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INFLUENCE OF ORGANIC AND INORGANIC FERTILIZERS MANAGEMENT ON DIFFERENT POOLS OF NITROGEN IN SOIL AND UPTAKE OF MAJOR NUTRIENTS CONTENT BY RICE CROP IN CALCAREOUS SOIL OF BIHAR

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ABSTRACT

A field experiment was conducted to assess the impact of conjoint use of organic and chemical fertilizers on yield in rice crop and on different forms of inorganic –N (NO_3^- & NH_4^+) as well as total –N content in post harvest soil of rice under rice – wheat cropping system at North Chhaunia Farm of Rajendra Prasad Agricultural University, Pusa, Samastipur. The grain and crop residue yield of rice was significantly influenced by different organic sources when apply alone or in combinations, increased the nutrient content in rice crop as well inorganic – N (NO_3^- & NH_4^+) and total – N content in post harvest soil of rice as compared to control and unfertilized control treatments. Green manuring by dhaincha increased the nutrient content to,, maximum, in rice crop which was followed by FYM, urd (GL) and crop residue of rice at all the levels of chemical fertilizers. Superiority of different organic sources with respect to inorganic forms (NO_3^- & NH_4^+) of N were observed in the order: GM > GL > FYM > Crop residue > Control. However, total – N content was found highest with FYM + 100% NPK treatment combination.

Key words : Organic sources, nutrient content, forms of N, rice-wheat system.

Rice-Wheat cropping system is one of the most important cropping systems in India. Studies conducted in India has conclusively indicated that inorganic nor organic manures alone were conducive to crop productivity and soil health but their integrated use may be helpful in sustaining the productivity of soil and crop yield under intensive cropping system practicing in regions. In addition, the chemical fertilizer is becoming expensive over the years. Therefore, the importance of organic manures such as dhaincha green manuring, urd green legume, farm yard manure, crop residue is gaining prominence. Soil changes are associated with the application of organic manures (Katyal et al., 2002). The addition of organic manures along with chemical fertilizer is known to stimulate mineralization and immobilization, thereby affecting the levels of different inorganic (NO_3^- & NH_4^+) and total – N fraction in the soil.

I n the study of soil –nutrient-crop inter relationship, it is imperative to identify the of N like NO_3^- - N, NH_4^+ - N and total –N contributing towards availability of nitrogen

for rice crop under a particular set of soil and environmental conditions. Fertilizers – N management in soil amended with different organic sources are governed by N transformations following application of organic and inorganic materials. The present investigation was undertaken to study the integrated effect of organic and chemical fertilizers on nutrient contents of rice and wheat crop, as well as forms of nitrogen (NO_3^- - N, NH_4^+ -N and total –N) of the post harvest soil of rice crop.

MATERIALS AND METHODS

A field experiment was conducted at the University Farm, Pusa, Bihar on Chhawania Sandy Loam Soil. The soil (0-15 cm) had the following characteristics i.e. pH 8.5, organic carbon (OC) 5.1 g kg^{-1}, EC 0.30 dSm^{-1}, available N (alkaline $KMnO_4$) 200.32 kg ha^{-1}, Olsen P 14.46 kg ha^{-1}, 1 N NH_4OAC K 96.18 kg ha^{-1} and total N 0.0478%. The experiment was conducted in a split plot design with five sources of organic namely Dhaincha green manure (GM), urd green legume (GL), farm yard manure (FYM), crop residue and control in the main plot treatment and five levels of chemical fertilizers namely, control, 50% PK, 50% NPK, 100% PK and 100% NPK in sub-plot treatment. The treatments were replicated thrice. The recommended N, P_2O_5 and K_2O doses were 120, 60, and 40 kg ha^{-1} applied through urea, single super phosphate and murate of potash, respectively, to each rice and wheat crop. Half of N and whole P and K were applied at the time of transplanting of rice and showing of wheat and remaining half N was applied in two equal splits at tillering and flowering stages. He biomass yields of dhaincha (GM) and urd (GL) ay 55 days old stage were recorded and

Table-1: Influence of organic and inorganic fertilizers on yield of rice in rice-wheat cropping system (Mean of two years).

