USE OF MOLASSES ON THE LAND

A REPORT OF FOUR EXPERIMENTS BEING CARRIED OUT BY THE TONGAAT SUGAR COMPANY, LTD.

By T. G. CLEASBY

Molasses is undoubtedly the most valuable by-product from the sugar mill. It is a source of alcohol and other chemicals, and is an important constituent of animal feeds. Its value on the European market varies between £10 and £14 per ton. In South Africa the average price paid to the miller is less than 1d. per gallon, or 12s. per ton, which explains why he can consider disposing of it to advantage on his fields. It has not been done to any extent in the past because of doubt about the response which would be obtained in terms of tons sugar per acre and also the difficulties involved in handling it in large quantities.

It is the purpose of this paper to show again the fertiliser value of molasses, both in terms of its nutrient content and the response which has been obtained in some recent experiments being carried out by The Tongaat Sugar Company.

The majority of sugar producing countries have found more profitable outlets for their molasses and do not use much on the land. Considerable quantities are still used, however, in Mauritius and Australia. Without going into details, it may be concluded from work in these, and other countries, that where soils are deficient in potash and of poor structure, the application of molasses is extremely beneficial. In soils high in potash with good physical properties, the response[1] appears to be proportional only to the nitrogen content of the molasses, and can be equalled by the application of ammonium sulphate or other forms of nitrogen.

In Natal, extensive areas exist where the soil is deficient in potash, as indicated by field experiments, soil and plant analysis. In addition, there are areas where the soil has poor physical properties, notably in the middle and lower ecca shales, and the dwyka conglomerate soils. It seems, therefore, from the work done in other countries, that favourable conditions exist in South Africa to justify the wide-scale use of molasses on the land.

The mean analysis[2] of Tongaat molasses from the 1957 crop has been reproduced in the following table:

THE COMPOSITION OF TONGAAT MOLASSES IN THE 1957 CROP

Substance	*Per cent by Weight*
Water	21.36
Sucrose	34.42
Glucose+fructose	15.18
Gums	4.37
Starch (included in gums) ...	0.72
Wax	0.54
Nitrogen	.65
Soluble silica (SiO_2)	0.27
Phosphates (P_2O^5)	0.28
Potash (K_2O)	3.46
Calcium (CaO)...	1.05
Magnesium (MgO)	1.10
Total sulphated ash	13.10

If the fertiliser value of molasses is based on its nitrogen, phosphate and potash content, then it can be evaluated as follows:

	% by wt.	Amt. per ton	Amt. per 1,000 galls.	
Nitrogen N	0.65	13.3 lbs.	91 lbs.	=273 lbs. Am. Nitr.
Phosphate P_2O^5 ...	0.28	5.6 lbs.	39.2 lbs.	=196 lbs. Super Phos.
Potash K_2O ...	3.46	69.2 lbs.	484.2 lbs.	=781 lbs. Muriate of potash

Or, in terms of money, using the basic fertiliser prices for 1959.

	Amount per 1,000 galls.	*Value per 1,000 galls.*	
Nitrogen	273 lbs.	£3 16 6	(£28 0 0 per ton)
Superphosphate	196 lbs.	£1 1 6	(£11 0 6 per ton)
Muriate of potash	781 lbs.	£7 19 0	(£20 8 0 per ton)
		£12 17 0	value per 1,000 galls.
	OR	£1 17 0	per ton

This is necessarily a minimum value because it does not take into account the minor and trace elements contained in molasses, or its organic content both of which could benefit the cane. The case of magnesium is worth noting. An application of 1,000 gallons of molasses contains approximately 150 lbs. of magnesium oxide, which is equivalent to an application of 950 lbs. of dolomitic lime (45 per cent magnesium carbonate).

