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Studies on the effect of integrated nutrient management on growth and yield of barley [*Hordeum vulgare* (L.)] under central plain region of Punjab

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Abstract
A field experiment was conducted at Agricultural farm, at L.P.U to study the effect of integrated nutrient management on growth and yield of barley during the season 2020-2021 The experiment was laid in randomized complete block design with three replications. The results showed that treatment T8 (50 percent RDF+ 50 percent Vermicompost) had the highest test weight, length of spike (cm), number of spikes m-2, and no. of grains/spike. T4 (75% RDF + 25% FYM) showed the highest Plant height. Whereas T6 (25 percent RDF + 75 percent FYM) has a higher Harvest Index percent. T10 (50 percent RDF + 25 percent FYM + 25 percent Vermi) also produced the best results in terms of, dry weight of the plant. Treatment T3 had the highest nitrogen and protein content of grain (100 percent RDF) and no. of tillers/plant. T7 (75 percent RDF + 25 percent Vermicompost) had the highest grain yield and straw yield. Thus, Integrated Nutrient Management, which use both organic and inorganic fertilizers, results in higher barley growth, development, production, and yield characteristics.

Keywords: Crop growth, INM, FYM, vermicompost, crop yield, barley

Introduction
After wheat, rice, and maize, barley (*Hordeum vulgare* L.) is the fourth most important cereal in the world. It is commonly referred to as "Jau." Barley is a key cereal in many dry places of the world, and it is essential for many farmers' livelihoods. Barley is an annual grain crop that may be produced anywhere from the Middle East's deserts to the Himalayan highlands (Hayes *et al.*, 2003) [6]. Barley is farmed all year in the world, with Europe producing the biggest yield. In terms of overall area and production, India is ranked seventh in the world. It contains water soluble fibre (Betaglucons) and an oil compound (tocotrinal) that have been shown to reduce blood cholesterol levels. As a good source of protein, this crop has industrial demand due to malt use. It comes in a variety of forms, including bread, porridge, soup, and roasted grain, and it's also used to make alcoholic and non-alcoholic drinks, thanks to its straw. Animal feed, thatching roofs, and bedding are all made from straw. Barley is a cool-season annual grain crop that can be used as both feed and a cover crop to increase soil fertility. The nutritional value of barley grain is high, with 11.5 percent protein, 74 percent carbohydrates, 1.3 percent fat, 3.9 percent crude fibre, 1.5 percent ash, and 1.2 percent minerals. Furthermore, barley malt extracts are used to make energy beverages such as bournvita, boost, horlics, maltava, and others. Many sections of Uttar Pradesh, Rajasthan, and Haryana consume the preached barley grains. It is favored over wheat for ingestion during the summer because of its supposed cooling impact on the human system. This crop is more adaptable, requires less water, and is more resistant to salinity and other stresses. As a result, it's critical in locations where a successful wheat crop can't be grown due to poor soil or insufficient irrigation. Under residual moisture, the crop is sown with minimal care and administration.

Materials and Methods
The present field experiment was conducted during the rabi season of 2020-2021 at the experimental farm of Agronomy, school of Agricultural, of Lovely professional university, phagwara, Punjab.
The soil of experimental site was sandy loam to clay in texture with a p^h range of 7.8-8.5, the soil in low in nitrogen but has fair amount of phosphorus and potassium. The experimental field was laid out in a Randomized Block Design with eleven treatments and three replications and the variety was PL 807.

The treatments were as follows Control, 100% FYM, 100% VERMI, 100% RDF, 75% RDF+ 25% FYM, 50% RDF + 50% FYM, 25% RDF + 75% FYM, 75% RDF + 25% Vermicompost, 50% RDF + 50% Vermicompost, 25% RDF + 75% Vermicompost, 50% RDF + 25% FYM + 25% VERMI. The FYM and Vermicompost are applied in all plots before the sowing as per the requirement of the treatments. The well decomposed FYM is applied before 2-3 weeks of sowing and Vermicompost before the day of sowing.

Results and Discussion

Effect of organic and inorganic sources of nutrients on growth and yield of barley

The results regarding Plant height, Dry weight, no. of tillers/plant, Spike length (cm), spikelet's/sq.m, Grain/spike, Test weight, Grain yield (q/ha), Straw yield (q/ha), HI(%), Protein % and nitrogen% in grain.

Plant height (cm)

The plant was significantly influenced by the various treatments. The maximum plant height was obtained in treatment T4 (75% RDF + 25% FYM) with (79.35 cm) followed by T10 (50% rdf + 25% FYM + 25% Vermi) with 77.79 cm and the lowest was recorded with control 50.47 cm. similarly results were also obtained by Meena et. al. (2017) [8].

