

CANE GROWTH AS INDICATED BY POT EXPERIMENTS

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The following are the results of the past two years' work on pot tests with sugarcane as the indicator plant.

TECHNIQUE.

Cement pots 42.6 inches in circumference and 14 inches deep were used. About 3 tons of a particular soil type for each series were taken over selected areas. This was mixed in the loading and off-loading, then in the pile itself, and finally the pots were progressively filled by small quantities in rotation, so as to ensure perfect representative samples in each pot.

Three times the number of selected eyes from young plant cane were germinated between wet sacks for each series. After two weeks a final selection of the planting material was made.

As each pot represents a square foot of soil, the required amount of a fertilizer to represent so many pounds per acre can be calculated. The arbitrary standard used was 4.16 grammes representing 100 lbs. per acre.

Equal quantities of water were used as required.

SOIL TYPES AND FERTILIZERS.

Five representative soil types were selected in the Darnall area. Analyses were as follows:—

Soil types.	Light sandy type.	Red clay type.	Cement type.	Heavy black type.	Good sandy loam.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Moisture content	0.20	4.40	1.67	4.24	0.30
Analysis on D.S.—					
Loss on ignition... ..	0.90	9.00	4.10	10.17	1.78
Fe ₂ O ₃ , Al ₂ O ₃	2.30	29.50	7.22	13.05	3.31
CaO	0.35	0.78	0.71	1.30	2.51
MgO	0.31	0.66	0.48	0.55	0.24
P ₂ O ₅ Total	0.16	0.17	0.12	0.32	0.45
P ₂ O ₅ Available... ..	0.004	0.004	0.003	0.045	0.045
K ₂ O Total	0.104	0.282	0.104	0.207	0.083
K ₂ O Available... ..	0.003	0.019	0.003	0.012	0.001
N... ..	0.04	0.10	0.22	0.31	0.48
Lime requirements p.a.	1.03	2.01	3.33	3.91	0.75
pH	7.0	6.35	5.55	5.65	7.60

The results show the great variation in soils in the Darnall area. The loss on ignition varies from 0.90 per cent. to 10.17 per cent.; P₂O₅ from 0.12 per cent. to 0.45 per cent.; total K₂O from 0.08 per cent. to 0.28 per cent.; and nitrogen from 0.04 per cent. to 0.48 per cent.

The pH values ranged from 5.55 per cent. to 7.60 per cent.

Analysis of Government Fertilizer, Compost and Filter Cake used (Experiment A).

	Organic Nitrogen.		
	Per cent.	P ₂ O ₅ .	K ₂ O.
Government Fertilizer	3	13	3
	Compost. Sulpho-defecation Oliver Campbell filter cake.		
	Per cent.	Per cent.	
Moisture	48.0	65.0	
Loss on ignition	17.2	40.2	
Analysis on D.S.—			
Sulphate SO ₃	0.64	14.16	
Fe ₂ O ₃ , Al ₂ O ₃	2.05	5.35	
CaO	2.30	14.40	
MgO	0.96	0.98	
Total P ₂ O ₅	0.95	3.33	
Total K ₂ O	0.91	0.10	
N	1.20	0.70	

EXPERIMENT A.

The cane variety used was Co.301. This variety is not such a good pot plant as streak-free Uba, which was used in the later series of tests. The cane was allowed to grow for five months (October to February) and the summarized results were as follows:—

Soil type.	Control. No treatment.	Filter cake 15 tons p.a.	Compost 15 tons p.a.	Govt. fertilizer 1,000 lbs. p.a.	Govt. fert. 1,000 lbs., Compost 15 tons p.a.
Light sandy	4.21	2.62	8.75	4.29	7.29
Red clay... ..	9.04	7.71	12.29	7.42	11.88
Cement	6.30	6.04	11.50	7.75	11.46
Heavy black	11.08	10.54	14.75	11.17	16.33
Good sandy loam... ..	9.08	8.25	17.38	7.58	12.50
Average	7.94	7.03	14.93	7.64	11.89

(See index for replicated results.)

Controls.—Variations in the controls for each soil type show a minimum average yield on light sand of 4.21 to a maximum of 11.08 on heavy black type.

Filter Cake.—Four months' old filter cake gave a depressing effect in each case. This is due to undecomposed bagasse present in filter cake from Oliver Campbell filters.

A report from Dr. I. Levisohn on the roots from these experiments throws further light on this problem. "One differential feature was observed within all series, namely, the absence of 'vesicles' in root material from plants treated with filter cake."

Mycorrhizal Infection.—Dr. Levisohn writes: "In sugarcane" the mycorrhizal infection has the following features. The mycorrhizal fungus is of large diameter, hyaline to honey-yellow in colour. The hyphae, after entering the cortex, usually pass down through one or two layers of cells, mostly running parallel to the long axis of the root. They branch and form cells within the cells and show, especially in the outer layer, intercalary swellings. Formation of 'vesicles' and 'arbuscles' is rather sporadic and may occur in any part of the cortex. Specially the inner zone of the cortex shows digestion stages."

