci of infestation.

The extent and location of infested areas naturally vary to some extent each season, but in 1962 an attempt was made to assess the incidence of the scale. In the Tamarin-Magenta area, where the scale is chronic, a field-to-field survey in August revealed 37 fields totalling about 170 arpents to be appreciably or heavily infested, while the insect was found to be present in small numbers in 103 other fields. Reports of infested fields in other parts of the island brought the total area of appreciably, or heavily infested, cane to about 200 arpents. This is a very conservative figure as a number of infested fields were certainly not reported. In fact, infestation is frequently overlooked or ignored until its extent is revealed by trashing preparatory to harvest when there may be little inclination to report the occurrence of the insect.

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* See Publications, pp. 31 & 32.

Nature of losses

Apart from reduction of cane yield, the extent of which has not been determined, it is well established that the scale insect has a pronounced adverse effect on composition of the cane juice. To elaborate existing data, a heavily infested field of B.37172 at Tamarin was selected in July and its harvest deferred until the end of the season so that the progress of the infestation and its effect upon the canes could be studied.

The following experiments were made with canes from this field :

(a) Eight heavily infested and eight healthy canes were cut at soil level and topped in the normal manner. None of the canes were flowering or showed signs of doing so. Using a circular saw, a transverse section about 1″ thick was cut from the middle of every internode of each cane. The maximum amount of juice was expressed from each section with a vice and the Brix read with a bench refractometer. This was done in July and again in October.

Results are shown in fig. 31, each point on the graphs representing the difference between the means of eight readings from healthy and infested canes, respectively.

It is evident from the figure that the scale insect causes a large drop in Brix when it infests stalks heavily. This drop was greatest in July in the upper half of cane stalks and exceeded 50% in several internodes. In October, the reduction of Brix was less, the startling reduction in the top part of the canes being absent. These results can be correlated with scale infestation, as discussed below.

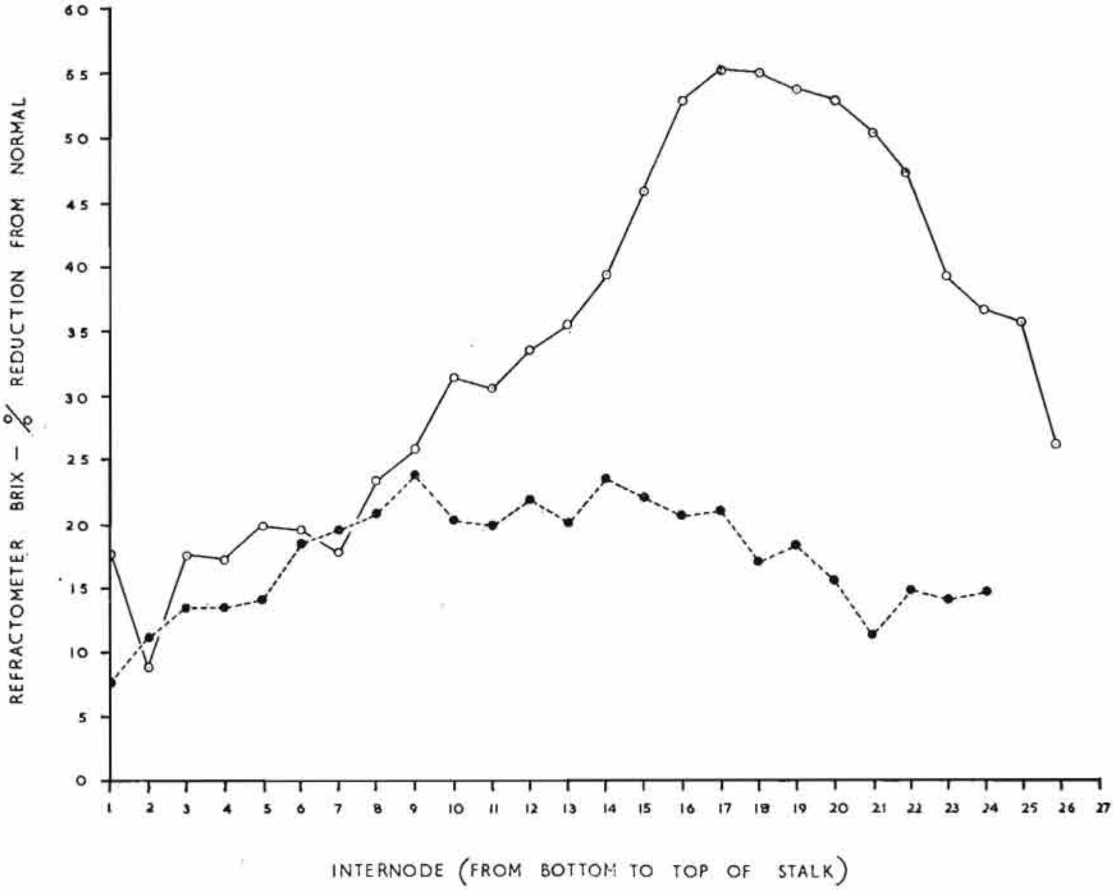


Fig. 31. Reduction of Brix in stalks infested with the scale insect, *Aulacaspis tegalensis* (*Zehnt*)

o—o—o July 1962

●--●--● October 1962.

(b) In July, healthy and heavily infested canes were taken and cut in half to make samples for analysis. None of these canes showed signs of flowering. Six samples of 15 half-canes in each of the following categories were analysed : healthly top-halves, healthy bottom-halves, infested top-halves, infested bottom-halves. Results are given in Table 16.

Table 16. Analysis of healthy canes and canes infested with the scale insect.

	Top			Bottom			Whole cane (i.e. average)		
MONTH	Healthy	Infested	% Difference	Healthy	Infested	% Difference	Healthy	Infested	% Difference
Sucrose % juice	16.16	11.62	— 28.1	19.53	16.47	— 15.7	17.85	14.05	— 21.3
Reducing sugars % juice ...	0.28	0.60	+114.3	0.10	0.33	+230.0	0.19	0.47	+147.4
Refractometer Brix	18.05	13.66	— 24.4	20.86	17.90	— 14.2	19.46	15.78	— 28.9
Pol % cane	14.08	8.07	— 42.7	15.14	13.09	— 13.5	14.62	10.74	— 26.5

(c) To supplement the July analyses, similar cane samples were taken in September, October, and November. They differed by consisting of only 5 half-canes per sample with 4 replications, and only Pol % cane was assessed. The results for Pol % cane obtained at different dates are given in Table 17.

Table 17. Pol % cane of healthy and infested canes in the same field at different dates in the crop season.

	Top			Bottom			Whole cane (i.e. average)		
MONTH	Healthy	Infested	% Difference	Healthy	Infested	% Difference	Healthy	Infested	% Difference
July	14.1	8.1	— 42.7*	15.1	13.1	— 13.5*	14.6	10.7	— 26.5*
September	14.3	11.3	— 20.9*	15.4	14.8	— 3.9	14.9	13.1	— 12.1*
October	13.6	12.7	— 6.6	14.8	15.2	+ 2.7	14.1	13.8	— 2.1
November	15.8	14.5	— 8.2	16.0	15.9	+ 0.6	16.0	15.2	— 5.0

* $P < 0.01$.

The above data have to be considered in relation to the scale infestation within the field and to the general state of the cane.

Infestation was very heavy in July at the beginning of the crop season when observations were started and most stalks in the fields were encrusted with scales. The lower internodes of attacked stalks were, however, clean or showed only the dead remains of scales : this reflected a gradual intensification of the attack during the growing and maturation period and the fact that the young mobile stages choose soft stalk tissue on which to fix themselves so that infestation moves upwards along the stalk with growth. The other significant feature of infestation in the field was that it fell away during August-September and by mid-October relatively few live scales were left : this may have been entirely due to natural enemies, several species of which were extremely active.

The severity of the effect of the scale upon composition of the cane juice was obviously correlated with the number and position of live scales on the stalks. Thus, the peak in the July graph in fig. 31 occurs where live scales were massed on the stalks : the October graph shows really the residual effect of the scale, for at that time live scales were nearly absent and the so-called infested stalks then taken bore mainly dead scales or traces of former scale attack. Similarly, Table 17 shows a marked reduction of sucrose in the stalks in July, a lesser but still highly significant reduction in September, and a non-significant reduction in October-November.

The field when harvested in November yielded 25.87 tons cane/arp. Taking this figure and ignoring other factors which affect cane quality as the crop season progresses, it may be calculated from the data in Table 17 that had all canes been uniformly and heavily infested there would have been a loss of 1.5 tons sugar/arp. if cropped in July, 0.7 tons in September, and a non-significant loss in October-November. Even if these figures are reduced by 25% to allow for the fact that all canes were not uniformly infested, the loss of sugar if cropped in July-September would still have been high.

Two questions at once arise. Does infestation normally diminish as the crop season progress, so allowing some recovery ? Assuming that it does — to what extent would reduced cane quality consequent to over-ripeness detract from recovery should harvest of infested cane be deferred to late in the crop season ? It may be noted that flowering had been heavy in the field studied, that there were many side-shoots when harvested, and that flowered canes were not included in the cane samples.

Cultural practices and natural enemies

It is evident that the date of harvest of an infested field may influence considerably the amount of sugar lost but more has to be learned of the rise and fall of infestation in fields, and the factors responsible, to resolve this point. In this connection, natural enemies are important : they are known to comprise three species of Coccinellids, one Nitidulid and two Chalcidoids. The Coccinellid *Lindorus lophanthae* seems to be the most active of these. Other cultural practices which have a bearing on control of the scale are trashing, removal of all water-shoots at harvest, and burning. The latter may do more harm than good when natural enemies are abundant. Further data upon all these subjects is being acquired.

WEED CONTROL

E. ROCHECOUSTE

1. PRACTICAL ASPECTS OF THE CONTROL OF *CYNODON DACTYLON*

VARYING results in Mauritius upon the control of *C. dactylon* by TCA and Dalapon led to detailed studies on the botany of that grass. Four biotypes were distinguished, two of which are tetraploids named Constance and Réduit and two triploids named Beau Champ and Bel Ombre. Growth studies made on the four clones established that the most important phases in their development are seasonal, and investigations on the total available carbohydrates in the rhizomes have shown that the quantity varies also with the season.

The growth responses of the four biotypes to TCA and Dalapon investigated by water culture technique showed that the biotypes differed in their tolerance to the acids, the order of resistance from high to low being Réduit, Constance, Beau Champ and Bel Ombre.

Field trials were subsequently laid down on pure swards of the biotypes, but the Réduit biotype could not be included owing to the difficulty of establishing it as a pure sward under field conditions. In these trials TCA at 100, 200, 300, and 400 lb/acre and Dalapon at 10, 20, 40 and 80 lb/acre were applied at different times of the year on pure swards of the biotypes growing under the same environmental conditions. Sprayings were made in May, beginning of the cool dry season; July, during the cool dry season; September, beginning of the warm dry season and February, during the warm wet season.

From the results obtained it was established that :

(1) the three biotypes were best controlled by the September spraying, and of the other sprayings that in May gave the most satisfactory results.

(2) to spray in September is more economic since rates of application necessary to obtain satisfactory results are lower.

One interesting point that has been brought forward in these studies is that the most important phases in rhizome development coincide with the time of the year at which TCA and Dalapon are more effective. This observation is of importance for it may explain why varying results may be obtained in the control of *C. dactylon* if the herbicide is applied at different times of the year.

It is also interesting to note that a better control of two other rhizomatous grasses *Phalaris arundinacea* and *Paspalidium geminatum* is also obtained in September. This may indicate that in that month a particular phase growth in the development of some of our perennial grasses is reached which makes them more susceptible to herbicide activity.

2. PHYTOTOXIC EFFECTS OF HERBICIDES

(a) *Dalapon.* Experiments laid down in ratoon canes in 1962 to determine the effects of dalapon at application 4, 8, 12 and 16 lb/acre on cane growth and sucrose content, are in progress. Preliminary observations, however, have demonstrated that this chemical may cause severe injury to sugar cane as exemplified by diverse malformations, the commonest being :

(i) inhibition of terminal bud caused by fusion of the tender leaves of the

Fig. 32. *Top* : Effect of DCMU (4 lb active/arpent) on cane germination and growth in fields where subsoil has been exposed. *Foreground* : exposed subsoil area. *Background* : soil of normal fertility.
Bottom : Malformations caused by Dalapon, at the rate of 4 lb per arpent, on cane variety B.37172.

spindle into a solid pointed mass.

(ii) Complete or partial tubular leaf formation causing distortion of the upper leaves (tangle top) (fig. 32).

(iii) Inhibition of terminal bud causing the formation of tillers from basal nodes.

(iv) Chlorosis of the blade generally accompained by rigidness of the chlorotic tissues.

(v) Reduction of stalk size and internode length.

(vi) Depending on dosage rate, depressed to severely depressed growth, which may lead to death of the plant.

Observations made in field trials and in cane plantations on sugar estates where dalapon had been applied showed that cane varieties differ in their susceptibility to this chemical. Our information to date may be summarized thus :

M.147/44	—	very susceptible
M.31/45	—	,, ,,
M.93/48	—	,, ,,
Ebène 50/47	—	,, ,,
M.202/46	—	susceptible
B.3337	—	,,
B.37172	—	,,
Ebène 1/37	—	moderately susceptible

The 'very susceptible' varieties showed a high proportion of malformed shoots and death of plants, even at the lowest rate of application (4 lb/arpent). The 'susceptible' varieties showed effects similar to those found in the very susceptible varieties at the same dosage, but to a lesser degree. Ebène 1/37 is the only variety which showed some tolerance to this chemical as far as morphological malformations are concerned. However, it would appear that this tolerance decreases from the super-humid to humid areas. In fact an 8 lb/arpent treatment produced only minor visual effects in a super-humid area whereas a 6 lb/arpent treatment in a humid area caused stunted growth and death of plants.

Concluding from these preliminary observations it is recommended that for the present the use of dalapon should be avoided in fields of Ebène 50/47, M.147/44, M.93/48, M.31/45, M.202/46, B. 3337 and B.37172. In Ebène 1/37 dalapon may be used, but with caution, and rates exceeding 4 lb/arpent should not be applied until information is obtained on the effect of this chemical on cane yield and sucrose content of the variety.

(b) *DCMU.* Following the wide use of DCMU in sugar cane plantations during these last three years indications have been obtained that this herbicide may cause severe injury to plant canes under certain environmental conditions. The characteristic symptom indicating that plants are being effected by this chemical is a gradual yellowing of the leaves. When there is only a mild intoxication the leaves recover their normal green colour but in cases of severe poisoning they dry off and the plant dies.

Injury caused by DCMU in plant canes was found in all cases reported to be associated with one of the following conditions :

(i) the use of sprayers not provided with agitators. In such sprayers the chemical slowly settles down in the tank and the concentration of DCMU in the spray solution increases as the volume of water decreases during the spraying operation. As a result the last few feet of cane row sprayed before the sprayer is refilled generally receive the chemical at a much higher concentration, and this may prove toxic to the young cane plant. (fig. 32).

(ii) Lack of supervision of the spraying unit. This happens in practice when the operator, after having emptied his sprayer in a cane row, comes back after having refilled his tank and starts spraying that row again. Such rows which receive twice the rate of application originally intended, are generally severely affected by the overdose of the herbicide.

(iii) In poorly drained areas particularly during the rainy season.

(iv) In soils which are deficient in Phosphorus (fig. 32). In three fields where this was observed soil samples collected from areas where canes were severely affected and from areas where no damage was registered on the crop, the following results were obtained from the analyses.

	Unaffected Area		Affected Area	
	pH	ppmP	pH	ppmP
Field No. 1	5.4	25	5.2	5
Field No. 2	5.0	20	4.8	10
Field No. 3	5.4	17	6.1	12

(v) In areas where subsoil has been exposed through erosion, deep cultivation or the breaking of half banks on hill sides.

(vi) In cases where deep furrowing has been performed and the canes are planted on the subsoil in the furrow.

3. EVALUATION OF NEW HERBICIDES

Two logarithmic trials were laid down at Belle Rive Experiment Station in order to assess the following new herbicides in pre-emergence treatment of both crop and weeds :

Hyvar — 5 bromo — 3 — isopropyl 6 — methyluracil.

Lorox (*U.S.A.*) *Afalon* (*Germany*)- — 3,4—dichlorophenyl — methyl —methoxy — urea.

Aresin — p-chlorophenyl — methoxy methyl urea.

2,4,5 TP — 2,4,5 — trichloro phenoxy proprionic acid.

Kuron — propylene butyl glycol ester of 2,4,5 trichloro phenoxy proprionic acid.

2,4 DP — 2,4, dichlorophenoxy propionic acid.

Fenac — 2,3,6 — trichlorophenyl acetic acid.

Thiuron — N — 3 — methyl phenyl — N —dimethyl urea.

Dichloral Urea — dichloral urea.

These herbicides were tested in comparison to DCMU at equivalent rates of application. The first trial was laid down at the beginning of the cool season in May with the variety M.93/48 and the other at the end of the cool season in August with the variety Ebène 1/37. In each trial the treatment was duplicated. During the first month of the trials observations were made on germination and early growth. Effects on weeds and cane growth were assessed twelve weeks from planting. In the first trial information on cane growth could not be obtained owing to damage caused by hares to the canes. It must be recalled here that results of these trials reported below must be considered with caution particularly with regard to the effects of these new herbicides on cane growth on account of the low number of replicates.

Results and Conclusions

Data obtained in the logarithmic trials are presented in tables 18 and 19.

Effects on canes. Fenac at rates between 5.0 — 1.6 lb active and 2,4,5 — T.P. at those between 5.0—2.8 severely affected germination and cane growth. There are also indications that Kuron and 2,4—D.P. had slightly affected cane growth at higher dosages. The other herbicides : Hyvar, Lorox (Afalon) and Aresin did not have any adverse effect on cane germination and growth.

Effects on weeds. Of the herbicides tested Hyvar gave, in both trials, excellent weed control throughout the dosage range investigated. Lorox (Afalon) and Fenac proved also effective up to rates of application of about 2.8 lb active. The other herbicides : Kuron, 2,4,5—T.P. and 2,4—D.P. gave unsatisfactory results in comparison to the above mentioned weed killers. Thiuron gave exceedingly poor control of weeds at all dosage rates tested (8.0 — 1.2 lb active) in these trials.

Table 18. Effects of new herbicides on weed infestation 12 weeks after planting Trial No. 1 May 29th — September 5th 1962

Treatments	*WEED INFESTATION % CONTROL* Dosage range per acre (lb active) per 3 yd. logarithmic strip				
	5.0—3.8	3.8—2.8	2.8—2.1	2.1—1.6	1.6—1.2
DCMU	4.3	18.5	18.6	44.3	38.6
AFALON } LOROX }	10.0	18.5	25.7	38.5	42.8
ARESIN	27.2	32.9	41.5	52.9	68.6
HYVAR	14.3	14.3	15.7	27.2	45.8
THIURON	80.0	75.7	81.4	71.5	71.4
DICHLORAL UREA	62.8	80.0	74.3	85.0	88.5
FENAC	5.7	8.5	15.7	31.4	45.7

Duration of Experiment = 100 days
Total Rainfall (inches) = 25.28
No. of rainy days = 63

Table 19. Effects of new herbicides on weed infestation and cane growth 12 weeks after planting Trial No. 2 — August 7th — November 5th 1962.

Treatments	WEED INFESTATION % CONTROL *Dosage range per acre (lb active) per 3 yd. logarithmic strip*					MEAN SHOOT LENGTH % CONTROL *Dosage range per acre (lb active) per 3 yd. logarithmic strip*				
	5.0—3.8	3.8—2.8	2.8—2.1	2.1—1.6	1.6—1.2	5.0—3.8	3.8—2.8	2.8—2.1	2.1—1.6	1.6—1.2
DCMU	3.8	7.7	11.3	17.6	17.7	87.7	88.8	86.6	97.4	94.7
AFALON } LOROX }	6.1	7.7	16.9	23.8	28.4	78.5	76.9	87.3	82.4	95.7
ARESIN	23.8	24.6	30.8	36.9	38.9	83.4	93.0	94.4	90.1	109.1
HYVAR	1.5	3.9	6.2	9.8	12.3	84.2	101.3	109.1	93.7	101.6
KURON	31.5	29.6	41.8	47.5	50.1	71.1	76.2	66.8	80.5	73.8
2,4,5—TP	32.3	30.8	47.7	47.7	53.8	58.3	54.3	69.0	62.8	78.9
2,4—DP	46.2	52.3	46.2	58.7	62.1	74.9	73.3	84.1	84.4	88.5
FENAC	8.5	11.5	26.1	35.4	36.5	41.7	52.4	49.2	56.7	76.7
	8.0—6.0	6.0—4.5	4.5—3.4	3.4—2.6	2.6—1.9	8.0—6.0	6.0—4.5	4.5—3.4	3.4—2.6	2.6—1.9
THIURON	63.5	67.5	70.1	75.4	80.4	65.8	74.1	78.3	84.2	79.9

Duration of Experiment = 91 days
Total Rainfall (inches) = 26.74
No. of rainy days = 60

CLIMATE, IRRIGATION, CULTIVATION

1. NOTES ON CLIMATIC CONDITIONS OF THE 1962 CROP

P. HALAIS

FOR the third year in succession, meteorological conditions over Mauritius have deviated considerably from normal values for rainfall, wind speed, air temperature and relative insolation. Such conditions have, for obvious reasons, been unfavourable to sugar production. Apart from maintaining a continuous stress on the whole economy of the island, those abnormal circumstances have delayed the pursuance of various research projects at the Institute dealing with the behaviour of the cane crop in the fields. However, better understanding of the role played by the interaction of the different meteorological factors involved is being exploited for the benefit of the various sugar sectors as far as cane growth and sugar content are concerned.

Four comparative graphs (figs. 33 to 36) are presented and will be reproduced as a regular feature in the annual reports of the Institute to recapitulate the meteorological conditions which prevailed during the last three crop years.

The following short notes cover only the 1960-61 and 1961-62 seasons, as they are very sharply contrasted concerning the four main meteorological elements selected : rainfall, wind speed, air temperature and relative insolation. The data refer to Mauritius as a whole and the usual distinction between the November-June vegetative period and the July--October maturation period is maintained.

Rainfall. It has been proved locally that sugar canes grown in regions below the 110 in. (2750 mm) isohyet benefit from low rainfall deficits, and above this value, benefit from high rainfall deficits when averaged over the island. This is well illustrated in the cane yields per arpent (TCA) obtained on an average in the north and central sectors.

Crop Year		*Sum of monthly deficits Nov–June*	*North TCA*	*Centre TCA*	*N—C*
1960/61 dry year	...	28.7 in.	26.5	30.6	— 5.1
1961/62 wet year	...	5.7 in.	24.0	19.4	+ 5.6

The dry spell which occurred at the end of the 1962 vegetative period and during the first month of the maturation period, favoured early maturity; unfortunately rainfall went up from the middle of August onwards, resulting in sugar manufactured % cane of 11.53 for the whole crushing season, a figure well below normal.

The month of December 1961, which experienced during the first part, torrential convectional rains, and later on, massive cyclonic rains (Beryl) adding to a total of 45 in. (1125 mm) averaged over the whole island, is the highest monthly rainfall on record.

Wind Speed. Cyclones Beryl and Jenny caused differential damage to the 1962 crop from high winds and moisture excesses according to general climatic characteristics of each sector. On the other hand, the 1960-61 season experienced very calm conditions throughout, associated with one of the severest droughts ever encountered during the first half of any vegetative period.

Cyclone Jenny, which skirted the north coast, had a very rapid translation rate and brought comparatively high wind speed (59 miles per hour for one hour) for only a short period. This accounts for the moderate damage done directly to the growing canes.

Fig. 33. Rainfall deviations from 10 days median values

Dotted line : 1959 – 1960
Broken line : 1960 – 1961
Plain line : 1961 – 1962

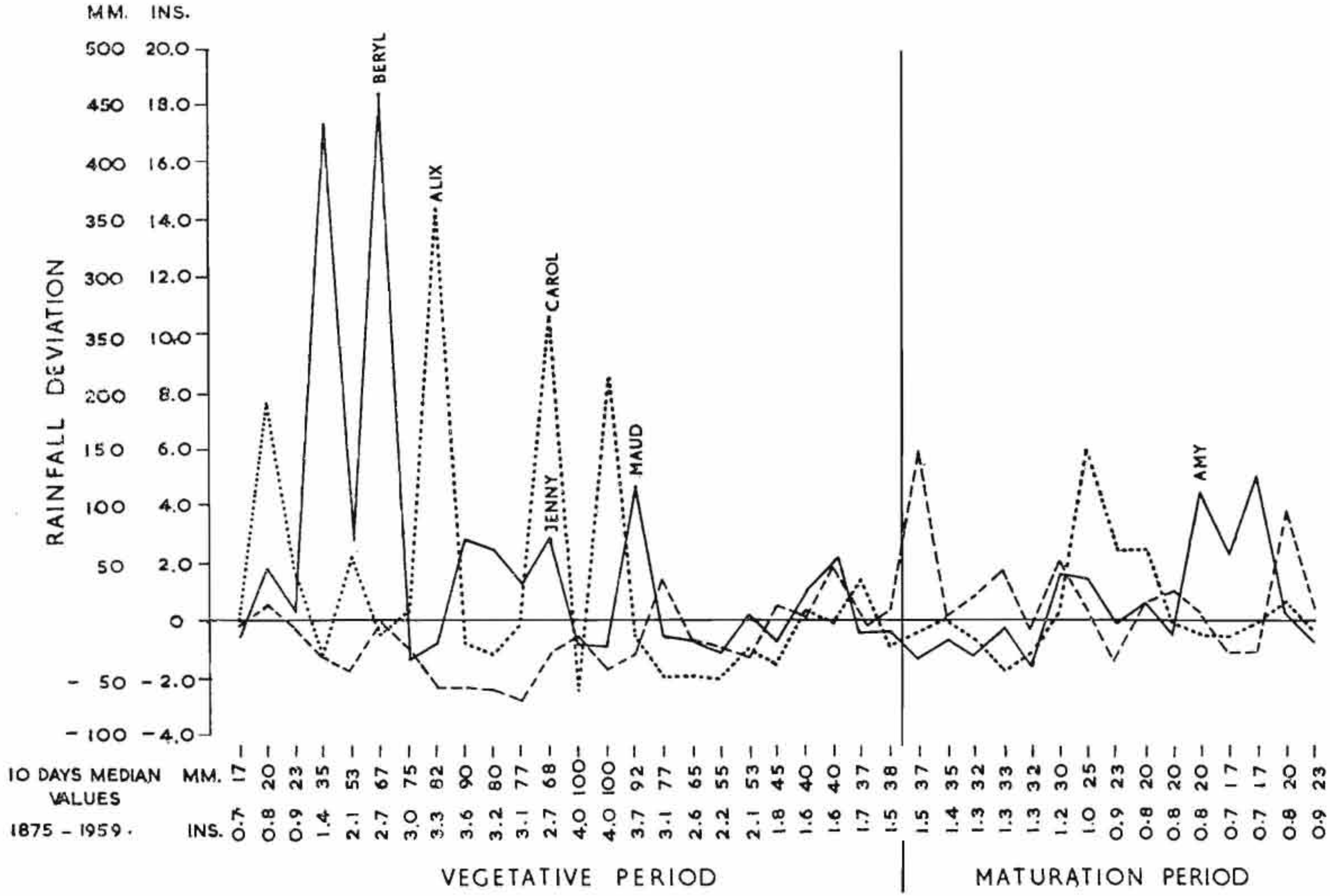
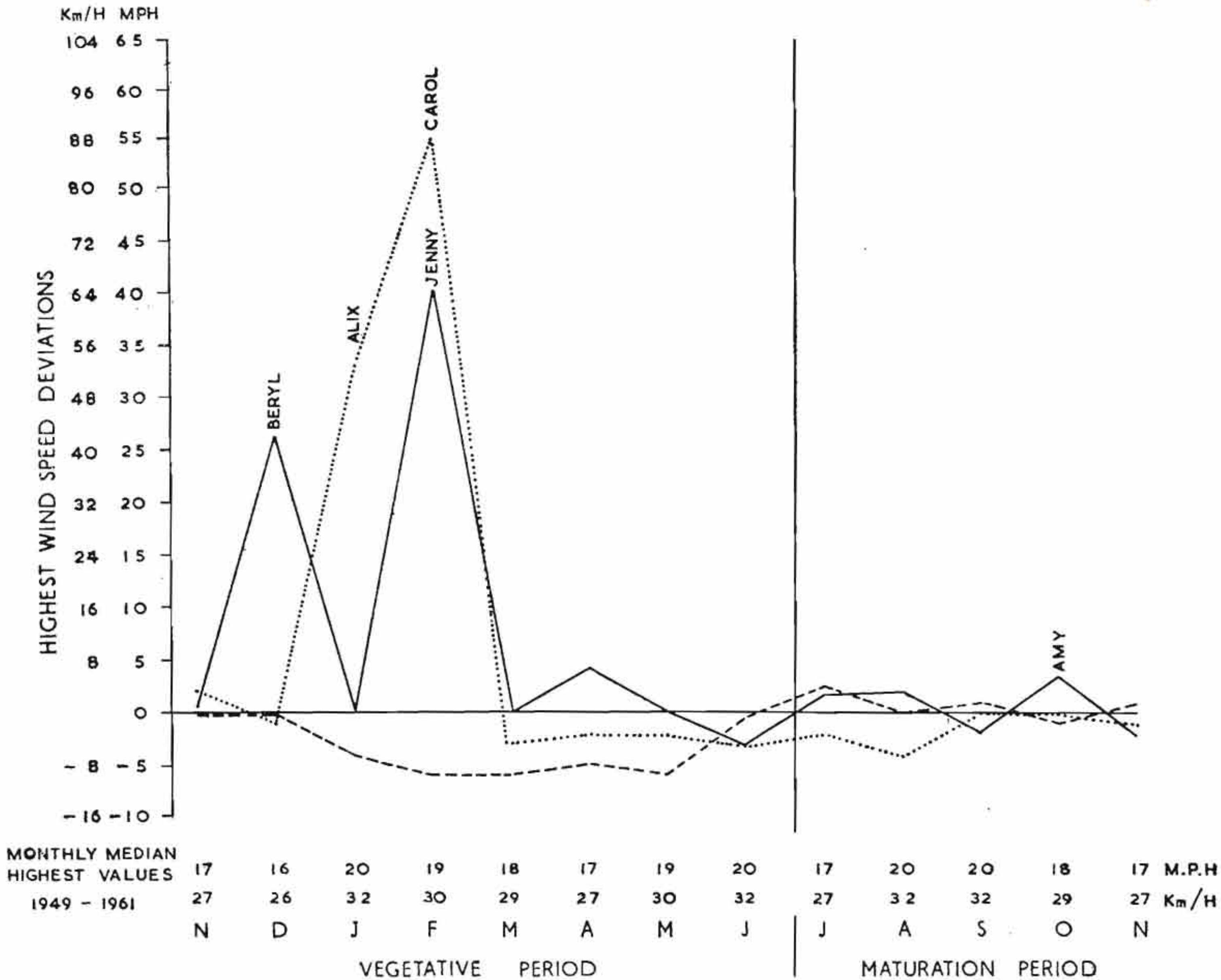


Fig. 34. Deviations of highest wind speed during one hour from corresponding monthly median values. Dotted line : 1959 – 1960. Broken line : 1960 – 1961. Plain line : 1961 – 1962.



