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Tracer Studies on the Utilisation of Added Phosphorus by Co 10 Finger Millet (*Eleusine coracana* Gaertn.)

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ABSTRACT

Co 10 finger millet was grown as test crop to study the utilization of added P in the form of P^{32} labelled super phosphate. It was found that the fraction of P in plants derived from fertilizer increased progressively with increasing dose of added P, the proportion of fertilizer P being significantly higher at harvest stage than on the 35th day. Fertilizer P remained in more available form throughout the crop growth than the native soil P and the percentage utilization of added P on the 35th day after transplantation, increased with increasing dose of P in calcareous and non-calcareous red soils The overall percentage utilization was higher in the non-calcareous red soil than in the calcareous red soil. At this stage a maximum of 9.34% in calcareous red soil and 12.86% in non-calcareous red soil of added P was utilized at 53 kg P/ha level by finger millet crop. At harvest stage, the maximum percentage utilization of added P was 21.58 in calcareous red soil and 22.35 in non-calcareous red soil at 13 kg P/ha level. A direct relationship on the 35th day and an inverse relationship at harvest stage existed between utilization and levels of fertilizer P applied.

INTRODUCTION

Phosphorus, when added to the soil forms a multitude of compounds of low solubility. Caldwell *et al.* (1954) reported that the recovery of applied P was low regardless of the kind, rate or time of application. The best recovery was only 11.6 per cent of the P from superphosphate applied at the rate of 135 kg P/ha. Thomas (1964) recorded a maximum recovery of only 21.7 per cent of the added P. In this paper the results obtained from an experiment conducted to find out the percentage utilization of added P by finger millet (*Eleusine coracana* Gaertn.) crop are reported.

MATERIALS AND METHODS

A pot-culture experiment was conducted on calcareous (pH 8.2) and non-calcareous (pH 7.0) red soils of Coimbatore District with 5 treatments *viz.*, (i) the control (no P), (ii) 13 kg P/ha, (iii) 26 kg P/ha, (iv) 39 kg P/ha and (v) 53 kg P/ha. Each treatment was replicated 4 times.

Phosphorous was applied as P^{32} labelled superphosphate. Nitrogen at

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90 kg/ha as ammonium sulphate in 2 split doses (one at the time of planting and other as top dressing two weeks after transplantation) and potassium at the rate of 37 kg K/ha as potassium sulphate at planting were applied for all treatments. Available P values (Olsen's) were 5.6 kg/ha. and 12.3 kg/ha respectively. Finger millet seedlings of the variety 'Co 10' were transplanted at the rate of 8 seedlings per pot and the entire experiment was duplicated. On the 35th day after transplantation, plant samples were drawn from the duplicate set and analysed for total P by the Vanadomolybdate method of Koenig and Johnson (1942) and for radioactive P by the method of McKenzie and Dean (1948). The original set was allowed to grow to maturity, harvested and the grain and straw were analysed for total and fertilizer P contents. P^{32} labelled superphosphate was analysed for total and radioactive P contents. The fraction of P in the plant derived from fertilizer was calculated from specific activities of the P in the plant and the fertilizer. Utilization of added phosphorous on the 35th day after transplantation and at harvest stage were calculated from the dry matter yield of plant, fertilizer P fraction in the plant and the amount of P added.

RESULTS AND DISCUSSION

The fraction of fertilizer P in plants was significantly higher in calcareous red soil (Table 1). This may be due to greater availability of added P and poor native P status of the soil due to the more sandy nature of the calcareous soil than the non-calcareous one. The fertilizer P fraction in the plants increased progressively with increasing doses. Similar findings have been reported by Venkatachalam *et al.* (1969 a) in sunnhemp (*Crotalaria juncea* L.), Venkatachalam *et al.* (1969 b) in Co32 rice (*Oryza sativa* L.), Shanmugam (1970) in IR 8 rice, Gopalachari and Nagaraj (1970) in tobacco and Ramachandran (1971) in IR 20 rice. In the present study, the proportion of fertilizer P in plants was significantly higher at harvest stage than on the 35th day after transplantation. This trend could be due to the appreciable utilization of the limited source of soil P by the crop during the early stages of growth followed by a greater availability of fertilizer P in the later stages of crop growth.

The utilization of added P by finger millet crop increased with increase in the doses of P on the 35th day after transplantation as evidenced in the present studies. This is contrary to the general observation of an inverse relationship between the percentage utilization and the doses of the nutrient applied thereby indicating higher demands and uptake of P during the early stages of plant growth. Mitchell (1957), Mistry (1962) and Goswamy *et al.* (1971) have reported that maximum absorption of P by plants occurs mostly in the early srages of growth. At this stage the maximum utilization of the added P in non-calcareous red soil was 12.86 per cent as compared to 9.34 per cent in calcareous red soil. Thus, the overall utilization of added P was greater in non-calcareous red soil resulting in a

TABLE 1. Fraction of fertilizer P in plants expressed as percentage of total P uptake and the percentage utilization of added P.