"It is difficult to test the quantitative degree of mycorrhizal infection in sugarcane, as the infected zones are not as easily recognisable by external features as in most plants. Microscopic examination of a number of rootlets can only give a rather rough indication of the amount of infection throughout the whole of the root system."

Compost.—The effect of 15 tons of compost per acre on each one of the series is remarkable, the average of all tests showing almost 100 per cent. increase in yield over the controls.

Government Fertilizer.—Under the conditions of pot growth, the 3 : 13 : 3 Government mixture gives variable plus and minus yields in comparison with the controls. The general average shows a slight depression, which is repeated in the compost-fertilizer series, when compared with compost alone. This peculiarity has been further investigated in a later test series.

EXPERIMENT B.

The following tests on Karroo manures were carried out on the good sandy loam type of soil. The same procedure was adopted, with the exception that Co.281 was used as the indicator plant. The pots were planted out of season, namely, in April, and were harvested nine months later. The results were:—

Controls.	Government fertilizer 100 lbs. p.a.	Compost 10 tons p.a.	Karoo Manures.							
			First type.			Second type.				
			10 tons p.a. mixed with soil.	5 tons p.a. mixed with soil.	5 tons p.a. placed below set.	1,000 lbs. p.a. mixed with soil.	10 tons p.a. mixed with soil.	5 tons p.a. mixed with soil.	5 tons p.a. placed below set.	
ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	
Average, 3 replications	11.6	8.6	14.8	19.7	15.6	17.5	11.3	24.2	21.4	19.2

Government Fertilizer.—The 3 : 13 : 3 mixture gave a decided depressing effect in this series.

Karoo Manures and Compost.—All the heavy dressings of Karroo manures gave comparatively good yields compared with the controls. A dressing of 1,000 lbs. per acre gave no results, which confirms the general opinion that organic manures require heavy dressings for effective results.

The compost results in this experiment are not so good as in Experiment A. Considering the high moisture contents of compost the results are fairly comparable with that obtained from Karroo manure. The low cost of the former makes compost the more economical product.

Heavy rains were experienced during these tests, so that any possible burning effect of alkaline salts in the Karroo manures, even with the heavy dressings used, was rendered nugatory.

EXPERIMENT C.

The chief object of this experiment was to determine whether the method of applying the 3 : 13 : 3 mixture has any effect on the subsequent growth. With this object in view, the Government mixture was applied in the following ways:—

1. Mixed with the soil 9 inches below the sets.
2. Mixed with all the soil in the pots.
3. Placed without any admixture with soil immediately below the sets.
4. Placed on top of the soil after planting and lightly raked with the top soil.

Streak-free Uba cane was used as the indicator plant and a good sandy loam was the soil type used. This experiment was

Controls.	Super, 1,000 lbs. p.a.		Compost, 10 tons p.a.		Compost, 10 tons p.a. + 1,000 lbs. Super, mixed	Compost, 10 tons p.a. + 1 ton Lime mixed	Karoo Manure, 10 tons p.a. mixed.	Filter Cake, 10 tons p.a.		
	Not mixed with soil.	Mixed with all soil.	Not mixed with soil.	Mixed with all soil.				6 months mixed.	12 months mixed.	
ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	ozs.	
Average, 3 replications	12.5	14.0	13.8	19.7	22.2	19.1	21.1	19.9	15.5	15.5

* Mixed means that the manure has been mixed with the soil below the set.

The Results.—The superphosphate series gave a slight increased yield. Six-months-old and year-old filter cake gave the same increase, and compost and Karroo manure again showed their superiority.

GENERAL CONCLUSIONS.

From a practical standpoint pot tests, using sugarcane as the indicator plant, are simple and quick compared to field tests.

To what extent the results can be compared with field work is unknown. Owing, however, to the standardization of all the factors in pot tests, except the point under observation, many interesting effects can be studied. After several years observation of this method, I consider it worthy of further investigation.

Outstanding results from these experiments are:—

1. Organic Manures.—Compost and Karroo manures give outstanding results under the conditions of the tests. Thus compost showed a total average increase over the controls of 45 per cent. and Karroo manure 69 per cent. The larger yields from Karroo manure are chiefly due to its more concentrated form. Small applications of such materials, as shown in the 1000 lbs. per acre series, are not worth the cost. Heavy applications, as indicated above, give the best returns. The standard application in Mauritius is 17½ tons of compost per acre for plant cane.

planted at the end of August, 1943, and reaped at the end of February, 1944. The results were as follows:—

Controls.	Government Fertilizer 3 : 13 : 3, 1,000 lbs. per acre.			
	Mixed with soil below sets.	Mixed with all the soil in pots.	Placed below the sets without mixing.	
ozs.	ozs.	ozs.	ozs.	
Average, 3 replications...	12.5	12.7	12.2	13.7

Series B.—In this series selected sets of cane from streak-free Uba seed bed were used instead of sprouted eyes. The sets were single stalks 9 inches high when replanted into the pots.

Controls.	Mixed with soil below sets.	Placed on top of the soil after planting.		
		1,000 lbs. p.a.	2,000 lbs. p.a.	
ozs.	ozs.	ozs.	ozs.	
Average, 3 replications...	15.2	14.8	14.2	*14.0

* One test only.

