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Growth and yield of wheat (*Triticum aestivum*) as influenced by levels of farmyard manure and nitrogen

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) season of 1996–97 and 1997–98 on sandy-loam soils of Hisar, Haryana, to study the effect of farmyard manure (FYM) and nitrogen on growth and yield of wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Application of graded levels of nitrogen and recommended dose of NPZn fertilizer significantly enhanced number of tillers at 45 days after sowing, plant height, dry-matter accumulation, effective tillers, grains/spike, grain, straw and biological yields. The plant height, dry-matter accumulation, effective tillers, grains/spike, grain, straw and biological yields increased significantly with the graded levels of FYM up to 20 tonnes/ha, but the response decreased with the increase of FYM from 20 to 30 tonnes/ha. Interactive effect of FYM and nitrogen levels on grain yield of wheat showed that integration of recommended NPZn and 10 tonnes FYM/ha or 120 kg N/ha and 20 tonnes/ha FYM was found to be superior than other combinations.

Key words : FYM, Nitrogen, Growth, Yield, Wheat

Wheat is a predominant winter (*rabi*) crop of North-western plain zone and Central zone of India, occupying about 26.6 million ha area with annual production of 68.7 million tonnes. In India, during the past 3 decades intensive agriculture involving exhaustive high-yielding varieties of cereals particularly of wheat has led to heavy with drawal of nutrients from the soil. The productivity of a crop is controlled by many factors, of which the mineral nutrition specially of nitrogen is by and large the most important factor; but the heavy and imbalanced use of chemical fertilizer has led to think about the use of organic manures in intensively growing areas for sustainable production system. Therefore to sustain the land and to achieve production potential of crops, judicious use of fertilizers in integration of organic manures and their scientific management is important. Keeping in view the above points, present investigation was carried out.

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MATERIALS AND METHODS

The field experiment was conducted during winter season of 1996–97 and 1997–98 at Agronomy Research Farm of CCS, Haryana Agricultural University, Hisar. The soil was sandy loam, having pH 8.05, organic carbon 0.34%, low available nitrogen (154.6 kg/ha), medium available phosphorus (10.2 kg/ha) and high available potassium (343 kg/ha). The experiment was laid out in split-plot design with 4 levels of farmyard manure (0, 10, 20 and 30 tonnes/ha) in main plots and 5 nitrogen levels (0, 60, 120, 180 kg N/ha and 120 + 60 +25 kg NPZn/ha, i.e. recommended dose of fertilizer) in subplots with 4 replications. Decomposed FYM was applied uniformly as per treatment and incorporated into the soil 1 mongh before the sowing. Full dose of phosphorus and zinc was given just before sowing while nitrogen through urea was applied in 3 split doses (half at the time of sowing, one-fourth 3 days after first irrigation and remaining one-fourth 3 days after second irrigation) as top-dressing. The crop was sown on 10 and 18 December in 1996 and 1997 with the seed rate of 125 kg/ha. The harvesting was done in the third week of April. The sorghum for fodder was grown in rainy season *(kharif)* 1996 and the field was kept fallow during *kharif* 1997 due to continuous stagnation of water.

RESULTS AND DISCUSSION

Growth parameters

Plant height and dry matter increased significantly with the application of FYM at 20 tonnes/ha over the control and FYM 10 tonnes/ha (Table 1). The application of FYM at 10, 20 and 30 tonnes/ha enhanced 6.2, 10.0, 11.2 and 4.8, 7.8, 8.4% plant height and 21.3, 30.9 and 38.8 and 17.7, 26.3 and 28.8% dry matter over the control at harvest during 1996–97 and 1997–98 respectively. Application of 180 kg N and balanced NPZn/ha significantly improved the number of tillers (45 days) and plant height and dry matter at harvest. The recommended dose of fertilizer enhanced the dry matter 98.6 and 124.4%, 43.3 and 41.2%, 18.1 and 13.9% and 5.6 and 3.7% over 0, 60, 120, and 180 kg N/ha, respectively, in both the crop seasons. The enhancement in growth parameters with increase in N levels and balanced NPZn was due to rapid conversion of synthesized carbohydrates into protein to form more protoplasm and this increase in number and size of cell may cause an increase in number of tillers, plant height and thereby increase in dry matter. The results confirm the findings of Yadav *et al.* (1995).