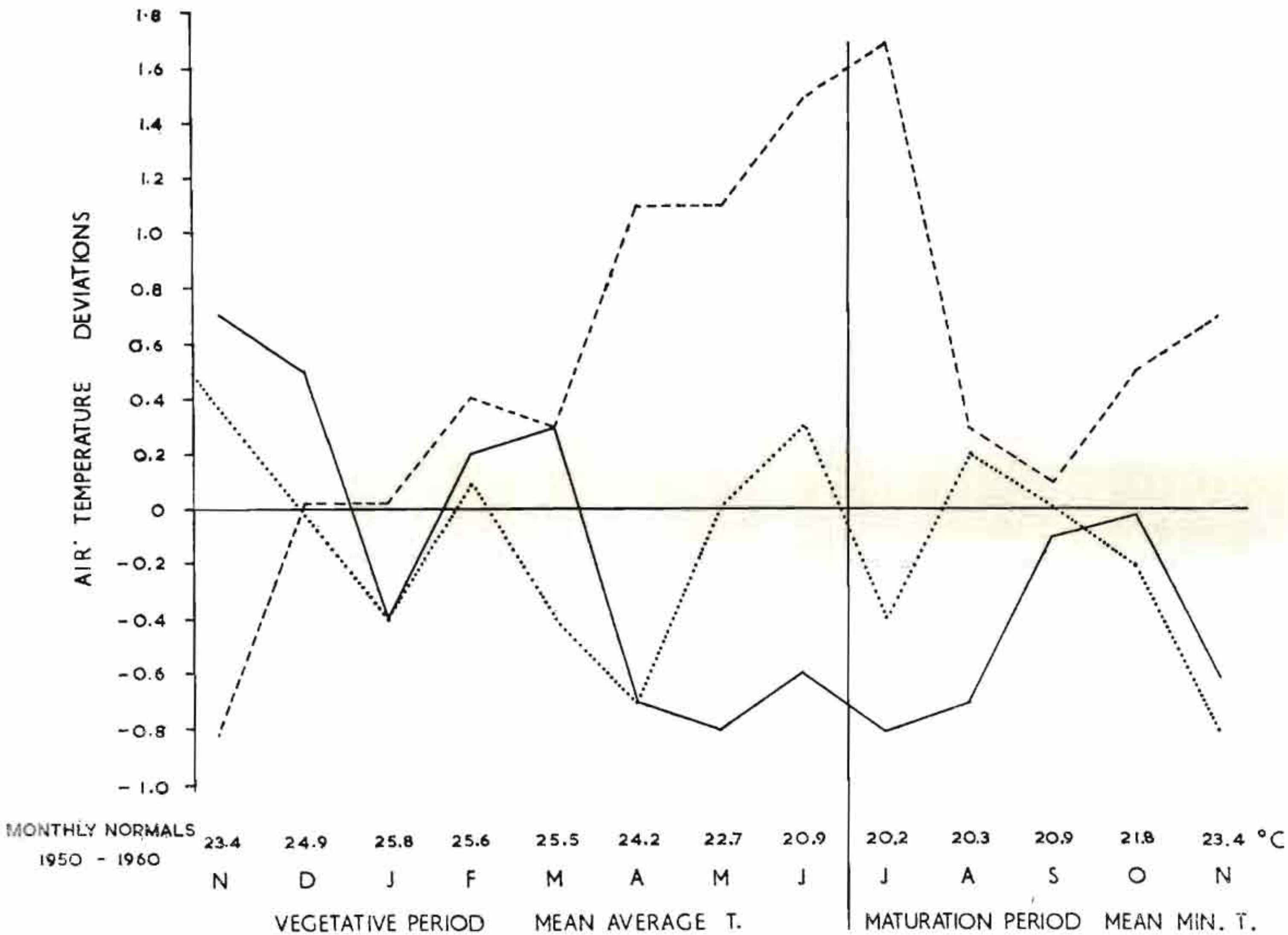


Fig. 35. Temperature deviations of air from monthly normals.

Dotted line: 1959 – 1960. Broken line: 1960 - 1961. Plain line: 1961 – 1962.

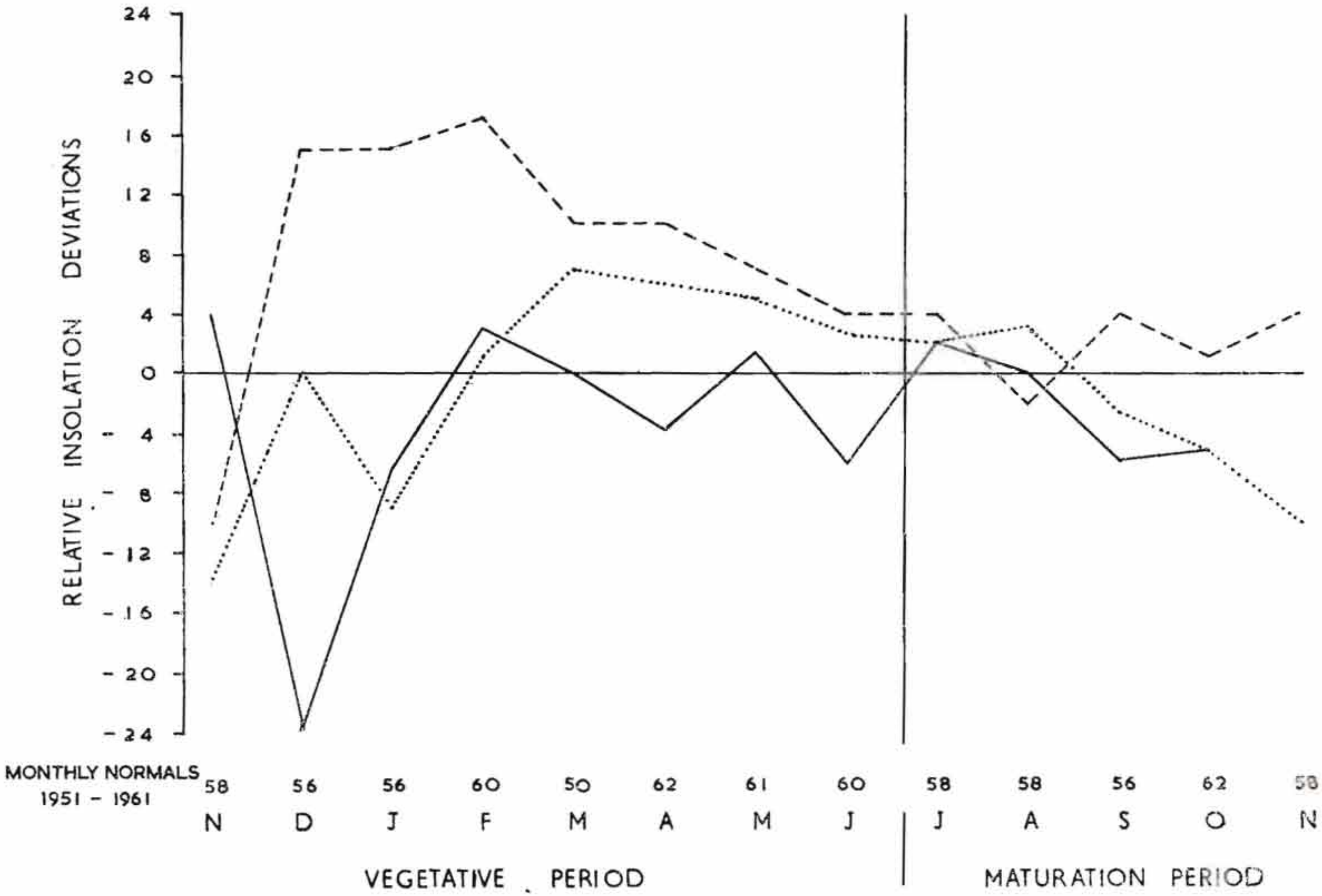


Fig. 36. Relative insolation deviations from monthly normals.

Dotted line : 1959 – 1960
Broken line : 1960 – 1961
Plain line : 1961 – 1962

Temperature. Again, the last two seasons, 1960-61 and 1961-62, are most constrasted as far as air temperature is concerned. Similar conditions were observed all over the islands in the Indian Ocean.

During the last three months of the vegetative period, mean temperature was 1.2 °C above normal in 1961 and 0.7 °C below normal in 1962. Under such circumstances, cane growth on the high ground was boosted and reached the record figure of 30.6 T.C.A. in 1961, whereas the cool weather which set in after cyclone Jenny obstructed the recovery of the shattered crop, resulting in final cane yields of only 19.4 tons per arpent in the central sector.

Relative Insolation. This meteorological element, mentioned for the first time in the Annual Report of this Institute, also shows wide differences for the two seasons 1960-61 and 1961-62, the former with much more sunshine than the latter.

It is worth mentioning the high relative insolation which prevailed early during the severe drought and the extremely low value observed in December of the same year, a month associated with an all time high record for monthly rainfall. Our experience concerning the real importance of this insolation factor is at the moment rather scanty.

2. PATTERNS OF WATER DISTRIBUTION IN OVERHEAD IRRIGATION

G. MAZERY & M. HARDY

The object of the experiment under review was to compare, under windy conditions, the distribution of water by various types of sprinklers used in Mauritius, namely : «Boom-O'-Rain», «Rainspray» No. 8, Low-Pressure «Bancilhon Rav 1» and the lesser known type «Rainspray» No. 9.

The main characteristics of the different sprinklers are summarised in Table 20.

Table 20. Characteristics of the different sprinklers

Type of Sprinkler	*Working Pressure* (a) *Recommended*	*Working Pressure* (b) *During Experiment*	*Total water actually collected in wet area cu. ft./sec.*	*Usual spacing of sprinklers*	*Approximate net area (sq. ft.) irrigated by one unit*
	p.s.i.	p.s.i.			
«Boom-O'-Rain» ...	75—80	80	1.33	220'×240'	52,800
«Rainspray» No. 9 ...	100—110	100	1.00	212'×212'	45,000
«Rainspray» No. 8 ...	70—75	75	0.45	100'×120'	12,000
Low Pressure «Bancilhon» ...	14—50	30	0.012	36'×36'	1,300

Table 21. Wind conditions during experimental period.

Type of spinkler			*Average Wind direction*	*Wind speed (miles per hour)*	
				Average	*Highest*
«Boom-O'-Rain»	...	...	ESE	20	›30 (17 gusts)
«Rainspray» No. 9	...	...	ESE	18	›30 (8 ,,)
«Rainspray» No. 8	...	...	E	12	›30 (2 ,,)
Low pressure «Bancilhon»		...	ESE	18	›30 (3 ,,)

The experiment consisted in working the different sprinklers and in measuring the water reaching the ground by means of rain-gauges. These were made of cylindrical containers $2\frac{1}{2}$ inches in diamater by $4\frac{1}{2}$ inches in depth and were placed 18" above the ground in a systematic pattern over the area to be watered by the different instruments. The spacing of the rain-gauges was $15' \times 30'$ for the «Boom-O'-Rain» and «Rainspray» No. 9; $10' \times 10'$ for the «Rainspray» No. 8 and $5' \times 5'$ for the low pressure sprinklers.

The wind data were obtained from an anemometer situated about $1\frac{1}{4}$ miles north of the site of the experiment. In view of the topography of the region, these data may be considered as valid for the experiment.

Wind direction and velocity during the experiment are shown in Table 21.

Each sprinkler was operated during a sufficient time to give a precipitation of approximately 1 inch of water over the experimental area.

The results obtained are shown in figs. 37 to 42 which illustrate :

(a) the relative areas covered by the various sprinklers;

(b) the pattern of water distribution for each type of sprinkler in relation to prevailing winds during the experiment;

(c) comparative efficiency of each type of sprinkler with regard to uniformity of water distribution.

It may be seen from these results that under the conditions of the experiment the «Boom-O'-Rain» gave a better and more efficient water

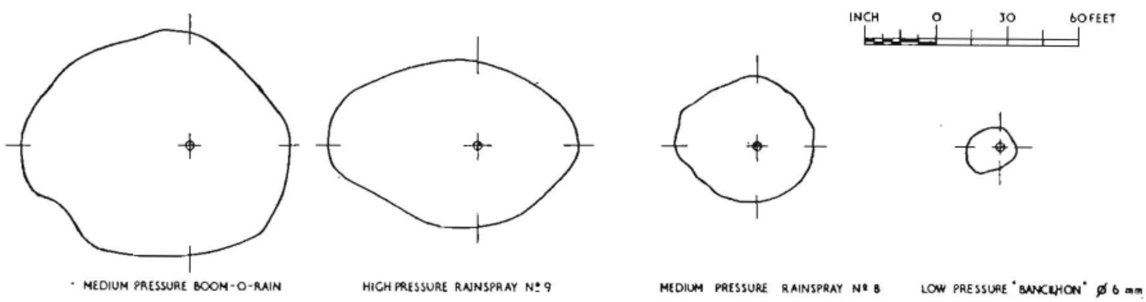


Fig. 37. Comparative area covered by 4 types of sprinklers.

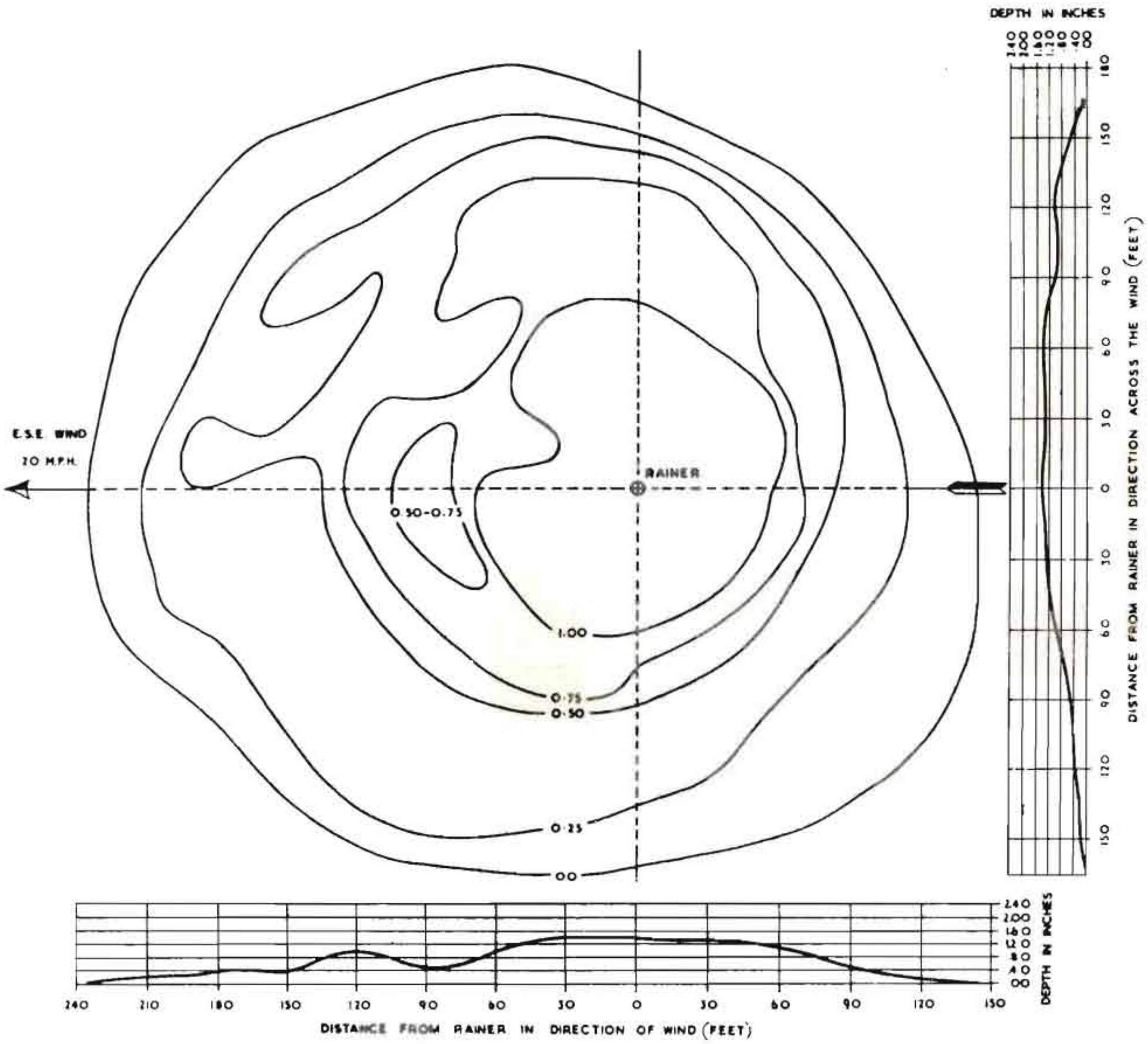


Fig. 38. Pattern of water distribution with *'Boom O' Rain'*. Duration of experiment 1 hour.

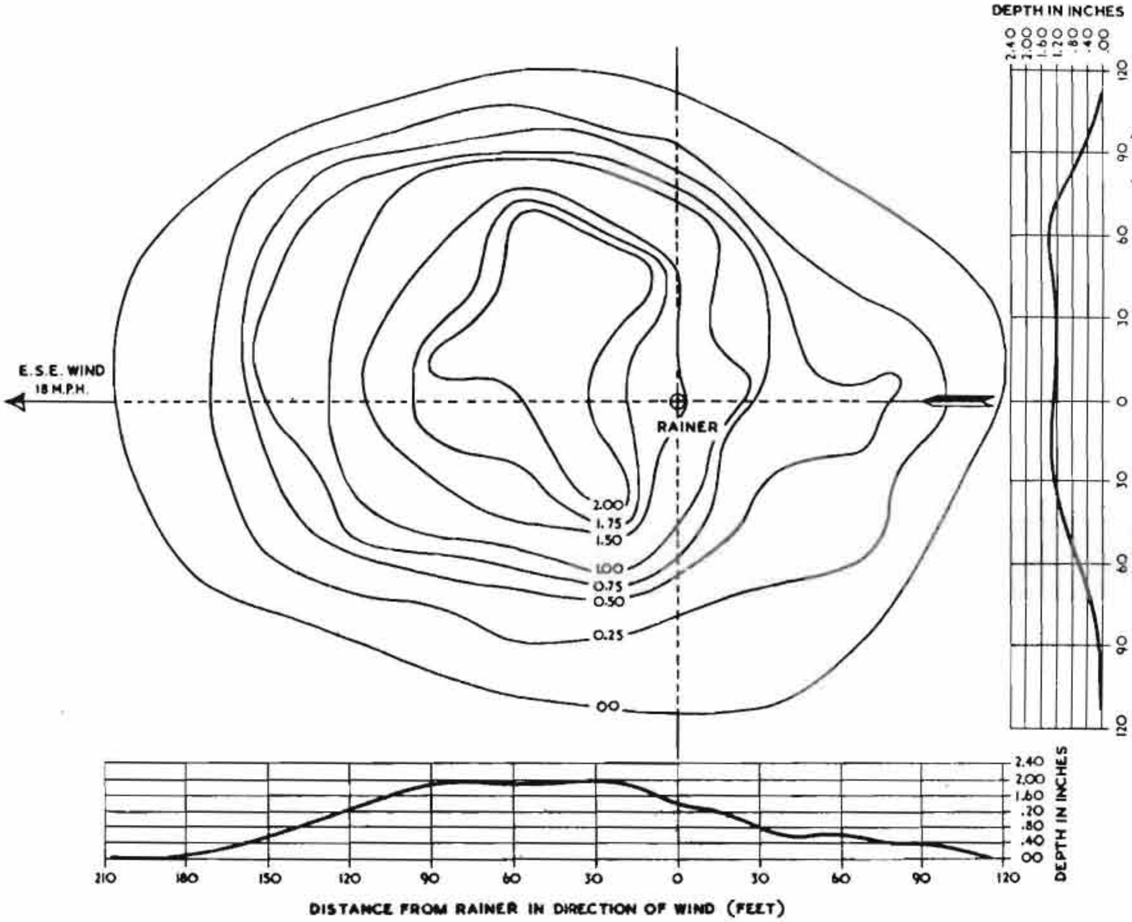


Fig. 39. Pattern of water distribution with *Rainspray. No. 9.* Duration of experiment 1 hour.

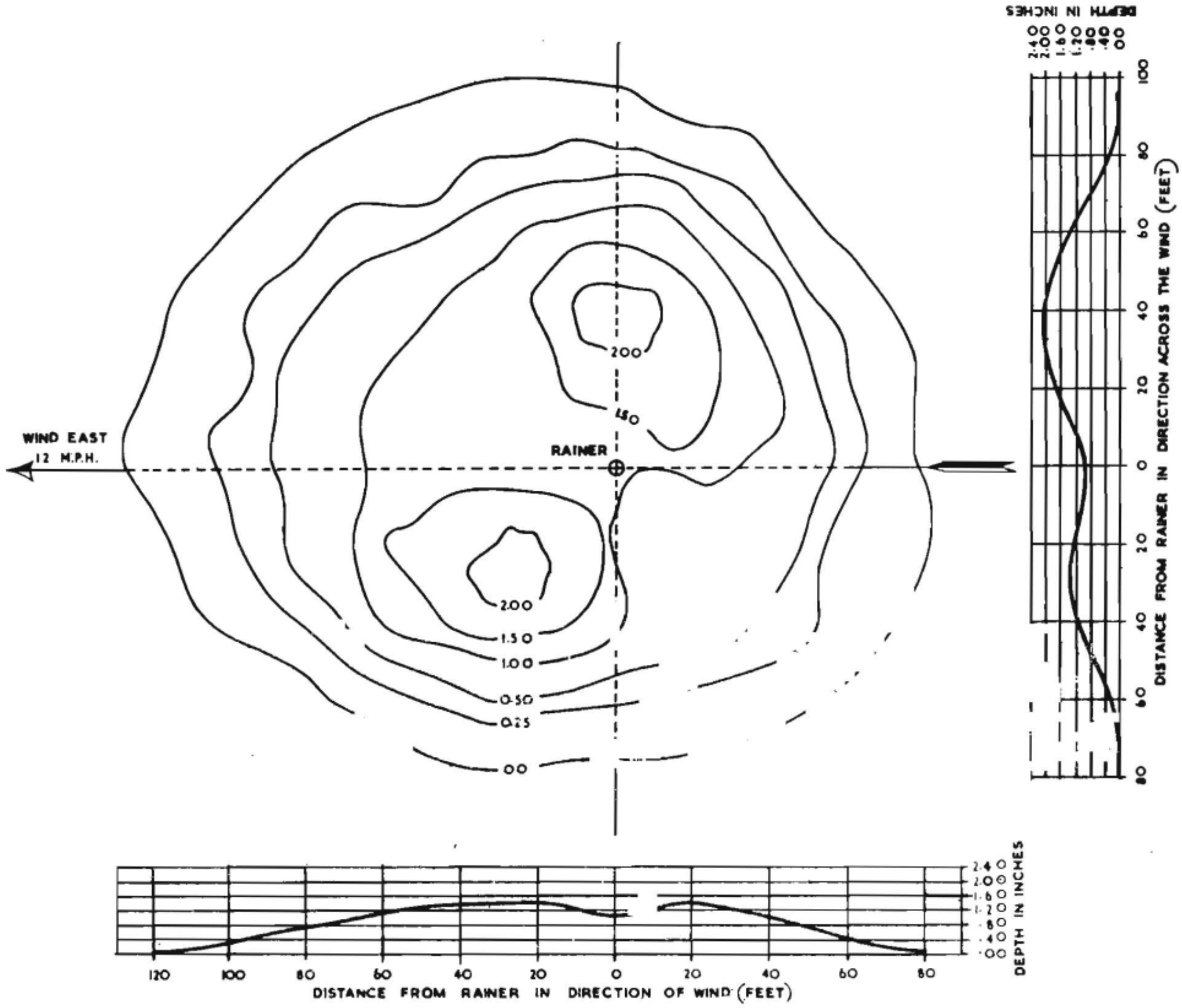


Fig. 40. Pattern of water distribution with *Rainspray No. 8*. Duration of experiment 1½ hours.

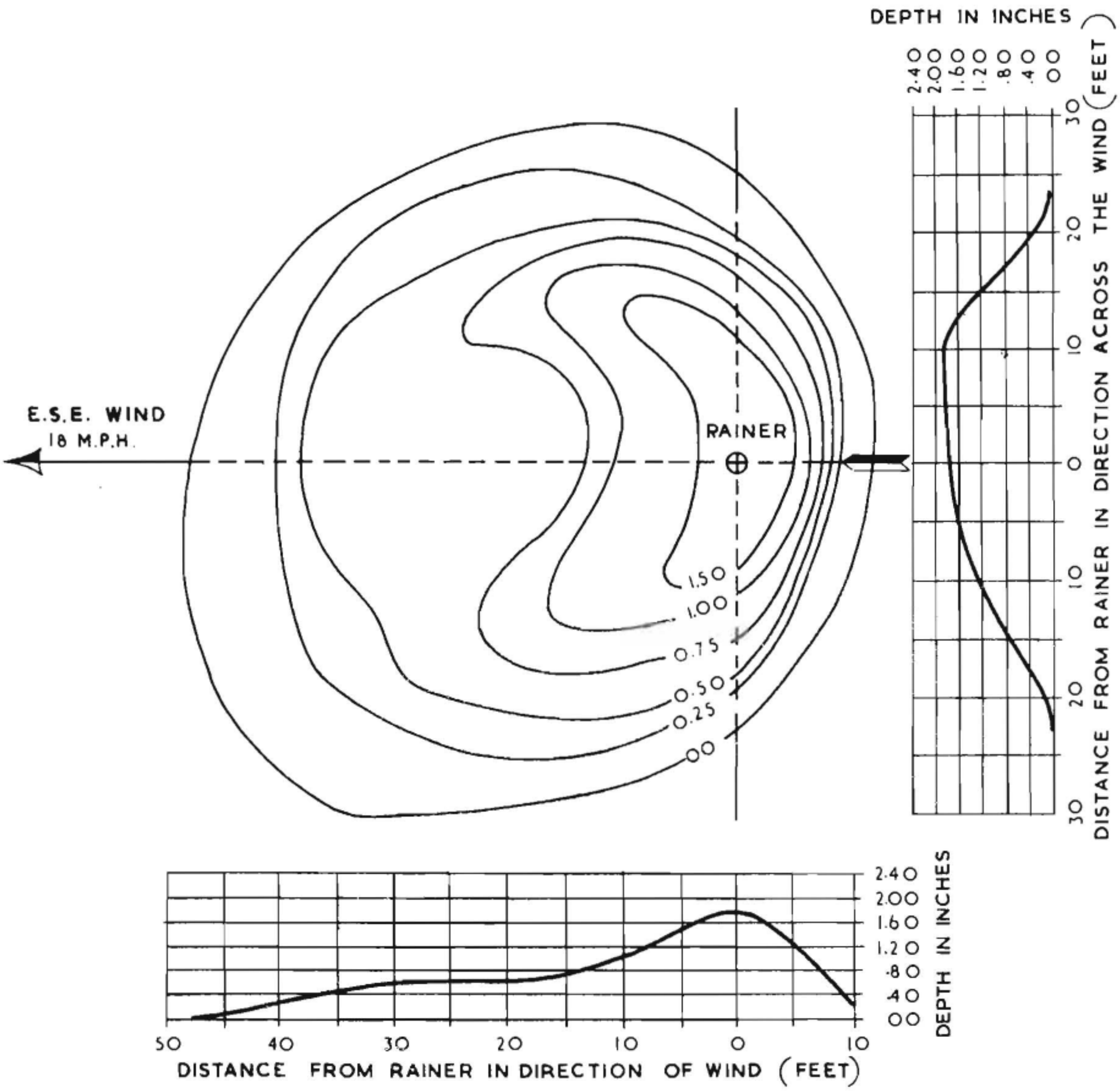


Fig. 41. Pattern of water distribution with '*Bancilhon low pressure*'. Duration of experiment 4 hours.

distribution than the other instruments. The long arms of the boom and the efficient wind vanes may account for this advantage.

«Rainspray» No. 9 has an appreciably long range but water distribution is more affected by the wind. It should be suitable for night irrigation when the weather is normally calm and could then be operated from the roadways. However, its higher working pressure increases the pumping costs by about 15%. Unless cheap energy is available, its advantages over the «Boom-O'-Rain» with regard to capital expenditure and handling facilities seem to be offset by its disadvantages.

The use of «Rainspray» No. 8 implies less capital expenditure than that of the «Boom-O'-Rain» and about the same as for the «Rainspray» No. 9. Its efficiency in water distribution is comparable to this latter sprinkler under the conditions of the experiment. However, due to its comparatively short range, the «Rainspray» No. 8 must be operated from inside the cane fields and the handling of the equipment becomes more difficult, especially at night time. This sprinkler works at a pressure of 70 to 75 p.s.i. and requires less energy than the «Rainspray» No. 9 which in spite of its advantages is probably more expensive to operate.

The low pressure sprinkler is less affected by the wind than the «Rainspray» sprinklers. On the other hand, its short range necessitates a much closer spacing which renders its use in tall canes very difficult. Moreover, in view of its small output, a comparatively large amount of equipment and labour are required.

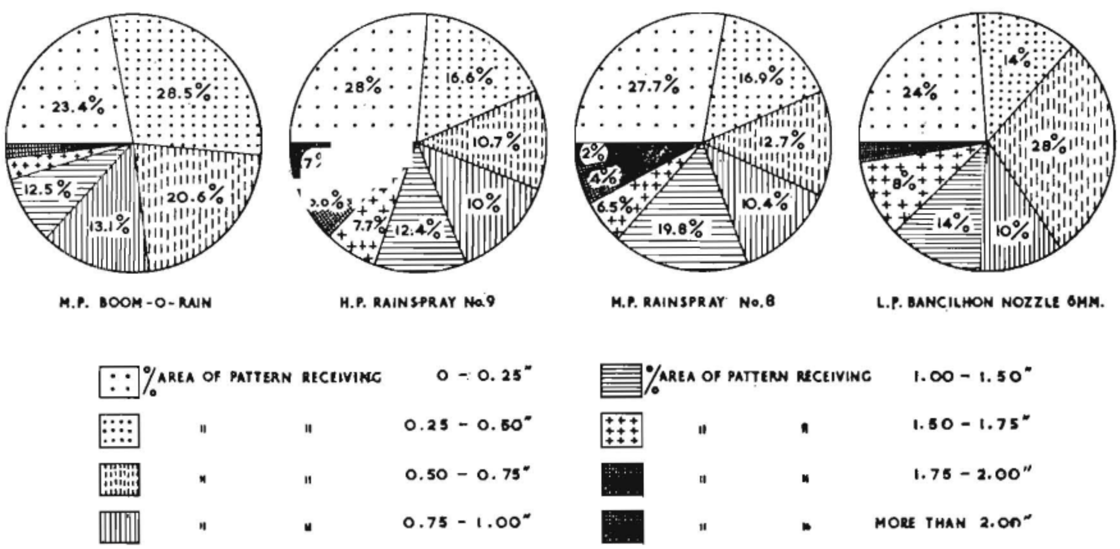


Fig. 42. Relative efficiency of 4 types of sprinklers expressed in % of area receiving different amounts of water.

3. THE ESTIMATION OF GLOBAL RADIATION AND OF POTENTIAL EVAPOTRANSPIRATION BY MEANS OF TURC'S FORMULA

P. HALAIS

In the past, irrigation according to the furrow system has been often practised with advantage in Mauritius for growing sugar cane, spccially in regions where the mean annual rainfall does not reach 60 in. (1500 mm), and on comparatively deep soils containing only a small amount of stones and gravel.

