Effect of Vermicompost and Fertility Levels on Productivity and Quality of Barley (*Hordeum vulgare L.*)

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Abstract— *A field experiment entitled "Effect of Vermicompost and Fertility Levels on Productivity and Quality of Barley (Hordeum vulgare L.)" was conducted at Research Farm, Vivekananda Global University, Jaipur during Rabi season of 2021-22. The experiment was laid out in factorial randomized block design with three replications and consisting three vermicompost levels (control, vermicompost @ 2.5 t ha-1 and vermicompost @ 5.0 t ha-1) and three fertility levels (75% RDF, 100% RDF and 125% RDF). The barley var. RD - 2035 was used for experimentation. Results showed the interaction effect of vermicompost and fertility levels on yield and net returns of barley was found significant, therefore, application of vermicompost at 2.5t ha-1 with 125% RDF, closely followed by application of vermicompost at 5.0 t ha-1 with 100% RDF may be recommended for higher productivity and profitability of barley as it gave highest net returns of 66602 ha-1 with highest B: C ratio of 2.87.*

Keywords— Vermicompost, Fertility, Productivity, Quality, Economics.

I. INTRODUCTION

Barley (Hordeum vulgare L.) is a valuable crop because it is grown for several purposes such as food for human being and feed for cattle and poultry birds. It is one of the first domesticated cereals of world agriculture which is a member of grass family grown in temperate climates globally. Its grain is also valued for smothering and cooling effect on the body for easy digestion and as a source of vitamin B complex. Besides these conventional uses, it is an important industrial crop used as raw material for beer, whisky for brewing industries. Each 100 g of barley grains comprise 10.6 g protein, 2.1 g fat, 64.0 g carbohydrate, 50.0 mg calcium, 6.0 mg iron, 31.0 mg vitamin B1, 0.1 mg vitamin B2 and 50.0 µg folate (Vaughan et al., 2006). Its β– glucans located in the cell wall of endosperm is useful in reducing the risk of cardio- vascular diseases. Thus, this crop is frequently being described as the most cosmopolitan of the crops and also considered as poor man's crop because of the low input requirement and better adaptability to drought, salinity, alkalinity and marginal land (FAO, 2002). It is cultivated in almost all parts of the world. The major barley producing countries are China, Russia, Germany, USA, Canada, India, Turkey and Australia. In India, barley is mainly grown in Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, West Bengal and Bihar. In India, barley is grown over an area of 0.61 m ha with a production of 1.82 m t and yield of 2988 kg ha-1 (Anonymous, 2021). In Rajasthan, it is grown over an area of 0.26 m ha with a production of 0.96 m t and productivity of 3607 kg ha-1 (Anonymous, 2021). The average productivity of barley in the state is more than that of productivity in India but it is far behind in the attainable yield of 45-50 q ha-1 due to water and nutritional stresses. Its cultivation in India was suffered during green revolution period due to replacement of barley from marginal land and rainfed areas by more remunerative oilseed and pulses. The productivity of this crop could be increased by the use of different fertilizers but one of the major constraints in boosting up the barley production is the deteriorating effect on soil health due to the imbalanced and heavy use of chemical fertilizer. Soil health deterioration is the prime threat to Indian agriculture which is being aggravated with excessive use of fertilizers particularly in less responsive soils which have low organic matter content. The improper use of inorganic fertilizer has led to think about the use of FYM, vermicompost, poultry manure; bio-fertilizers etc. in growing areas for sustainable production system but organic manure alone cannot produce the sufficient food for present population and other uses. Under these circumstances, integrated use of organic manures with inorganic fertilizers shown promising results not only in sustaining the productivity but have also proved effective in maintaining soil health and enhanced nutrient use efficiency (Chesti et. al., 2013). Among 17 essential plant nutrients, N and P play the most important role in augmenting

agriculture production which is required in the larger quantity of all the mineral nutrients absorbed by plant roots.

II. MATERIAL AND METHOD

A field experiment entitled "Effect of Vermicompost and Fertility Levels on Productivity and Quality of Barley (*Hordeum vulgare L.*)" was carried out during Rabi season of 2021-22 at Research Farm, Vivekananda Global University, Jaipur.

