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Synergistic Effects of Organic and Inorganic Nutrient Sources on Nutrient Uptake and Productivity of Barley (*Hordeum vulgare* L.)

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Abstract

The present investigation entitled "Synergistic Effects of Organic and Inorganic Nutrient Sources on Nutrient Uptake and Productivity of Barley (*Hordeum vulgare* L.)" was carried out at the Research Farm, Department of Agronomy, Vivekananda Global University, Jaipur, Rajasthan. The experiment was laid out in Randomized block design with eight treatments replicated thrice. The experiment was comprised with eight treatment viz., T_1- control, T_2- RDF 100%, T_3- Vermicompost 10 t/ha, T_4- FYM 20 t/ha, T_5- RDF 75% + FYM 5 t/ha, T_6- RDF 50% + FYM 10 t/ha, T_7- RDF 50% + Vermicompost 5 t/ha and T_8- RDF 75% + Vermicompost 2.5 t/ha. The treatment with application of T8- RDF 75% + Vermicompost 2.5 t/ha was recorded significantly higher plant height (107.63 cm), number of tillers/running row meter (66.32), plant dry weight (22.31 g/plant) and crop growth rate (25.73 g/m^2/day). Treatment RDF 75% + Vermicompost 2.5 t/ha (T8) significantly improved the yield attributes viz., number of effective tillers per plant (278.85) and number of grain per spike (52.27). However, T7- RDF 50% + Vermicompost 5 t/ha, T6- RDF 50% + FYM 10 t/ha and T5- RDF 75% + FYM 5 t/ha was found to be statistically at par with T8- RDF 75% + Vermicompost 2.5 t/ha. For test weight difference between treatments was observed non-significant.

The treatment T8- RDF 75% + Vermicompost 2.5 t/ha registered significantly higher values of N, P and K uptake in seed as well as grain. The maximum cost of cultivation (INR 40755.10 /ha), maximum gross return (INR 1,30,130.17/ha), maximum gross return (INR 1,30,130.17/ha), maximum net return (INR 89,375.07/ha) and maximum benefit cost ratio (2.19) was observed in T8- RDF 75% + Vermicompost 2.5 t/ha. Whereas the minimum cost of cultivation ((INR 38399.10 /ha), minimum net return ((INR 68,870.27/ha)) and minimum benefit cost ration (1.79) was observed in treatment T1- control.

Keywords: Growth, RDF, Vermicompost, and Yield

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Introduction

Barley (*Hordeum vulgare* L.) is one of the most important cereal crops in India and globally, used for food, feed, malt, and brewing purposes. However, its productivity is often limited by poor nutrient availability, imbalanced fertilization, and declining soil fertility. Integrated nutrient management (INM), which combines organic and inorganic sources of nutrients, is a sustainable approach to maintain soil health and crop productivity. Organic manures like farmyard manure (FYM) and vermicompost not only provide essential nutrients but also improve soil structure, water-holding capacity, and microbial activity. On the other hand, inorganic fertilizers ensure immediate nutrient availability and meet crop demands during critical growth stages [1, 2]. Several studies have reported enhanced growth, yield, and profitability in barley under integrated use of organic and inorganic sources [3–5]. However, the optimization of nutrient combinations remains context-specific, warranting location-specific trials.

Despite evidence on the benefits of integrated nutrient management (INM), limited studies exist on optimizing the proportion of inorganic fertilizers and organic manures for barley under semi-arid conditions of Rajasthan. Most earlier research emphasized either sole organic or inorganic sources, with little focus on their synergistic effects on nutrient uptake, yield, and economics. Therefore, location-specific evaluation of RDF, FYM, and vermicompost combinations is required to enhance productivity and nutrient use efficiency in barley. The present study was conducted to assess the effects of different combinations of RDF (Recommended Dose of Fertilizer), FYM, and vermicompost on growth parameters, yield attributes, productivity, and economics of barley under semi-arid conditions of Rajasthan.

