

Long Term Influence of Organic and Inorganic Fertilizers on Nutrient Uptake by Rice and Wheat in Calcareous Soil

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Abstract

To study the long term effect of fertilizer on the uptake of nitrogen phosphorus, potassium and sulfur by rice and wheat, a field experiment was conducted during rabi of 1988-89 in calcareous soil in split plot design with NPK levels in main plot and organic sources in sub-plot treatments under rice-wheat cropping system. After completion of 13th cycle, the result revealed that the uptake of N, P, K and S by rice increased significantly with graded dose of fertilizer, alone or in combination with compost and crop residue. Nutrient removal by rice at higher level of NPK was relatively higher than that of the lower levels of NPK fertilizer. The uptake of N, P, K and S by rice under control increased to 168.66, 156.84, 138.87 and 406.01% at 150% NPK + compost + crop residue treatment. The nutrient uptake was enhanced by the integrated use of compost + crop residue with chemical fertilizer at all levels of NPK.

Key word : Long term influence, Organic and inorganic fertilizer, Uptake, Nutrient, Rice-wheat system.

The agricultural scene in India has recently changed considerably with the introduction of high yielding varieties of crops, intensive cropping system and use of high analysis fertilizer. Continuous addition of chemical fertilizer poses problem like toxicity due to high amount of salt as a residue of fertilizer, deterioration of the physical properties of soil impairing the aeration and soil water plant relationship resulting in decreased productivity. The recycling of organic waste for increasing soil fertility has gained importance in recent year due to high cost of fertilizer and reduced availability of organic manure. A wide variety of wastes being generated which are known to contain appreciable amount of organic matter and plant nutrient element that can be effectively used as a source of organic manure (1). However, due to its low nutrient content and slow acting nature, compost alone may not be able to meet the high nutrient requirement of crop. Likewise the use of only NPK fertilizer under modern intensive farming will not be sufficient. Therefore, integrated use of organic and inorganic fertilizer and their management for efficient and economic use of fertilizer and maintenance of soil fertility and productivity are important. The present study was aimed to find out the integrated effect of chemical fertilizer along with compost and crop residue on uptake of nutrient (N,P, K and S) under rice

wheat cropping sequence in calcareous soil.

Methods

A long term field experiment was conducted at RAU, Pusa Farm in 1988 (*rabi*) with rice-wheat sequence. The crop reported in this report are 26th crop rice (cv Rajshree) in *kharif* season (2001) and 27th crop wheat (cv Rajeshwari) in *rabi* season (2001-02). The experiment was conducted in a split plot design with four levels of NPK namely, no NPK, 50% NPK, 100% NPK and 150% NPK in the main treatment and organic sources namely, no manure, compost, crop residue and compost+crop residue in sub-plot treatment. The treatments were replicated thrice. The recommended N, P₂O₅ and K₂O doses were 100, 60 and 40 kg/ha. At maturity, the crops were harvested and the yields of grain and straw were recorded. The grain and straw samples were analyzed for their N, P, K and S content and the uptake of N, P, K and S were computed.

Results and Discussion

N-Uptake

The uptake of N was more in wheat than rice. Increasing doses of fertilizer significantly increased N-uptake by rice and wheat while their interaction

Table 1. Long term influence of organic and inorganic fertilizer on nutrient uptake by rice (26th crop) under rice-wheat cropping system in calcareous soil.

