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Effect of integrated nutrient management with vermicompost on productivity of wheat (*Triticum aestivum*)

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ABSTRACT

The results of the field experiment conducted during winter seasons of 1994-96 revealed that application of organic manures improved yield attributes and grain, straw and biological yields of wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Application of vermicompost at the rate of 7.5 or 10 t/ha yielded higher than 10t/ha FYM. Increasing dose of nitrogen improved significantly the yield attributes and yields of the crop. Integration of vermicompost at 10 t/ha or 7.5 t/ha or FYM 10 t/ha with 100 kg N/ha produced grain, straw as well as biological yields on par to recommended dose of fertilizers (120 + 60 + 25 kg/ha N + P_2O_5 + Zn SO_4) during both years.

Key words : Wheat, Integrated nutrient management, Vermicompost

Integrating chemical fertilizers with organic manures has been found to be quite promising not only in maintaining higher productivity but also in providing greater stability in crop production (Nambiar and Abrol, 1992). Farmyard manure (FYM) is being used as a major source of organic manure in field crops. Limited availability of this manure is, however, an important constraint in its use as a source of nutrients. Vermicompost has been advocated as a good organic manure for use in integrated management practices in field crops (Shroff and Devasthali, 1992). It is a well known fact that wheat crop responds to applied nitrogen up to 120 to 150 kg N/ha (Parkash *et al.,* 1990; Singh and Brar, 1994) and some substitution of plant nutrients particularly all nutrients except nitrogen may be achieved by using organic manures. Positive response of wheat to applied nitrogen along with FYM has been reported by several workers (Gill *et al.*, 1994). However, no work has been reported on the effect of vermicompost and nutrients substitution through this manure in wheat crop. Keeping this in view, the studies were carried out to study the effect of integration of chemical nitrogen with vermicompost on wheat crop.

MATERIAL AND METHODS

The field experiment was conducted dur-

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ing winter seasons of 1994-95 and 1995-96 at Agronomy Research Farm of the CCS Haryana Agricultural University, Hisar. The treatment comprised five levels of organic manures viz., no organic manure (control), farmyard manure (FYM) at 10 t/ha, vermicompost at 5, 7.5 and 10 t/ha in main plots and 5 level of N, viz. no N, 50, 100, 150 kg N/ha and recommended fertilizers (120 + 60 + 25 kg/ha N + P_2O_5 + Zinc Sulphate respectively) thrice replicated split-plot design. The soil of the experimental field was sandy loam in texture, alkaline in reaction ('pH 8.1'), low in organic carbon (0.34-0.36%), low in available nitrogen (160-168 kg/ha), medium in available phosphorus (9.5 to 10.8 kg/ha) and high in available potash (328 to 358 kg/ha). The FYM contained 0.68 and 0.70% N, 0.20 and 0.24% P_2O_5 and 0.75 and 0.82% K_2O (on oven dry basis) during 1994-95 and 1995-96 respectively. During both the years, FYM and vermicompost were applied about 3 weeks before the sowing of the crop. Half of the nitrogen in the form of urea and full doses of phosphorus and zinc sulphate as per treatments were applied at the time of sowing and remaining half nitrogen was top dressed after first irrigation. All other operations were performed as per the recommendations for the crop. The sowing was done on 9 December, 1994 and 6 December 1995 and crop was harvested on 22 April, 1995 and 21 April, 1996 respectively. The data on various yield attributes, grain, straw and total biological yields were recorded in different treatments.

Table 1. Yield attributes of wheat as influenced by organic sources and fertilizer levels.