More recently, overhead irrigation has offered new potentialities for increasing cane output economically on lands normally receiving up to 80 in. (2000 mm) of rain annually, or on coarser soils of low moisture retentive power. Nevertheless, the success of this advanced system should not be hindered by the use of insufficient amounts of water, or burdened by excessive and wasteful applications. In other words, the water needs of the sugar cane crops must be properly evaluated in practical terms all along the year, but more specially during the peak months of September and October which are dry and relatively warm, therefore favourable to active growth under irrigation applied for supplementing deficient rainfall.

The water needs of crops in general can be evaluated with reasonable accuracy, by calculating from critical meteorological data potential evapotranspiration ETp expressed in terms of mm of water. It is advisible to use, if available, a special correction factor to account for the actual needs of the particular crop grown. Furthermore, potential evapotranspiration or even pan evaporation data, however good the evaluation may be, cannot be used with full advantage unless the reserve of each specific soil in available moisture is known approximately. This available moisture evaluation is far from being straigthforward, except for conditions of deep soils of homogenous texture rarely met with in Mauritius. However, such useful and complementary information falls outside the scope of this short note which aims at providing a workable starting point towards solving the complex problem of the water needs of sugar cane crops. Stress should be placed, however, on the necessity of direct observations on the growing cane crop, at critical stages when the issue is doubtful, by measuring the elongation rates of the cane stalks, or the moisture content of sensitive tissues such as the 4 - 5 joints.

The meteorological data required, as well as the formula proposed for computing ETp, vary considerably from one author to the other. Amongst them, TURC (1961, 1962) has recently improved and simplified his formula in order to enhance its usefulness for practical agriculture under a wide range of climatic conditions.

The first step advocated by Turc is to estimate global or net radiation (Ig), a measure of light intensity very seldom evaluated by direct measurement. The critical observation needed by Turc is derived from blue print sunshine recorders (Campbell, Stokes), in regular use at most meteorological stations throughout the world, which give the duration of bright sunshine in hours (h) for each day. The other information needed, and worked out once for all by means of astronomical calculations for a given latitude (south or north) and a given month of the year, comprise : incoming radiation in the absence of atmosphere (IgA) and the length of day (H). As example, and for latitude 20° South (Mauritius), incoming radiation IgA, expressed in terms of small calories per cm^2 per day, has the average value of 992 in December and of 571 in June, whereas the astronomic length of day has an average value of 13.30 hr and of 10.91 hr for the same months respectively.

The ratio h : H is termed relative insolation or percentage of possible hours of sunshine. Turc's formula I for estimating global radiation from hours of bright sunshine is :

$$Ig = IGA \; (0.18 + 0.62 \; \frac{h}{H}) \qquad \text{(I)}$$

No difficulty is encountered under our local conditions in estimating this global radiation as blue print sunshine recorders data have been available for a number of years at various sugar plantations, or other representative locations working with the technical co-operation of the official Meteorological Services of the island. Uninterrupted sunshine data are available for Pamplemousses in the north as from 1917, for Vacoas from 1923, for Réduit from 1930, and for Plaisance from 1951. A provisional map of the relative insolation of Mauritius has been drawn by the Institute and shows lines of average yearly percentage values of 65, 60, 55, 50 and 45. It appears that irrigation is only needed in the leeward region when annual average relative insolation exceeds 60, and in the windward region above 55.

A closer network of sunshine recorders is probably not needed, as interpolations are quite legitimate and will give the necessary information for any location within comparable geographical limits of properly selected stations.

The usefulness of the above estimation of global radiation from sunshine recording is confirmed by observations made by JEN-HU CHANG (1961) in Hawaii, who states «where reflection from clouds is insignificant, the duration of sunshine can be used to estimate the approximate radiation intensity».

Turc's formula II evaluates potential evapotranspiration ETp, expressed in mm of water for periods of N days equal, or superior to 10. Apart from global radiation Ig (estimated by means of Turc's formula I mentioned previously), mean air temperature (t) in °C is also needed for the same period of N days.

$$\mathrm{ETp} \quad (\mathrm{Ig} + 50)\ 0.013\ \mathrm{N}\ \frac{t}{t+15} \qquad \text{(II)}$$

It is important to note that the formula II holds only for periods of 10 days or longer. This does not detract from its usefulness as, in practice, irrigation intervals are seldom shorter than ten days for commercial field crops.

In actual practice, and under our local conditions, the evaluation of ETp for irrigation control does not ask for the collecting of mean air temperature data for the period considered as is needed for duration of bright sunshine. The fluctuations of temperature which occur are not sufficient to alter the ETp values significantly. For instance, a difference of 2°C, which is likely to occur, around an average temperature of 20°C only alters the computed ETp by 5%, which is well within the limits accepted for the practical use of the concept. Consequently, the normal values of air temperature for each month can be used safely for working Turc's formula II. This shortening of actual meteorological measurements is quite appreciable.

Recent compilation made at the Institute from existing air temperature data are summarized in Table 22 which shows the normal mean air temperature applicable to any location and month in Mauritius, provided that the altitude in metres and the orientation (geographical situation) are known. The table permits an evaluation of potential evapotranspiration when global radiation is known.

Table 22. Mean monthly air temperatures in Mauritius.

Orientation	*Altitude*	J	F	M	A	M	J	J	A	S	O	N	D
Leeward	Sea Level	27.5	27.8	26.9	25.8	24.8	22.9	21.9	23.0	23.6	24.5	26.0	27.1
Inter	Sea Level	26.8	27.0	26.3	25.3	23.8	22.1	21.3	22.0	22.5	23.4	24.7	26.1
Windward	Sea Level	26.0	26.1	25.8	24.7	22.9	21.3	20.7	20.9	21.4	22.3	23.5	25.0
	600 m	22.5	22.1	22.1	20.6	18.7	17.0	16.4	16.6	17.2	18.2	19.7	21.8

The appropriate linear correction for each 100 m of altitude can be easily worked out from data in Table 22 and is applied to the corresponding sea level values in order to find out, once for all, the mean t values applicable to any location for which ETp is being sought.

It will be observed that Turc in his formula II does not apparently take relative humidity or wind velocity into account, as does for instance PENMAN (1956) in his general formula. Actually, the former applies a correction only when mean relative humidity over a whole month is inferior to 50%. Such conditions only occur in arid climates which are not encountered in Mauritius. Furthermore, no wind correction is attempted by Turc. Fortunately, such a correction is hardly needed under the oceanic climate which prevails on the small and unelevated island of Mauritius.

Once again mention will be made of recent observations made by JEN-HU CHANG who also considers, under Hawaiian conditions of equable temperature throughout the year, that radiation is the primary factor of the evaporative process. He writes : «indeed, the correlation coefficient between the monthly pan evaporation and incident radiation at Field 906 is as high as 0.86, the same as that between Penman estimate and pan evaporation».

Two nomograms have been specially drawn at the Institute for obtaining Ig and ETp, and are available to the sugar planters interested, in order to reduce the calculation to a single multiplication when total hours of bright sunshine are known for any period ranging from 10 to 31 days and for mean temperature ranging from 15 to 30°C.

As a conclusion, potential evapotranspiration, which constitutes one of the major information leading to proper irrigation, can be easily estimated by classical observations obtained from blue print sunshine recorders already maintained on a number of sugar plantations, or representative locations on the island. The long range observations, for both rainfall and sunshine, which are available at three key stations (Pamplemousses, Réduit and Plaisance) allow for the probability of maximum moisture deficits to be calculated for average periods of five or ten years to suit the needs of proper economic planning of overhead irrigation schemes.

The cards from the sunshine recorders should be measured on the spot every day and the observer should be satisfied that his assessment of the duration of bright sunshine checks normally with the standard evaluation made by the official Meteorological Services in Mauritius.

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4. A NEW HITCHING DEVICE FOR WHEEL TRACTORS

G. MAZERY

Important factors limiting the use of wheel tractors of the Massey-Ferguson and Fordson types for the hauling of heavy loads on difficult terrain are the lack of adherence of the front wheels when using single axle trailers, and lack of grip of the rear driving wheels when using trailers with two axles.

In order to make good these important

weaknesses, a linkage system has been devised which, when used with single axle trailers, transfers the weight carried by the draw-bar of the trailer to a point situated between the front and rear axles of the tractor and, at the same time, gives a minimum turning radius to the assembly.

This new device patented under the name of «Rational Load Distributor» may be described as follows, with reference to figures 43 and 44.

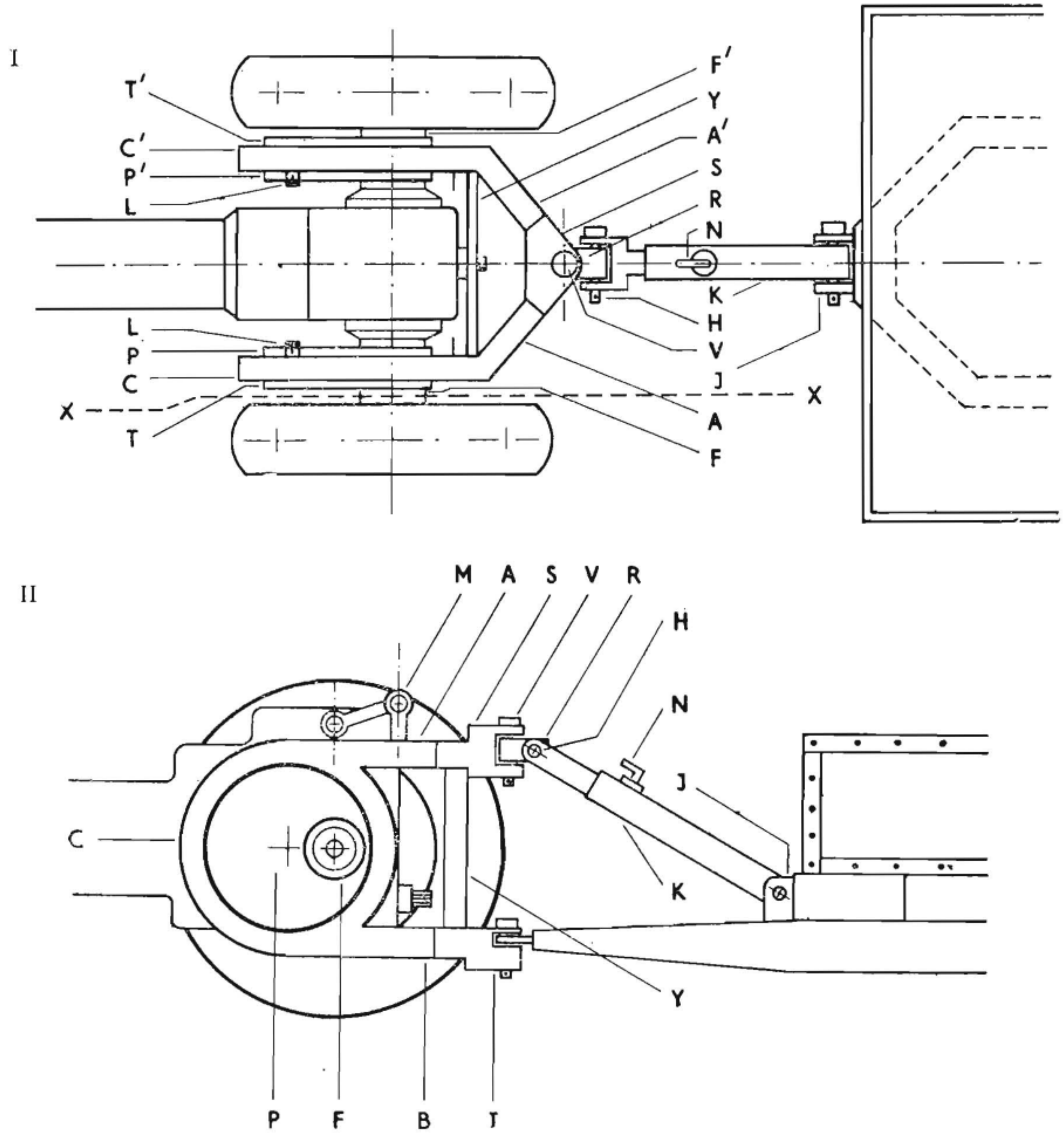
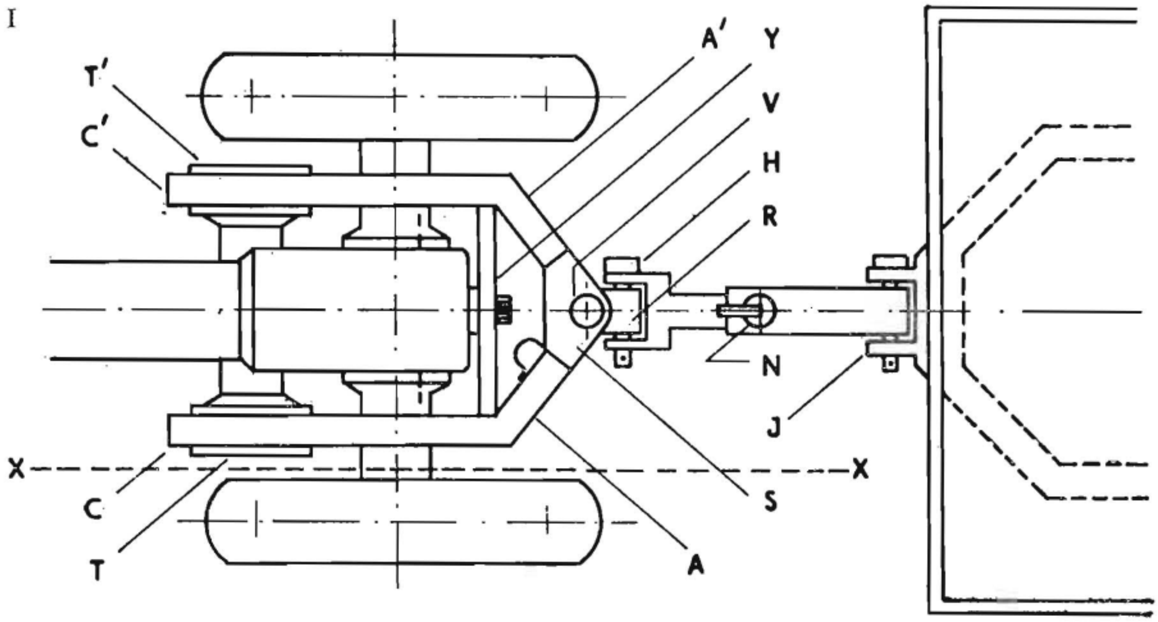


Fig. 43. 'Rational Load Distributor'

I. Plan view

II. Side elevation through X X



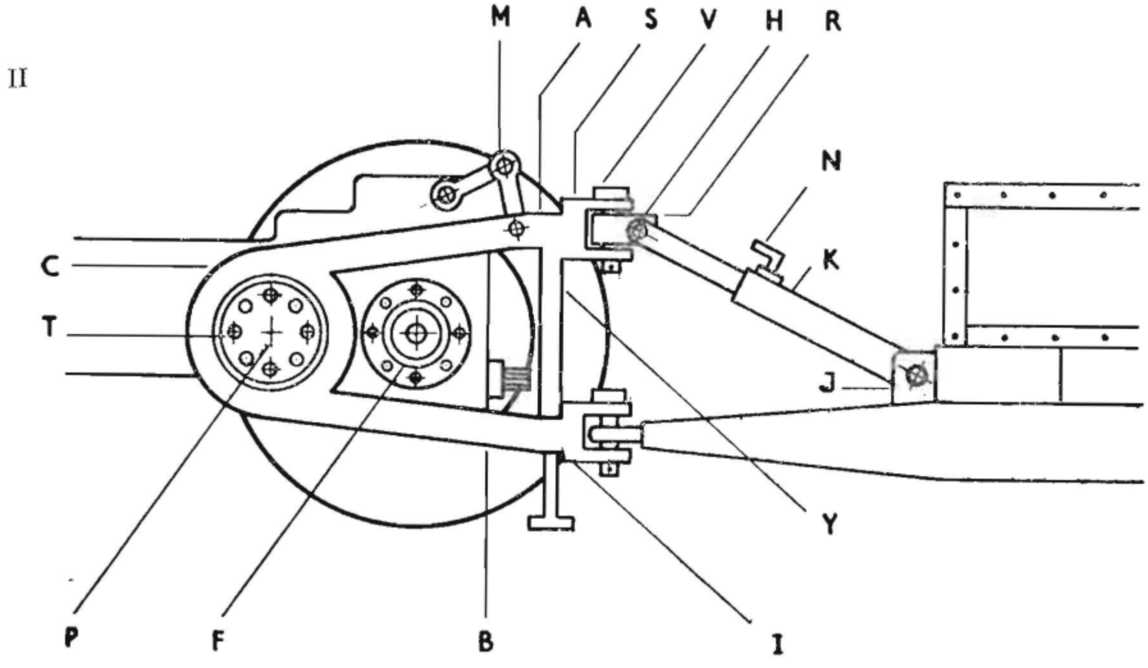


Fig. 44. 'Rational Load Distributor'

I. Plan view

II. Side elevation through XX

T and T' are two strong drums secured one on each side of the body of the tractor. These drums may be mounted either excentrically on the rear axle casings F, or on the body of the tractor, provided that their centre line P P' lies in front of the rear axle and parallel to it.

C and C' are two strong collars which rotate on T and T' respectively, in planes parallel to those of the rear wheels of the tractor.

A and B are two strong arms having their fore ends fixed respectively to the top and bottom of collar C and their rear ends extending backward towards the rear of the tractor. A' and B' (the latter not visible on the drawings) are fixed in a similar way to collar C'. The projecting rear ends of A and A' bend inwards behind the body of the tractor and join in S to form the upper linkage point between tractor and trailer. Similarly B and B' join in I, situated about 24 inches vertically below S, to constitute the lower linkage point between the tractor and the trailer. The length of arms A, A', B and B' is such that the line SI lies clear behind the tractor. The rigidity of the structure consisting of these four arms and collars C and C' is ensured by means of adequate braces Y. These braces are fixed in such a way as to allow the free oscillation of the whole structure in the vertical plane, and a clear space at the rear for the eventual use of the power take off of the tractor.

A robust piece of metal R having two holes pierced at right angles can pivot laterally round a vertical pin V secuied at S. The top end of a telescopic strut K is attached to R by means of an horizontal pin H. K may be adjusted to any length by means of locking device N. When the tractor-trailer assembly is in operating position, the draw bar D of the trailer exerts a downward pressure at link point I to which it is attached, while strut K, whose lower end is pinned to wings J fixed to the root of draw-bar D, exerts at point S an upward thrust which maintains the whole system in equilibrium. The ground clearance of point I is determined by the adjusted length of K.

With this combination, the structure supporting link points S and I on the one part, and the trailer and strut K on the other, form an assembly which is perfectly rigid in the vertical plane. In consequence, any load carried by draw bar D is supported by collars C and C' which exert a corresponding vertical thrust passing through centre line P.P' of drums T and T', i.e. between the rear and front axles of the tractor. Thus the whole weight of the trailer is distributed between the front and rear wheels, ensuring an adherence to the ground directly proportional to the load being carried. On the other hand, the link points S and I being clear behind the tractor, draw bar D and strut K can pivot freely at S and I in an horizontal plane giving a minimum turning radius to the assembly.

For the hitching operation, link points S and I may be lowered or raised by means of the hydraulic lift M of the tractor, or manoeuvred by hand.

If it is not desired to use the strut K, for example when moving light loads, the link point I may be maintained at the normal working height by means of locking device L, which can secure the whole oscillating structure in any required position.

The "Rational Load Distributor" fitted to a light tractor has increased its safe carrying capacity from 2.5 tons to 4.5 tons. In another case, when fitted to a 40 H.P. tractor, it has been possible to haul safely heavy cane loads on mountain slopes with gradients of over 1 in 4, where empty trailers could hardly be manoeuvred when using the standard attachment.

SUGAR MANUFACTURE

1. THE PERFORMANCE OF SUGAR FACTORIES IN 1962

H. F. WIEHE

THE twenty-three factories of the island were in operation in 1962 by the end of July. A synopsis of the chemical control figures of these factories is given in Appendix XVII (i) — (v).

Cane and Sugar Production

In spite of the damage done, especially in the North of the island, by cyclone Jenny, the canes recovered rapidly and by the 15th June, an estimated crop of four and three quarter million tons was on foot.

The duration of the harvest was shorter in 1962 than the previous year and averaged 171 days. From the beginning of July to the end of December, 4,624,487 tons of cane were crushed and 532,669 tons of sugar, both raw and white, were manufactured. The weight of the different grades of sugar produced was the following :

Raw sugar ...	492,516 tons
Low pol raw sugar (97.3 Pol)...	20,773 ,,
White sugar ...	19,380 ,,
Total ...	532,669 tons

Cane Quality

Cane quality although better than in 1961 was nevertheless still poor in 1962 and due mainly to the abnormally wet season which prevailed from September to November. Sucrose % cane varied from a minimum of 12.03 to a maximum of 14.14, the average for the island being 13.19.

Sucrose content figures for the various sectors of the island are given in Table 23 for the period 1957 - 1962 whereas average fibre per cent cane and mixed juice Gravity Purity for the same period are given in Table 24.

Table 23. Sucrose per cent cane, 1957-62.

	Island	*West*	*North*	*East*	*South*	*Centre*
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
1960	11.83	12.69	12.32	11.63	11.29	11.58
1961	12.81	13.06	13.46	12.53	12.42	12.91
1962	13.19	13.61	13.73	12.85	12.85	13.26

Table 24. Fibre per cent Cane and Mixed Juice Gravity Purity, 1957-62.

	Fibre % cane	*Mixed Juice Gravity Purity*
1957	11.86	87.8
1958	12.21	87.2
1959	11.96	87.3
1960	14.38	83.5
1961	12.61	85.2
1962	13.85	85.9

The ever increasing figure of fibre % cane from 11.96 in 1959 to 12.61 in 1961 and 13.85 in 1962 may be explained by analysis of the data contained in Table 25 which reveals that the harvesting of the high-fibre varieties M.147/44, B. 37172 and B.3337 has increased from 24.6% to 39.6% and 49.7% for the respective years mentioned above.

Table 25. Percentage of varieties harvested on estate lands, 1959, 1961, and 1962.

	1959	*1961*	*1962*
M.134/32 ...	33.8	18.1	13.7
Ebène 1/37 ...	28.0	27.0	17.7
M.147/44 ...	13.0	21.4	30.6
B. 37172 ...	6.6	10.5	13.6
B. 3337 ...	5.0	7.7	5.5

Milling

A synopsis of the crushing data and milling figures for the period 1957–1962 is given in Table 26.

Table 26. Milling results, 1957-62.

	1957	*1958*	*1959*	*1960*	*1961*	*1962*
No. of factories	26	25	24	23	23	23
No. of crushing days	105	108	110	89	123	116
No. of net crushing hours/day ...	20.89	19.50	20.32	14.92	18.86	19.08
Hours of stoppages/day* ...	0.80	0.89	0.82	0.57	0.80	1.03
Time efficiency	96.3	95.6	96.1	96.3	95.8	94.9
Tons cane/hour	76.1	82.5	87.7	77.0	92.8	91.0
Tons fibre/hour	9.03	10.07	10.49	11.07	11.70	12.60
Imbibition % fibre	231	217	230	209	222	222
Sucrose % bagasse	2.63	2.50	2.32	2.21	2.09	2.18
Moisture % bagasse	47.5	48.2	48.3	49.8	48.6	47.1
Reduced mill extraction ...	95.3	95.3	95.7	95.2	95.8	95.8
Extraction ratio	37.1	38.5	34.1	39.6	33.3	33.9

* Exclusive of stoppages due to shortage of cane.

The fact that both the crushing rate of factories and the net number of crushing hours were lower in 1962 as compared to 1961 may be attributed to the smaller crop on hand.

The average performance of milling trains was as good as the previous year, the reduced mill extraction figure of 95.8 obtained in 1962 being the same as that recorded in 1961.

Bagasse moisture varied appreciably from factory to factory, ranging between a minimum of 45.6% and a maximum of 52.5%. The average figure obtained, namely 47.1%, was however the lowest on record.

Several factories brought improvement to their cane unloading equipment. The two revolving cranes existing at Mon Loisir were replaced by two travelling cranes of 8 tons capacity each. At The Mount, the two derricks of 3 and 5 tons were modified so as to increase their lifting capacity to 5 and 6 tons, while at Riche en Eau an additional derrick of 6 tons was erected.

For the first time in the history of cane preparation in Mauritius, a third set of knives equipped with 92 blades was installed at Savannah. The benefits derived from this additional set of knives was to ease up the work of the milling train. Dealing with canes of higher fibre and sucrose content as compared to 1961, Savannah nevertheless reached in 1962 a milling efficiency comparable to that obtained the previous crop.

Amongst factories which improved their milling train in 1962, special mention should be made of Bel Ombre, where the first mill was replaced by a new unit of Fletcher design equipped with a 450 H.P. steam turbine as prime mover. This new installation proved beneficial, an average first mill extraction of 75 being obtained for the crop. At the same factory, the chutes to the third and fourth mills were also modified. This modification together with the installation of the new first mill enabled Bel Ombre to increase its crushing capacity from 56.8 tons/hr. in 1961 to 64.4 tons/hr. in 1962, whilst improving its mill performance at the same time.

Processing

Juice clarification was relatively easy in 1962. At those factories where refractory juices had to be dealt with, the use of «separan» solved the problem without difficulty. However, the question of juice deterioration in clarifiers during shut down periods seems to be one needing more consideration. Over week-ends, the drop in clarifier juice purity, due to deterioration by micro-organisms, is of the order of 2 to 3 points. Some 600 tons of sugar are thus lost annually due to this cause. In this connection, investigations are planned with a view to reducing these losses.

The average performance of filter stations was somewhat better than the prevoius year, sucrose % filter cake having dropped from 2.46 in 1961 to 2.38 in 1962. Being given, however, that scums % cane increased from 2.80 in 1961 to 3.20 in 1962, sucrose lost in filter cake % cane was thus higher than the previous year by 0.01.

It must be mentioned here that at two factories, F.U.E.L. and Médine, the rotary vacuum filters were equipped with the Door-Oliver Rapifloc system. The filtering operation, as regards filtrate clarity, was particularly good at those two factories.

As may be seen from the figures given in Table 27, pan and crystalliser work was not as good as in 1961.

Purity drop between massecuite and molasses was on the average lower by 2 points approximately. It is also surprising to note that although many factories had installed low-head vacuum pans for their final boilings, the crystal content of the C massecuite was nevertheless lower than the previous year.

The relatively low reducing sugar content of final molasses affected exhaustion adversely. Thus, as shown in Table 28, the average Gravity Purity of final molasses was 36.2 in 1962 as compared to 35.7 in 1961.

The industrial losses % cane as well as the Reduced Boiling House Recovery figure recorded in 1962 were good and comparable to those obtained in 1961.

Table 27. Syrup, Massecuites and Molasses, 1957-62.

		1957	1958	1959	1960	1961	1962
Syrup purity	...	88.2	87.3	87.9	83.6	85.3	86.5
A massecuite purity	...	79.6	81.0	81.7	79.7	82.0	82.2
Purity drop :	A massecuite	20.7	20.8	20.1	20.6	22.3	20.3
	B massecuite	21.1	20.8	21.1	19.5	22.2	21.2
	C massecuite	22.3	22.7	23.6	21.6	24.6	22.9
Crystal % Brix in C massecuite		33.4	34.1	35.3	33.2	36.0	34.6
Magma purity		82.1	81.0	81.5	81.8	82.3	82.4

Table 28. Final molasses, losses and recoveries.

		1957	1958	1959	1960	1961	1962
Final molasses :	Gravity purity ...	37.7	37.9	36.7	37.2	35.7	36.2
	Red. Sug. % Brix ...	16.2	15.8	14.6	14.6	16.6	13.8
	Tot. Sug. % Brix ...	53.9	53.7	51.3	53.4	52.4	50.1
	Wt. % cane @ 95° Brix ...	2.45	2.59	2.53	3.08	2.81	2.67
Sucrose loss in final molasses % cane ...		0.92	0.93	0.88	1.09	0.96	0.92
Undetermined losses % cane		0.23	0.17	0.16	0.26	0.21	0.21
Industrial losses % cane		1.22	1.18	1.13	1.43	1.24	1.21
Boiling House Recovery		91.3	91.1	91.4	87.1	89.9	90.4
Reduced Boiling House Recovery ...		89.0	89.3	89.6	88.5	89.7	89.7

2. RESULTS OF EXPERIMENTS WITH BUSAN 881 FOR MILL SANITATION

E. C. VIGNES & R. de FROBERVILLE

During the past few years, a new type of organic sulphur bactericide, Busan 881, has been used for the control of micro-organisms in sugar factories in several countries of the Western Hemisphere. It is reported that tests have given very encouraging results leading to considerable savings in sucrose. In order to assess the effectiveness of this compound under local conditions, tests were carried out during the 1962 campaign in two sugar mills : one situated in the north of the island (A), and one in the south (B). This account aims at reviewing the results obtained in the light of data collected.

Nature and action of Busan 881.

Only recently has Busan 881 been added to the list of bactericides already on the market. It is manufactured by Beckman Laboratories Inc., Memphis, Tennessee and has the following composition :

Active ingredients	%
Disodium cyanodithioimidocarbonate	12.7
Ethylenediamine	4.8
Potassium N-methyldithiocarbamate	17.5
Inactive ingredients	65.0
	100.0

Many claims have been advanced in favour of this compound. Its action is twofold. It is supposed, in the first place, to reduce the amount of slime on housings and other parts of mill equipment and, secondly, to inactivate invertase which is at the root of all fermentation trouble in the factory. As is well known, invertase not only is secreted by micro-organisms found in slime deposits but is also present in sugar cane juice. Unlike chlorine and chlorine-containing compounds which react quickly with organic matter in cane juice, it is claimed that Busan 881 does not, and consequently cannot, lose its potency. Perhaps the most interesting property of the product is its ability to control micro-organisms in very dilute solution. The addition of a few parts per million in mixed juice has been found effective. It is believed that the bactericidal action depends on certain non-identified unstable compounds formed on dilution.

In view of the toxic nature of Busan 881, it is absolutely essential that none of this chemical remains as a residue in sugar and molasses. It is reported by APPLING and WARNER (1959) that comprehensive tests have been conducted on the bactericide and according to experimental evidence obtained, the conclusion was reached that «Busan 881 can be added to cane juice in amounts as large as 40 parts per million without producing any detectable residue of this product based on the absence of cyanide in all cases and based on no increase in sulfide content as compared with sugars and molasses produced from juices to which no Busan had been added».

Table 29. Weekly averages for crusher and mixed juices in factory A.

Week of grinding	*Brix*	*Sucrose*	*Purity*	*Invert sugar*	*Glucose ratio*	*Drop in purity*	*Increase in glucose ratio*
NO BUSAN 881							
Seventh							
Crusher juice ...	20.33	18.51	91.1	0.42	2.3		
Mixed juice ...	16.54	14.55	88.0	0.41	2.8	3.1	0.5
Eighth							
Crusher juice ...	20.85	18.86	90.5	0.44	2.3		
Mixed juice ...	16.61	14.61	88.0	0.41	2.8	2.5	0.5
BUSAN 881 — 15 ppm.							
Ninth							
Crusher juice ...	20.78	18.77	90.3	0.49	2.6		
Mixed juice ...	17.02	14.90	87.5	0.49	3.3	2.8	0.7
Tenth							
Crusher juice ...	20.82	18.88	90.7	0.49	2.6		
Mixed juice ...	16.97	15.01	88.4	0.48	3.2	2.3	0.6
NO BUSAN 881							
Eleventh							
Crusher juice ...	21.26	19.39	91.2	0.50	2.6		
Mixed juice ...	17.03	14.97	87.9	0.49	3.3	3.3	0.7
Twelfth							
Crusher juice ...	21.54	19.42	90.2	0.56	2.9		
Mixed juice ...	17.48	15.31	87.6	0.53	3.5	2.4	0.6

Table 30. Weekly averages for crusher and mixed juices in factory B.

