PROGRESS REPORT ON THE FIELD EXPERIMENTS DEALING WITH THE TREATMENT OF TRASH AND FERTILIZER APPLICATIONS

By C. H. O. PEARSON

In a questionnaire circulated from the Experiment Station in 1927, to which some fifty planters replied, the percentage of this small sample that burnt their cane before cutting was in the neighbourhood of 45 per cent.

Earlier than this, in 1912, reference is made in the Cedara Memoirs to the practice of trashing the cane. A number of experiments were carried out at that time to test, not only the effect of trash on the subsequent crop, but also the effect of removing the trash from the growing cane at various intervals prior to cutting.

The shortage of labour seems to have been the main factor which stopped the practice of trashing by hand and encouraged the practice of burning the standing cane prior to cutting.

The whole problem of burning versus trashing cane did not again come under experimental scrutiny until 1939, when a trial was laid down at the Experiment Station. This trial was laid out with a split-plot design, the treatments falling into two main categories—

1. Burning versus Trashing.
2. Fertilizer versus No fertilizer.

In the plant cane crop a further treatment of the interplanting of mealies was included. This, however, does not affect the main interest as it only affected the plant cane when no trash was involved.

The plant cane was harvested in 1941 and ratoon crops in 1943-45-47. The yields from these harvestings are given below, together with that obtained from the plant cane crop of the replant cut in 1950.

In 1947 the Co.281 was ploughed out, a green manure planted, and in 1948 Co.301 was planted on the same plots. Treatments were maintained.

The following table gives the yields in tons cane per acre, together with the increase gain of trashing over burning. The rainfall for each crop is also given.

	Plant cane July 1941	First ratoon cut June 1943	Second ratoon cut June 1945	Third ratoon cut June 1947	Plant cane June 1950
Burnt	39.78	52.83	40.26	28.10	54.12
Trashed	42.18	61.13	49.16	41.42	54.74
Increase T/B ...	2.40	8.30	8.90	13.32	0.62
Rainfall per crop (inches)	66.66	83.19	77.49	54.65	53.76

It will be noted that in 1941 there was a soil fertility grade in favour of the trashed plots. These, without any difference in treatment, yielded 2.40 tons of cane per acre more than the burnt plots. If this is taken into account through the ratoons of Co.281 it will give preferential differences for trash management of (rat. 1) 5.4, (rat. 2) 6.5, (rat. 3) 10.92 tons cane per acre. After ploughing out the Co.281, a green manuring with sun-hemp was ploughed-in in March 1948. The next crop of Co.301 was not planted until October, leaving the ground as a bare fallow for seven months.

The plant cane crop of Co.301 harvested in 1950 had no differential trash treatment between the two series of plots, except for the residual effect derived from the trash treatments carried out on the crops of Co.281. Any residual effect that might have accumulated between 1941 and 1947 had during 1948 either been spread by the ploughing and other cultivations or been consumed by oxidation or bacterial action. It is apparent from the crop figures of the 1950 plant cane crop of Co.301 that there is a more uniform fertility grade than in 1941 when the experiment was first harvested. The difference in yield of 2.4 tons cane per acre in 1941 was reduced to only 0.62 tons cane per acre in 1950.

From this experiment it would appear that an advantage can be obtained by trashing the cane which increases considerably in the third ratoon crop, but all residual effect is lost when a crop is ploughed out and a green manure and bare fallow introduced before replanting.

The second part of this experiment, fertilizer versus no fertilizer, can now be examined.

The original soil tests showed an analysis of the following contents :

Total carbon ...	3.03	Available P_2O_5 .	0.002
Total nitrogen .	0.20	Available K_2O .	0.012
C/N ratio	15.1	pH	6.0

The fertilizer used and applied to those plots scheduled to receive fertilizer was :

320 lbs. 20 per cent. Superphosphate at planting in the furrow.

150 lbs. Sulphate of Ammonia
75 lbs. Muriate of Potash
} Top-dressed on the growing cane four months later.

The fertilizer applied after each cutting to the growing ratoon crop, and applied on to those plots

scheduled to receive fertilizer, was of the same order as that originally applied at planting.

The fertilizer was applied by taking out a furrow alongside the row of cane with a pony plough and later scuffling the soil back into place. Where the trash was left the fertilizer was scattered over the line of cane.

