

## Effect of preceding crops and fertility levels on wheat (*Triticum aestivum*) in light-textured soil

JAGDEV SINGH<sup>1</sup>, K.P. SINGH<sup>2</sup>, S.S. YADAV AND J.S. YADAV

Regional Research Station, Chaudhary Charan Singh Haryana Agricultural University, Bawal-123 501

Received : April 2001

### ABSTRACT

A field experiment was conducted during the winter season of 1994–95 to 1996–97 at Regional Research Station, Bawal, on loamy sand soil. The yield attributes, yield and NP uptake of wheat (*Triticum aestivum* L. emend. Fiori & Paol.) were markedly higher after cowpea [*Vigna unguiculata* (L.) Walp.] and clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert] than pearl millet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz]. Application of 5 tonnes farmyard manure (FYM)/ha significantly improved growth, yield attributes, yield and NP uptake compared with the control. Application @ 5 tonnes FYM in combination with 90 kg N+45 kg P<sub>2</sub>O<sub>5</sub>/ha was statistically at par with 120 kg N+60 kg P<sub>2</sub>O<sub>5</sub>/ha in terms of growth, yield attributes and yield and these were significantly superior to lower fertility levels. However, the NP uptake increased significantly up to 120 kg N + 60 kg P<sub>2</sub>O<sub>5</sub>/ha. The residual effect of 5 tonnes FYM/ha along with 90 kg N+ 45 kg P<sub>2</sub>O<sub>5</sub>/ha and 120 kg N + 60 kg P<sub>2</sub>O<sub>5</sub>/ha applied to wheat was also found significant on the grain and straw yields of the succeeding pearl millet, clusterbean and cowpea crops compared to no NP application. The clusterbean–wheat was more economical than cowpea–wheat and pearl millet–wheat crop sequences.

**Key words :** Pearl millet, Cowpea, Clusterbean, FYM, N, P, Wheat, Economic returns

On account of increasing prices of chemical fertilizers and deterioration in the soil fertility and fertilizer-use efficiency due to their continuous use (Gaur and Sadasivan, 1981), the concept of integrated nutrient supply involving use of organic manures has been gaining importance in nutrient management of a cropping system (Nambiar and Abrol, 1989). Farmyard manure is a major source of organic nutrition of field crops and it enhanced the fertilizer-use efficiency and thus reduces the requirement of chemical fertilizers. Inclusion of legumes in crop rotation increases the soil fertility by fixing atmospheric nitrogen, which consequently enhances the productivity of succeeding cereal crop. The requirement of N and P also varies in relation to preceding crops. The information regarding effect of preceding crops and organic manure in association with chemical fertilizers on wheat is meagre in light soils. Hence the present experiment was conducted.

### MATERIALS AND METHODS

The field study was carried out at the Regional Research Station, CCS HAU, Bawal, during winter (*rabi*) seasons of 1994–95 to 1996–97. The soil was loamy sand, (0.22–0.24%), medium in available and slightly alkaline in re-

action (pH 8.3–8.4). The experiment consisting of 3 preceding crops (i.e. pearl millet, clusterbean and cowpea) in main plots and 6 fertility levels to wheat (control, 5 tonnes FYM, 5 tonnes FYM+30 kg N+ 15 kg P<sub>2</sub>O<sub>5</sub>, 5 tonnes FYM + 60 kg N + 30 kg P<sub>2</sub>O<sub>5</sub>, 5 tonnes FYM + 90 kg N+45 kg P<sub>2</sub>O<sub>5</sub> and 120 kg N+ 60 kg P<sub>2</sub>O<sub>5</sub>/ha in subplots. The trial was laid out in split-plot design with 3 replications. The varieties of preceding crops, i.e. 'HHB 67' of pearl millet, 'HG 365' of clusterbean and 'CS 88' of cowpea, were raised as per package of practices under rainfed conditions. After applying a pre-sowing irrigation, wheat cv. 'WH 283' was sown in rows 20 cm apart using a seed rate of 125 kg/ha on 17, 28 and 16 November in first, second and third year respectively. Half dose of N and whole of the P<sub>2</sub>O<sub>5</sub> as per treatments were drilled at sowing time, and remaining half of N was top-dressed at the time of first irrigation applied 22 days after sowing. The crop was harvested on 7, 12 and 6 April in first, second and third year, respectively.

