A STUDY OF THE GROWTH, SUCROSE ACCUMULATION AND PLANT FOOD UPTAKE OF SUGARCANE DURING SUCCESSIVE MONTHS

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Introduction

As a result of a relatively short active growing season and cold dry winters the sugarcane crop, in South Africa, remains a predominantly two-year crop. Fertiliser applications normally take place at planting and soon after, or at harvesting and soon after, and very seldom in the second year of growth or even at the end of the first year's growth. It was, therefore, decided to test out experimentally the nutrient absorption by the sugarcane plant at successive stages of growth, under our conditions, and at the same time to assess its growth rate, sucrose accumulation, purity and fibre fluctuations and do such other analyses as may be of interest.

The Experiment

The experiment was situated on a black doleritic soil on the Experiment Station, Mount Edgecombe, and consisted of three fertiliser treatments each replicated six times. The fertiliser treatments were:-

(*a*) control;

(*b*) 100 lbs. per acre each of N, P_2O_5 and K_2O; and

(*c*) 200 lbs. per acre each of N, P_2O_5 and K_2O.

All the phosphate was applied in the furrow as superphosphate. A quarter of the nitrogen and potash as ammonium sulphate and muriate of potash respectively were applied at planting on the 30th of September, 1953, to the heat-treated N:Co.310 setts, and the rest in two equal top dressings on 21st December, 1953, and 18th November, 1954. The four rows of cane to be harvested in each plot were sub-divided by four-foot breaks to give a total of twenty-four lines. One of these short lines per plot was harvested each month for twenty-four months.

For the first three months when the cane was very small the setts were dug up and the total shoots removed for weighing and analysis and thereafter the above-ground cane was cut off and used. These short lines were only seven and a half feet long and there was considerable variation between lines with the response to fertiliser small to moderate. The results reported will therefore be, unless otherwise stated, the average of all eighteen lines harvested per month irrespective of treatment.

Growth

It is known that under dry land conditions the growth made by sugarcane is at a minimum during our cold dry winter months of June, July and August. It is severely restricted during May and September and to a lesser extent during April and October, with generally good growing conditions prevailing from November to the end of March and probably the maximum growth being made during the wet hot month of February.

Some years ago growth measurements done at the Experiment Station on the varieties Co.281, Co.331 and Co.301 gave the following results in inches of growth per stick of cane per month.

Month	Growth in inches per stick	Rainfall in inches	Mean Temperature in °F
January	6.7	3.05	75.6
February ...	7.6	6.59	73.2
March	7.2	2.22	72.8
April	5.3	3.90	71.1
May	3.7	0.49	66.2
June	2.6	0.56	64.0
July	1.5	0.10	62.3
August	0.9	0.21	64.3
September ...	1.3	2.45	67.8
October ...	5.3	4.72	68.0
November ...	4.7	6.53	70.2
December ...	5.5	5.79	73.5

In this case the elongation during January to March amounted to 41 per cent. of the total for the year and that occurring from October to December was 30 per cent., with April to June equalling 22 per cent. and July to September only 7 per cent.

Graph I illustrates the data and shows clearly how the growth curve follows those of rainfall and mean temperature.

In the experiment now completed on N:Co.310 plant cane, the weights of the total cane plant including leaves and trash, are available for the whole of the twenty-four months, growth period and the amount of millable cane was weighed separately from the end of the eighth month. The results obtained were as follows:

