SOME ITEMS OF ECONOMIC IMPORTANCE IN SUGARCANE PRODUCTION

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The purpose of this paper is to examine some items of cane production which are common to all cane growers and which will have an effect on the whole sugarcane Industry and not to analyse the economic performance of one type of implement and compare it with another or even one method of agriculture or process of manufacture with another.

It is sometimes considered that the research worker should avoid economic consideration because it may well distract him from his own possible contribution and that by doing so he is entering a field in which he is most unlikely to be an expert. This contention is not altogether devoid of substance, but at the same time, and this applies particularly to applied research, it would be wrong and indefensible for the research worker to blind himself to all economic considerations and to ignore economic implications which result from an intimate knowledge of his own field of work.

The profit margin in the production of an essential food such as sugar must of necessity always be somewhat limited and consequently any contribution that will lead to a *truer assessment of value*, that will *accomplish a saving* or that will *avoid loss*, will be worthy of consideration.

Sucrose Content

Sugarcane is grown exclusively for the sugar that can be processed from it. In fact it can be stated that it is only the sugar or sucrose which the cane contains which is an asset and the rest of its weight is a liability. Sucrose content is therefore, as an economic factor, all-important. A good stand of cane is admired by the farmer not so much in keen anticipation of a huge tonnage costing a lot of money to harvest and transport but rather on account of the anticipated average sucrose content which when multiplied by the large tonnage of cane is likely to result in a good profit. The days when cane was paid for on a cane tonnage basis are long past and consequently one often hears that experimental results and even field yields should be given in tons sucrose per acre or tons sucrose per acre per unit time basis. Undoubtedly tons sucrose per acre is an improvement on tons cane per acre but it is an over-simplification and not ideal as will be shown.

Let us assume the price per ton of sucrose to the planter is £14.3 which means that the price per one per cent sucrose in cane is 2.86s. and that the cost of cutting, loading and transport per ton of cane for this individual amounts to 12.87s. If he now has two varieties yielding respectively 40 tons cane at 13.0 per cent sucrose and 50 tons cane at 11.0 per cent sucrose, then on a sucrose per acre basis we have:

Variety A 40 tons at 13.0 = 5.2 T.S.A. = £74.36
Variety B 50 tons at 11.0 = 5.5 T.S.A. = £78.65

On the basis of tons sucrose per acre and also on total income variety B will be favoured but its cost of cutting, loading and transport will amount to £32.175 compared with £25.74 for variety A leaving a nett return per acre from variety A of £48.62 compared with £46.475 for variety B. Obviously it is more economical to grow variety A and sucrose per acre by itself is not altogether a sound basis to determine which variety is to be grown. For this planter a sucrose per cent cane equal to $\frac{12.87}{2.86} = 4.5$ will always be needed simply to pay for cutting and transport. This means that 4.5 should be subtracted from the sucrose per cent cane before multiplying by tons per acre in order to get the profitable tons sucrose per acre and a just method of comparison. Thus:

Variety A $40 \times \frac{(13.0-4.5)}{100} = 3.40$ T.S.A. = £48.62

Variety B $50 \times \frac{(11.0-4.5)}{100} = 3.25$ T.S.A. = £46.475

For variety B with 11 per cent sucrose a yield in excess of $\frac{3.40 \times 100}{6.5} = 52.3$ tons cane per acre would have been required to make it better than variety A.

This method of assessing the relative values of two varieties is certainly a great improvement on a T.S.A. basis. The cost of cutting, loading and transport will however, vary from planter to planter and for milling companies, but the cost and value of cane will be known and each individual can make his own assessment, but what about experimental results from the Experiment Station dealing with the Industry as a whole? Transport cost, unlike cutting and loading costs, is most variable but any reasonable assumed average cost for obtaining profitable sucrose per acre must be more correct than T.S.A. which presupposes no such cost at all. The assumed cost of 12.87s. per ton may therefore be retained until a truer average becomes available.

