

than no K application. This may be due to role of K in improving utilization of N which directly plays a role in cellular metabolism and reflected in improved growth and yield-attributing characters, which ultimately resulted into higher yield. The result is in conformity with that reported by Purohit *et al.* (1986).

Significant improvement in growth and yield-attributing characters of wheat was with zinc sulphate @ 25 kg/ha compared with no ZnSO₄. Application of Zn beyond 25 kg/ha did not remarkably improve these characters. Application of 25 and 50 kg ZnSO₄/ha did not differ in grain and straw yields but gave markedly higher yields over the control. This might be due to its function as catalyst or stimulant in most of the physiological and metabolic processes and metal

activator of enzyme, resulting in increased growth and development of plant which ultimately gave higher grain and straw yields of wheat. The finding is in accordance with that reported by Yadav and Verma (1991) in wheat.

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Effect of fertilizer and organic manure on rice (*Oryza sativa*) and their residual effect on wheat (*Triticum aestivum*)

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A field experiment was conducted at Faizabad during 1988–89 and 1989–90 to study the direct effect of different sources of organic matter alone and in combination with different rates of NPK in rice (*Oryza sativa* L.) and their residual effect on subsequent crop of wheat (*Triticum aestivum* L. emend. Fiori & Paol.). The experiment was

laid out in randomized block design with 4 replications. The details of treatments are given Table 1. Green-manuring was done through prickly sesban or *dhaincha* [*Sesbania cannabina* (Retz.) Pers.] and wheat straw @ 10 tonnes/ha was used in rice as crop residues 1 month before transplant. Half dose of N and full doses of P and

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Table 1. Effect of fertilizer treatments on rice and their residual effects on succeeding wheat

Treatment	Rice				Wheat					
	Grain yield (q/ha)		Straw yield (q/ha)		Grain yield (q/ha)		Straw yield (q/ha)		N uptake (kg/ha)	
	1988	1989	1988	1989	1988-89	1989-90	1988-89	1989-90	1988-89	1989-90
Control	20.2	27.5	31.3	32.0	22.1	21.8	41.2	39.3	35.8	35.9
50% NPK/ha	32.0	39.3	43.1	49.4	22.3	21.5	41.6	40.8	36.7	35.8
75% NPK/ha	37.1	42.1	47.6	38.7	23.3	22.1	42.4	40.1	36.0	36.0
100% NPK/ha	37.9	44.0	48.2	62.8	23.1	22.7	42.0	41.0	36.9	36.2
Green-manure	33.9	38.4	44.4	47.2	36.9	37.6	55.4	56.6	61.3	62.1
GM + 50% NPK/ha	41.6	47.7	52.3	65.9	38.1	38.9	56.9	59.5	63.2	63.1
GM + 75% NPK/ha	42.5	51.1	53.0	70.6	38.0	39.2	56.5	59.5	63.2	63.1
GM + 100% NPK/ha	43.7	54.7	55.1	73.3	38.9	38.3	59.0	57.7	60.6	63.2
Crop residues @ 10 tonnes/ha	28.7	37.1	37.9	41.7	25.5	26.0	44.2	45.2	45.6	48.3
CR + 50% NPK/ha	37.4	44.1	48.2	51.1	26.0	27.7	44.8	45.8	49.4	50.7
CR + 75% NPK/ha	39.0	44.7	50.0	61.0	26.9	27.5	45.8	46.3	50.9	51.5
CR + 100% NPK/ha	40.3	48.7	52.5	70.2	26.4	27.9	45.7	46.8	50.4	51.3
CD (P = 0.05)	2.8	2.8	3.6	2.2	3.2	3.6	4.5	5.3	8.4	8.3

GM, Green-manure; CR, crop residue; 50% N, P, K = 60, 30 and 30 kg N, P₂O₅ and K₂O/ha respectively; 75% N, P, K = 90, 45 and 45 kg N, P₂O₅ and K₂O/ha and 100% N, P, K, 120, 60 and 60 kg N, P₂O₅ and K₂O/ha

K were applied as basal and remaining half N was applied in 2 equal splits, i.e. 1 month after sowing and at panicle-initiation stage. The seedlings of 'Sarjoo 52' rice were transplanted on 20 and 16 July in 1988 and 1989 respectively. A uniform dose of 60 kg N/ha, 30 kg P_2O_5 /ha and 30 kg K_2O was applied.

Addition of organic matter through green-manure or crop residues with 50% or more of NPK gave higher grain yield than the addition of organic matter alone. Budhar *et al.* (1991) reported that grain yield of rice was significantly influenced by farm wastes and green-manures over the control. Green-manure alone and crop residue + 50% NPK were comparable to 60, 30, 30 and 120, 60 and 60 kg N, P and K/ha respectively. Singh *et al.* (1987) reported that green-manuring contributed at least 60 kg N/ha in rice.

The combinations of green-manure with different rates of NPK recorded higher grain and straw yields over crop residue and NPK separately or in combinations. The green-

manure alone or in combination with 50, 75 and 100% NPK recorded similar yield but higher than rest of the treatments. It indicated marked residual effect of green-manure in wheat crop. Similar behaviour was observed in case of N uptake by wheat crop, which may be attributed to higher grain and straw yields. Sharma and Mitra (1990) reported that application of organic materials increases grain and straw yields of rice and succeeding wheat and uptake of N and other nutrients in wheat.

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Performance of wheat (*Triticum aestivum*) under limited irrigation resources of Bundelkhand region

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In Bundelkhand region average yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) is very low due to less irrigation re-

sources (20%) and other limitations. Keeping this in view, a field study was conducted during the winter (*rabi*) season 1988-89 at