The effect of molasses on the soil is firstly to supply considerable quantities of plant food, in particular potassium, but also appreciable quantities of nitrogen, magnesium, phosphate and calcium. In addition, some trace elements are applied, but which, and in what quantity, is not known by the author. In Australia it is claimed that molasses has a beneficial effect on the structure of heavy clay soils with poor physical properties. It is supposed to improve their tilth and bring about an increase in the number and stability of the soil aggregates. Molasses is said to be of particular value on soils sensitive to both wet and dry conditions. As far as is known no reason has been given for this effect on soil structure, but it is undoubtedly a function of the organic content of the molasses.

A third action of molasses on the soil is glibly spoken of as an effect on the micro-organic population. This is done with very little understanding of what actually takes place. It appears that there is a partial sterilisation of the soil, with a corresponding change in the colonies and populations of organisms. The outcome of this is a possible increase in nitrification, resulting in an increase in the soil nitrogen in a form available to the plant. Further discussion on this effect of molasses applied to the soil is really outside the scope of this paper and its author.

Four molasses experiments are being carried out at Tongaat. One has been harvested as a 1st ratoon and the other as plant cane only. It is too early to draw any final conclusions from these experiments, but in addition, molasses has been used in the fields during the past three years and observations confirm the beneficial results which will be seen in the experimental results. The experience gained in handling molasses in the field and the current interest being shown in the application of molasses justifies reporting the results which have been obtained so far.

Experiment I was planted in 1954 and designed to test the effect of molasses, trace elements and magnesium in an area of recent sand so weak that it has been termed "growth failure".

The results of this experiment may be summarised as follows:

(i) An increase of 10.1 tons per acre as plant cane to an application of 800 gallons per acre of molasses and 7.3 tons per acre as 1st ratoon, to a second application of 1,000 gallons per acre. The result for the plant cane crop was mathematically significant but at 1st ratoon it could not be analysed statistically.

(ii) A residual effect of 3.8 tons per acre due to the molasses applied at planting which, again, could not be assessed statistically.

(iii) No effect from magnesium and trace element treatment.

(iv) The sucrose per cent cane was unaffected by the molasses treatment. It appeared to be reduced by magnesium in plant cane, when the reduction was significant, but it has not been reproduced in the 1st ratoon crop.

Although a significant increase in the yield has been obtained from molasses applications, the overall result from the experiment suggests that factors other than N, P and K are limiting. It is now believed that parasitic nematodes or eelworms are a problem in these areas and molasses, although of some benefit, is not capable of bringing them into full production, even when combined with liberal applications of organic matter and fertilisers.

The second ratoon crop of this experiment looked so unpromising after a molasses application of 2,000 gallons per acre, that it has been ploughed out. The experiment will be put back after the soil has been sterilised with E.D.B. Smut disease in the variety Co.301 was also very bad and finally influenced the decision to plough out.

Experiments II, III and IV were put down at the same time in October 1956, to test the effect of molasses at 1,000, 2,000, 3,000 and 4,000 gallons per acre on a recent sand, lower ecca shale and a T.M.S. soil. A number of other treatments were included in the experiments and have been recorded in the summary of the results.

Experiment II. Molasses trial on a recent sand harvested as plant cane, age 19 months, variety N:Co.292, Random Block design.

Treatment	Yield t.p.a.	Sucrose %	Response over control t.p.a.
Control	37.4		—
Molasses 1,000 g.p.a. ...	46.0		8.60
Molasses 2,000 ,, ...	40.0		2.60
Molasses 3,000 ,, ...	48.0	Not	10.60
Molasses 4,000	45.0	Taken	7.60
Molasses ash 1,000 lbs./a	35.7		−1.70
Sugar 1,000 lbs./a	34.2		−3.20
Sugar+molasses ash... ...	40.5		3.10

Overall fertiliser treatment, ammonium nitrate 350 lbs./acre Superphosphate 800 lbs./acre, potash 280 lbs./acre

This experiment shows rather variable results (standard error 15.16 per cent) and the only molasses treatment to reach significance is the 3,000 gallons per acre level. The mean effect of molasses is, however, significantly better than control. No significance can be attached to the sugar and molasses ash treatment which has yielded better than the control and the sugar and molasses ash treatment separately.

Experiment III. Molasses trial on lower ecca shale harvested as plant cane, age 19 months, variety N:Co.339. Design a Latin square.

