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<https://doi.org/10.29321/MAJ.10.A03614>

## Soil and Plant P & K Indices for Sugarcane in Thiru Arooran Sugar Farms

by

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**Introduction:** Soil tests are valuable guides for determining the available nutrient status of the soil so that fertilisation can be planned on a sound basis. But, as has been pointed out by Nelson *et al* (1953), no one method of determination of available P is satisfactory for all soils, varying in physico-chemical characteristics. Anon (1956) has emphasized the necessity of placing soils into different groups based on their  $\frac{C.E.C.}{A.E.C.}$  ratios for satisfactory correlation of soil tests with crop responses having different values for soil tests for full availability or 100% yield in the different groups.

Studies on the sugarcane plant itself as an index for fertiliser practices are fairly well developed in other countries and particularly so in Hawaii. The relative merits of various methods of foliar diagnosis in sugarcane have been discussed by Samuels (1959). Very little work has been done on sugarcane in India on the use of plant tests for P and K for commercial fertiliser practices. There is thus need for study of comparative merits of soil and plant tests for P and K for the cane crop under the conditions prevailing in Tiru Arooran Sugar Farms, Vadapathimangalam in Thanjavur District.

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**Materials and Methods:** The soils of the experimental fields were clayey in texture and neutral in reaction. The E.C. of the soils was below 1.5 millimetres/cm. The following were the experimental treatments:

- A. 150 lb N/ac+100 lb K<sub>2</sub>O/ac - NK
- B. 150 lb N/ac+100 lb P<sub>2</sub>O<sub>5</sub>/ac - NP
- C. 150 lb N/ac+100 lb P<sub>2</sub>O<sub>5</sub>/ac+100 lb K<sub>2</sub>O/ac - NPK

The trial was arranged in scattered block, the number of blocks being five. Variety CO 419 was planted in March-April, 1964 and harvested at the age of 12 months. N was supplied in the form of urea in two equal instalments on 45th and 100 to 120 days after planting. Superphosphate and potassium sulphate were applied by placement by about 45 days.

Soil samples were analysed for available P by various methods, viz., Olsen's NaHCO<sub>3</sub> (1954), Bray I (1945) Bray II and Truog's 0.002 NH<sub>2</sub>SO<sub>4</sub> (1930). Phosphorus in leaf sheath was determined colorimetrically by the method given by Clements (1959). Potassium in leaf sheath was estimated by the Cobalti-nitrite method as described by Jackson (1962). 'Leaf sheath' in this paper refers to 4, 5, 6 leaf sheath.

**Results and Discussion:** The data of cane yields for the various treatments, percentage yields and yield responses in the five experimental fields are given in Table 1.

TABLE 1. Cane yields and yield responses

	Yield of cane in tonnes/ac			Percent yield response to		Percentage yields for	
	NK	NP	NPK	P	K	P	K
Poosangudi Fd 26	19.95	29.44	25.10	+	25.9 - 14.7	79.5	100.0
Fd 22	32.75	39.79	43.90	+	34.0 + 10.4	74.6	90.7
Mayanur Fd 24	30.68	27.81	31.77	+	3.5 + 14.3	96.6	87.4
Fd 31	27.17	30.62	34.12	+	25.5 + 11.4	80.0	90.0
Fd 44	29.04	38.95	30.03	+	3.3 - 22.9	96.7	100.0

Comparatively, there appears to be greater response for P than for K.

The data of available P by various methods and average sheath P of the NK treatment are given in Table 2.

TABLE 2. Soil and plant indices for phosphorus

Field	Available P in lb/ac			Truog's	Average (4, 5 & 6) leaf sheath P% of NK treatment (4-8 months)
	Olsen's	Bray I	Bray II		
26 Poosangudi	8.0	1.8	41.8	27.0	0.065
22 Poosanguni	3.4	5.8	27.6	25.0	0.050
24 Mayanur	9.0	2.8	38.4	57.8	0.085
31 Mayanur	8.3	3.3	28.4	38.5	0.060
44 Mayanur	8.2	3.1	27.6	77.0	—

The correlation coefficients are furnished in table 3.

