A COMPARISON OF METHODS OF PHOSPHATE APPLICATION TO RATOON CANE

By P. K. MOBERLY and G. H. WOOD*

South African Sugar Association Experimental Station

Abstract

Using a virgin Table Mountain Sandstone (Inanda series) soil with a low P status and high sorption capacity, a comparison of methods of superphosphate application to ratoon cane was carried out. By means of P-32 labelled superphosphate the uptake of fertilizer P by the plant was studied in first ratoon cane at intervals from 2½ to 18 weeks after the date of treatment application.

Uptake of labelled P was greater when the fertilizer was applied over the top of a trash blanket as compared with application to bare soil. Broadcasting was superior to banding irrespective of the presence or absence of a trash blanket, whilst deep placement was no more effective than surface banding on bare soil. Total P uptake showed the same trends but the treatment differences were not as great.

Differences between treatment effects on cane yields did not attain a level of statistical significance in the first ratoon. In the second ratoon, however, when residual effects were measured, the surface-applied treatments were significantly ($P<0.01$) better than the deep placement treatment, and broadcasting was superior ($P<0.05$) to surface banding.

Treatment effects on the crop's growth rate, harvested crop characteristics and soil P status were determined.

The results are discussed in the context of the movement of P in the soil, P sorption characteristics of different soils and methods of fertilizer placement which might minimize P fixation.

Introduction

It has generally been accepted that fertilizer P moves from its zone of placement in very small amounts. Mass flow of water carries to the roots of the plant all the nitrogen, calcium, magnesium and some of the potassium needed by the plant but, because the concentration of P in the soil solution, is generally very low, the amount of movement of P in this way is generally insignificant (Cook, 1966[3]). Barber (1964[2]) calculated that only 2½% of the plant's requirements reached the plant in this way. The remainder of the supply of P occurs by diffusion to the root zone. As an illustration of the slow rate of P diffusion, Russell (1968[7]) records how, after 15 years of basic slag application to grassland in England, the P content of the soil below 7.6 cm was barely affected.

* Present address: Research Laboratories, Shell and B.P. S.A. Petroleum Refinery (Pty.) Ltd., Island View Laboratory, P.O. Box 400, Durban.

It is also accepted that for good plant growth it is essential that the roots of a young plant should reach the phosphate zone in the soil as soon as possible. In this regard there is no doubt that placement of fertilizer P for the plant crop of sugarcane should be in the bottom of the furrow at planting.

"Where the P status of the soil is very low or the sorption capacity is high it is necessary, by fertilizer placement, to attempt to restrict the amount of soil that the fertilizer actually contacts in order for part of the growing medium at least to reach a satisfactory P level" (Larsen, 1967[6]). To test the applicability of this statement to sugarcane production in Natal an experiment was established in 1966 to study (i) the uptake of phosphorus by ratoon cane and (ii) the response in terms of cane growth and ultimate yield, using different methods of applying single superphosphate (8.3% P).

Experiment site

The experiment was located on virgin land recently broken from natural grassland in the mistbelt area of Inanda. The soil, an Inanda series derived from Table Mountain Sandstone, is inherently very low in available P (<4 p.p.m.) and has an exceptionally high P sorption capacity.

Experimental design and plot size

A 2 × 5 split-plot design with four replications was employed. Bare soil and a trash blanket were the two whole-plot treatments whilst the split-plot treatments comprised the various methods of phosphate application. The gross plot size was 1/148 ha consisting of six cane rows 9.3 m long and 1.2 m apart. The harvested net plots comprised the two centre rows with 0.9 m of end-effect removed from each end of the plot. A microplot consisting of 1.6 m of one centre row in each plot was demarcated for the application of labelled P-32 superphosphate.

Sampling

In the first ratoon crop punch samples were taken from the third leaf blade of each well-grown tiller in the microplots at intervals of 2½, 4½, 7½, 11, 14½ and 18 weeks from the treatment date, after which no further P-32 measurements were possible due to radio-active decay. The P-32 was measured with a Geiger Muller pour-in counter and the total P content by the method of Fogg and Wilkinson (1958[4]). In addition, third leaf samples were taken in the first and second ratoons from the net plots of the main experiment when the cane was three and four months old, for total P analysis.