Treatment	Yield t.p.a.	Sucrose %	Response over Control t.p.a.
Control	66.8	14.04	—
Molasses 1,000 g.p.a.... ...	73.1	13.82	6.3
Molasses 2,000 ,, ...	74.8	13.97	8.0
Molasses 3,000 ,, ...	75.6	13.98	8.8
Molasses 4,000 ,, ...	76.6	14.20	9.8
Muriate of potash 750 lbs./acre+Am. nitrate 180 lbs./a	70.9	13.97	4.1

Overall fertiliser treatment, Ammonium Nitrate 350 lbs./acre, Superphosphate 800 lbs./acre, Potash 180 lbs./acre.

There is a highly significant difference between the molasses treatments and the control, but no significance between the individual levels of molasses. The difference in yield between the potash and ammonium nitrate treatment and the control is not significant, neither is the difference between this treatment and 1,000 gallons per acre of molasses.

Experiment IV. Molasses Trial on T.M.S. soil harvested as plant cane, age 21 months, variety N:Co.339. Factorial design with three levels of nitrogen.

Treatment	Yield t.p.a.	Sucrose %	Response over Control t.p.a.
Control	45.8	14.9	—
Molasses 1,000 g.p.a.... ...	55.2	15.0	9.4
Molasses 2,000 ,, ...	56.8	15.1	11.0
Molasses 3,000 ,, ...	58.4	14.9	12.6
Molasses 4,000 ,, ...	61.3	14.9	15.5
300 lbs./a Am. Nitrate ...	53.9	14.9	—
450 ,, ,, ,, ...	56.0	15.0	2.1
600 ,, ,, ,, ...	56.5	15.0	2.6

Overall fertiliser, Superphosphate 800 lbs./acre, Potash 180 lbs./acre.

The response to molasses is highly significant and in this case the increase with the amount of molasses is also significant. The small increase in yield due to the higher levels of nitrogen is not significant and barely economical.

Comments on the results of Experiments II, III and IV

1. Significant responses have been obtained from the application of molasses in all three experiments. They have also shown a trend in which the yield continues to rise with increasing amounts of molasses up to 4,000 gallons per acre. In each experiment an overall dressing of potash was applied, corresponding to field practice. If this had not been done, the response to molasses could possibly have been greater.

2. Some of these increases in yield are economical on the basis of the plant cane crop only, if the molasses is valued at 1d. per gallon and the cost of application (by the Tongaat method, which will be described later), at 7s. 6d. per ton or £2 12s. 6d. per 1,000 gallons. This value has been taken on the high side as it is only a rough estimate until detailed costs can be worked out. If the value of cane produced by a molasses treatment is £1 7s. 6d. per ton (i.e. £1 17s. 6d. less 10s. for cutting and transport to the factory), then the amount of cane required to 'break even' is shown in the following table.

Treatment	Cost of molasses	Cost of Application	Total Cost	Tons cane/acre required to cover total cost.
	£	£	£	
1,000 gallons	4 3 4	2 12 6	6 15 10	5 tons
2,000 ,,	8 6 8	5 5 0	13 10 0	10 ,,
4,000 ,,	16 13 4	10 10 0	27 0 0	20 ,,

These figures suggest that the economical level of application is in the region of 1,000 gallons/acre, but this could be changed in the light of the ratoon results when residual effects may be found and will have to be taken into consideration.

3. The effect of molasses applications on the soil has been investigated. Soil samples taken before the application of molasses and at first ratoon have shown that the molasses has had little effect on the soil phosphate, pH, organic matter and the carbon-nitrogen ratio. Unfortunately no figures are available for magnesium. There has been a marked effect on the soil potash which might have been anticipated, and is shown in the following table.