The results obtained from these two treatments are as follows in tons cane per acre :

	Co.281				Co.301
	Plant cane July 1941	First ratoon cut June 1943	Second ratoon cut June 1945	Third ratoon cut June 1947	Plant cane June 1950
Fertilizer... ...	40.96	58.56	46.30	36.23	57.31
No fertilizer ...	40.98	55.40	43.12	33.30	51.54
Trash fertilizer .	42.85	63.46	51.78	43.68	57.63
Trash, no fert. .	41.50	58.80	46.55	39.17	51.85
Burnt fertilizer .	39.08	53.67	40.82	28.78	57.00
Burnt, no fert. .	40.47	52.00	39.70	27.43	51.24

Though there is little response to fertilizer versus no fertilizer, the interaction of trashing and burning × fertilizer is significant, there being a significant response in the third ratoon to fertilizer where the cane has been trashed, but none when burnt. In the plant cane crop of Co.301 though the effect of trash has been completely eliminated during the ploughing and green manuring there is a highly significant response to fertilizer dressings on the plant cane crop of 1950.

Further experiments of a similar nature have been laid down at Compensation, Gingindhlovu, Doornkop, Empangeni and the Experimental Farm, Chakas Kraal.

At Compensation, on a soil that had a marked fertility variation and was inclined to water-logging, the following results were obtained from burning versus trashing given in tons cane per acre :

	Plant	1st ratoon 14 months old	2nd ratoon 18 months old
Trash burnt	49.13	28.59	27.47
Trash lined	50.42	26.41	34.87
Trash blanket	50.88	22.16	30.21

It will be noticed that the average yields from the plots in the various treatments were comparatively uniform in the plant cane crop. In the first ratoons the blanket treatment dropped sadly behind. A note entered at the time of harvesting this first ratoon crop reads : "Statistically no significance is attached to the differences in yields between trash treatments due to high variance within the large main plots. The site of this experiment is level and poorly drained which may largely account for the lower yields of trashed plots, that is, the effect of trash blanket has been to depress the yield rather than that the lining or burning treatment should have increased the yield of cane."

The subsequent second ratoon crop bears this out as the increase in yield within the treatments between first and second ratoons is very marked, being : Burnt —1.12, Lined =8.46, Blanket =8.05 tons cane per acre.

The effect of a blanket of trash left over the stools where damp cold conditions are prevalent has been found to have a disastrous effect on the subsequent ratoons, many stools dying from the wet, cold conditions.

The fertilizer treatments of this experiment were :

	Plant Cane	1st ratoon	2nd ratoon
Supers	0-00-1000 15% F	0-540 18% T	0-540 18% T
Nitrogen... ...	Uniform 200 lbs. sulphate of ammonia.		

The yields given in tons cane per acre as a result of the basal furrow dressing are given below :

	Plant cane Sept. 1948	1st ratoon Nov. 1949	2nd ratoon May 1951
0	36.84	22.92	28.58
500	55.10	26.83	31.62
1000	58.46	27.41	32.35

The response to 500 lbs. superphosphate in the furrow is significant, whilst an additional 500 superphosphate in no way justifies its application.

Top-dressings were broadcast on the blanket treatment and applied by fertilizer machine on the other two treatments yielding the following results in tons cane per acre :

	1st ratoon	2nd ratoon
0 No top-dressing...	23.98	28.99
540 lbs. 18 per cent. supers...	27.46	32.71

A significant response in the first ratoon crop was not repeated in the second ratoon.

The soil of this experiment was a sandy loam, never having carried cane previously, being ploughed out from grass six months prior to planting the cane in 1946. The chemical analysis was :

Section.	Total C	Total N	C/N Ratio	Available P_2O_5	Available K_2O	pH
East ...	2.31	0.14	16.5	0.002	0.007	5.2
S-West.	6.80	0.47	14.5	0.006	0.008	5.0

Soil Formation Recent Sands.

A similar trial at Empangeni also planted in 1946 gives the following results :

	Plant cane Nov. 1948	1st ratoon Sept. 1950
Burnt	50.49	48.40
Lined	46.94	45.61
Blanket	48.22	48.85

A soil variation was in favour of the burnt plots, and the lined plots started at the disadvantage. It will be noticed that the trash blanket treatment is the only treatment to give any increased yields in the first ratoon crop and although not significant, it may lead to significant results in further ratoon crops.