The Results.—From these 6 control pots and 16 fertilized pots no significant results were obtained from any of the different methods of fertilizer application.

EXPERIMENT C.

This experiment was a continuation of the previous series, in which various other fertilizer and compost applications were used.

2. Government Fertilizer and Superphosphate.—The general results for 21 tests, using the Government mixture 3 : 13 : 3, show a depressing effect of 2.8 per cent. No significant differences were observed when this fertilizer was applied by—

- (a) Mixing with the soil under the set.
- (b) Mixing with all the soil.
- (c) Placing without mixing directly below the set.
- (d) Applying on the surface of the soil.

Superphosphate, either placed directly below the sets or mixed with all the soil, gave an increased trend over the controls.

Compost applications alone appeared sufficient, as combinations with Government fertilizer, superphosphate and lime gave no apparent benefits.

3. Filter Cake.—Undecomposed filter cake (four months old) containing bagasse particles from the Oliver Campbell filters, gave a depressing effect on growth in five different types of growth. A root analysis confirmed and explained the reason for this effect.

Later tests with rotted filter cake, six and twelve months old, gave identical increases in each case.

APPENDIX. Detailed Results of Pot-Testing Experiments.

EXPERIMENT A.

	Control.	Filter cake 15 yons p.a.	Compost 15 tons p.a.	Govt. fertilizer 1,000 lbs. p.a.	Compost 15 tons, Govt. fert. 1,000 lbs. p.a.		Control.	Filter cake 15 yons p.a.	Compost 15 tons p.a.	Govt. fertilizer 1,000 lbs. p.a.	Compost 15 tons, Govt. fert. 1,000 lbs. p.a.
Series 1	4.50	2.88	9.50	4.38	5.75	Series 4	12.00	11.50	13.25	13.28	19.50
	3.62	2.88	8.50	4.50	9.25		10.50	10.38	17.62	9.62	16.25
	4.50	2.12	8.25	4.00	6.88		10.75	9.75	13.38	11.50	13.25
Average	4.21	2.63	8.75	4.29	7.29	Average	11.08	10.54	14.75	11.17	16.33
Series 2	7.88	8.88	10.62	7.00	13.75						
	9.75	8.25	14.50	8.50	10.25						
	9.50	6.00	11.75	6.75	11.62						
Average	9.04	7.71	12.29	7.42	11.88	Series 5	9.50	8.50	20.38	7.75	11.88
Series 3	5.88	6.88	10.62	6.75	8.75		9.50	8.50	17.75	8.12	14.00
	7.25	5.75	11.25	9.25	11.50		8.25	7.75	14.00	6.88	11.62
	5.75	5.50	12.62	7.25	14.12	Average	9.08	8.25	17.38	7.58	12.50
Average	6.29	6.04	11.50	7.75	11.46	Total average :	7.94	7.03	14.93	7.64	11.89

EXPERIMENT B.

Control.	Government Fertilizer. 1,000 lbs. p.a.	Compost. 10 tons p.a.	Karoo Manures.						
			First type.			Second type.			
			10 tons p.a. mixed with soil.	5 tons p.a. mixed with soil.	5 tons p.a. direct below set.	10 tons p.a. mixed with soil.	5 tons p.a. mixed with soil.	5 tons p.a. direct below set.	
10.75	7.75	15.50	19.50	14.25	15.50	25.25	20.50	18.50	
12.50	9.00	14.25	20.75	16.00	18.25	23.75	21.00	21.50	
11.50	9.00	14.75	18.75	16.50	18.75	23.75	22.75	17.50	
Average	11.6	8.6	14.8	19.7	15.6	17.5	24.2	21.4	19.2

EXPERIMENT C.

Government fertilizer 3 : 13 : 3, 1,000 lbs. per acre.				Government fertilizer 3 : 13 : 3.					
Controls.	Mixed with soil below sets.	Mixed with all soil in pot.	Placed below set. No mixing.	Controls.	Mixed with soil below sets.	Placed on top of the soil and lightly covered.			
						1,000 lbs. p.a.	2,000 lbs. p.a.		
Series A	13.00	12.00	13.00	13.75	Series B	16.00	14.50	15.00	14.00
	12.00	13.50	11.75	14.50		14.50	13.00	14.50	one test
	12.50	12.75	11.75	12.75		15.00	17.00	13.00	only
Average	12.5	12.7	12.2	13.7	Average	15.2	14.8	14.2	14.0

EXPERIMENT D.—(Continuation of Experiment C, Series A.)

Controls.	Superphosphate.		Compost.				Karoo Manure.	Filter Cake.		
	1	2	1	2	3	4		1	2	
13.00	14.00	14.25	20.50	24.50	17.75	24.50	20.00	16.25	15.50	
12.00	13.75	13.50	19.75	20.50	20.00	21.00	20.50	15.75	15.50	
12.50	14.25	13.75	20.00	21.50	19.75	17.75	19.25	14.50	15.50	
Average	12.5	14.0	13.8	19.7	22.2	19.1	21.1	19.9	15.5	15.5

Note.—All weights in ounces.