

Effects of Continuous use of Fertilizers on Soil pH, EC and Organic Carbon Content in Soil under Wheat-Rice Intensive Crop Rotation

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Abstract – Continuous application of N alone or in combination with P and K during 4 years period did not influence soil pH significantly over control. pH value of soil after harvesting of crop year after year were comparable. The relative values of soil pH during experimentation period varied from 98-101 over initial pH value assuming as 100. Ec and Organic Carbon of soil generally increased. Maximum increase in Ec was seen under combined application of NPK and minimum under no fertilizer. The magnitude of increases in Ec being in the order of 8, 16 and 22 percent and organic carbon content of soil improved by 4, 5 and 9 percent under N, NP, and NPK treatments, respectively.

Intensive use of fertilizers, intensive cropping and high yielding seeds have no doubt brightened the hopes of humanity 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. Soil fertility is considered in the past in a restricted sense as a physico-chemical phenomenon or as an index of available nutrients for plants, but the modern usage of the term cannot the capacity of the soil produce crops of economic value to man and maintain the health of the soil for future use. An integrated application of fertilizer showed better response in long term nutrient experiment in soil (Prasad et-al 1995). Thus, any system of management of soil fertility will ultimately consider all aspects of soil-plant relationship and pollution of the environment as well.

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MATERIALS & METHODS

The experiment was initiated in rabi with wheat as the first crop followed by rice. The mildly alkaline soil pH (8.03) of the experimental field, which have sandy loam soil in texture. These soil have a little free calcium carbonate at the surface but the lower layers are rich in this constituents and small calcium incrustation in the form of ankar nodules are found in the bottom of soil profile, Iron mottlings are very common in lower horizons. The soluble salt contents are average to high but the exchange complex is saturated with calcium to the extent of eighty percent. Sand, Silt, Clay were 52.0, 27.5 & 20.0 % respectively. The Organic Carbon was 0.36 % and Ec 0.35%. The Available Plant Nutrients (ppm) were Phosphoru-8, Potash 97.5, Sulphur 10, Zinc 0.65, Iron 2.60, Manganese 7.35, and Copper 1.77 ppm, respectively.

The experiment was laid out in a randomized block design with four treatments viz.,

(1) N0P0K0 (2) N120P0K0 (3) N120P60K0

(4) N120P60K60 with four replications. Wheat variety HD 2204 and rice variety Saket 4 was grown in a sequence. Nitrogen, phosphorus and potash were applied through urea, single super phosphate and muriate of potash, respectively, as per treatments. 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 plots were kept free of weeds. Irrigation were done according to crop requirement as and when needed.

The soil samples were air dried, powdered and passed through a 2 mm sieve. Various soil chemical analyses were done by the standard methods (Piper, 1966 and Jackson, 1967) as per details given below:

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

RESULT & DISCUSSION

Effect on Soil pH

The soil pH after harvest of wheat and rice for each year of examination are presented in Table 1. It has been observed that continuous application of N alone and in combination with P and K during 4 years period did not influence soil pH significantly over control wherein no such fertilizer was added. On an average, pH value of soil after harvesting of crop year after year were comparable under continuously fertilized plots with that receiving no fertilizer. Considering pH value averaged over seven crop seasons irrespective of fertilizer application, it was observed that pH of the soil slightly increased by cropping. The relative values of soil pH during experimentation period varied from 98-101 over initial pH value assuming as 100. Kanwar and Parihar (1962) found that the continuous application of fertilizers in Punjab soil decreased pH value. Sahu and Nayak (1971) found that pH of Bhubaneswar soil did not decline as a result of continuous fertilizer application over a period of 10 years and hence had no deleterious effect on soil properties and crop yield. Lin et al (1973). Singh et al. (1980) also worked out the effect of application of chemical fertilizers on Haryana soil depression in pH of the soil with phosphate dressing during 4 years period. Sharma et al. (1980) observed that soil pH did not affect adversely with phosphate and potassium application during 6 years period on Tolewal loamy sand soil (Typic ustochrept) of Ludhiana. Savci (2012). The high level of potassium containing fertilizers makes negative impact on soil pH

Effect on soluble salt (Ec)

The effect of continuous use of fertilizers on electrical conductivity (Ec) was monitored and data are given in Table 1. It is observed that Ec of soil generally increased with continuous fertilization over control. On the basis of average figures for 4 years, it is apparent that maximum increase in Ec was seen under combined application of NPK and minimum under no fertilizer-control. The magnitude of increases in Ec being in the order of 8,16 and 22 per cent under N, NP and NPK plots, respectively. In control plot where no fertilizer was applied, on an average over years Ec value decreased to the extent of 13 per cent as compared to initial Ec value (0.35) before start of experiment. But considering Ec value irrespective of fertilization, it reduced 2 per cent only from initial value obtained at starting. Sharma et al. (1980) observed that phosphate and potassium fertilization during 6 years period on loamy sand soil of Ludhiana increased Ec of soil to that of initial level at the time of field experimentation start. On the

other hand, Chaudhry et al. (1981) and Tiwari (1982) reported that the application of phosphorus and potassium fertilizers over a prolonged period, Ec was remained more or less unaffected under intensive cropping system.

