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Effect of Integrated Nutrient Management on Growth and Yield of Barley (*Hordeum vulgare.L*) under North Plain Zone of Dehradun, Uttarakhand

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This article as a brief review, give concise information on the "Effect of Integrated nutrient management on growth and yield of barley under north plain zone of Dehradun, Uttarakhand. The experiment was set up in a Randomized Block Design with 3 Replications and 7 Treatments. Generally analysis of variance shows significant difference between the treatments. Application of

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T_3 75%RDF+ 100% FYM 10q per ha^{-1} gave higher number of tillers. The higher plant height was obtained from T_3 75%RDF+ 100% FYM 10q per ha^{-1} .Higher spike length, Grain weight, optimum yield and economic return recommended for barley was recorded under T_3 75%RDF+ 100% FYM 10q per ha^{-1} at Dehradun District.

Keywords: FYM; vermicompost; grain barley; yield component; yield.

1. INTRODUCTION

Barley (*Hordeum vulgare*.L) is an rabi season crop in India. It belongs to Poaceae family. It annually grown on 48 million hectares in wide range of environment. In India, barley has been cultivated since ancient times and is considered a spooked grain. Rajasthan has maximum area and productivity of barley, 0.31 m ha and 0.86 m tons independently. Barley grains have colorful uses. The portion of grains used for food is consumed as flour to prepare chapattis or by riding and grinding grains of barley sattu is prepared [1-3]. It's also used to manufacturing of beer, whiskey and other products similar as artificial alcohol, ginger and malt saccharinity. Integrated nutrient management (INM) help to provide nutrients to crop. It also help in maintenance of humus level in the soil like physical texture of soil, help to avoid weeds, pest and disease control. Organic manures, which were perhaps the major sources of plant nutrients in traditional agriculture, received less emphasis with the advent of high-analysis chemical fertilizers.without detracting from the fact that chemical fertilizer will continue to be the main instrument for quickening the pace of agricultural production, recent research indicates that a judicious combination of organic manures and inorganic fertilizers can better maintain long-term soil fertility and sustain high levels of productivity. Therefore, the use of both organic manure and chemical fertilizers in appropriate proportions assumes special significance as complementary and supplementary to each other in crop production [4,5].

2. MATERIALS AND METHODS

A field experiment on the inspection entitled "Effect of Integrated Nutrient Management on Growth and Yield of Barley (*Hordeum vulgare* L.) under the North Plain Zone of Dehradun, Uttarakhand, during the rabi season of the year 2023-24 was conducted at agriculture research farm of Dolphin (P.G.) Institute of Biomedical and Natural Sciences, Dehradun Uttarakhand. The experiment was conducted in Randomized Block Design having 3 Replications with 7 Treatments viz; (T1) Control, (T2) 100% RDF, (T3) 75% RDF+ FYM 10q ha-1, (T4) 50% RDF+ FYM 10q ha-1, (T5) 75% RDF+ Vermicompost 10q ha-1, (T6) 50% RDF+ Vermicompost 10q ha-1, (T7) 75% RDF+ Poultry manure 10q ha-1. The treatments were assigned to various plots at random in all three replications using a random table. For this experiment, observations were made on the following growth parameters: initial plant population (m3),plant height (cm), number of shoots (m2), Number of leaves ,dry matter accumulation , yield attributes ,Number of spikelets per spike, Spike length (cm), number of grains per spike, 1000-grain weight (g), grain yield (q per ha), straw yield (q per ha),Biological yield, harvest index (%), and also quality study (nitrogen content and absorption in grain and straw). Treatments were assigned to plots at random. The data were analysed by the technique of analysis of variance described by Fisher [6]. Test of significance is made at 5 % level of significance and crucial differences were calculated to compare the significant differences between treatments [7].

3. RESULTS AND DISCUSSION

For this experiment, the data were statistically analyzed and presented using tables. The following results should be obtained from this experiment.

