Fertiliser Trials on Sugar Cane at Umbogintwini

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In a paper read at the Fifth Annual Sugar Congress in May, 1927, a programme was given of the sugar cane experiments laid down at Umbogintwini during the 1926 planting season. The present paper deals chiefly with the results of these experiments, together with one or two started prior to that time.

As practically all the cane in these experiments remained free from Streak Disease during its growing season, it was all used for plant cane after being cut. In consequence, it was found necessary to weigh the cane untrashed. Numerous determinations of the percentage of trash on the various plots of cane were made, and it was ascertained that the average figure was fifteen per cent. This figure was therefore deducted from all weights obtained, in order to get a true cane figure.

The weighing was carried out on a platform scale, supplied with a cradle, in the field, and was capable of handling 1,000 lbs. for each weighing.

It was unfortunate that these experiments had to be planted on a hillside, owing to the impossibility of obtaining sufficient flat land for the purpose. As a result, it will be noted that there are very considerable differences between the yields from the plots at the top of the hill and those given similar treatment at the foot of the hill. This difficulty was foreseen at the time of planting, and plots treated in the same manner were distributed as evenly as possible, in order to get a representative average. In the same way, the controls were uniformly distributed.

In all the fertiliser trials conducted, wherever any one of the three essential plant foods (phosphate, potash and nitrogen) was tested, all the plots, including controls, were supplied with the other two plant foods. Thus in a phosphate series, where the effects of different forms of phosphate were being investigated, all the plots, including controls, were supplied with nitrogen and potash. On the other hand, where nitrogen was being tested, phosphates and potash were applied to all plots.

First Phosphate Series.

Object.—To determine the effect of various ground rock phosphates, i.e. Egyptian, Morocco, Florida and Christmas Island, on the yield of sugar cane.

In all plots, including controls, Sulphate of Potash and Sulphate of Ammonia, at the rate of 100 lbs. and 150 lbs. per acre, respectively, were applied.

The phosphates were applied according to the phosphate content, and in all cases the actual amount of phosphoric oxide was the same. The basis was 400 lbs. of Egyptian Rock Phosphate and the other phosphates were adjusted to this amount, according to total content of phosphoric oxide of each rock.

The plots were one-twentieth of an acre in extent, and a boundary row was left between each plot. The layout of the plots and yields obtained were as follows :—

No. of Plot	Phosphate Treatment	Yield of Sugar Cane per acre, in tons
1.	Control	26.78
2.	Egyptian Rock Phosphate	30.69
3.	Morocco Rock Phosphate	25.83
4.	Control	25.82
5.	Florida Rock Phosphate	41.05
6.	Christmas Island Rock Phosphate	38.23
7.	Control	31.91
8.	Egyptian Rock Phosphate	39.07
9.	Morocco Rock Phosphate	30.48
10.	Control	24.92
11.	Florida Rock Phosphate	28.28
12.	Christmas Island Rock Phosphate	30.09
13.	Florida Rock Phosphate	32.50
14.	Control	27.01
15.	Christmas Island Rock Phosphate	36.59
16.	Control	27.53
17.	Morocco Rock Phosphate	38.35
18.	Egyptian Rock Phosphate	42.63
19.	Control	36.48
20.	Florida Rock Phosphate	46.73
21.	Christmas Island Rock Phosphate	47.30
22.	Control	40.47
23.	Morocco Rock Phosphate	40.97
24.	Egyptian Rock Phosphate	46.70

The average yields for the various treatments are as follows :—

Egyptian Phosphate	Morocco Phosphate	Christmas Island Phosphate	Florida Phosphate	Controls
39.77	33.91	38.05	37.14	30.78

From these results, it will be seen that the sugar cane derives considerable benefit from the application of rock phosphate in the untreated state, and that the Egyptian Rock Phosphate, which is the one generally recommended, gave the highest return.

Second Phosphate Series.