Treatments	Fraction of fertilizer P in plants				Percentage utilization of added P by plants			
	Calcareous red soil		Non-calcareous red soil		Calcareous red soil		Non-calcareous red soil	
	35th day after transplantation I	Harvest stage II	35th day after transplantation I	Harvest stage II	35th day after transplantation I	Harvest stage II	35th day after transplantation I	Harvest stage II
13 kg P/ha	35.91	46.16	40.41	47.71	5.62	21.58	11.34	22.35
	(36.80)	(42.80)	(39.45)	(43.70)	(13.52)	(27.66)	(19.66)	(28.14)
26 kg P/ha	59.24	73.56	54.73	60.56	8.94	19.59	11.60	14.19
	(50.38)	(59.16)	(47.75)	(51.11)	(17.37)	(26.26)	(19.88)	(22.76)
39 kg P/ha	70.17	68.06	55.33	63.80	7.82	17.96	10.31	13.15
	(56.97)	(55.61)	(48.08)	(53.07)	(16.16)	(25 04)	(18.73)	(21.19)
53 kg P/ha	76.27	81.80	72.35	70.46	9.34	12.44	12.86	14.03
	(61.25)	(64.91)	(58 51)	(57.11)	(17.80)	(20.65)	(20.93)	(21.97)

(Figures in parentheses show the sine inverse transformed values)

Fertilizer P fraction in plants

	S. E.	C. D. at 5%
Soils	0.644	1.83
Treatments	0.910	2.58
Stages	0.644	1.83

Percentage utilization on the 35 th day

	S. E.	C. D. at 5%
Soil	).427	1.27
Treatments	0.604	1.76
Percentage utilization at harvest stage		
Soils	0.457	1.33
Treatments	0.65	1.88

better performance of the crop than in the calcareous red soil. However at harvest stage, the percentage utilization was greater under calcareous red soil due to its very low inherent available P status and the consequent utilization of the added fertilizer P with the advance of crop growth. The percentage utilization of added P was highest at 13 kg P/ha level and an inverse relationship was recorded with increasing doses of P.

At the final stage of growth a maximum percentage utilization of 21.58 in calcareous red soil and 22.5 non-calcareous red soil was recorded at 13 kg P/ha level. Venkatachalam *et al.* (1969 a) have reported that sorghum on the 35th day after sowing utilised 3 per cent of added P in calcareous red soil and 6 to 9 per cent in non-calcareous red soil. Hemwall (1957) and Kanwar and Grewal (1971) have observed that the recovery of added P by plants is to the extent of 10 to 30 per cent only and the rest goes into unavailable forms.

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REFERENCES

CALDWELL, A. C., A. HUSTRULID, and J. M. MACGREGOR. 1954. The absorption of phosphorus from radio active phosphate fertilizers applied to established meadows. I. Effect of source, rate and time of application. *Proc. Soil Sci. Soc. Am.* 18 : 440-3.

GOPALACHARI, N. C. and J. G. NAGARAJ. 1970. Phosphorus requirement of tobacco in soils of varying available phosphorus status. Radiation and radioisotopes in soil studies and plant nutrition. *Proc. of Symp held at the University of Agricultural Seiences Hebbal, Bangalore.*

GOSWAMY, N N., D. BAGCHI, S GOPALAKRISHNAN and J. R. SAHA. 1971. Efficiency of applied phosphorus and its utilizatian by jute. *(Corchorus olitorius and C. capsularis) Int. Symp. Soil Fert. Evalu. New Delhi* 1 : 737-46.

HEMWALL, J. B. 1975 Fixation of phosphorus by soils. *Adv. Agron.* 9 : 95-112.

KANWAR, J. S. and J. S. GREWAL. 1971. *Tech. Bull. (Agric.)* 29 *Indian Coun. Agric. Res., New Delhi.*

KOENIG, R. A. and C. R. JOHNSON. 1942. Colorimetric determination of phosphorus in biological materials *Ind. Engg. Chem. Analyt Edn.* 14 : 155.

McKENZIE, A. J. and L. A. DEAN. 1948. Procedure for measurement of P^{31} and P^{32} in plant materials. *Analyt. Chem.* 20 : 559-60.

MITCHELL, J. 1957. A review of tracer studies in Saskatchewan on the utilization of phosphates by grain crops. *J. Soil. Sci* 8: 73-85

MISTRY, K. B 1962. Relative efficiencies of phosphatic fertilizers for wheat through radioactive tracer technique. II. Studies on the black and alluvial soils of India. *Radioisotopes in Soil-plant Nutrition studies. Proceedings of the International Atomic Energy Agency, Vienna* 1962 *pp.* 427-42

RAMACHANDRAN, S. 1971. *Effect of organic manure on the uptake of phosphorus using* P^{32} *labelled superphosphate on IR 20 paddy (Oryza sativa L.) M.Sc. (Ag)* Thesis, University of Madras.

SHANMUGAM, K. 1970. *Nutrient uptake studies with particular reference to phosphorus using* P^{32} *labelled super phosphate on IR 8 rice.* M. Sc. (Ag.) Thesis, University of Madras.

THOMAS, J. R. 1964. Availability of residual phosphorus as measured by alfalfa yields phosphorus uptake and soil analysis. *Soil Sci.* 98 : 79-84.

VEŃKATACHALAM, S, C. P. NATARAJAN, S. PREMANATHAN and K. KUMARASWAMY, 1969 a. Soil Fertility studies in Tamil Nadu using radio-tracer technique. II. Phosphorus uptake by sunnhemp in different paddy soils. *Madras agric. J.* 56 : 574-80.

VENKATACHALAM, S., C. P. NATARAJAN, S. PREMANATHAN, and K. KUMARASWAMY, 1969 b. Soil fertility studies in Tamil Nadu using raidio-tracer techniqe. III. Utilization of superphosphate applied to paddy through a preceding green manure crop. *Madras agric. J.* 56 : 309-15.