Date Sampled	Month used for rainfall etc.	Approx. age in months	Tons Cane per Acre Whole plant	Millable cane	Moisture in whole plant	Monthly rainfall in inches moisture	Monthly mean temp. in °F
30/10/53	Oct.	1	0.1	—	0.08	2.02	69.2
1/12/53	Nov.	2	0.5	—	0.4	4.92	70.7
4/ 1/54	Dec.	3	3.0	—	2.5	6.10	73.2
1/ 2/54	Jan.	4	8	—	7	3.31	73.1
1/ 3/54	Feb.	5	16	—	13	4.23	74.6
31/ 3/54	March	6	27	—	22	3.39	72.9
29/ 4/54	April	7	29	—	22	0.95	69.4
28/ 5/54	May	8	29	18	22	2.02	66.4
30/ 6/54	June	9	29	19	21	0.55	62.5
31/ 7/54	July	10	27	18	18	0.41	61.4
30/ 8/54	August	11	30	21	20	1.52	63.1
30/ 9/54	Sept.	12	29	20	19	5.42	66.3
1/11/54	Oct.	13	34	24	24	10.78	67.7
1/12/54	Nov.	14	37	25	27	3.67	69.9
5/ 1/55	Dec.	15	43	30	30	1.08	73.2
2/ 2/55	Jan.	16	46	30	32	7.64	73.1
7/ 3/55	Feb.	17	57	42	41	1.44	74.0
4/ 4/55	March	18	63	49	44	6.50	72.1
3/ 5/55	April	19	70	53	49	3.22	69.6
1/ 6/55	May	20	68	55	48	0.61	66.2
4/ 7/55	June	21	72	59	49	0.60	62.5
2/ 8/55	July	22	76	62	50	0.17	62.9
31/ 8/55	August	23	67	55	43	0.87	62.4
6/10/55	Sept.	24	79	67	50	3.71	63 9

The above Table and Graph No. II shows that the weight of whole cane remained practically unaltered from April to September in 1954 and there was only a slight increase for the same period in 1955. In both cases the increase in tons millable cane was somewhat better but still very small. Growth as reflected in both total plant weight and tons millable cane was excellent from December to March and here it is interesting to note that rate of increase in 1953-54 when the cane was three to six months was very similar to that for the same period in 1954-55 when the cane was fifteen to eighteen months old. It can also be seen that the unseasonable drought of December 1954 made itself felt and is reflected in a flattening of the cane per acre curve in January 1955. The exceptionally heavy rains of October 1954 and to a lesser extent September and November 1954 resulted in good growing conditions from October to December 1954 and it is difficult to compare this period with that of the year before when the cane was either germinating or very young. It is the difference in growth between these two periods, however, which accounted largely for the fact that considerably more cane was obtained during the second year's growth than the first.

Sucrose Accumulation

From the end of May 1954 when the cane was about eight months old to the end of the experiment when the cane was twenty-four months, sucrose, purity, fibre, etc., were regularly determined.

As a result of increased crops to be handled our normal crushing season has now been considerably extended. The first factories often start as early as April and some do not close down until sometime in February. This experiment enabled us to follow the percentage fluctuations of sucrose of a crop from the same field for seventeen consecutive months and also to assess the total amount of sucrose per acre obtainable from the field each month. The results are given in the following table:

Date Sampled	Sucrose per cent. Cane	Tons Sucrose per acre	Date Sampled	Sucrose per cent. Cane	Tons Sucrose per acre
28/ 5/54	12 31	2 2	7/ 3/55	12 94	5.4
30/ 6/54	15.11	2.9	4/ 4/55	12.08	5.9
31/ 7/54	16.92	3.0	3/ 5/55	12.53	6.6
30/ 8/54	17.72	3.7	1/ 6/55	13.23	7.3
30/ 9/54	18.74	3.7	4/ 7/55	16.16	9.5
1/11/54	15.32	3.7	2/ 8/55	16.65	10.3
1/12/54	14.06	3.5	31/ 8/55	16.92	9.3
5/ 1/55	13.96	4.2	1/10/55	17.80	11.9
2/ 2/55	14.43	4.3			

Normally sucrose per cent. cane reaches a peak about September or October and then declines gradually to November and December with a further fall in later months if crushing is continued. The above table and Graph No. III show an excessive fall in sucrose per cent. cane during October and November, a somewhat unexpected rise in January and an expected absolute low during March or April. The rapid fall of sucrose per cent. cane during October to November was undoubtedly the result of the exceptionally heavy rainfall of October 1954 which has already been referred to. In fact this fall in sucrose content was so great that in spite of renewed excellent growth there was no accumulation of sucrose per acre and actually a downward tendency was evident. It would appear that the cane which was at a very high sucrose level just before the rain used some of the stored energy in the form of sucrose to make the extra growth when extremely moist and cloudy conditions suddenly developed.