Treatments

1. *Plant Crop*

In order to establish ratoon cane deficient in P, treatments 1, 2, 3 and 4 were planted without phosphate fertilizer. Treatment 5, however, received 1 120 kg per ha of single superphosphate (8.3% P) in the furrow at planting. All treatments received a blanket top-dressing of 112 kg N as urea and 168 kg K as muriate of potash per ha. Variety N:Co.293 was planted in January, 1966, in ideal soil moisture conditions and good rains fell after planting. Germination and subsequent tillering was comparatively poor where no phosphate had been applied, whereas germination, tillering and growth in treatment 5 was excellent. The plant crop was cut prematurely at 10 months old in November, 1966, and all plant material removed from the plots. Third leaf samples from treatment 5 and composite samples from the remaining treatments were analysed. The following analytical data indicate the extent of the induced P deficiency:

	N%	P%	K%	Mg%	Ca%
Treatments 1-4 .	2.28	0.15	0.91	0.22	0.33
Treatments ...	2.13	0.20	0.78	0.34	0.30

2. *First Ratoon*

Whole-plot treatments: equal quantities of trash were brought in from an adjacent field to form a trash blanket on the respective whole plots, whilst the other whole plots were left bare.

Sub-plot treatments: control was treatment (1) with no phosphate applied. Treatment (2) received 93 kg P per ha as 1 120 kg/ha single superphosphate (8.3%) broadcast uniformly over either the bare ground or the trash blanket. Treatment (3) received the same quality of superphosphate in a band approximately 15 cm wide on one side of the cane row and 30 cm from the centre of the row either on bare soil or on the trash blanket. Treatment (4) received the phosphate applied in a 10 cm-wide band in a furrow 25 cm deep on one side of the row and 30 cm from the centre of the row. The furrow was drawn alongside each row of all treatments with a tractor-mounted tined implement, so as to obviate any possible subsoiling effect confounding the phosphate treatments. Treatment (5), which had received phosphate in the furrow at planting, received no further phosphate treatment. All treatments were top-dressed over the row with 134 kg N and 112 kg K per ha. The single-row micro plots, each 1.6 m long, received the tagged superphosphate (8.7% P) applied in the same way and at the same rate of P per ha as is described above for the commercial "supers". The treatments were applied in December 1966, four

TABLE I

P supplying efficiency of the various treatments during early stages of growth of the first ratoon crop using third leaf blades as indicater tissue

Treatment		Time interval between treatment and sampling (wks)					
Whole plot	Sub Plot	2½	4½	7½	11	14½	18
		Fraction of P derived from fertilizer (%)					
Trash blanket	(2) — Broadcast	1.88	14.51	32.9	43.8	36.9	33 4
	(3) — Banded	1.03	4.89	16.0	26.6	23 5	20.9
	(4) — Deep	1.38	4.22	9.5	13.4	12 6	11.7
Bare soil	(2) — Broadcast	0.52	4.70	21.9	32.5	28.9	28.4
	(3) — Banded	0.91	3.79	9.4	14.7	13.2	16.1
	(4) — Deep	1.28	4.98	10.9	15.9	14.3	14.4
S.E.		±0.48	±2.86	±3.21	±3.03	±2 66	±2 19
L.S.D. (0.05)		1.49	8.81	9.9	9.3	8 2	6.7
L.S.D. (0.01)		2.08	12.36	13.9	13.1	11 5	9.5
Main Effects		Fraction of P derived from fertilizer (%)					
Trash		1.43	7.87	19.5	27.9	24 4	22 0
No Trash		0.90	4.49	14.1	21.0	18.8	19.7
S.E.		±0.21	±1.55	±1.36	±0.69	±0.56	±1.41
L.S.D. (0.05)		0.95	6.98	6.12	3.10	2 5	6.3
L.S.D. (0.01)		1.75	12.80	11.2	5.7	4.6	11.6
(2) — Broadcast		1.20	9.60	27.4	38.1	32 9	30 9
(3) — Banded		0.97	4.34	12.7	20.6	18.4	18.5
(4) — Deep		1.33	4.60	10.2	14.6	13.5	13.1
S.E.		±0.34	±2.02	±2.27	±2.14	±1 88	±1.55
L.S.D. (0.05)		1.05	6.22	7.0	6.6	5.8	4 8
L.S.D. (0.01)		1.47	8.73	9.8	9.2	8.1	6.7

TABLE II

The effect of treatments on the P contents of the laminae of the third leaf blade.