Dry weight

The dry weight of the plant sample was influenced by the various treatments. The maximum dry weight of the plant sample is obtained in T10 with 13.75 g and lowest was obtained in control with 7.41 g the similar results were also obtained by sepat *et al.*, (2010).

Yield parameters: The following yield parameters such as Spike length, Grains/spike, Spiklets/ sq. m and Test weight are influenced by the various organic and inorganic source of nutrients. whereas the maximum was obtained with the treatment of T8(50% RDF + 50% VERMI) and minimum was obtained in control ie., spike length, Grains/spike, Spiklets/ sq.m and Test weight with 7.63cm, 515.33, 62.37 and 44.41 respectively, and minimum of 5.84cm, 384.66, 48.05 and 36.47 respectively. Similar results regarding spike length was seen in Abera *et al.*, (2018) [1] Grain/spike is seen in Admasu *et al.*, (2018) [2] spike/sq.m is similar to Devkota *et al.*, (2019) [5] and test weight is similar to chala *et al.*, (2020) [3].

Yield: The economical yield and the biological yield i.e., grain yield and the straw yield were significantly influenced by the various treatments. The maximum grain yield and straw yield was shown in the treatment T7 (75% RDF +25% Vermi) with 44.06 q/ha and 102.21 q/ha respectively. And the lowest was recorded with control 21.2 q/ha and 52.24 q/ha respectively. Similar results are shown with S Sindhi *et al*., (2016) when it comes to Harvest index the maximum harvest index was seen in treatment T6(25% RDF + 75% FYM) with 31.38% and the lowest was seen in control with 28.79% similar results were seen in Kumar, A *et al.*, (2018).

Quality

When it comes to quality the protein and nitrogen content of the grain was influenced by different treatments highest protein and nitrogen content was shown in T3(100% RDF) with 11.34% and 1.81% respectively and the lowest was in control with 8.91% and 1.76% respectively. Similar results were found in Choudhary, P (2019) [4].

Table 1: Effect of organic and inorganic sources of nutrients on growth and yield of Barley

	Treatment	Plant height (cm)	Dry Weight (g)	Spike length (cm)	Spikelets/sq.m	Grains/Spike	Test weight
TO	Control	50.47	7.41	5.84	384.66	48.05	36.47
T1	100%FYM	67.84	10.04	6.72	488.33	55	38.8
12	100%VERMI	65.52	8.19	6.95	463.66	53.5	38.83
13	100% RDF	76.59	12.46	7.09	509.66	60.69	41.73
T4	75% RDF + 25% FYM	79.35	10.77	7.14	501	59.02	42.9
15	50% RDF+ 50% FYM	77.07	13.54	7.06	476.66	58.18	40.58
16	25% RDF+ 75% FYM	68.74	10.49	7.41	453	52.97	38.89
T7	75% + RDF + 25%VERMI	73.58	13.09	7.3	473	59.57	41.54
18	50% RDF+ 50% VE RMI	76.09	10.68	7.63	515.33	62.37	44.41
19	25% RDF+ 75%VERMI	66.66	10.26	7.04	508.33	58.03	41.26
T10	25% FYM + 25% VERMI + 50% RDF	77.79	13.75	7.02	507.33	60.13	42.37
	SErn	2.18	0.75	0.16	11.42	2.24	1.29
	CD. I N-0.05}	6.36	2.19	0.48	33.33	6.53	3.76

Table 2: Effect of organic and inorganic sources of nutrients on growth and Quality of Barley

	Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest Index%	Protein% in grain	Nitrogen% in grain
TO	Control	21.2	52.24	28.79	8.91	1.42
T1	1006SFYM	35.26	84.07	29.5	10.88	1.74
T2	100'%VERMI	34.83	82.46	29.69	10.16	1.62
T3	100% RDF	43.88	99.23	30.66	11.34	1.81
T4	75% RDF + 25% FYM	40.06	90.23	30.72	10.48	1.67
T5	50% ROF+ 50% FYM	39.88	87.26	31.37	10.31	1.64
T6	25%RE1F+ 75% FYM	38.46	84.06	31.38	10.46	1.67
T7	75% RDF + 25% VERMI	44.06	102.21	30.12	10.61	1.69
T8	50%REIF + 50% VERMI	39.21	88.06	30.77	10.72	1.71
T9	25%MN+ 75% VERMI	36.73	82.77	30.71	10.56	1.69
T10	25% FYM + 25%VERMI + 50%REIF	41.94	101.17	29.29	11.06	1.76
	SEm	1.03	1.34	0.47	0.13	0.02
	C.D. P41.05)	3.01	3.9	1.36	0.38	0.06

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