Treatment	Effective tillers/m row length at harvest		Length of ear (cm)		No. of grains/ spike		Grain weight (g)/ spike		Test weight (g)	
	1994-95	1995-96	1994-95	1995-96	1994-95	1995-96	1994-95	1995-96	1994-95	1995-96
Organic sources										
No organic manure	94.5	96.5	8.5	8.4	41.6	43.8	1.28	1.31	29.5	
FYM at 10 t/ha	97.4	102.9	8.6	8.7	44.0	46.4	1.37	1.42	30.8	30.7
Vermicompost at 5 t/ha	97.1	101.5	8.5	8.6	42.5	44.6	1.35	1.38	30.9	30.6
Vermicompost at 7.5 t/ha	99.6	105.1	8.6	8.8	43.9	47.8	1.42	1.48	30.9	30.9
Vermicompost at 10 t/ha	101.4	107.3	8.9	9.1	46.6	49.7	1.47	1.52	31.1	31.0
CD (P = 0.05)	2.50	2.13	NS	0.37	NS	4.13	0.11	0.12	NS	NS
Fertiliser levels										
N_0 (control)	74.9	79.6	6.3	6.8	25.6	31.2	0.78	0.87	30.1	30.2
N_{50} kg/ha	91.4	96.9	8.5	8.5	43.0	44.2	1.41	1.45	30.4	30.3
N_{100} kg/ha	100.7	107.4	9.0	9.0	46.7	49.0	1.49	1.55	30.7	30.5
N_{150} kg/ha	110.6	113.7	9.6	9.6	51.0	53.3	1.57	1.58	30.8	30.7
$N_{120} P_{60} Zn_{25}$ kg/ha	112.4	115.8	9.8	9.8	52.2	54.6	1.64	1.66	31.0	31.0
CD (P = 0.05)	1.09	1.49	0.30	0.32	3.14	3.48	0.09	0.10	NS	NS

RESULTS AND DISCUSSION

Effect of organic manures

The 2 years results revealed that all levels of organic manures improved the yield attributing characters and grain, straw and biological yields over no organic manure. Number of effective tillers, length of ears, number of grains/spike, grain weight/spike and 1,000- grain weight were maximum with vermicompost 10 t/ha but statistically at par with vermicompost 7.5 t/ha (Table 1). However, effect of organic manures was non-significant on ear length and number of grains/spike during first year as well as on 1,000-grain weight during both years. Application of FYM 10 t/ha was also superior to vermicompost 5 t/ha. These effects on yield attributes were reflected in grain yield and significantly higher grain yield was recorded with vermicompost 10 t/ha over 5 t/ha during 1995-96 and on pooled basis but it was statistically on par with rest of organic manures during both the years as well as on pooled basis (Table 2). Vermicompost 7.5 t/ha and FYM 10 t/ha were also better than vermicompost 5 t/ha. On pooled basis highest grain yield of 3,835 kg/ha was recorded with vermicompost 10 t/ha which was 16.5, 7.2, 3.4 and 1.6% higher than no organic manure, vermicompost 5 t, FYM 10 t and vermicompost 7.5 t/ha respectively. The beneficial effect of organic manures were also recorded in straw and total biological yields. The maximum straw and biological yields were observed with vermicompost 10 t/ha which was closely followed by vermicompost 7.5 t/ha and on pooled basis per cent increase in these 2 treatments in straw yields was 13.8 and 12.2 over control respectively. The beneficial effect of organic sources of manures on yield attributes, grain, straw and biological yields could be attributed to the fact that after proper decomposition and mineralization of organic manure, the manures supplied available plant nutrients directly to the plants and also had solubilizing effects on fixed form of nutrients (Sinha *et al.*, 1981). Better response of field crops to vermicompost was also reported by Shroff and Devesthati (1994).

Effect of nitrogen and fertilizer levels

The application of nitrogen and recommended fertilizer levels had significant effect on various yield attributes and grain, straw and total biological yields of the crop (Table 2). These parameters increased significantly with each successive increase in fertilizer level in both the years and on pooled basis. Maximum yield of 4,385 kg/ha (pooled) was recorded with recommended fertilizers followed by 4,200 kg/ha with 150 kg N/ha. The per cent increase with recommended dose over no N, 50, 100 and 150 kg N/ha was 83.4, 32.9, 12.1 and 4.4 respectively (pooled) while increase due to application of 150 kg N/ha was 75.7, 27.3 and 7.4% over on N, 50 and 100 kg N ha respectively. These findings are in accordance with those of Prakash *et al.* (1990) and Singh and Brar (1994).