The rise in sucrose per cent. cane during January may possibly be the result of the December drought.

On the average, fertiliser seems to have had a slightly depressing effect on sucrose per cent. cane. Thus the average of fifteen sucrose determinations gave 15.27 per cent. on the control plots, 15.01 and 15.09 per cent. on the medium and heavily fertilised plots respectively.

Yield of cane was, however, increased as a result of fertiliser application, the medium fertilised plots as millable cane averaged 104 per cent. of the controls over sixteen successive months and the heavily fertilised plots 111 per cent. of controls over the same period. The heavily fertilised plots only once averaged slightly less than the controls and then it was 99.6 per cent. of the control.

Cane Quality and Cane Tops

Juice purity, reducing sugars, reducing sugar ratio and fibre per cent. cane were determined on all cane samples. Purity and reducing sugars bear the expected relationship to sucrose per cent. cane and will not be commented on further. Fibre per cent. cane can be expected to rise with the desiccation of cane. During this experiment the crop went through dry winters but this did not seem to affect the fibre per cent. cane in this way as will be seen from the following table.

Date	Fibre % cane	Date	Fibre % cane	Date	Fibre % cane
28/5/54	9.93	1/12/54	11.99	1/ 6/55	12.99
30/6/54	11.60	5/ 1/55	12.57	4/ 7/55	12.42
31/7/54	11.15	2/ 2/55	12.31	2/ 8/55	13.72
30/8/54	10.85	7/ 3/55	12.35	31/ 8/55	13.27
30/9/54	11.25	4/ 4/55	12.86	6/10/55	12.98
1/11/54	11.58	3/ 5/55	11.99		

The tendency here appears to be for the fibre per cent. cane to increase with the age of the crop rather than during the dry winter period. The average results from our factories also show that fibre per cent. cane in general decreases from May to September or October and thereafter rises again. The conclusion must therefore be drawn that the loss of moisture is compensated for, or more than compensated for, by the rise of sucrose in cane during our winter months. The result is that the ratio of sucrose to fibre rises steeply during the winter to early spring months. It is also interesting to note that the sucrose to fibre ratio is appreciably higher in one-year-old cane than in two-year-old cane. Thus for the months of May to September when comparable figures were available, the eight- to twelve-months-old cane had a percentage sucrose to fibre ratio of 147.2 and the twenty- to twenty-four-months-old cane a percentage ratio of 123.6.

During the visit to this country of the eminent sugar technologist, Dr. Pieter Honig, surprise was expressed at the amount of top left on our cane for the mills. It was then decided, whilst busy on this experiment, once again to test out the juice quality of cane tops during different periods of growth. For this purpose the cane was divided into four parts, i.e. the first two inches from the breaking point at the top, the next four inches, the next six inches, and the rest of the cane. Sucrose and purity were determined and the percentage ash content of the juice was also done. The results are given in the table shown at the foot of this page.

It will be seen from this table that the sucrose content and purity of the top of the cane stalk are extremely variable. When the cane is fully mature, purities of over 60 or 70 can be obtained from the cane top two to six inches from the breaking point, but when the cane is still in active growth or has not had time to ripen, this same part may have juice purities as low as 15 to 20 or much lower than that of the juice from the upper two inches in winter. The upper part of the cane stalk invariably contains large amounts of ash and at times as much ash as sucrose may be introduced into the factory in the upper two inches of cane. These higher parts of the cane stalk are also very rich in plant nutrients, which were regularly determined. Thus the analyses of these parts of the cane harvested on the 1st June 1955 were as follows:

	2 inches from Top	Next 4 inches	Next 6 inches	Rest of cane
N % cane ...	0.270	0.184	0.121	0.067
P_2O_5 % cane	0.126	0.066	0.041	0.026
K_2O % cane ...	0.538	0.329	0.226	0.092

The last two inches of cane is therefore about five times as rich, on a percentage basis, in plant nutrient as the mature stick of cane. It is obviously in the interest of all concerned to keep this immature cane top in the field. It is of no value in the factory where the sucrose is not recoverable and the ash constituents can only cause trouble and it is of decided value in the cane field where its return will mean the recirculation of valuable plant nutrients while transport and handling costs are eliminated.

