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Influence of Moisture and Added N on P Availability*

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The influence of soil moisture regimes, doses of added N and their interaction on the quantum of available P was investigated under pot and field conditions in red and black soils of Tamil Nadu with Co. 10 ragi as test crop at Tamil Nadu Agricultural University, Coimbatore. The available P content of soils in general was affected by the moisture regimes. Higher doses of N reduced the available P content. Response to the variables introduced were more pronounced in red soil than in black soil and the available P decreased with crop growth.

Among the multiple factors contributing to plant growth and yield, water is the most important and limiting one which controls to a great extent soil fertility and productivity. It controls the degree of availability forms, rate of movement and extent of the uptake of mineral nutrients by the plant. Of all the major nutrients, P is considered probably the one which is most influenced by the soil moisture status (Jackson, 1972). with a view to study the influnce of soil moisture and added levels of N on the available P status of soil an investigation was carried out at Tamil Nadu Agricultural University, Coimbatore, with Co. 10 ragi (*Eleusine coracana* Gaertn) as test crop.

MATERIALS AND METHODS

Two pot experiments and a field investigation were conducted during 1974-75. The characteristics of the experimental soils are presented in Table I.

TABLE-I Characteristics of experimental soils.

	Experiment-I Red soil	Experiment-I Black soil	Experiments-II and III Red soil
Clay content(%)	16.35	44.48	13.74
Maximum water holding capacity(%)	35.40	58.80	37.70
Field capacity(%)	19.60	39.80	20.30
Wilting point moisture(%)	–	–	6.4
Available P content	7.0	3.4	5.4
pH	7.2	8.1	7.2

Experiment I: A pot experiment was coducted under glass house conditions with red and black soils collected from Semmankuzhipur and from the University farm respectively. The treatments consisted of four levels of N viz., 0(N_0), 45(N_1), 90 (N_2) and 135 (N_3) kg N/ha as ammonium sulphate with a

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constant dose of 45 kg/ha each of P_2O_5 and K_2O as super phosphate and muriate of patash respectively. The five levels of soil moisture tried were maintaining the soil moisture at 100 (M_1) 75 (M_2) and 50 percent (M_3) field capacity throughout the crop growth and irrigating to field capacity whenever the surface layer dried up (M_4) corresponding to farmers practice and at the appearance of first perceptible symptoms of wilting (M_5). Ten kg soil was taken in glazed porcelain pots. There were 3 replications with 120 pots in all. The entire dose of fertilizers was added as basal application. Twenty one days old seedlings were transplanted at the rate of 5 hills pe pot with 2 seedlings in each. After giving life irrigation, moisture regimes were established as per the treatments and the same were maintained through out the cropping period by weighing the pots daily and adding calculated quantity of water to replenish the moisture loss. One of the replications (40 pots) was removed at tillering and another at flowering stage for soil and plant analysis, The third replication was maintained till maturity. Soil samples collected at pre-planting, tillering, flowering and post-harvest stages were analysed for their available P content as per the method of Olsen *et al.* 1(954).

Experiment II. The second pot experiment was conducted with the soil collected from the University Campus. The forms and levels of nutrients were the same as in experiment I except that N was applied in two split doses, one at the time of planting and the other at flowering. The moisture treatments consisted of irrigating to field capacity at 20 (M_1), 40 (M_2), 60 (M_3), 80 (M_4) and 100 per cent (M_5) available soil moisture depletion. Each treatment was replicated thrice and there were 60 pots in all. One replication was removed at flowering and the other two were maintained till maturity. Soil moisture content between field capacity and 15 atmospheric pressure was taken as avilable soil moisture. Field capacity was estimated as per the method of Dastane (1967) and the moisture content at atmospheric pressure was determined with a pressure membrane apparatus. Moisture levels were maintained by weighing the pots daily Soil samples collected at preplanting, flowering and post-harvest stages were analysed for available P content.

Experiment III. A field experiment was conducted in a split plot design with moisture levels as main plot treatments and N levels as sub-plot treatments during 1975 at the millet breeding station of the University farm. The treatments were the same as under experiment II. There were three replications with 20 plots in eash. The plot size was 5.0 × 1.5 m. Seedlings were planted giving a spacing of 15 cm on either side and after giving the life irrigation moisture regimes were maintained. Required quantity of water to bring the soil moisture content to field capacity was applied by regulating the flow through a 'V, notch. The available P content of soils was estimated periodically as in experiment II.

RESULTS AND DISCUSSION

The available P content of soils under experiment I is given in Table II and that of experiments II and III in Table III. Significant differences in the available P content of soils due to treatment effects were in evidence only under experiment I, whereas in experiments II and III neither moisture levels nor the levels of added N influenced the available P status of soils. In all the three experiments significant reductions in the available P content of soils could be observed as the crop growth advanced. This was suggestive of the fact that there was increased P uptake by the growing crop with the advancement of age which resulted in the depletion of the soil P and consequential reduction in available P content.

In experiment I the available P content of soils was maximum at M_2 moisture treatment and this was on par with M_3 but superior to other three levels. The mobility of soil P and its diffusion are known to be dependent on the soil moisture content and the amount and nature of clay (Juang and Chau, 1966). In the present investigation these two moisture treatments are relatively drier regimes when compared to the other three moisture treatments and hence under these conditions of lower moisture regimes mobility of soilP might have been restricted resulting in reduced P uptake by the crop and a consequent enhanced P accumulation in the soil. In the other two experiments the soil moisture content was allowed to fluctuate between field capacity and a pre-determined level. The possibility of soil remaining at a dry state long enough to cause a variation in the movement of soil P was very much limited and hence the effect of soil P availability was not in evidence.

