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Long Term Effect of Fertilizers on Availability of Micronutrients in Soil under Wheat Rice Intensive Cropping System

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Abstract – It has observed that the application of fertilizers, in general, depleted availability of Zn in soil on comparing with the control. Nitrogen application alone or combination with phosphorus showed decreasing trend of Zn. Maximum reduction was recorded under NPK treatment. The availability of Zn decreased by 23 per cent with cropping and it was maximum after wheat harvest than that after rice harvest. The availability of Fe, over seven seasons increased to the extent of 15-20 percent over control. However, the highest availability of Fe in soil was found consequent upon application of nitrogen alone, followed by combined application of nitrogen and phosphorus. The availability of Mn increased significantly over control and also over nitrogen alone. On an average, the availability of Mn increased 3, 5 and 10 per cent with N, NP and NPK fertilizer application. On the basis of relative values, available Cu was in the range of 91-96 per cent after rice and 83-98 per cent after wheat, when initial value of 1.74 ppm Cu at the start was considered as 100. The overall reduction in Cu content was found to be 16 per cent after harvest of wheat.

Intensive use of fertilizers, intensive cropping and high yielding seeds have no doubt brightened the hopes of huminity for successfully meeting the challenge of food shortage, but it has also brought into the sharp focus numerous problem of soil fertility, fertilizer, soil and water management. Universal deficiency of nitrogen and serious deficiency of phosphorus and potassium and increasing deficiency of micro nutrients particularly Zn, Fe and Mn could be well understood under soil fertility problems, in modern agriculture. The continuous application of fertilizers N, P and K could help to improve such nutrients deficiencies due to imbalanced application of fertilizers under intensive farming systems in case of micronutrients.

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MATERIALS & METHODS

The experiment was conducted in rabi with wheat followed by rice in a randomized block design with 4 treatment and 4 replication. i.e. N0P0K0, N120P0K0, $N_{120}P_{60}K_0$ and $N_{120}P_{60}K_{60}$. The experimental field have sandy loam soil in texture with mild alkaline pH. These soil have a little free calcium carbonate at the surface but the lower layers are rich in this constituents and small calcium incrustation. The soluble salt contents are average to high but the exchange complex is saturated with calcium to the extent of eighty percent. The percentage of Sand, Silt, Clay were 52.0, 27.5 & 20.0 respectively with Organic Carbon 0.36 % and Ec 0.35%. The available Plant Nutrients were Phosphoru-8 ppm, Potash 97.5 ppm, Sulphur 10 ppm. The micronutrient level of Zinc 0.65 ppm, Iron 2.60 ppm, Manganese 7.35 ppm, and Copper 1.77 ppm respectively.

Wheat variety HD 2204 and rice variety Saket 4 was grown in a proper crop rotation. Nitrogen, phosphorus and potash were applied through urea, single super phosphate and muriate of potash, respectively. Nitrogen was applied in two splits, half the quantity at sowing time and the remaining half after first irrigation in wheat. In rice, one-third quantity of N was applied at transplanting and remaining N in two equal splits at tillering and panicle initiation stages. The entire quantities of P and K were applied at the time of sowing/transplanting.

The soil samples were collected and air dried, powdered and passed through a 2 mm sieve. Various soil chemical analysis were done by the standard methods followed by Piper,1966 and Jackson, 1967.

Mechanical analysis was done by International Pipette method. pH was determined by Elico digital pH meter in 1:2:5 soil water suspension.

Electrical conductivity was determined by Philips conductivity meter in 1:2.5 soil-water suspension.

Organic carbon was determined by Walkley and Black's rapid titration method.

Available nutrients in the soil were determined by standard methods (Jackson, 1967 and Black, 1965).

Available phosphorus Olsen-P was determined by sulphomolybdi.c blue colour method.

Available Potassium was extracted with neutral IN NH_4OAC solution and estimated Flame photometrically. Available Sulphur was estimated by turbidimetric method of Chesnin and Yien (1950).

Available Zn, Fe, Mn and Cu were extracted with DTPA solution (Lindsay and Norvell, 1978) and determined with the help of Atomic Absorption Spectrophotometer. (Pye Unicam, SP -2900).

RESULTS & DISCUSSIONS

Effect on available Zn

It is observed from the data presented in Table 1 that the application of fertilizers, in general, depleted availability of Zn in soil on comparing with the control plot where no fertilizer was added in any season. The average value over seven crop seasons showed that the extent of reduction due to fertilizer application was to the tune of 2-18 per cent over control (0.55). Nitrogen application alone or combination with phosphorus showed decrease in availability in of Zn. Maximum reduction was recorded when potassium was combined with nitrogen and phosphorus. The availability of 20 decreased with cropping and it was maximum after wheat harvest than that after rice harvest. The value over seven crops clearly indicates that the availability of Zn decreased by 23 per cent as compared to initial status of Zn (0.65). The availability of Zn in soil decreased by continuous application of nitrogen or with combined use of nitrogen and phosphorus which may be ascribed to the conversion of Zn from available to non-available for particularly under phosphorus treatment, thus, resulting in depletion of soil Zn. Decrease available Zn content has also been reported by Prasad and singh (1979) with added nitrogen and Badanur and Venkata Rao (1973). Sen and Deb (1975), Deb and Zellang (1976) and Subba Rao and Ghosh (1983) with added phosphorus. Joint application of NPK further decreased Zn availability. Anand Swarup and Ghosh (1980) also made asimilar observations under intensive use of NPK fertilizer and cropping system in an alluvial soil of New Delhi.

