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A Study on the Fixation of NPK by Noyyal Alluvium

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The results of a laboratory incubation study with Noyyal Alluvium on the fixation of major plant nutrients under three levels in each of NPL and their combinations are reported in this paper. The study revealed that with increase in the levels of application of N, P and K the fixation of the NH_4 was maximum under constant moisture level, while the fixation of K was maximum under alternate wetting and drying. The fixation of P was not influenced by the changes in moisture levels. The NH_4 fixation was not affected by the presence of K while the K fixation was maximum in the presence of higher levels of NH_4.

The fixation and release of plant nutrients by the soils are important characteristics to be assessed in a programme involving the fertility management of the soils. In order to utilise the limited amount of fertilizers available for the maximum benefit, it is essential to pay adequate attention to this aspect. Efficient utilisation of the added fertilizer depends on the nature and amount of fertilizer added, method and time of application besides the soil characteristics. If a soil has a high fixing capacity, it is likely that a considerable portion of the added plant food may be fixed or immobilised either temporarily or even permanently. Hence in a study aiming at the economic usage of fertilizers, a knowledge, on the fate of added fertilizer may be necessary. In the present investigation an attempt has been made to study the nutrient fixing capacity of an alluvial soil of Tamil Nadu.

MATERIALS AND METHODS

Alluvial soil from the river bed of Noyyal (a tributary of Cauvery) was chosen for the study. The soil is a sandy clay loam. The exchange characteristics of the soil are as follows :

Cation exchange capacity	...	22.9 me/100 g soil.
Exchangeable calcium	..	9.0 ,,
Exchangeable magnesium	..	6.0 ,,
Exchangeable potassium	...	6.1 ,,
Exchangeable sodium	...	1.1 ,,
Exchangeable hydrogen	...	0.7 ,,

The silica sesquioxide ratio of the soil was 1.6. The soil was air dried, sieved through a 2 mm. sieve and 500 g of soil was taken in beakers. The major nutrients NPK added at 0 - 100 - 200, 0 - 25 - 50 and 0 - 100 - 200 ppm respectively in all possible combinations as ammonium sulphate, superphosphate and muriate of potash. Thus, the treat-

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ment combinations were in all 27. The experiment was conducted with two different moisture levels. One set was maintained at constant moisture level (30%) roughly corresponding to field capacity by weighing the beakers containing the soil every day and adding water to replenish the loss due to evaporation. The treatments under the second set were subjected to alternate wetting and drying at room temperature. After the addition of the calculated quantities of the nutrient solutions and required water, the soils under different treatments were thoroughly mixed and left for equilibration. Samples were drawn from each treatment 24 hours after the addition of fertilizer solutions and at the end of 15 weeks of incubation. The soil samples were analysed for available nitrogen, phosphoric acid and potassium employing suitable methods (Subbiah and Asija, 1956; Olsen *et al.*, 1954 and Stanford and English, 1949 respectively). The amounts of nutrients fixed were calculated by difference from the initial and final contents and the data were analysed statistically. It was assumed that the losses due to volatilization were negligible.

RESULTS AND DISCUSSION

The summary of the results of the statistical analysis of the data is furnished in Table I.

TABLE I. Summary of statistical analysis (Mean values of N, P and K fixed in ppm)

		Moisture I	Moisture II	C. D. (P=0.01)
Available N		71.30	50.59	8.4
Available K		67.41	91.30	10.4
	N_0	N_1	N_2	
K_0	40.00	57.50	50.83	
K_1	73.33	75.83	88.33	22.06
K_2	81.67	99.17	147.50	

It was observed that the fixation of all the three nutrients viz., N, P and K increased with increase in the doses of the respective nutrients. Several workers have reported increased fixation of plant nutrients with increase in dosages. Bakheitsaid (1973) observed increased fixation of NH_4 with increase in NH_3 dose. Chatterjee and Datta(1951) found that the amount of P fixation increased with increase in the concentration of added phosphoric acid. Increasing amounts of K fixation with increased application of K have been reported by Mclean and Simon (1958) and Grewal and Kanwar (1967).

The fixation of added NH_4 was significantly higher in the treatments which were kept at constant moisture level (30 per cent) than that of alternate wetting and drying. Bower (1950) observed that the fixation of NH_4 was higher under moist conditions. In contrast to the behaviour of NH_4, the K fixation was maximum in the treatments under alternate wetting and drying and minimum under constant moisture level. References on the increased K fixation under alternate wetting and drying are numerous (Demumbrum, 1958; Kaila, 1965 and Grewal and Kanwar, 1967).

It is well known that there exists a competition between different ions for adsorption on the colloidal surfaces of soil mass. The possible reasons for the preferential or increased fixation of K^+ over NH_4^+ under alternate wetting and drying can be explained as follows. It is likely that K ions might be precipitated in the interior of the clay lattice or might be held very tenaceously as a result of contraction of clay sheets after the entry of K due to drying (Mehrotra *et al.*, 1972). Further it may be also possible that as a result of adsorption of NH_4 particularly on the edges of the clay colloid, it may entrap the already fixed K thus preventing the release of adsorbed K. Pratt and Goulben (1957) reported that the entrapment of K ion in the exchange sites reduced the cation exchange capacity of the soil. Thus the increased fixation of K on alternate wetting and drying reduced the fixation of NH_4 as a result of reduction in the site for fixation.

The above observations clearly showed that the ability of one ion getting fixed in preference to the other or one ion forcing the other to get entrapped or released are influenced by moisture conditions. Hence under constant moisture level, the NH_4 fixation was high while the K fixation was enhanced under alternate wetting and drying.

When both the moisture levels were considered together, it was found that the addition of K did not influence the NH_4 fixation. Gama (1969) and Raju and Mukhopadhyay (1973) also reported that K had no effect on the amonnt of NH_4 fixation. But on the contrary the present study also revealed that K fixation was maximum when NH_4 application was high, while the lower NH_4 levels did not show any significant variation. This might be perhaps due to the fact that after the precipitation or adsorption of K inside the clay lattice, the NH_4 getting adsorbed on the edges under high levels of NH_4 application would have blocked the release of K. The observations of Lutz (1966) who found that the NH_4 was released in the presence of K but K was released only in the presence of low levels of NH_4 lend support to the above hypothesis.

Different moisture levels tried did not have any significant influence on the P fixation indicating that the P fixation possibly is not governed very much by these two moisture conditions.

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