Date Sampled	2 inches from Top: Sucrose per cent. Cane	Purity	Ash per cent. Juice	Next 4 inches: Sucrose per cent. Cane	Purity	Ash per cent. Juice	Next 6 inches: Sucrose per cent. Cane	Purity	Ash per cent. Juice	Rest of Cane: Sucrose per cent. Cane	Purity	Ash per cent. Juice
30/9/54 ...	5.08	38.0	1.31	12.11	79.8	0.74	17.44	92.4	0.56	19.18	94.5	0.28
2/2/55 ...	1.17	10.8	1.26	2.10	20.0	0.78	8.17	71.4	0.51	15.92	93.7	0.32
3/5/55 ...	1.57	17.4	1.37	1.36	16.2	0.85	2.95	34.5	0.57	13.22	89.5	0.35
1/6/55 ...	1.62	16.3	1.32	1.76	15.4	0.82	4.41	41.7	0.57	13.87	89.8	0.30
4/7/55 ...	4.09	31.2	1.19	6.09	46.3	0.78	9.82	67.6	0.61	15.61	90.3	0.35
2/8/55 ...	7.41	37.7	1.09	9.67	66.0	0.66	12.54	77.2	0.55	16.97	94.8	0.31
31/8/55 ...	8.07	48.5	—	10.64	63.8	—	13.43	76.4	—	17.34	90.2	—
6/10/55 ...	8.90	58.4	—	12.16	74.5	—	14.91	84.5	—	18.28	93.7	—

Plant Food Uptake

Mineral nutrients were regularly determined in the total cane plant so as to get an idea of the uptake of plant foods with time. The percentage composition on a dry basis was as follows:

Date Sampled	Approx. Age in months	Per cent. N	Per cent. P_2O_5	Per cent. K_2O	Per cent. CaO	Per cent MgO
30/10/53	1	1.99	0.81	4.21	0.41	0.48
1/12/53	2	1.81	0.56	2.89	.45	.45
4/ 1/54	3	1.76	0.50	3.14	.34	.43
1/ 2/54	4	1.42	0.40	2.59	.35	.46
1/ 3/54	5	1.20	0.45	2.41	.36	.38
31/ 3/54	6	0.87	0.23	1.56	.31	.35
29/ 4/54	7	0.78	0.19	1.12	.32	.37
28/ 5/54	8	0.70	0.15	0.98	.31	.35
30/ 6/54	9	0.61	0.16	0.89	.35	.33
31/ 7/54	10	0.63	0.15	0.78	.30	.30
30/ 8/54	11	0.56	0.13	0.61	.21	.28
30/ 9/54	12	0.48	0.12	0.55	.23	.26
1/11/54	13	0.49	0.12	0.56	.21	.29
1/12/54	14	0.55	0.13	0.57	.26	.30
5/ 1/55	15	0.48	0.12	0.51	.27	.29
2/ 2/55	16	0.39	0.12	0.42	.24	.29
7/ 3/55	17	0.48	0.13	0.49	.22	.24
4/ 4/55	18	0.48	0.13	0.47	.21	.22
3/ 5/55	19	0.42	0.13	0.41	.19	.24
1/ 6/55	20	0.39	0.12	0.50	.18	.21
4/ 7/55	21	0.36	0.11	0.37	.18	.22
2/ 8/55	22	0.35	0.11	0.35	.18	.24
31/ 8/55	23	0.37	0.10	0.39	.16	.23
6/10/55	24	0.35	0.10	0.30	.14	.23

Fertiliser application did have an effect on the percentage composition of the samples. Thus the high level of fertiliser application resulted in an average increase in the percentage composition of N, P_2O_5 and K_2O of 10, 25 and 8 per cent. respectively for the first three months of growth. For the three months period nineteen to twenty-one months, the increase in phosphate had fallen to 12 per cent. and the other two remained more or less the same as they were.