### RESULTS AND DISCUSSION

#### Growth, yield attributes and yield of wheat

The mean of tillers/m, spike length, grains/spike and 1,000-grain weight (Table 1) were significantly higher

when the wheat crop was raised after cowpea and clusterbean as compared to pearl millet. However, the effect of preceding crops on plant height was not significant. The grain and straw yields of wheat were maximum after cowpea in all the 3 seasons and these were significantly reduced when the crop was raised after pearl millet. However, the yields obtained after clusterbean were at par to those of cowpea. The increase in mean grain yield of wheat raised after cowpea and clusterbean was 14.4 and 11.8% compared to that raised after pearl millet respectively. The corresponding increase for mean straw yield was 15.5 and 10.6%. Ahlawat *et al.* (1981) and Balyan (1997) also reported higher yields of wheat grown in rotation with legume. Sandhu *et al.* (1985) also reported pearl millet as the poorest preceding crop resulting in the lowest yield of succeeding wheat. Higher yields after legume crops may be attributed to biological fixation of N and addition of large biomass in the form of leaf fall, which might have improved physical and chemical prop-

erties of soil. Both grain and straw yields were low during 1995–96 because the crop was sown late in this season as compared to other 2 growing seasons.

Application of FYM @ 5 tonnes/ha significantly increased the plant height, spike length and grains/spike of wheat compared with the control. However, the increase in number of tillers/m and 1,000-grain weight was not significant (Table 1). The grain and straw yields of wheat were increased appreciably by application of FYM @ 5 tonnes/ha compared with the control in all the 3 seasons. Application of 5 tonnes FYM + N<sub>90</sub>P<sub>45</sub> kg/ha and N<sub>120</sub>P<sub>60</sub> kg/ha were statistically at par in terms of growth and yield parameters as well as grain and straw yields in all the seasons. Both these treatments were significantly superior to rest of the treatments. The increase in mean seed yield over the control was 18.8, 61.2, 99.1, 124.7 and 138.6% with 5 tonnes FYM, 5 FYM + N<sub>30</sub>P<sub>15</sub>, 5 tonnes FYM + N<sub>60</sub>P<sub>30</sub>, 5 tonnes FYM + N<sub>90</sub>P<sub>45</sub> and N<sub>120</sub>P<sub>60</sub> kg/ha respectively. The corresponding increase in mean straw yield

**Table 1.** Effect of crop sequences and fertility levels on growth, yield attributes, yield and nutrient uptake of wheat (mean data of 3 years)

Treatment	Growth and yield attributes					Yield (q/ha)		Nutrient uptake (kg/ha)	
	Plant height (cm)	Tillers/m	Spike length (cm)	Grains/spike	1,000-grain weight (g)	Grain	Straw	N uptake	P uptake
<i>Crop sequence</i>									
Pearlmillet	71.34	56.40	7.16	36.78	37.63	31.58	43.86	72.20	16.77
Clusterbean	74.31	60.31	7.83	41.99	39.27	35.30	48.50	82.21	19.53
Cowpea	75.28	61.58	7.84	41.86	38.90	36.13	50.65	84.81	25.50
CD (P=0.05)	NS	3.51	0.55	1.74	1.17	3.27	4.18	7.68	2.25
<i>Fertility level (kg/ha)</i>									
N <sub>0</sub> P <sub>0</sub>	61.23	46.11	5.83	32.35	37.45	19.75	27.38	43.25	9.23
5 tonnes FYM	64.86	47.37	6.72	34.69	37.99	23.47	33.40	53.22	12.46
5 tonnes FYM + N <sub>30</sub> P <sub>15</sub>	73.33	53.19	7.62	39.94	38.65	31.98	43.91	74.43	17.66
5 tonnes FYM + N <sub>60</sub> P <sub>30</sub>	77.50	63.37	8.06	42.79	39.03	39.32	54.91	93.21	23.00
5 tonnes FYM + N <sub>90</sub> P <sub>45</sub>	81.56	71.22	8.71	44.93	39.22	44.38	61.63	106.54	26.99
N <sub>120</sub> P <sub>60</sub>	83.24	75.33	8.73	46.27	39.25	47.12	65.77	114.18	29.15
CD (P=0.05)	3.50	4.64	0.85	2.66	1.30	3.42	5.36	7.22	2.08

