

Effect of organic manure and nitrogen fertilization on productivity of barley (*Hordeum vulgare*)

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ABSTRACT

The results of the field experiment conducted during winter (irrigated) seasons of 2000–2001 and 2001–2002 revealed that application of organic manure improved yield attributes and yield of barley (*Hordeum vulgare* L., s.l.). Application of vermicompost @ 4.5 tonnes/ha resulted in the highest grain yield over no-organic manure, vermicompost @ 1.5 and 3.0 tonnes/ha and FYM @ 5.0, 7.5 and 10.0 tonnes/ha respectively. However, vermicompost @ 4.5 tonnes/ha being at par with vermicompost @ 3.0 tonnes/ha recorded significantly highest net returns. However, vermicompost @ 4.5 tonnes/ha brought significantly highest uptake of NPK over rest of the treatments. Further, the vermicompost @ 1.5 tonnes/ha was almost equally effective with FYM @ 7.5 and 10.0 tonnes/ha. Increasing dose of nitrogen improved significantly the yield attributes, yields, net returns, total uptake of NPK in barley crop. The combined application of vermicompost @ 4.5 tonnes/ha + 40 kg N/ha obtained higher grain yield.

Key words : Barley, Vermicompost, FYM and Nitrogen.

A judicious combination of organic and organic fertilizers can maintain long-term soil fertility and sustain higher productivity of crops. Farmyard manure (FYM) is being used as 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 good organic manure for use in field crops. Nitrogen is considered to be the most limiting factor for realizing higher yields. Nitrogen is the most deficient element, especially in the coarse textural soils of Rajasthan. An adequate supply of nitrogen to barley is associated with efficient source to sink relationship leading to higher productivity. Thus to maintain the soil health, integrated nutrient-management approaches involving FYM, vermicompost and mineral source need to be standardized. Therefore, keeping this view the studies were carried out to study the response of barley to organic manure and nitrogen fertilization.

MATERIALS AND METHODS

The field experiment was conducted during winter (irrigated) season, 2000–2001 and 2001–2002 at Agronomy Farm, S.K.N. College of Agriculture, Jobner, Rajasthan. The treatments comprised 7 levels of organic manure, viz. no organic manure (control), farmyard manure (FYM) @

5.0, 7.5 and 10.0 tonnes/ha and vermicompost @ 1.5, 3.0 and 4.5 tonnes/ha in main plots and 4 levels of nitrogen, viz. 0, 20, 40 and 60 kg N/ha, in sub-plots replicated 4 times in split-plot design. The soil of the field was loamy sand in texture, alkaline in reaction (pH 8.1–8.4), low in available nitrogen (129–130 kg/ha) and phosphorus (16.5–17.3 kg/ha) and medium in available potash (144.0–147.5 kg/ha). The FYM and vermicompost contained 0.42 and 1.80% N, 0.26 and 1.26%, P_2O_5 and 0.39 and 1.15% K_2O respectively. The FYM was applied as per treatment at 3 weeks before sowing and vermicompost before sowing and thoroughly incorporated into 15 cm top soil layer. A uniform dose of 30 kg P_2O_5 /ha through and half of nitrogen through urea was drilled 10 cm deep at sowing time and remaining half dose of nitrogen was top-dressed after first irrigation. All other operations were performed as per recommendations for the crop. The sowing was done on November 2000 and 13 November 2001 and harvested on 16 March 2001 and 12 March 2002 respectively.

RESULTS AND DISCUSSION

Effect of organic manure : Application of vermicompost @ 4.5 tonnes/ha recorded significantly highest effective tillers, spike length, grains/spike, grain and straw yields over rest of the treatments (Table 1). Fur-

Table 1. Effect of organic manure and nitrogen on yield attributes, yield and net return of barley (Pooled data of 2 years)

Treatment	Effective tillers/ m row length	Spike length (cm)	Number of grains/ spike	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Net returns (Rs/ha)
<i>Organic manure (tonnes/ha)</i>								
No organic manure	53.7	5.4	33.3	42.2	32.38	46.61	41.9	18,932
Vermicompost @ 1.5	59.5	6.2	40.4	42.6	41.81	57.00	43.3	23,943
Vermicompost @ 3.0	62.3	6.7	44.0	42.8	48.96	63.84	43.3	27,128
Vermicompost @ 4.5	64.3	7.1	46.8	43.7	52.64	67.96	43.6	27,831
FYM @ 5.0	57.2	5.9	37.2	42.5	37.16	51.95	41.7	21,240
FYM @ 7.5	59.1	6.2	40.0	42.9	40.82	56.21	42.1	23,637
FYM @ 10.0	60.6	6.4	42.3	43.1	43.76	59.80	42.3	25,459
CD (P=0.05)	1.9	0.3	2.3	NS	2.39	2.93	NS	1,646
<i>Nitrogen (kg/ha)</i>								
0	49.8	5.2	34.0	42.5	30.84	43.32	41.6	14,703
20	59.1	6.1	39.5	42.7	41.92	56.65	42.8	23,589
40	63.5	6.8	43.7	42.9	47.18	63.17	43.1	27,718
60	65.7	7.1	44.7	43.0	50.08	67.34	42.9	30,087
CD (P=0.05)	1.2	0.2	1.0	NS	1.07	1.71	NS	682

NS, Non-significant

ther, the vermicompost @ 1.5 tonnes/ha and FYM @ 7.5 and 10.0 tonnes/ha were almost equally effective. The maximum grain yield (52.64 q/ha) recorded under vermicompost @ 4.5 tonnes/ha was 62.6, 25.9, 7.5, 41.7, 29.0 and 16.9% higher over no-organic manure, vermicompost @ 1.5 and 3.0 tonnes/ha and FYM @ 5.0, 7.5 and 10.0 tonnes/ha respectively. The beneficial effect of organic manure on yield attributes and yield could be attributed to the fact that proper decomposition and mineralization of organic manure, the manures supplied available plant nutrients directly to the plants also had solubility effects on fixed form of nutrients (Sinha *et al.* 1981).