Materials and Methods

A field experiment was conducted during the Rabi season at the Agronomy Research Farm, Rajasthan. The soil was sandy loam, low in available nitrogen and organic carbon, medium in phosphorus, and adequate in potassium. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments replicated three times: T1: Control, T2: RDF (90 kg N, 40 kg P_2O_5, 40 kg K_2O ha^{-1}), T3: Vermicompost @ 10 t ha^{-1}, T4: FYM @ 20 t ha^{-1}, T5: RDF 75% + FYM @ 5 t ha^{-1}, T6: RDF 50% + FYM @ 10 t ha^{-1}, T7: RDF 50% + Vermicompost @ 5 t ha^{-1}, and T8: RDF 75% + Vermicompost @ 2.5 t ha^{-1}. he experiment was laid out in a Randomized Block Design (RBD) with 8 treatments and 3 replications on plots of 3.0 × 5.0 m (gross) and 2.6 × 5.0 m (net). The barley variety RD 2786 was sown on 20 November 2024 at a seed rate of 100 kg ha^{-1}, maintaining a spacing of 30 cm row to row and 15 cm plant to plant. The entire recommended dose of fertilizers (90 kg N, 40 kg P_2O_5, 40 kg K_2O ha^{-1}) as per treatments was applied basally at sowing using urea, single super phosphate, and muriate of potash. Two irrigations were scheduled at 30 and 60 DAS, supplemented by one pre-sowing irrigation. Weed control was carried out manually at 25–30 DAS and 55–60 DAS. Pest and disease management was done following standard agronomic practices of the region, and no major outbreak occurred during the crop period. The crop was harvested manually on 15 March 2025, and yield was recorded after threshing and cleaning. In the experiment, fertilizers were applied as per the treatment requirements. In the control (T1) treatment, no fertilizers or organic manures were applied. For the RDF treatment (T2), the recommended dose of fertilizers was applied at the rate of 90 kg nitrogen (N), 40 kg phosphorus (P_2O_5), and 40 kg potassium (K_2O) per hectare, using urea, single super phosphate (SSP), and muriate of potash (MOP) as sources. In the vermicompost treatment (T3), vermicompost was applied at 10 t/ha and thoroughly incorporated into the soil 10–15 days before sowing. For the farmyard manure treatment (T4), FYM was applied at 20 t/ha, also incorporated during land preparation well in advance of sowing. All organic amendments were applied on a dry weight basis and were allowed to decompose and mineralize to ensure nutrient availability to the crop. Plant height and dry weight were recorded at 30, 60, 90, and 120 DAS. The experimental field soil, a part of the central Gangetic alluvium, was sandy loam in texture with 62.5% sand, 21.6% silt, and 13.3% clay, classified as sandy loam. The soil was slightly acidic with a pH of 6.2, low in electrical conductivity (0.157 dS m^{-1}), and contained 0.82% organic carbon. It was medium in available nitrogen (175.48 kg ha^{-1}) and phosphorus (26.80 kg ha^{-1}), while available potassium was low (232.24 kg ha^{-1}). These characteristics indicate that the soil was moderately fertile but required integrated nutrient management for sustaining barley productivity. Yield attributes included effective tillers per m², grains per spike, and test weight. Grain and straw yields were recorded at harvest. Economics (cost of cultivation, gross return, net return, and benefit-cost ratio) were computed based on prevailing input and market prices. The data were statistically analyzed using ANOVA and means were compared at the 5% level of significance [6].

Results and Discussion

Growth parameters

The results (**Table 1**) show that integrated nutrient treatments significantly influenced plant height and dry matter accumulation at later stages (60, 90, and 120 DAS). Maximum plant height at harvest (107.63 cm) was recorded under T8 (RDF 75% + Vermicompost 2.5 t ha^{-1}), which was significantly superior to all other treatments. This can be attributed to enhanced nutrient availability and synergistic effects of combined nutrient sources [7]. Dry weight followed a similar trend, with T8 showing the highest values across all stages (22.31 g plant^{-1} at 120 DAS). The improvement in biomass might be due to better microbial activity and nutrient synchronization from both organic and inorganic sources [8]. Treatments involving only organic (T3 and T4) or only inorganic (T2) sources showed lower growth compared to integrated applications.