Treatment		Time interval between treatment and sampling (wks)					
Whole Plot	Sub Plot	2½	4½	7½	11	14½	18
		Mg P/g dry matter (mean of 4 reps).					
Trash blanket	(2) — Broadcast	1 43	1.61	2.20	2 00	1.70	1 69
	(3) — Banded	1 40	1.39	1.82	1 80	1.61	1.63
	(4) — Deep	1.48	1.62	1.93	1.71	1.50	1.53
Bare soil	(2) — Broadcast	1.46	1.49	1.96	1.85	1 67	1.74
	(3) — Banded	1.48	1.37	1.74	1 60	1.57	1.66
	(4) — Deep	1 60	1.76	2 02	1 69	1.54	1.53
S.E.		±0 068	±0.095	±0 097	±0 044	±0 032	±0 028
L.S.D. (0 05)		0 21	0.29	0.30	0 14	0.10	0.09
L.S.D. (0.p1)		0 29	0.41	0.42	0 19	0 14	0.12
Main effects		Mg P/g dry matter					
Trash		1.44	1.54	1.98	1.84	1.60	1.62
No Trash		1.51	1.54	1.91	1.71	1.59	1.65
S.E.		±0.023	±0.005	±0.030	±0 033	±0 016	±0.006
L.S.D. (0.05)		0.10	0.02	0.13	0.15	0.07	0.03
L.S.D. (0.01)		0.19	0.04	0.25	0 27	0.13	0.05
(2) — Broadcast		1.44	1.55	2 08	1.93	1.69	1.72
(3) — Banded		1.44	1.38	1.78	1.70	1.59	1.65
(4) — Deep		1.54	1.69	1.98	1.70	1.52	1.53
S.E.		±0.048	±0.607	±0.031	±0.031	±0.023	±0.020
L.S.D. (0.05)		0.15	0.21	0.21	0.10	0.07	0.06
L.S.D. (0.01)		0.21	0.29	0.29	0.13	0.10	0.09

weeks after cutting the plant crop. Good rain with excellent distribution was recorded for this first ratoon crop. A total of 92.2 mm fell during the remaining two weeks in November after cutting the plant crop, followed by 109 mm in December, 217 mm in January, 114 in February, 218 mm in March and 93 mm in April. After a dry winter good spring rains fell in October and November. The total rainfall for the 13-month crop harvested in January 1967 was 1 210 mm.

3. *Second Ratoon*

In the second and final ratoon no further phosphate fertilizer was applied, only 134 kg N and 112 kg K per ha being top-dressed on the cane row. The treatment differences obtained were therefore due to the residual effects of the treatments applied to the first ratoon. All plots were trashed when the first ratoon was harvested and therefore the effects of whole-plot treatments in the second ratoon were also residual. The second ratoon was harvested in July 1969 when it was 19 months old. The rainfall during the growth of this crop was 1 560 mm and its distribution was good.

Results

Treatment effects on apparent fertilizer P uptake

In the leaf samples the percentage of P derived from the P-32 labelled superphosphate is shown in Table I.

As was to be expected, no significant effects were apparent 2½ weeks after fertilizer application. However, two weeks later significantly more fertilizer P was apparently being taken up from the broadcast treatment on trash than from the other treatments ($P<0.05$). This treatment maintained its superiority for the remainder of the sampling period. The presence of a trash blanket appeared to enhance uptake of P from both surface treatments (2) and (3) but not from the subsurface treatment (4). Fertilizer P content of the leaves was greater where the superphosphate was broadcast compared with deep placement or surface banding both in the presence or absence of a trash blanket. Banding on top of trash resulted in higher fertilizer P content in the leaf sample than did deep placement under trash. However, the statistical significance of the differences between the effects of applying superphosphate on trash or bare soil showed a tendency to decrease in later samples.

