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Availability of NPK Under Long Term Fertilization

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The influence of long term fertilization with organic manures and inorganic fertilizers under rainfed and irrigated conditions on the available NPK status was investigated with the soil samples collected from the permanent manurial experimental plots of Tamil Nadu Agricultural University farm at Coimbatore. The available N content was positively influenced by the addition of organic manures under rainfed condition. Under irrigated conditions, continuous fertilization with organic manures and inorganic fertilizers had no effect on the available N content. Available P and K contents were higher in plots which received P and K applications respectively. Under irrigated condition, the application of N had a depressive effect on the available K content.

Continuous applicatins of fertilizers might alter the properties of soils especially the amount of available nutrients. The best tool to assess the effects of long term fertilization on soil characteristics is the permanent manurial experiments. Acharya and Rajagopalan(1956) and Ambika Singh and Roysharma (1968) have reviewed the efficiency of various organic and inorganic manures under continuous long term application in building up the fertility level of the soils. With a view to find out the effects of continuous fertilization on soil fertility, a study was made on the available NPK status of soils under long term fertilization and the results are presented in this paper.

MATERIALS AND METHODS

The new and old permanent manurial experimental plots at the Agricultural University farm, Coimbatore were selected for the investigation.

The old permanent manurial experiment (OPM) was commenced in the year 1907 and it consists of ten treatments with one plot each having an area of five cents. The plots were under the same treatment year after year for 65 years. Initially it was maintained under irrigated conditions and from the year 1937, it was brought under rainfed cultivation.

The treatments are: (1) Control (No manure), (2) N alone, (3) N and K, (4) N and P, (5) N, P and K, (6) P and K, (7) K alone, (8) P alone, (9) Cattle manure and (10) Cattle manure residue.

For treatments 2 to 8, N is applied as ammonium suphate at the rate of one cwt/ac, P as superphosphate at the rate of 3 cwt/ac and K as sulphate of potash at the rate of one cwt/ac. Cattle manure is applied at the rate of

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5 tons/ac. Treatment 9 and 10 received cattle manure in alternate years i.e. CM plot will be the CMR plot in the succeeding year and *vice versa*.

The new permanent manurial experiment (NPM) started in the year 1934, is under irrigated conditions. The treatments are the same as under OPM excepting that the treatments are replicated twice and called Eastern and Western series. Farmyard manure at the rate of 2000 lb per acre per year is applied to all but the cattle manure residue plot in the Western series alone. The soil of the experimental plots is a calcareous red loam. Sorghum, finger millet and cotton are raised under these experiments in rotation.

Soil samples were collected from each of the treatments of OPM at the rate of three samples per treatment from three depths viz. 0-20, 20-40 and 40-60 cm. In the NPM also similar samples were collected from the plots of both the series separately. The samples were air dried and a portion of the same was powered and passed throug 2 mm sieve. The sieved material was used for analysis of physical and chemical parameters. The soils were analysed for available N and P by the method of Subbiah and Asija (1956) and Olsen (1954) respectively. The available K was estimated by flame photometer (Jackson, 1967).

RESULTS AND DISCUSSION

The available nutrient contents are given in Table-I.

From the results, it could be seen that in the OPM, the available nitrogen content under organic manure treatments was higher than those plots under fertilizer treatments. This may be due to the continuous annual application of cattle manure at the rate of 5000 lb/ac for 65 years which would have brought an optimum environment of microbial population thus enabling

TABLE I-a. Available nutrients - Old permanent manurial experiment

Treatments	Available N (ppm)			Available P (ppm)			Available K (ppm)		
Depth in cm	0—20	20—40	40—60	0—20	20—40	40—60	0—20	20—40	40—60
Control	65.8	61.6	65.8	1.6	0.8	...	170	140	120
N	60.2	67.2	61.6	1.2	0.2	0.2	190	160	125
NK	67.2	65.2	61.6	1.2	0.2	0.2	385	255	160
NP	67.2	58.8	71.4	3.6	0.2	0.2	150	150	110
NPK	75.6	61.6	49.0	2.4	1.4	0.6	335	230	175
KP	58.8	67.2	78.4	3.6	0.8	0.8	335	160	135
K	67.2	70.0	67.2	1.2	...	...	285	105	135
P	65.8	75.6	56.0	6.4	2.0	1.8	220	115	110
CM	75.6	65.8	71.4	3.2	0.8	...	225	120	125
CMR	88.2	77.0	72.8	2.4	1.6	0.6	270	160	160