Geographically, the study area is located at 75o 88'99" E longitude and 26o 81'17" N latitude and this region falls under agro-climatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan. The details of procedure adopted for raising the crop and criteria adopted for evaluation of treatments during the course of present investigation are described in this chapter. The climate of this region is typically semi-arid, characterized by extremes of temperature during both summer and extremes of temperature during both summer and winters. During summers, the temperature may go as high as 48 °C, while in winters, it may fall as low as - 1.0°C. The maximum and minimum temperatures during the crop season ranged between 17.9 0C to 40.50C and 6.0 0C to 23.1 0C, respectively. A total of 43.4 mm rainfall was recorded during the cropping season. The relative humidity fluctuated between 18.5 to 85.0 per cent, while the average sunshine hours ranged between 2.0 to 10.4 hrs. / day. The soil of the experimental field was loamy sand, slightly alkaline, with low available nitrogen (132.73 kg/ha), high available phosphorus (19.92 kg/ha) and potassium (231.76 kg/ha), status. The experiment consisting three vermicompost levels (control, vermicompost @ 2.5 t ha-1 and vermicompost @ 5.0 t ha-1) with variety RD-2035, and 3 levels of fertilizer [75%, 100%, 125% recommended dose of fertilizer (RDF)] making 9 treatments combination. There were laid out in a factorial randomized block design with 3 replications. The fertilizer 60 kg N + 30 P2 O5 + 40K2O kg/ha was applied as per treatments. Half dose of nitrogen and full dose of phosphorus and potash was applied as basal at sowing through urea, DAP and MOP and remaining half dose of nitrogen was top dressed at first irrigation.

Seeds were treated with carboxin at 2 g kg-1 seed and fipronil 5 SC at 30g a.i. quintal-1 of seed as prophylactic measures against seed borne diseases and control of termite. The crop was sown by "kera" method in rows spaced at 20 cm apart on, using 100 kg seed/ha. In barley crop, four irrigations were applied as per the requirement of crop using sprinkler irrigation method. The barley crop was harvested separately from each net plot, tied in bundles and tagged. These bundles were left on the threshing floor for sun drying.

Threshing was done by beating with wooden sticks and winnowed traditionally. The cleaned produce thus obtained from each net plot was weighed on physical balance to record seed yield in kg plot-1. The straw yield was computed by deducting the weight of seed from total biological yield. The crude protein content in grain was calculated by multiplying the nitrogen per cent in grain with a factor 6.25 as suggested (AOAC, 1984). The grain yield was expressed in t/ha.

Straw yield was obtained by subtracting the grain yield from the weight of total biological yield for individual plots and was expressed in tones/ha. The net returns of each treatment were calculated by deducting the total cost of cultivation from gross returns of respective treatments and the benefit: cost ratio was calculated by dividing the net returns with total cost of cultivation. Experimental data recorded in various observations were statistically analyzed with the help of analysis of variance technique (Panse and Sukhatme, 1985). The critical difference (CD) for the treatment comparisons was worked out wherever the variance ratio (F test) was found significant at 5% level of significance.

III. RESULT AND DISCUSSION

3.1 Grain and Straw yield:

The significantly highest grain yield (4141 kg ha-1) of barley was recorded with application of vermicompost at 5 t ha-1 as compared to control (2962 kg ha-1) and vermicompost at 2.5 t ha-1 (3703 kg ha-1). The increase in grain yield due to application of vermicompost at 5 t ha-1 in terms of per cent was 39.79% and 11.83%, respectively over control and vermicompost at 2.5 t ha-1. The effect of fertility levels on Further reference of data given in (table 1) revealed that grain yield of barley was significantly increased due to the different fertility levels. The highest grain yield (4043 kg ha-1) of barley was recorded under the treatment of 125% RDF which was significantly higher by 39.05% over 75% RDF and remained statistically at par with 100% RDF which produced grain yield of 3855 kg ha-1.