The available P content was distinctly higner in red soil than in black soil. Similar observations were also made by Kandaswamy *et al.* (1974). This was possible since the initial available P content of red soil was higher than that of black soil... Moreover, red soils are known to be relatively poor in their P fixing capacity, thereby the added P might have been in an easily available form resulting in higher available P content. In contrast: the black soil was clayey in texture and calcareous in nature and tended slightly towards alkalinity. Hence this might have favoured the transformation of the added P into relatively non-available forms in black soils as reported by Kumaraswamy and Dhanapalan Mosi (1969) and Jose (1973). The significant interactions of soils and moisture, soils and nitrogen and soils and growth stages clearly indicated that the available P content was higher in red soil than in black soil at each moisture and nitrogen levels and at all the stages of crop growth which lend support to the above inference. Levels of applied N had a significant influence on the available P content of soils in experiment I. The lower levels of added N lead to greater available P content of the soils and the maximum P was under no N treatmenr. This was due to the fact that the total dry matter production and total P uptake by the crop were maximum under higher levels of N addition, Since the crop removal of soil P was higher under higher levels of N addition the available P content was less. However, in experiments II and III such variations due to N applications could not be observed althrough variations in total dry matter production and total P uptake were associated with applied N levels. Such increased P uptake due to the influenee of applied N without a corresponding decrease in the available P content of soil was possible due to the withdrawel of P from relatively unavailable sources in the soil. Release of P from these sources due to priming effect could have compensated the enhanced P uptake consequent to the increases in the available N status of soil and eventually the equilibrium could have been established (Dravid and Apte. 1975)

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TABLE II Available P status of soil (ppm)-Experiment

Treatment		Pre-planting		Tillering		Flowering		Post-harvest	
		Black Sil	Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil	Red Soil
M_1	N_0	1.5	10.8	2.0	6.5	1.5	6.0	1.0	7.5
	N_1	1.3	8.5	1.5	4.0	1.3	4.5	1.0	2.0
	N_2	2.5	9.0	2.5	3.8	1.3	2.8	1.0	4.3
	N_3	1.0	9.8	1.3	6.8	1.3	2.5	1.0	1.5
M_2	N_0	1.5	7.8	1.5	5.5	1.0	6.0	1.0	7.5
	N_1	2.5	7.5	1.5	5.0	1.3	6.0	1.5	8.0
	N_2	2.5	8.8	1.3	6.0	1.0	7.0	1.0	5.5
	N_3	1.5	8.0	1.3	6.0	1.0	7.0	1.0	5.0
M_3	N_0	2.5	10.8	1.5	11.5	1.3	10.3	1.0	7.8
	N_1	2.5	10.8	2.5	10.8	1.0	5.0	1.0	6.0
	N_2	1.5	7.0	1.5	7.5	1.0	6.0	1:0	8.0
	N_3	1.5	6.0	1.5	6.0	1.3	3.5	1.5	7.0
M_4	N_0	1.5	6.0	2.8	6.3	1.0	5.3	1.3	7.5
	N_1	1.0	8.8	3.8	6.0	1.0	7.3	1.5	5.5
	N_2	1.0	6.8	1.5	6.0	1.0	7.3	1.0	6.7
	N_3	1.3	10.8	1.5	8.5	1.0	4.5	1.0	6.0
M_5	N_0	1.0	11.5	2.8	10.5	1.0	5.3	2.0	8.5
	N_1	2.0	11.0	2.5	8.8	1.3	7.5	1,3	8.3
	N_2	2.8	6,0	3.0	8.5	1.3	6.0	1.0	7.3
	N_3	1.3	6.0	1.5	6.3	1.0	8.0	1.0	8.8

TABLE III Available P status of soils (ppm) Experiments II and III

Treatment		Experiment II			Experiment III		
		Pre-planting	Flowering	Post harvest	Pre-planting	Flowering	Post-harvest
M_1	N_0	15·4	7·5	8·3	12·6	5·4	4·3
	N_1	16·5	6·6	6·1	11·6	7·0	4·6
	N_2	17·0	6·3	4·5	11·8	4·7	3·8
	N_3	16·0	5·8	4·9	12·4	5·4	3·9
M_2	N_0	16·3	7·5	6·8	12·4	7·4	3·3
	N_1	16·5	6·1	5·9	12·7	5·5	4·1
	N_2	17·0	6·9	6·1	11·6	7·4	3·4
	N_3	17·5	9·5	5·9	11·9	5·1	2·8
M_3	N_0	16·5	8·5	6·5	12·9	6·6	4·2
	N_1	14·7	5·5	5·7	12·3	6·8	3·0
	N^2	15·1	8·0	4·8	12·8	7·3	4·3
	N_3	17·5	5·4	5·4	12·5	4·9	3·9
M_4	N_0	15·7	8·9	8·5	13·0	6·8	3·7
	N_1	15·4	6·0	6·5	12·6	6·4	4·6
	N_2	17·9	5·4	5·6	12·3	6·3	2·6
	N_3	16·7	5·8	6·4	12·8	6·7	4·0
M_5	N_0	15·5	5·5	6·4	12·6	6·7	3·5
	N_1	15·0	8·1	6·7	12·4	7·5	5·0
	N_2	15·4	7·7	5·8	11·5	7·1	4·7
	N_3	15·7	6·3	5·8	12·7	6·0	3·7