Week of grinding	*Brix*	*Sucrose*	*Purity*	*Invert sugar*	*Glucose ratio*	*Drop in purity*	*Increase in glucose ratio*
NO BUSAN 881							
Third							
Crusher juice ...	17.18	15.45	89.9	0.407	2.63		
Mixed juice ...	13.00	11.41	87.8	0.342	2.99	2.1	0.36
Fourth							
Crusher juice ...	17.69	15.92	90.0	0.452	2.84		
Mixed juice ...	13.30	11.64	87.5	0.424	3.64	2.5	0.80
BUSAN 881 — 15 ppm.							
Fifth							
Crusher juice ...	18.17	16.47	90.6	0.402	2.44		
Mixed juice ...	13.50	11.93	88.4	0.389	3.26	2.2	0.82
Sixth							
Crusher juice ...	18.62	16.88	90.7	0.353	2.09		
Mixed juice ...	13.79	12.35	89.6	0.298	2.41	1.1	0.32
Seventh							
Crusher juice ...	18.76	17.16	91.5	0.393	2.29		
Mixed juice ...	14.26	12.64	88.6	0.370	3.13	2.9	0.84
Eighth							
Crusher juice ...	19.43	17.34	89.2	0.472	2.72		
Mixed juice ...	14.77	12.92	87.5	0.424	3.28	1.7	0.56
NO BUSAN 881							
Ninth							
Crusher juice ...	18.95	17.19	90.7	0.470	2.74		
Mixed juice ...	14.42	12.74	88.3	0.446	3.51	2.4	0.77
Tenth							
Crusher juice ...	19.48	17.71	90.9	0.355	2.00		
Mixed juice ...	14.82	13.25	89.4	0.362	2.74	1.5	0.74

Mode of application

Both factories concerned in the experiment employ the same system of compound imbibition, cold water being applied to the bagasse entering the last mill. Busan 881 was added to the juice leaving the last mill and, therefore the chemical circulated with the juice back towards the first mill. The compound flowed under gravity into the last mill juice gutter, the flow being adjusted to the crushing rate. A steady flow was maintained.

According to instructions received from the manufacturers the efficacy of the bactericide was assessed in two different ways, namely, the effect on the drop of purity between crusher juice and mixed juice and the effect on the increase in glucose ratio on passing from crusher juice to mixed juice.

In both factories, crusher juice is sampled by hand every 5–10 minutes for $1\frac{1}{2}$ hours. Mixed juice is sampled automatically. Refractometric Brix is determined on the samples which are then composited; part being preserved with neutral lead acetate for the determination of glucose and part with basic lead acetate for sucrose determinations. Every day the composite samples are analysed for sucrose and glucose. The daily averages for Clerget purity and glucose ratio for the two juices are calculated. Weekly averages are arithmetical in the case of crusher juice, and proportional in that of mixed juice. In both factories, Busan was added at the rate of 15 p.p.m. on the mixed juice; in factory A during the ninth and tenth weeks of the grinding season, and in factory B during the fifth, sixth, seventh and eighth weeks. The relevant averages obtained in both factories are shown in Tables 29 and 30. Weekly figures are tabulated for the period when Busan 881 was applied as well as for two weeks before and two weeks after the tests.

Discussion

In Table 29 are assembled the averages for factory A. As far as the average drop in purity is concerned, the slight differences, between the figures obtained before, during and after the tests, have probably no practical significance. However, it is interesting to compare the figures for the increase in glucose ratio. This ratio, being the result of exact chemical analysis of carefully preserved samples, is a most reliable criterion for assessing the value of the bactericide. Unexpectedly, the percentage of reducing sugars is apparently greater when Busan 881 was added at 15 p.p.m. than for the two weeks prior to addition. In other words, the data seem to indicate that the addition of Busan 881 had no practical effect on the amount of inversion encountered in the course of manufacture at factory A.

A review of Table 30 reveals a similar state of affairs in factory B. Although actual differences are observed between individual averages, no consistent improvement due to the use of Busan 881 was recorded. Some low averages do occur during the period of treatment but in view of the inconsistency of results obtained no real significance can be attributed to these figures.

It thus appears that the amount of Busan 881 employed in both factories did not prove effective in preventing the growth of micro-organisms. This may be due, in part, to the apparently high standard of sanitation encountered in both mills concerned. Mill housings are washed every few hours with powerful jets of hot water and the amount of slime is kept at a minimum. Moreover, thorough cleaning is effected during the week-end shutdown. As a result, the use of up to 15 p.p.m. of the compound apparently has no effect on mill-house efficiency. Busan 881 is an expensive chemical and it would seem, in consequence, that its use for mill sanitation is not warranted under local conditions.

REFERENCE

APPLING, J. W. and WARNER, I. (1959). Micro-organism control in Cuban sugar mills. *Sug. J.* **22** (8) : 19–27.

3. NOTES ON THE PERFORMANCE OF ROTARY VACUUM FILTERS

H. F. WIEHE

As pointed out by St. Antoine and Vignes (1961), the best way of judging the performance of a vacuum filter as regards elimination of solid impurities from the filtrate is to determine the daily retention. However, since the ultimate purpose of the filter station is to recover as much sucrose as possible from the muds leaving the clarifier, the overall efficiency of the filtering operation cannot be evaluated only by the percentage of mud solids retained in the cake as it will be greatly influenced by the following closely associated factors :

(a) the sucrose content of the cake,

(b) the purity drop between clarified juice and filtrate.

The pol of the filter cake will indicate the amount of sucrose actually lost in the cake while the filtrate purity will have a direct bearing upon the recovery of that proportion of sucrose which has been extracted from the muds into the filtrate.

In other words, it may be said that a vacuum filter operates efficiently, provided the following aims are attained :

(a) a filter cake of low sucrose content,

(b) a low purity drop between clarified juice and filtrate, and

(c) a good separation of mud solids from the filtrate.

The object of the present study is to evaluate the sucrose loss that may result when the above conditions do not prevail. Pertinent data were collected from those factories where sufficient figures relative to the filtering operation were available. These data are presented in Table 31 in which the figures for factory A, the filter performance of which is the best, are compared to the average figures for 10 other factories in which the vacuum filters could operate more efficiently.

Using the figures given in Table 31 and assuming that weight of filtrate amounts to 15% on cane, a balance of sucrose recoverable from muds, based on 100 tons of cane, has been worked out for factory A and for the other group of factories. The results of this study are summarized in Table 32.

Table 31. Filter Performance — Comparative figures.

	CLARIFIED JUICE		*FILTRATE*		*Pol % Filter Cake*	*Filter Cake % Cane*	*Bagacillo in Filter Feed % Cane*
	Densimetric Brix	*Clerget Purity*	*Densimetric Brix*	*Clerget Purity*			
Factory A ...	13.28	85.5	11.04	83.8	0.63	5.10	0.65
Average of 10 other factories ...	13.95	86.8	10.55	83.0	1.89	3.22	0.42

Table 32. Filtrate dilution figures and sucrose balance.

	Filtrate Dilution	*Recoverable Sucrose from Filtrate (Kilos/100 Tons Cane)*	*Sucrose lost in Filter Cake (Kilos/100 Tons Cane)*
Factory A	20.3%	1210	32
Average of 10 other factories	32.2%	1159	61

Sucrose balance in favour of factory A =
(1210 — 1159) + (61 — 32) =
80 Kilos/100 Tons Cane

An analysis of the figures of Table 32 clearly shows that factory A loses definitely less sugar at its filter station than the other group of factories. Had the average filter performance of the other factories been the same as that of factory A, an additional gain of some 80 kilos of sugar per 100 tons of cane crushed, or an increase of 0.08 on extraction would have resulted mainly due to a better recovery of sucrose from filtrate.

It must be mentioned here that, although factory A is using appreciably less wash water on its filter (filtrate dilution 20.3 %), compared to other factories (filtrate dilution 32.2 %), it is nevertheless securing the lowest pol per cent filter cake. An interesting point to note in this connection is that factory A uses in its filter feed 0.65 bagacillo % cane while the other factories use on the average only 0.42.

From these facts it is possible to conclude that, in order to achieve a high overall performance of the filtering operation, the following points should be observed.

1. The muds must be adequately treated prior to filtration. The addition of the required amount of bagacillo of the correct particle size and operation at the proper pH of the filter feed will not only promote good retention but also yield a filtrate of high purity and a filter cake of low sucrose content.

2. A thorough and careful chemical control of the filter station should also be exercised if success is to be achieved.

REFERENCES

ST. ANTOINE, J. D. de R. de and VIGNES, C. (1961). The determination of retention in vacuum filters. *Ann. Rep. Sug. Ind. Res. Inst. Mauritius :* 89–91.

4. EXPERIMENTS ON THE CURING OF LOW-GRADE MASSECUITES IN HIGH-SPEED CENTRIFUGALS

J. D. de R. de SAINT ANTOINE & H. F. WIEHE

Mon Loisir factory had installed in 1961 a new battery of five fully automatic centrifugals for the curing of C massecuites. These $48'' \times 30''$ machines, fitted with Ward Leonard drives are capable of running at a maximum top speed of 1700 r.p.m.

With this battery of centrifugals three series of test were carried out with the object of determining :

1o. The effect of the rate of acceleration on the quality of C sugar produced.

2o. The capacity of a $48'' \times 30''$ machine when running at 1700 vs 1450 r.p.m. and the effect of high speeds on C-sugar polarization.

3o. The influence of the temperature of the water used for reheating the C massecuite, prior to centrifugalling, on the purity of final molasses.

The results of those experiments have shown that :

1o. Provided power is available, it is a better proposition to reach top speed in three minutes than in four minutes since the higher acceleration does not affect the quality of the sugar produced and results in an increase of capacity of 6 % for a total cycle time of 15 minutes.

2o. A $48'' \times 30''$ centrifugal running at 1700 r.p.m. has 25–30 % more capacity than a machine of the same dimensions running at 1450 r.p.m. for curing of low grade massecuites. Sugar of better quality is obtained with the higher-speed machine which can cure more viscous massecuites than the lower speed centrifugal. This alone is a major advantage because :

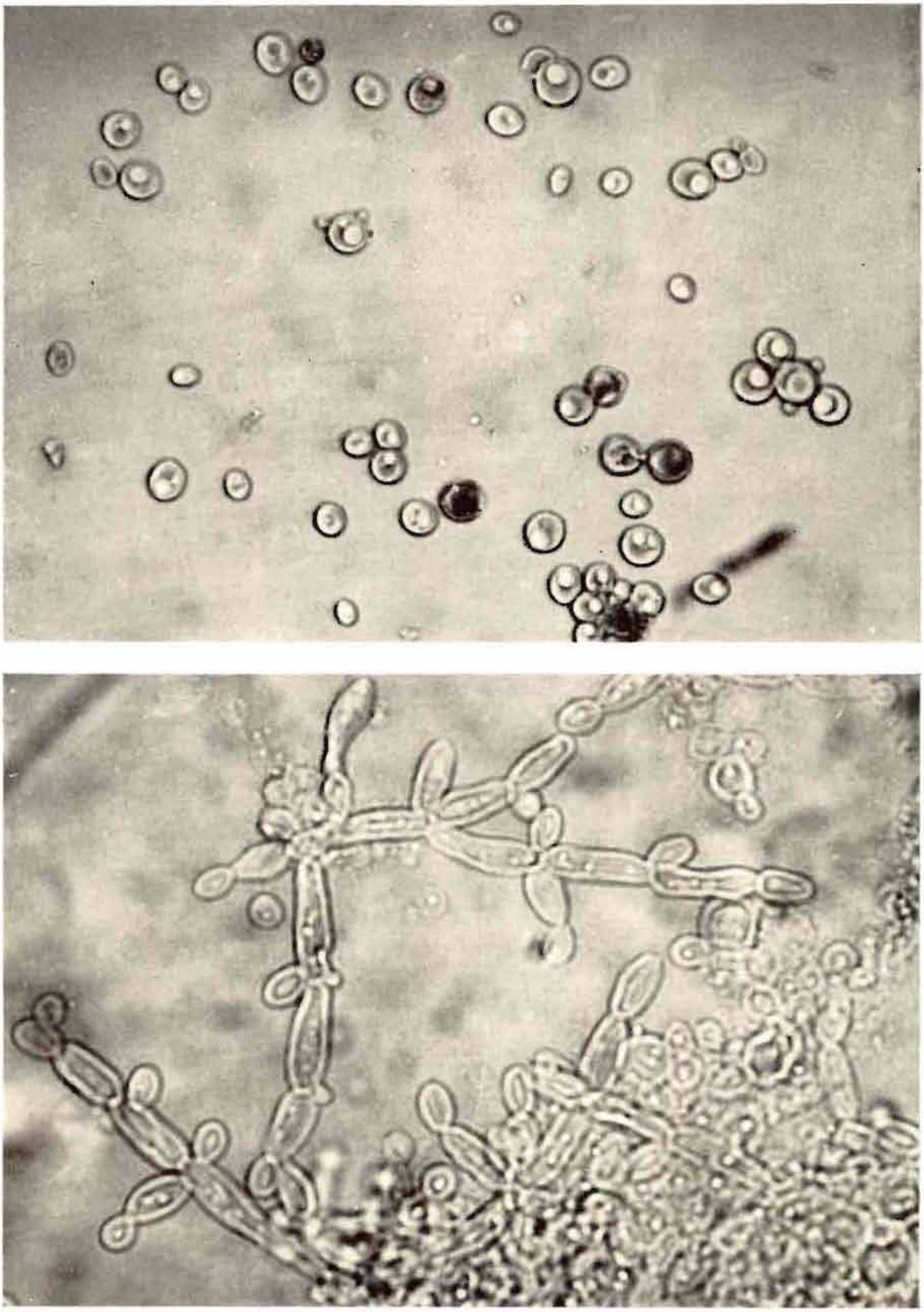


Fig. 45. Yeast cells from raw sugar. Top : *Saccharomyces rosei*, Bottom : *Dekkeromyces* sp.

(a) Viscosity being the major limiting factor to molasses exhaustion, the 1700 r.p.m. machine may be expected to cause a reduction in the sugar lost in final molasses as it can efficiently purge more viscous molasses than the 1450 r.p.m. machine.

(b) Since the 1700 r.p.m. machine can deal with more viscous massecuites, the latter may be reheated to a lower temperature before centrifugalling, with consequently less danger of re-melting the sugar crystals.

(c) In the boiling process generally followed in Mauritius, in which the C sugar is used as a footing for the A and B strikes, heavy recycling of molasses results with decreasing magma purities. The use of 1700 r.p.m. centrifugals considerably reduces this danger since it is an easy matter with these centrifugals, to obtain C sugar polarizing 85° or better, whilst during the tests C sugar exceeding 82° could not be obtained, on the average, with the 1450 r.p.m. machine.

3o. Under conditions prevailing during the tests, for a given massecuite temperature, molasses purity was a direct function of the heating water temperature. It thus seems that it is possible to reduce appreciably the sucrose losses in final molasses by lowering the temperature of the water used for reheating final massecuites to 60°C or below.

5. STUDIES ON THE OSMOPHILIC YEASTS IN RAW SUGARS

R. ANTOINE, R. de FROBERVILLE & C. RICAUD

(a) Survey of the yeast flora

The investigations started at the end of 1961 have progressed further this year. These involved : (i) analysis of raw sugar samples from each factory so as to determine their osmophilic yeast content and activity by plate counts on osmophilic agar and fermentation tests on sugar solutions at 55° Brix; (ii) identification of yeasts isolated; (iii) evaluation of the effect of yeasts on the keeping qualities of raw sugars; and (iv) determination of the manufacturing stage at which the sugar product is contaminated.

The analysis of sugar samples showed that active yeasts are present in raw sugars from all factories, the numbers and types varying considerably from factory to factory and probably from one season to another. The lowest number of colonies encountered was 17 per gram of sugar and the highest 1,690. There was no correlation, however, between the number of yeast colonies present and fermentative capacity.

Several colonies, which appeared structurally different, were isolated from the plates. Some of their morphological and physiological characters were studied and, with the assistance of the *Centraal Bureau Voor Schimmelcultures* in Holland, eight different species were identified. Table 33 gives a list of these yeasts and their ability to ferment certain sugars, as revealed by fermentation tests.

A few of these yeasts could prove dangerous, particularly *Saccharomyces rouxii* which was the most frequently encountered. This yeast does not ferment saccharose but tolerates high osmotic pressures, up to 70°Brix, and can attack glucose and lower the pH dangerously.

In order to assess the effect of yeasts on the keeping qualities of raw sugars, the yeast content, humidity and pol. of sugar samples were determined immediately after sampling and again after 5 months storage, in the laboratory, in sterile conical flasks stoppered with cotton wool. The changes observed are shown in Table 34.

Table 33. Sugar Fermentation by Yeasts Isolated from Raws.

Yeast	*Glucose*	*Galactose*	*Lactose*	*Maltose*	*Saccharose*
Schizosaccharomyces pombe ...	+	—	—	+	+
Saccharomyces rouxii ...	+	—	—	+	—
Saccharomyces rosei ...	+	—	—	—	+
Torulopsis etchellsii	+v.w.	—	—	—	—
Torulopsis versatilis	+	+w.	—	—	+
Endomycopsis ohmeri	+	+w.	—	+	+
Candida tropicalis	+	+	—	+	+
Dekkeromyces sp.	+w.	—	—	+v.w.	—

Table 34. Changes observed in Raw Sugars stored for 5 months in Conical Flasks.

Factory	*Fermentation (No. of days)*		*Moisture %*		*Pol. %*		*No. of yeast colonies per gm sugar*	
	Before	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
A	6	4	0.3463	0.9980	99.08	98.00	36	34,125
B	5	4	0.3018	0.8700	99.15	97.30	838	400,000
C	5	2	0.3821	0.9960	98.75	95.18	17	760,000
D	4	2	0.5530	0.8820	98.86	95.98	1,123	331,250
E	4	3	0.2532	0.6360	99.07	98.10	385	57,000
F	4	2	0.3606	0.7260	98.55	96.50	1,110	42,200

It should be mentioned that the conditions of storage were not representative of normal conditions in bulk storage or in bags. The high relative humidity and good aeration, due to adequate diffusion through the cotton wool stoppers, were no doubt responsible for the big rise in moisture content, considerable increase in yeast population and drop in pol. There was no correlation, however, between the original and final numbers of yeasts, nor between the yeast build up and drop in polarization.

So as to have a more precise picture of the changes that may occur during storage under normal conditions, yeast build-up and sugar deterioration are at present being followed on raw sugars stored in bags at the docks. Samples are taken for analysis at monthly intervals. Plate counts have revealed that these sugars are contaminated with several species of *Aspergillus* which had never been encountered before on plates prepared from sugar discharged directly from the sugar bin at the factory. As it has been reported elsewhere that these fungi may prove troublesome in raw sugars, isolates have been sent to the Commonwealth Mycological Institute for identification and their role in sugar deterioration will be assessed.

Investigations on sugar products at various stages during manufacture have confirmed that the original yeast populations, probably brought in with the canes, are completely destroyed by the normal boiling processes and that recontamination takes place in the massecuite in the crystallizers. Plate counts from massecuite leaving the vacuum pans have never revealed the presence of viable yeasts but only colonies of *Bacillus subtilis*. The rate of recontamination of the massecuite could vary from factory to factory.

In order to improve the keeping qualities of raw sugars, steps should be taken at the factory to prevent or reduce considerably contamination of the massecuite from the moment it leaves the vacuum pan until it enters the centrifugal.

(b) **Preliminary investigations on the control of yeasts in sugar factories.**

Preliminary investigations, carried out at one factory where crystallizers are cleaned with steam at regular intervals during the crushing season, have given an indication that this procedure could slow down the build-up of the yeast population to a certain extent but would not be efficient enough to reduce the yeast content in raw sugar to a desirably low level. The search for a suitable sanitizing agent that could be used, economically, in addition to steaming, has thus started. Such a compound could also be used for regular disinfection of the gutters along which massecuite is carried to the centrifugals.

To this effect, a series of laboratory tests have been carried out to evaluate the activity of the germicide Weladyne, a detergent compound containing iodine, against the yeasts *Saccharomyces rouxii* and *Torulopsis versatilis*. The following procedure was adopted. Standard 24 - hour malt extract broth cultures of the test organisms were used in all the tests. One ml. of the culture was added to each of 100 ml. germicide solutions of different concentrations. From the resulting suspensions, one ml. aliquots were removed after 1, 5, 15 and 30 minutes and transferred to 9 ml. of neutralizer. After allowing an exposure of two minutes to the neutralizer, one ml. of the germicide-neutralizer mixture was transferred to malt extract broth and incubated for 72 hrs. at room temperature. The presence or absence of viable yeast cells in these broth cultures, after incubation, was ascertained by plating. The neutralizer used, a suspension of Lecithin in Tween 80, was tested concurrently and found to be effective against the highest concentration of germicide tested. Control tests, in which water was substituted for the germicide solution, showed that the neutralizer had no germicidal activity.

The germicide was tested at concentrations giving 5, 10, 15, 20 and 25 ppm. of available iodine. The first tests were carried out with the germicide solution in pure sterile water. Further tests were made with the addition of different amounts of pure sucrose (25, 50, 75 and 100 gm.) to 100 ml. aliquots of the germicide solution.

The results of these tests for *S. rouxii* are summarized in Table 35. There was no appreciable difference in response between *S. rouxii* and *T. versatilis*. In the absence of sugar, short exposure to Weladyne at a concentration as low as 10 ppm. available iodine can be totally effective against these yeasts. The effect of adding sucrose was appreciable only at the highest levels, 75 and 100 gm. i.e. approximately 40 - 50° Brix. At such sugar concentrations, which are likely to be expected in the crystallizer wash water, a longer time of exposure to the germicide is needed.

Table 35. Lowest time of Exposure (minutes) at which *S. Rouxii* is killed by Germicide at various concentrations, in presence of varying amounts of Sucrose.

Germicide concentration (ppm. available iodine)	*Sucrose added (gm.)*				
	0	25	50	75	100
5	5	5	5	30	—*
10	1	1	1	5	15
15	1	1	1	5	15
20	1	1	1	5	5
25	1	1	1	1	5

* Yeasts not killed even at 30 min. exposure.

6. CHEMICAL CONTROL NOTES

RESULTS OF TESTS CARRIED OUT WITH A DSM SCREEN ON MIXED JUICE

M. RANDABEL

Tests were carried out at Mon Loisir factory during the 1962 crop to compare the efficiency of vibrating screens with that of a Dorr-Oliver DSM screen which was installed this year.

The DSM screen consists essentially of a stationary housing equipped with a curved screen, the surface of which is constructed of wedge-shaped bars mounted in a frame at right angles to the direction of flow of the feed. Both screen and frame are shaped to an arc of a circle and clamped to the screen housing.

Juice from a feed trough is fed tangentially on to the upper surface of the screen and flows down the curved surface at right angles to the wedge bars. Juice and undersize particles pass through the screen whereas the oversize particles move by gravity down the screen and are discharged at its lower end. The DSM screen thus has no moving parts and both its upper and under surface are easily accessible for cleaning.

The dimensions of the DSM screen used were 72″ × 63″ and the clearance between wedge bars 1 mm.

The vibrating screens were both 55″ × 46″ equipped with 24 mesh/inch screen cloth with square perforations of 0.75 mm. They were vibrated at 2850 oscillations/min. through V – belts by 3.5 H.P. electric motors at 2900 r.p.m.

During the tests, Mon Loisir factory was crushing at the rate of 120 TCH approximately and processed about 130 tons of mixed juice per hour. Half of the mixed juice was screened through two vibrating screens and half through the DSM screen which however had to be slightly modified to cope with this juice rate (65 tons/hr.). The screened mixed juice was sampled simultaneously as it flowed from the under surface of the screens. Each sample was representative of about 65 tons of mixed juice.

Bagacillo per litre of mixed juice was determined on 2 litres sub-samples which were strained through a 100 mesh sieve. The bagacillo left on the sieve was washed with a jet of water until the washings were clear and further washed with boiling water. The bagacillo was then dried in an oven at 105°C. The results obtained are given in Table 36.

These results show that mixed juice screened on the DSM screen contains half as much bagacillo as that leaving the vibrating screens.

More efficient removal of bagacillo will yield a more accurate weight of mixed juice. It should be noted, however, that the net result on sucrose per cent. cane is very slight, amounting on the average to only 0.01 in this particular case.

If most of the bagacillo is separated by screening of the juice, it will doubtless be found necessary to add more of it per ton of cane to the clarifier mud prior to filtration. This should be borne in mind to ensure good filter performance. Since however the presence of bagacillo in the clarified juice has a tendency

Table 36. Bagacillo content of mixed juice, g/litre.

Date	10/10	11/10	12/10	15/10	16/10	17/10	18/10	19/10	*Average*
DSM screen ...	0.80	0.63	0.85	0.63	0.90	0.64	0.90	0.73	0.76
Vibrating screen ...	1.20	1.53	1.98	1.90	1.33	1.48	1.34	1.43	1.52

to yield sugars of poor keeping quality, technically it is a better proposition to separate as much of it as possible by fine screening even if more has to be added at the filter station.

Although the capital cost of a DSM screen is appreciably larger than that of a vibrating screen of the same capacity, the following points, already mentioned, should again be emphasized :

(i) low maintenance costs, as there are no moving parts,

(ii) good sanitation, as both the upper and under surface of the DSM screen are easily accessible for cleaning.

7. NOTES ON THE INSTALLATION AND MAINTENANCE OF pH CONTROLLERS

F. LE GUEN

Many factories in Mauritius have in recent years installed automatic pH controllers for the liming of the mixed juice. Whilst excellent results have been obtained in some factories, this has not been the case everywhere. Most of the difficulties that have been encountered could be traced to the fact that, in many instances, pH controllers had been installed without attention being paid to the fact that a liming station which is being operated manually, may not be satisfactory with automatic control. It is therefore necessary to make a study of the liming system of a factory whenever it is proposed to install an automatic pH controller and to carry out the modifications that may be required.

It is most important when using automatic control for the liming of cane juice, to try to attain stable conditions because the reactions between lime and cane juice are extremely complex, and as a result, equilibrium conditions are probably never attained (HONIG, 1953). In order to obtain good control, it is therefore necessary to reach a state of dynamic equilibrium at the liming tank, i.e. for the pH to be constant at the outlet of the tank, the rate of flow of juice through the tank, the density of the added milk of lime, and the hydrostatic head of lime supplying the control valve must also be kept constant. In addition to this, it is essential that efficient mixing of the added milk of lime with the incoming juice be attained; this is all the more difficult to obtain on account of the large volumetric ratio between the juice and the milk of lime.

Mixing

The tanks normally used for mixing are cylindrical in shape and slightly taller than wide. Owing to the cylindrical shape of the tanks, a paddle which merely imparts horizontal circular motion to the liquid in the tank is inefficient as a mixing device since it whirls the liquid without promoting turbulence. One of the best ways of promoting turbulence is to have, as in fig. 46, an inverted cone submerged in the tank. A propeller pushes the liquid down the tank and up along the sides. It then flows down again into the cone towards the propeller. This promotes active circulation in a vertical plane and creates a high degree of turbulence; it is essential however, that the cone be submerged.

Variations in the flow of juice and pre-liming

The liming station is normally situated after the juice scales and before the juice heaters if, as is the case in most of our factories, cold liming is practised. The flow of juice from the scales being intermittent, it is necessary to have surge tanks to even out this flow before the juice goes to the liming tanks. The capacity of these surge tanks depends upon that of the scales; there are usually two of them. These tanks are also used to carry out a pre-liming of the juice before it reaches the final liming tank in order to enable finer control at the final liming tank to be achieved.

It is therefore necessary to have efficient mixing in the second of these tanks.

There are two ways of carrying out the pre-liming operation; the milk of lime is either added in pre-set quantities each time the scales tip over, or the milk of lime is added at a continuous rate at the inlet of the second tank. Since it is necessary that the pre-liming be as even as possible in order not to disturb the dynamic equilibrium of the liming operation, the continuous method is likely to give better results if the flow of juice has been almost completely evened out at the point where the milk of lime is added. Both methods, however, can give excellent results.

An important point to remember in connection with pre-liming is that the automatic controller is able to correct a shortage of lime, but it cannot remove an excess and it is important therefore to see that the pre-liming is not too high.

Density of the lime and hydrostatic head of lime on the control valve or feeder.

The effect of variations in the density of the milk of lime is equivalent to that of variations in the flow of juice. When the milk of lime is prepared in batches that are sufficient to last for an hour or more, and care is taken to prepare each batch at the correct density, no trouble should be encountered in this connection. With automatic control it is usual to work at a low density of the milk of lime, 2 or 3° Baumé (HUGOT, 1960) in order to achieve accurate control.

It is also important to see that the head of lime upon the valve supplying the control valve be constant. It sometimes happens, when the same pump is used to supply the pre-liming equipment and the final control valve, that the latter is periodically starved whenever the periodic demand from the intermittent pre-liming device reaches a peak. The use of a constant head device to regulate the hydrostatic head at the valve helps, but the device should incorporate a stirrer and provision for flushing since milk of lime settles easily if it is allowed to, and this gives rise to clogging when the deposits are allowed to build up.

In fig. 46 is outlined the juice flow diagram of a liming station with automatic pH control designed according to the principles outlined above.

There are also certain points to be observed in connection with the controlling equipment itself. This equipment consists of :

1o — The electrode assembly.
2o — the electronic pH amplifier.
3o — the pneumatic controller.
4o — the final control valve or feeder regulating the amount of milk of lime added according to the pneumatic signal received from the controller.

The electrode assembly

The electrode assembly should be located in such a way that the juice reaches it as soon as possible after leaving the liming tank. The time lag which exists between the moment the juice leaves the tank and that when it affects the electrodes, is detrimental to good control and should be made as short as possible.

Unless specially designed to work under high pressures, the electrodes are affected by the pressure in the electrode vessel. The piping layout shown in fig. 46 ensures that even if there is a large pressure in the supply piping, this is not transmitted to the electrode vessel if valves A and B are correctly adjusted. The branch leading off the surplus juice should discharge below the electrode vessel in order to lessen the chance of air bubbles being sucked backwards into the main branch. Such bubbles flowing into the electrode vessel would affect the potential of the electrodes and give rise to false indications of pH variations.

When installing the electrode vessel, it is best to choose the location in such a way that when the factory is being cleaned, the electrodes are not likely to be drenched with water, for they are often very sensitive to the presence of moisture on their insulation.