Treatment	N-uptake (kg/ha)					P-uptake (kg/ha)				
	No manure	Compost	Crop residue	compost + crop residue	Mean	No manure	Compost	Crop residue	compost + crop residue	Mean
No NPK	32.04	44.98	38.44	52.94	42.10	7.30	10.30	9.10	12.00	9.67
50% NPK	49.94	65.42	57.62	74.74	61.93	10.75	14.58	13.02	15.73	13.52
100% NPK	63.57	74.97	68.16	82.06	72.19	13.61	16.25	15.97	18.34	16.04
150% NPK	71.68	82.36	80.00	86.08	80.03	14.68	16.89	16.64	18.75	16.74
Mean	54.30	66.93	61.05	73.95		11.58	14.52	13.68	16.20	
Source	SEm ±		CD (P = 0.05)			SEm ±		CD (P = 0.05)		
Fertilizer (F)	1.14		3.96			1.39		4.82		
Manure (M)	1.31		3.82			1.26		3.68		
F × M	2.54		NS			2.59		NS		
Treatment	K-uptake (kg/ha)					S-uptake (kg/ha)				
	No manure	Compost	Crop residue	Compost + crop residue	Mean	No manure	Compost	Crop residue	Compost + crop residue	Mean
No NPK	80.40	99.52	89.62	128.25	99.54	3.49	6.66	5.53	8.67	6.08
50% NPK	102.27	129.52	119.00	160.34	127.78	8.12	10.57	9.70	13.59	10.49
100% NPK	125.31	155.85	144.63	190.59	154.09	12.16	14.13	13.39	16.27	13.98
150% NPK	135.77	166.87	162.61	195.45	165.17	13.69	15.88	16.41	17.66	15.91
Mean	110.93	137.94	128.96	168.65		9.36	11.81	11.25	14.04	
Source	SE ±		CD (P = 0.05)			SE ±		CD (P = 0.05)		
Fertilizer (F)	2.21		7.12			1.24		4.31		
Manure (M)	3.05		9.84			0.87		2.55		
F × M	0.76		NS			1.96		NS		

effects were found to be non-significant. It might be due to early and faster decomposition of organic matter and decreased immobilization of nutrients during Kharif season. Maximum dose of fertilizer (150% NPK) resulted in the highest removal of nutrient and the increase in nutrient uptake at this level over control was 192.5 and 160.9% by rice and wheat. These results are in conformity with the finding of Naphade et al. (2).

Effect of compost and crop residue on nitrogen uptake was found in the order : compost + crop residue > compost > crop residue > no manure in both rice and wheat crop. Uptake of nitrogen increased from 54.30 to 73.95 kg/ha in rice and from 54.53 to 87.49 kg/

ha in wheat with the incorporation of compost + crop residue. The benefit derived from organic manure and crop residue in addition to chemical fertilizer might be due to applied nutrients and release of nutrients as a result of decomposition process finally enhanced their availability to crops. The effectiveness of combined use of organic and inorganic fertilizer on nitrogen uptake was highest by rice and wheat crop when maximum dose of NPK was incorporated in conjunction with compost and crop residue. Since there was significant variation in the nitrogen content of crop, It is quite possible that increase in grain and straw yield was accompanied with incommittant increase in the N-uptake Rokima (3) also reported similar results.

Table 2. Long term influence of organic and inorganic fertilizer on nutrient uptake by wheat (27th crop) under rice-wheat cropping system in calcareous soil.

Treatment	N-uptake (kg/ha)					P-uptake (kg/ha)				
	Organic sources					Organic sources				
	No manure	Compost	Crop residue	Compost + crop residue	Mean	No manure	Compost	Crop residue	Compost + crop residue	Mean
No NPK	25.96	38.47	36.85	51.67	38.30	3.50	6.33	5.00	8.31	5.66
50% NPK	48.77	63.74	61.23	78.84	63.14	7.98	9.27	9.85	11.18	9.57
100% NPK	68.50	92.58	92.16	106.12	90.51	11.13	14.45	13.98	15.87	13.87
150% NPK	74.90	99.95	99.49	113.35	96.67	12.23	15.23	14.89	17.02	14.84
Mean	54.53	73.68	72.43	87.49		8.71	11.32	10.93	13.09	
Source	SE ±		CD (P = 0.05)			SE ±		CD (P = 0.05)		
Fertilizer (F)	1.83		5.99			0.10		0.32		
Manure (M)	3.51		12.27			0.40		1.24		
F × M	1.61		NS			0.49		NS		
Treatment	K-uptake (kg/ha)					S-uptake (kg/ha)				
	Organic sources					Organic sources				
	No manure	Compost	Crop residue	Compost + crop residue	Mean	No manure	Compost	Crop residue	Compost + crop residue	Mean
No NPK	25.66	37.81	29.63	51.63	36.18	1.96	4.01	3.69	6.01	3.91
50% NPK	51.46	68.98	59.70	85.51	66.41	6.41	7.97	7.73	9.41	7.88
100% NPK	71.55	98.66	88.55	115.87	93.55	10.39	12.78	12.09	14.54	12.45
150% NPK	87.36	107.41	97.35	121.80	103.47	12.51	15.16	14.57	16.80	14.70
Mean	59.00	78.21	68.80	9.60		7.81	9.98	9.52	11.69	
Source	SE ±		CD (P = 0.05)			SE ±		CD (P = 0.05)		
Fertilizer (F)	3.22		10.01			0.10		0.35		
Manure (M)	3.09		8.97			0.09		0.27		
F × M	6.20		NS			0.19		NS		