3.1 Growth Attributes

Among treatment T3 75%RDF (60:30:30 kg K2O ha-1)+FYM10q ha-1 resulted higher Plant height and Number of leaves and proved significantly over rest of the other treatment. This might be due to the combined application of RDF and FYM which enhanced the availability of nitrogen being a major constituent of Chlorophyll which help to facilitated more synthesis of food materials which the caused greater cell division and cell enlargement. This could have contributed towards the increase in plant height with the inclusion of organic and inorganic fertilizer. These findings are in conjuction with those of Gurwinder Singh et al. [8] and also by Ramandeep Kaur et al. [9].

Maximum number of tillers running meter due to addition of 75%RDF (60:30:30 kg K2O ha-1) +FYM10q ha-1 being significantly higher in the same nutrient management at all the intervals. The integrated use of organic and inorganic fertilizer would have facilitated better growth and development ultimately resulted more number of tillers running meter.

These results are in with close agreement those of Gurwinder Singh et al. [8] and also by Ramandeep Kaur et al. [9].

The data indicated that Dry matter accumulation per plant was progressively increased with increase in the age of the crop and was found maximum. Data revealed that maximum (98.71 g) dry matter accumulation was found in T3 75%RDF (60:30:30 kg K2O ha-1)+FYM10q ha-1 treatment and it was significantly superior to other treatments.It also suggested that inorganic fertilizers along with FYM gave higher dry matter accumulation per plant. These results agree with the findings of Gurwinder Singh et al. [8] and also by Ramandeep Kaur et al. [9].

3.2 Yield Attributes and Yield

Different yield attributing characters viz. spike length (cm), number of spikelet's per spike, number of grains per spike and test weight (1000-seeds weight) in (Table 2) were found significantly higher in T3 75%RDF (60:30:30 kg K2O ha-1)+FYM10q ha-1 treatment than rest of the other treatments. The minimum number of spike length (cm), number of spikelet's spike, number of grains spike and test weight (1000-seeds weight) were noted over a control treatment (T1) but all the attributes were increased with application of integrated nutrient management being maximum under 75%RDF (60:30:30 kg K2O ha-1)+FYM10q ha-1 and proved significantly superior. It was seen that the plants grown in the control plots were not growing well.These findings are in close agreement with the results of Gurwinder Singh et al. [8] and also by Ramandeep Kaur et al. [9]. Grain yield of barley and straw yield of barley was significantly increased by integrated nutrient management. Appreciable higher grain (58.53) and straw (61.91q per ha-1) yields of barley were noted when 75%RDF (60:30:30 kg K2O ha-1)+FYM10q ha-1 was applied this treatment exhibited its superiority over rest of other treatment. While (T1) which receiving no nutrients result as significantly minimum grain (30.36 q per ha-1) and straw (41.93 q per ha-1) yields. Significant improvement in growth and yield attributes of barley due to application of integrated nutrient management resulted in production of superior growth and yield attributes over control, which ultimately resulted in higher grain and straw yields. Superiority in growth parameters and yield attributes is due to application of integrated nutrients. This improved nutrient availability and contributed to improved growth and yield outcomes. These findings are consistent with Kumawat et al. [10] findings.

Significantly maximum Biological yield per hectare (120.4 ha-) was recorded in T3 75%RDF (60:30:30 kg K2O ha-1)+ FYM10qha-1. Treatment T3 significantly superior than other treatment(T1), (T2),(T4),(T5),(T6),(T7).Treatment T3 and T7 was found at part to each other and these treatment was found significantly and superior than (T1),(T2),(T4),(T5),(T6). It is revealed that harvest is not influenced by the various treatments.

The maximum harvest index was reported by the treatment in T3 75%RDF (60:30:30 kg K2O ha-1)+FYM 10q ha-1 (48.61). The minimum Harvest index (42.15%) was found in T1 at Control (No application).