Yield Attributes and Yield

Yield attributes like effective tillers/m², grains per spike, and test weight were positively influenced by INM (**Table 2**). T8 again proved to be the most effective treatment, recording the highest number of effective tillers (278.85) and grains per spike (52.27). These traits directly contribute to sink capacity, resulting in higher grain production [9]. Test weight was not significantly affected; however, numerically, T8 showed the highest value (46.50 g), indicating better grain filling. Grain yield was significantly influenced by treatments, with T8 recording the maximum (4.29 q ha^{-1}), followed by T7 (4.11 q ha^{-1}) and T5 (4.09 q ha^{-1}). Improved growth traits, better nutrient uptake, and balanced fertilization under these treatments contributed to higher productivity [10].

Straw yield also followed a similar pattern, with T8 yielding 6.72 q ha^{-1}. Harvest index, though statistically non-significant, ranged from 38.96% to 42.80%, indicating efficient partitioning under INM.

Table 1 Effect of integrated nutrient management on growth traits of barley

Symbol	Treatment combination	Plant height (cm)				Dry weight (g)			
		30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS
T1	Control	23.30	51.13	80.15	88.27	0.65	5.58	10.27	18.15
T2	RDF (90 kg N, 40 kg P_2O_5, 40 kg K_2O/ha)	27.04	56.87	87.37	92.80	0.69	6.12	10.74	19.25
T3	Vermicompost @ 10 t/ha	27.73	59.12	89.27	97.00	0.71	6.45	11.12	19.73
T4	Farm yard manure @ 20 t/ha	28.13	60.12	90.24	99.10	0.73	6.61	11.62	20.15
T5	RDF 75% + Farm yard manure @5 t/ha	28.63	60.92	91.11	100.70	0.76	6.82	12.02	20.53
T6	RDF 50% + Farm yard manure @10 t/ha	28.78	61.86	91.77	102.67	0.78	7.02	12.46	20.89
T7	RDF 50% + Vermicompost @ 5 t/ha	29.08	62.12	92.21	103.70	0.81	7.12	12.70	21.25
T8	RDF 75% + Vermicompost @2.5 t/ha	29.47	65.92	95.41	107.63	0.84	8.26	13.44	22.31
	F-test	NS	S	S	S	NS	S	S	S
	SEm (±)	1. 438	2.638	2.673	3.487	0.072	0.42	0.571	0.783
	CD (p=0.05)	-----	7.838	7.942	10.361	-	1.26	1.698	2.345

Economics

Economic analysis (**Table 3**) revealed that T8 resulted in the highest gross return (Rs.130130.17 ha^{-1}) and net return (Rs. 89375.07 ha^{-1}). It also recorded the highest B:C ratio of 2.19, followed closely by T7 (2.11). The integration of vermicompost and RDF not only enhanced productivity but also improved profitability [11]. Treatments involving only organic or only inorganic inputs had lower returns due to either limited nutrient supply or higher input costs. Hence, integrated approaches are more cost-effective and sustainable in the long run.

Table 2 Effect of integrated nutrient management on yield attributes and yields of barley