The quantities of plant foods taken up by the crop during its growth are given by the following table:

Date Sampled	Approx. Age in months	Lbs. per Acre N	P_2O_5	K_2O	CaO	MgO
30/10/53	1	.56	.23	1.19	.10	.12
1/12/53	2	3.47	1.09	5.67	.85	.85
4/ 1/54	3	17.59	5.07	32.32	3.41	4.31
1/ 2/54	4	38	11	69	9	13
1/ 3/54	5	68	26	122	20	21
31/ 3/54	6	89	23	159	32	36
29/ 4/54	7	102	25	148	43	49
28/ 5/54	8	102	22	144	42	47
30/ 6/54	9	103	26	150	59	56
30/ 7/54	10	107	26	133	52	52
30/ 8/54	10	111	25	120	42	55
30/ 9/54	12	91	23	104	44	50
1/11/54	13	98	25	113	42	58
1/12/54	14	113	26	117	55	63
5/ 1/55	15	123	32	132	69	74
2/ 2/55	16	108	33	116	65	79
7/ 3/55	17	158	44	161	72	78
4/ 4/55	18	179	49	181	78	82
3/ 5/55	19	179	56	181	81	102
1/ 6/55	20	162	51	207	74	86
4/ 7/55	21	166	49	171	83	102
2/ 8/55	22	179	56	179	95	127
31/ 8/55	23	178	46	184	76	110
6/10/55	24	200	57	172	80	135

In this experiment an attempt was made to weigh and analyse the total aerial portion of the cane plant including dry leaves. It was inevitable, however, that a certain amount of dead leaves got lost and consequently the total uptake of plant food might have been a little higher than given.

The nitrogen status of the crop was evidently better than the potash status and the ratio of nitrogen to potash in the plant is somewhat higher than normal, but on the whole the crop did take up appreciably more potash than nitrogen, particularly so during the first year of growth. The phosphate uptake is as expected, much lower. Somewhat more MgO than CaO was absorbed.

Ignoring minor fluctuations, which must be expected in data of this nature, it is clear as shown in Graph No. IV that plant foods are mainly taken up during the maximum growing periods of the first and second year. During the winter months nitrogen and phosphate uptake comes practically to a standstill, whereas in the case of potash the indications are very strong that the aerial part of the plant actually looses potash during the winter months.

It is interesting to note that the plant food uptake during the second year of growth is comparable in quantity to that of the first year and that this applies equally to phosphate, which is generally considered so important for the early development of the plant. It further seems obvious that whatever is done to stimulate growth during the early stages of development, conditions must not arise during the second year that will retard further development, and for this reason adequacy of mineral nutrients is essential for the second year's active growth period. In this experiment it was found, however, that the plant does take up relatively more of its total plant nutrients from the applied fertiliser in its early stages of growth. Thus the plants with the high rate of fertiliser had 56, 37 and 31 per cent. more P_2O_5, N and K_2O respectively than controls for the first three months, whereas the corresponding average increases at the nineteen- to twenty-one-months-old cane were 26, 23 and 23 per cent., some of which was due to the heavier uptake in the earlier months.

Although leaf analyses were done regularly on both mid-laminae samples and total third leaf as well as on leaf sheaths, it is not intended to discuss these here, except to point out the potash level became rather low during the second year of growth and that it reached a peak in May-June with a minimum value about January. Nitrogen and phosphate levels were of course very low during the dry winter months when whole cane composition remained relatively constant and dropped rapidly during the early stages of growth.

Summary

A study was made of the growth, sucrose accumulation and plant food absorption of N:Co.310 at the Experiment Station, Mount Edgecombe. For this purpose monthly harvestings were made and analyses done. From the end of the eighth month sucrose, purity, fibre, etc., analyses were also done on the millable cane. Separate analyses were done on portions of the top foot of the cane stalk to examine the quality of the juice and the mineral nutrients contained in it.