There is no response to any dressing of phosphate and the soil would appear to be adequately supplied.

The trial at Gingindhlovu planted in 1947 on land that had been down to grass for some twenty years, gives the following results to date :

	Plant cane	1st ratoon
Burnt	50.06	28.37
Trash lined	49.48	31.88
Trash blanket	49.33	33.98

By the first ratoon crop the two trash treatments are significantly superior to the burnt. In this experiment both in the plant cane and in the first ratoon crop the trash on the plots, termed "burnt," was removed, as were the tops.

The fertilizer treatments in this experiment consisted on :

0 Control.
P 600 18 per cent. superphosphate in furrow.
PP 600 18 per cent. superphosphate in furrow.
300 18 per cent. superphosphate on ratoons.
PN 600 18 per cent. superphosphate in furrow.
400 20 per cent. sulphate of ammonia on plant cane and ratoons.

The results from these treatments in tons cane per acre are :

	Plant cane	First Ratoon Trash burnt	First Ratoon Trash blanket	First Ratoon Trash lined
0	44.98	24.93	29.86	28.69
P	51.98	28.58	33.56	31.29
PP... ...	51.62	28.80	34.10	33.97
PN	49.95	31.17	38.39	33.59

In the plant cane crop, fertilizer gave a highly significant response over control, but there was no significant differences between fertilizer treatments.

In the ratoon crop again, fertilizer treatments give a highly significant difference over control, and phosphates and nitrogen (PN) are significantly superior to phosphates in the furrow (P).

The phosphate and nitrogen (PN) gives a higher yield than phosphate in the furrow, and phosphate top-dressed (PP), but this does not prove significant. It also needs to be noted that where the fertilizer was broadcast on top of the trash, in the trash blanket treatments a higher yield was recorded than when the fertilizer was applied by pony plough. However, the interaction of fertilizer versus trash treatments does not show up significantly.

Chaka's Kraal Experimental Farm trial also planted in 1947 was laid out on similar lines to the others, the treatments being :

1. Trash blanket.
2. Trash burnt.
3. Trash burnt and tops removed.

Fertilizer:

N 400 lbs. sulphate of ammonia top-dressed on all crops.
K 300 KCl top-dressed on all crops.
O Control, no fertilizer.

The results from the trash treatments to date are :

	Plant Cane Tons cane	Plant Cane Tons sucrose	First Ratoon Tons cane	First Ratoon Tons sucrose
1. Trash blanket ...	39.13	5.88	29.98	5.46
2. Trash burnt ...	39.22	5.94	30.19	5.45
3. Trash burnt, tops removed	40.01	6.11	27.46	4.99
4. Difference between rows 2 and 3 .	0.79	0.17	2.73	0.46

The idea of leaving the tops on one treatment and removing them on another was to test the effect these had on the ratooning cane. As the top of the cane is of a high potash content, a treatment of muriate of potash was also included. The fertilizer treatment will be dealt with later. By removing the tops a significant depression in yield was caused in the first ratoon crop. If the plant cane and the first ratoon crop are considered jointly this depression is probably even more marked than would at first appear from the results of the first ratoon crop. In the plant cane crop, there was a bias in favour of the plots to have the tops removed of 0.79 tons per acre and 0.17 tons sucrose per acre. At the first ratoon this favourable bias had been changed to a depression of 2.73 tons cane per acre and 0.46 tons sucrose per acre.

The sucrose % cane remains level in all treatments both trashed and fertilizer.

The results from the fertilizer treatment per acre are :

	Plant Cane Tons cane	Plant Cane Tons sucrose	First Ratoon Tons cane	First Ratoon Tons sucrose
O	37.39	5.65	25.99	4.69
N	41.08	6.33	31.08	5.67
K	39.88	5.95	30.56	5.54

There is a highly significant response from both N and K top-dressings.