Inorganic fertilizer levels	Grain Yield (q/ha)						Crop residue yield (q/ha)					
	Organic Sources						Organic Sources					
	Dhaincha (GM)	Urd (GL)	FYM	Crop residue	Control	Mean	Dhaincha (GM)	Urd (GL)	FYM	Crop residue	Control	Mean
Control	31.4	28.7	30.6	25.7	21.4	27.6	40.0	34.7	37.0	34.4	31.2	35.3
50% PK	34.3	31.9	33.6	27.3	25.6	30.5	43.0	40.0	40.7	38.8	33.8	39.3
50% NPK	44.1	36.8	43.6	34.7	30.9	38.0	59.02	46.4	56.0	43.2	39.3	48.9
100% PK	36.5	32.8	35.7	29.9	28.3	32.6	47.7	41.8	46.7	40.2	35.1	42.36
100% NPK	53.2	43.3	52.6	40.6	34.9	44.9	69.8	59.3	68.3	57.5	50.2	61.0
Mean	39.9	34.7	39.3	31.6	28.2		51.7	44.4	49.9	42.8	37.9	
Sources	CD at 5%						CD at 5%					
Organic manures (M)	2.9						2.9					
Inorganic manures (S)	1.6						1.6					

Table-2 : Influence of organic and inorganic fertilizers on nitrate and ammonical nitrogen of rice in rice-wheat cropping system.

Inorganic fertilizer levels	NO_3^--N (mg kg^{-1}) in PHS of rice						NH_4^+-N (mg kg^{-1}) in PHS of rice					
	Organic Sources						Organic Sources					
	Dhaincha (GM)	Urd (GL)	FYM	Crop residue	Control	Mean	Dhaincha (GM)	Urd (GL)	FYM	Crop residue	Control	Mean
Control	19.12	18.06	16.02	15.37	16.75	17.06	52.41	41.53	44.72	37.34	35.45	42.29
50% PK	19.96	18.72	16.18	16.09	16.78	17.54	54.53	44.62	47.79	38.62	35.67	44.25
50% NPK	21.72	20.00	17.08	16.89	17.77	18.69	57.83	54.56	56.33	51.87	45.32	53.10
100% PK	20.56	18.94	16.48	16.11	17.08	17.83	55.54	47.63	50.25	45.18	37.82	47.28
100% NPK	24.02	22.91	19.17	19.17	20.65	21.18	78.63	70.92	76.88	64.31	55.57	69.26
Mean	21.08	19.73	16.99	16.73	17.80	-	59.79	51.85	55.19	47.46	41.96	-
Sources	CD at 5%						CD at 5%					
Organic manures (M)	0.972						2.619					
Inorganic manures (S)	1.357						2.066					

incorporated into the soil before 15 days of transplanting whereas, FYM and crop residue were incorporated 30 days before transplanting. N, P and K contents in grain and crop residue and weeds biomass were estimated (Jackson, 1973). Composite surface soil samples (0-15 cm) from each plot were collected after rice crop in rice – wheat system.

Inorganic forms of N (Nitrate – N and Ammonical –N) and total-N were determined in post harvest soil of rice crop. The nitrate –N in soil was estimated calorimetrically by phenol disulphonic acid method (Jackson, 1973). However, ammonical – N was estimated with acidified NaCl solution method as described by Jackson (1973). Whereas, total-N was determined by the modified Kjeldahl method as described by Jackson (1973).

RESULTS AND DISCUSSION

Grain and crop residue yield **:** The grain and crop residue yield of rice varied from 21.42 to 53.2 q/ha and from 31.2 to 69.8 q/ha as influenced by different treatment combinations (Table-1). The grain and crop residue yield of rice was significantly influenced by different organic sources. The maximum grain yield (39.9 q/ha) was recorded in dhaincha (GM) treatment and was at par with FYM treatment (39.3 q/ha) but was superior over Urd (GL) (34.7 q/ha), crop residue (31.6 q/ha) and control (28.2 q/ha). Thus, the effect of organic manures on grain yield of rice were in the order:

Table-3 : Influence of organic and inorganic fertilizers on total nitrogen of rice in rice-wheat cropping system.