TABLE 3. Correlation Coefficients

Method Soil available P	Percent yield response	Percentage yield
Olsen's extractant	- 0.63	+ 0.65
Bray I	+ 0.45	- 0.43
Bray II	- 0.13	+ 0.11
Truog's	- 0.938*	+ 0.936*
log Olsen's value	-	+ 0.633
log Truog's value	-	+ 0.947
Average sheath P	- 0.866	+ 0.982*
log average sheath P	-	+ 0.972*

\* Significant at P = 0.05

Of the various extractants tried, only Truog's was found to be satisfactory. Available P by Truog's method only was found to be significantly related to percent cane yield responses and percentage cane yields, the correlation coefficients being -0.93 and +0.936 respectively, significant at 5% level. The regression equation is given by  $y = 0.6x + 45.6$  where  $y$  is the percent cane yield response to 100 lb  $P_2O_5$ /ac and  $x$  the available P in lb/ac by Truog's method. Ayers and Haji Hara (1955) have analysed soil samples from the many phosphate experiments in the various sugar plantations in Hawaii for available P by Truog's method and found it to be quite satisfactory as a measure of response of cane to applied P.

According to Clements (1959) it is not the soil test but the plant index that is a valuable guide for determining the nutrient needs of the cane crop. If the 3-6 sheath P index is more than 0.085%, the crop is supposed to have adequate P status. Bayer (1961) however points out that there is lack of correlation of sheath P with stalk P, with available soil P and with yield responses and considers 8-10 P a much superior index of P status. The correlation coefficient between average sheath P (NK treatment) and percentage cane yield in this study was +0.982 significant at 5% level. The correlation coefficients between sheath P and percent yield response was -0.866, just missing significance. From the limited data in the above study, it would appear that there may not be any increase in cane yields due to P application, if the average sheath P (4-8 months) is about 0.09% or more or if the available P in soil by Truog's method is more than 75 lb/ac.

The available K in soil, the average sheath K and  $K_2O$  index in the NP treatment are given in Table 4.

Table 4. *Soil and plant indices for Potassium*

Field	Available K in soil lb/ac	4-5 month sheath		Average sheath (4-7 month)	
		K%	K <sub>2</sub> O	K%	K <sub>2</sub> O
26 Poosangudi	355	2.33	0.47	2.20	0.44
22 Poosangudi	394	1.57	0.29	1.69	0.53
24 Mayanur	225	1.76	0.37	1.77	0.38
31 Mayanur	225	1.99	0.35	1.67	0.30
44 Mayanur	190	—	—	—	—

The correlation coefficients are furnished in Table 5.

TABLE 5. *Correlation coefficients*

Index	Percent yield response	Percentage yields
Soil test for available K	+ 0.14	+ 0.05
Sheath K% (4th month)	- 0.83	+ 0.55
Sheath K <sub>2</sub> O (4th month)	- 0.84	+ 0.50
Average sheath K (4-7 month)	- 0.96*	+ 0.62
Average sheath K <sub>2</sub> O (4-7 month)	- 0.23	+ 0.19

\* = Significant at P = 0.06

The available K by the method followed in soil test laboratories was not found to be significantly related to cane yield responses to added K. On the other hand, the sheath K indices seemed to fare better, though it was only the average sheath K content that was found to be significantly related to percent cane yield responses to K. According to Bayer (1961), of the soil and plant K indices, the highest correlation with percentage increase in yields was obtained only in the case of available K in soil. The sheath K index was considered far superior to the soil test for available K by Clements (1959). The indications from the limited data in this study are in line with Clements' findings. The regression equation is given by  $y = -51.8x + 100.5$  where  $y$  is the percent cane yield response to K and  $x$  the average sheath K%. The sheath K% for zero response is about 2.00. The poor performance of sheath K<sub>2</sub>O as index of K status is perhaps due to the widely varying sheath moisture conditions prevalent in this area.

The conclusions drawn from the soil and plant tests are from limited data and refinements have to be made in respect of nutrient indices in the light of further experience on this aspect.

**Summary:** Among the various methods of determination of available P in soil, Truog's method was found to be significantly related to cane yield response to P under the conditions prevailing in T. A. Sugar Farm, Vadapathimangalam in Thanjavoor District. The average leaf sheath P (4-8 months) was also significantly related to percentage cane yields. An average sheath P of 0.09% seemed to be optimum for cane in this area. The soil available K was a poor measure of response of cane yields to K application, while the plant indices were better. The average sheath K (4-7 months) was significantly related to yield response to K application, an average sheath K content of 2.0% seemed to be optimum.

**Acknowledgement:** The authors wish to express their thanks to the Managing Agents, Messrs T. A. Sugars Ltd., Vadapathimangalam for providing facilities for this work and also the Government of Tamil Nadu for financial assistance for the establishment of this laboratory. Thanks are also due to Mr. S. V. Parthasarathy, former Chief Sugarcane Officer, for valuable suggestions in the planning of this study.

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