It is further known that our laboratory tests almost invariably result in a sucrose per cent cane higher than that obtained in a mill return. Thus a laboratory analysis of 15 per cent sucrose may normally result in a factory return of 13.5 per cent sucrose. This discrepancy is largely due to the fact that in the laboratory clean, fresh mature sticks are tested but in the factory trash and immature as well as dead sticks form part of the cane supply which is often not fresh either. Whatever the reason it is on the factory result that payment is made and it is consequently on this that the assessment is to be made. This means that we have a further 1.5 to be added to the 4.5 before subtraction from the laboratory sucrose per cent cane.

If now variety C yields 40 tons cane per acre at a laboratory sucrose of 15 per cent what must the yield of variety D be at 12 per cent sucrose to compare favourably with C?

On a sucrose per acre basis:

$$\text{Variety C gives } 40 \times \frac{15}{100} = 6.0 \text{ T.S.A.}$$

$$\text{Variety D must yield } \frac{6.0 \times 100}{12} = 50 \text{ T.C.A.}$$

But if we take the abovementioned factor into consideration to get profitable sucrose from our experimental result the comparison is as follows:

$$\text{Variety C gives } 40 \times \frac{15-(4.5+1.5)}{100} = 3.6 \text{ T.S.A.}$$

$$\text{Variety D must yield } \frac{3.6 \times 100}{12-(4.5+1.5)} = 60 \text{ T.C.A.}$$

It will be seen that on T.S.A. variety D needs only to yield 50 T.C.A. to compare favourably with variety C whereas in reality it should yield at least 60 T.C.A. to compare economically with C under average conditions.

It is felt that these considerations have to be borne in mind in the release of varieties and in all experimental work on fertilizer, etc. where a sucrose difference is obtained and by doing so greater importance will be justly attached to sucrose content, for the lower sucrose cane will have to outyield the higher sucrose cane by a greater amount than just to equal it in T.S.A.

Recoverable Sucrose

The above considerations take no account of a further premium which high sucrose canes should get, i.e. the fact that it must cost less to recover the sucrose from a high sucrose cane than from a low sucrose cane—a fact which is taken into account in some cane payment systems but not in ours. Neither does our payment system take into account the recoverability of the sucrose in the cane. Both fibre and purity are known to effect recovery. It is impossible with the same input of energy to extract as much sucrose from high fibre cane as from a low fibre cane and it is similarly impossible to recover the same percentage sucrose from a low purity juice as from a high purity juice. Thus although the same is paid at present for cane with 14 per cent sucrose, 18 per cent fibre and 85 purity crusher juice as for cane with 14 per cent sucrose, 14 per cent fibre and 90 purity crusher juice, it is known that the latter cane will result in more sugar in the bag than the first and it is therefore worth more. By paying the same for good and bad cane per unit of sucrose we are subsidising the bad at the expense of the good to the detriment of the Industry as a whole, for it is only recoverable sugar that ensures a monetary return to the Industry.

In addition to the adverse effect of high fibre on extraction, which should determine the value of sucrose to the extent that it reduces its availability, fibre also leads to the mal-distribution of the sucrose for payment purposes.

Not only is cane with 14 per cent sucrose associated with 18 per cent fibre not as valuable to the Industry as a whole as the same sucrose per cent cane associated with only 14 per cent fibre, but even worse, because of a common Java Ratio the first consignment will be paid for more than the second. Using the Queensland formula of pol. per cent cane = pol. of 1st expressed juice $\times \frac{100-(F+5)}{100}$ and accepting $100-(F+5)$ as the real operating Java Ratio, then the factor or Java Ratio to be applied to the first lot of cane is 77 and to the second 81; but under our system using the average Java Ratio 79, the apparent sucrose for the poor cane is 14.36 per cent and for the good 13.65, resulting in the payment of 41s. per ton of bad and 39s. per ton of superior cane! If the effect of fibre on extraction and purity on recovery are taken into consideration then the values of the two lots of cane are almost exactly the reverse of the above! Surely under these circumstances there is little inducement to get the best cane to the mills and the Industry as a whole must suffer economically.

It is felt that purity and fibre content should also be taken into account in experimental work and particularly in determining the release of varieties, but however necessary these may be, such an assessment will only have meaning if the effects of fibre and purity are incorporated in a cane payment system.