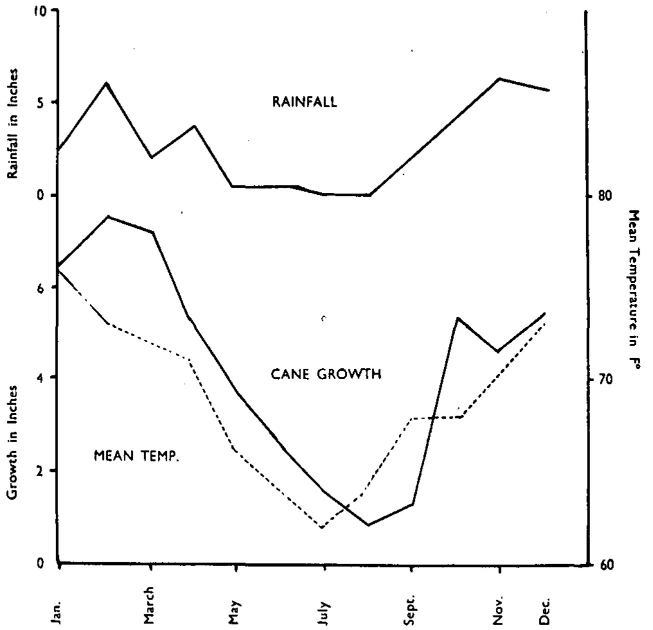
It was found that the total weight of the cane plant comes virtually to a standstill during our cold dry winter months but there is a small gain in millable cane during these periods and a very considerable gain in sucrose per acre because sucrose per cent. cane is rapidly increasing during this period to a maximum in about September. The accumulation of sucrose proceeded fairly steadily throughout the period tested with the exception of the period following heavy rains in October 1954.

The sucrose and purity of juice from cane tops vary a great deal with season. These juices are, however, always very high in ash and plant foods, and at least a portion of them are always more economically left in the field.

In this experiment leaf analyses pointed to possible potash deficiency during the second year's growth, and the total potash uptake was low compared with that of nitrogen although on the whole more potash than nitrogen was taken up. Second season's uptake of nutrients was comparable with that of the first year but during the cold dry winter months nutrient absorption virtually ceased as far as nitrogen, phosphate, calcium and magnesium are concerned and there were indications that the aerial part of the plant actually lost potash.

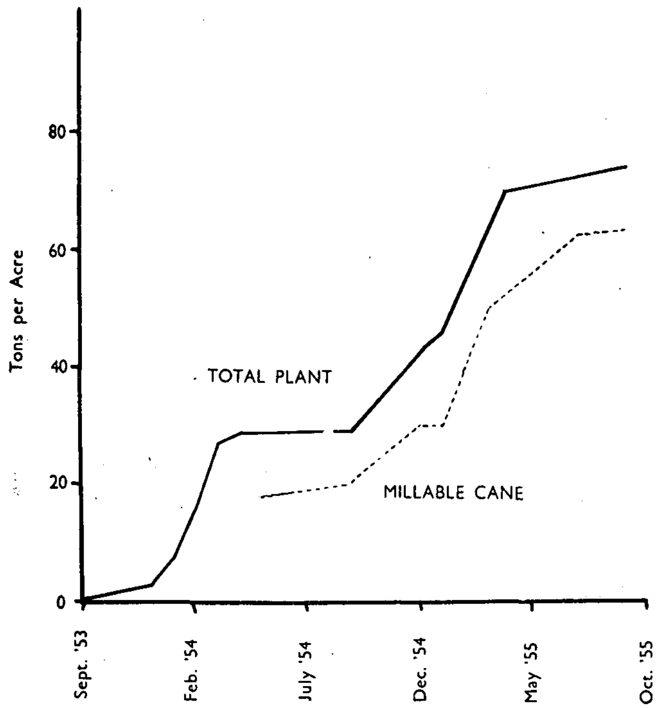
These tests were done on plant cane only, but it is hoped to continue work on ratoon cane later.