Treatment effects on total P content of leaf samples from microplots

Treatment effects on the total P content of the sampled tissue were similar to the effects on labelled P but differences tended to be smaller (Table II).

Treatment effects on Total P content of leaf samples from the subplots in the first and second ratoon crops.

TABLE III

The effect of treatment on the P % dry weight of the third leaf laminae in the first and second ratoon crops

		Age at sampling (weeks)			
		1st ratoon		2nd ratoon	
		15	20	13	16
Trash Blanket	Control	0.14	0.14	0.17	0.16
	Broadcast	0.22	0.17	0.20	0.21
	Banded	0.19	0.16	0.20	0.19
	Deep	0.19	0.15	0.19	0.17
	In furrow	0.19	0.17	0.19	0.19
Bare Soil	Control	0.15	0.15	0.15	0.15
	Broadcast	0.19	0.17	0.20	0.20
	Banded	0.18	0.15	0.20	0.18
	Deep	0.19	0.15	0.18	0.17
	In furrow	0.20	0.17	0.19	0.18
Mean	Control	0.145	0.145	0.160	0.155
	Broadcast	0.210	0.170	0.200	0.205
	Branded	0.185	0.155	0.200	0.185
	Deep	0.190	0.150	0.185	0.170
	In furrow	0.195	0.170	0.190	0.185

The data in Table III confirm those in Table II for the first ratoon but also illustrate that the advantages of the surface applications of phosphate fertilizer persist to some extent into the following ratoon. The advantages of broadcasting compared with banding, and surface placement on trash compared with bare soil, which existed in the first ratoon, virtually disappeared in the second ratoon. It is of interest, too, that the third leaf P values for the in-furrow treatment are marginal even in the first ratoon. (Standard threshold value of 0.19%.)

The Mt. Edgecombe soil sampler was used to sample all plots in the recommended manner, viz. to a depth of approximately 23 cm, with one core taken from the cane row to every eight taken from the inter-row. Sampling was carried out after the first and second ratoons were harvested. It is well known that soil sampling for P determinations in ratoon cane is unlikely to reflect accurately the amount of P available to the plant. However, it is interesting to note in Table IV that the amount of residual P

TABLE IV

The effect of treatments on the soil P (p.p.m.) after harvesting the first and second ratoon crops

		Soil P in p.p.m. after	
Treatments		1st ratoon	2nd ratoon
Trash Blanket	Control	6.5	5.0
	Broadcast	20.0	18.0
	Banded	13.2	6.0
	Deep	6.0	6.0
	In furrow	9.3	9.0
Bare Soil	Control	8.0	5.0
	Broadcast	19.5	21.0
	Banded	12.0	6.0
	Deep	7.0	6.0
	In furrow	8.8	6.0

from the surface treatments is considerably greater than that from the other treatments after the first ratoon, and that this persists into the following ratoon in the case of the broadcast treatment. The trash blankets had no effect in this regard.

Treatment effects on the growth of cane

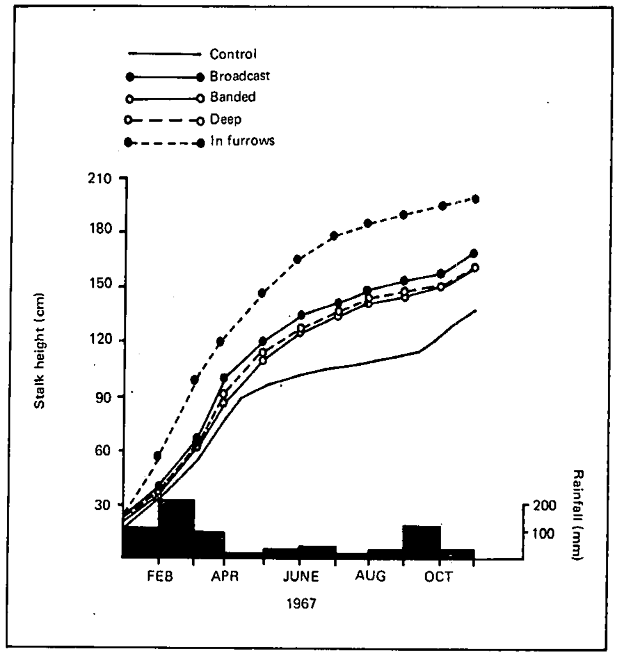

FIGURE 1: The effect of treatments on stalk elongation in the first ratoon.

