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Long Term Effect of Organic and Inorganic Fertilizer on Yield of Rice and Wheat

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Abstract

A long term field experiment was conducted during *rabi* of 1988-89 in calcareous soil in split plot design with NPK levels in main plot and organic source in sub-plot. After completion of 13th cycle, the results revealed that grain and straw yield of rice and wheat increased significantly with increasing level of fertilizers. The combined effect of compost and crop residue in conjunction with chemical fertilizer at any level of NPK, resulted in higher grain and straw of rice and wheat than those of NPK alone. The grain yield of rice and wheat under 150% NPK alone were lower than the yields of rice and wheat obtained under 100% NPK + compost + crop residue. The grain yield of rice and wheat under 100% NPK alone were also at par with the yields of rice and wheat obtained under 50% NPK + compost + crop residue. The indicated that one of the recommended dose of NPK fertilizer could be substituted by 10 t compost/ha + crop residue to realize the same quantum of yield of rice and wheat.

Key word : Long term effect, Organic and Inorganic fertilizer, Yield, Rice, Wheat.

Increasing sustainability problems and shortage of fertilizers require a system of nutrient management that makes optimum use of nutrient from soil resources, efficient recycling of organics as carrier of nutrients, synergistic and antagonistic effect of nutrient on plant plant nutrition in the cropping system for the purpose of devising appropriate fertilizer dose. The long term experiments reported by Hegde and Dwivedi (1992) indicated a declining trend in productivity even with balanced use of fertilizer NPK was associated with poor soil physical conditions and imbalance in secondary and micronutrient. Crop residues and organic manures are important source of plant nutrients for crop production and play an important role in improving the physical, chemical and biological properties of the soil. Prasad (1999) reported that conjoint use of macro and micronutrient fertilizers with organics, crop residue and green manuring hold a great promise not only in securing high level of crop productivity but also in protecting soil health and pollution hazard. Keeping these in view the present study was undertaken to investigate the influence of organic and inorganic fertilizer on yield and fertility status of calcareous soil under rice-wheat cropping system on long term basis.

Methods

A long term field experiment was conducted at Rajendra Agricultural University, Pusa Farm in the year 1988 *(rabi)* with rice-wheat sequence. The crop reported here is 26 th crop rice (cv Rajshree) in *kharif* season (2001) and 27th crop wheat (cv Rajeshwari) in *rabi* season (2001-02) with continuous application of compost at 10 t/ha and/or crop residue of the respective plot alone or in combination with different levels of NPK. The residue of rice before wheat cropping and the residue of wheat before rice cropping were incorporated to the soil. Different doses of complete fertilizers in terms of N, P_2O_5 and K_2O were applied at 100 : 60 : 40 kg/ha respectively as recommended dose in each crop of the rice-wheat sequence. Mineral fertilizers such as urea (46% N), SSP (16% P_2O_5) and MOP (60% K_2O) were used for conducting the field experiment. Four levels of NPK namely No NPK, 50% NPK, 100% NPK and 150% NPK of recommended dose were applied as a treatment in main plot. The treatment involving organic sources namely no manure, compost, crop residue and compost + crop residue were assigned to sub-plots. Treatments were replicated three times in a split-plot design.

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

Treatment (%)	Organic sources				
	No manure	Compost	Crop residue	Compost + crop residue	Mean
			Grain Yield (q/ha)		
No NPK	20.40	31.90	29.87	35.60	29.44
50 NPK	33.60	39.30	37.60	42.80	38.32
100 NPK	38.90	43.20	42.10	46.50	42.67
150 NPK	40.60	43.37	42.60	44.30	42.72
Mean	33.37	39.44	38.04	42.30	
Source		SE ±		CD (P = 0.05)	
Fertilizer (F)		0.85		2.97	
Manure (M)		0.45		1.32	
F × M		0.90		2.64	
			Straw Yield (q/ha)		
No NPK	31.30	46.30	33.80	55.30	41.67
50 NPK	48.80	63.50	59.30	72.90	61.12
100 NPK	60.73	67.30	66.50	76.30	67.70
150 NPK	63.40	72.20	74.80	75.60	71.50
Mean	50.55	62.97	57.95	70.02	
Source		SE ±		CD (P = 0.05)	
Fertilizer (F)		0.60		2.07	
Manure (M)		0.65		1.91	
F × M		1.31		3.83	