The reason why the effects of fibre and purity have not been incorporated into our cane payment system is probably the difficulty of assessing the fibre content of individual consignments and the uncertainty of the relationship between purity of crusher and mixed juice. The present method has the advantage of simplicity and an ideal method is difficult to visualise, but minor imperfections in such a new method should not stand in the way of its adoption if it will give a truer assessment of value and thereby lead to progress in the Industry.

Deterioration of Cut Cane

The deterioration of cut cane or the sucrose loss therein has often been the subject of investigation not only in this country but in other sugarcane producing countries and the general conclusion is that sugarcane starts deteriorating with accompanying sucrose losses almost immediately after it has been cut and the process accelerates so long as the cane is left unprocessed. And yet there must be many in our Industry who do not realise the extent of the losses incurred and the economic importance of getting the cane milled as soon as possible. This may be due to the fact that as sucrose is being destroyed there is also generally a drying out of the cane which tends to raise the concentration of the remaining sucrose. Sucrose per cent cane, on which the deterioration may in this case be wrongly judged, may only show a slight fall or even occasionally a rise although the total amount of sucrose in the cane and its availability has fallen considerably.

A recent investigation carried out during November and December 1959 at the Experiment Station on several commercial varieties, gave interesting results. The object here was to find out to what extent cane cut up in one foot lengths, as is likely to be done with a Massey Ferguson cane cutter, will deteriorate quicker than cane cut as whole sticks. Reference will here be made to the losses in whole cane only. The cane was divided into approximately 50-lb. bundles which were accurately weighed and the control bundles analysed. The remaining bundles were then kept under prevailing weather conditions in the open and re-weighed and analysed after 2, 4 and 6 days. The average results were as follows:

TABLE I

	No. of days			
	0	*2*	*4*	*6*
Per cent original weight	100.0	96.6	93.8	91.1
Sucrose per cent cane	13.82	14.03	13.82	13.48
Fibre per cent cane	13.59	14.11	14.13	14.53
Per cent of original sucrose lost	0.0	2.0	6.2	10.6
Average daily loss as per cent	0.0	1.0	1.5	1.8
Purity of crusher juice	90.9	88.8	86.8	83.9
Approximate per cent loss of available sucrose	0.0	3.6	9.0	15.4
Approximate daily loss of available sucrose ...	0.0	1.8	2.3	2.6

The table shows that although sucrose per cent does not drop in this case until the fourth day (and there is even an increase after two days), sucrose losses set in almost at once and after two days two per cent of the actual sucrose present has been lost while a further quantity becomes unavailable as a result of a marked drop in purity and an increase in fibre and the actual daily loss of recoverable sucrose increases progressively with time. The table indicates that a day gained on 2–4 days old cut cane, will lead to a saving of about two per cent or an annual saving of approximately £500,000 on a £25,000,000 crop.

It is conceivable that the losses during the cooler winter months may be lower than the figures here given but higher values may also sometimes occur. The fact remains, however, that the necessity of getting cane crushed as soon as possible after cutting can hardly be over-stressed. It is of vital economic importance to both the planter and the miller.

Fertilizer Application

The importance and need for an adequate and balanced fertilizer application to sugarcane have often been stressed and it is not intended to deal with the subject here in detail but rather to refer to some economic aspects affecting the issue.

Fertilizer responses almost invariably follow a law of diminishing returns over the range of applications commonly made but the cost rises linearly with the amount of fertilizer applied. It therefore follows that there is an economic optimum amount above and below which the profit margin necessarily decreases and it is most important that this level be aimed at in practice, in advice given and be indicated in experimental results which are to be applied in practice.

As a general rule the response to the second 100 lbs. per acre N, P_2O_5 or K_2O is about one-third of the first 100 lbs. applied. Accepting this relationship for nitrogen and assuming the cost of 100 lbs. N to be £4 10s. 0d., the cost of cutting and transport as before 12.87s. per ton, the response to the first 100 lbs. N to be 8 tons cane per acre and the value of cane £1 18s. 0d. per ton with no change in sucrose or cane value with nitrogen applications, what then is the optimum amount of nitrogen to be used?