The last of this series of trials to be planted in 1947 was placed on the Doornkop Sugar Estates land. This experiment was laid down to test the effect of trash and treatments, as it was claimed that at the higher altitude of 2,000 feet, trash could only be burned or lined. The results from the two crops are given below :

	Plant cane	1st ratoon
Trash burnt	41.38	56.81
Trash lined	42.79	56.24
Trash blanket	40.76	54.69

No significant difference can be attached to these yields. The fertilizer treatments at first were laid down as :

1. Control, no fertilizer.
2. 600 lbs. superphosphate at planting.
3. 600 lbs. superphosphate at planting and 300 lbs. supers as top-dressing on ratoon crops.
4. 600 lbs. superphosphate and 600 lbs. rock phosphate (Langebaan) at planting.

As the results of the plant cane crop showing no response to phosphates, it was decided to add a top-dressing in treatment of 2 of 200 lbs. muriate of potash (60 per cent. 120 lbs. K_2O). A further treatment was added by top-dressing blocks I, IV and V with 300 lbs. 12 per cent. ammonium sulphate.

The results so far obtained, given in tons cane per acre, are :

	Plant cane	1st ratoon
O...	41.01	54.90
P (F) K (T)	40.95	57.33
P (F) P (T)	43.33	55.77
Pr	41.18	55.45
No	—	57.65
N...	—	54.18

(F) = In furrow at time of planting. (T) = Top-dressed.

These results are difficult to interpret, especially the depressing effect created by top-dressings of N. Phosphates appear to have no effect whatever, and K only a slight effect which is not sufficient to pass significance.

Thus to date there are the following trials; in each case showing the number of ratoons harvested.

1. Experiment Station trial, completed one rotation and at present cut as plant cane in second rotation.
2. Compensation trial, cut as plant, first and second ratoon, now ploughed out and not to be repeated.
3. Empangeni trial, cut as plant and first ratoon.
5. Experimental Farm trial, cut as plant and first ratoon.
6. Doornkop Sugar Co. trial, cut as plant and first ratoon.
4. Gingingdhlovu trial, cut as plant and first ratoon.

The attached graph gives the treatment expressed as a percantage of control.

If the oldest experiment is studied in relation to the lightly-hatched columns, it would appear that there is advantage derived from trashing from the first ratoon onwards and that in the third ratoon crop this advantage is very pronounced. The fertility gradient mentioned earlier has to be taken into account.

In the Compensation and the Experimental Farm experiments, the effect of a trash blanket had a definite depressing effect on the first ratoon crop. In both cases the cold, wet conditions prevailed after cutting the plant cane crop early in the season, and many stools died out as a result.