The electrodes, particularly the glass electrode, are by far the most delicate parts of the equipment and also the ones most likely to be faulty when trouble is encountered. Maintenance is therefore an important factor

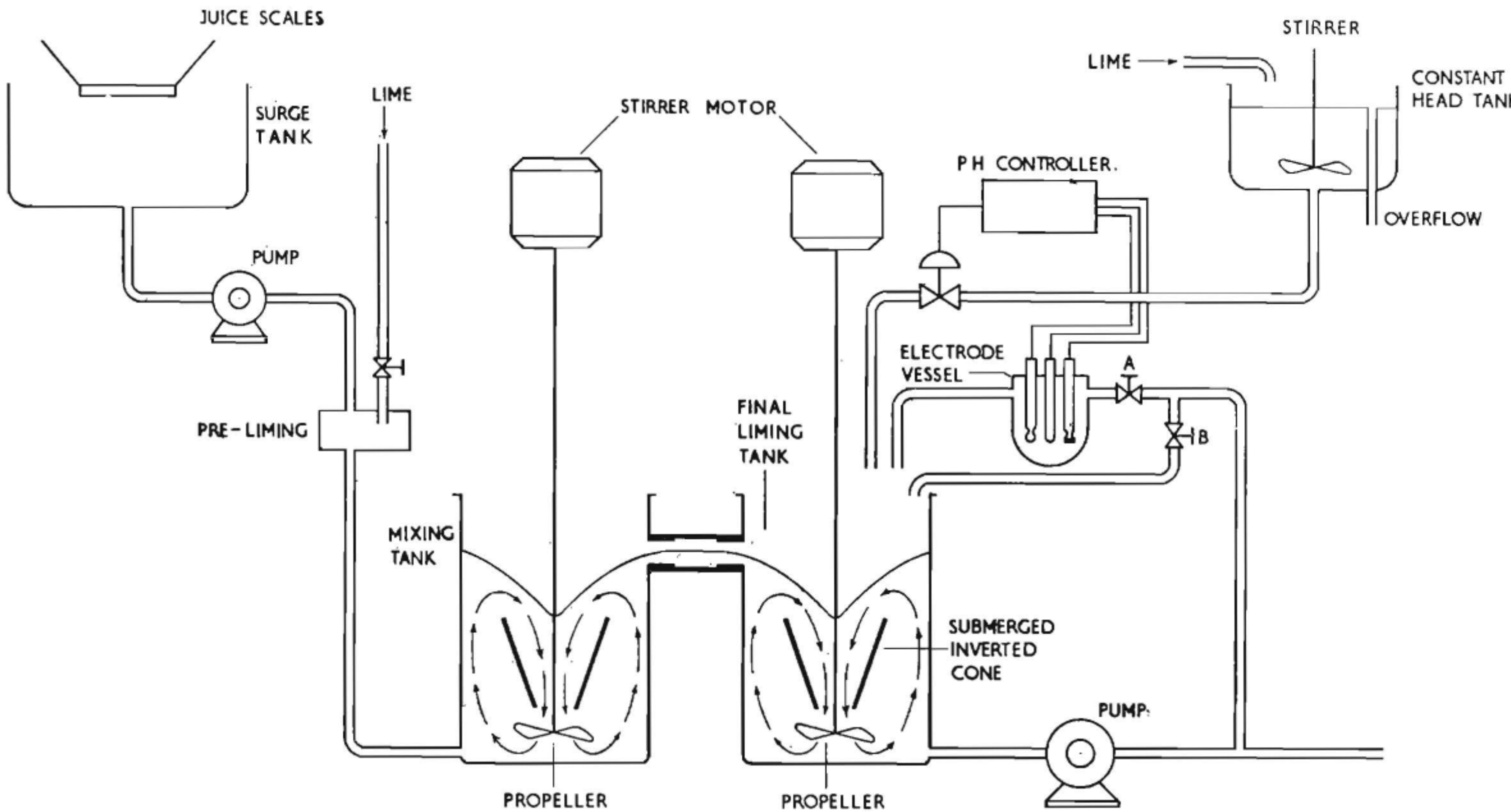


FIG. 46 — JUICE FLOW DIAGRAM FOR A LIMING STATION WITH AUTOMATIC pH CONTROL

Note : Pre-liming may alternatively be carried out before the surge tank by an intermittent device triggered by the scales when they tip over.

in connection with them; they should be washed daily in dilute hydrochloric acid to remove any deposit forming upon their surface. The sensitive part of the glass bulb should not be handled and the electrodes should not, as far as possible, be allowed to stay dry except for very short periods. It is very useful to have two electrode assemblies with facilities for switching from one set to the other; not only does this enable one set to be serviced whilst the other is in use, but it is also easy to test whether a set of electrodes is in working order by switching from one set to the other.

The self-balancing electronic potentiometer

Modern electronic equipment is extremely reliable and normally gives very little trouble to the user once it has been installed. The cables from the electrodes to the amplifier should not be made to go near power lines and the equipment should be connected to earth at one point only.

It is good practice to have an electric bulb switched on inside the amplifier case when the amplifier is left switched off for long periods such as during the off-season for this prevents moisture from damaging the components.

The pneumatic controller

The pneumatic controller is also extremely unlikely to give trouble provided the compressed air supply is clean and dry. With a dirty and wet air supply, plenty of trouble is likely to occur through clogging of the various parts of the equipment; it is essential therefore that air filters be incorporated in the compressed air supply lines and that these filters be cleaned periodically.

The pneumatic controller has various controls, the setting of which depends upon the particular plant upon which they are installed. There are several methods available for finding these settings (LE GUEN, 1962); this is usually carried out, however, by the engineer commissioning the equipment.

The final control element

Milk of lime gives rise easily to clogging of pipes and valves; the final control element therefore consists usually of a Saunders patent valve, which does not choke easily, or there is a feeder specially designed for handling milk of lime. Used with the low densities of milk of lime which are normal practice with automatic control, they have performed quite satisfactorily.

The final control element should, as far as possible, be located near the liming tank in order not to introduce any unnecessary time lag in the control loop.

The best and also the cheapest way to obtain satisfactory performance from an automatic liming station is to design it correctly from the start, since failure to observe this principle usually leads to unsatisfactory results.

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BY-PRODUCTS

1. FURTHER EXPERIMENTS ON THE RECOVERY AND NUTRITIVE VALUE OF CANE JUICE PROTEIN

E. C. VIGNES & R. de FROBERVILLE

FOLLOWING the work carried out in previous years on the extraction of protein from sugar cane juice, it was decided to apply certain modifications to the existing process during the 1962 crop. The aim was to attempt to reduce as much as possible the amount of hard wax present in the protein coagulate. As a result, it was hoped that the percentage of crude protein in the product would, at the same time, be increased. For this purpose the small Westfalia KG 10006 discontinuous separator was again used, this year at Mon Désert–Alma S. E.

The following procedure was adopted. Cold mixed juice was strained through a 120–mesh stationery screen, centrifuged in the separator and stored in tanks capable of holding 4 tons of juice. Centrifuging was continued until the tanks were filled when the machine was dismantled and cleaned. The stored pre-centrifuged juice was then pumped into a tank fitted with a perforated steam coil, heated to over 90°C by live steam injection and again fed to the centrifuge. The coagulate obtained during the hot centrifugation was then collected for analysis.

As will be seen from Table 37 it was possible to obtain a product with a lower percentage of fats and wax.

Moreover the amount of hard wax was higher in the case of the cake separated by cold centrifugation than in the heat coagulate.

Table 37. Fats & Wax and Protein content of cake obtained by centrifuging cane juice

	Dry cake % juice	*Fats & Wax % Dry matter*	*Protein % Dry matter*
1. Cake separated by centrifuging cold mixed juice	0.21	8.2	9.8
2. Coagulate obtained by heating pre-centrifuged juice	0.28	22.0	25.6
3. Coagulate obtained in 1961 without pre-centrifugation	—	25.0	22.8

Table 38. Fats and Wax content of Benzene Extract

	Fatty fraction %	*Waxy fraction* %
1. Benzene extract of cake from cold centrifugation	37.3	62.7
2. Benzene extract of heat coagulate	70.9	29.1

This indicates that although the decrease in facts and wax in the heat coagulate was only 3%, the reduction is mainly due to the elimination of hard wax. While the latter may not be desirable from the point of view of animal metabolism, the fats, on the other hand could be nutritionally beneficial.

A complete analysis of the coagulate obtained by heat treatment during one run was made and is given in Table 39.

Table 39. Composition of heat coagulate from cane juice

	%
Crude Protein	25.2
Sugars	21.2
Alcohol/Benzene extract	23.6
Starch and other polysaccharides (excluding cellulose)	5.8
Ash	7.8
Fibre (by difference)	16.4
	100.0

Despite the fact that pre-centrifuging cold mixed juice is not the best way of removing hard wax, this new coagulate is potentially of better quality than previously obtained. Unfortunately, drying had to be effected in a large air oven at 105°C. This oven was the only equipment available and, as it was being used concurrently for other purposes, it was not possible to reduce the temperature. As is already known, the nutritive value of protein is considerably lowered on heating to high temperatures and therefore the dry cake, as obtained, could hardly be used in assessing digestibility in animals possessing a simple stomach. In spite of this limitation, it was rightly believed that the product was well worth testing from the point of view of palatability and toxicity. Consequently, comparative feeding trials on laying hens were conducted at Mapou (Daruty) under the supervision of Mr. S. LIONNET, M.R.C.V.S.

No difficulty was encountered in feeding heat coagulate mixtures to the hens. There was a slight temporary reluctance on the part of the birds to eat the new material at the beginning of the test, but they quickly became accustomed to the feed mixtures and appeared to eat normally. Apparently they were not affected. For example, egg production as well as egg size were maintained. No thin-shelled or abnormal eggs were noticed, and no taint or unusual taste was detected in the eggs. However, the inclusion of 15% cane juice protein in the feeding mixture led to an increased feed consumption. From analyses of droppings throughout the experiments, it was found that the hens under test consistently excreted more fats and wax, the excess being presumably the hard indigestible portion of the wax.

The next step now envisaged is the use of a lower coagulation temperature in conjunction with spray drying. Thanks to the generous help of «Freedom From Hunger Committee» of F.A.O., it is intended to work along those lines during 1963.

2. THE DIGESTIBILITY OF RATIONS COMPOSED OF CANE TOPS, MOLASSES, AND SCUMS

D. H. PARISH

Introduction

In Mauritius dietary protein supplies for non-ruminants and human beings are expensive and generally imported, but even for ruminants, fodder is often scarce and of poor quality. Any local source of potentially cheap protein therefore must be exploited.

The only crop of importance in Mauritius is sugar cane, and although the green tops could be used for the preparation of leaf-protein (PIRIE (1960)), local cow-keepers take most of the available tops for fodder.

BONAME (1897) stressed the value of scums as a potential fodder and pointed out that they were used in the West Indies as food for oxen and pigs, whilst PRINSEN GEERLIGS (1921) speaks of the use of filter press cake as food for animals, and mentions that it was even eaten by the poor of the district.

PARISH (1960) drew attention to the fact that in Mauritius several thousand tons of plant protein were being dumped in fields in the form of filter cake, in an island whose population is chronically short of dietary protein.

This paper has led to attempts to prepare a high protein meal by centrifuging heated cane juice (ST. ANTOINE and VIGNES (1962)) and has resulted in renewed interest in scums as a feeding stuff (STAUB and DARNÉ (1962)).

As the by-products of the sugar industry which contain some protein are cane tops, filter muds, and molasses, the chemical composition of these materials has been studied.

Whilst molasses can be fed to all animals, the feeding of cane tops and filter muds must probably be restricted to ruminants. Preliminary studies on the digestibility of rations composed of cane tops, scums, and molasses, have therefore been made using sheep as the test animal.

Two sheep of equal weight (about 25 Kgs) were used in these trials, the harness equipment for collecting faeces and urine being of the type used by MAC DONALD (1962); the cages, which were made locally, were also based on his design.

All the rations were fed *ad lib.* and water was available at all times. In each trial the animals were kept on the experimental ration for a total of seventeen days, a ten day stabilization period followed by a seven-day collection period.

Results

Table 40 shows the crude protein content of cane tops from different varieties harvested at different periods of the crushing season.

Table 41 shows the average composition of Mauritius cane tops together with data obtained by BUTTERWORTH (1962) in Trinidad.

Table 42 shows the nitrogen content of local molasses from the sub-humid, humid, and superhumid zones. Samples of molasses were taken each fortnight from factories in the three zones and a weighted sample, depending on the molasses production of the factory concerned, was taken to give a final sample as representative as possible of local molasses.

Table 43 gives the results of the analyses carried out on factory filter muds produced in 1962. The samples were taken daily from each factory throughout most of the crushing season and bulked for weekly analyses.

The results of the digestibility trials are given in Tables 44, 45 and 46.

Table 40. The crude protein (%D.M.) content of cane tops from four commercial varieties at different times of harvest.

Varieties	*HARVEST PERIOD* Early	Mid.	Late	*Average per varieties*
E.1/37	5.75	5.19	5.94	5.63
M.134/32	7.06	5.06	4.96	5.70
B.37172	6.00	4.75	5.25	5.33
M.147/44	5.50	4.63	5.19	5.10
Average for harvest dates ...	6.06	4.94	5.38	

General Average: 5.45%

Table 41. Average composition of Cane Tops (%D.M.)

	Mauritius	*Trinidad*
Crude protein	5.4	6.3
Crude fibre	34.5	35.0
Ether extract	1.0	2.2
Ash	5.9	6.2
Nitrogen-free extract	53.2	50.3

Table 42. The nitrogen content % of local molasses.

	Sub-humid zone	*Humid zone*	*Super-Humid zone*
Lowest	0.69	0.45	0.58
Highest	0.83	0.68	0.82
Average	0.76	0.60	0.72

General Average: 0.67%

Table 43. The nitrogen content (%D.M.) of factory filter muds during 1962 and the average crude protein content (N × 6.25)

Factory	*Type of filter*	*Lowest*	*Average*	*Highest*	*Average crude protein content*
Mon Trésor ...	Rotary	1.71	1.78	1.86	11.1
Mon Désert ...	Rotary	1.78	1.88	2.04	11.8
Médine	Rotary	1.80	1.99	2.16	12.4
F.U.E.L.	Rotary	1.89	2.22	2.36	13.9
Rose Belle	Press	2.37	2.54	2.63	15.9
Highlands	Press	2.54	2.60	2.66	16.3

Table 44. Ration 1

48% scums (oven dried), 12% molasses, 40% cane tops

Analysis of ration: (% dry matter)

Crude protein	11.6
Crude fibre	20.4
Wax	6.3
Ash	12.1
N. F. E.	49.6
Organic matter	87.9

Sheep A	*Fed (grams)*	*Excreted (grams)*	*Digestibility Coefficient*	*T. D. N.*
Crude protein	833	647	22.3	2.58
Crude fibre	1465	912	37.7	7.69
Wax	452	320	29.2	4.14
Ash	869	686	21.2	—
N. E. F.	3561	1696	52.4	25.99
Organic matter	6311	3576	43.3	—
Total	7180	4262	—	40.40

Average daily food intake : 1026 grams

Sheep B				
Crude protein	833	614	26.3	3.05
Crude fibre	1465	979	33.2	6.77
Wax	452	348	23.0	3.26
Ash	869	700	19.4	—
N. F. E.	3561	1710	52.0	25.79
Organic matter	6311	3650	42.2	—
Total	7180	4350	—	38.87

Average daily food intake : 1026 grams

Table 45. Ration 2

38% scums (air dried), 14% molasses, 48% cane tops

Analysis of ration : (% dry matter)		*Mean Digestibility Coefficient*	*Mean T.D.N.*
Crude protein ...	9.7	33.1	3.21
Crude fibre ...	21.7	40.1	8.69
Wax	5.5	50.6	6.26
Ash	10.8	30.9	—
N.F.E.	52.3	56.7	29.65
Organic matter ...	89.2	49.7	—
Total			47.81

Average daily food intake : 960 grams.

Table 46. Ration 3

77% cane tops, 23% molasses

Analysis of ration: (% dry matter)

Crude protein	7.1
Crude fibre	28.0
Wax	2.5
Ash	8.9
N. F. E.	53.5
Organic matter	91.1

Sheep A	*Fed (grams)*	*Excreted (grams)*	*Digestibility Coefficient*	*T. D. N.*
Crude protein	432	265	39.7	2.81
Crude fibre	1704	967	43.3	12.12
Wax	122	79	35.2	1.98
Ash	542	251	53.7	—
N. F. E.	3257	1358	58.3	31.19
Organic matter	5545	2670	51.8	—
Total	6087	2920	—	48.10

Average daily food intake: 870 grams.

Sheep B				
Crude protein	432	272	37.0	2.63
Crude fibre	1704	991	41.8	11.70
Wax	122	84	31.1	1.75
Ash	542	253	53.3	—
N. F. E.	3257	1413	57.6	30.82
Organic matter	5545	2759	50.2	—
Total	6087	3012	—	46.90

Discussion

Composition of cane tops

The cane tops available after the removal of five million tons of cane would weigh about 1,400,000 tons green, or 360,000 tons dried.

As the average crude protein content of the tops varies between 5 – 6% on a dry matter basis, this means that in future about 20,000 tons of leaf protein will be available in Mauritius.

The varietal effect of the levels of crude protein occurring in cane tops is small, and the effects of harvest dates, although marked, are of little nutritional significance, all canes tops being low in protein and high in fibre.

The chemical composition of the tops available in Mauritius is almost identical with the tops available in Trinidad.

On the basis of chemical analyses, tops cannot be considered as anything but a low grade fodder.

Composition of filter mud cakes

The author, (PARISH, 1962) reviewing the data available on the composition of filter muds, concluded that those produced in Mauritius were amongst the richest in the world in terms of crude protein content, with an average content of 17%. However the results obtained in 1962 give an average crude protein content (excluding the filter press factories) of only about twelve per cent.

Whether the low levels obtaining in 1962 were the results of climatic conditions is not known, but 1962 was certainly an abnormal year for cane growth, there being an intense cyclone at the end of February, followed by one of the coldest and wettest cane ripening periods on record.

As would be expected, the filter press muds have a much higher content of crude protein, due to the generally lower level of fibre.

The total crude protein from the cane juices removed in the factory filters was formerly estimated at about 6000 tons, but on the results of the 1962 analyses, the figure would be much lower, being around 4000 tons.

The value of scums as a potential feeding stuff, if the 1962 analyses are taken into account, is lower than had been supposed.

The digestibility of rations composed of mixtures of dried cane tops, dried scums and molasses.

The results of the digestibility trials are given in tables 44, 45 and 46.

In Mauritius there is no shortage of roughage for animals, and molasses being cheap should be readily available for feeding. Much work has been done in the United States on the utilization of bagasse-molasses mixtures for fattening steers (BROWN 1962) and there is no doubt that if a high quality basic ration is available then these mixtures can find a place in the general farm economy.

The major livestock feeding problem in Mauritius is, however, one of a complete lack of cheap dietary protein.

If scums which are known to contain fairly large amounts of protein could be used, then, a valuable advance in the economy of this island would be made.

The results of these preliminary digestibility trials enable an indirect assessment of the digestibility of the protein in the scums to be made, by calculating the digestibility of the protein in the cane-tops: molasses ration, and correcting the digestibility of the protein in the scums: cane-tops: molasses ration for this.

If this is done then the crude protein in the air-dried scums has an apparent digestibility coefficient of about one-third, and for the oven-dried scums about one-seventh of the protein only is digested.

This would seem to indicate that, even when the scums are carefully dried, the digestibility of the protein is low and also, possibly, that the high levels of scums depressed the digestibility of the rations.

If the high scums: cane-tops: molasses ration (ration 1) is compared with the cane - tops molasses ration, it is seen that the digestible crude protein is actually less in the former, although it contained almost twice as much protein.

Total digestible nutrients are also lower in the scums ration, but feed intake was slightly higher.

It is known that the percentage of molasses in a diet affects the digestibility of the ration, and it could be that a higher level of molasses in the rations would have improved the value of the protein in the scums.

The results of this work indicate that the original aim of isolating the protein from the juice before liming is the most profitable line of research, as the protein of dried scums is of low digestibility.

Summary

The composition of cane tops and filter muds and molasses has been studied, and digestibility trials using sheep have been carried out on rations composed of these materials.

Results indicate that for the 1962 crushing season the level of the protein in scums was around 12% and that the digestibility of the protein is low.

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APPENDIX*

I. Description of cane sectors.

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V. Sugar manufactured % cane.

VI. Sugar manufactured per arpent.

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* *Grateful acknowledgment is made to the Secretary, Mauritius Chamber of Agriculture, for providing the necessary data to compile Tables II to VI.*

Table I. General description of sugar cane sectors of Mauritius.

SECTORS	WEST	NORTH	EAST	SOUTH	CENTRE
DISTRICT	Black River	Pamplemousses & Rivière du Rempart	Flacq	Grand Port & Savanne	Plaines Wilhems & Moka
ORIENTATION	Leeward	—	Windward	Windward	—
PHYSIOGRAPHY	Lowlands and Slopes	Lowlands	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 - 125) 90	(60 - 150) 90
MONTHS RECEIVING LESS THAN TWO INCHES RAIN	June to October	September to October	None		
AVERAGE TEMPERATURE °C — JAN.	27.0°	26.5°	25.5°	25.0°	23.5°
AVERAGE TEMPERATURE °C — JUL.	21.0°	20.5°	19.5°	19.0°	17.5°
CYCLONIC WINDS, greater than 30m.p.h. during 1 hour	December to May				
PEDOLOGY Great Soil Groups	Soil Families				
Low Humic Latosol	« Richelieu »	« Richelieu » « Réduit »	« Réduit » « Bonne Mère »	« Réduit »	« Réduit » « Ebène »
Humic Latosol	—	« Rosalie »		« Riche Bois »	« Riche Bois »
Humic Ferruginous Latosol	—	—	« Sans Souci »	« Belle Rive » « Sans Souci » « Midlands » « Chamarel »	« Belle Rive » « Sans Souci » « Midlands »
Latosolic Reddish Prairie	« Médine »	« Labourdonnais » « Mont Choisy »	« Mont Choisy »	« Labourdonnais » « Mont Choisy »	« Médine »
Latosolic Brown forest	—	—	« Rose Belle »	« Rose Belle » « Bois Chéri »	« Rose Belle » « Bois Chéri »
Dark Magnesium Clay	« Lauzun » « Magenta »	« Lauzun »	—	—	—
Grey Hydromorphic	« Balaclava »	« Balaclava » « St. André »	« Balaclava »	—	—
Low Humic Gley	—	—	« Valetta »	—	« Valetta » « Petrin »
Lithosol	—	« Melleville »	« Pl. des Roches » « Melleville »	« Melleville »	—
IRRIGATION	Common	Some	Rare		
APPROXIMATE AREA 1000 arpents — Sector	56	91	72	160	63
APPROXIMATE AREA 1000 arpents — Cane	11	53	44	63	26
CANE PRODUCTION 1000 metric tons	290	1,300	960	1,590	480
SUGAR PRODUCTION 1000 metric tons	35	154	109	177	57
SUGAR FACTORIES Production in 1000 metric tons (1961 - 1962)	Médine 34	Belle Vue 29 Mon Loisir 28 St. Antoine 25 Solitude 24 Beau Plan 22 The Mount 19	Union Flacq 62 Beau Champ 26 Constance 22	Savannah 27 Mon Trésor 23 Riche en Eau 21 Rose Belle 20 Union 19 Britannia 18 Bel Ombre 15 Benarès 12 St. Félix 12 Ferney 11	Mon Désert 31 Highlands 21 Réunion 19

Table II. Area under sugar cane in thousand arpents(1), 1956 - 1962.

Year	Area under cane Island	Area reaped					
		Island	West	North	East	South	Centre
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	195.31	183.12	9.62	50.37	40.93	58.77	23.43
1960	201.61	188.36	10.22	51.50	42.15	60.34	24.14
1961	201.17	187.29	10.33	50.71	41.98	60.29	23.98
1962(2)	202.00	192.88	10.42	52.51	42.61	62.38	24.97

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), 1956 - 1962.

Crop Year	No. of factories operating	Av. Pol.	Island	West	North	East	South	Centre
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	24	98.6	580.4	35.22	141.95	123.76	195.86	83.59
1960	23	98.0	235.8	18.06	75.22	50.02	72.24	20.24
1961	23	98.8	553.3	32.62	140.05	111.92	183.77	84.90
1962(2)	23	98.7	532.6	35.06	154.67	109.25	176.78	56.88

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), 1956 - 1962.

	1956	1957	1958	1959	1960	1961	1962(2)
ISLAND							
Millers	32.0	32.2	30.5	32.5	15.3	32.2	28.0
Planters	21.0	19.1	19.1	19.7	10.2	20.5	19.8
Average	26.3	25.6	24.5	25.9	12.7	26.4	24.0
WEST							
Millers	32.2	35.9	32.4	34.4	21.3	35.3	31.8
Planters	24.1	27.8	25.2	26.4	13.5	23.4	25.1
Average	27.0	30.8	28.0	29.3	16.2	27.8	27.9
NORTH							
Millers	32.2	29.0	29.5	30.0	19.2	29.2	31.1
Planters	22.2	16.9	17.5	17.1	11.4	20.6	21.4
Average	25.5	21.1	21.6	21.5	14.1	23.5	24.8
EAST							
Millers	31.6	31.5	31.5	33.0	16.3	32.7	29.0
Planters	19.2	17.2	16.8	19.2	9.3	17.9	17.1
Average	23.9	22.9	22.4	24.8	12.2	24.4	22.5
SOUTH							
Millers	31.7	32.8	30.3	32.3	14.6	31.7	27.7
Planters	20.9	22.0	22.5	21.4	9.4	20.8	20.7
Average	28.3	29.3	27.4	28.6	12.9	28.3	25.5
CENTRE							
Millers	32.7	34.1	30.6	34.9	9.7	36.7	22.1
Planters	19.0	20.4	19.9	22.0	7.6	23.7	16.0
Average	27.1	28.6	25.9	29.1	8.8	30.8	19.4

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), 1956 - 1962.**

Crop Year	Island	West	North	East	South	Centre
1956	12.95	13.17	13.59	12.84	12.47	12.89
1957	12.94	13.07	13.86	12.64	12.49	12.88
1958	12.14	12.36	12.95	12.22	11.53	12.12
1959	12.24	12.48	13.08	12.22	11.64	12.27
1960	9.84	10.94	10.34	9.73	9.29	9.56
1961	11.19	11.40	11.76	10.94	10.78	11.47
1962(2)	11.52	12.07	11.88	11.38	11.13	11.77

NOTE: (1) To convert into tons cane per ton sugar manufactured: divide 100 by above percentage.
(2) Provisional figures.

Table VI. Tons sugar manufactured per arpent reaped, 1956 - 1962.

	Island	West	North	East	South	Centre
1956	3.41	3.56	3.47	3.07	3.53	3.49
1957	3.31	4.02	2.92	2.89	3.66	3.68
1958	2.98	3.46	2.79	2.74	3.16	3.14
1959	3.17	3.66	2.81	3.03	3.33	3.57
1960	1.26	1.96	1.49	1.19	1.20	0.84
1961	2.95	3.16	2.76	2.67	3.05	3.54
1962(1)	2.76	3.36	2.95	2.56	2.83	2.28

NOTE (1) Provisional figures.

Table VII. **Monthly rainfall in inches. Average over whole sugar cane area of Mauritius.**

Crop year	GROWTH PERIOD (deficient months in italics)								NOV-JUNE (sum of monthly deficits)	MATURATION PERIOD (excess months in italics)				JULY-OCT. (sum of monthly excesses)
	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE		JULY	AUG.	SEPT.	OCT.	
Normals 1875-1949	3.77	7.09	11.04	11.06	12.09	9.50	6.91	4.96	15.00	4.59	4.15	2.90	2.81	2.50
Extremes to date	0.52 13.18	1.74 44.81	2.69 32.46	2.59 36.04	3.35 38.98	1.45 27.60	1.62 21.41	0.97 16.49	2.20 29.20	1.62 10.23	0.60 12.52	0.69 8.06	0.76 9.83	0.00 9.40
1947	10.36	*3.42*	*8.06*	*6.83*	*4.26*	9.69	*3.50*	5.66	22.57	2.76	3.91	2.20	1.24	0.00
1948	*2.52*	*6.83*	*8.23*	*5.10*	*8.04*	12.13	*2.61*	*1.80*	21.79	4.12	2.84	*3.34*	*2.98*	0.61
1949	4.01	*5.48*	*4.81*	16.71	*8.86*	*7.01*	*3.30*	10.09	17.17	4.11	1.91	1.39	1.39	0.00
1950	*3.34*	*3.42*	*10.20*	*5.21*	23.18	11.39	2.98	7.02	14.72	4.47	*5.02*	2.80	2.35	0.87
1951	*3.15*	*5.86*	11.65	*8.20*	*10.89*	*7.98*	7.00	7.26	7.43	*4.91*	*5.41*	*4.16*	*3.84*	3.87
1952	4.08	*2.22*	*5.26*	11.17	16.88	10.11	*5.69*	*4.86*	12.31	*8.22*	*5.20*	*3.47*	*3.13*	5.61
1953	6.06	18.05	11.65	*6.59*	*10.57*	*8.35*	11.95	12.75	7.14	*10.10*	*4.72*	*3.07*	2.68	6.25
1954	*3.76*	11.47	*5.00*	*7.96*	14.89	*6.20*	*6.49*	6.06	12.88	*6.44*	*5.04*	*4.11*	1.53	3.76
1955	4.81	*5.19*	*4.50*	23.28	19.60	10.97	8.83	7.73	8.44	*4.66*	3.85	*3.68*	1.12	0.85
1956	*3.03*	7.70	12.02	13.59	*10.60*	*4.14*	*5.93*	*4.90*	8.63	2.94	2.82	1.68	1.40	0.00
1957	*2.08*	8.11	*7.80*	*6.98*	*8.93*	10.66	*6.14*	*3.66*	14.24	3.55	2.54	*3.32*	0.96	0.42
1958	*2.09*	10.26	13.49	13.28	29.54	13.29	*4.95*	*2.20*	6.40	*8.22*	*4.51*	1.50	2.47	3.99
1959	*1.18*	*3.06*	13.64	*9.48*	13.93	4.81	*3.04*	*1.80*	19.91	3.07	*6.01*	2.67	*6.53*	5.59
1960	11.43	*6.58*	23.46	18.29	16.97	*1.73*	*3.23*	5.06	11.96	3.57	2.29	*8.06*	1.49	5.16
1961	*2.48*	*3.13*	*4.31*	*2.59*	*7.96*	*7.58*	*4.70*	7.13	28.71	*7.84*	*5.65*	2.05	2.26	4.75
1962	3.89	44.81	11.17	15.42	14.47	*5.12*	*5.62*	*5.49*	5.67	2.89	3.50	*3.79*	*5.28*	3.36

NOTE: To convert into millimetres, multiply by 25.4

Table VIII. Highest wind speed during one hour in miles(1). Average over Mauritius.

Crop Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
November	—	21	17	24	18	18	14	16	12	13	13	19	16	18
December	18	16	24	21	15	16	15	17	13	13	14	15	15	*43(2)*
January	27	26	21	22	18	28	13	20	20	14	17	*53(2)*	16	20
February	20	24	20	25	15	15	*34(2)*	16	19	18	17	*74(2)*	13	*59(2)*
March	20	17	18	25	15	15	29	19	18	*33(2)*	18	15	13	18
April	18	21	17	22	20	16	16	17	16	28	17	15	12	21
May	20	19	20	24	22	22	19	18	15	14	16	17	13	20
June	24	20	23	25	23	20	22	17	13	14	17	17	19	17
July	21	23	21	20	24	16	17	15	12	11	16	15	19	19
August	18	19	24	25	24	23	20	14	17	20	18	16	20	22
September	20	21	21	21	20	19	19	17	17	17	17	20	21	18
October	18	19	20	20	19	20	14	18	15	17	18	18	19	22

NOTE: (1) To convert into knots, multiply by 0.87

„ „ kilometres/hr., multiply by 1.61

„ „ metres/sec., multiply by 0.45

(2) Cyclonic wind above 30 miles per hour.

