https://doi.org/10.29321/MAJ.10.A03006

Madras agric. J. 66 (10) : 655—658. Oct., 1979.

Influence of Continuous Cropping on the Availability of Phosphorus and Potassium Status in a Black Soil

K.K. MATHAN[1], K. SANKARAN[2], N. KANAKABUSHINI[3] and K.K. KRISHNAMOORTHY[4]

Available P and K status in a soil after six crops was assessed in the Long Term Fertilizer Experiments conducted at Coimbatore. The availability of P was changed by various fertilizer doses. There was depletion of available P from the control plots. As the the rate of P application increased, the availability also increased giving rise to a quadratic equation of $Y = 2.632 + 0.17824X - 0.0006 X^2$. The available K was depleted over years except in 150% NPK dose (based on soil test) treatments, and FYM applied plots. A positive and significant correlation ($R^2 = 0.997$) was obtained which gave a quadratic equation in the form of $Y=450.75 + 1.365X - 0.0041 X^2$.

Information on the changes in available K and P status in the soil which is subjected to intensive manuring and cultivation and the same type of fertilizers for a fairly long time is very much limited. Kudjin *et al*. (1970) reported that the P regime did not deteriorate after prolonged use of NK fertilizers. In fact systematic addition of NK fertilizers resulted in the mobilization of P from poorly available compounds into forms more available to plants in the absence of P entering from without. James *et al*. (1975) stated that soil test K decreased from the highest to the lowest K test category. Further, the management practices changed the pattern of decrease. Cooke (1974) reported that proper rotation of crop did not alter the percentage of total P in the soil. According to Biswas *et al*. (1977) even at higher rates of application, the available K did not increase substantially.

Therefore, in order to assess the status of available P in black soil after continuous intensive cropping, the present investigation was carried out.

MATERIAL AND METHODS

The soil of the area under investigation is typical black belonging to the Peelamedu series and is clayey loam having a pH of 8.2 and E. C. of 0.2 mmhos/cm. The available P status at the start of the experiment was medium (20 kg/ha) and it contained available K in the range of 542 to 560 kg K_2O per hectare.

A randomised block design has been adopted for the field experiments, the plot size being 200 sq.m. The ten treatments tried are detailed in Table I and they were replicated four times. NPK were added in the form of ammo-

1-4 : Department of Soil Science and Agricultural Chemistry, Tamil Agricultural University, Coimbatore - 641003

nium sulphate, single superphosphate and muriate of potash Micronutrients were not included since there was no deficiency. Sulphur free source of fertilizers used for treatment No. 9 were urea for N and ammonium phosphate for P. Based on the soil test values, the dosages fixed for NPK for ragi and cowpea was 36 kg N, 18 kg P_2O_5 and 7 kg K_2O/ha. For maize, it was 54 kg N, 27 kg P_2O_5 and 14 kg K_2O/ha. Farm yard manure for treatment No. 8 was given at 10 t/ha. The trial was started in 1972 with ragi (*Eleucine coracana*) (CO 7), cowpea (CO 2) and maize (Ganga-5) in rotation. At the end of sixth crop (maize) soil samples from individual plots were collected and analysed for available P by Olsen's method and organic carbon by Walkley and Black method (Jackson, 1967). Available K was analysed by the neutral normal ammonium acetate method (Jackson, 1967).

RESULTS AND DISCUSSION

Available phosphorus: The data on the available P content of soil at the start of the experiment and after 3 years are furnished in Table I. After six seasons of continuous cropping available P content in the soil was observed to either increase or decrease depending upon the treatments. The increase ranged from 1.2 to 1.6 fold. Increase in available P during a short period of time up to 5.3 folds was reported from similar experiments at Ludhiana (Biswas *et al.*, 1977). They reported that increase in P might be due to mineralization of organic P. Findlay (1973) also made similar observation.

TABLE I. Changes in Available phosphorus status of so

Treatment	Available P (kg/ha)		Change in P content kg/ha	% change of P over 1972
	Initial	After 3 years		
50% of Optimum NPK+W+P	7.6	9.2	+1.6	+22.1
100% of Optimum NPK+W+P	15.5	18.2	+2.7	+17.6
150% of optimum NPK+W+P	17.9	20.8	+2.9	+16.4
100% of optimum NPK+HW+P	16.8	15.1	—1.7	—10.2
100% of optimum NPK+M+W+P	14.9	15.3	+0.4	+ 2.9
100% of optimum NP+W+P	17.2	15.6	—1.5	— 8.8
100% of optimum N+W+P	14.8	4.7	—10.1	—68.4
100% of optimum NPK+FYM+W+P	20.5	24.7	+4.2	+20.5
100% of optimum NPK+W+P	15.4	18.5	+3.1	+20.4
Control	10.2	3.0	—7.1	—69.0

W = Weedicide
P = Pesticide
HW = Hand weeding
M = Micronutrient

When 100 per cent P was given from a sulphur free source continuously for 6 crops, the increase in available P status was as much as that obtained from 100 per cent NPK plus FYM plots and was superior to those treatments containing sulphur rich fertilizers. Increase in available P was also reported by

Havangi and Mann (1970) and Lutz and Jones (1971). A close relationship existed between the available P content and the rate of P application ($R^2 = 0.9081$) and it was quadratic ($Y = 2.632 + 0.17824\ x - 0.0036\ x^2$).

