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Response of barley (*Hordeum vulgare* L.) to organic and inorganic nutrient sources

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Abstract

A field experiment was conducted at Agronomy farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur (Rajasthan) during *Rabi*, 2025-26 in loamy sand soil with objective to study the Response of Barley (*Hordeum Vulgare* L.) to Organic and Inorganic Nutrient Sources. The eight treatments were tested in randomized block design with three replications. The highest number of effective tillers, number of grains per spike, grain, straw, biological yield and net return and B: C ratio obtained with 100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter which was significantly superior to control, 100% recommended dose of fertilizer (RDF), 75% RDF + FYM 7.5 t/ha, 50% RDF + FYM 10 t/ha, and 50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha and remained statistically at par with 100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha and 75% RDF + FYM 5 t/ha + VC 2.5 t/ha.

Keywords: *Hordeum vulgare* L., barley, organic nutrient sources, inorganic fertilizers

Introduction

Barley, the world's fourth most significant cereal crop, is grown in alkaline soils and in frost or drought-prone areas. It is utilized in the brewing industry to produce malt, and its straw is used as cattle feed. In comparison to wheat, barley grains and straw have 12.5% moisture, 11.5% albuminoids, 74.0% carbohydrate, 1.3% fat, 3.9% crude fiber, and 1.5% ash. Barley ranks next to wheat both in acreage and production among *rabi* cereals in India. Barley is grown in China, Russia, Germany, the United States, Canada, India, Turkey, and Australia. Barley is farmed in the Indian states of Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, Punjab, West Bengal, and Bihar. India ranks first in the world in barley production with 6.05 million hectare area and an annual production of 18.44 million tonnes. It is mainly grown in the northern plains and concentrated in the states of U.P., Rajasthan, M.P., Bihar, Haryana and Punjab. Rajasthan stands second with regard to its acreage and production. It is cultivated on about lakh hectares area in the state with an annual production of 12.1 lakh tonnes and productivity of 2950 kg/ha. Organic manures are possible micronutrient sources, improve soil structure by providing binding action to soil aggregates, and boost soil water retention and buffering ability. It also improves nitrogen utilization by chelating the chemical fertilizer. Organic supplementation is more than just a source of nutrients. Vermicompost is now being promoted as a good manure for use in field-based integrated nutrient management strategies. Earthworm processed organic waste, also known as vermicompost, is a final divided peat-like material with great porosity, aeration, rainability, and water holding capacity. Vermicomposting is high in macro and micronutrients, vitamins, enzymes, antibiotics, and growth hormones. Apart from providing a balanced nutrient supply, it enhances fertilizer and water use efficiency even more than FYM (Abedi *et al.*, 2010) ^[10].

Method and materials

The experiment was conducted during *rabi* 2025 at Agronomy farm, School of Agriculture, Suresh Gyan Vihar University, Jaipur. Geographically, the study area is located at 75°48'84" E longitude and 26°82'47" N latitude and this region falls under agro-climatic zone III A (Semi-arid Eastern Plain Zone) of Rajasthan. The experiment consisting eight treatments control, 100% recommended dose of fertilizer (RDF), 100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha, 100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter,

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75% RDF + FYM 7.5 t/ha, 75% RDF + FYM 5 t/ha + VC 2.5 t/ha, 50% RDF + FYM 10 t/ha and 50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha. The total eight treatment combinations were tested in randomized block design with three replications.

Results and Discussion

The highest number of total and effective tillers was recorded in the treatment 100% RDF + FYM 5 t/ha + vermicompost (VC) 2.5 t/ha, which was significantly superior to control, 100% recommended dose of fertilizer (RDF), 50% RDF + FYM 10 t/ha and 50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha and remained statistically at par with 100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter, 75% RDF + FYM 7.5 t/ha and 75% RDF + FYM 5 t/ha + VC 2.5 t/ha (Singh *et al.* 2021) [3]. The presence of Azotobacter, although beneficial, did not significantly increase the tiller count beyond that of RDF + FYM + VC alone, indicating that the major growth benefit came from the combined application of RDF and organic matter. These results align with the findings of Yadav *et al.* (2016) [11], who reported enhanced tillering in cereals with integrated use of inorganic and organic nutrient sources. The significant improvement (33.33% and 40% increase over control and RDF alone) highlights the benefits of integrating organic amendments and biofertilizers with chemical fertilizers, which aligns with findings from previous studies emphasizing the positive impact of INM on crop productivity (Thakur *et al.* 2024). The percent increase of grains yield due to 100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter and 100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha were 106.58 and 105.00% over control and 100% RDF, respectively. The marked increase in grain yield