Object of Experiment.—To compare the yields of Sugar Cane obtained from plots treated with the following :—

(1) Basic Slag.
(2) Kyphos (a mixture of Rock Phosphate and Superphosphate).
(3) Superphosphate.

The plots were one-twentieth of an acre in extent, and each treatment was carried out in quadruplicate. All plots, including controls, were supplied with 150 lbs. Sulphate of Ammonia and 100 lbs. Sulphate of Potash per acre.

The following table shows the tonnages obtained from the various treatments :—

No. of Plot	Treatment	Yield in tons per acre
1.	Basic Slag	44.98
2.	Kyphos	46.62
3.	Superphosphate	47.96
4.	Control	35.71
5.	Superphosphate	49.10
6.	Kyphos	49.67
7.	Basic Slag	53.32
8.	Control	49.83
9.	Superphosphate	51.31
10.	Kyphos	51.42
11.	Basic Slag	50.54
12.	Control	42.81
13.	Superphosphate	50.68
14.	Kyphos	49.61
15.	Basic Slag	46.86
16.	Control	36.10

The average tonnages for the various treatments are as follows :—

Basic Slag	Kyphos	Superphosphate	Controls
48.92	49.33	49.80	41.11

The results obtained from these experiments again clearly show the necessity for applying phosphate to the sandy soils of the South Coast. The average yields show Superphosphate and Kyphos to be slightly superior to Basic Slag.

Third Phosphate Series.

Object of Experiment.—To ascertain which mixture of Egyptian Rock Phosphate and Superphosphate gave the best results.

The mixtures used were as follows :—

(1) 4 parts Rock and 1 part Superphosphate.
(2) 3 parts Rock and 1 part Superphosphate.
(3) 2 parts Rock and 1 part Superphosphate.
(4) 1 part Rock and 1 part Superphosphate.

All plots, including controls, were supplied with 100 lbs. Sulphate of Potash and 150 lbs. Sulphate of Ammonia per acre.

The quantity of the Rock and Super mixture applied in each instance was equivalent to 106 lbs. of phosphoric oxide per acre.

The tonnages obtained from the various plots were as follows :—

No. of Plot	Phosphate Treatment	Yield of Sugar Cane in tons, per acre.
1.	4 Rock Phos. plus 1 Super.	46.04
2.	3 Rock Phos. plus 1 Super.	44.94
3.	Control	33.53
4.	2 Rock Phos. plus 1 Super.	43.46
5.	1 Rock Phos. plus 1 Super.	40.57
6.	Control	28.95
7.	4 Rock Phos. plus 1 Super.	37.60
8.	3 Rock Phos. plus 1 Super.	39.70
9.	Control	24.75
10.	2 Rock Phos. plus 1 Super.	31.96
11.	1 Rock Phos. plus 1 Super.	31.63
12.	Control	20.34
13.	4 Rock Phos. plus 1 Super.	30.04
14.	3 Rock Phos. plus 1 Super	28.34
15.	Control	10.01
16.	2 Rock plus 1 Super	27.56
17.	1 Rock plus 1 Super.	34.84
18.	Control	16.31
19.	4 Rock plus 1 Super.	28.37
20.	3 Rock plus 1 Super.	29.92
21.	Control	14.75
22.	2 Rock plus 1 Super.	30.16
23.	1 Rock plus 1 Super.	30.42
24.	Control	14.57

The average tonnages for the various treatments are as follows :—

4 Rock plus 1 Super	3 Rock plus 1 Super	2 Rock plus 1 Super	1 Rock plus 1 Super	Controls
35.51	35.75	33.29	34.36	20.39

Here again, is seen the tremendous effect of phosphates on the yield of sugar cane. There does not, however, appear to be any great differences between the plots treated with the different ratios of Rock Phosphate to Superphosphate.

It will be noted that some of the controls towards the top of the slope are exceedingly poor, and during the growing period it was seen that the lack of phosphates had a very large influence on the plants in these plots, and that the adjoining plots, with phosphates, were a long way ahead of these.