EFECT OF MOLASSES ON THE SOIL POTASH

Expressed as lbs. K_2O per acre 6 inches

Treatment	Experiment II Recent Sand		Experiment III Lower Ecca Shale		Experiment IV T.M.S.	
	Before Plntg.	1st Ratoon	Before Plntg.	1st Ratoon	Before Plntg.	1st Ratoon
No molasses	110	126	196	254	88	76
Molasses 1,000 g.p.a.	104	152	216	386	104	120
Molasses 2,000 ,,	100	192	200	518	102	132
Molasses 3,000 ,,	82	232	170	728	88	150
Molasses 4,000 ,,	78	156	260	876	94	170

In the recent sand and T.M.S. soil, it is obvious that considerable quantities of potash applied in the form of molasses have been removed or leached from the top foot of soil. On the lower ecca shale the potash has remained concentrated near the surface. A separate experiment on a recent sand showed a fairly small but uniform increase in soil potash when sampled as a first ratoon down to a depth of four feet. It also indicated, from the amount of potash applied in the molasses at planting, that considerable quantities had leached below this level. Assuming that potash is at least partially responsible for the beneficial effect of molasses it will be interesting to see what residual effects occur on these three soil groups.

4. The application of molasses appears to have had no effect on the sucrose per cent cane.

5. The other treatments incorporated in the experiments have not shown up to any extent.

(i) The potash and ammonium nitrate treatment equivalent to 1,000 gallons of molasses did not yield as well as this treatment, although the difference was not statistically significant.

(ii) The molasses ash at 1,000 lbs./acre (K_2O 27 per cent) and sugar together did increase the yield over control but the high standard error in this experiment has made it impossible to draw any conclusions.

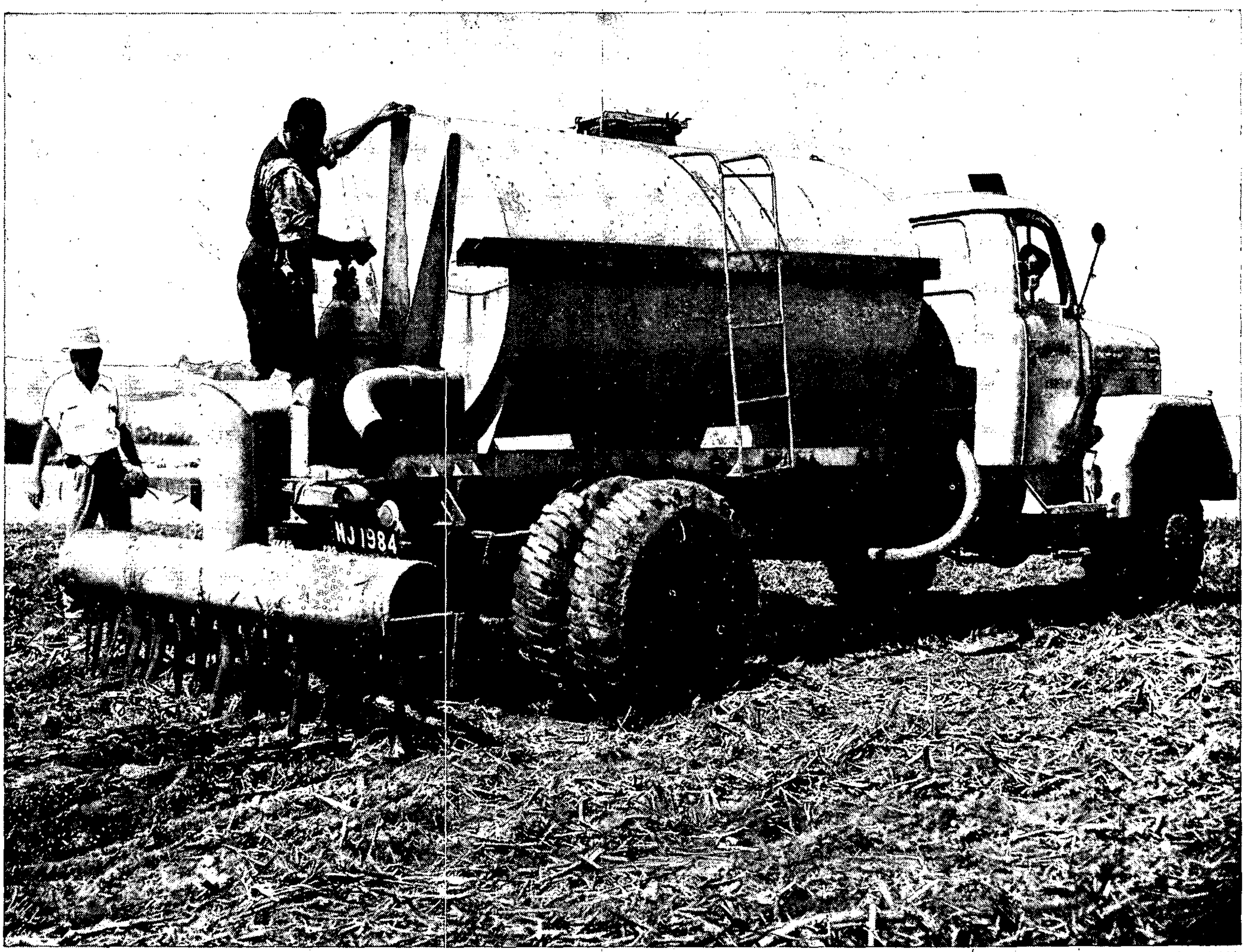
(iii) The higher levels of nitrogen in the experiment on T.M.S. have produced a small increase in yield which, as has already been mentioned, was not statistically significant. This response to nitrogen on plant cane on T.M.S. soils is now quite common in the absence of molasses.