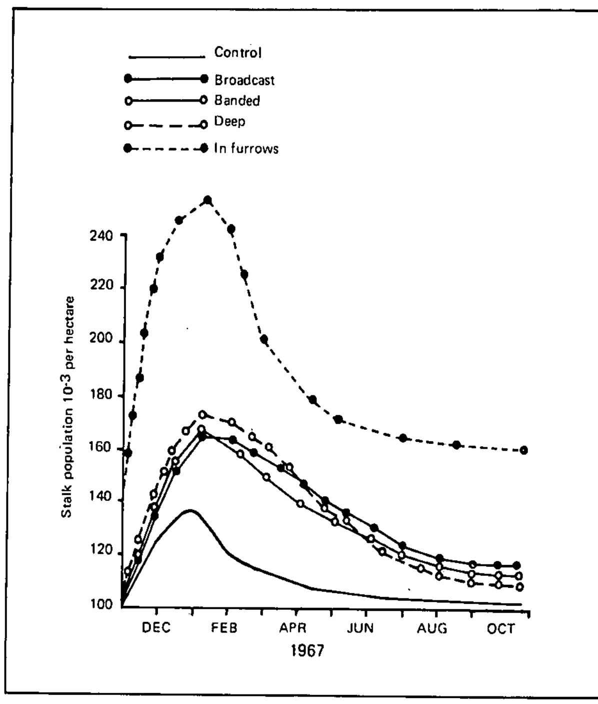

FIGURE 2: The effect of treatments on stalk population in the first ratoon.

Growth in terms of stalk elongation and population development is illustrated graphically in Figures 1 and 2 for the first ratoon crop. It can be seen how markedly the P deficiency in the control treatment reduced tillering and the rate of stalk elongation. The three methods of phosphate application were very similar in their effects on growth but there was a small advantage in favour of the broadcast treatment.

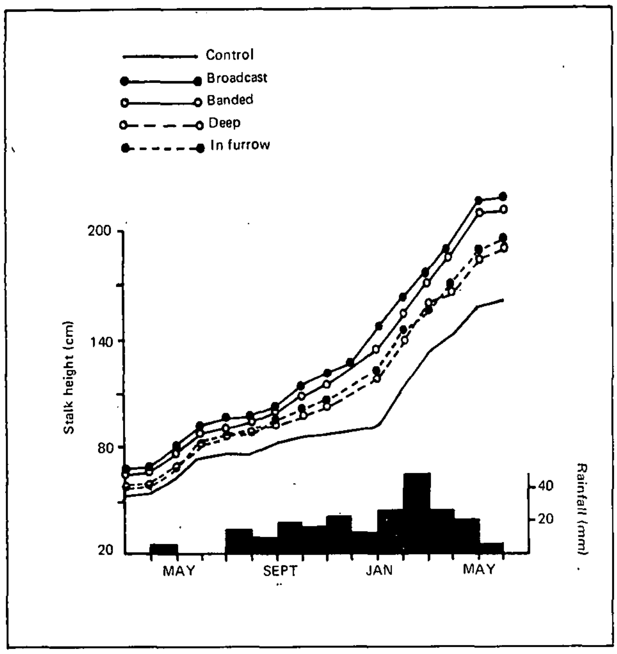

FIGURE 3: The effect of treatments on stalk elongation in the second ratoon.