These upper plots were badly exposed to the wind and the weakling plants in the controls appeared to suffer severely from the exposure.

Potash Series.

Object of Experiment.—To determine whether Chloride (Muriate) or Sulphate of Potash had the greater beneficial effect on the yield of sugar cane.

These plots were planted in November, 1926, and reaped in September, 1928. All plots, including controls, were supplied with a mixture of 300 lbs. Superphosphate, 300 lbs. Egyptian Rock Phosphate and 150 lbs. Sulphate of Ammonia per acre.

Each plot was one-twentieth of an acre in extent, and an unfertilised boundary row was left between each plot.

The quantity of potassium oxide added per acre in each instance, was 48 lbs.

The following shows the results obtained from the various plots :—

No. of Plot	Treatment	Yield in tons, per acre
1.	Sulphate of Potash	44.23
2.	Chloride of Potash	41.13
3.	Control	40.35
4.	Sulphate of Potash	45.81
5.	Chloride of Potash	44.91
6.	Control	39.52
7.	Sulphate of Potash	43.51
8.	Chloride of Potash	47.28
9.	Control	42.12
10.	Sulphate of Potash	35.18
11.	Chloride of Potash	40.24
12.	Control	36.78

The average tonnages per acre from the various treatments are as follows :—

Sulphate of Potash	Chloride of Potash	Controls
42.55	43.76	39.69

The figures obtained show that there is a very definite increase in yield from the use of potash, and that this is the case with both Chloride and Sulphate of Potash, although the former appears, in these experiments, to give the greater benefit.

First Nitrogen Series.

Object of Experiment.—To ascertain which of the following nitrogenous compounds gave the most benefit to sugar cane under the conditions existing at Umbogintwini.

Nitrate of Soda.
Sulphate of Ammonia.
Urea.
Whale Guano.

The plots were planted in October, 1926, and cut in October, 1928. All plots were one-twentieth of an acre in extent, and each treatment was conducted in quadruplicate. All plots, including controls, were treated with a mixture of 300 lbs. Superphosphate, 300 lbs. Rock Phosphate and 100 lbs. Sulphate of Potash per acre. The nitrogen was all placed in the furrow at time of planting, and in each case, the quantity of nitrogen was 31 lbs. per acre, equivalent to 200 lbs. Nitrate of Soda.

The following gives the yields obtained from each plot, together with the form in which the nitrogen was applied to each :—

No. of Plot	Form in which Nitrogen was applied	Yield in tons, per acre
1.	Sulphate of Ammonia	38.98
2.	Nitrate of Soda	41.83
3.	Control	42.96
4.	Whale Guano	43.17
5.	Urea	48.85
6.	Control	44.43
7.	Sulphate of Ammonia	43.47
8.	Nitrate of Soda	46.42
9.	Control	49.63
10.	Whale Guano	50.09
11.	Urea	46.48
12.	Control	52.32
13.	Urea	43.48
14.	Whale Guano	45.38
15.	Control	48.22
16.	Nitrate of Soda	39.82
17.	Sulphate of Ammonia	41.06
18.	Control	42.96
19.	Urea	33.80
20.	Whale Guano	30.86
21.	Control	29.43
22.	Nitrate of Soda	29.11
23.	Sulphate of Ammonia	42.70
24.	Control	32.44

The average tonnages from the different treatments are as follows :—

Sulphate of Ammonia	Nitrate of Soda	Whale Guano	Urea	Controls
41.55	39.29	42.32	43.15	42.54

It will be seen from these figures that there is very little increase in the tonnage from the use of nitrogen in any form, and that in the cases of Sulphate of Ammonia and Nitrate of Soda, there is actually a decrease.

Second Nitrogen Series.

Object.—To ascertain the increase in yield obtainable by applying Nitrate of Soda at the following rate per acre :—

(1) 100 lbs.
(2) 200 lbs.
(3) 300 lbs.
(4) 500 lbs.