6. At this stage it is not possible to draw any conclusions as to whether molasses has had any beneficial effect on soil structure. This may be observed when the experiments are ploughed out.

Practical Side of the Application of Molasses to the Land

Molasses has been applied to the land at Tongaat at an average rate of 1,500 gallons per acre. Although this figure was at first arbitrarily chosen, the experiments reported above indicate that it is not too far from the mark. It has been used chiefly on the recent sands where the results have been most encouraging. These areas have received primary attention due to their weakness, potash deficiency and their proximity to the source of the molasses.

The realisation that potash is deficient in the soil fairly generally, has led to a change in policy, with the result that much more molasses is being distributed away from the coast on shale, dwyka and T.M.S. soils. In fact, potash deficiency judged by soil and leaf analysis, has become the chief criterion of where to apply molasses. So far the amount



applied on T.M.S. soils has been small but this is chiefly due to their distance from the factory. The results of the experiment on T.M.S. soil reported in this paper will lead to more liberal applications in the future.

Some molasses has been used in ratoon cane as is the practice in Mauritius and Australia. It has been of considerable benefit to the cane from observations, and has been without any detrimental effect during, or immediately after, application. However, while there are so many areas to be planted which appear to show potash deficiency, it is better to use the limited supply of molasses available to help to establish the best possible plant cane crop.

The method of application at Tongaat is well known, and can be seen to advantage in the photograph reproduced on page 98. The four-wheel drive Magirus-Deutz tanker takes molasses from the factory and distributes it on flat land and reasonable slopes directly. The capacity of the tank is 1,000 gallons which weighs approximately 7 tons.

The method works well and economically for relatively short journeys to and from the factory. For more distant areas an alternative method is being considered, although it is not yet in operation. The suggestion is that a tanker is used to deliver the molasses to a convenient point on the section where it is transferred to a smaller tanker, or tankers, which will do the actual field distribution. A 500 gallon tank pulled by a Fordson tractor is actually in use and has worked very well indeed. In this case the expensive unit is occupied entirely in delivering molasses and it could probably be increased in capacity. The idea may involve small storage facilities on sections, but this will depend on the number of secondary tankers it is decided to operate.

In conclusion, one further point is worth making. If molasses is applied to the land in conjunction with filter cake, all the elements removed from the soil by the cane are returned. This is the element of good husbandry, for it ensures that no serious depletion of the soil can take place and that there is a minimum of wastage. At Tongaat we are convinced that the application of molasses to the land is not only good farming, but that it is also economical.