Results and Discussion

Productivity of Rice

Grain and straw yield of rice increased significantly with increasing level of fertilizers upto 100% NPK (Table 1). The grain yield at 150% NPK was at par with 100% NPK. However, grain and straw yield under 50, 100 and 150% were all significantly higher than the yield of control. Maximum grain yield (42.72 q/ha) and straw yield (71.50 q/ha) were obtained with 150% NPK. On incorporation of compost, crop residue and compost + crop residue the grain yield of control (33.37 q/ha) significantly increased to the tune of 18.18, 13.99 and 26.76%, respectively. Similarly, straw yield increased to 24.60, 14.63 and 38.51% over control (50.55 q/ha) due to incorporation of compost, crop residue and compost + crop residue, respectively. Similar results were also reported by Prasad (1994) and Rokima (1985). Even though, the interaction were found to be significant, the integrated effect of fertilizer and manure/crop residue were noted to be more beneficial than the use of chemical fertilizer alone. Additional increase in grain and straw yield was registered due to integrated effect of compost, crop residue and compost + crop residue with inorganic fertilizer ; 100% NPK + compost + crop residue produced highest grain yield (46.50 q/ha). Grain and straw yield with 50% NPK + compost + crop residue (42.80 and 72.90 q/ha) were significantly higher than the yield obtained at 100% NPK alone (38.90 and 60.73 q/ha). This indicated that more than half of the nutrients in fertilizer could be substituted with 10 t of compost and crop residue to get the higher yield as that could be obtained with optimum dose of NPK.

Productivity of Wheat

Table 2 shows that both grain and straw yield of

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

Treatment (%)	Organic sources: No manure	Compost	Crop residue	Compost + crop residue	Mean
		Grain Yield (q/ha)			
No NPK	9.60	14.00	12.80	18.60	13.25
50 NPK	20.60	23.40	21.20	26.90	23.05
100 NPK	29.00	33.40	30.90	34.50	31.95
150 NPK	27.30	34.80	33.30	37.00	31.35
Mean	21.62	26.40	24.55	29.28	
Source		SE ±		CD (P = 0.05)	
Fertilizer (F)		0.30		1.06	
Manure (M)		0.26		0.77	
F × M		0.53		1.55	
		Straw Yield (q/ha)			
No NPK	16.30	23.80	20.40	32.00	23.13
50 NPK	34.50	38.70	35.90	45.40	38.13
100 NPK	48.40	54.20	52.30	61.00	53.97
150 NPK	54.00	57.80	55.80	62.80	54.35
Mean	38.28	43.62	41.10	50.38	
Source		SE ±		CD (P = 0.05)	
Fertilizer (F)		0.24		0.84	
Manure (M)		0.29		0.87	
F × M		0.59		1.74	

wheat were significantly increased with increasing level of fertilizers. Irrespective of levels of NPK, the wheat yield due to incorporation of compost, crop residue and compost + crop residue was significantly increased over control and among themselves. The magnitude of per cent increase in grain yield of wheat due to compost, crop residue and compost + crop residue were 22.10, 13.55 and 35.42, respectively. Similarly, the straw yield (38.28 q/ha) in control was increased to 13.94, 9.97 and 31.60% due to application of compost, crop residue and compost + crop residue, respectively. From these results it may be inferred that manure and crop residue applied to the previous crop could definitely display a significant role on the succeeding wheat crop. These observations were in agreement with the result of Rokima (1985) and Singh (1991). Even though the interactions were found to be significant, the integrated effect of fertilizer and manure/crop residue were noted to be more beneficial than the use of chemical fertilizer alone. Besides these the grain yield (27.30 q/ha) recorded under 150% NPK alone was significantly lower with the yield (34.50 q/ha) obtained with 100% NPK + compost + crop residue indicating the possibility of harnessing the residual manurial value at the cost of nearly 2/3 rd of nutrient contained in a costly chemical fertilizer. This finding has wide range of practical utility in the view of shortage of costly fertilizers for poor and marginal farming community in our country. Rokima (1985) and Pandey (1999) also reported the saving of fertilizer through long-term application of organic manures with inorganic fertilizers.

Conclusion

It is concluded that over and above the effects of inorganics and organics individually, integrated use of compost, crop residual and compost plus crop residue along with chemical fertilizers enhanced crop yield. Adoption of an integrated nutrient manage-

ment could reduce the fertilizer dose to the extent of about half of the recommended dose of chemical fertilizer without decreasing the yield and thereby increasing the profit per unit investment.

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