The application of Nitrate of Soda was made in three dressings, as follows :—

15 per cent. applied one month after planting.
25 per cent. applied in the April after planting.
60 per cent. applied in the Spring of the year following planting.

The plots were planted at the beginning of December, 1926, and were carried out in quadruplicate. The following mixture was applied to all plots, including controls, at the time of planting :—

300 lbs. Superphosphate, per acre.
300 lbs. Rock Phosphate, per acre.
100 lbs. Sulphate of Potash, per acre.

The following table gives the tonnages of cane cut from the different plots, when cut in October, 1928 :—

No. of Plot	Quantity of Nitrate of Soda applied	Tonnage of Cane per acre
1.	100 lbs. Nitrate of Soda	52.07
2.	200 lbs. Nitrate of Soda	52.87
3.	Control	51.98
4.	300 lbs. Nitrate of Soda	51.49
5.	500 lbs. Nitrate of Soda	52.16
6.	Control	47.10
7.	100 lbs. Nitrate of Soda	49.21
8.	200 lbs. Nitrate of Soda	48.94
9.	Control	48.92
10.	300 lbs. Nitrate of Soda	44.86
11.	500 lbs. Nitrate of Soda	36.26
12.	Control	36.46
13.	100 lbs. Nitrate of Soda	38.40
14.	200 lbs. Nitrate of Soda	41.95
15.	Control	39.71
16.	300 lbs. Nitrate of Soda	35.55
17.	500 lbs. Nitrate of Soda	38.04
18.	Control	37.03
19.	100 lbs. Nitrate of Soda	42.07
20.	200 lbs. Nitrate of Soda	41.69
21.	Control	37.37
22.	300 lbs. Nitrate of Soda	40.05
23.	500 lbs. Nitrate of Soda	39.60
24.	Control	33.55

The average tonnages from the various treatments are as follows :—

100 lbs. Nitrate of Soda	200 lbs. Nitrate of Soda	300 lbs. Nitrate of Soda	500 lbs. Nitrate of Soda	Controls
45.69	46.36	42.99	41.51	43.59

From these results it would appear that the method of applying the Nitrate of Soda as top dressing is better than applying same at time of planting, as was done in the previous series. There is a decrease in yield from the 300 and 500 lb. applications, whereas the lighter dressings show increases Under our small rainfall and sandy soil conditions, it would not be payable to make heavy applications of nitrate of soda to sugar cane.

General Fertiliser Series on Argentine Selection Cane (P.O.J. 213).

Object of Experiment.—To ascertain what results could be obtained by fertilising Argentine selection, and how the various plant foods affected the yields.

The treatments of the various one-twentieth acre plots were as follows :—

(1) 4 plots Phosphate only.
(2) 4 plots Phosphate and Potash.
(3) 4 plots Phosphate and Nitrogen.
(4) 4 plots Phosphate, Potash and Nitrogen.
(5) 8 plots no fertiliser (controls).

The fertilisers used were as follows :—

(1) Phosphate.—300 lbs. Superphosphate, plus 300 lbs. Egyptian Rock Phosphate per acre.
(2) Nitrogen.—150 lbs. Sulphate of Ammonia per acre.
(3) Potash.—100 lbs. Sulphate of Potash per acre.

The following table gives the layout of the plots, together with the yields per acre.

No. of Plot	Treatment	Yield in tons, per acre
1.	Phosphate	22.75
2.	Phosphate and Potash	26.44
3.	Control	28.57
4.	Phosphate and Nitrogen	30.35
5.	Phosphate, Nitrogen and Potash	26.48
6.	Control	19.71
7.	Phosphate	30.30
8.	Phosphate and Potash	28.81
9.	Control	28.30
10.	Phosphate and Nitrogen	31.65
11.	Phosphate, Nitrogen and Potash	25.78
12.	Control	21.67
13.	Phosphate	25.47
14.	Phosphate and Potash	28.45
15.	Control	25.21
16.	Phosphate and Nitrogen	27.81
17.	Phosphate, Nitrogen and Potash	29.25
18.	Control	19.17
19.	Phosphate	27.60
20.	Phosphate and Potash	24.67
21.	Control	20.52
22.	Phosphate and Nitrogen	21.17
*23.	Phosphate, Nitrogen and Potash	19.80
*24.	Control	15.47

*Damaged by Cattle.