**Table 2.** Yield of rainy-season crops as influenced by residual fertility levels of wheat crop (mean data of 3 years)

Residual fertility level	Yield (q/ha)					
	Pearlmillet		Clusterbean		Cowpea	
	Grain	Stover	Grain	Straw	Grain	Straw
N <sub>0</sub> P <sub>0</sub>	13.52	30.25	9.15	19.71	8.10	20.66
5 tonnes FYM	14.07	31.73	9.47	20.04	8.56	20.72
5 tonnes FYM + N <sub>30</sub> P <sub>15</sub>	14.39	32.43	9.59	20.80	9.02	22.95
5 tonnes FYM + N <sub>60</sub> P <sub>30</sub>	14.52	32.54	9.82	21.25	9.27	23.84
5 tonnes FYM + N <sub>90</sub> P <sub>45</sub>	14.95	32.77	9.94	21.73	9.38	24.50
N <sub>120</sub> P <sub>60</sub>	14.66	32.48	10.02	22.00	9.23	24.2
CD (P=0.05)	1.37	2.45	0.70	1.81	1.09	3.00

**Table 3.** Effect of fertility levels on economic returns of various crop sequences (mean data of 3 years)

Fertility level (kg/ha)	Net returns (Rs/ha)			Benefit : cost ratio		
	Pearlmillet- wheat	Clusterbean- wheat	Cowpea- wheat	Pearlmillet- wheat	Clusterbean- wheat	Cowpea- wheat
N <sub>0</sub> P <sub>0</sub>	2,241	6,916	5,417	0.35	1.01	0.75
5 tonnes FYM	4,972	8,839	7,424	0.68	1.25	0.99
5 tonnes FYM + N <sub>30</sub> +P <sub>15</sub>	8,836	13,683	12,507	1.11	1.76	1.54
5 tonnes FYM + N <sub>60</sub> +P <sub>30</sub>	12,377	17,656	17,060	1.45	2.16	2.02
5 tonnes FYM + N <sub>90</sub> +P <sub>45</sub>	15,884	19,723	19,166	1.79	2.34	2.19
N <sub>120</sub> P <sub>60</sub>	17,694	20,926	20,223	1.96	2.46	2.19
Mean	10,334	14,624	13,633	1.22	1.83	1.63

was 22.0, 60.4, 100.5, 125.1 and 139.70%. Gill *et al.* (1994) reported positive response of wheat to applied nitrogen in combination with farmyard manure. The organic manure supplied available nutrients to the plants and also had solubilizing effects on fixed form of other nutrients (Sinha *et al.*, 1981) and therefore, improved the productivity of wheat in all the cropping systems.

#### Nutrient uptake by wheat

The uptake of N and P by wheat sown after cowpea and clusterbean was statistically at par to each other and significantly higher than that raised after pearl millet (Table 1). On mean basis, the increase in N uptake was 16.7 and 13.1% while P uptake was higher by 22.2 and 16.5% when wheat was grown after cowpea and clusterbean, respectively, compared with pearl millet. Similar results were reported by Balyan (1997). Application of 5 tonnes FYM/ha and NP levels significantly improved N and P uptake by wheat compared with the control (Table 1). The N and P uptake was increased significantly with each increasing level of fertilizer up to 120 kg N+60 kg P<sub>2</sub>O<sub>5</sub>/ha. Singh (1999) also reported increase in uptake of N and P with increasing level of FYM and NP.