The answer is about 120 lbs. N per acre with a yield increase due to N of 8.79 tons cane per acre and a profit of £5 13s. 0d. per acre due to fertilizer application. An amount of fertilizer either greater or smaller will result in less profit but the change is small near the 120 lbs. N level and amounts varying from 100 to 140 will result in profits not very different from the optimum.

An increase in the price of cane and a reduction in fertilizer and cutting and transport cost will increase the amount of fertilizer which can profitably be applied. Thus if the value of cane is £3 per ton, the cost of 100 lbs. N £3, and cutting and transport cost 5s. per ton, then the optimum amount of nitrogen indicated is about 230 lbs. N per acre with a yield increase of 11 tons cane per acre and a profit as a result of this nitrogen application of £23 8s. 0d. per acre. The optimum amount of fertilizer to be applied is therefore apart from actual response very dependent on such economic factors as the value of cane and the cost of fertilizer and its application.

Let us now examine the results of an actual fertilizer experiment which has had an overall dressing of 800 lbs. superphosphate per acre and varying amounts of nitrogen and potash. The sucrose per cent cane as determined at the Experiment Station and without corrections for purity will be taken and cutting and transport cost will be taken as 10s. per ton. In this experiment both nitrogen and potash affected sucrose per cent cane and there was an interaction between nitrogen and potash. The experimental results and financial calculations are given in Table II. The cost of 100 lbs. N is taken as £5.2, 100 lbs. K_2O as £1.7 and 800 lbs. Super as £4.

TABLE II

lbs. N per acre	*lbs. K_2O per acre*	*T.C.A.*	*Sucrose per cent cane*	*T.S.A.*	*Value in £*	*Ferti-lizer cost*	*Cutting and Trans-port cost*	*Net Value £*
0	0	28.12	17.34	4.88	69.8	4.0	14.1	51.7
0	100	32.58	16.98	5.54	79.2	5.7	16.3	57.2
0	200	29.66	17.28	5.14	73.5	7.4	14.8	51.3
0	300	34.32	18.08	6.21	88.8	9.1	17.2	62.5
0	400	29.54	17.44	5.15	73.6	10.8	14.8	48.0
100	0	26.02	16.56	4.30	61.5	9.2	13.0	39.3
100	100	41.85	18.26	7.64	109.3	10.9	20.9	77.5
100	200	46.84	17.25	8.06	115.3	12.6	23.4	79.3
100	300	41.38	17.47	7.26	103.8	14.3	20.7	68.8
100	400	43.94	17.64	7.76	111.0	16.0	22.0	73.0
200	0	24.72	16.18	4.01	57.3	14.4	12.4	30.5
200	100	42.54	17.30	7.33	104.8	16.1	21.3	67.4
200	200	41.18	17.59	7.25	103.7	17.8	20.6	65.3
200	300	38.20	17.66	6.76	96.7	19.5	19.1	58.1
200	400	46.48	17.10	7.94	113.5	21.2	23.2	69.1
300	0	24.36	15.84	3.86	55.2	19.6	12.2	23.4
300	100	37.16	16.31	6.08	86.9	21.3	18.6	47.0
300	200	43.14	17.18	7.41	106.0	23.0	21.6	61.4
300	300	46.26	17.66	8.17	116.8	24.7	23.1	69.0
300	400	49.96	17.02	8.50	121.5	26.4	25.0	70.1
400	0	22.64	15.72	3.56	50.9	24.8	11.3	14.8
400	100	36.14	16.38	5.92	84.7	26.5	18.1	40.1
400	200	45.28	17.60	7.96	113.8	28.2	22.6	63.0
400	300	42.61	17.10	7.28	104.1	29.9	21.3	52.9
400	400	35.88	17.37	6.24	89.2	31.6	17.9	39.7

The results here show that the best yield in T.S.A. is obtained from 300 lbs. N and 400 lbs. K_2O per acre, but the most profitable treatments were 100 lbs. N with either 100 or 200 lbs. K_2O per acre which yielded a profit in excess of £25 per acre due to fertilizer application. The results of this experiment show that while correct fertilizer application may be most profitable, incorrect, excessive or unbalanced applications may also result in severe losses.