The average tonnages from the various treatments were as follows :—

Phosphate	Phosphate and Nitrogen	Phosphate and Potash	Phosphate Potash and Nitrogen	Controls
26.53	27.79	27.09	27.17	23.30

UBA CANE versus ARGENTINE CANE (P.O.J. 213).

Object of Experiment.

To ascertain which of the two canes gave the higher yield under similar conditions.

Four one-twentieth acre plots of each were planted alternately and all plots were fertilised with 600 lbs. of a complete mixed fertiliser. The tonnages obtained were as follows :—

No. of Plot	Type of Cane	Yield in tons per acre
1.	Argentine	20.84
2.	Uba	29.25
3.	Argentine	26.59
4.	Uba	38.84
5.	Argentine	25.13
6.	Uba	40.30
7.	Argentine	28.53
8.	Uba	39.00

The average tonnages from each type of cane were as follows :—

Argentine	Uba
25.27	36.84

Both canes took two years to mature, and from the above results it would appear that on sandy soils and under low rainfall conditions, Uba cane is far superior to Argentine selection.

RESIDUAL EFFECT OF FERTILISERS ON RATOON SUGAR CANE.

A series of single plot experiments were laid down in 1924, and the first cutting of cane from these plots was made during 1926. As these plots were laid out as demonstration plots, more than fertiliser trials, there were no repetitions of the various treatments, and the results obtained were therefore not of much value. During 1928, the first ratoons from these plots were reaped, no further fertilisers having been applied after the first cutting. The following table gives the weights of sugar cane obtained in 1926, together with those obtained in 1928 :

Field Plot No.	Treatment of Plots per Acre 1924	Tons per acre cut 1926	Tons per acre cut 1928
33.	Control (no fertiliser	28.28	23.19
34.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as S/Amm. & Whale Guano 40lbs. Potash as Chloride	42.32	26.49
39.	72lbs. P_2O_5 as Super 14½lbs. Nitrogen as Sul/Amm. and Whale Guano 40lbs. Potash as Chloride	41.17	27.05
40.	Control (no fertiliser)	19.31	20.43
41.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as Sul/Amm. and Whale Guano 40lbs. K_2O as Chloride 600gls. Molasses	44.92	32.76
42.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as Sul/Amm. and Whale Guano	40.05	28.73
43.	Control (no fertiliser)	25.26	23.05
44.	111lbs. P_2O_5 as Rock & Super (95% Rock) 40lbs. K_2O as Chloride	36.50	31.74
45.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as Sul/Amm. and Whale Guano 40lbs. K_2O as Chloride 500lbs. Silicate of Soda	37.27	27.03
46.	Control	22.45	25.18
47.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as Sul./Amm. and Whale Guano 40lbs. K_2O as Chloride Mixture cont. ½% Magnes.	37.63	27.83
48.	111lbs. P_2O_5 as Rock & Super (95% Rock) 14½lbs. Nitrogen as Sul/Amm. and Whale Guano 40lbs. K_2O as Chloride 5gls. Microl	40.04	22.88

The figures given above are interesting, as they show that the plots fertilised in 1924, gave much smaller yields for the ratoon cutting than they did when the crop from the plant cane was cut. It is evident that the plant cane crop utilised most of the plant foods available in the fertilisers, and that the residual effect was comparatively small.

It will also be noted that the plots left untreated in 1924, yielded practically at the same rate for plant cane crop and first ratoon crop. This makes the drop in yield from the second cutting of the fertilised section all the more significant.