TABLE I-b. Available nutrients - New Permanent Manurial Experiments. Western Series

Treatments	Available N (ppm)			Available P (ppm)			Available K (ppm)		
Depth in cm	0—20	20—40	40—60	0—20	20—40	40—60	0—20	20—40	40—60
Control	74.2	61.6	49.0	0.8	0.6	0.2	355	160	140
N	72.8	65.8	68.6	2.2	0.4	0.2	370	135	110
NK	85.4	58.8	57.4	1.4	1.0	0.4	445	195	110
NP	82.6	65.8	64.4	5.6	0.8	0.6	385	130	105
NPK	78.4	56.0	58.8	5.6	1.6	1.6	420	215	115
KP	78.4	58.8	67.2	5.2	0.4	0.2	430	260	125
K	85.4	47.6	63.0	2.4	1.0	0.2	500	195	120
P	81.2	40.6	49.0	8.8	0.8	0.8	455	110	95
CM	81.2	36.4	51r8	4.8	0.2	0.2	450	200	80
CMR	91.0	40.6	56.0	4.4	1.0	0.6	465	170	150

TABLE I-c. Available nutrients - New Permanent Manurial Experiments. Eastern Series

Treatments	Available N (ppm)			Available P (ppm)			Available K (ppm)		
Depth in cm	0—20	20—40	40—60	0—20	20—40	40—60	0—20	20—40	40—60
Control	92.4	64.4	36.4	2.6	2.0	1.6	390	180	90
N	99.4	57.4	43.4	3.2	0.8	1.0	375	150	115
NK	78.4	64.4	57.4	2.0	0.2	0.2	390	265	205
NP	71.4	68.6	56.0	4.8	1.4	1.0	280	165	70
NPK	81.2	78.4	51.8	6.6	0.8	0.4	390	265	95
KP	70.8	72.8	58.8	6.6	1.4	0.8	390	360	160
K	79.8	70.0	32.2	1.2	1.6	...	385	350	180
P	98.0	75.6	64.4	4.8	1.0	0.8	320	185	120
CM	96.6	74.2	40.6	3.0	0.8	0.8	355	270	90
CMR	85.4	67.2	57.3	0.6	0.2	0.2	315	155	150

quicker mineralisation of organic nitrogen. Sanyasi Raju (1952) and Mandal and Pain (1965) have also reported similar observations.

There was no marked variation in the available N content at the different depths studied. Under dryland conditions, plant roots would have gone to deeper layers to tap soil moisture. On maturity, these roots would have added to the soil organic matter which on decomposition would release soluble N compounds at all depths and hence no variation in available N content with depth.

In NPM, the surface soils contained higher N than sub-surface soils. The lower layers contained less available N due to the reason that under irrigated conditions, root growth was probably restricted to the surface layers alone. The application of organic manure or inorganic fertilizer did not significantly increase the available N content as seen from the absence of significant difference in available N content due to the various treatments. The nitrogen applied through organic manures and inorganic fertilizers was probably fully utilized by the crop under irrigated conditions where crop growth is not limited by water stress. Under OPM, water was a limiting factor of crop production which lead to frequent crop failures thus not utilising the nutrients fully. Therefore under OPM conditions, significant variations in available N due to effect of treatments, were not observed.

Available P was more in plots receiving superphosphate in both the experiments. It is natural, since only a part of the added P was absorbed by the crop and the rest added to the exchangeable or fixed P. This part of P transforms more easily to available forms subsequently and thus increases the available P content of the soil. This observation agrees with the findings of Russell (1960) and Kanwar and Prihar (1962) who have reported similar trends in soils with which they worked. The surface samples of both the experiments had a higher available P content than the sub-surface soils and this is probably due to the comparative immobility of the applied P (De Turk, 1938; Russell, 1960).

In both OPM and NPM, application of potassium sulphate significantly increased the available K content of the surface soil. Djokoto and Stephens (1961) and Maclean and Doyle (1963) have also reported similar findings. The available K content was higher in the surface soils than in the sub-surface soils of the experimental plots studied. This could have been probably due to the fact that fertilizers are incorporated in the surface layers only and get fixed there itself. Further the plants remove K from lower depths and deposit it in surface layers through their leaf droppings which offsets any downward leaching of K due to water movement.

In the NPM, application of N had a depressing effect on the available K content and this could have been due to higher crop removal of K owing to the enhanced vegetative growth as a result of N application.

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