3.3 Nitrogen and Phosphorus Content in Grain and Straw

The results of present investigation indicated that various combination of organic and inorganic fertilizers significanty influenced the N, P and uptake except in grain and straw. N, P and content in grain was recorded highest in treatment T3 (75%RDF (60:30:30 kg K2O ha-1 +FYM10q ha-1)due to the combined application of organic and in organic fertilizer more nutrient availability might have increased the cation exchange capacity of roots there by increasing absorption and nutrient content in grain and straw (Kumar et al. 2002) and Ramwater Meena et al. (2016), Gurwinder Singh et al. [8] and also by Ramandeep Kaur et al. [9].

3.4 Economics of the Treatments

Generally, the cost of cultivation of a crop under particular treatment varied as per the market value of the seed and other inputs. For determining the cost of cultivation under a particular treatment, the variable and invariable costs of inputs and operations were taken into consideration.Cultivation of barley can be judged from common expenditure of R$ 20450 ha. The

Table 1. Growth attributes influenced by integrated nutrient management in barley

T.NO.	Treatment	Plant height(cm)	Number of leaves	Number of Tillers running meter	Dry matter accumulation
T_1	Control	76.47	8.36	40.58	72.04
T_2	100% RDF (80kg N : 40 kg P_2O_5 : 40 kg K_2O ha^{-1})	87.65	13.36	52.76	82.93
T_3	75%RDF(60:30:30kg K_2O ha^{-1})+ FYM 10q ha^{-1}	104.7	19.06	70.80	98.71
T_4	50%RDF (40:20:20kg K_2O ha^{-1})+ FYM 10q ha^{-1}	96.76	16.05	62.68	92.41
T_5	75%RDF(60:30:30kg$K_2O$$ha^{-1}$)+Vermicompost 10q ha^{-1}	92.87	16.04	57.80	87.11
T_6	50%RDF(40:20:20kg K_2O ha^{-1})+ Vermicompost 10q ha^{-1}	88.93	14.05	55.36	85.09
T_7	75%RDF (60:30:30kg K_2O ha^{-1})+ Poultry manure 10q ha^{-1}	99.39	18.29	66.40	93.98
S.Em+		0.498	0.306	0.350	0.424
CD(p=0.05)		1.552	0.954	1.090	1.321

Table 2. Yield attributes and yield influenced by integrated nutrient management in barley

T.NO.	Treatments	Spike length	Number of spikelets per spike	Number of Grains per spike	Test weight	Grain yield	Straw yield	Biological yield	Harvest index
T_1	Control	6.01	9.33	36.23	35.73	30.36	41.93	72.49	42.15
T_2	100% RDF (80kg N: 40 kg P_2O_5 : 40 kg K_2O ha^{-1})	7.46	13.10	38.70	41.06	36.87	46.61	83.48	44.16
T_3	75%RDF(60:30:30kg K_2O ha^{-1})+ FYM 10q ha^{-1}	13.33	23.33	52.26	51.36	58.53	61.91	120.4	48.61
T_4	50%RDF (40:20:20kg K_2O ha^{-1})+ FYM 10q ha^{-1}	10.4	17.83	45.96	46.56	48.83	57.50	106.3	45.92
T_5	75%RDF(60:30:30$K_2O$$ha^{1}$))+Vermicomp-ost 10q ha^{-1}	9.33	14.93	43.03	43.40	43.83	52.62	96.45	45.44
T_6	50%RDF(40:20:20kg K_2O ha^{-1})+ Vermicompost 10q ha^{-1}	8.79	13.63	41.53	41.63	40.70	49.62	90.32	45.06
T_7	75%RDF(60:30:30kg K_2O ha^{-1})+ Poultry manure 10q ha^{-1}	11.5	20.70	48.83	49.00	56.83	61.17	118.0	48.16
S.Em+		0.506	0.624	0.401	0.486	0.140	0.083	0.223	0.62
CD(p=0.05)		1.576	1.943	1.249	1.515	0.436	0.259	0.695	0.62