Straw yield of barley was increased due to application of vermicompost over control. Application of vermicompost at 5 t ha-1 gave highest straw yield (6327 kg ha-1) of barley which was significantly higher when compared with control and vermicompost at 2.5 t ha-1. The corresponding increase in straw yield due to application of vermicompost at 5 t ha-1 in terms of per cent over control and vermicompost at 2.5 t ha-1 was 41.06% and 12.79%, respectively. The fertility levels of data presented in (table 1) revealed that straw yield of barley was increased significantly due to the different fertility levels. The

application of 125% RDF recorded highest straw yield of 6148 kg ha-1 of barley which was significantly higher over application of 75% RDF and closely Biological yield of barley indicated presented in (table 1) clearly revealed that biological yield of barley was significantly increased due to application of vermicompost over control. The application of vermicompost at 5 t ha-1 produced maximum biological yield (10468 kg ha-1) of barley which was significantly higher than control and vermicompost at 2.5 t ha-1. The application of 45 vermicompost at 5.0 t ha-1 resulted 40.56% and 12.40% increase in biological yield of barley over control and vermicompost at 2.5 t ha-1, respectively. Among the different fertility levels, application of 125% RDF remained statistically at par with application of 100% RDF, produced highest biological yield (10191 kg ha-1) of barley which was significantly superior to application of 75% RDF. The increase in biological yield due to application of 125% RDF as compared to application of 75% RDF was 39.17%. Harvest index (table 1.) indicated that the application of vermicompost did not bring any significant effect on harvest index of barley and all the treatment remained statistically at par with each other and the effect of fertility levels on harvest index of barley was found non-significant and all the treatments recorded similar values of harvest index of barley.

TABLE 1
EFFECT OF VERMICOMPOST AND FERTILITY LEVELS ON YIELDS OF BARLEY

Treatments	Yield (kg ha-1)			Harvest index (%)
	Grain Yield	Straw Yield	Biological Yield	
Vermicompost (t ha-1)				
Control	2962	4485	7447	39.82
2.5	3703	5610	9313	39.76
5	4141	6327	10468	39.58
SEm ±	78	115	153	0.64
CD (P=0.05)	233	345	458	NS
Fertility Levels				
75%	2908	4415	7323	39.82
100%	3855	5859	9714	39.68
125%	4043	6148	10191	39.65
SEm ±	78	115	153	0.64
CD (P=0.05)	233	345	458	NS
VC x F	SIG	SIG	SIG	NS

NS=Non-significant

3.2 Crude protein content in grain (%) Effect of Vermicompost:

An examination of data on crude protein content in grain presented in (table 2) showed that the application of vermicompost at 5 t ha-1 recorded significantly maximum crude protein content in grain which was 28.61% and 7.54% higher over control and vermicompost at 2.5t ha-1, respectively.

3.3 Effect of fertility levels:

The findings presented in (table 2) revealed that application of fertility levels had significant influence on crude protein content in grain. Application of 125% RDF recorded highest crude protein content in grain of barley which was significantly superior by 30.33% and 6.62% over application of 75% RDF and 100% RDF, respectively.

TABLE 2
EFFECT OF VERMICOMPOST AND FERTILITY LEVELS ON CRUDE PROTEIN CONTENT IN GRAIN AND ECONOMICS OF BARLEY

Treatments	Crude Protein Content in grain (%)	Economics		
		Gross returns ₹(ha-1)	Net returns ₹(ha-1)	B:C ratio
Vermicompost (t ha-1)				
Control	7.76	69652	39931	2.33
2.5	9.28	87074	52354	2.5
5	9.98	97425	57704	2.45
SEm ±	0.15	1737	1737	0.05
CD (P=0.05)	0.44	5208	5208	0.15
Fertility Levels				
75% RDF	7.65	68385	34594	2
100% RDF	9.37	90668	55947	2.62
125% RDF	9.99	95099	59448	2.67
SEm ±	0.15	1737	1737	0.05
CD (P=0.05)	0.44	5208	5208	0.15
VC x F	NS	--	SIG	SIG

NS = Non-significant, RDF = Recommended dose of fertilizer

3.4 Net returns and benefit: cost ratio:

The application of vermicompost at 5 t ha-1 recorded significantly highest net returns (57704 ha-1) of barley over control and vermicompost at 2.5 t ha-1. The fertility levels are significantly increased the highest net returns of barley (59448 ha-1) were recorded under the treatment of 125% RDF which was significantly higher when compared with application of 75% RDF (34594 ha-1) and benefit cost ratio of vermicompost at 2.5 t ha-1 gave maximum B: C ratio (2.50) and the different fertility levels are highest B: C ratio of barley (2.67) were recorded with the application of 125% RDF which was significantly higher when compared with application of 75% RDF (2.00).

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