GRAPH No. I



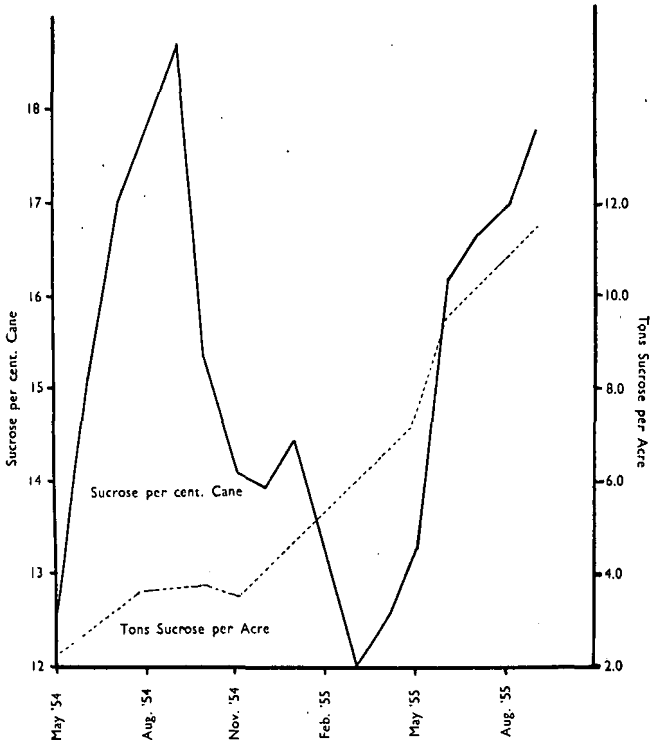
MONTHLY INCREMENTS OF CANE LENGTH, RAINFALL AND MEAN TEMPERATURE

GRAPH No. II



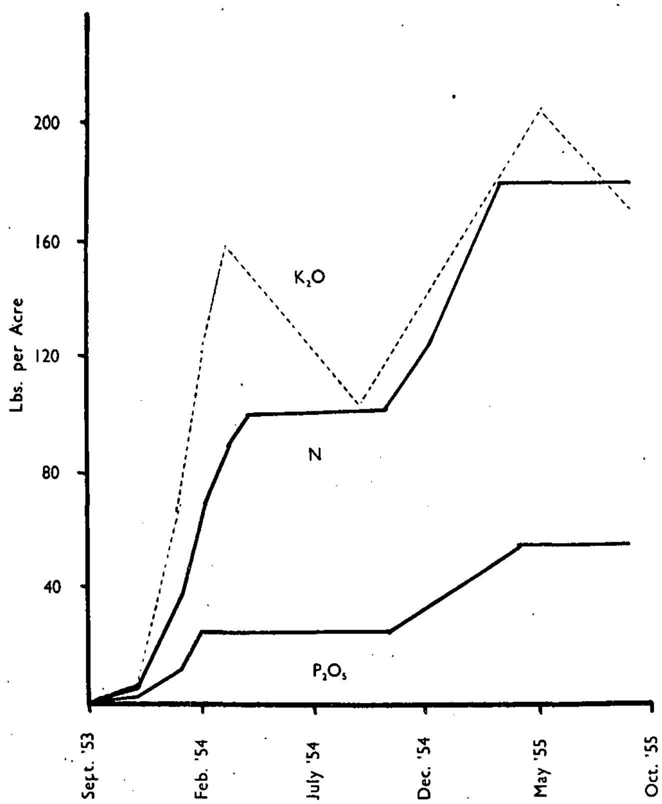
TONS TOTAL CANE AND TONS MILLABLE CANE

GRAPH No. III



SUCROSE PER CENT. CANE AND TONS SUCROSE PER ACRE

GRAPH No. IV



LBS. N, P_2O_5 AND K_2O PER ACRE

Dr. Dick, in the Chair, referred to his own observations on the effect of defoliation on the length of internode of cane and asked whether Mr. du Toit had considered using measurements of internodes as an index of rate of growth. He wondered if Mr. du Toit had been able to shew any relationship between leaf area and length of internode.

Mr. du Toit replied that it was well known that conditions of poor growth gave rise to the formation of very short internodes. He did not, however, use the length of internode as a quantitative measure in this experiment.

Dr. Dick asked if Dr. Brett could indicate if the number of internodes was more a matter of time than of growing conditions.

Dr. Brett said that work at the Experiment Station had indicated that prevailing conditions had little effect upon the number of internodes formed within a given time. Work in Formosa had suggested that the supply of food substances from a particular leaf had a great influence upon the length of the corresponding internode.