Yield and yield attributes

Effective tillers and grains/spike increased significantly with the successive increment in FYM up to 20 tonnes/ha (Table 1). This dose enhanced the number of effective tillers and grains/spike 26.7 and 4.1% during 1996–97 and 17.9 and 4.2% during 1997–98 over the untreated plots. It may be owing to beneficial effect of FYM on crop growth and various physiological parameters, which affected yield-attributing characters positively. Rathore *et al.* (1995) also reported increase in yield attributes of wheat with organic manure.

It was also observed that recommended dose of NPZn fertilizer significantly improved the effective tillers and grains/

Table 1. Effect of farmyard manure and nitrogen levels on growth and yield attributes of wheat

Treatment	Total tillers/m row length at 45 days*		Plant height at harvest (cm)		Dry matter (g/m row length) at harvest		Effective tillers/ m row length		Grains/ spike		Test weight (g)	
	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98	1996–97	1997–98
FYM (tonnes/ha)												
0	79.8	81.8	70.5	70.6	138.0	119.9	42.9	49.2	30.8	27.1	41.1	37.5
10	85.1	86.8	74.9	74.0	167.1	141.2	49.8	54.0	31.6	27.8	41.5	37.8
20	88.2	90.0	77.6	76.1	180.4	151.5	53.5	57.9	32.1	28.4	41.6	38.1
30	90.2	92.3	78.4	76.5	191.3	154.5	54.8	59.4	32.4	28.7	41.8	38.3
CD (P=0.05)	NS	NS	1.89	1.4	10.9	6.7	1.4	2.1	0.4	0.4	NS	NS
Nitrogen (kg/ha)												
0	49.6	56.6	59.8	61.2	106.7	79.1	42.6	46.5	22.9	19.8	40.8	36.9
60	77.6	82.8	74.4	71.7	147.8	125.6	48.0	51.9	28.7	24.7	41.3	37.8
120	92.9	93.1	79.0	78.5	179.4	155.7	51.4	55.7	34.5	30.4	41.6	38.1
180	101.2	100.4	81.5	80.0	200.6	171.1	54.2	58.9	35.8	32.0	41.7	38.2
120 + 60+25	107.8	105.6	82.1	80.4	211.9	177.4	55.2	60.4	36.7	32.9	42.0	38.6
CD (P=0.05)	4.6	4.8	2.6	1.1	5.7	6.2	0.9	1.3	0.8	0.8	NS	NS

*Days, Days after sowing

spike over all the levels of nitrogen. The application of balanced dose of fertilizer recorded 1.8 and 5.7% higher effective tillers during 1996–97 and 1997–98, respectively, than 180 kg N/ha alone. The corresponding improvement in grains/spike was 2.4 and 2.7%. The favourable effect of increased levels of N and recommended fertilizer on yield attributes may be ascribed to the availability of higher amount of N as well as other nutrients throughout growth period which resulted in improved plant vigour and consequently better yield attributes. Significant improvement in yield attributes owing to the application of N and recommended fertilizer were also recorded by Singh and Prasad (1998).

The grain, straw and biological yields were significantly higher with the application of FYM at 20 and 30 tonnes/ha over FYM at 0 and 10 tonnes/ha respectively (Table 2). Addition of FYM 20 tonnes/ha enhanced the grain yield 31.4, 22.9 and 27.3% over the control and 9.4, 7.2 and 8.4% over FYM 10 tonnes/ha in 1996–97, 1997–98 and based on pooled analysis respectively. Increased grain yield of wheat with higher FYM application could be owing to higher availability of nutrient and because of proliferous root system under FYM application resulting in adequate uptake of nutrients. This led to higher photosynthetic efficiency, which favourably affected the yield-contributing parameters and consequently higher grain and straw yields of wheat. Kumar and Yadav (1995) also reported similar effects of FYM on grain and straw yields.

