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Research Article

Influence of Barley (*Hordeum vulgare* L.) in Relation to Integrated Nutrient Management under Late Sown Conditions in Vindhya Region

Sunil Kumar[1]* and D.P. Chaturvedi[2]

[1]M. Sc. (Ag) Student, Department of Agronomy, AKS University, Satna (M.P.)

[2]Teaching Associate, Department of Agronomy, AKS University, Satna (M.P.)

*Corresponding Author E-mail: onthegame12gmail.com

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ABSTRACT

A field experiment was conducted at Instructional Farm Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) to study the effect of integrated nutrient management on yield of barley during winter seasons of 2020- 21. Eleven treatments were evaluated in randomized block design with three replications. Results revealed that the FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha significantly influenced the plant height (82.99 cm) and number of tillers per meter row length at 90 DAS (90.87), spike length (21.99 cm), number of grains per spike (37.11) and test weight (42.87 g) of barley. Application of FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha produced highest grain yield (53.11 q/ ha) and straw yield per hectare (71.51 q/ ha) of barley. The integrated use of organic manure and bio-fertisol with biofertilizer improved the protein content in grain and maximum value (9.84 %) was recorded with FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha. The results indicated that combined use of FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha was the most appropriate nutrient management for higher growth, yield and quality parameters of barley.

Keywords: *Tillers, Grain, Straw, Test weight, Protein content.*

INTRODUCTION

Barley (*Hordeum vulgare* L.) is the world´s fourth most important cereal crop after wheat, rice and maize and the most dependable crop in alkali soils and areas where frost or drought occurs. The barley crop has wider adoptability and less water requirement, it is more tolerant to salinity and other stress conditions.

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Therefore, it is of great significance in areas where successful wheat crop cannot be grown due to unsuitable soil and insufficient irrigation. Globally barley was cultivated on nearly 51.50-million-hectare area with a production of 142.01 million metric tons. In India, barley crop was grown over an area of 7.72 lakh hectare with a production of 17.26 lakh tons grain with a productivity of 2522 kg/ha during 2016-2017 (Anonymous, 2017).

The increased use of chemical fertilizers in agriculture has certainly enhanced the food production but brought with it a lot of problems related to micronutrient deficiency and environmental pollution. Organic manures have become scarce seems to be infeasible under intensive agriculture. It is advocated the use of organics plus limited input of chemical fertilizers and pesticides as the first stage of transition from conventional to organic farming. Integrated use of chemical fertilizers with organic manures could be quite promising in maintaining higher productivity and providing greater stability in crop production.

Different varieties of barley under late sown condition respond variably to various nitrogen management practices. Thus, the combination of FYM, vermicompost, biofertilizers with inorganic fertilizers may be highly effective for increasing the yield under late sown barley as well as better quality of produce in addition to sustaining biological health and maintaining balanced C: N ratio of the soil. The organic manures being cheaper and ecofriendly like FYM, Vermicompost with biofertilizers viz., PSB, Azotobacter and chemical fertilizers is receiving great attention are intensive agriculture. Application of organic along with inorganic sources not only improve soil health but with also improve the produce quality and fertilizer use efficiency and thereby reducing the cost of cultivation. Integrated nutrient management approaches involving FYM, vermicompost, biofertilizers viz., PSB, Azotobacter in combination with mineral sources of nutrients need to be standardized. Hence, present investigation was carried out to study the growth, yield and qualitative behavior of barley to define optimum dose under integrated use of organic manure and fertilizers.