All soils will not follow the same pattern of responses nor will the results be identical to these here obtained in a plant cane crop on a Table Mountain sandstone soil, but fortunately soil and leaf analyses can indicate potash and phosphate responses and nitrogen responses may be generalised from field trials.

Instances have been seen, however, where potash and phosphates are applied even where soil and leaf analyses show abundant supplies and no likelihood of a response. The reason is apparently to maintain soil fertility and to put back what has been removed. This is a most laudable motive but very false economy, for in the case of potash excessive applications will be lost in luxury consumption and in leaching without giving any return and may even cause a drop in yield and trouble in the factory.

Ratoons

It is a common and generally correct observation that the profit in cane farming lies in ratoons. This is of course due to the fact that it is a costly procedure to re-establish a cane field and that it invariably leads to a period of complete loss of cane growth. On the other hand old ratoons are inclined to be less productive than plant cane although their yields can often be improved very considerably by higher fertilizer application which of course again increases the cost. When then should a ratoon be ploughed out?

The question is so involved that it is often in practice side-tracked and an incorrect and over-simplified answer is given such as: "Plough out after second ratoon" or "Plough out as soon as the yield drops below 30 tons per acre". Obviously the answer will depend on the yield variation between plant cane and the various ratoons, the cost involved in each crop other than cutting and transport and the value of the cane. It will simplify calculations if we express the cost in terms of cane value, i.e. the value of the cane on the land, or the price of cane at the factory minus cutting, loading and transport costs. Thus if we assume for the purposes of calculation that the cost of a plant cane crop up to cutting time is equal to the value of 20 tons of cane and the cost of a ratoon equals 7 tons cane, then these values must be subtracted from the crop yield to get the profitable cane yield.

Let us take a field which has given the following yields:

TABLE III

Plant	*1st Ratoon*	*2nd Ratoon*	*3rd Ratoon*	*4th Ratoon*	*5th Ratoon*	*6th Ratoon*	
60.0	57.0	54.2	51.4	48.9	46.4	44.1	Yield T.C.A.
20.0	7.0	7.0	7.0	7.0	7.0	7.0	Cost in T.C.A.
40.0	50.0	47.2	44.4	41.9	39.4	37.1	Profitable T.C.A.

If each crop was grown for two years and in addition the land before planting had one year's fallow, then the 40 profitable T.C.A. was the result of three years' endeavour or the annual production was 40÷3=13.3 P.T.C.A., the first ratoon 50÷2=25 P.T.C.A. and the second ratoon 47.2÷2=23.6 P.T.C.A. The fact that there appears to be a fall in the second ratoon is, however, no reason for ploughing out the field, because the accumulated average annual production calculated from plant cane is still on the increase. Thus plant cane remains at 13.3 P.T.C.A. but at the end of the first ratoon we have had 40.0+50.0=90.0 P.T.C.A. in five years or an accumulated average of 18.0 P.T.C.A. and at the end of the second ratoon we have produced in all 137.2 P.T.C.A. in seven years averaging 19.6 P.T.C.A. per annum, which is an improvement on the first ratoon.

We may therefore arrange the results as follows:

TABLE IV

Plant	*1st Ratoon*	*2nd Ratoon*	*3rd Ratoon*	*4th Ratoon*	*5th Ratoon*	*6th Ratoon*	
40.0	50.0	47.2	44.4	41.9	39.4	37.1	Profitable T.C.A.
13.3	25.0	23.6	22.2	20.95	19.7	18.55	Annual P.T.C.A.
3	5	7	9	11	13	15	Total years.
13.3	18.0	19.6	20.2	20.3	20.2	20.0	Acc. An. P.T.C.A.

The correct stage to plough out this field is after the fourth ratoon because after that the accumulated annual return will diminish but this will not be known until the fifth ratoon is cut and therefore in practice the field should be ploughed out after this ratoon and the loss in yield will be negligible. This stage is marked by a fall in the accumulated P.T.C.A. and of course also by the fact that the annual P.T.C.A. 19.7, becomes less than the current or preceding accumulated P.T.C.A. 20.2 or 20.3.