#### Yield of rainy-season crops

The residual effect of application of 5 tonnes FYM/ha along with 90 kg N+45 kg P<sub>2</sub>O<sub>5</sub>/ha applied to wheat was found significant on grain and straw yields of the succeeding rainy-season crops, i.e. pearl millet, clusterbean and cowpea, compared to no nitrogen and phosphorus application (Table 2). The application of recommended dose of fertilizer to wheat, i.e. 120 kg + 60 kg P<sub>2</sub>O<sub>5</sub>/ha failed to improve yield of succeeding pearl millet crop but significantly enhanced the yield of cowpea and clusterbean crops compared to no NP application. This was mainly due to the fact that clusterbean and cowpea being leguminous crops efficiently utilized the left-over phosphorus of wheat crop. However, pearl millet being cereal crop, responds to nitrogen most of which was already utilized by the wheat crop. In cowpea crop, the yields even with 5 tonnes FYM

in association with 60 kg N+ 30 kg P<sub>2</sub>O<sub>5</sub>/ha applied to wheat were significantly higher compared to no NP application.

#### Economic returns

The maximum net returns (Rs 14,624/ha) as well as benefit : cost ratio (1.83) were obtained in clusterbean-wheat sequence followed by cowpea-wheat sequence with net returns of Rs 13,633 and benefit : cost ratio of 1.63 (Table 3). The least net returns (Rs 10,334) and benefit : cost ratio (1.22) were recorded under pearl millet-wheat crop sequence. In all the 3 sequences, the economic returns were the maximum with the recommended dose of NP fertilizers. However, clusterbean-wheat and cowpea-wheat sequences even with 5 tonnes FYM in association with 60 kg N+30 kg P<sub>2</sub>O<sub>5</sub>/ha gave almost equal economic returns to pearl millet-wheat sequence with recommended dose of NP fertilizers.

#### REFERENCES

- Ahluwat, I.P.S., Singh, A. and Saraf, C.S. 1981. Effect of winter legumes on the economy and productivity of succeeding cereals. *Experimental Agriculture* 17 : 57-62.
- Balyan, J.S. 1997. Production potential and nitrogen uptake by succeeding wheat (*Triticum aestivum*) under different cropping sequences. *Indian Journal of Agronomy* 42 : 250-252.
- Gaur, A.C. and Sadasivan, K.V. 1981. Organic manures in aid of fertilizers. *Indian Farming* 31 : 30-32.
- Gill, M.S., Singh, Tarlok and Rana, D.S. 1994. Integrated nutrient management in rice (*Oryza sativa*)-wheat (*Triticum aestivum*) cropping sequence in semi-arid tropic. *Indian Journal of Agronomy* 39 : 606-608.
- Nambiar, K.K.M. and Abrol, I.P. 1989. Long term fertilizer experiments in India-An overview. *Fertiliser News* 34 : 11-26.
- Sandhu, H.S., Virk, J.S., Brar, S.S., Gill, G.S. and Dhaliwal, J.S. 1985. Effect of preceding crops on the performance of succeeding wheat. *Haryana Journal of Agronomy* 1 : 70-76.
- Singh, V.P. 1999. Effect of organic sources of nutrients on rainfed wheat (*Triticum aestivum*). *Indian Journal of Agronomy* 44 : 347-352.
- Sinha, N.P., Prasad, B. and Ghosh, A.B. 1981. Effect of continuous use of fertilizers on yield and nutrient uptake in wheat in wheat-soybean-potato cropping system. *Journal of Indian Society of Soil Science* 29 : 537-542.