Environment & Ecology 27 (3A) : 1436—1439, 2009
 ISSN 0970-0420

Efficiency of Applied Nutrients in Soil Amended with Green Manuring and Green Gram Straw Incorporation under Rice-Wheat Cropping System

VIPIN KUMAR*, R. K. PRASAD AND RAJESH KUMAR

Department of Soil Science, Rajendra Agricultural University
Pusa, Samastipur, Bihar, 848125, India
E-mail : drvipinkumar@sify.com
**Correspondence*

Abstract

A field experiment on integrated management of green manure (GM) and straw incorporation with inorganic fertilizers in rice-wheat cropping system was conducted. The apparent nitrogen recovery by rice was lower than that of wheat in the first year but reverse trend was observed in second years. The relative apparent nutrient recovery of N, P and K by rice and wheat in the both years was in the order : GM>GGSI>no GM or GGSI. In the second year, average apparent nitrogen recovery by rice in chemical fertilizer treated plot was 24.8%, which increased to 26.4 and 34.1% with the incorporation of straw of summer green gram and green manuring, respectively.

Key word : Green manure, Crop residue, Apparent nutrient recovery, Calciorthent.

Rice-wheat is the most widely practiced cropping system in northern India. According to Narang et al.(1990) both rice and wheat are exhaustive feeder of nutrients. Integrated use of organic and inorganic sources of nitrogen and their management for efficient and economic use of fertilizers and maintenance of soil fertility and crop productivity is important for tropical countries. Integrated use of fertilizer nitrogen along with green biomass is known to estimate mineralization and immobilization of organic nitrogen. Low use efficiency of N by upland crop and low land rice in particular is because of basal N application which is subjected to maximum N loss. By meeting the nitrogen requirement through green manure crop, a significant improvement in N use efficiency may be possible.

Methods

A field experiment was conducted at University farm at Pusa on Harpur clay loam soil (calciorthents) which has the following characteristics, $CaCO_3$ 33.3%, organic carbon 4.5 g/ha, pH 8.5, EC 0.46 dS/m, available N 192 kg/ha, Olsen's P 12.8 kg/ha and IN NH_4OAc-K 88 kg/ha. Five levels of NPK fertilizers based on soil test value viz. No NPK (F_0), 25% NPK (F_1) , 50% NPK (F_2), 75% NPK (F_3) and 100% NPK (F_4) were used as treatments in the main plots. Each main plot was divided into 3 sub-plots in which three sub-treatments viz. no green manure (M_0), green gram straw incorporation (M_1) and green manure (M_2) were superimposed over NPK levels. Green gram incorporated in soil at flower initiation stage and green gram residues incorporated after harvest of pods. The treatments were replicated thrice; 100% NPK referred to 100 kg N/ha, 26.7 kg P/ha and 33.2 kg K/ha were applied as urea, single super phosphate and murate of potash, respectively to each crop of rice and wheat in rice-wheat rotation. Half of nitrogen and the entire dose of P and K were applied at transplanting of rice and sowing of wheat and remaining N fertilizer was applied in equal splits at tillering and flower initiation stage.

After the harvest of rice and wheat crop, surface soil samples from 0—15 cm depth were collected and processed for measurement of total N, P and K and uptake was calculated. The apparent nutrient recovery was calculated following Sharma and Prasad. (1990).

$$\text{Apparent nutrient recovery (\%)} = \frac{\text{Uptake in treatment plot} - \text{Uptake in control plot}}{\text{Fertilizer dose}} \times 100$$

Table 1. Effect of green manuring by green gram, straw incorporation of green gram and chemical fertilizers on the nitrogen use efficiency (%) by rice and wheat under rice-wheat cropping system in calcareous soil.

Fertilizer levels (% NPK)	1st year No GM or GGSI	1st year Green gram straw incorporation GGSI	1st year Green manuring (GM)	1st year Mean	2nd year No GM or GGSI	2nd year Green gram straw incorporation GGSI	2nd year Green manuring (GM)	2nd year Mean
Rice								
25	22.8	29.8	36.6	29.7	27.6	32.1	42.3	34.0
50	21.6	29.0	34.7	28.4	26.3	27.4	34.2	29.3
75	20.8	27.8	30.2	26.3	24.3	25.4	30.3	26.7
100	19.4	25.7	27.4	24.2	21.1	20.8	29.3	23.9
Mean	21.1	28.1	32.2	–	24.8	26.4	34.1	–
Wheat								
25	31.7	32.4	36.9	33.7	24.7	30.6	37.9	31.1
50	27.4	32.2	33.2	30.9	24.0	28.0	29.2	27.1
75	22.6	27.4	29.5	26.5	21.6	25.8	27.4	24.9
100	21.3	24.8	29.0	25.0	21.5	21.7	27.2	23.5
Mean	25.7	29.2	32.1	–	22.9	26.8	30.4	–

Results and Discussion

Nitrogen

Apparent nitrogen recovery decreased with increasing levels of nitrogen in all treatments in both years by rice and wheat crops under rice-wheat cropping system in calcareous soil (Table 1). The average apparent-nitrogen-recovery (27.1%) by rice was lower than that of wheat (29.0%) in first year but reverse trend was observed in second year. The relative apparent nitrogen recovery by rice and wheat was in the order : GM > GGSI > no GM or GGSI. In the second year, average apparent-nitrogen-recovery in

Table 2. Effect of green manuring by green gram, straw incoration of green gram and chemical fertilizers on the phosphorus use efficiency (%) by rice and wheat under rice-wheat cropping system in calcareous soil.