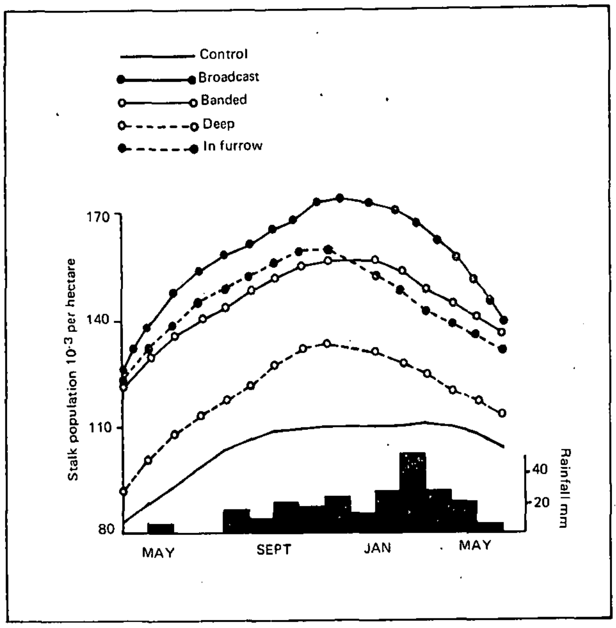

FIGURE 4: The effect of treatments on stalk population in the second ratoon.

Figure 3 illustrates how, in the second ratoon, the residual effects of the surface placement treatments, in particular broadcasting, were superior to deep placement with regard to growth rate. The stalk population (Fig. 4) in the deep placement treatment declined markedly relative to the surface placement treatments in the second ratoon.

Treatment effect on yield and harvested stalk characteristics

Confirmation of some of the findings regarding the uptake of fertilizer P by the plant following the various methods of phosphate fertilizer application was found only to a limited extent in the yield and harvested crop characteristics. These data are given in Tables V and VI respectively.

The superiority, with regard to uptake of fertilizer P, of the two surface application methods, but in particular broadcasting, was reflected slightly in the yield data (t.c.h.) of the first ratoon crop, but significantly ($P<0.01$) in the second ratoon where broadcasting was also significantly ($P<0.05$) superior to banding. The superior yields were due to slightly higher populations of longer and heavier stalks. The improved uptake of fertilizer P in the case of surface application on a trash blanket was not, however, reflected in t.c.h. in either the first or second ratoon. With regard to yield in the first ratoon, the response to application of fertilizer P to the ratooning crop was significantly inferior ($P<0.01$) to the residual effect of fertilizer P applied in the furrow at planting, but the results from the second ratoon showed the reverse effect. The 93 kg/h of P applied in the furrow at planting was shown to be inadequate for the second ratoon.

The treatment effects on sucrose % cane were rather inconsistent for the two ratoons. In the first ratoon, surface placement of phosphate fertilizer resulted in the sucrose % cane being significantly ($P<0.01$) lower than that of the control, and lower ($P<0.05$) than that of the in-furrow or deep placement treatments. However, in the second ratoon the surface placement and the in-furrow treatments, which produced the best-grown cane, resulted in a higher ($P<0.01$) sucrose % cane than that of the control, and higher (n.s.) than that of the deep placement treatment.

In terms of t.s.h. therefore, treatment differences followed very closely those described for t.c.h.

Discussion

To raise the P potential in the rooting zone of this Inanda soil to a level where P is freely available to the plant would require considerably more than 93 kg P per hectare. In a comparison of six widely differing soils of the sugarbelt it was shown (Anon., 1968[1]) that to increase the phosphate potential of these soils to a satisfactory and equivalent level, the following amounts of P in ppm had to be added to the respective soils: Cartref 28, Clansthal 49, Williamson 98, Shortlands 198, Glenrosa 230 and Inanda 2 100. The Inanda series soil has, relatively, therefore a very high P sorption capacity.

With surface application of P on a trash blanket, where soil disturbance was minimal, there was less chance of P fixation, and the roots growing into the moist trash mulch could absorb the P which had been intercepted by the trash. In the bare soil treatments, disturbance of the surface soil by rain and cultivation would give rise to a deeper layer of less enriched