Effect of integrated nutrients supply

The integration of fertilizer nitrogen and recommended dose of fertilizers with FYM or various levels of vermicompost also exerted its effect on grain and straw yields of wheat. The productivity of crop in terms of grain yield was recorded minimum in no fertilizer treatment without organic manure. Response of crop to the increasing levels of

Table 2. Yield and harvest index of wheat as influenced by organic sources and fertilizer levels

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)			Biological yield (kg/ha)			Harvest index	
	1994-95	1995-96	Pooled	1994-95	1995-96	Pooleld	1994-95	1995-96	Pooled	1994-95	1995-96
Organic sources											
No organic manure	3,185	3,397	3,292	4,696	4,741	4,719	7,881	8,139	8,010	40.2	41.7
FYM at 10 t/ha	3,514	3,905	3,710	5,146	5,386	5,266	8,661	9,290	8,976	40.4	42.0
Vermicompost 5 t/ha	3,400	3,756	3,578	4,963	5,221	5,092	8,363	8,977	8,670	40.5	41.8
Vermicompost at 7.5 t/ha	3,573	3,973	3,773	5,125	5,462	5,293	8,698	9,435	9,067	41.0	42.2
Vermicompost at 10 t/ha	3,637	4,032	3,835	5,178	5,564	5,371	8,815	9,596	9,206	41.2	42.0
CD (P = 0.05)	296	206	161	171	289	148	355	450	258	NS	NS
Fertiliser levels											
N_0 (control)	2,298	2,483	2,391	3,516	3,425	3,471	5,815	5,908	5,861	39.5	42.0
N_{50} kg/ha	3,153	3,446	3,300	4,689	4,769	4,729	7,842	8,214	8,029	40.2	42.0
N_{100} kg/ha	3,730	4,094	3,912	5,425	5,689	5,557	9,155	9,783	9,469	40.7	41.8
N_{150} kg/ha	3,932	4,468	4,200	5,623	6,133	5,878	9,555	10,601	10,078	41.2	42.1
N_{120} P_{60} Zn_{25} kg/ha	4,197	4,573	4,385	5,855	6,358	6,107	10,052	10,931	10,492	41.7	41.8
CD (P = 0.05)	77	90	64	126	154	82	108	67	70	1.03	NS

Table 3. Interaction effects of organic sources and fertilizer levels on grain yield (kg/ha) of wheat

Organic sources	Fertilizer levels (kg/ha)				
	N_0	N_{50}	N_{100}	N_{150}	Recomm.
No organic manure					
1994-95	2,000	2,822	3,300	3,700	4,105
1995-96	1,995	2,851	3,551	4,153	4,436
Pooled	1,998	2,837	3,426	3,927	4,271
FYM at 10 t/ha					
1994-95	2,254	3,272	3,865	3,962	4,218
1995-96	2,487	3,563	4,279	4,583	4,612
Pooled	2,317	3,418	4,072	4,273	4,415
Vermicompost at 5 t/ha					
1994-95	2,248	3,056	3,673	3,914	4,110
1995-96	2,470	3,445	4,025	4,380	4,460
Pooled	2,359	3,251	3,849	4,149	4,285
Vermicompost at 7.5 t/ha					
1994-95	2,430	3,296	3,888	3,996	4,255
1995-96	2,648	3,663	4,301	4,598	4,656
Pooled	2,539	3,480	4,095	4,297	4,456
Vermicompost at 10 t/ha					
1994-95	2,560	3,318	3,924	4,088	6,296
1995-96	2,841	3,706	4,315	4,624	4,701
Pooled	2,687	3,512	4,120	4,356	4,499

CD (P = 0.05)	*1994-95*	*1995-96*	*Pooled*
Two fertilizer levels at same organic source	172	202	135
Two organic sources at same or different fertilizer levels	412	273	229

fertilizers was more in no organic manure treatment and relative increase in grain yield with increasing levels of fertilizer nitrogen was lower in manurial treatments and least improvement was recorded under vermicompost 10 and 7.5 t/ha (Table 3). Vermicompost at 10 t and 7.5 t and FYM at 10 t/ha in combination with 100 kg N/ha produced grain yield statistically at par with recommended fertilizer level of $N_{120}\,P_{60}\,Zn_{25}$ under no organic manure treatment. Similar interactive effects of organic manures and fertilizer N were also visible on straw yields.

So far as the productivity of the crop is concerned, best combination was vermicompost 10 t/ha along with 100 kg N/ha. The beneficial interactive effects of organic manures with fertilizer nitrogen in wheat due to supplementation of nitrogen and supply of other essential nutrients by organic manures

have also been reported by Gill *et al.* (1994).

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