Acknowledgments

The author would like to thank the S.A. Sugar Experiment Station for the statistical analysis of the experiments and the S.A.S.A. Fertilizer Advisory Service for analysing the soil samples from all the experiments.

REFERENCES

[1] G. Rouillard: Annual Report 1954, Mauritius Sugar Institute, page 40–42.

[2] P. N. Boyes: The Condenser, Vol. IV No. 1, 1958, page 44.

Mr. du Toit welcomed this paper on molasses used as a fertilizer. He was associated with the first molasses experiment put down at Tongaat and he congratulated Dr. Cleasby on the progress made.

Dr. Cleasby replying to a question by Mr. Bentley about the discrepancy in the table of soil test results where the control plots differed in the soil potash although they had not received molasses, pointed out that all the land had had treatment with potash apart from the application of molasses. Some of the discrepancy might be due to errors in soil sampling.

Mr. Pearson said that he chiefly regarded molasses as being capable of supplying potash to the soil, but he wondered if the increased yields might also be due to nitrogen supplied in the molasses. He said that it was noticed that there was no further increase in yields of ratoons, which fell into line with the results found at the Experiment Station where nitrogen gave an increased yield in the crop to which it was applied but no residual effect in subsequent crops. He would like to ask Dr. Cleasby if in Experiment 4 there was any interaction between the quantities of molasses and the quantities of nitrogen applied.

Dr. Cleasby said it was possible that the nitrogen in the molasses had had an effect. He thought that the possibility of responses from potash was more likely than from the nitrogen. Statisticians could not find interaction between nitrogen and the potash in the molasses.

Dr. Cleasby replying to a question by Mr. Coignet said that no one knew exactly what happened when molasses was applied to the soil as regards the population of organisms. Under laboratory conditions it had been shewn that application of sugar to soil might increase the nitrogen through nitrifying organisms but he could not say if this was happening in the field.

Mr. du Toit said that the Tongaat Company should be congratulated on doing this work so thoroughly. This type of effort was very much welcomed by the Experiment Station. Dr. Cleasby had made out an excellent case for the application of molasses to the fields under certain conditions such as where there was low potash and poor soil structure. It was however, interesting to note that so little potash had been found in the soil after the tremendous application of molasses. He had thought that a greater effect would be shown than was actually demonstrated in the table. In sandy soils there was hardly any residual effect at all. Dr. Cleasby had explained that this was probably due to leaching, but it was rather remarkable that it could have leached out to this tremendous extent. In the case of Ecca soils the effect was not so noticeable, but the huge amount put in was certainly not shown up in the soil analysis. If this happened to potash what would happen to nitrogen? Dr. Cleasby had shown that with the ridiculously low price we get for molasses it was more valuable as a fertilizer.

Dr. Cleasby commented that at Tongaat they were most interested in what was happening to the potash from the molasses on soils and they had adapted an old water purification plant to an lysometer and were now studying the amount of leaching taking place. They had now come to the conclusion that large applications of potash must be split on sandy soils to minimise leaching.

Mr. Rault said that he was interested in the range of cane sucrose content of this investigation. He wanted to know what time of the year the cane was cut; was it this season or the year before? He said that this year the average sucrose content of cane was extremely low and very few canes had reached 15 per cent level at the factories. It had been stated very often that with higher yields, the sucrose content had a tendency to be lowered. This was not shown from the results given in this paper, where the substantial increase of 10 tons of cane per acre had no depreciating influence on the average high sucrose content of the better-grown material.

Dr. Cleasby said that most of the experiments had been cut between July and October. As far as the sucrose content was concerned the experimental plots were reaped in small samples and tested in the laboratory and they invariably obtained results about 2 per cent higher in sucrose per cent cane compared with the factory figures. He thought one explanation was the fact that the cane was well topped and very well trashed. There might be other factors as well. He was not aware that increasing the fertilizer necessarily meant that the cane should be lower in sucrose per cent cane, if under the same climatic condition.