TABLE V

The effect of treatments on cane yield in the first and second ratoon crops

Treatment	Tons cane per hectare						Sucrose % cane						Tons sucrose per hectare					
	1st ratoon			2nd ratoon			1st ratoon			2nd ratoon			1st ratoon			2nd ratoon		
	B	T	M	B	T	M	B	T	M	B	T	M	B	T	M	B	T	M
Control	35 4	32 5	34 0	35 2	40 1	37 7	14 5	14 3	14 4	14 0	14 1	14 1	5.11	4 64	4.88	4 91	5.58	5 25
Broadcast	72 8	73.9	73 4	98.6	102 9	100 7	14 2	13.3	13 8	14.7	14 8	14 8	10 33	9 86	10 10	14 49	15 25	14.87
Banded	67 2	67 9	67 6	91.4	93.9	92.7	13 8	14.1	13.9	14 9	14 9	14 9	9 32	9 59	9 46	13 57	13 96	13.77
Deep Placement	68 3	64 7	66 5	68 1	69 0	68.6	14 8	14.5	14.7	14.5	14 6	14 6	10 06	9 41	9 74	9 90	10 10	10.00
In furrow	100.1	97 9	99 0	80 4	78 8	79 6	14.3	14.2	14 3	14.9	15 0	14 9	14 36	13 93	14.15	11 98	11.80	11.89
Mean	68 6	67.4	68 1	74 7	76 9	75.8	14 3	14.0	14 2	14.7	14 8	14 8	9 84	9 49	9 67	10 97	11 33	11.15
S.E. Treatment (Phosphate) Mean			±2 24			±2.53			±0.12			±0 11			0.332			0.40
L.S.D. (0 05) (0.01)			6 7 9.2			7 4 10.3			0.37 0.51			0 34 0 50			0.99 1.34			1.16 1.59
C.V. (Sub Plots) %			8.2			8.4			2.5			2 2			8.6			8.8

B = Bare ground T = Trash blanket M = Mean

TABLE VI

The effect of treatments on harvested crop characteristics in the first and second ratoon crops

	Stalk length (cm.)						Stalk weight (g)						Stalk counts in 10^{-3} per hectare					
	1st ratoon			2nd ratoon			1st ratoon			2nd ratoon			1st ratoon			2nd ratoon		
	B	T	M	B	T	M	B	T	M	B	T	M	B	T	M	B	T	M
Control	88.5	88 5	88.5	119 0	131.2	125.1	454.0	499.4	476 7	635 6	681.0	658.3	75.8	67 9	71.9	57.6	59.8	58.7
Broadcast	119 0	146 4	132 7	183 0	186.1	184.6	862 4	726 4	794 5	1316 6	1271 2	1293 9	86 7	101 5	94.1	74 9	82.0	78 4
Banded	115 9	115.9	115 9	173.9	173.9	173.9	726.4	681.0	703.7	1180.4	1180 4	1180 4	92 9	99 0	96.0	78 3	80 3	79.3
Deep placement	115 9	115.9	115.9	155 6	155.6	155.6	771.8	771.8	771.8	998.8	1044 2	1021.5	88.4	85 5	87.0	68 7	71.1	69.9
In furrow	152 5	158 6	155 6	158.6	161 7	160 2	862 6	908.0	885 3	1089.6	1044 2	1066 9	113.1	107 2	110.2	74.6	77.8	76 2
	118.4	125.1	121.7	158.0	161.7	159.9	735.5	717.3	726.4	1044.2	1044.2	1044.2	91.4	92.2	91.8	70.8	74.2	72.5

B = Bare Soil T = Trash Blanket M = Mean soil subject to extreme wetting and drying, thus limiting root growth. It is considered that by placing the P in a narrow band, either at depth or on the surface, uptake of P by the roots may be limited by the high osmotic concentration in the fertilizer zone (Golden, 1965[5]).

Uhlen and Steenberg (1965[8]) working with P-32 applied at depths of 0-32 cm in grassland found that the efficiency of P uptake decreased linearly with depth of placement. These findings apparently confirm those of many field experiments in Norway which were designed to compare methods of application. It is generally accepted that the root activity is greater near the surface when rainfall and subsurface moisture are adequate. Golden (1965[5]), also using P-32 in sugarcane, found that the rainfall during the four-week period prior to tissue sampling was closely correlated with fertilizer P uptake from the 15 cm depth but was not associated with uptake from the 30 cm to 45 cm depth of placement.