Hazra and Tripathi (1986) also indicated increasing trend in Ec level with phosphate application under different cropping system for maximization of forage production in Bundelkhand soil. Under study Ec values were increased to the tune of 0.25-0.32 Ec, 0.28-0.35 Ec, 0.21-0.32 Ec and 0.35-0.43 Ec under tree canopy of Acacia, Hardwickia, Leucaena and Open (no tree), respectively. Tripathi and Hazra (1987) also noted appreciable increase in Ec with an increase in the level of phosphorus for sweet clover crop.

Effect on organic carbon content

Table 1 showed that the organic carbon status of soil improved with continuous use of fertilizer as compared to no fertilizer-control, but it was significant neither with single application nor with combined application of P and K. The highest organic carbon content was recorded in the plot receiving combined application of NPK closely followed by NP. On the basis of average figures for 4 years, it is apparent that the organic carbon content of soil improved by 4,5 and 9 per cent under N, NP, and NPK treatments, respectively, over no fertilizer-control. The addition of fertilizer helped in improving organic carbon content as compared to initial level of organic carbon content which was in the range of 0.368 -0.530 per cent, as a result of 4 years cropping and fertilization. Considering averaged values of organic carbon after several years cropping, it was noted that the content of organic carbon increased by 27 per cent from value (0.36% obtained at the time of experimentation start. As a result of cropping and fertilization improvement in organic carbon content was more during kharif than during rabi. Sahu and Nayak (1971) organic carbon content declined in control plot (no fertilization) as compared with plots which received nitrogen through ammonium sulphate for a period of ten years and they also stated that fertilizer and organic manure had equally effective to improve organic matter content in Bhubaneswar soil. Chang Yi et al (2012) increase in organic matter content by application of NPK in black soil.

Table 1: Effect on Soil pH, Ec and Organic carbon content (%) in Soil after harvest of wheat and rice

Treatments	Wheat		Rice		Wheat		Rice		Wheat		Rice		% Increase over control
	pH	Ec	pH	Ec	pH	Ec	pH	Ec	pH	Ec	pH	Ec	
Control	8.2	0.35	8.1	0.35	8.2	0.35	8.1	0.35	8.2	0.35	8.1	0.35	0
N	8.3	0.42	8.2	0.40	8.3	0.45	8.2	0.43	8.4	0.48	8.3	0.46	27
NP	8.4	0.45	8.3	0.43	8.4	0.50	8.3	0.48	8.5	0.55	8.4	0.52	42
NPK	8.5	0.50	8.4	0.48	8.5	0.55	8.4	0.53	8.6	0.60	8.5	0.58	58
Initial	8.1	0.35	8.0	0.35	8.1	0.35	8.0	0.35	8.1	0.35	8.0	0.35	0
Final	8.3	0.42	8.2	0.40	8.3	0.45	8.2	0.43	8.4	0.48	8.3	0.46	27
Mean	8.3	0.42	8.2	0.40	8.3	0.45	8.2	0.43	8.4	0.48	8.3	0.46	27
SD	0.1	0.05	0.1	0.05	0.1	0.05	0.1	0.05	0.1	0.05	0.1	0.05	0
CV	1.2	14.3	1.2	14.3	1.2	14.3	1.2	14.3	1.2	14.3	1.2	14.3	0
Significance	***	***	***	***	***	***	***	***	***	***	***	***	***

Continuous application of N alone or in combination with P and K during 4 years period did not influence soil pH significantly over control, wherein no such fertilizer was added pH of the soil slightly increased by cropping. Ec of the Soil generally increased with continuous fertilization over control. On the basis of average figure for 4 years, maximum increase in Ec was seen under combined application of NPK and minimum under no fertilizer-control. Ee values obtained in kharif (rice) was always greater than rabi crops (Wheat). Organic carbon status of soil improved with continuous use of fertilizers as compared to no fertilizer-control. The highest organic carbon content was recorded in the plot receiving combined application of NPK closely followed by NP. As a result of cropping and fertilization, improvement in organic carbon content was more during kharif than during rabi.

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