Application of N and recommended NPZn had significant effect on grain, straw and biological yields of wheat (Table 2). Maximum grain, straw and biological yields were recorded with recommended NPZn, followed by 180 kg N/ha in pooled analysis. Based on pooled analysis, the increase in grain, straw and biological yield, with application of recommended NPZn was 115.8, 109.6 and 112.1% over 0; 42.9, 40.1 and 41.2% over 60; 14.2, 15.1 and 15.6% over 120; and 4.1, 3.7 and 3.9% over 180 kg N/ha. Such response with increasing levels of N and recommended NPZn may be attributed to higher availability of nutrients to plants that improved the plant height, number of effective tillers and dry matter, which ultimately resulted in higher grain, straw and biological yields. These results are in conformity with the findings of Singh and Prasad (1998) and Patel *et al.* (1995).

An interaction effect of FYM and N levels on grain yield of wheat was found significant during both the years (Table 3). Balanced application of fertilizer caused significant improvement in grain yield of wheat under FYM 10 tonnes/ha over the control, but remained on a par with FYM 20 tonnes/ha. The grain yield of wheat was significantly higher at 180 N/ha with FYM 10 tonnes/ha compared with 120 kg N/ha. The above trend was similar in both the years including pooled data. This can be attributed to the beneficial effect of FYM in combination with N fertilizer on growth and yield-attributing parameters, which ultimately resulted in higher grain yield of wheat. Thus, neither the use of organic manure alone nor the sole use of chemical fertilizer may be adequate in maintaining sustained higher productivity under modern

Table 2. Effect of farmyard manure and nitrogen levels on grain, straw and biological yields of wheat

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)			Biological yield (kg/ha)		
	1996–97	1997–98	Pooled	1996–97	1997–98	Pooled	1996–97	1997–98	Pooled
FYM (tonnes/ha)									
0	2,782	2,570	2,676	4,140	3,592	3,866	6,922	6,163	6,542
10	3,342	2,949	3,145	4,958	4,103	4,530	8,301	7,049	7,645
20	3,657	3,161	3,409	5,393	4,412	4,902	9,051	7,574	8,312
30	3,750	3,236	3,493	5,553	4,887	5,020	9,304	7,724	8,514
CD (P=0.05)	102	78	92	164	147	153	265	226	237
Nitrogen (kg/ha)									
0	2,046	1,656	1,851	3,092	2,339	2,715	5,139	3,993	4,566
60	2,982	2,609	2,795	4,454	3,671	4,062	7,437	6,280	6,858
120	3,611	3,241	3,426	5,356	4,535	4,946	8,967	7,778	8,372
180	4,040	3,631	3,835	5,948	5,022	5,485	9,989	8,653	9,321
120+60+25	4,234	3,756	3,995	6,202	5,177	5,691	10,442	8,933	9,686
CD (P=0.05)	81	57	70	124	113	115	203	191	201

Table 3. Interactive effect of farmyard manure and nitrogen on grain yield (kg/ha) of wheat

FYM (tonnes/ha)	Nitrogen levels (kg/ha)				
	0	60	120	180	120+60+25 (recommended dose)
			1996–97		
0	1,442	2,447	2,943	3,453	3,627
10	2,115	2,935	3,373	4,031	4,259
20	2,282	3,218	4,014	4,288	4,486
30	2,348	3,331	4,116	4,391	4,567
			1997–98		
0	1,088	2,044	2,744	3,346	3,629
10	1,663	2,638	3,218	3,573	3,653
20	1,841	2,846	3,480	3,791	3,849
30	2,034	2,909	3,531	3,817	3,894
			Pooled		
0	1,265	2,245	2,843	3,399	3,628
10	1,889	2,786	3,295	3,802	3,956
20	2,061	3,032	3,754	4,047	4,168
30	2,191	3,120	3,823	4,104	4,230
CD (P=0.05)			*1996–97*	*1997–98*	*Pooled*
2 N levels at same FYM levels			203	155	165
2 FYM levels at different or same N levels			251	205	217

farming owing to this inherent limitations. Integration of FYM 10 tonnes/ha and recommended NPZn or FYM 20 tonnes along with 120 kg N/ha was found to be effective in maintaining sustained productivity. Patel *et al.* (1995) also reported improvement in grain yield of wheat owing to integration of organic manure and fertilizer.

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