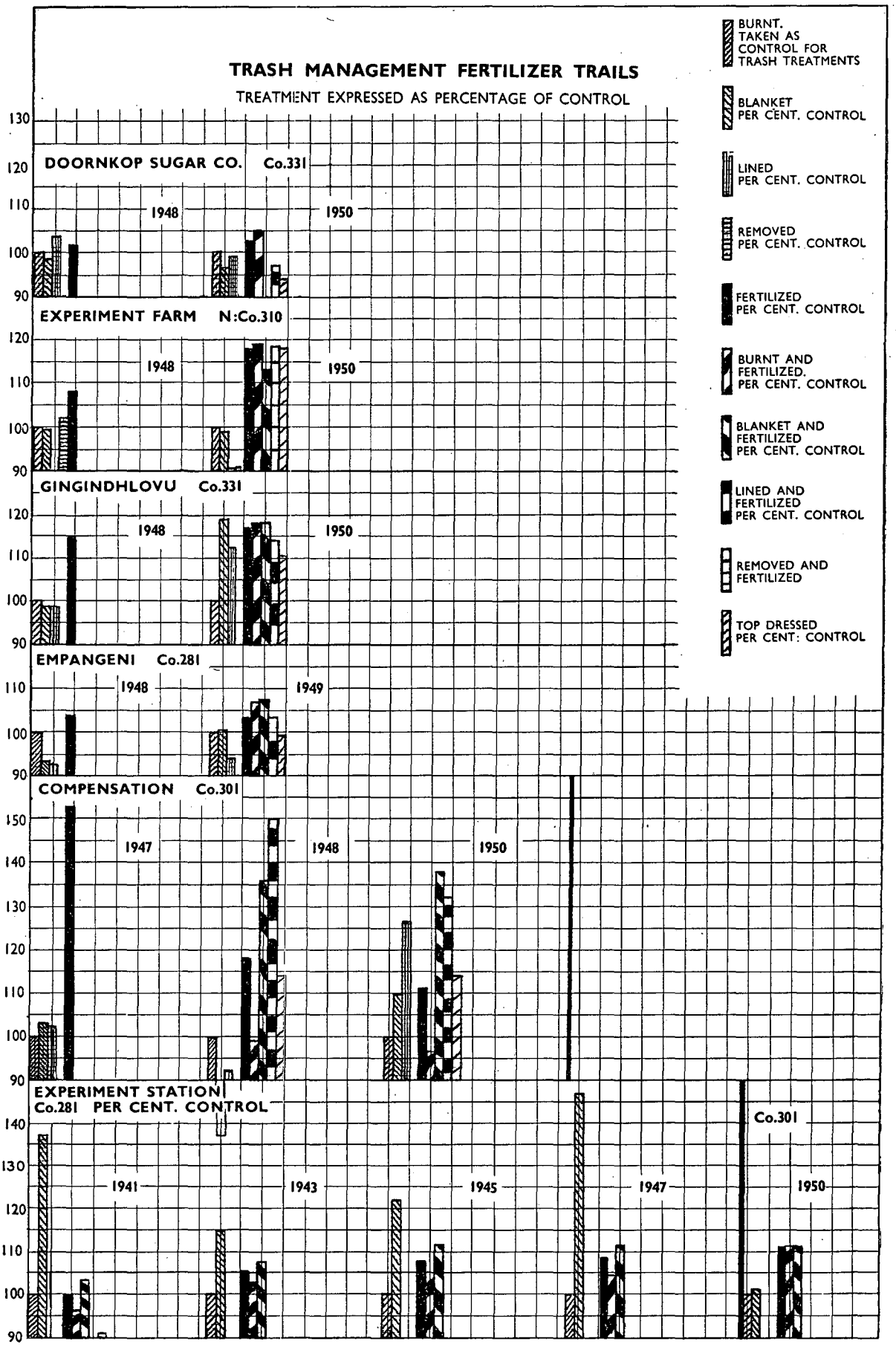
The blanket treatment at Compensation made big improvements by the second ratoon and it would have been interesting to see if the large increase occurred in the third ratoon. This experiment has, however, been ploughed out and is not being replanted. From both these experiments it would appear dangerous not to relieve the trash from the line of cane when cutting takes place early in the season and that the trash blanket can only be left undisturbed when the soil is well drained or when cutting takes place late in the season.

The effect of trash on later ratoons after the first ratoon cannot yet be proved, but the indications would tend to confirm the finding in the Experiment Station trial. The effect of fertilizer and no fertilizer is marked throughout, and the added effect of fertilizer applied to trash treatment is also noteworthy.

In conclusion it would seem that trashing should be practised, that the trash should not be left as a blanket but possibly relieved in some way from the line of cane, especially when cutting takes place early in the season.

Fertilizer should be used in conjunction with trash and the greatest responses to this treatment may be expected in the second or third ratoon.

The residual effect of trash treatment, as shown in the Experiment Station trial after ploughing and green manuring, needs further investigation; and if this loss of fertility can be checked, a cumulative effect from crop to crop would probably result.


TRASH MANAGEMENT FERTILIZER TRAILS
TREATMENT EXPRESSED AS PERCENTAGE OF CONTROL
BURNT. TAKEN AS CONTROL FOR TRASH TREATMENTS
BLANKET PER CENT. CONTROL
LINED PER CENT. CONTROL
REMOVED PER CENT. CONTROL
FERTILIZED PER CENT. CONTROL
BURNT AND FERTILIZED. PER CENT. CONTROL
BLANKET AND FERTILIZED PER CENT. CONTROL
LINED AND FERTILIZED PER CENT. CONTROL
REMOVED AND FERTILIZED
TOP DRESSED PER CENT: CONTROL
DOORNKOP SUGAR CO. Co.331
1948
1950
EXPERIMENT FARM N:Co.310
1948
1950
GINGINDHLOVU Co.331
1948
1950
EMPANGENI Co.281
1948
1949
COMPENSATION Co.301
1947
1948
1950
EXPERIMENT STATION
Co.281 PER CENT. CONTROL
Co.301
1941
1943
1945
1947
1950