Should the original results have been the result of one year's growth with a year's fallow the calculation would have been:

TABLE V

Plant	1st Ratoon	2nd Ratoon	3rd Ratoon	4th Ratoon	5th Ratoon	6th Ratoon	
60.0	57.0	54.2	51.4	48.9	46.4	44.1	T.C.A.
20.0	7.0	7.0	7.0	7.0	7.0	7.0	Cost in T.C.A.
40.0	50.0	47.2	44.4	41.9	39.4	37.1	P.T.C.A.
20.0	50.0	47.2	44.4	41.9	39.4	37.1	Annual P.T.C.A.
2	3	4	5	6	7	8	Total years.
20.0	30.0	34.3	36.3	37.3	37.6	37.5	Acc. An. P.T.C.A.

Here the critical stage where a plough out is indicated is not reached until the sixth ratoon.

Again to revert to a two year crop but with no fallow:

TABLE VI

Plant	1st Ratoon	2nd Ratoon	3rd Ratoon	4th Ratoon	5th Ratoon	6th Ratoon	
40.0	50.0	47.2	44.4	41.9	39.4	37.2	P.T.C.A.
20.0	25.0	23.6	22.2	20.95	19.7	18.55	Annual P.T.C.A.
2	4	6	8	10	12	14	Total years.
20.0	22.5	22.9	22.7	22.35	21.9	21.4	Acc. An. P.T.C.A.

Under these conditions the crop must be ploughed out after the third ratoon or even if the drop could have been anticipated after the second ratoon.

Let us now take a more realistic set of data where crops of different ages are cut and where it takes three months for ploughing out the old crop, preparing the land and planting the new crop. Two sets of data will also be given for the fourth ratoon: one for the normal procedure and another with an increased fertilizer application equal to the value of two tons of cane.

TABLE VII

Plant	1st Ratoon	2nd Ratoon	3rd Ratoon	4th Ratoon	4th Ratoon E	
50	35	40	35	34	40	T.C.A.
20	7	7	7	7	9	Cost in T.C.A.
30	28	33	28	27	31	P.T.C.A.
24+3	18	24	22	24	24	Age of crop in months.
27	45	69	91	115	115	Total age in months.
1.11	1.29	1.32	1.30	1.26	1.30	Acc. monthly P.T.C.A.

The most profitable cycle for this farm would be to plough out after second ratoon or in practice after the third ratoon when the fall was noticeable. The fact that the fourth ratoon can be increased by six tons by applying extra fertilizer to the value of two tons cane must make it most tempting for the planter to continue ratooning, but while it is definitely more profitable to grow a fourth ratoon with the extra fertilizer than without it, the return is still too low to warrant a continuation of ratooning. For that to happen the yield obtained with the extra fertilizer should have been in excess of 42 tons cane per acre.

The calculation is of course further complicated by the fact that one season's growth is not always comparable with that of another and the same applies to an even greater extent for the different months. Allowances can however be made. Thus if the average farm yield is 10 per cent down on that of the previous year, then this correction should be made.

The method here described should offer a means of determining the ratoon at which it becomes economic to plough out by using the actual conditions and costs on the particular plantation or field. Fortunately in most cases there seems to be some latitude. Thus if the third ratoon is indicated as the most economic, then though ploughing out after the second or the fourth ratoon will certainly not be as profitable as after the third ratoon, the losses involved will not in general be very great.

Conclusion

Some factors which influence the economy of sugar production have been discussed. Some of them have a direct bearing on the planter and others affect the availability of the sugar in the factory. All of them, however, must influence the economy of the Industry as a whole.

Profitable tons sucrose per acre defined as (sucrose per cent cane — x) (tons cane per acre)) with x a cost factor associated with cane and expressed in terms of sucrose per cent cane is a better yardstick than tons sucrose per acre for judging varieties, etc.

The availability of sucrose should be taken into account in judging experimental results and in determining the value of cane.

The importance of cane deterioration after cutting can hardly be over-stressed.

Fertilizer application and the growing of ratoons are important economic factors in cane production but there is an economic limit to both.

S.A.S.A. Experimental Station,
MOUNT EDGECOMBE.
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Mr. Wilson (in the Chair) said that practical guidance from the Experiment Station to growers was usually expected to start in the field and finish in the field. Profit per acre, not gross yields of cane or sucrose per acre, was however the main criterion in deciding the real value of any recommendation and in consequence it was impossible to divorce agricultural research either in field or laboratory from economics.