Symbol	Treatment combination	Number of effective tillers/m^2	Number of grain per spike	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T1	Control	188.25	42.49	41.33	3.58	4.78	42.80
T2	RDF (90 kg N, 40 kg P_2O_5, 40 kg K_2O/ha)	207.75	46.35	41.70	3.87	5.64	40.69
T3	Vermicompost @ 10 t/ha	213.16	47.78	42.17	3.90	5.74	40.48
T4	Farm yard manure @ 20 t/ha	224.51	48.86	41.91	3.77	5.82	39.33
T5	RDF 75% + Farm yard manure @5 t/ha	234.85	49.37	43.03	4.09	5.92	40.87
T6	RDF 50% + Farm yard manure @10 t/ha	236.98	50.04	43.63	4.06	6.06	40.09
T7	RDF 50% + Vermicompost @ 5 t/ha	238.10	50.62	44.27	4.11	6.22	39.82
T8	RDF 75% + Vermicompost @2.5 t/ha	278.85	52.27	46.50	4.29	6.72	38.96
	F-test	S	S	NS	S	S	NS
	SEm (±)	15.84	1.54	1.24	0.12	0.21	1.43
	CD (P=0.05)	47.07	4.59	-	0.36	1.64	-

Table 3 Effect of integrated nutrient management on economic of barley

Symbol	Treatment combination	Economics			
		Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net Return (INR/ha)	B:C
T1.	Control	38399.10	107269.37	68870.27	1.79
T2.	RDF (90 kg N, 40 kg P_2O_5, 40 kg K_2O/ha)	40355.10	116820.00	76464.90	1.89
T3.	Vermicompost @ 10 t/ha	40755.10	117833.00	77077.90	1.90
T4.	Farm yard manure @ 20 t/ha	39955.10	114323.33	74654.23	1.86
T5.	RDF 75% + Farm yard manure @5 t/ha	40355.10	123357.67	83002.57	2.05
T6.	RDF 50% + Farm yard manure @10 t/ha	40755.10	122658.00	81902.90	2.00
T7.	RDF 50% + Vermicompost @ 5 t/ha	39955.10	124517.00	84561.90	2.11
T8.	RDF 75% + Vermicompost @2.5 t/ha	40755.10	130130.17	89375.07	2.19

Conclusion

It is concluded that application of treatment RDF 75% + Vermicompost 2.5 t/ha was recorded significantly higher seed yield, higher gross returns, net returns and benefit cost ratio as compared to other treatments. Since, the findings based on the research done in one season.

References

[1] Bairwa SK, Verma R, Meena M, Kumawat SM. Effect of zinc fertilization on growth and yield of wheat (Triticum aestivum L) under southern Rajasthan conditions. Int J Chem Stud 2021; 9(2):1743–1746.
[2] Biswas DR, Narayanasamy G. Integrated nutrient management in wheat: long-term effect of FYM and fertilizers. Indian J Agric Sci 2006; 76(2):87–90.
[3] Singh Y, Singh BP, Sekhon GS. Fertilizer use efficiency and balance sheet of nutrients under integrated nutrient management systems. Indian J Agric Sci 2003; 73(10):577–580.
[4] Choudhary MA, Gill MA, Hussain A. Productivity and nutrient uptake of barley under integrated nutrient management. Pak J Agric Res 2012; 25(1):14–18.
[5] Brar BS, Dhillon NS, Dhillon KS. Long-term effects of inorganic and organic fertilizers on crop productivity and soil fertility. Indian J Agric Sci 2011; 81(5):408–412.
[6] Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. 4th ed. New Delhi: ICAR; 1985.
[7] Kapoor A, Singh R, Singh VK, Serawat M, Vishwakarma DK. Effect of organic, inorganic and biofertilizers on growth and yields of mungbean (Vigna radiatus L. Wilczek). Biol Forum Int J 2023; 15(2):929–937.
[8] Sharma V, Yadav SK, Meena RS. Impact of INM on soil fertility and productivity of barley. J Cereal Res 2020; 12(1):45–50.
[9] Kumar V, Ahlawat IPS. Effect of organic manures and fertilizers on barley productivity. Indian J Agron 2012; 57(2):137–140.
[10] Ali SM. Effect of integrated nutrient management on growth and yield of wheat and barley. MSc Thesis, UAS, Bengaluru; 2014.
[11] Tiwari R, Patel M, Sharma A, Verma S. Economic viability of integrated nutrient management in wheat. J Pharmacogn Phytochem 2023; 12(2):2310–2314.

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