Mr. d'Hotman de Villiers stated that long-term experiments were most valuable and as such he welcomed the two papers now under discussion. The practices of burning cane, or trashing, varied from country to country and from estate to estate, depending upon the labour position; the condition of the cane, e.g. whether thick or thin canes were grown; and the yield per acre, as well as whether irrigation was used or not. He then described the conditions in Mauritius. Trashing was a time-honoured custom and the trash was put in alternate lines, leaving one cane row clean and the other covered with a blanket of trash. After cutting the next crop the trash blanket would be moved to the clean row, and it was then found that quite a layer of humus had accumulated under the trash. After fertilizing on the cane stools, the cane was partly covered up with soil and enriched by humus from the now clean row. This led to an increase in production. That was the position in Mauritius, where labour was plentiful. In South Africa, with labour difficulties, he could understand that part of the crop was burned. In Hawaii, burning was common practice and in spite of that the yields had been increased and now averaged as much as 6 to 7 tons sugar per acre per annum, and in British Guiana and Puerto Rico the burning of cane before cutting was also practised. In South Africa the yields were lower and some of the soils were deficient in humus, and unless the yields could be increased appreciably by new varieties and fertilizer control, by such methods as foliar diagnosis and rapid soil analysis, he considered trashing of cane essential. With proper care, sugar-cane could be one of the main crops for enriching the soil.

Mr. Pearson stated that he agreed that burning was commonly practised in Hawaii and Puerto Rico. With their heavy yields and high water table it was possible to maintain the organic content of the soils as a result of root decomposition, but he doubted whether that would be the case under South African conditions.

Mr. Pearce stated that it was his impression that even in Puerto Rico trashing gave better results than burning and may in future be increased, but there were some factors operating against a general practice of trashing cane. In relating his experience of South African conditions to Dr. Baber in Hawaii, the latter stated that if it had not been for trashing and organic matter conservation in Barbados that country would have been out of production by now.

Mr. Barnes observed that the soils in Barbados were very shallow. Trashing and the conservation of all forms of organic matter had been practised there for about 300 years. The yields had increased during recent years by the application of the results of fertilizer investigations. They also used, in the drier areas, a mulch of sour grass which was specially grown for the purpose, and by that means they increased the yields by 5 tons of cane per acre. In some parts of the West Indies, where the rainfall was low, the trash was removed before replanting a field and later brought back to cover the soil. He thought that mechanisation could play an important part in "rowing" the trash. In reply to Mr. Lintner's query regarding the depressing effect of green manure on a soil, Mr. Barnes said that green manuring was not the general practice in the West Indies. Some experiments with legumes were, however, now being carried out.

Mr. Pearce said that he was surprised that there were so few weeds in certain fields in the Dominican Republic, and after enquiries he came to the conclusion that this was largely due to trash blankets being left on the fields.

Mr. Main asked Dr. Douwes Dekker whether it was common practice in Java to grow a legume crop on a high ridge in the inter-row and later to plant this crop on the cane stools.

Dr. Douwes Dekker said that that might have been done during the war years because of the fertilizer shortage, but he felt sure that only fertilizers would be used if supplies were adequate.

Mr. Pearson stated that Natal Estates did grow cow peas after a devastating fire, simply to have a soil cover. The cow peas were later shuffled back on the cane.

Mr. Palairet stated that cane cut in July or earlier ratooned very badly, and particularly so after trashing. He, therefore, thought that it was a mistake to start the cutting season too early.

Mr. Pearson agreed and said that poor ratooning after early July cutting was particularly noticeable in the cooler areas.

Dr. Dodds found it rather difficult to discuss the results of these experiments without having studied the paper beforehand. He was glad, however, to see that these experiments confirmed earlier ones conducted at the Experiment Station which indicated higher yields from trashed than from burnt cane. In Australia similar experiments were in progress, but there no difference between burning and trashing was found.

Mr. Moerdyk stated that ploughing-in wheat in the Orange Free State led to dust storms. Where, however, the wheat was disced in, only a few inches in the soil, the results were much more satisfactory. He wondered whether such a system could not be used in the cane areas.

Mr. Pearson stated that discing might be applied to a green manure crop, but it would be insufficient to break up cane stools and the large amounts of trash would also lead to difficulties.

Mr. Dymond thanked Mr. Pearson for an interesting paper and asked the meeting to accord him a hearty vote of thanks.