There is little doubt that when the available P in a soil is relatively high then the method of placement of a maintenance dressing of P on ratoon cane is unimportant. However, in soils of low P availability and high P sorption characteristics it becomes important to place the P fertilizer in a way which will result in the least possible fixation. With such soils, results of this experiment indicate that P fixation is reduced when fertilizer P is applied over a trash blanket. However, when burning is practised, surface application to the bare soil is preferable to deep placement. With limited soil disturbance where handweeding is practised or herbicide sprays are used, then broadcast placement should be preferable. With tractor cultivation of the inter-row, however, it is likely that placement in a broad band over the cane row would result in the least P fixation. Banding of large quantities of fertilizer P in narrow rows appears to limit P uptake.

Acknowledgements

The authors wish to record their thanks to Mr. Murray Armstrong for allowing the experiment to be conducted on his Inanda farm. Thanks are also due to Mr. D. Stevenson for his valuable assistance with the field work and to Mr. M. Murdoch for the analysis of the results.

References

1. Anonymous (1968). S.A. Sug. Assoc. Exp. Stat. Annual Report, 1968.
2. Barber, S. A. (1964). Water essential to nutrient uptake. *Plant Food Review, 10* (No. 2), pp. 5-7.
3. Cook, G. W. (1966). Phosphorus and potassium fertilizers, their forms and their places in agriculture. The Fertilizer Society. Proc. No. *92,* April 1966.
4. Fogg, D. N., and Wilkinson, N. T. (1958). The colorimetric determination of phosphorus. Analyst *83,* 406-414.
5. Golden, L. E. (1965). The uptake of fertilizer phosphorus by sugarcane in Louisiana as measured by radioisotope methods. Proc. Int. Soc. Sug. cane tech. 12th Cong., Puerto Rico, 1965. 540 p.
6. Larsen, S. (1967). Soil phosphorus. Advances in Agron. *19,* 1967. 201 p.
7. Russell, E. W. (1968). The place of fertilizers in food crop economy of tropical Africa. The Fertilizer Society. Proc. *101,* Jan. 1968.
8. Uhlen, G., and Steenberg, K. (1965). The effects of surface and subsurface applied P on grassland. Forskn, for. Landbr., 1965. *16,* p. 115-28.

Discussion

Professor Summer: Was a proliferation of roots observed under the trash blanket, either near the surface or even on the bare ground?

One thousand pounds of phosphate applied on the surface would react with, say, the top 2 mm of soil, saturating its sorption capacity. If there were roots close to the surface the phosphate would be highly available to them and would explain your results, particularly as rainfall was good.

With poor rainfall, banding could be expected to give better results where phosphate occurred at depth in the soil. There would be more moisture available lower down as the soil surface would have dried out.

Mr. Moberly: We notice that wherever there is a trash blanket the roots penetrate into the humic layer. That is presumably why the broadcasting on trash is better, because the roots were able to get at the P before it touched the soil.

I agree that under dry conditions, where roots are more active at depth, broadcasting on bare soil would probably not have shown up as well as it did.

Of course, the organic content of an Inanda soil is high and therefore the water holding capacity is comparatively good.

Mr. Meyer: How do you account for the higher yields for the second ratoon against the first ratoon in treatments 2, 3, and 4?

Mr. Moberly: That was due to length of season. The first ratoon was a fourteen-month crop and the second a nineteen-month crop.

Dr. Hill: What was the phosphate fertiliser policy for this soil?

Would you get the same results if you had half the application on plant cane and half broadcast at first ratoon?

Mr. Moberly: We have no data to go on. But bearing in mind the P sorption properties of some of these soils it would seem logical to apply half the supers in the furrow and the balance on the first ratoon.

I refer of course to relatively acid soils. At Pongola, for example, on a soil with a pH of 6.5, there was, when we started, only 1 ppm of P. The application of 500 pounds of single supers per acre was more than adequate for a plant crop and two ratoons. It yielded as well as did 1,000 pounds and 1,500 per acre. This was a soil with comparatively low fixing powers. We had three levels of supers at 500, 1,000 and 1,500 pounds of single supers per acre in the plant crop, the idea being to apply more P when the yield difference between 500 and 1,500 became apparent. They have not become apparent so we have kept on testing residual responses.

This is simply an example of a soil at the other end of the range — one that fixes very little P compared with Inanda, which must be rated high with regard to fixation.