Table IX. Highest wind speed during one hour in miles in different sectors. Cyclone years.

	West	North	East	South	Centre
February 1955	—	30	—	37	35
March 1958	34	29	22	35	31
January 1960 *Alix*	60	48	43	60	—
February 1960 *Carol*	83	82	78	74	55
December 1961 *Beryl*	49	45	33	51	40
February 1962 *Jenny*	64	74	49	58	54

Table X. Variety trend in Mauritius, 1950 - 1962.

% Area cultivated (Estate lands).

	M. 134/32	M. 112/34	M. 147/44	M. 31/45	M. 202/46	M. 93/48	M. 253/48	Other M. seedlings	Ebène 1/37	Ebène 50/47	B. 3337	B. 34104	B. 37161	B. 37172	Others
1950	91	2	—	—	—	—	—	5	1	—	—	—	—	—	1
1951	92	2	—	—	—	—	—	4	2	—	—	—	—	—	—
1952	90	2	—	—	—	—	—	3	4	—	—	—	—	—	1
1953	86	2	—	—	—	—	—	3	8	—	—	—	—	—	1
1954	83	2	—	—	—	—	—	3	9	—	1	—	1	—	1
1955	74	2	—	—	—	—	—	2	15	—	3	—	2	1	1
1956	66	2	1	1	—	—	—	3	17	—	4	—	3	2	1
1957	55	2	6	3	—	—	—	1	21	—	4	1	3	3	1
1958	43	2	10	4	—	—	—	2	24	—	5	1	3	5	1
1959	33	2	15	5	—	—	—	1	25	—	5	2	3	8	1
1960	25	2	19	5	—	—	—	1	26	—	6	2	3	10	1
1961	19	1	23	5	2	1	1	—	24	1	7	2	2	11	1
1962	13	1	26	4	4	3	1	—	21	3	7	3	2	11	1

Table XI. Percentage annual plantations under different cane varieties on sugar estates, 1958 to 1962.

Years / Varieties	Island					West					North					East					South					Centre				
	1958	1959	1960	1961	1962	1958	1959	1960	1961	1962	1958	1959	1960	1961	1962	1958	1959	1960	1961	1962	1958	1959	1960	1961	1962	1958	1959	1960	1961	1962
M.134/32	3.0	1.2	2.8	1.0	1.7	6.2	—	—	—	—	8.1	2.7	11.3	5.0	8.0	0.5	0.2	0.4	—	—	3.0	1.5	1.2	0.4	1.0	0.4	0.4	0.3	0.1	—
M.147/44	28.9	32.7	30.0	30.1	28.9	25.2	20.5	17.8	17.8	44.1	35.3	50.4	49.4	55.4	53.3	34.8	39.0	27.8	34.4	32.5	25.1	31.2	27.9	27.9	23.6	22.0	8.0	16.4	8.9	3.6
M.31/45	8.0	3.8	2.6	0.8	1.2	13.1	4.8	7.4	—	—	4.8	4.9	6.7	3.3	1.9	15.7	5.7	3.8	1.0	2.7	7.3	2.4	0.3	0.2	0.8	2.8	3.3	—	—	1.0
M.202/46	—	—	7.7	12.6	16.1	—	—	9.2	18.3	15.6	—	—	6.2	11.2	12.1	—	—	4.9	15.3	26.3	—	—	10.4	11.5	15.7	—	—	5.0	10.8	8.1
M.93/48	—	—	2.9	11.6	20.4	—	—	1.5	—	3.3	—	—	0.9	2.9	3.1	—	—	1.8	12.8	28.6	—	—	5.3	18.7	24.0	—	—	0.4	5.5	27.4
M.253/48	—	—	2.1	3.6	3.7	—	—	20.2	12.8	7.4	—	—	0.2	3.1	3.7	—	—	3.6	4.0	3.3	—	—	0.6	2.2	3.1	—	—	0.7	3.4	3.6
Ebène 1/37	28.9	24.3	14.5	12.7	3.0	—	—	—	—	—	5.2	7.2	3.2	3.3	—	27.5	25.2	17.8	11.7	—	30.5	30.2	14.5	12.3	1.2	57.5	35.2	—	30.3	16.4
Ebène 50/47	—	—	—	7.3	12.6	—	—	—	3.1	2.9	—	—	—	0.5	6.3	—	—	—	6.4	4.4	—	—	—	3.9	12.5	—	—	—	26.3	35.5
B.3337	4.8	6.9	10.3	6.0	2.4	—	—	—	—	—	—	—	—	—	—	1.7	6.4	10.2	5.7	0.1	7.6	8.3	15.2	6.9	5.4	8.4	14.7	—	12.9	1.7
B.34104	2.9	2.8	2.5	4.0	3.5	32.0	29.6	15.9	26.7	24.5	5.6	2.9	2.1	0.6	2.2	0.1	—	0.3	1.5	0.9	3.2	2.1	2.9	4.3	2.5	2.7	1.2	—	0.6	0.6
B.37161	0.9	—	—	—	—	1.1	—	—	—	—	4.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
B.37172	20.6	21.0	16.5	8.7	5.4	13.3	30.9	26.4	18.7	1.3	32.3	25.7	19.6	14.0	8.6	18.8	15.9	17.4	6.1	0.6	22.3	19.8	18.6	9.2	9.4	3.0	23.0	0.5	0.6	0.2
Other varieties	1.2	6.8	8.1	1.6	1.1	6.3	14.2	—	2.6	0.9	1.9	5.1	0.4	0.7	0.8	0.7	7.0	12.0	1.2	0.6	0.7	4.2	3.1	2.5	0.8	2.6	14.1	—	0.6	2.9
Total area arpents	13011	13203	14321	15451	13406	403	512	729	1042	1203	2573	2579	2796	2559	2251	2964	2620	2834	3071	2800	5536	5565	6058	6318	5225	1939	1927	1905	2461	2077

Table XII. 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
1960	81.9	82.2	82.7	78.3	75.2	84.8
1961	85.4	78.5	84.4	85.1	86.3	86.7
1962	82.9	72.8	83.3	82.1	84.6	82.1

NOTE: The weight of cane produced on estates in 1962 was: virgins 473,259 tons; ratoons 2,272,404.

Table XIII. Average yields of virgin and ratoon canes on estates.
Tons per arpent. A: 1956 - 1961(1) B: 1962.

	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
Virgin	35.6	34.8	43.2	37.9	34.5	39.8	38.3	39.0	33.9	33.1	35.9	25.5
1st Ratoon	34.1	29.5	36.5	34.0	32.0	32.9	35.0	31.4	33.7	28.7	35.7	22.0
2nd ,,	32.6	28.6	34.1	31.3	31.4	32.2	33.2	30.5	32.0	27.8	34.2	22.3
3rd ,,	31.7	27.3	32.7	28.1	29.8	31.1	32.4	28.2	31.3	26.7	33.5	21.3
4th ,,	30.6	27.0	30.7	28.0	28.7	31.0	30.7	27.4	30.4	27.3	33.3	20.0
5th ,,	29.9	24.7	31.4	27.5	28.9	26.8	29.1	24.3	29.6	25.2	32.3	20.0
6th ,,	29.3	24.3	29.8	25.9	28.2	26.4	28.6	23.2	29.8	25.2	30.9	19.9

NOTE: (1) 1960 excluded.

Table XIV. Evolution of 1962 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
	7th July						*14th July*						*21st July*						*28th July*					
Cane crushed (1000 m. tons)	29	—	—	8	21	—	140	9	—	51	80	—	297	23	13	100	150	11	497	37	48	149	220	43
Sugar manufactured % cane	10.00	—	—	9.80	10.20	—	10.00	10.41	—	9.92	10.10	—	10.21	10.63	10.48	10.01	10.20	10.87	10.43	10.75	10.74	10.23	10.31	11.12
Sugar manufactured (1000 m. tons)	2.9	—	—	0.8	2.1	—	14.0	0.9	—	5.0	8.1	—	30.3	2.4	1.4	10.0	15.3	1.2	52.2	4.0	5.3	15.3	22.8	4.8
	4th August						*11th August*						*18th August*						*25th August*					
Cane crushed (1000 m. tons)	727	51	103	198	302	73	981	64	177	248	384	108	1,155	74	232	280	438	131	1,425	89	310	333	525	168
Sugar manufactured % cane	10.64	10.95	10.99	10.43	10.43	11.26	10.83	11.17	11.23	10.68	10.55	11.39	10.97	11.32	11.43	10.79	10.60	11.48	11.17	11.50	11.67	10.96	10.78	11.65
Sugar manufactured (1000 m. tons)	77.3	5.6	11.1	20.7	31.6	8.3	106.3	7.2	19.9	26.6	40.6	12.0	126.6	8.3	26.5	30.3	46.4	15.0	159.2	10.2	36.2	36.6	56.6	19.6
	1st September						*8th September*						*15th September*						*22nd September*					
Cane crushed (1000 m. tons)	1,655	102	373	377	604	199	1,905	116	451	422	684	232	2,161	129	523	471	771	267	2,401	143	601	517	843	298
Sugar manufactured % cane	11.26	11.64	11.79	11.07	10.82	11.72	11.35	11.76	11.88	11.17	10.89	11.76	11.44	11.83	11.99	11.27	10.98	11.83	11.50	11.90	12.06	11.34	11.04	11.86
Sugar manufactured (1000 m. tons)	186.5	11.9	44.1	41.8	65.4	23.3	216.3	13.6	53.6	47.2	74.5	27.4	247.2	15.2	62.7	53.1	84.7	31.5	276.2	17.9	72.4	58.6	93.0	35.3
	29th September						*6th October*						*13th October*						*20th October*					
Cane crushed (1000 m. tons)	2,653	157	677	562	926	331	2,903	172	752	608	1,007	364	3,150	185	829	655	1,085	396	3,374	199	899	697	1,157	422
Sugar manufactured % cane	11.55	11.96	12.07	11.40	11.07	11.89	11.59	12.03	12.09	11.46	11.12	11.89	11.62	12.07	12.11	11.51	11.17	11.88	11.64	12.10	12.10	11.53	11.20	11.85
Sugar manufactured (1000 m. tons)	306.5	18.8	81.7	64.1	102.5	39.4	336.5	20.6	91.0	69.7	112.0	43.2	366.1	22.3	100.3	75.4	121.1	47.0	392.8	24.0	108.8	80.4	129.6	50.0
	27th October						*3rd November*						*10th November*						*17th November*					
Cane crushed (1000 m. tons)	3,559	210	956	739	1,227	427	3,766	223	1,015	778	1,295	454	3,978	237	1,086	822	1,363	470	4,168	252	1,149	861	1,429	477
Sugar manufactured % cane	11.65	12.11	12.09	11.55	11.21	11.85	11.65	12.13	12.07	11.55	11.21	11.83	11.63	12.12	12.05	11.52	11.20	11.80	11.60	12.11	12.01	11.48	11.19	11.78
Sugar manufactured (1000 m. tons)	414.6	25.5	115.6	85.4	137.5	50.6	438.8	27.2	122.6	90.0	145.2	53.8	462.6	288	130.9	94.7	152.7	55.5	483.5	30.5	138.0	98.9	159.9	56.2
	24th November						*1st December*						*8th December*						*Total crop production (preliminary figs.)*					
Cane crushed (1000 m. tons)	4,354	266	1,212	901	1,492	483	4,508	281	1,268	938	1,538	483	4,605	290	1,302	960	1,570	483	4,624	290	1,302	960	1,589	483
Sugar manufactured % cane	11.57	12.11	11.96	11.45	11.17	11.77	11.54	12.09	11.90	11.40	11.18	11.77	11.53	12.07	11.88	11.38	11.15	11.77	11.52	12.07	11.88	11.38	11.13	11.77
Sugar manufactured (1000 m. tons)	503.9	32.2	144.9	103.1	166.8	56.9	520.4	33.9	150.8	106.9	171.9	56.9	530.8	35.1	154.6	109.2	175.0	56.9	532.6	35.1	154.6	109.2	176.8	56.9

Table XV. Evolution of cane quality during 1962 sugar crop.

Week Ending	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
21st July	12.22	10.29	12.85	10.79	12.35	10.48	11.96	10.03	12.15	10.26	12.68	10.87
28th ,,	12.53	10.75	12.99	10.95	12.68	10.84	12.36	10.67	12.35	10.52	12.89	11.21
4th August	12.80	11.03	13.19	11.48	13.27	11.24	12.56	11.01	12.50	10.67	13.00	11.44
11th ,,	13.03	11.37	13.35	12.00	13.58	11.55	12.82	11.31	12.72	11.03	13.17	11.67
18th ,,	13.34	11.63	13.76	12.30	13.88	12.00	13.09	11.60	12.85	11.04	13.99	11.97
25th ,,	13.63	11.95	13.81	12.39	14.21	12.39	13.33	11.88	13.19	11.37	13.75	12.25
1st September	13.47	11.87	13.80	12.59	14.12	13.33	13.27	11.83	12.97	11.25	13.56	12.13
8th ,,	13.61	12.00	13.88	12.66	14.20	12.45	13.39	11.97	13.19	11.47	13.47	12.00
15th ,,	13.74	12.13	14.06	12.45	14.36	12.62	13.56	12.16	13.36	11.65	13.59	12.18
22nd ,,	13.69	12.10	14.04	12.48	14.12	12.40	13.51	12.14	13.30	11.59	13.64	12.21
29th ,,	13.66	11.99	14.09	12.56	14.14	12.27	13.42	12.05	13.27	11.55	13.61	12.12
6th October	13.71	12.07	14.32	12.80	14.13	12.35	13.53	12.13	13.37	11.67	13.43	11.90
13th ,,	13.70	12.01	14.15	12.58	14.14	12.26	13.61	12.03	13.40	11.63	13.31	11.74
20th ,,	13.47	11.79	14.06	12.60	13.84	12.03	13.35	11.86	13.20	11.47	13.11	11.46
27th ,,	13.35	11.70	13.78	12.32	13.89	12.02	13.20	11.72	13.00	11.34	13.04	11.57
3rd November	13.25	11.63	13.86	12.42	13.61	11.75	13.02	11.55	13.06	11.45	12.85	11.40
10th ,,	12.93	11.24	13.34	11.94	13.48	11.58	12.55	11.10	12.64	10.94	12.44	10.93
17th ,,	12.79	11.30	13.43	11.99	13.20	11.40	12.38	10.92	12.60	10.84	11.94	10.21
24th ,,	12.60	10.88	13.57	12.08	13.01	11.08	11.88	10.38	12.46	10.67	12.91	11.31
1st December	12.56	10.78	13.16	11.66	12.68	10.79	11.81	10.27	12.72	10.89	—	—
8th ,,	11.89	10.20	—	—	—	—	—	—	11.89	10.20	—	—
15th ,,	11.56	9.82	—	—	—	—	—	—	11.56	9.82	—	—
22nd ,,	11.04	8.89	—	—	—	—	—	—	11.04	8.89	—	—

NOTE : *A = Sucrose % cane.*

B = 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, 1948 - 1962.

YEARS	Island		West		North		East		South		Centre	
	A	B	A	B	A	B	A	B	A	B	A	B
1948	132	167.6	140	7.3	122	42.1	136	33.6	140	60.0	125	24.6
1949	133	176.5	142	7.7	128	44.0	129	37.0	140	62.4	127	25.4
1950	141	184.6	130	10.1	140	47.9	145	35.1	144	65.0	135	26.5
1951	154	197.8	150	10.3	169	52.0	159	40.3	140	65.8	132	29.4
1952	149	192.4	151	9.9	149	50.5	155	40.2	154	63.4	131	28.4
1953	158	205.7	162	11.8	167	57.7	161	42.5	153	66.0	145	27.7
1954	140	214.1	142	11.7	137	60.5	138	42.9	147	68.7	134	30.3
1955	133	222.6	134	12.8	122	64.2	140	41.5	140	71.6	127	32.5
1956	136	227.3	129	12.7	137	62.7	138	43.4	138	76.2	128	32.3
1957	128	237.5	144	13.3	104	68.2	133	42.9	141	78.6	129	34.5
1958	131	232.2	131	13.7	109	68.2	142	42.9	142	76.4	135	30.9
1959	134	248.4	127	15.5	106	71.8	152	46.7	148	79.4	136	35.1
1960	113	148.3	110	10.5	116	43.9	123	29.5	118	46.2	81	18.2
1961	150	230.2	147	13.6	126	66.2	160	44.6	165	72.2	154	33.6
1962	140	231.4	158	12.9	136	66.9	159	42.2	141	78.8	111	30.6

Table XVII. Summary of chemical control data 1962.

(i) CANE CRUSHED AND SUGAR PRODUCED.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau
CRUSHING PERIOD	From	6/7	19/7	27/7	13/7	30/7	20/7	3/8	5/7	6/7	4/7	6/7	28/7
	To	8/12	7/12	7/12	4/12	11/12	3/12	29/11	7/12	5/12	13/12	8/12	24/11
	No. of crushing days	129	114	109	117	112	112	96	129	126	136	130	123
	No. of crushing hours per day	19.42	21.64	20.73	18.95	20.48	22.37	20.42	20.00	18.10	18.49	16.70	18.22
	Hours stoppage per day	1.51	0.80	0.42	1.00	2.59	0.70	1.04	0.90	1.77	0.19	0.45	0.65
	Overall time Efficiency	92.8	96.4	98.0	95.0	88.8	97.0	95.1	83.3	90.2	99.0	97.4	96.3
CANE CRUSHED (Metric Tons)	Factory	137,174	45,288	58,912	113,324	103,334	81,592	142,742	88,338	314,383	162,203	64.724	164,324
	Planters	153,277	171,433	120,744	46,155	157,513	168,477	91,990	141,673	169.900	83.703	48.770	24,383
	Total	290,451	216,721	179,656	159,479	260,847	250.069	234,732	230,011	484.283	245.906	113,494	188.707
	Factory % Total	47.2	20.9	32.8	71.1	39.6	32.6	60.8	38.4	64.9	66.0	57.0	87.0
	Per day	2,252	1,901	1,648	1,363	2,339	2,233	2,445	1,783	3,844	1,808	873	1,534
	Per hour actual crushing	116.0	87.8	79.5	71.9	114.3	99.8	119 7	89.0	212.3	97.8	52.3	87.3
VARIETIES CRUSHED (Factory)	M.134/32 per cent	21.6	23.8	29.9	12.3	46.6	10.6	26.4	9.2	8.2	4.2	3.1	2.3
	Ebène 1/37 per cent	1.0	0.3	2.3	9.3	0.5	—	2.2	4.8	27.2	16.6	12.5	20.1
	M.147/44 per cent	20.9	38.2	41.1	45.1	34.0	49.1	49.3	61.7	29 5	32.2	37.7	32.8
	M.31/45 per cent	3.8	1.4	3.0	6.7	1.7	4.0	2.0	4.6	4.6	7.1	7.0	3.9
	B.3337 per cent	—	—	—	0.1	—	—	—	—	5.9	2.8	6.2	13.3
	B.37172 per cent	14.3	19.9	8.4	17.4	7.7	· 31.5	12.9	14.4	7.6	25.3	10.8	18.4
	Other varieties	23.6	2.5	8.9	5.6	8.2	1.6	6.3	0.3	4.5	6.5	16.0	4.5
SUGAR PRODUCED (Metric tons)	Raw Sugar	35,057	25,118	21,200	18,713	31,376	23,019	29,391	26,475	55,490	27,286	3,767	19,535
	White Sugar	—	—	—	—	—	5,854	—	—	—	—	7,645	—
	Total Sugar	35,057	25,118	21,200	18,713	31,376	28,873	29,391	26,475	55,490	27,286	11,412	19,535
	Tons Sugar 96° Pol.	35,968	25,821	21,772	19,274	32,223	29,710	30,126	27,216	56,877	28,077	11,789	20,120
CANE/SUGAR RATIO	Tons cane per ton sugar made	8.3	8.6	8.4	8.5	8.3	8.7	8.0	8.7	8.7	9.0	10.0	9.6
	„ „ „ „ „ of 96° Pol.	8.1	8.4	8.2	8.3	8.1	8.4	7.8	8.5	8.5	8.6	9.6	9.3

		Mon Tresor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CRUSHING PERIOD	From	30/7	9/7	6/7	16/7	9/7	9/7	6/7	26/7	20/7	21/7	17/7	—
	To	8/12	8/12	1/11	14/11	28/11	30/11	11/12	22/12	26/11	13/11	20/10	—
	No. of crushing days	136	129	94	102	119	122	133	125	108	95	81	116
	No. of crushing hours per day	16.40	19.50	18.25	16.90	15.49	17.34	19.17	20.00	17.20	21.27	20.40	19.08
	Hours stoppage per day	1.14	0.56	0.84	0.75	0.26	0.53	1.10	2.63	0.60	0.88	0.72	1.03
	Overall time Efficiency	94.5	97.1	95.6	95.6	98.4	97.1	84.5	91.1	96.8	96.0	96.6	94.9
CANE CRUSHED (Metric Tons)	Factory	177,401	180,315	96,090	106,667	103,519	173,861	52,450	82,414	91,385	83,750	128,799	2,752,989
	Planters	36,749	57,428	40,155	18,955	1,647	209	80,362	78,612	71,846	51,616	55,901	1,871,498
	Total	214,150	237,743	136,245	125,622	105.166	174,070	132,812	161,026	163,231	135,366	184,700	4,624,487
	Factory % Total	82.8	75.8	70.5	84.9	98.4	99.9	39.4	51.2	56.0	61.9	69.7	59.5
	Per day	1,575	1,843	1,449	1,232	884	1,427	999	1,288	1,511	1,425	2,280	1,736
	Per hour actual crushing	96.0	94.5	79.4	72.9	57.0	82.3	52.0	64.4	87.9	67.0	111.8	91.0
VARIETIES CRUSHED (Factory)	M.134/32 per cent	10.8	29.9	0.7	11.0	8.4	22.0	2.1	21.3	4.9	—	3.7	13.7
	Ebène 1/37 per cent	22.7	12.5	46.2	27.5	8.3	14.4	11.3	4.0	30.8	49.9	56.4	17.7
	M.147/44 per cent	23.2	27.4	9.0	19.9	21.2	22.6	42.2	33.5	29.0	3.2	20.8	30.6
	M.31/45 per cent	2.5	1.9	4.8	8.6	6.0	5.1	5.3	5.3	1.2	—	0.1	3.9
	B.3337 per cent	1.6	1.7	28.4	25.5	2.3	4.7	5.0	1.7	17.9	13.1	6.3	5.5
	B.37172 per cent	16.0	17.6	0.9	1.2	38.6	12.0	18.5	16.8	3.6	—	—	13.6
	Other varieties	17.0	4.5	1.3	1.9	10.5	5.8	6.7	9.6	4.7	4.4	0.1	6.8
SUGAR PRODUCED (Metric tons)	Raw Sugar	26,161	27,980	15,365	14,375	6,108	19,039	13,774	17,152	18,440	16,600	21,868	513,289
	White Sugar	—	—	—	—	5,881	—	—	—	—	—	—	19,380
	Total Sugar	26,161	27,980	15,365	14,375	11,989	19,039	13,774	17,152	18,440	16,600	21,868	532,669
	Tons Sugar 96° Pol.	26,815	28,707	15,779	14,792	12,385	19,572	14,173	17,649	18,710	18,956	22,415	548,926
CANE/SUGAR RATIO	Tons cane per ton sugar made	8.2	8.5	8.9	8.7	8.8	9.1	9.6	9.4	8.9	8.2	8.5	8.7
	„ „ „ „ „ of 96° Pol.	8.0	8.0	8.6	8.5	8.5	8.9	9.4	9.1	8.6	8.0	8.3	8.4

Table XVII. Summary of chemical control data 1962.

(a) CANE, BAGASSE AND JUICES.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau
CANE	Sucrose per cent	13.61	13.46	13.53	13.19	14.14	13.65	14.15	13.10	12.81	12.70	12.20	12.03
	Fibre per cent	13.86	14.02	13.84	13.88	14.95	16.11	13.75	14.91	13.52	13.93	14.41	14.38
BAGASSE	Sucrose per cent	2.31	2.35	2.44	1.91	2.52	1.95	1.94	2.52	2.03	1.52	2.38	1.63
	Moisture per cent	49.19	48.18	47.97	47.68	47.99	50.17	48.67	46.70	49.20	47.40	47.10	48.66
	Fibre per cent	47.54	48.66	48.58	49.48	48.31	47.15	48.79	49.93	48.00	50.27	49.66	49.15
	Weight per cent cane	29.2	28.8	28.5	28.1	31.0	34.2	28.2	29.9	28.1	27.7	29.0	29.3
1st EXPRESSED JUICE	Brix (B_1)	19.75	20.15	19.99	18.98	20.54	20.82	20.17	19.42	18.52	18.70	15.57	17.85
	Gravity Purity	87.5	87.5	86.8	89.5	88.4	88.3	88.8	87.8	87.7	88.1	87.4	88.4
	Reducing sugar/sucrose ratio	3.2	4.4	3.5	3.1	2.6	2.8	2.5	3.6	2.4	2.8	3.7	2.7
LAST EXPRESSED JUICE	Brix	3.03	4.45	3.52	1.98	3.02	4.59	2.83	3.85	3.76	2.62	3.58	3.40
	Apparent Purity	70.5	74.4	70.8	67.7	68.0	72.9	76.6	74.3	72.9	65.6	73.2	74.4
MIXED JUICE	Brix	15.04	15.61	15.52	14.63	14.76	16.48	14.47	13.81	15.11	13.05	13.03	13.24
	Gravity Purity	85.6	84.3	84.7	86.3	85.8	85.3	86.6	85.7	85.6	85.2	84.2	84.9
	Reducing sugar/sucrose ratio	3.6	5.1	4.0	3.7	3.2	3.5	3.2	4.3	3.0	3.2	4.6	3.5
	Gty. Pty. drop from 1st expressed juice	1.9	3.2	2.1	3.2	2.6	3.0	2.1	2.1	2.1	2.9	3.2	3.5
ABSOLUTE JUICE	Brix (B_A)	18.66	18.69	18.73	17.95	19.64	19.25	19.03	18.15	17.44	17.49	17.07	16.63
	B_A/B_1	0.945	0.928	0.937	0.946	0.956	0.925	0.943	0.930	0.942	0.935	—	0.931
	Gravity Purity	84.7	83.7	83.9	85.3	84.7	84.6	86.2	84.9	84.9	84.4	83.5	84.4
CLARIFIED JUICE	Brix	14.20	15.59	15.07	14.49	14.42	15.91	14.30	13.39	15.01	12.90	13.00	13.07
	Gravity Purity	—	—	84.6	86.6	86.3	85.4	—	86.0	86.0	85.3	84.2	84.8
	Reducing sugar/sucrose ratio	3.6	4.9	4.5	3.7	3.1	3.5	—	4.3	2.9	3.3	4.5	3.4

		Mon Trésor	Savannah	Rose Belle	Britannia	Benarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
CANE	Sucrose per cent	13.81	13.48	12.94	12.75	13.11	12.62	12.40	12.56	12.89	13.68	13.30	13.19
	Fibre per cent	12.80	14.03	12.89	14.76	14.46	12.70	14.40	13.81	13.33	11.49	11.33	13.85
BAGASSE	Sucrose per cent	2.41	2.42	2.73	1.97	2.12	1.88	2.38	2.30	2.23	2.19	2.40	2.18
	Moisture per cent	47.76	47.80	50.19	45.60	45.82	49.11	50.00	49.30	52.46	50.50	50.07	47.08
	Fibre per cent	48.99	48.90	46.30	51.48	51.24	48.10	46.84	47.60	44.56	46.48	46.76	48.30
	Weight per cent cane	26.0	28.6	27.9	28.6	28.2	26.4	30.7	29.0	29.9	22.8	24.2	28.7
1st EXPRESSED JUICE	Brix (B_1)	19.45	18.75	18.17	17.98	18.61	17.98	16.18	17.73	18.41	18.61	18.24	18.93
	Gravity Purity	88.8	88.7	89.2	90.7	88.7	88.9	88.2	87.4	88.6	90.3	89.6	88.4
	Reducing sugar/sucrose ratio	2.6	3.8	2.2	2.8	2.5	2.9	2.9	2.8	1.9	2.2	2.2	2.9
LAST EXPRESSED JUICE	Brix	3.75	3.37	3.71	2.81	2.84	2.15	2.49	3.95	3.39	1.54	3.68	3.29
	Apparent Purity	74.1	74.2	77.8	67.6	72.3	67.5	76.3	74.7	74.8	73.3	75.6	72.4
MIXED JUICE	Brix	14.83	13.65	13.84	12.81	13.31	13.56	13.11	13.86	14.41	13.67	14.21	14.33
	Gravity Purity	86.7	86.7	87.4	87.9	86.9	86.6	85.3	85.0	87.1	87.2	87.1	85.9
	Reducing sugar/sucrose ratio	3.3	5.3	2.9	3.3	2.5	3.5	3.4	3.3	2.2	2.5	2.6	3.4
	Gty. Pty. drop from 1st expressed juice	2.1	2.0	1.8	2.8	1.8	2.3	2.9	2.4	1.5	3.1	2.5	2.5
ABSOLUTE JUICE	Brix (B_A)	18.42	18.24	17.12	17.24	17.82	16.88	17.09	17.29	17.22	17.87	17.33	17.98
	B_A/B_1	0.947	0.972	0.940	0.960	0.958	0.939	—	0.975	0.935	0.960	0.950	0.950
	Gravity Purity	86.0	86.0	86.8	86.7	86.0	85.7	84.7	84.3	86.4	86.5	86.6	85.2
CLARIFIED JUICE	Brix	14.47	13.81	13.77	13.02	13.37	13.52	13.02	13.78	14.40	13.41	13.92	14.11
	Gravity Purity	87.1	86.9	—	87.8	86.5	87.4	85.6	85.1	88.3	87.8	87.6	87.6
	Reducing sugar/sucrose ratio	2.9	5.2	3.0	4.0	2.5	3.3	3.1	3.2	2.3	2.7	2.6	3.3

Table XVII. Summary of chemical control data 1962.