Mr. Bentley criticised the suggestion that the time to plough out was at the peak of a grower's return. He though he should carry on until his return from a ratoon crop was the same as that from plant cane. He asked for further information on this aspect.

Mr. du Toit replied that it was accumulated annual profitable return which was important.

Mr. Pollock said if it cost him as much as 12s. per ton for transporting and cutting cane he would not be able to continue cane growing.

Mr. du Toit replied that some planters would criticise the figure he had given as being too low. He considered his figure to be something like the average estimated by the Cane Growers' Association. He realised that for The Tongaat Sugar Co. the figure would be much lower. His paper merely gave the outline of the method which he considered necessary to give a true assessment of value and the figures he had given were subject to alteration to suit individual cases.

Mr. W. J. G. Barnes agreed that 12s. per ton was not very far from the average.

Dr. McMartin said he welcomed a paper which emphasised the importance of economics in fertilizer application. It was known that increase in yield was not directly proportional to the increase in fertilizer used but that each increase of the latter produced a smaller increase of the former. There was thus a point at which yield was at a maximum, but this was not necessarily the point at which maximum profit was obtained, and the object should be to determine the latter. Another point which could be taken into account was the hazards involved in obtaining a profitable return; for example, under irrigation the hazard of drought was removed, but under dry land conditions it might be argued that a smaller expenditure on fertilizer should be decided upon to counterbalance the effect of a bad year: he wondered if the author had any views on this aspect of the subject?

Mr. du Toit said that one should work on the average of good and bad years.

Mr. W J. G. Barnes asked how could the grower tell when he had cut his second ratoon, that his third ratoon would not be better.

Mr. du Toit said it might be necessary to go to one extra ratoon to find out when profit began to decrease. This would not be a great mistake.

Dr. Dodds thought it was advisable to arrange an Economic Advisory Department at the Experiment Station as well as a Fertilizer Advisory Service. Another point was that he thought the Java ratio was no credit to the Industry. Fibre was a very important factor. He said that planters who sent in cane with a low fibre were penalised, while a grower supplying a high fibre in cane was given an unduly high payment.

Mr. du Toit said even the use of the common Java ratio had certain advantages because it was so simple. He mentioned work done by Mr. Hugo on the same subject of assessing value as far as profitable sucrose was concerned, and when a ratoon should be ploughed out. Mr. Hugo came to the same conclusion as himself although they had worked independently. Mr. Hugo had evolved a formula but he himself had tried to make his approach more simple, and he had completed his paper before his attention was drawn to the work of Mr. Hugo.

Mr. de Robillard stated that from the figures given in Tables IV and VI we saw that with a long fallow the field should be ploughed after the 4th ratoon and after the 3rd ratoon with a short fallow. It would then appear that long fallowing was more economical. But taking the time factor into account in 11 years the long fallow had given a total of 105 tons of profitable canes, and in 8 years the short fallow has given a total of 90.8 tons of profitable canes; reducing to profitable tons canes per two year crop, the long fallow had given an average of 19.1 profitable ton canes and the short fallow in the same two year crop had given 25.2 profitable tons canes. The short fallow then was more economical as it gave 6.1 tons more profitable tons canes per crop.

Mr. du Toit said that if the same yield could be assumed from a short as from a long fallow, then obviously the short fallow was more advantageous because with a long fallow you had to continue cropping for a longer period to make up for the time wasted. His opinion was that land should not be out of production unnecessarily. If one was going to plant in March, green manuring would be advantageous but not when spring planting was done.

Mr. de Robillard asked if anyone had any views comparing the yields of short and long fallows, because apparently it needed an extra yield of 6 tons per acre with the long fallow to make it more economical than the short fallow.

Mr. du Toit said this was really outside the scope of the present paper.

Dr. Dick said that, if sucrose content were to be given its true value as a criterion in selection, more care would have to be exercised in sampling variety trials for sucrose.

Mr. du Toit agreed that sampling should be as exact as possible but the figures shown were an average of a number of tests and thus more reliable than individual variety trials.