Inorganic fertilizer levels	Total–N (%) in PHS of rice					
	Organic Sources					
	Dhaincha (GM)	Urd (GL)	FYM	Crop residue	Control	Mean
Control	0.0487	0.0473	0.0497	0.0460	0.0438	0.0471
50% PK	0.0490	0.0473	0.0500	0.0470	0.0446	0.0476
50% NPK	0.0517	0.0493	0.0520	0.0490	0.0463	0.0497
100% PK	0.0496	0.0478	0.0503	0.0477	0.0452	0.0401
100% NPK	0.0583	0.0557	0.0603	0.0543	0.0503	0.0558
Mean	0.0515	0.0495	0.0525	0.0488	0.0460	-
Sources	CD at 5%					
Organic manures (M)	0.003					
Inorganic manures (S)	0.003					
Interaction (M x S)	NS					

dhaincha (GM) > FYM > Urd > crop residue > control. The impact of chemical fertilizers was founded significant in improving the grain yield of rice from 27.6 q/ha in control to 44.9 q/ha in 100% NPK. The grain yield in 100% NPK treatment (44.9 q/ha) was followed by 50% NPK (38.0 q/ha), 100% PK (32.6 q/ha), 50% PK (30.5 q/ha) and control (27.6 q/ha). The effect of NPK with respect to grain yield of rice can be shown in the flowing order: 100% NPK > 50% NPK > 100 PK > 50 % PK > Control. The results were in conformity with the findings of Pandey *et al.* (1993) and Bhagat *et al.* (1995).

Inorganic forms of nitrogen

Nitrate – N : Addition of dhaincha green manuring and urd (GL) consistently increased NO_3^- **-** N irrespective of FYM and crop residue treatments (Table 2). This might be due to mineralization of green manure and green legume having low C/N ratio. Soil NO_3^- **-** Nin different treatments varied from 15.53 mg kg $^{-1}$ I n control + crop residue combination to 24.02 mg kg^{-1} in treatment of 100% NPK + dhaincha (GM) combination NO_3^- **-** N increased with the application of increasing doses of chemical fertilizer alone, or in combination with GM and GL. As low build up of NO_3^- **-** N in soil with FYM and crop residue incorporation or even with high dose of fertilizer application might be because of little nitrification under anaerobic conditions in sobmerged soil. Losses of NO_3^- **-** N due to denitrification and leaching under flooded conditions in rice soils could be the other reasons of low NO_3^- **-** N buildup in soil. These results are in conformity with the findings of (Vipin, 2003).

Ammoniacal – N : A small and consistent increasing trend in NH_4^+ **-** N fraction (Table 2) was observed in the decreasing order dhaincha (59.79 mg kg^{-1}) > FYM (55.19 mg kg $^{-1}$) > urd (51.85 mg kg^{-1}) > crop residue (47.46 mg kg^{-1}) > control (41.46 mg kg $^{-1}$). Similarly, the application of chemical fertilizers also increased the NH_4^- **-** N content which was recorded higher at 100% NPK level (69.26 mg kg-^{1}), followed by 50% NPK (53.18 mg kg^{-1}), 100% PK (47.28 mg kg^{-1}), 50% PK (44.25 mg kg $^{-1}$) and control (42.29 mg kg $^{-1}$). The interaction effects due to conjoint use of organic and inorganic nitrogen on NH_4^+ **-** N content of soil were also found significant and recorded the highest NH_4^+ **-** N content (78.63 mg kg $^{-1}$) under dhaincha (GM) + 100% NPK treatment combination. Application of these integrated treatments resulted in higher accumulation of organic matter. The subsequent decomposition and mineralization of the organic matter might have contributed in the accumulation of higher NH_4^+ **-** N content over the other treatments (Basumatary and Talukdar, 1998).

Total – N content : Total – N content in post harvest soil of rice significantly increased due to the impact of different organics (Table-3). The highest total – N (0.0525%) was recorded with FYM treatments followed by dhaincha (GM) (0.0515%), urd (0.0495%), crop residue (0.0488%) and control (0.0460%) treatments. The significantly increased further due to application of various levels of chemical fertilizers in the order: 100% NPK (0.0558%) > 50% NPK (0.0497%) = 100% PK (0.0481%) = 50% PK (0.0476%) = control (0.0471%). However, effectiveness of conjoint use of different

organic sources with inorganic fertilizers on total –N content in post harvest soil of rice was recorded highest as 0.0603% when 100% NPK were used in conjunction with FYM treatment. Purnanik *et al.* (1978) also observed that continuous application of FYM for more than 8 years increased the total – N content of the soil.

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