Application of vermicompost @ 4.5 tonnes/ha remaining at par with vermicompost @ 3.0 tonnes/ha, recorded significantly highest net return over rest of the treatments. Further, the vermicompost @ 1.5 tonnes/ha and FYM @ 7.5 and 10.0 tonnes/ha were almost equally economic. The maximum net returns (R 27,831/ha) obtained under vermicompost @ 4.5 tonnes/ha was 47.0, 16.2, 31.0, 17.7 and 9.3% higher over no-organic manure, vermicompost @ 1.5 tonnes/ha and FYM @ 5.0, 7.5 and 10.0 tonnes/ha respectively.

Application of vermicompost @ 4.5 tonnes/ha brought significantly maximum total uptake of NPK over no-organic manure, vermicompost @ 1.5 and 3.0 tonnes/ha and FYM @ 5.0, 7.5 and 10.0 tonnes/ha.

Effect of nitrogen

Application of nitrogen showed significant effect on effective tillers, spike length, grains/spike and grain and

straw yields, net returns and total NPK uptake of the crop (Tables 1 and 2). An increase in N level substantially improved these parameters and consequently the highest yield. The maximum grain yield (50.08 q/ha) obtained with 60 kg N/ha was 62.4, 19.5 and 6.2% higher than that obtained at 0, 20 and 40 kg N/ha, respectively, whereas 40 kg N/ha increased the grain yield by 53.0 and 12.6% over 0 and 20 kg N/ha respectively. These findings are in accordance with those of Bhakhar *et al.* (1997) and Awasti and Bhan (1993).

Nutrient balance sheet

Application of FYM @ 10.0 tonnes/ha remaining at par with FYM @ 7.5 tonnes/ha and vermicompost @ 4.5 tonnes/ha recorded significantly highest organic carbon content and available N, P and K in soil after harvest of barley over no organic manure, vermicompost @ 1.5 and 3.0 tonnes/ha and FYM @ 5.0 tonnes/ha (Table 2).

Interaction

Interactive effect of organic manure treatments and N levels on grain yield was significant (Table 3). Combined application of vermicompost @ 4.5 tonnes/ha + 40 kg N/ha, remaining at par with vermicompost @ 3.0 or 4.5 tonnes/ha + 60 kg N/ha resulted in significantly higher grain yield (55.98 q/ha) of barley over rest of the combinations of organic manure and nitrogen. Similar interactive effects of organic manure and nitrogen fertilizer were also visible on straw yield.

So far as the productivity of the crop is concerned, best

Table 2. Effect of organic manure and nitrogen on nitrogen, phosphorus and potassium uptake of barely and organic carbon and available nitrogen, phosphorus and potassium content in soil after harvest of barley (pooled data of 2 years)

Treatment	Total uptake of N (kg/ha)	Total uptake of P (kg/ha)	Total uptake of K (kg/ha)	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Initial				0.210	129.5	16.9	145.8
<i>Organic manure (tonnes/ha)</i>							
No organic manure	73.9	12.6	73.1	0.195	126.9	16.9	139.5
Vermicompost @ 1.5	101.5	16.9	107.6	0.197	129.7	17.3	145.5
Vermicompost @ 3.0	121.3	20.1	134.3	0.210	132.7	17.6	149.2
Vermicompost @ 4.5	132.4	21.7	146.4	0.224	134.9	17.8	153.4
FYM @ 5.0	88.4	14.8	91.0	0.209	131.4	17.6	147.6
FYM @ 7.5	99.2	16.5	105.5	0.220	134.3	17.8	152.3
FYM @ 10.0	107.5	17.6	114.8	0.227	136.3	18.0	154.4
CD (P=0.05)	5.5	0.9	4.2	0.008	2.1	0.3	3.1
<i>Nitrogen (kg/ha)</i>							
0	70.0	12.5	82.4	0.209	131.5	17.5	149.4
20	100.5	16.9	108.5	0.211	132.1	17.5	149.0
40	116.5	19.1	121.4	0.213	132.8	17.6	148.5
60	126.9	20.2	129.3	0.214	132.9	17.7	148.4
CD (P=0.05)	2.3	0.4	2.3	NS	NS	NS	NS

NS, Non-significant

Table 3. Interaction effect of organic manure and nitrogen on grain yield (q/ha) of barley (pooled of 2 years)

Organic manure	Nitrogen (kg/ha)			
	0	20	40	60
No organic manure	17.83	31.20	37.69	42.82
Vermicompost @ 1.5 tonnes/ha	30.08	41.11	46.29	49.78
Vermicompost @ 3.0 tonnes/ha	39.76	48.60	53.11	54.37
Vermicompost @ 4.5 tonnes/ha	44.35	53.09	55.98	57.14
FYM @ 5.0 tonnes/ha	23.20	36.12	42.57	46.75
FYM @ 7.5 tonnes/ha	28.06	40.07	45.93	49.21
FYM @ 10.0 tonnes/ha	32.59	43.24	48.73	50.50
CD (P=0.05)				
Nitrogen at same levels of organic manure				2.81
Organic manure at same or different levels of nitrogen				2.89

combination was vermicompost @ 4.5 tonnes/ha + 40 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, was also reported by Ranwa and Singh (1999).

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