The average yield from the fertilised plots in 1926, was 40.06 tons per acre against 27.99 tons in 1928, or a difference of 12.07 tons. The average of the controls in 1926 was 23.82 tons, and 23.21 tons in 1928.

Umbogintwini, 25th March, 1929.

Discussion following the reading of a paper on the above subject by Mr. E. S. Caudwell.

Chairman: This very long and interesting paper suggests a large number of subjects for discussion that might very well occupy all the remaining time of the Congress. They are specially interesting when taken in conjunction with the results obtained from the Experiment Station, because many of these experiments were planned co-operatively and have been duplicated identically with us.

Generally speaking, I think one may say that the results obtained at Umbogintwini are diametrically opposed to those obtained at Mount Edgecombe, except for one fact which I think is more or less common to all our soils, that is the response to phosphatic fertilizer of almost any kind. But it shows the necessity for duplicating our field work in all typical soils which are of any commercial importance in the Sugar Industry. On just a casual glance through these experiments one can see that the bugbear here has been, as we know only too well at the Experiment Station, the variability of our soils and the extraordinary difference you get in yields from equal sections that have been treated precisely the same. We have had a good deal of experience of this at the Experiment Station, and it is a difficulty that is met with in experimental work everywhere, but is greater in Natal than in any other land I know. The mean experimental error is not shown in this paper but in many cases it must be sufficiently great to discount any small difference in average yields, so I do think one should only place stress on those results where a considerable difference in yield is to be seen.

To just glance through the experiments in detail —the first one mentioned is the comparison of Rock Phosphates of different origin, in which it is shown that there is no material difference between any of those except that perhaps Egyptian phosphate happens to show a little more than the rest, but I don't think it can be considered a significant difference The main fact arising there is the response to phosphate even in its insoluble form. At Mount Edgecombe we have a similar series to this in progress. We have found there is very little apparent response as yet to rock phosphate whether of pyrogenetic or fossiliferous origin, but where it has been mixed with superphosphate there is a difference beginning to be shown, and that is in line with our experiments generally at Mount Edgecombe. We have found there that the phosphate must be in a rapidly available or soluble form to be of value for the plant cane crop. That evidently is not the case at Umbogintwini, nor is it the case in our experiments at Empangeni. The principal differences in soil are that at Umbogintwini where these experiments were carried on, they are in a wind blown sandy soil, very light in character and poor in chemical analysis, but as you can see it is capable of giving remarkably good results in yields of cane in the two very dry seasons we have had. The soil at Mount Edgecombe is of sedimentary origin, and rather heavy clay loam. It has been under cane for a very long time, whereas the Umbogintwini soil is virgin so far as sugar cane is concerned.

With regard to the various forms in which phosphate can be applied, we found that the super is the best with us, and it is practically equalled by basic slag, but at Umbogintwini there is no practical difference between any of the three forms, basic slag, superphosphate, or rock phosphate. The same applies to the result of the potash experiments. We found so far as our experiments have gone up to the present, that sulphate of potash is rather better than the chloride, but the difference is so small and the experimental error so large that I would not place any great stress on the results. But the results at Umbogintwini show exactly the opposite so far as they have gone. The same with the nitrogen series. You will see at Umbogintwini there was very little response to any form of nitrogen; what little response there was, was mostly shown in the plots fertilized with urea. In our experiments urea was the only series which gave a monetary loss. It showed a very slight increase but not sufficient to pay for the cost of the fertilizer, whereas with the sodium nitrate, which gives a loss at Umbogintwini in their comparative nitrogen series, we got a very considerable and profitable increase at Mount Edgecombe. It shows again the necessity for dealing with our typical soils separately and not drawing conclusions from one type and applying them generally to others.