Fertilizer levels (% NPK)	1st year No GM or GGSI	1st year Green gram straw incorporation GGSI	1st year Green manuring (GM)	1st year Mean	2nd year No GM or GGSI	2nd year Green gram straw incorporation GGSI	2nd year Green manuring (GM)	2nd year Mean
Rice								
25	13.7	14.6	21.5	16.6	14.4	19.2	22.7	18.8
50	12.5	13.6	18.6	14.9	14.3	17.4	21.2	17.6
75	11.8	12.9	17.4	14.0	13.7	15.8	20.2	16.6
100	11.1	12.1	15.3	12.8	13.3	15.7	19.3	16.1
Mean	12.3	13.3	18.2	–	13.9	17.0	20.8	–
Wheat								
25	14.6	17.5	21.2	17.8	14.4	16.5	21.1	17.3
50	14.4	17.3	19.8	17.2	11.9	13.9	16.2	14.0
75	14.0	15.9	18.3	16.1	11.1	13.7	16.1	13.6
100	13.4	15.2	16.0	14.9	11.0	12.8	13.7	12.5
Mean	14.1	16.5	18.7	–	12.1	14.2	16.8	–

Table 3. Effect of green manuring by green gram, straw incorporation of green gram and chemical fertilizers on the potassium use efficiency (%) by rice and wheat under rice-wheat cropping system in calcareous soil.

Fertilizer levels (%NPK)	1st year				2nd year			
	No GM or GGSI	Green gram straw incorporation GGSI	Green manuring (GM)	Mean	No GM or GGSI	Gerrn gram straw incorporation GGSI	Green manuring (GM)	Meam
Rice								
25	104.7	107.3	120.6	110.7	91.0	105.1	118.2	104.8
50	88.8	98.9	109.0	98.9	72.5	92.2	99.0	87.9
75	80.6	94.9	87.7	87.7	71.7	83.2	88.0	80.8
100	75.6	86.2	86.3	82.7	68.5	80.7	83.4	77.5
Mean	87.4	96.8	100.9	–	75.8	90.3	97.1	–
Wheat								
25	112.0	121.9	130.3	121.4	104.2	107.6	130.9	114.2
50	97.5	96.3	108.8	100.9	89.5	94.5	101.0	95.1
75	91.4	90.4	96.2	92.7	87.4	89.6	94.2	90.4
100	85.0	83.4	85.0	84.5	80.2	89.2	90.3	84.6
Mean	96.5	98.0	105.0	–	90.3	93.7	104.1	–

chemical fertilizer treated plot by rice was 24.8% which increased to 26.4 and 34.1% with the incorporation of straw of summer green gram after plucking pod and green manuring, respectively. Similar trend in apparent nitrogen recovery by wheat was also observed. These results indicated that the efficiency of applied nutrients was augmented when chemical fertilizers were applied along with green gram straw and green manure. The combined application of chemical fertilizer with green manure and green gram straw incorporation showed appreciably higher apparent nitrogen recovery as compared to chemical fertilizer alone. Integrated use of green manuring with chemical fertilizer increased the efficiency of nitrogen as compared to chemical fertilizers. This is in conformity with earlier results of Nagarajah (1988) and Prasad et al. (1995).

Phosphorus

The apparent phosphorus recovery by rice decreased from 16.6 to 12.8% increasing levels of fertilizer from 25 to 100% recommended dose of fertilizer (Table 2). The average apparent-phosphorus-recovery by rice was higher in second year than that of first year. The reverse trend of apparent-phosphorus-recovery was observed by wheat. The apparent-phosphorus-recovery by rice and wheat in both the years varied in the order : GM > GGSI > no GM or GGSI. Efficient utilization of phosphorus was observed by rice and wheat at lower level of phosphorus than that of higher level of applied phosphorus.

Potash

The apparent potassium recovery by rice and wheat ranged in the sequence : GM > GGSI > no GM or GGSI (Table 3). Further the apparent potassium recovery by rice and wheat were decreased as usual with increasing level of potassic fertilizer. Apparent potassium recovery by rice and wheat further increased, when inorganic fertilizers were added in conjunction with green manuring and green gram straw incorporation. Similar results were also observed by Budhar and Palaniappan (1996).

Conclusion

The apparent nitrogen recovery by rice was lower than that of wheat in the first year but reverse trend was observed in the second year. The relative apparent N, P, K recovery by rice and wheat in both the year was in the sequence : GM > GGSI > no GM or GGSI. The apparent nutrient recovery of N, P and K increased by green gram and green gram straw incorporation.

References

Budhar M. N. and S. P. Palaniappan. 1996. Effect of

conjunctive and individual application of fertilizer and green manure nitrogen on N uptake and yield of lowland rice. *Fert. News* 41 : 51—54.

Nagarajah S. 1988. Green manure in rice farming P. 193. *In Sustainable agriculture*. Int. Rice Res. Inst. Philippines.

Narang R. S., S. S. Cheema, D. S. Grewal, B. D. Sharma and G. Dev. 1990. Yield, nutrient removal and changes in soil fertility under intensive rice-wheat cropping system. *Indian J. Agron*. 33 : 113—119.

Prasad B., J. Prasad and R. Prasad. 1995. Nutrient management for sustainable rice wheat production in calcareous soil amended with green manure, organic manure and zinc. *Fert. New*s 40 : 39—45.

Sharma S. N. and R. Prasad. 1990. Effect of rates of nitrogen and relative efficiency of sulphur coated urea and nitrapyrin treated urea on dry matter production and nitrogen uptake by rice. *Pl. Soil* 55 : 389—396.