(iii) FILTER CAKE, SYRUP, pH, FINAL MOLASSES, SUGAR.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney
FILTER CAKE	Sucrose per cent	1.18	2.10	2.58	1.73	3.28	2.06	1.11	1.10	1.13	1.00	6.96
	Weight per cent cane	3.1	3.1	4.3	3.1	3.7	4.1	3.1	3.0	3.2	3.8	2.5
SYRUP	Brix	58.2	55.0	58.3	60.7	59.8	65.3	60.1	60.2	56.6	55.7	57.0
	Gravity Purity	—	—	84.4	86.1	86.1	—	—	85.6	85.9	85.6	85.9
	Reducing sugar/sucrose ratio	3.8	4.5	4.5	3.7	3.1	3.3	—	3.4	2.8	3.3	4.4
pH VALUES	Limed juice	7.3	—	8.1	8.3	7.9	6.9	—	8.1	8.6	8.2	8.6
	Clarified juice	6.9	7.0	7.3	7.0	6.9	6.8	7.1	6.7	7.0	7.0	6.9
	Filter Press juice	7.8	—	8.7	—	—	—	—	6.7	7.2	—	—
	Syrup	—	—	6.9	6.5	6.4	—	—	6.5	6.9	6.8	6.8
FINAL MOLASSES	Brix	99.4	98.3	96.3	97.3	96.5	93.4	95.1	93.4	97.5	95.3	96.3
	Sucrose per cent	34.3	35.3	33.8	34.8	36.6	35.1	34.3	30.9	35.0	34.8	32.4
	Reducing sugar per cent	14.7	16.2	18.2	13.8	12.4	10.4	14.7	15.5	10.5	14.7	15.3
	Total sugars*	49.0	51.5	51.9	48.6	49.0	45.5	49.0	46.4	45.5	49.5	47.8
	Gravity Purity	34.5	35.9	35.1	35.8	37.9	37.6	36.1	33.1	35.9	36.5	33.7
	Reducing sugar/sucrose ratio	42.9	45.8	53.7	39.7	33.7	29.5	42.7	50.3	30.0	42.1	47.3
	Weight per cent cane at 95° Brix	2.79	3.02	2.93	2.62	2.95	3.24	2.79	2.82	2.45	2.88	2.93
SUGAR MADE†	White sugar recovered per cent cane	—	—	—	—	—	2.34	—	—	—	—	6.74
	Raw ,, ,, ,, ,,	12.07	11.59	11.80	11.73	12.03	9.21	12.52	11.51	11.46	11.10	3.32
	Total ,, ,, ,, ,,	12.07	11.59	11.80	11.73	12.03	11.55	12.52	11.51	11.46	11.10	10.06
	Average Pol. of sugars	98.50	98.66	98.60	98.84	98.58	98.82	98.37	98.73	98.41	98.81	99.16
	Total sucrose recovered per cent cane	11.89	11.43	11.64	11.60	11.86	11.41	12.32	11.36	11.28	10.97	9.97
	Moisture content of raw sugar per cent	0.22	0.35	0.39	0.24	0.35	—	0.37	0.29	0.40	0.29	0.42
	Dilution indicator.	17.2	35.4	37.9	26.1	32.7	—	29.1	29.9	33.6	31.5	28.4

		Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
FILTER CAKE	Sucrose per cent	0.70	2.89	2.00	6.09	1.54	2.36	2.28	6.86	7.40	7.20	5.02	3.15	2.38
	Weight per cent cane	5.1	3.4	2.2	1.7	3.7	3.8	2.2	1.8	2.0	2.0	2.0	4.1	3.2
SYRUP	Brix	53.9	65.7	55.5	64.9	67.5	63.4	58.0	56.2	60.2	56.0	63.0	65.3	59.8
	Gravity Purity	85.7	87.4	87.1	--	88.1	87.0	87.2	85.7	85.8	87.2	88.0	87.6	86.5
	Reducing sugar/sucrose ratio	3.3	3.1	3.3	2.9	4.4	2.3	3.2	3.1	2.6	2.3	2.8	2.8	3.3
pH VALUES	Limed juice	8.3	8.2	8.2	8.0	8.0	7.9	7.6	—	7.4	8.3	8.2	7.5	8.0
	Clarified juice	7.1	7.1	6.9	6.9	7.1	6.8	7.0	6.8	7.3	7.2	7.2	7.0	7.0
	Filter Press juice	8.6	7.6	6.4	6.9	—	6.5	6.6	—	—	7.4	8.2	6.9	7.3
	Syrup	6.8	6.9	6.5	—	—	6.5	6.8	—	7.1	7.0	6.9	6.9	6.8
FINAL MOLASSES	Brix	96.9	95.6	97.2	95.0	94.6	99.0	94.7	90.5	96.1	98.6	94.9	95.3	96.1
	Sucrose per cent	34.5	31.9	34.4	34.8	35.2	37.6	37.1	34.5	36.0	37.7	35.9	35.9	34.8
	Reducing sugar per cent	12.3	14.6	13.6	14.4	15.3	10.7	11.3	12.2	10.0	12.2	12.7	11.8	13.3
	Total sugars*	46.8	46.5	48.0	49.2	50.5	48.3	48.4	46.7	46.0	49.9	48.6	47.7	48.1
	Gravity Purity	35.6	33.4	35.4	36.6	37.2	38.0	39.1	38.1	37.4	38.2	37.9	37.7	36.2
	Reducing sugar/sucrose ratio	35.6	45.7	39.5	41.3	43.0	28.7	30.5	35.3	27.8	32.3	35.4	32.9	38.2
	Weight per cent cane at 95° Brix	2.97	2.23	2.36	2.08	2.25	2.72	2.49	2.59	2.79	2.42	2.40	2.46	2.67
SUGAR MADE†	White sugar recovered per cent cane	—	—	—	—	—	5.59	—	—	—	—	—	—	4.19
	Raw ,, ,, ,, ,,	10.35	12.22	11.77	11.28	11.44	5.81	10.94	10.37	10.65	11.30	12.26	11.84	11.10
	Total ,, ,, ,, ,,	10.35	12.22	11.77	11.28	11.44	11.40	10.94	10.37	10.65	11.30	12.26	11.84	11.52
	Average Pol. of sugars	98.87	98.44	98.53	98.58	98.75	99.24	98.72	98.77	98.74	98.70	98.38	98.36	98.63
	Total sucrose recovered per cent cane	10.23	12.03	11.60	11.12	11.30	11.31	10.80	10.24	10.52	11.15	12.06	11.64	11.36
	Moisture content of raw sugar per cent	0.28	0.42	0.28	0.37	0.33	0.40	0.44	0.37	0.34	0.28	0.43	0.31	0.36
	Dilution indicator.	33.6	37.2	23.2	34.6	35.9	48.8	38.0	39.1	36.8	39.5	36.1	23.4	32.1

* Sucrose % + Reducing sugar %.

† Provisional figures.

Table XVII. Summary of chemical control data 1962.

(ii) CANE, BAGASSE AND JUICES.

		Medine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau
CANE	Sucrose per cent	13.61	13.46	13.53	13.19	14.14	13.65	14.15	13.10	12.81	12.70	12.20	12.03
	Fibre per cent	13.86	14.02	13.84	13.88	14.95	16.11	13.75	14.91	13.52	13.93	14.41	14.38
BAGASSE	Sucrose per cent	2.31	2.35	2.44	1.91	2.52	1.95	1.94	2.52	2.03	1.52	2.38	1.63
	Moisture per cent	49.19	48.18	47.97	47.68	47.99	50.17	48.67	46.70	49.20	47.40	47.10	48.66
	Fibre per cent	47.54	48.66	48.58	49.48	48.31	47.15	48.79	49.93	48.00	50.27	49.66	49.15
	Weight per cent cane	29.2	28.8	28.5	28.1	31.0	34.2	28.2	29.9	28.1	27.7	29.0	29.3
1st EXPRESSED JUICE	Brix (B_1)	19.75	20.15	19.99	18.98	20.54	20.82	20.17	19.42	18.52	18.70	15.57	17.85
	Gravity Purity	87.5	87.5	86.8	89.5	88.4	88.3	88.8	87.8	87.7	88.1	87.4	88.4
	Reducing sugar/sucrose ratio	3.2	4.4	3.5	3.1	2.6	2.8	2.5	3.6	2.4	2.8	3.7	2.7
LAST EXPRESSED JUICE	Brix	3.03	4.45	3.52	1.98	3.02	4.59	2.83	3.85	3.76	2.62	3.58	3.40
	Apparent Purity	70.5	74.4	70.8	67.7	68.0	72.9	76.6	74.3	72.9	65.6	73.2	74.4
MIXED JUICE	Brix	15.04	15.61	15.52	14.63	14.76	16.48	14.47	13.81	15.11	13.05	13.03	13.24
	Gravity Purity	85.6	84.3	84.7	86.3	85.8	85.3	86.6	85.7	85.6	85.2	84.2	84.9
	Reducing sugar/sucrose ratio	3.6	5.1	4.0	3.7	3.2	3.5	3.2	4.3	3.0	3.2	4.6	3.5
	Gty. Pty. drop from 1st expressed juice	1.9	3.2	2.1	3.2	2.6	3.0	2.1	2.1	2.1	2.9	3.2	3.5
ABSOLUTE JUICE	Brix (B_A)	18.66	18.69	18.73	17.95	19.64	19.25	19.03	18.15	17.44	17.49	17.07	16.63
	B_A/B_1	0.945	0.928	0.937	0.946	0.956	0.925	0.943	0.930	0.942	0.935	-	0.931
	Gravity Purity	84.7	83.7	83.9	85.3	84.7	84.6	86.2	84.9	84.9	84.4	83.5	84.4
CLARIFIED JUICE	Brix	14.20	15.59	15.07	14.49	14.42	15.91	14.30	13.39	15.01	12.90	13.00	13.07
	Gravity Purity	—	—	84.6	86.6	86.3	85.4	—	86.0	86.0	85.3	84.2	84.8
	Reducing sugar/sucrose ratio	3.6	4.9	4.5	3.7	3.1	3.5	—	4.3	2.9	3.3	4.5	3.4

		Mon Trésor	Savannah	Rose Belle	Britannia	Benarés	Union St. Aubin	St. Félix	Bel Ombre	Reunion	Highlands	Mon Désert	Totals & Averages
CANE	Sucrose per cent	13.81	13.48	12.94	12.75	13.11	12.62	12.40	12.56	12.89	13.68	13.30	13.19
	Fibre per cent	12.80	14.03	12.89	14.76	14.46	12.70	14.40	13.81	13.33	11.49	11.33	13.85
BAGASSE	Sucrose per cent	2.41	2.42	2.73	1.97	2.12	1.88	2.38	2.30	2.23	2.19	2.40	2.18
	Moisture per cent	47.76	47.80	50.19	45.60	45.82	49.11	50.00	49.30	52.46	50.50	50.07	47.08
	Fibre per cent	48.99	48.90	46.30	51.48	51.24	48.10	46.84	47.60	44.56	46.48	46.76	48.30
	Weight per cent cane	26.0	28.6	27.9	28.6	28.2	26.4	30.7	29.0	29.9	22.8	24.2	28.7
1st EXPRESSED JUICE	Brix (B_1)	19.45	18.75	18.17	17.98	18.61	17.98	16.18	17.73	18.41	18.61	18.24	18.93
	Gravity Purity	88.8	88.7	89.2	90.7	88.7	88.9	88.2	87.4	88.6	90.3	89.6	88.4
	Reducing sugar/sucrose ratio	2.6	3.8	2.2	2.8	2.5	2.9	2.9	2.8	1.9	2.2	2.2	2.9
LAST EXPRESSED JUICE	Brix	3.75	3.37	3.71	2.81	2.84	2.15	2.49	3.95	3.39	1.54	3.68	3.29
	Apparent Purity	74.1	74.2	77.8	67.6	72.3	67.5	76.3	74.7	74.8	73.3	75.6	72.4
MIXED JUICE	Brix	14.83	13.65	13.84	12.81	13.31	13.56	13.11	13.86	14.41	13.67	14.21	14.33
	Gravity Purity	86.7	86.7	87.4	87.9	86.9	86.6	85.3	85.0	87.1	87.2	87.1	85.9
	Reducing sugar/sucrose ratio	3.3	5.3	2.9	3.3	2.5	3.5	3.4	3.3	2.2	2.5	2.6	3.4
	Gty. Pty. drop from 1st expressed juice	2.1	2.0	1.8	2.8	1.8	2.3	2.9	2.4	1.5	3.1	2.5	2.5
ABSOLUTE JUICE	Brix (B_A)	18.42	18.24	17.12	17.24	17.82	16.88	17.09	17.29	17.22	17.87	17.33	17.98
	B_A/B_1	0.947	0.972	0.940	0.960	0.958	0.939	--	0.975	0.935	0.960	0.950	0.950
	Gravity Purity	86.0	86.0	86.8	86.7	86.0	85.7	84.7	84.3	86.4	86.5	86.6	85.2
CLARIFIED JUICE	Brix	14.47	13.81	13.77	13.02	13.37	13.52	13.02	13.78	14.40	13.41	13.92	14.11
	Gravity Purity	87.1	86.9	—	87.8	86.5	87.4	85.6	85.1	88.3	87.8	87.6	87.6
	Reducing sugar/sucrose ratio	2.9	5.2	3.0	4.0	2.5	3.3	3.1	3.2	2.3	2.7	2.6	3.3

Table XVII. Summary of chemical control data 1962.

(iv) MASSECUITES

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St. Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MAGMA	Apparent Purity	76.3	89.7	83.3	82.0	82.0	81.8	82.3	76.0	78.6	80.8	87.9	87.5	84.1	91.4	77.1	79.9	80.8	81.4	—	—	81.9	—	—	82.4
A—MASSECUITE	Brix	95.6	94.2	94.3	95.2	95.0	94.1	95.3	94 9	94.3	95.0	93.8	93.7	94.6	93.2	94.1	94.4	94.1	93.7	94.1	94.6	95.5	95.1	94.0	94.5
	Apparent Purity	80.9	81.6	83.2	83.8	82.5	83.6	80.8	79.4	81.1	80.9	84.6	85.4	84.8	81.2	86.0	84.8	86.4	86.4	85.6	83.0	80.0	82.7	80.5	82.2
	,, ,, of A—Molasses	64.0	59.8	62.8	62.4	63.4	61 6	56.9	56.7	63.1	56.0	65.5	66.0	62.3	61.5	65.5	61.4	70.9	67.8	64.0	61.2	59.1	59.5	60.9	61.9
	Drop in Purity	16.9	21.8	20.4	21.4	19.1	22.0	23.9	22.7	18.0	24.9	19.1	19.4	22.5	19.7	20.5	23.4	15.5	18.6	21.6	21.8	20.9	23.2	19.6	20.3
	Crystal per cent Brix in massecuite	46.9	54.2	54.8	56.9	52.2	57.3	55.5	52.4	48.8	56.6	55.4	57 1	59.7	51.2	59.4	60.6	53.3	57.8	60.0	56.2	51.1	57.3	50.1	53.3
	Cubic feet per ton Brix in Mixed Juice	30.0	25.1	25.5	20.2	28.9	31.0	32.3	26.8	31 1	25 3	29.1	24.8	27.0	30.7	30.6	24.2	30.5	27.7	16.3	25.0	26.5	22.3	33.3	27.8
	A—Massecuite per cent total massecuite	56.6	52.8	57.2	48.6	61.7	64.0	64.2	54.8	66 2	51 0	47.4	50.4	61.5	60.9	59.7	52.2	50.2	52.5	39.6	53.4	63.4	51.5	67.2	57.5
B—MASSECUITE	Brix	97.9	96.4	95.9	98.0	98.1	96.6	96.1	97.1	95.6	96 0	95.7	95.3	96.8	94.5	94.9	96.2	95.9	95.2	95.0	96.9	97.6	95.5	95.2	96.2
	Apparent Purity	70.0	68.9	70.5	74.2	69.0	72.7	70 9	69 9	69.8	68.7	74.2	74.7	68.9	72.5	72.7	70.4	77.8	75.5	75.5	72.7	71.2	70.9	73.4	71.5
	,, ,, of B—Molasses	49.2	50.6	46.0	49.3	50.0	48 9	49.3	47.6	50.7	45 7	56.4	50.8	44.3	52.7	49.8	45.6	60.2	56.8	53.3	51.2	51.8	49.5	51.8	50.3
	Drop in purity	20.8	18.3	24.5	24.9	19.0	23 8	21.6	22.3	19.1	23.0	17.8	23.9	24.6	19.8	22.9	24.8	17.6	18.7	22.2	21.5	19.4	21.4	21.6	21.2
	Crystal per cent Brix in massecuite	40.9	37.0	45.4	49.1	38.0	46.6	42.6	42 6	38.7	42.3	40.8	48.6	44.2	41.9	45.6	45.6	44.2	43.3	47.5	44.1	40.2	42.4	44.8	42.7
	Cubic feet per ton Brix in Mixed Juice	13.5	12.6	11.3	13.7	10.1	7.9	9.5	13.3	9 1	13.0	19.0	15.2	10.2	11.5	11.5	15.1	18.4	16.2	15.4	12.2	8.7	13.4	10.0	12.0
	B—Massecuite per cent total Massecuite	25.5	26.6	25.3	33.0	21.6	16.1	19.0	28.7	19.4	26.2	31.0	31.0	23.1	22.7	22.5	32.6	30.2	30.8	37.2	25.9	20.9	31.0	20.2	24.8
	Kgs. Sugar per cubic foot of A & B Massecuite	18.4	20.3	21.2	23.6	19.8	19.5	19.1	19 9	19 9	20.0	15.3	18.9	21.4	18.9	17.0	21.0	16.2	17.8	23.9	20.5	22.9	22.8	18 4	19 8
C—MASSECUITE	Brix	100.5	100.1	100.0	101.0	101.8	99.3	99.6	99.5	99.1	100.0	100.3	97.2	100.7	100.5	98.8	98.6	100.6	100.0	98.5	98.7	100.6	99.0	100.4	99.8
	Apparent Purity	56.1	56.8	54.0	57.1	57.0	58.6	57.0	53.1	56.0	55.6	58.3	56.6	55.1	56.6	55.8	52.8	61.7	57.0	59.1	58.5	58.1	60.3	56.9	56.7
	,, ,, of final molasses	34.5	33.6	30.9	34.1	37.3	35.7	32.9	28.8	33.5	32.6	31.7	33.5	30.2	32.4	32.4	37.2	35.0	36.2	35.3	37.4	35.7	34.0	35.7	33.8
	Drop in Purity	21.6	23.2	23.1	23.0	19.7	22.9	24.1	24.3	22.5	23.0	26.6	23.1	24.9	24.2	23.4	15.6	26.7	20.8	23.8	21.1	22.4	26.3	21.2	22.9
	Crystal per cent Brix in massecuite	33.0	34.9	33.4	34.9	31.4	35.6	35.9	34 1	33.8	34.1	38.9	34.7	35.7	35.8	34.6	25.0	41.0	32.6	36.8	33.7	34.8	39.8	33.0	34.6
	Cubic feet per ton Brix in Mixed Juice	9.5	9.8	7.8	7.7	7.8	9.6	8.3	8.2	6.8	11 3	13.2	9.1	6.8	8.3	9.1	7.1	11.9	8.8	9.5	9.7	6.6	7.6	6.3	8.5
	C—Massecuite per cent total massecuite	17.9	20.6	17.5	18.5	16.7	19.9	16.9	16.5	14.4	22.8	21.6	18.6	15.4	16.4	17.8	15.2	19.6	16.7	23.2	20.7	15.7	17.5	12.6	17.7
TOTAL MASSECUITE	Cubic feet per ton Brix in Mixed Juice	53.0	47.4	44.6	41.6	46.9	48.6	50.2	48.2	47.0	49.6	61.3	49.1	43.9	50.5	51.2	46.4	60.8	52.7	41.2	46.9	41.8	43.3	49.6	48.3
	,, ,, ,, sugar made	66.4	62.0	57.2	52.0	60.7	64.1	62.9	60.4	58.6	65.1	83.3	64.6	54.7	63.2	63.3	56.2	76.9	67.5	54.3	61.6	51.9	53.3	61.1	61.3

Table XVII. Summary of chemical control data 1962.

(v) MILLING WORK, SUCROSE LOSSES & BALANCE RECOVERIES.

		Médine	Solitude	Beau Plan	The Mount	Belle Vue	St. Antoine	Mon Loisir	Constance	Union Flacq	Beau Champ	Ferney	Riche en Eau	Mon Trésor	Savannah	Rose Belle	Britannia	Bénarès	Union St Aubin	St. Félix	Bel Ombre	Réunion	Highlands	Mon Désert	Totals & Averages
MILLING WORK	Imbibition water % cane	29.7	26.0	26.1	28.9	36.4	26.6	36.7	34.3	22.7	38.1	33.9	32.0	28.7	36.6	28.5	36.8	36.5	29.6	34.9	29.9	27.3	35.0	27.0	30.8
	,, ,, % fibre	214	185	189	204	243	165	267	230	168	274	235	223	224	261	221	250	252	233	243	217	205	305	238	222
	Extraction ratio	36.0	35.9	37.1	29.3	36.9	29.8	28.1	38.4	32.5	23.9	39.6	27.6	35.5	36.5	45.5	29.8	31.7	31.0	40.9	38.4	38.9	34.4	38.6	33.9
	Mill extraction	95.1	95.0	94.9	95.9	94.5	95.2	96.1	94.2	95.6	96.7	94.3	96.0	95.5	94.9	94.1	95.6	95.4	96.1	94.1	94.7	94.8	96.1	95.6	95.3
	Reduced mill extraction	95.6	95.6	95.4	96.4	95.5	96.4	96.5	95.3	96.0	97.1	95.2	96.7	95.6	95.5	94.3	96.4	96.1	96.1	95.0	95.2	95.2	95.7	95.1	95.8
SUCROSE LOSSES	Sucrose lost in bagasse % cane	0.67	0.68	0.69	0.54	0.78	0.66	0.55	0.75	0.57	0.42	0.69	0.48	0.63	0.69	0.76	0.57	0.60	0.50	0.73	0.67	0.67	0.54	0.58	0.62
	,, ,, in filter cake % cane	0.04	0.06	0.11	0.05	0.12	0.08	0.03	0.03	0.04	0.04	0.18	0.04	0.10	0.04	0.10	0.06	0.09	0.05	0.12	0.15	0.15	0.10	0.13	0.08
	,, ,, in molasses % cane	0.91	1.03	0.97	0.89	1.04	1.16	0.96	0.89	0.84	1.00	0.94	1.00	0.71	0.80	0.72	0.79	0.98	0.93	0.93	0.99	0.88	0.86	0.88	0.92
	Undetermined losses % cane	0.10	0.25	0.12	0.11	0.34	0.34	0.29	0.08	0.08	0.27	0.42	0.28	0.34	0.35	0.24	0.03	0.13	0.34	0.38	0.23	0.05	0.12	0.07	0.21
	Industrial losses % cane	1.05	1.34	1.20	1.05	1.50	1.58	1.28	0.99	0.96	1.31	1.26	1.32	1.15	1.19	1.06	0.88	1.20	1.32	1.43	1.37	1.08	1.08	1.08	1.21
	Total losses % cane	1.72	2.02	1.89	1.59	2.28	2.24	1.83	1.74	1.53	1.73	2.23	1.79	1.78	1.88	1.82	1.45	1.80	1.82	2.16	2.04	1.74	1.62	1.66	1.83
SUCROSE BALANCE	Sucrose in bagasse % sucrose in cane	4.92	5.04	5.14	4.05	5.51	4.83	3.89	5.72	4.45	3.31	5.67	3.98	4.56	5.12	5.87	4.47	4.58	3.94	5.94	5.33	5.20	3.95	4.37	4.73
	,, ,, filter cake % sucrose in cane	0.29	0.45	0.82	0.04	0.85	0.59	0.21	0.23	0.31	0.32	1.44	0.30	0.72	0.30	0.78	0.47	0.68	0.40	0.96	1.19	1.16	0.73	0.96	0.57
	,, ,, molasses % sucrose in cane	6.69	7.65	7.21	6.76	7.36	8.57	6.78	6.72	6.56	7.87	7.68	8.34	5.14	5.93	5.56	6.20	7.48	7.37	7.50	7.88	6.82	6.28	6.62	6.96
	Undetermined losses % sucrose in cane	0.73	1.89	0.84	0.08	2.40	2.42	2.05	0.61	0.62	2.12	3.48	2.32	2.47	2.60	1.85	0.23	0.99	2.69	3.06	1.84	0.39	0.88	0.80	1.62
	Industrial losses % sucrose in cane	7.71	9.99	8.87	7.97	10.61	11.58	9.05	7.56	7.49	10.31	12.60	10.97	8.33	8.83	8.19	6.90	9.15	10.46	11.53	10.91	8.38	7.89	8.08	9.15
	Total losses % sucrose in cane	12.63	15.03	14.01	12.03	16.12	16.41	12.93	13.28	11.94	13.62	18.26	14.94	12.89	13.95	14.06	11.37	13.73	14.40	17.41	16.24	13.50	11.84	12.45	13.88
RECOVERIES	Boiling house recovery	91.9	89.5	90.6	91.7	88.8	87.8	90.6	92.0	92.1	89.3	86.6	88.6	91.2	90.7	91.3	92.7	90.4	89.1	87.7	88.5	91.2	91.8	91.5	90.4
	Reduced boiling house recovery (Pty. M.J.85°)	91.5	90.0	90.9	90.8	88.0	87.5	89.3	91.5	91.7	89.2	90.0	88.7	89.9	89.3	89.2	90.5	88.8	87.5	87.5	88.5	89.4	90.1	89.9	89.7
	Overall recovery	87.3	85.0	86.0	88.0	83.9	83.6	87.1	86.7	88.1	86.4	81.7	85.1	87.1	86.0	85.9	88.6	86.3	85.6	82.5	83.8	86.5	88.2	87.6	86.1
	Reduced overall recovery (Pty. M.J.85°, F % C12.5)	87.5	86.0	86.7	87.5	84.1	84.4	86.1	87.2	88.0	86.5	85.7	85.7	85.9	85.3	84.1	87.2	85.3	84.1	83.1	84.3	85.1	86.2	85.5	85.9
	Boiling house efficiency	100.3	99.3	99.9	100.0	98.1	97.3	98.5	100.0	101.1	98.3	95.4	97.6	98.2	98.5	99.0	100.6	99.0	98.3	97.5	98.3	99.8	100.0	99.8	100.0

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
1959	118,056	59,985	9,632	48,439	252	121	2,490
1960	72,991	45,180	8,871	18,940	98	47	970
1961	139,234	64,633	7,357	67,244	350	168	3,456
1962(1)	122,890	76,800	7,750	38,340	199	96	1,534

(1) *Provisional figures.*

Table XIX. Importation of inorganic fertilizers, in metric tons, 1950 - 1962.

	N	P_2O_5	K_2O
1950	3,990	870	1,930
1951	5,710	1,020	4,080
1952	5,800	1,140	2,960
1953	5,080	560	2,380
1954	4,170	1,110	3,340
1955	5,620	570	3,110
1956	8,870	2,170	3,940
1957	6,900	2,770	4,390
1958	6,210	3,020	4,690
1959	8,500	2,740	5,310
1960	8,170	4,382	5,765
1961	7,462	4,769	4,569
1962	9,467	5,377	6,373

Table XX. Sales of Herbicides, 1961 - 1962.

HERBICIDES	1961			1962		
	Quantity		Sales in Rupees	Quantity		Sales in Rupees
	Imperial gallons	Kgs.		Imperial gallons	Kgs.	
MCPA — Metallic Salt	14,153	—	197,009	14,897	—	198,187
2, 4 - D Amines	33,989	—	602,580	25,118	—	440,647
2, 4 - D Esters	11,132	—	420,857	14,492	—	444,008
Pentachlorophenol	1,403	—	23,335	1,010	—	16,077
Sodium Chlorate	—	214,301	263,638	—	272,937	349,715
TCA	—	363,716	1,125,550	—	335,595	1,034,933
Dalapon	—	9,553	27,695	—	21,933	226,810
Sodium arsenite	—	8,000	11,208	—	—	
Substituted Ureas	—	30,000	960,000	—	38,279	1,185,000
Substituted Triazines	—	1,812	35,345	—	21,432	303,191
Unclassified	600	—	10,800	—	1,000	6,600
	—	117	1,501	—		
TOTAL			3,679,518			4,205,168

Table XXI. List of crosses made in 1962.

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
B.3337	x M.219/56	1	1	—	—	—	—	1	1	—
B.3439	x M.423/41	—	—	—	2	971	—	2	971	—
B.34104	x M.63/39	2	—	—	1	86	—	3	86	—
,,	x M.147/44	—	—	—	2	13	—	2	12	—
,,	x M.202/46	—	—	—	6	13	—	6	13	—
,,	x M.81/52	3	20	—	—	—	—	3	13	—
,,	x M.92/53	—	—	—	1	47	—	1	47	—
,,	x M.403/54	2	—	—	—	—	—	2	—	—
,,	x M.158/55	—	—	—	1	53	—	1	53	—
,,	x M.212/56	3	17	—	—	—	—	3	17	—
,,	x M.361/56	1	—	—	—	—	—	1	—	—
,,	x M.254/58	1	—	—	—	—	—	1	—	—
,,	x M.463/59	4	—	1	—	—	—	4	—	1
,,	x P.O.J.2878	—	—	—	2	265	202	2	265	202
,,	x P.O.J.2940	—	—	—	1	19	—	1	19	—
,,	x R.397	—	—	—	1	—	—	1	—	—
,,	x Self	3	1	—	—	—	—	3	1	—
B.37161	x 47 R 4066	2	—	—	—	—	—	2	—	—
B.37172	x M.241/40	1	—	—	—	—	—	1	—	—
,,	x M.202/46	—	—	—	3	—	2	3	—	2
,,	x M.379/51	—	—	—	1	3	—	1	3	—
,,	x M.381/51	—	—	—	1	—	—	1	—	—
,,	x 47 R 4066	—	—	—	1	8	—	1	8	—
B.41227	x M.202/46	—	—	—	1	—	—	1	—	—
,,	x M.380/51	—	—	—	1	—	—	1	—	—

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
B.4362	x D.109	2	—	—	—	—	—	2	—	—
,,	x M.99/48	2	1	—	—	—	—	2	1	—
John Bull	x Unknown	3	1	—	—	—	—	3	1	—
C.B.38—22	x M.147/44	—	—	—	4	—	32	4	—	32
Co.281	x M.63/39	—	—	—	1	535	—	1	535	—
,,	x M.381/51	—	—	—	3	—	6	3	—	6
,,	x M.262/55	2	—	—	—	—	—	2	—	—
,,	x M.394/57	1	11	—	—	—	—	1	11	—
,,	x M.463/59	1	23	—	—	—	—	1	23	—
Co.290	x M.361/56	1	—	—	—	—	—	1	—	—
,,	x M.436/57	2	—	1	—	—	—	2	—	1
,,	x P.O.J. 2940	2	9	—	—	—	—	2	9	—
,,	x Unknown	3	—	—	—	—	—	3	—	—
Co.419	x M.204/40	1	182	—	—	—	—	1	182	—
,,	x M.462/54	1	—	—	—	—	—	1	—	—
,,	x M.347/57	1	63	—	—	—	—	1	63	—
,,	x Unknown	2	15	—	—	—	—	2	15	—
Co.779	x M.196/31	—	—	—	1	74	—	1	74	—
,,	x M.147/44	1	150	—	4	34	100	5	184	100
,,	x M.81/52	—	—	—	2	17	—	2	17	—
,,	x M.85/53	1	140	—	—	—	—	1	140	—
,,	x M.462/54	1	—	—	—	—	—	1	—	—
,,	x M.349/55	—	—	—	1	30	—	1	30	—
,,	x M.146/56	1	148	—	—	—	—	1	148	—
,,	x M.361/56	1	—	—	—	—	—	1	—	—

CROSS	Greenhouse			Field			TOTAL		
	No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
		Bunches	Singles		Bunches	Singles		Bunches	Singles
Co.779 x M.394/57	1	—	—	—	—	—	1	—	—
,, x N:Co.310	1	205	—	—	—	—	—	1	205
C.P.34 - 120 x M.81/52	1	13	—	—	—	—	1	13	—
,, x M.219/56	1	—	—	—	—	—	1	—	—
,, x Q.58	1	211*	1500	—	—	—	1	211*	1500
Chalain x M.202/46	2	—	—	—	—	—	2	—	—
Ebène/61 x Unknown	4	41	—	—	—	—	4	41	—
Ebène 1/37 x John Bull	2	—	—	—	—	—	2	—	—
,, x M.63/39	4	3	—	—	—	—	4	3	—
,, x M.147/44	—	—	—	2	3	—	2	3	—
,, x M.202/46	—	—	—	3	37	4	3	37	4
,, x M.423/51	2	9	—	—	—	—	2	9	—
,, x M.81/52	—	—	—	2	27	290	2	27	290
,, x M.92/53	—	—	—	2	144	—	2	144	—
Ebène 1/37 x M.392/54	1	52	—	—	—	—	1	52	—
,, x M.462/54	2	70	380	2	17	250	4	87	630
,, x M.516/54	—	—	—	2	8	—	2	8	—
,, x M.158/55	—	—	—	1	19	—	1	19	—
,, x M.245/56	2	—	—	—	—	—	2	—	—
,, x M.361/56	2	300	250	—	—	—	2	300	250
,, x M.201/59	—	—	—	2	—	—	2	—	—
,, x M.239/59	1	—	1	—	—	—	1	—	1
,, x M.280/59	1	—	15	—	—	—	1	—	15
,, x M.463/59	2	—	—	—	—	—	2	—	—

* Bunches of 3 and 5.