P-Uptake

P-uptake by rice significantly increased to 39.81, 65.87 and 73.11% over control (9.67 kg/ha) at 50, 100 and 150% NPK, respectively. Similarly P-uptake by wheat increased to 67.88, 145.05 and 162.19% over control (5.66 kg/ha) at 50, 100 and 150% NPK of the recommended dose, respectively. P-uptake by rice increased to 25.21, 18.13 and 39.89% over control (11.58 kg/ha) under compost, crop residue and compost + crop residue treatment. Similarly per cent increase of 29.96, 25.48 and 50.28 over control (8.7 kg/ha) was recorded under compost, crop residue and compost + crop residue. This indicates that compost and crop

residue applied during kharif season left a substantial quantity of phosphorus even under higher temperature, humid and tropical condition which might be subsequently utilized by the succeeding wheat crop.

Conjoint use of 150% NPK + compost+crop residue resulted in maximum P-uptake (18.75 kg/ha) by rice and (17.02 kg/ha) wheat. This pattern was also observed under lower level of fertilizers, when used in conjunction with compost and crop residue incorporation.

K-Uptake

Uptake of K increased significantly by 28.37,

54.80 and 65.93% control (99.54 kg/ha) by rice and 83.55, 158.56 and 185.98% over control (36.18 kg/ha) by wheat at 50, 100 and 150% NPK levels, respectively. These results are in consonance with the finding of Prasad and Singh (4). Uptake of K by rice increased to 24.34, 16.25 and 52.03% over control (110.95 kg/ha) under compost, crop residue and compost + crop residue treatment. Similarly per cent increase in K-uptake by wheat over control (59.00 kg/ha) was noted to 32.55, 16.61 and 58.64 with the incorporation of compost, crop residue and compost + crop residue treatment. At 150% NPK level incorporation of compost and crop residue resulted in maximum uptake of K by wheat (121.80 kg/ha). This might be possible due to favourable effect of compost on the decomposition of crop residue besides extra amount of nutrient supplied by compost.

S-Uptake

The data explained that S-uptake by rice was more than the wheat. Increasing dose of fertilizer significantly increased the mean S-uptake. The magnitude of S uptake by rice increased to 72.53, 129.93 and 161.67% where as it increased to 101.53, 218.41 and 277.49% by wheat at 50, 100 and 150% NPK level over their respective control. This increase in S-uptake by increasing fertilizer levels might be due to addition of S through SSP and secondly due to remarkable increase in crop yield. The per cent increase in S-uptake was noticed to 26.17, 20.19 and 50.00 over control (9.36 kg/ha) in rice and 27.78, 21.89 and 49.67 over control (7.81 kg/ha) in wheat under compost, crop residue and compost + crop residue treatment, respectively.

Since all the superimposed treatment sources contained S, their application has increased the S-

uptake. It increased the uptake to a maximum value of 17.66 kg/ha and 16.80 kg/ha in rice and wheat respectively as compared to 3.49 and 1.96 kg/ha under control, respectively. It might be due to solubilization of native S and enhancement of the efficiency of applied S through the process of decomposition of organic manure. Increase in S-uptake with addition of S fertilizer and FYM has also been reported by Sinha and Sakal (5).

Conclusion

The nitrogen, phosphorus, potassium and sulfur uptake by rice and wheat increased significant with graded doses of fertilizer, alone or in combination with compost and crop residue. Nutrient removal by crop at higher level of NPK was relatively higher than that of the lower level of NPK fertilizer.

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