Mr. du Toit said that the difference between experimental and mill results was too big to be explained only by the cleanliness of the cane. Another point was that only well-grown cane was tested in the laboratory whereas some cane going into the factories was half-grown cane and there was also dead cane. High yields were not necessarily associated with decrease in sucrose. It could be so if large quantities of nitrogen were applied late in the year. The association between high yields and low sucrose was probably due more to weather conditions. If in this coming season we got a poor rainfall we could get a high sucrose content but we would not get the yield. As far as the weather was concerned the sucrose and weather were intimately associated, but as far as fertilizer was concerned this did not necessarily apply. By correcting a deficiency in plant food one could easily get a higher sucrose content as well as a higher yield of cane. It did not necessarily mean either that irrigation would decrease sucrose content. Some results showed that while one could increase the growing process by too much nitrogen, that could lead to a decrease in sucrose content.

Dr. Brett asked if the application of molasses was made on top of the soil or below it.

Dr. Cleasby said that in field practice it was done on top of the soil as soon as possible after the field had been cut and before ploughing out. Some furrow applications however had been tried out in the past which were successful, although not as convenient to apply.

Mr. du Toit said when the molasses was applied in the case of ratoons was it placed on the roots or in the inter-row?

Dr. Cleasby said that in the case of their methods of application, molasses was quite randomly distributed over the ratoon field soon after cutting.

Dr. Dodds said that it was obvious that molasses was most valuable as a raw material for the large scale production of organic chemicals. For this purpose it was more valuable than as a fertilizer. The by-products from molasses were valued at about £10 per ton of molasses. There must be, however, some special reason why the price received for molasses was so low in this country. As mentioned, molasses has a certain sterilizing effect and in Australia they were puzzled to find certain fields suddenly giving very poor yields to varieties which had previously given excellent performances. Chemical analysis showed no deterioration of the soil. The soils could grow green manures just as effectively as before and it was suspected that there was some bacterial effect on the soil which was harmful to cane. This was proved to be correct by sterilizing the soil. This was done in three different ways—by heat, by application of chemical sterilizers such as mercury compounds, and also by molasses. Any of these forms of sterilization proved successful and the land became as fertile for cane production as previously. This effect might also be operating in the experiment shown.

Mr. de Robillard asked as to the application of ammonium nitrate, e.g. shown in Experiment 4—he wanted to know when the nitrate was applied. He said that in Mauritius high applications of nitrogen with molasses had a depressing effect on the yield. The results shewn in the paper were conflicting in that the sucrose had not changed. He wondered if this was due to the age of the cane. This experiment was for 21 months old cane whereas in Mauritius it was one year old.

Mr. du Toit agreed that in Mauritius they found depression in yield with high levels of nitrogen together with molasses. This depression applied also to sucrose content. He thought there might be a lot in the suggestion that this might depend on the age of the cane as far as sucrose content was concerned. He stated that in Mauritius molasses contained a lot of nitrogen in the organic form. This became slowly available and tended to reduce the sucrose content. This they applied to their 12 month old crop but he thought that in our case with older cane the result would not be so obvious. In the case of cane cut at one year one could expect to get a reduction in sucrose content. In the experiments shown one might have two influences—potash might have tended to raise the sucrose whereas nitrogen had tended to lower it, but the two cancelled each other out.

Mr. P. Coignet stated that the beneficial effect of an application of sugarcane molasses on sugarcane lands might be judged by the fact that in many sugarcane countries molasses was applied to the land as far back as 1860, a fact reported by a Sir Celicourt Anthelme in his "Memoire sur la culture de la Canne à Sucre à Maurice", and that practice is still prevalent. Boname, who was in charge of the Sugarcane Experimental Station in Mauritius in 1890, reported that although the practice of applying molasses to the sugarcane fields was widespread in Mauritius, there was still much controversy as to its beneficial effect on the crop, due probably to different soil conditions and to the fact that molasses does not contain all the plant nutrients required by the sugarcane crop. Drs. H. P. Tempany and F. Giraud in their report on an exhaustive research published in 1924 on the application of molasses as manure to the soils of Mauritius, arrived at the conclusion that the increase in the yields of sugarcane crop due to an application of molasses is far in excess of the effect of the amount of fertilizing elements contained in that amount of molasses. This was confirmed by other workers on this subject such as Boname, Ebbels and Fouque, and by other experimenters in Java. They concluded that this beneficial effect was due to physical improvement of soil, increase in the biological activities of beneficial micro-organisms (nitrogen fixing bacteria) due to partial sterilization of the soil, and liberation of certain plant nutrients from the soil. But they sound a note of warning that molasses applied to a growing sugarcane field may cause some harm and depress the yields, due to a reversion of nitric nitrogen to the organic form, and to some extent to denitrification, and that greater benefit is obtained if molasses is applied long in advance of planting, preferably during the fallow period.