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
Ebène 1/37	x 39MQ832	—	—	—	1	—	—	1	—	—
,,	x P.T. 43-52	—	—	—	1	110	—	1	110	—
,,	x Q. 58	3	4	—	—	—	—	3	4	—
,,	x 47 R.4066	—	—	—	3	2	188	3	2	188
,,	x 40 SN5819	2	—	—	—	—	—	2	—	—
,,	x Self	3	—	8	—	—	—	3	—	8
Ebène 50/47	x D.109	—	—	—	2	—	91	2	—	91
,,	x M.233/40	—	—	—	1	—	—	1	—	—
,,	x M.147/44	2	34	—	3	24	100	5	58	100
,,	x M.99/53	—	—	—	3	275	—	3	275	—
,,	x M.403/54	—	—	—	1	1	—	1	1	—
,,	x M.462/54	2	3	—	—	—	—	2	3	—
,,	x M.361/56	2	11	—	—	—	—	2	11	—
,,	x M.201/59	2	18	—	—	—	—	2	18	—
Eros	x M.196/31	—	—	—	1	6	—	1	6	—
,,	x M.99/34	1	31	—	—	—	—	1	31	—
,,	x M.47/38	1	2	—	—	—	—	1	2	—
,,	x M.233/40	2	112	—	—	—	—	2	112	—
,,	x M.81/52	2	—	—	—	—	—	2	—	—
,,	x R.397	1	1	—	—	—	—	1	1	—
M.23/16	x H.37-1933	1	—	—	—	—	—	1	—	—
,,	x M.462/54	2	—	—	—	—	—	2	—	—
M.109/26	x M.128/52	1	14	—	—	—	—	1	14	—
M.134/32	x John Bull	2	—	—	—	—	—	2	—	—
,,	x H.37-1933	2	—	—	—	—	—	2	—	—

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.134/32	x M.202/46	—	—	—	2	—	—	2	—	—
,,	x M.81/52	—	—	—	1	—	90	1	—	90
,,	x M.63/54	1	10	—	—	—	—	1	10	—
,,	x M.376/54	1	—	—	—	—	—	1	—	—
,,	x M.462/54	—	—	—	2	2	70	2	2	70
,,	x M.490/54	2	—	—	—	—	—	2	—	—
,,	x M.516/54	—	—	—	2	15	—	2	15	—
,,	x M.518/54	2	—	—	—	—	—	2	—	—
,,	x M.2/55	2	—	—	—	—	—	2	—	—
,,	x M.55/55	1	12	—	—	—	—	1	12	—
,,	x M.158/55	—	—	—	1	305	—	1	305	—
,,	x M.361/56	3	—	120	—	—	—	3	—	120
,,	x M.307/57	1	—	—	—	—	—	1	—	—
,,	x M.201/59	—	—	—	2	—	—	2	—	—
	x M.289/59	2	9	—	—	—	—	2	9	—
,,	x M.463/59	2	—	1	—	—	—	2	—	1
,,	x 47 R 2777	3	—	—	1	—	3	4	—	3
,,	x 47 R 4066	—	—	—	3	41	520	3	41	520
,,	x Vesta	2	9	—	—	—	—	2	9	—
M.99/34	x M.2/55	2	—	—	—	—	—	2	—	—
M.112/34	x M.423/41	1	—	—	—	—	—	1	—	—
,,	x M.147/44	—	—	—	1	53	—	1	53	—
,,	x M.202/46	1	18	—	—	—	—	1	18	—
,,	x M.232/52	2	—	—	—	—	—	2	—	—
,,	x M.99/53	1	—	—	—	—	—	1	—	—

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.112/34	x M.462/54	2	5	—	—	—	—	2	5	—
,,	x M.307/55	1	2	—	—	—	—	1	2	—
,,	x M.219/56	1	2	—	—	—	—	1	2	—
,,	x M.394/57	1	—	—	—	—	—	1	—	—
,,	x M.440/57	1	—	—	—	—	—	1	—	—
,,	x M.463/59	1	—	—	—	—	—	1	—	—
,,	x 47 R.2777	2	—	1	—	—	—	2	—	1
,,	x 40 SN 5819	2	—	—	—	—	—	2	—	—
M.47/38	x M.81/52	2	45	—	—	—	—	2	45	—
,,	x Unknown	2	5	—	—	—	—	2	5	—
M.63/39	x M.423/51	2	3	—	—	—	—	2	3	—
,,	x M.403/54	2	—	—	—	—	—	2	—	—
,,	x M.462/54	2	32	150	—	—	—	2	32	150
,,	x M.212/56	2	6	—	—	—	—	2	6	—
,,	x Self	7	3	1	—	—	—	7	3	1
M.204/40	x M.240/59	1	43	—	—	—	—	1	43	—
M.241/40	x D.109	1	—	—	—	—	—	1	—	—
,,	x H.37-1933	2	—	—	—	—	—	2	—	—
,,	x M.202/46	—	—	—	2	3	—	2	3	—
,,	x M.81/52	—	—	—	1	7	—	1	7	—
,,	x M.158/55	—	—	—	3	187*	1,362	3	187*	1,362
,,	x P.O.J. 3016	—	—	—	1	365	—	1	365	—
,,	x P.T. 43-52	—	—	—	1	118	—	1	118	—
,,	x 47 R 4066	—	—	—	1	430	—	1	430	—

* Bunches of 3 and 5.

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.241/40	x Unknown	6	13	—	—	—	—	6	13	—
M.296/41	x 47 R 2777	2	—	—	—	—	—	2	—	—
M.311/41	x M.202/46	—	—	—	2	—	—	2	—	—
,,	x P.O.J.3016	—	—	—	1	180	—	1	180	—
M.377/41	x Co. 419	1	—	—	—	—	—	1	—	—
,,	x M.147/44	1	—	1	—	—	—	1	—	1
,,	x M.202/46	—	—	—	1	3	—	1	3	—
,,	x M.92/53	—	—	—	2	18	—	2	18	—
,,	x M.99/53	2	—	—	—	—	—	2	—	—
,,	x M.347/57	1	—	—	—	—	—	1	—	—
,,	x M.463/59	1	—	—	—	—	—	1	—	—
,,	x N:Co. 310	1	—	—	—	—	—	1	—	—
,,	x N: Co. 310 Self	1	—	1	—	—	—	1	—	1
,,	x P.O.J. 2878	—	—	—	1	—	42	1	—	42
,,	x P.O.J. 3016	5	26	—	—	—	—	5	26	—
,,	x P.T. 43-52	—	—	—	3	37	2	3	37	2
,,	x Q. 58	2	9	14	—	—	—	2	9	14
M.112/42	x N: Co. 310	1	2	—	—	—	—	1	2	—
M.11/43	x M.240/59	1	—	1	—	—	—	1	—	1
M.31/45	x M.128/52	1	—	—	—	—	—	1	—	—
,,	x M.219/56	1	1	—	—	—	—	1	1	—
,,	x M.361/56	1	—	1	—	—	—	1	—	1
,,	x M.240/59	1	—	—	—	—	—	1	—	—
,,	x M.P. 87	1	84	—	—	—	—	1	84	—
,,	x R. 397	1	—	—	—	—	—	1	—	—

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.202/46	x Beau Bois	—	—	—	1	—	—	1	—	—
,,	x N: Co. 310 Self	1	3	—	—	—	—	1	3	—
,,	x 47 R 2777	1	137	—	—	—	—	1	137	—
M.93/48	x Ebène 1/37	2	—	70	2	1	60	4	1	130
,,	x M.63/39	2	—	—	2	242	190	4	242	190
,,	x M.147/44	—	—	—	2	—	—	2	—	—
,,	x M.423/51	2	—	—	—	—	—	2	—	—
,,	x M.462/54	4	—	4	—	—	—	4	—	4
,,	x Self	3	—	—	2	1	28	5	1	28
M.99/48	x M.63/39	—	—	—	2	—	—	2	—	—
,,	x M.147/44	—	—	—	2	350	—	2	350	—
,,	x 36 MQ 2717	—	—	—	2	21	—	2	21	—
,,	x 39 MQ 832	—	—	—	1	4	—	1	4	—
M.253/48	x John Bull	1	1	—	—	—	—	1	1	—
,,	x P.O.J. 3016	1	3	—	—	—	—	1	3	—
M.137/49	x Vesta	2	133	—	—	—	—	2	133	—
M.305/49	x M.63/39	—	—	—	1	—	—	1	—	—
M.322/51	x Ebène 1/37	—	—	—	1	213	—	1	213	—
,,	x M.99/34	—	—	—	3	272	—	3	272	—
,,	x M.93/48	2	2	—	—	—	—	2	2	—
,,	x M.92/53	—	—	—	1	155	—	1	155	—
,,	x Unknown	1	—	—	—	—	—	1	—	—
M.379/51	x M.63/39	—	—	—	2	—	—	2	—	—
,,	x 47 R 2777	2	—	—	—	—	—	2	—	—
M.380/51	x M.63/39	—	—	—	2	—	—	2	—	—

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.380/51	x M.245/56	2	—	—	—	—	—	2	—	—
M.381/51	x M.35/17	2	—	—	—	—	—	2	—	—
M.423/51	x M.35/17	1	1	—	—	—	—	1	1	—
,,	x M.147/44	1	—	6	—	—	—	1	—	6
,,	x M.92/53	1	—	—	—	—	—	1	—	—
M.442/51	x M.63/39	—	—	—	2	—	3	2	—	3
,,	x M.147/44	—	—	—	1	1	—	1	1	—
,,	x M.158/55	—	—	—	1	—	—	1	—	—
M.716/51	x Ebène 1/37	—	—	—	6	86	270	6	86	270
,,	x M.462/54	—	—	—	2	—	162	2	—	162
M.81/52	x Co. 419	2	8	—	—	—	—	2	8	—
,,	x M.63/39	2	1	—	—	—	—	2	1	—
,,	x M.92/53	1	5	—	—	—	—	1	5	—
,,	x M.403/54	2	—	—	—	—	—	2	—	—
,,	x M.490/54	2	14	—	—	—	—	2	14	—
,,	x M.212/56	2	2	—	—	—	—	2	2	—
,,	x P.O.J. 3016	1	—	—	—	—	—	1	—	—
,,	x Q.58*	1	70	—	—	—	—	1	70	—
,,	x R.397	1	3	—	—	—	—	1	3	—
,,	x Self	3	9	—	—	—	—	3	9	—
,,	x Unknown	4	60	—	—	—	—	4	60	—
M.127/52	x M.99/34	2	2	—	—	—	—	2	2	—
,,	x M.213/40	—	—	—	1	11	—	1	11	—
,,	x M.423/41	—	—	—	4	826	—	4	826	—

* Sown with Q.58 × M.81/52 by mistake.

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.128/52	x Ebène 1/37	—	—	—	1	213	—	1	213	—
,,	x M.147/44	—	—	—	4	214	100	4	214	100
,,	x Unknown	4	1	7	—	—	—	4	1	7
M.232/52	x Ebène 1/37	—	—	—	1	5	—	1	5	—
,,	x P.O.J. 2878	—	—	—	1	70	100	1	70	100
,,	x Unknown	1	—	—	—	—	—	1	—	—
M.272/52	x M.63/39	—	—	—	2	—	—	2	—	—
,,	x P.O.J. 2940	—	—	—	2	270	—	2	270	—
M.85/53	x M.147/44	—	—	—	4	309	100	4	309	100
,,	x M.92/53	1	23	—	—	—	—	1	23	—
,,	x N: Co. 310 Self	—	—	—	1	48	—	1	48	—
,,	x Selfed	2	11	—	—	—	—	2	11	—
,,	x Unknown	3	28	—	—	—	—	3	28	—
M.97/53	x M.63/39	1	17	—	—	—	—	1	17	—
,,	x M.213/40	1	—	—	1	85	—	2	85	—
,,	x M.147/44	—	—	—	1	10	—	1	10	—
,,	x M.P. 87	1	—	—	—	—	—	1	—	—
,,	x P.O.J. 3016	1	32	—	—	—	—	1	32	—
,,	x P.T. 43-52	1	—	—	—	—	—	1	—	—
M.98/53	x Ebène 1/37	—	—	—	1	43	—	1	43	—
,,	x P.O.J. 2940	—	—	—	1	14	—	1	14	—
,,	x 47 R 2777	2	—	—	—	—	—	2	—	—
M.99/53	x Unknown	4	18	—	—	—	—	4	18	—
M.8/54	x M.213/40	—	—	—	2	4	—	2	4	—
,,	x M.147/44	—	—	—	5	145	460	5	145	460

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.13/54	x M.147/44	—	—	—	2	—	—	2	—	—
M.63/54	x Unknown	2	—	—	—	—	—	2	—	—
M.159/54	x M.63/39	2	—	—	—	—	—	2	—	—
M.194/54	x M.63/39	—	—	—	2	—	—	2	—	—
,,	x M.147/44	—	—	—	1	—	2	1	—	2
,,	x M.202/46	—	—	—	1	9	—	1	9	—
M.210/54	x M.233/40	2	48	—	—	—	—	2	48	—
M.262/54	x M.213/40	—	—	—	2	—	—	2	—	—
M.323/54	x D.109	1	32	—	—	—	—	1	32	—
,,	x Ebène 1/37	—	—	—	1	8	—	1	8	—
,,	x M.213/40	1	—	—	—	—	—	1	—	—
,,	x M.147/44	1	—	—	—	—	—	1	—	—
,,	x M.128/52	1	1	—	—	—	—	1	1	—
,,	x 47 R 2777	1	3	—	2	—	—	3	3	—
M.376/54	x M.99/34	—	—	—	1	140	—	1	140	—
,,	x M.213/40	1	—	—	1	70*	1280	2	70*	1280
,,	x M.241/40	1	—	—	—	—	—	1	—	—
,,	x M.147/44	—	—	—	1	385	—	1	385	—
,,	x P.O.J. 3016	2	5	—	—	—	—	2	5	—
M.403/54	x M.63/39	2	4	—	—	—	—	2	4	—
,,	x M.147/44	—	—	—	1	395	100	1	395	100
,,	x M.92/53	—	—	—	2	329	—	2	329	—
,,	x M.347/57	—	—	—	1	—	—	1	—	—
,,	x Unknown	4	2	—	—	—	—	4	2	—

* Bunches of 3 and 5.

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.461/54	x P.O.J. 36	2	—	—	—	—	—	2	—	—
M.506/54	x M.213/40	1	72	—	1	93	—	2	165	—
,,	x M.147/44	—	—	—	1	2	—	1	2	—
,,	x M.99/53	1	8	—	—	—	—	1	8	—
M.516/54	x M.63/39	1	70	—	—	—	—	1	70	—
,,	x M.147/44	1	—	40	—	—	—	1	—	40
,,	x M.360/56	1	—	—	—	—	—	1	—	—
,,	x P.O.J. 2940	1	—	—	—	—	—	1	—	—
,,	x 47 R 2777	1	46	—	2	—	—	3	46	—
,,	x 40 SN 5819	2	25	—	—	—	—	2	25	—
M.518/54	x Co. 290	2	1	—	—	—	—	2	1	—
,,	x M.213/40	—	—	—	1	4	—	1	4	—
,,	x M.147/44	—	—	—	1	—	25	1	—	25
,,	x M.12/49	—	—	—	2	—	—	2	—	—
,,	x M.92/53	—	—	—	1	910	—	1	910	—
M.528/54	x M.196/31	1	24	—	—	—	—	1	24	—
,,	x M.92/53	1	16	—	—	—	—	1	16	—
,,	x 27 MQ 1124	1	6	—	—	—	—	1	6	—
,,	x P.O.J. 2878	1	—	26	—	—	—	1	—	26
,,	x P.O.J. 3016	1	101	—	—	—	—	1	101	—
M.55/55	x M.147/44	—	—	—	3	251	100	3	251	100
,,	x Q.50	1	17	—	—	—	—	1	17	—
,,	x Unknown	3	198	—	—	—	—	3	198	—
M.100/55	x Co. 290	2	—	—	—	—	—	2	—	—
,,	x M. 63/39	—	—	—	4	1	—	4	1	—

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.100/55	x M.147/44	2	—	—	—	—	—	2	—	—
M.107/55	x Co. 290	2	1	—	—	—	—	2	1	—
,,	x M. 63/39	—	—	—	2	—	—	2	—	—
,,	x 47 R 2777	—	—	—	2	—	—	2	—	—
M.117/55	x P.O.J. 3016	1	—	—	—	—	—	1	—	—
,,	x P.T. 43-52	—	—	—	1	206*	1500	1	206*	1500
,,	x 47 R 2777	—	—	—	1	244*	1500	1	244*	1500
M.152/55	x M.147/44	—	—	—	2	70	100	2	70	100
,,	x M.202/46	—	—	—	1	—	5	1	—	5
,,	x 47 R 2777	—	—	—	1	198	—	1	198	—
M.255/55	x M.147/44	—	—	—	2	1	—	2	1	—
,,	x M.81/52	2	1	—	—	—	—	2	1	—
,,	x M.349/55	—	—	—	1	5	—	1	5	—
,,	x M.394/57	—	—	—	1	—	—	1	—	—
M.262/55	x M.99/34	1	12	—	—	—	—	1	12	—
,,	x M.63/39	1	—	4	—	—	—	1	—	4
,,	x M.147/44	—	—	—	1	58	—	1	58	—
M.292/55	x M.196/31	1	33	—	—	—	—	1	33	—
,,	x M.99/34	2	403	—	—	—	—	2	403	—
,,	x M.63/39	1	44	—	—	—	—	1	44	—
M.307/55	x Unknown	1	—	—	—	—	—	1	—	—
M.340/55	x Co. 290	1	—	1	—	—	—	1	—	1
,,	x M.47/38	1	8	—	—	—	—	1	8	—
,,	x M.241/40	1	—	1	—	—	—	1	—	1

* Bunches of 3 and 5.

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.340/55	x M.147/44	1	83	—	2	40	—	3	123	—
,,	x M.202/46	1	1	—	—	—	—	1	1	—
,,	x M.394/57	—	—	—	1	—	—	1	—	—
M.349/55	x Unknown	1	—	—	—	—	—	1	—	—
M.351/55	x M.63/39	—	—	—	2	—	—	2	—	—
M.382/55	x M.12/49	2	—	—	—	—	—	2	—	—
M.349/55	x M.99/34	1	—	—	—	—	—	1	—	—
,,	x M.47/38	1	5	—	—	—	—	1	5	—
,,	x M.147/44	1	19	—	—	—	—	1	19	—
M.394/55	x P.O.J. 3016	1	13	—	—	—	—	1	13	—
M.402/55	x Co. 281	1	—	1	—	—	—	1	—	1
,,	x M.196/31	1	4	—	—	—	—	1	4	—
,,	x M.99/34	1	14	—	—	—	—	1	14	—
,,	x M.63/39	1	1	—	—	—	—	1	1	—
,,	x M.12/49	2	—	—	—	—	—	2	—	—
M.449/55	x M.99/34	1	—	—	—	—	—	1	—	—
M.146/56	x Co.290	1	—	—	—	—	—	1	—	—
,,	x M.196/31	1	223	—	—	—	—	1	223	—
,,	x M.112/42	1	—	—	1	—	—	2	—	—
,,	x M.147/44	—	—	—	4	7	100	4	7	100
,,	x M.85/53	1	—	—	1	15	—	2	15	—
,,	x N:Co. 310 self	—	—	—	1	18	—	1	18	—
,,	x P.O.J. 3016	1	7	—	1	3	—	2	10	—
,,	x Self	1	104	—	—	—	—	1	104	—

CROSS		Greenhouse No. Crosses	Greenhouse No. pots Bunches	Greenhouse No. pots Singles	Field No. Crosses	Field No. pots Bunches	Field No. pots Singles	TOTAL No. Crosses	TOTAL No. pots Bunches	TOTAL No. pots Singles
M.146/56	x Unknown	2	—	—	—	—	—	2	—	—
M.209/56	x 47 R 2777	—	—	—	1	—	—	1	—	—
M.212/56	x Beau Bois	2	55*	436	—	—	—	2	55*	436
,,	x M.99/34	1	61*	228	—	—	—	1	61*	228
,,	x M.394/57	1	16	—	—	—	—	1	16	—
,,	x Senneville	2	1	—	—	—	—	2	1	—
,,	x Unknown	1	5	—	—	—	—	1	5	—
M.219/56	x P.O.J. 2961	2	3	—	—	—	—	2	3	—
M.245/56	x 40 SN 5819	2	8	—	—	—	—	2	8	—
M.332/56	x M.99/34	2	111*	756	—	—	—	2	111*	756
,,	x M.63/39	1	2	—	—	—	—	1	2	—
,,	x M.12/49	—	—	—	2	—	—	2	—	—
,,	x M.403/54	1	—	—	—	—	—	1	—	—
M.361/56	x Unknown	6	884	250	—	—	—	6	884	250
M.158/57	x M.63/39	—	—	—	2	—	1	2	—	1
,,	x M.204/40	—	—	—	1	1	—	1	1	—
,,	x M.147/44	—	—	—	1	2	—	1	2	—
M.181/57	x D.109	1	—	—	—	—	—	1	—	—
,,	x M.213/40	1	—	—	—	—	—	1	—	—
,,	x M.322/51	1	6	—	—	—	—	1	6	—
,,	x M.232/52	1	—	—	—	—	—	1	—	—
,,	x M.240/59	1	74	—	—	—	—	1	74	—
M.280/57	x M.63/39	—	—	—	2	—	—	2	—	—
M.307/57	x M.63/39	—	—	—	2	—	—	2	—	—

* Bunches of 3 and 5.

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.307/57	x Unknown	2	3	—	—	—	—	2	3	—
M.308/57	x M.63/39	—	—	—	2	—	—	2	—	—
M.347/57	x M.196/31	1	1	—	—	—	—	1	1	—
,,	x M.241/40	1	—	—	—	—	—	1	—	—
,,	x M.423/41	1	6	—	—	—	—	1	6	—
,,	x P.O.J. 3016	1	12	—	—	—	—	1	12	—
M.394/57	x M.307/57	1	—	—	—	—	—	1	—	—
,,	x Unknown	4	3	—	—	—	—	4	3	—
M.436/57	x Self	2	10	—	—	—	—	2	10	—
,,	x Unknown	3	—	—	—	—	—	3	—	—
M.439/57	x M.147/44	—	—	—	6	2	1	6	2	1
M.440/57	x M.99/34	1	17	—	—	—	—	1	17	—
,,	x M.147/44	1	—	1	—	—	—	1	—	1
,,	x M.202/46	1	—	6	—	—	—	1	—	6
,,	x M.463/59	4	—	—	—	—	—	4	—	—
,,	x Q 58	1	9	—	—	—	—	1	9	—
,,	x Self	2	1	—	—	—	—	2	1	—
,,	x Unknown	1	—	—	—	—	—	1	—	—
M.441/57	x Self	2	—	—	—	—	—	2	—	—
M.442/57	x P.O.J. 3016	2	27	—	—	—	—	2	27	—
,,	x 47 R 2777	2	—	—	—	—	—	2	—	—
M.175/58	x M.99/34	1	—	—	—	—	—	1	—	—
,,	x M.241/40	1	—	1	—	—	—	1	—	1
,,	x P.O.J. 3016	1	33	—	—	—	—	1	33	—
M.206/58	x M.196/31	1	—	—	—	—	—	1	—	—

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
M.251/58	x M.147/44	1	32	100	—	—	—	1	32	100
,,	x M.349/55	1	—	—	—	—	—	1	—	—
,,	x N: Co. 310	1	73	—	—	—	—	1	73	—
M.253/58	x M.147/44	1	14	100	—	—	—	1	14	100
,,	x P.O.J. 2940	1	1	—	—	—	—	1	1	—
M.254/58	x M.196/31	1	88	—	—	—	—	1	88	—
,,	x P.O.J. 2961	1	—	6	—	—	—	1	—	6
,,	x Unknown	1	—	2	—	—	—	1	—	2
M.240/59	x Unknown	5	522	—	—	—	—	5	522	—
M.289/59	x M.63/39	—	—	—	2	—	—	2	—	—
M.463/59	x Unknown	2	2	—	—	—	—	2	2	—
M.494/59	x M.349/55	—	—	—	1	1	—	1	1	—
,,	x P.O.J. 2940	—	—	—	1	—	—	1	—	—
,,	x P.O.J. 3016	—	—	—	1	40	—	1	40	—
M.576/59	x M.63/39	—	—	—	2	—	—	2	—	—
M.633/59	x M.213/40	2	8	—	—	—	—	2	8	—
M.336	x M.147/44	—	—	—	4	—	1	4	—	1
M.L. 3-18	x 202/46	—	—	—	2	—	—	2	—	—
,,	x M.490/54	—	—	—	4	155	—	4	155	—
,,	x M.158/55	—	—	—	1	6	—	1	6	—
,,	x 47 R 4066	—	—	—	1	69	—	1	69	—
M.P. 87	x Unknown	2	—	—	—	—	—	2	—	—
27 MQ 1124	x M.147/44	2	—	1	—	—	—	2	—	9
,,	x M.219/56	1	—	—	—	—	—	1	—	—
,,	x Unknown	1	1	—	—	—	—	1	1	—

CROSS	Greenhouse			Field			TOTAL		
	No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
		Bunches	Singles		Bunches	Singles		Bunches	Singles
36 MQ 2717 x M.47/38	1	160	—	—	—	—	1	160	—
,, x M.204/40	1	11	—	—	—	—	1	11	—
,, x M.92/53	1	21	—	—	—	—	1	21	—
,, x M.403/54	1	9	—	—	—	—	1	9	—
,, x M.55/55	1	5	—	—	—	—	1	5	—
,, x M.349/55	1	—	—	—	—	—	1	—	—
,, x M.307/57	1	—	—	—	—	—	1	—	—
Mapou Perlée x M.463/59	1	—	—	—	—	—	1	—	—
N: Co. 310 x M.147/44	3	380	200	—	—	—	3	380	200
,, x M.347/57	1	266	—	—	—	—	1	226	—
,, x M.463/59	1	389	—	—	—	—	1	389	—
,, x N: Co. 310 self	—	—	—	1	—	100	1	—	100
,, x Unknown	3	1171	100	1	230	—	4	1401	100
N: Co. 310 Selfs x M.147/44	1	—	100	2	39	35	3	39	135
,, x M.202/46	—	—	—	3	19	—	3	19	—
,, x M.463/59	—	—	—	6	6	—	6	6	—
,, x N: Co. 310	1	10	—	—	—	—	1	10	—
,, x Sibbed	1	—	100	—	—	—	1	—	100
,, x Unknown	1	4	—	—	—	—	1	4	—
N: Co. 376 x M.196/31	1	126	—	—	—	—	1	126	—
,, x M.423/41	1	4	—	—	—	—	1	4	—
,, x M.147/44	—	—	—	4	810	100	4	810	100
,, x M.490/54	2	4	—	—	—	—	2	4	—
,, x M.347/57	1	16	—	—	—	—	1	16	—
,, x M.394/57	1	5	—	—	—	—	1	5	—

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
N: Co. 376	x M.280/59	1	55	—	—	—	—	1	55	—
,,	x N: Co. 310 self	1	65	—	—	—	—	1	65	—
,,	x Ebène/61	2	46	—	—	—	—	2	46	—
P.O.J. 2364	x Co. 419	1	—	—	—	—	—	1	—	—
,,	x M.112/42	1	4	—	—	—	—	1	4	—
,,	x M.147/44	1	146	100	1	18	—	2	164	100
,,	x M.85/53	1	—	—	—	—	—	1	—	—
,,	x M.146/56	1	—	—	—	—	—	1	—	—
,,	x Sdl. Cross 60-419	—	—	—	2	107	—	2	107	—
P.O.J. 2878	x M.81/52	1	41	260	—	—	—	1	41	260
,,	x M.128/52	1	—	18	—	—	—	1	—	18
,,	x M.99/53	2	—	25	—	—	—	2	—	25
,,	x M.63/54	1	3	—	—	—	—	1	3	—
,,	x M.516/54	1	—	—	—	—	—	1	—	—
,,	x M.2/55	2	—	102	—	—	—	2	—	102
,,	x M.361/56	2	—	95	—	—	—	2	—	95
,,	x M.436/57	4	—	91	—	—	—	4	—	91
,,	x M.441/57	4	—	72	—	—	—	4	—	72
,,	x M.240/59	1	34	100	—	—	—	1	34	100
,,	x 39 MQ 832	—	—	—	3	31	180	3	31	180
,,	x R 397	—	—	—	1	317	100	1	317	100
,,	x 47 R 4066	—	—	—	1	38	250	1	38	220
,,	x Unknown	1	47	—	—	—	—	1	47	—
P.O.J. 3016	x M.202/46	1	18	—	—	—	—	1	18	—
,,	x Unknown	9	7	18	—	—	—	9	7	18

CROSS		Greenhouse			Field			TOTAL		
		No. Crosses	No. pots		No. Crosses	No. pots		No. Crosses	No. pots	
			Bunches	Singles		Bunches	Singles		Bunches	Singles
P.R. 1000	x M.403/54	—	—	—	1	13	—	1	13	—
,,	x R 397	—	—	—	4	75	—	4	75	—
,,	x 47 R 2777	—	—	—	4	1038	1551	4	1038	1551
,,	x 47 R 4066	—	—	—	1	110	896	1	110	896
P T 43-52	x M.147/44	1	58	100	—	—	—	1	58	100
,,	x M.463/59	1	—	—	—	—	—	1	—	—
,,	x R 397	1	26	—	—	—	—	1	26	—
,,	x Unknown	2	129	—	—	—	—	2	129	—
Q.50	x M.63/39	1	13	—	—	—	—	1	13	—
,,	x M.204/40	3	—	1	—	—	—	3	—	1
,,	x Unknown	1	—	—	—	—	—	1	—	—
Q.56	x M.99/34	2	—	—	—	—	—	2	—	—
Q.58	x Unknown	4	99	3	—	—	—	4	99	3
R 397	x Unknown	4	1	1	—	—	—	4	1	1
47 R 2777	x Unknown	5	19	—	—	—	—	5	19	—
Rose Bambou	x M.436/59	1	—	—	—	—	—	1	—	—
Trojan	x M.72/31	2	239	—	—	—	—	2	239	—
Vesta	x Unknown	2	35	—	—	—	—	2	35	—
YEAR TOTAL**		549	10207	5980	312	14807	12754	861	25014	18734

** Does not account for stored fuzz of 50 crosses.