Available potassium : The percentage increase of available K in 100 per cent and 150 per cent of optimum NPK treated plots was 10.4 and 2.8, respectively. Kanwar and Prihar (1962) and Biswas *et al.* (1977) recorded similar accumulation of available K in plots supplied with FYM. The decline in available K in the control (no fertilizer) plots was the maximum (19.67 per cent) followed by the treatment consisted of sulphur free source of fertilizer (14.1 per cent). The decline in availability might be due to crop removal and fixation of added K in the soil (Mehta, 1976). Available K depletion in other treatments ranged from 0.8 to 0.6 per cent in spite of the fact that large amounts of K has been removed by crops (45.5 to 59.4 kg K_2O/ha).

TABLE II. Changes in Available potassium status of soil

Treatment	Available K_2O (kg/ha)		Change over years (kg/ha)	% change over 1972
	Initial	After 3 yrs		
50% of optimum NPK+W+P	542	511	— 31	— 5.7
100% of optimum NPK+W+P	549	544	— 5	— 0.8
150% of optimum NPK+W+P	549	564	+ 15	+ 2.8
100% of optimum NPK+HW+P	549	520	— 29	— 5.3
100% of optimum NPK+M++W+P	549	522	— 27	— 4.8
100% of optimum NP+W+P	563	520	— 33	— 6.0
100% of optimum N+W+P	560	529	— 31	— 5.6
100% of optimum NPK+FYM+W+P	560	618	+ 58	+10.4
100% of optimum (S free source) +W+P	553	475	— 22	—14.1
Control	560	450	—110	—19.6

W = Weedicide
P = Pesticide
HW = Hand weeding
M = Micronutrient

The availability of K increased with the dosage of NPK. A close relationship was observed between the rate of application of NPK and the availability of potassium. The relationship was positive and highly significant ($R^2 = 0.997$) and is given by the quadratic equation $Y = 450.75 + 1.365x - 0.0041x^2$. The rate of change of Y with respect to unit change in x is $b - 2cx$ where 'b' is the coefficient of x (1.365) and 'c' is the coefficient of x^2 (-0.0041).

The authers are indebted to the Indian Council of Agricultural Research for the facilities offered in conducting this research.

REFERENCES

BISWAS, C.R., G.S. SEKHON, and RAJINDER-JIT SINGH. 1977. Accumulation and decline of available phosphorus and potassium in a soil under multiple cropping. *J. Indian Soc. Soil Sci.* **25** : 23-7.

COOKE, G.W. 1974. Fertilizing for maximum yield. ELBS, London.

FINDLAY, W. I. 1973. Influence of fertilizers use on the phosphorus and potassium status of sandy soils. *Can. J. Soil Sci.* 53 : 103.

HAVANGI, G.V. anu H.S. MANN. 1970. Effect of rotations and continuous application of manures and fertilizers on soil properties under dryland farming. *J. Indian Soc. Soil Sci.* 18 : 45.

JACKSON, M.L. 1967. Soil Chemical Analysis. Prentice Hall, Inc. N.J.

JAMES, D.W., W. H. WEAVER, ROBERTS and A.H. HUNTER. 1975. Potassium in an arid Loessial soil : Changes in availability as related to cropping and fertilization. *Soil Sci. Soc. Amer. Proc.* 39 : 1111-15.

KANWAR, J.S. and S.S. PRIHAR. 1962. Effect of continuous application of farm yard manure and inorganic fertilizers on crop yields and properties of soil. *J. Indian Soc. Soil Sci.* 10 : 109-20

KUDZIN, K.Yu., V.A. GUBANKO, V.T. PASHOVA, and I.V. YAROSHIRICH. 1970. Mobilization of phosphorus reserves in chernozem and phosphatization after prolonged fertilization. *Soviet Soil Sci.* 2 : 409-16

LUTZ, H. A. and G. D. JONES. 1971. Crop yields and available P and K in soil as affected by sixteen annual application. *J. Indian Soc. Soil Sci.* 19 : 269.

MEHTA, B.V. 1976. Potassium status of Gujarat soils. *Bull. Indian Soc. Soil Sci.* 10: 25-32