Dr. Cleasby said that the ratoon crops in these experiments were now five to six months old and showed a residual benefit from molasses, even in recent sand which did not hold the potash as one might expect. In Experiment 1, there appeared to be a residual effect of 3.8 tons per acre due to molasses, but this could not be tested mathematically.

Mr. Hempson wanted to know if Dr. Cleasby had tried the effect of applying molasses with water such as irrigating with it. Would this not tend to burn the cane?

Dr. Cleasby said this had not been tried intentionally but where this had happened accidently the results were rather bad. In this case the factory effluent water contained very large amounts of molasses and it had done a certain amount of damage and killed the cane even when applied in the furrow. He thought that if the concentration of molasses was reasonably low there was no danger of burning.

Mr. K. Alexander said that in view of the large amount of potash contained in the applied molasses, the experiments under discussion could, to some extent, be regarded as potash-effect trials. Since potassic fertilizers had been applied to all plots, however, the economic gain due to the potash applied in the molasses was masked. This was an important aspect, since molasses might have been able to replace the potassic fertilizer rather than supplement it. He also asked whether the areas of actual growth failure (in connection with Experiment 1.) were not very limited in extent. Thus, the site selected for the experiment could not be confined to the extremely poor parts, but would have to include some of the better surrounding ground.

Dr. Cleasby said that the experiment was carried out in a fairly extensive growth failure area. There were some places where the cane was quite good, but the plant cane crop which could be analyzed statistically showed significant responses. He thought from the point of view of the experiments, it would have been better not to have applied potash to control plots, but normal field practice was to apply potash and the idea was to study the extra effect due to molasses.

Dr. Dick asked if it would not therefore be possible to obtain such an effect by applying molasses in spray irrigation water.

Dr. Cleasby said that this was possible but it was very difficult to control one large irrigation scheme. They were planning to run small quantities into the irrigation water at Tongaat next year. The application of molasses to T.M.S. soils had given very good results and some experiments had now been laid out using very much smaller quantities such as less than 1,000 gallons per acre.

Mr. Steward asked Mr. du Toit if the yield in tons of sucrose per acre was reduced by the late application of nitrogen. It was accepted that the sucrose per cent cane was reduced but the most important factor was the yield of sucrose per acre and not the sucrose per cent cane.

Mr. du Toit said that as far as he knew this question could only be answered by further experiments which had now been laid down. He mentioned an experiment where nitrogen was applied at different times and in this particular case the late application increased the tonnage but decreased the sucrose per cent cane, and it had proved uneconomic to apply a late dressing of nitrogen. It would have been better had it been applied earlier. This applied to one experiment only and he could not say if this was the general rule. He agreed that one should think in terms of sucrose per acre but from this should be subtracted increased cost of transport and handling. It was possible to increase the tonnage of sucrose per acre but the whole operation might prove uneconomical, as was the case in the experiment. He said that some system should be worked out whereby sucrose in cane, tons of sucrose per acre and costs of handling the extra cane could be worked into one formula.

Mr. Collins said that Dr. Cleasby had pointed to the loss of potash due to leaching and he wondered if it would not be better to apply smaller quantities more repeatedly.

Dr. Cleasby said that in the new experiments he had used smaller quantities of molasses more frequently and some light might be shewn on this particular aspect.