Effect on available Fe

The data presented in Table 1 indicates that the contents of Fe in soil after rice and wheat harvest were greatly influenced by fertilization and significant increases were noted in all seven season crops. The availability of Fe, averaged over seven seasons showed an increase to the extent of 15-20 percent over control (no fertilizer application). However, the highest availability of Fe in soil was found consequent upon application of nitrogen alone followed by combined application of nitrogen and phosphorus. It is interesting to note that availability of Fe in the soil was generally more after rice harvest than after wheat. On an average, relative values were 104-126 after rice and 86-103 after wheat as compared to initial content of 2.60 ppm assuming as 100. The availability of Fe due to cropping averaged over seven seasons showed increase by 6 per cent as compared with the value obtained at the time of start. The availability of Fe was reduced by 16 per cent as a result of cropping. The application of nitrogen alone or combination with phosphorus in all the seasons significantly increased Fe content of soil over control, Prasad and Singh (1980) also observed a considerable increase with the use of nitrogen application alone for a period of 20 years on acidic red loan soil of Bihar. Combined use of NPK further increased Fe. availability in soil. Anand Swarup and Ghosh (1979) also reported an increasing trend in available Fe content in a well-drained non calcareous sandy loam soil.

Effect on available Mn

The data in table 2 showed that the content of available Mn of soil increased with added fertilizers over no fertilizer. Addition of nitrogen alone or nitrogen with phosphorus in those years could not attain level of significance, but when potassium fertilizer was added along with nitrogen and phosphorus, the availability of Mn increased significantly over control and also over nitrogen alone. On an average, the availability of Mn increased 3,5 and 10 per cent with N, NP and NPK fertilizer application. The available Mn in soil was generally highest after wheat crop. The relative values irrespective of fertilizer application were 86-103 per cent after rice and 68-100 per cent after wheat assuming initial value (7.36 pps) as 100 per cent. An increase in the Mn content with continuous use of NP fertilizers has also been reported by Misra and Misra (1968), Gupta and Rangnekar (1970) and Mary and Ghosh (1972) was attributed to decrease retention of Mn in soil in presence of phosphorus. Highest availability of Mn was recorded under NPK treatment, Prasad af al. (1979) also observed that in content increased significantly with combined and continuous use of NPK through urea, single superphosphate and muriate of potash in a long term fertility trial conducted at Kanke in Bihar. This may be due to continuous removal of Mn from the soil which resulted depletion without addition of Mn fertilizers under such intensive cropping system. Gajbhiye and Goswami (1980) also reported overall effect of cropping on availability of micronutrient. Availability of Mn after wheat was relatively lower than rice which may be ascribed to its oxidation from Mn^{++} to M^{+++} form.

Effect on available Cu

The perusal of data in Table 2 indicate that with fertilizer application availability of Cu generally

decreased. Based on an average of seven seasons, the maximum reduction (7 was noted under NP treatment as compared to no such application of fertilizer (1.65 ppm); whereas reduction under NPK treatment was comparable (4%) with nitrogen treatment. The nitrogen application over phosphorus application significantly reduced Cu availability in soil. Amongst crops. Cu content of rice was higher than that of after wheat. On the basis of relative values, available Cu was in the range of 91-96 per cent after rice and 83-98 per cent after wheat, when initial value of 1.74 ppm Cu at the start was considered as 100. On the basis of average value irrespective of fertilizer treatments, the overall reduction in Cu content was found to be 16 per cent after harvest of wheat.

The continuous use of fertilizer decreased availability of cu in the soil over control. Similar observa tions were made by Nambiar and Ghosh (1964) consequent upon of NPK fertilizers during ten years period of Ludhiana soil. Application of nitrogen alone also depleted cu content over control. Prasad and Singh (1980) also found that continuous use of unbalanced fertilizer like Nitrogen application alone depleted available Cu status of soil. As a result of continuous cropping under both fertilized or unfertilized conditions resulted decrease in available Cu status of soil.

Application of fertilizers in general depleted availability of Zn in soil. The average value over seven crop season's showed that the extent of reduction due to fertilizer application was to the tune of 2-18 per cent.

Maximum reduction was recorded when potassium was combined with nitrogen and phosphorus. The availability of Zn decreased with cropping and it was maximum after wheat harvest than that after rice harvest.

The contents of Fe in soil after rice and wheat harvest were greatly influenced by fertilization. The availability of Fe, averaged over seven seasons showed an increase to the extent of 15-20 per cent over control. Highest availability of Fe in soil was found consequent upon application of nitrogen alone followed by combined application of nitrogen and phosphorus, Availability of Fe in the soil was generally more after rice harvest than after wheat. The availability of Fe on the whole was reduced by 16 per cent as a result of cropping.

Available Mn of soil increased with added fertilizers over no fertilizer treatment. On an average the availability of Mn increased 3, 5 and 10 percent with N, NP and NPK fertilizer application. The available Man in the soil was generally higher after harvest of rice than that after wheat crop. The availability of cu generally decreased with fertilization. Nitrogen application over phosphorus significantly reduced Cu availability in soil. Between the crops Cu content of application rice vas higher than that of after wheat. Overall reduction in Cu content was found to be 16 per cent after harvest of wheat.

Table 1: Effect of continuous use of fertilizers on available Zn, and Fe (in ppm) in Soil after harvest of wheat and rice

Table 2: Effect of continuous use of fertilizers on available Mn, and Cu (in ppm) in Soil after harvest of wheat and rice

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