over 100% compared to control and sole RDF application supports findings from recent studies that emphasize the role of integrated nutrient management in improving soil fertility, nutrient uptake efficiency, and crop productivity (Sharma *et al.*, 2022 and Verma and Yadav, 2021) [9, 8]. This higher productivity may be attributed to a sustained availability of essential nutrients to plants. Combined use of FYM and biofertilizer with chemical fertilizers gave the higher yields and proved significantly superior to most of the treatments. The beneficial effect of FYM and biofertilizer may be due to their contribution in supplying additional plant nutrients, improvement of soil physical conditions and biological process in soil. These results are in conformity with the finding of Thakur *et al.* 2024.

Application of 100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha, 75% RDF + FYM 7.5 t/ha, 75% RDF + FYM 5 t/ha + VC 2.5 t/ha, 50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha and 100% recommended dose of fertilizer (RDF) significantly influenced the gross and net return. These results are supported by recent studies that highlight the positive effects of integrated nutrient management on improving macronutrient uptake in cereals through enhanced microbial activity, organic matter content, and nutrient mineralization (Basu *et al.*, 2023 and Singh and Ahlawat, 2021) [2, 3]. The highest benefit cost ratio (2.62) due to 100% recommended dose of fertilizer, 75% RDF + FYM 7.5 t/ha and 100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter was 4.38, 3.83, 3.72 and 3.58 percent higher over control, respectively. These results are in line with previous studies suggesting that INM can improve crop productivity and profitability while reducing dependence on chemical fertilizers (Pandey *et al.*, 2022 and Choudhary & Kumar, 2021) [4, 7].

Table 1: Response of organic and inorganic nutrient source on yield attributes

Treatments	Effective tillers per meter row length	Grain per spike
Control	72.00	30.00
100% recommended dose of fertilizer (RDF)	84.33	33.33
100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha	97.67	40.00
100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter	96.00	42.00
75% RDF + FYM 7.5 t/ha	95.00	36.33
75% RDF + FYM 5 t/ha + VC 2.5 t/ha	92.00	36.33
50% RDF + FYM 10 t/ha	90.00	32.00
50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha	89.33	39.33
SEm +/-	2.26	1.59
CD = 0.05%	6.86	4.82

Table 2: Response of organic and inorganic nutrient source on yields (kg/ha)

Treatments	Grain yield	Straw yield	Biological yield
Control	2533	2900	5433
100% recommended dose of fertilizer (RDF)	4503	5412	9915
100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha	5193	6309	11502
100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter	5233	6490	11724
75% RDF + FYM 7.5 t/ha	4906	5899	10805
75% RDF + FYM 5 t/ha + VC 2.5 t/ha	5013	6064	11077
50% RDF + FYM 10 t/ha	4753	5742	10495
50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha	4806	5835	10642
SEm +/-	97	109	195
CD = 0.05%	295	330	592

Table 3: Response of organic and inorganic nutrient source on economics of barley

Treatments	Gross return	Net return	B : C ratio
Control	66473	32373	1.95
100% recommended dose of fertilizer (RDF)	113156	74643	2.94
100% RDF + farmyard manure (FYM) 5 t/ha + vermicompost (VC) 2.5 t/ha	131139	79126	2.52
100% RDF + FYM 5 t/ha + VC 2.5 t/ha + Azotobacter	138027	85514	2.63
75% RDF + FYM 7.5 t/ha	122963	76553	2.65
75% RDF + FYM 5 t/ha + VC 2.5 t/ha	128574	77664	2.53
50% RDF + FYM 10 t/ha	120851	65045	2.17
50% RDF + FYM 7.5 t/ha + VC 2.5 t/ha	124173	66367	2.15
SEm + /-	2709	2709	0.10
CD = 0.05%	9182	9182	0.31

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