Table 3. Effect of integrated nutrient management on nutrient content in barley grain and straw

T.NO.	Treatments	Nutrient content (%)			
		Nitrogen		Phosphorus	
		Grain	Straw	Grain	Straw
T_1	Control	27.08	35.83	3.09	1.12
T_2	100% RDF (80kg N : 40 kg P_2O_5 : 40 kg K_2O ha^{-1})	31.29	38.95	4.16	2.11
T_3	75%RDF(60:30:30kg K_2O ha^{-1})+ FYM 10q ha^{-1}	41.20	46.24	8.73	5.39
T_4	50%RDF (40:20:20kg K_2O ha^{-1})+ FYM 10q ha^{-1}	35.28	43.18	6.66	3.40
T_5	75%RDF(60:30:30kg$K_2O$$ha^{-1}$)+Vermicompost 10q ha^{-1}	32.62	41.38	4.48	2.38
T_6	50%RDF(40:20:20kg$K_2O$$ha^{-1}$)+ Vermicompost 10q ha^{-1}	32.15	40.04	4.37	2.17
T_7	75%RDF (60:30:30kg K_2O ha^{-1})+ Poultry manure 10q ha^{-1}	36.76	44.07	7.14	4.25
S.Em+		0.232	0.240	0.131	0.122
CD(p=0.05)		0.724	0.749	0.408	0.380

Table 4. Economic treatments influenced by integrated nutrient management in barley

T.NO.	Treatments	Cost of Cultivation	Gross Returns	Net Returns	B:C
T1	Control	20450	60625	40175	2.96
T2	100% RDF (80kg N : 40 kg P_2O_5 :40 kg K_2O ha^{-1})	21450	64792	43342	3.02
T3	75%RDF(60:30:30kg K_2O ha^{-1}) + FYM 10q ha^{-1}	24450	96498	72048	3.94
T4	50%RDF (40:20:20kg K_2O ha^{-1}) + FYM 10q ha^{-1}	22350	75100	52750	3.36
T5	75%RDF(60:30:30kg K_2O ha^{-1})+ Vermicompost 10q ha^{-1}	22250	72150	49900	3.24
T6	50%RDF(40:20:20kg K_2O ha^{-1})+ Vermicompost 10q ha^{-1}	21850	71130	49280	3.23
T7	75%RDF (60:30:30kg K_2O ha^{-1})+ Poultry manure 10q ha^{-1}	23050	84715	61665	3.67

investment further increased by using the different treatments.Among the Treatment minimum cost of cultivation was (Rs 20450 ha) for control plots and maximum (Rs 24450 ha) were for plots receiving 75%RDF (60:30:30 kg K2O ha-1)+FYM 10q ha-1 followed by 75% RDF(60:30:30 kg K2O ha-1)+Poultry manure 10 q ha-1 (23050).The maximum GMR Rs (96498) per ha.In all the treatment combinations, minimum GMR (R$ 60625) noted in T1 (control) because lowest seed yield and straw yield found in this treatment [11,12].

In barley, the NMR was maximum (Rs 72048 ha) with the application of 75%RDF (60:30:30 kg K2O ha-1)+FYM 10q ha-1followed by (Rs 61665 ha) 75%RDF(60:30:30 kg K2O ha-1)+ Poultry manure 10 q ha-1 . The value of NMR was less (Rs 40175 ha) in barley respectively under control plot T1 barley. These results are in close with the result of Kumawat et al. [10].

The maximum benefit cost ratio (3.94) was recorded under application of T3 75%RDF (60:30:30 kg K2O ha-1)+FYM 10q per ha Whereas lower profitability (2.96) was recorded under control [13,14].

4. CONCLUSION

From the results of experiments, it can be concluded that for getting maximum production and net return the application of T3 75%RDF (60:30:30 kg K2O ha-1)+FYM 10q ha-1 is very effective. The present study shows that the growth, yield and quality respond significantly to integrated application of organic and inorganic fertilizers.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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