Mr. Barnes said an interesting point was the delayed growth following changed weather conditions. He said that on a certain estate overseas where the rainfall was about 90 inches per annum, the sucrose held for a longer period than on another estate which was irrigated. Here the effect of rain on sucrose and juice purity was apparent in a very much shorter time.

Mr. Main said that it was well known that after heavy rainfall the sucrose and purity of cut cane fell considerably. This was understandable, but the same also applied to growing cane. He would like an explanation for this and why recovery took some time after the rainfall occurred.

Mr. du Toit agreed that under certain circumstances rainfall might have an immediate adverse effect on sucrose and purity of cane as was shown in this experiment. Recovery would necessarily take some time as it was dependent on further sucrose formation.

Dr. Dodds said that he noticed from the figures in the paper that more magnesia than lime was taken up. Lime was applied to the soils in various forms but magnesia was seldom applied. He wished to know if there were any indication of magnesium deficiencies in the cane belt. He noted that experiments shown in the paper were carried out only on N:Co.310 and he enquired if there was any intention to carry out similar experiments on other varieties.

Mr. du Toit stated that the ratio of magnesium to calcium was higher in millable cane than in leaves and consequently the magnesium drain from our fields was considerable. Magnesium deficiency was therefore a distinct possibility in future and even more so where more potash was likely to be applied in future.

It was not his intention to repeat this type of experiment on all new varieties but the nutrient content of different varieties was now determined.

Mr. Pearson considered that this type of experiment might be helpful to agriculturists by providing a guide as to when to apply various plant foods. He was aware that dressings of nitrogen were applied in the furrow in this experiment but because of the smallness of the sample the treatments were combined. He asked Mr. du Toit if he had any figures reflecting the differential amount of fertiliser applied.

Mr. du Toit said that some results showing the effect of treatment on cane composition were given. He hoped, however, to continue this experiment as a ratoon and hoped then to find bigger responses and bigger differences in composition due to fertiliser application.

Dr. van der Pol referred to graph 3 and said that if one looked at the peak of sucrose in cane it would be seen that this was narrow. He assumed that it was the same in the second year. He noticed that Mr. du Toit had not intended carrying out this experiment on other varieties. He asked if Mr. du Toit did not think that if this type of experiment was applied to other varieties it might be possible to establish early maturing varieties and late maturing varieties.

Mr. du Toit reminded the meeting that the sudden fall in sucrose per cent cane shown in the graph was the result of exceptionally heavy rains. Normally the deterioration of N:Co.310 would not be as rapid. Past tests had indicated that we had no variety which reached a peak sucrose content either early or late in the season. All our varieties reached their peaks much the same time although the steepness of the curve varied on either side of the peak and consequently some varieties can be cut more profitably early or late in the season. Varietal comparisons of this nature will be done in future but he pointed out once again that all varieties would not be submitted to such an exhaustive test as reported here.

Mr. Rault said that a few years ago, he had carried out a complete per cent analysis of the mineral constituents of cane juice, from the average sample of ash collected by calcining the mixed and clarified juices during the whole of the crushing season.

He was not so much interested in the plant food taken by the cane, but on the effect of clarification, and elimination of mineral non-sugars, and had found that the carbonatation process eliminated practically the whole of the magnesia content of raw juice.

At that time the ash of cane juice contained more magnesia than lime.

Mr. du Toit was welcome to the samples of cane juice ash he had collected and was still collecting for a number of seasons, for future reference.

Dr. Dodds said that in many agricultural industries a certain uniform lime-magnesia ratio in the soil was considered of importance. Possibly Mr. Sexton had now gained some information in this mattei under local conditions.

Mr. du Toit said he had no information as to the optimum quantities of calcium and magnesium which should be present in the soil.

Mr. Sexton in reply to a query by Dr. Dodds said he could not tell how important was the ratio of calcium to magnesium or what it should be, but he had found in soil, calcium was about twice the quantity of magnesium and this applied similarly to cane leaves where the ratio was $1\frac{1}{2}$ to 1.