Another very interesting fact is the result with the Argentine cane or P.O.J. 213 with which it has now been identified. In a paper I have prepared for this Congress I show that P.O.J. 213 gives remarkably superior results to Uba in our soils at Mount Edgecombe, whereas at Umbogintwini it is very much the opposite. Another point that is very evident here is that although the fertilizer gives remarkable high increases in the plant cane, it is very much reduced in the first ratoons, and that shows the necessity for fertilizing ratoons in our sandy soils. We have not yet come to the stage of testing any of our ratoon experiments at the Experiment Station, but in our experiments at Empangeni in heavy chocolate loam we found the residual effect of the fertilizer, even a light dressing of insoluble rock phosphate and a moderate dressing of ammonium sulphate, gave almost equal increases to the first ratoons as to the plant cane. In other words its effect was shown four years after planting to almost as great an extent as at first. This paper is a particularly interesting one, and we are very much indebted to Mr. Caudwell and African Explosives and Industries Limited for having carried out and reported these very interesting and valuable experiments.

Mr. Masters: It is of great interest to me as a Natal Estates man to see the experiments with treacle, as I notice other ingredients were used with it. I would like to say that our experiments with treacle and scum cake have been almost unique. We have put on treacle at the rate of five to seven tons per acre and also 400 pounds per acre of superphosphate. I am allowing for the four years of drought, and the controls are not as reliable as they might be, but we could find no difference between where we put the treacle on and where we had added the 400 pounds of superphosphates. I don't wish to be dogmatic on this point as we are going to carry out further experiments, but one of our sub-managers expressed the wish that he would like to try treacle without the addition of any superphosphates as he was of the opinion that the superphosphates with the treacle would not give any better results. Then again on our sandy soils on the beach side we have found that the scum cake, which I think contains 30 to 40% lime, gave about the same result. I have always been very strong for superphosphates as an addition to the scum cake, but during the past four years candidly we cannot see any appreciable difference with the addition of this 400 pounds of superphosphates with the scum cake, where the latter has been properly applied on the very sandy soils. I now come to the nitrogen. Our experiments with nitrogen are absolutely the same as experienced at Umbogintwini. Some four or five years ago we carried out exhaustive experiments of one acre each with 100, 200, 300, 400 and 500 pounds respectively per acre of nitrogen. The results were quite negative. You could not tell when the cane was twelve months old which had had one hundredweight and which had had five. In the same field we tried sulphate of ammonia with different results, there was certainly an improvement. But in other parts of the world nitrate of soda has given good results, and I had to change all my ideas when I came to this country. Sulphate of ammonia we liked where we had a good rich soil of depth, but sulphate of ammonia must be used very carefully where you have a shallow soil because it has a very souring effect. Our experience up to the present—though we are not quite convinced yet—has been that nitrate of soda has given no result. Sulphate of ammonia has given results but has to be used very judiciously. Our experience with nitrogen manures up to the present time has been that an organic nitrogen has always given better results than either nitrate of soda or sulphate of ammonia. Our best results have been obtained with meat meal containing 8 to 10% nitrogen. This paper by Mr. Caudwell is of extreme interest and we can all learn something from it.

Mr. Caudwell: In the nitrogen series I may say that with the whale guano and urea the difference from the controls was very marked at the twelve months growth, but when we cut the plots we could see no difference at all. In the early stages they appeared to be much superior.

Chairman: That was our experience also as regards whale guano. It was the only one in which we could see any apparent benefit in the earlier stages. Consequently we were fully prepared for the increase we actually found from that series, but I must say it came as an entire surprise to us that the sodium nitrate plots had equalled and even surpassed those, as there was no indication at any stage that it would be so. Our results were concordant and each treatment replicated four times, and I have no doubt that in that particular experiment sodium nitrate was effective.

Mr. Masters: We are still carrying on with the nitrate of soda experiments in addition to other fertilizers. We have entered into an arrangement with the Chilean Nitrate Syndicate and we have ten plots which are being treated. We are watching this very carefully and no doubt we will have some interesting figures later on.