MATERIALS AND METHODS

The experiment was carried out at Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during rabi season 2020- 21. The experiment was conducted in randomize complete block design with three replications. The treatments were; T_1= Control, T_2= PSB Culture, T_3= FYM @ 5 ton/ha, T_4= FYM @ 10 ton/ha, T_5= FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha, T_6= FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter, T_7= FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha, T8= PSB Culture + FYM @ 5 ton/ha, T9= PSB Culture + FYM @ 5 ton /ha + Bio-fertisol @ 750 ml/ha, T10= PSB Culture + FYM @ 5 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter and T11= PSB Culture + FYM @ 5 ton/ha + Bio-fertisol @ 750 ml/ha + VC @ 2 ton/ha + Azotobacter. The barley variety JB- 1 was sown on November 14th, 2020 using 100 kg seeds per ha. The gross and net plot size was 5.0 m x 3.5 m and 4.0 m x 3.0 m, respectively. The N, P_2O_5 and K_2O were applied through urea, single super phosphate and muriate of potash, respectively. Full recommended dose of phosphorus and potassium at the rate of 60 kg P_2O_5 /ha and 40 kg K_2O /ha and half dose of nitrogen @ 80 kg/ha, respectively was uniformly applied to each plot (except control plots) as basal dose before sowing. Remaining half dose of N was top dressed in two equal splits at 30 and 60 DAS i.e., at tillering and late jointing stage. Quantity of FYM & vermicompost (as per treatment) was mixed in respective plots as per treatments. Barley seeds were inoculated with PSB,

Azotobacter and Bio-fertisol (@ 750 ml/ha) cultures as per treatments by using ten packets (200 g each packet) for 100 kg seed of barley needed for sowing one-hectare area. The other crop management practices were followed as per standard recommendation. The crop was harvested at the physiological maturity. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

Data regarding plant height and number of tillers per plant are reported in Table- 1. Statistical analysis of the data revealed that maximum plant height (82.99 cm) and number of tillers per meter row length at 90 DAS (90.87) at maximum crop growth stage of 90 DAS were observed under the integrated use of chemical fertilizers and bio-organics with FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha while, lowest values were observed under the control.

Vermicompost & FYM improves the physical and biological properties of soil including supply of almost all the essential plant nutrients for the growth and development of plant. Thus, balanced nutrition under favourable environment might have helped in production of new tissues and development and ultimately increased the plant height, dry matter accumulation, and number of effective tillers per m2. Higher plant growth might be due to improved photosynthetically active leaf area for longer period during vegetative and reproductive phases, led to more absorption and utilization of radiant energy which ultimately resulted in higher dry matter accumulation and significant increase in plant growth.

It is an established fact that organic manure improves the physical, chemical and biological properties of soil and supplies almost all the essential plant nutrients for growth and development of plants along with growth hormones and beneficial microbes which might have developed more favorable environment of nutrients in soil for longer period resulted in increased plant height, new shoots and increased dry matter accumulation. It is fact that organic matter acts as a chelate for nutrients and soluble chelates probably increase their availability and uptake to plants and mobility in soils. This might be directly associated with the increased availability of nitrogen & phosphorus through biological fixation and solubility in soil to be readily utilized by the plants as they are atmospheric nitrogen fixers and phosphate solubilizers. The results of the present investigation are in conformity with those of Mubarak and Singh (2011), Mali et al. (2016) and Neelam et al. (2018).

Data regarding length of spike, number of grains per spike, test weight, grain & stover yield of barley and protein content are reported in Table- 1 and maximum values were observed when crop fertilized with chemical fertilizers and bio-organics. Statistical analysis of the data revealed that highest spike length (21.99 cm), number of grains per spike (37.11), test weight (42.87 g), grain yield (53.11 q/ ha) and straw yield per hectare (71.51 q/ ha) per hectare and protein content (9.84 %) recorded under the integrated use of chemical fertilizers and bio-organics with FYM @ 10 ton/ha + Bio-fertisol @ 750 ml/ha + Azotobacter + VC @ 2 ton/ha.

The beneficial effect of organic manure i. e. vermicompost & FYM on yield attributing characters might be due to its contribution in supplying additional plant nutrient and increasing solubility of native soil nutrients. Another probable reason could be efficient and greater partitioning of metabolites and adequate transformation of nutrients to developing plant structures. The significant increase in grain yield under the influence of vermicompost & FYM were largely a function of improved growth and consequently increase in different yield attributes as mentioned above.

Further, vermicompost & FYM increase the efficiency of added chemical fertilizers in soil and increased rate of humification. Humic acid in vermicompost enhances the availability of both native and added micronutrients in soil and thus plant growth, yield attributes and yield increased (Singh et al., 2010). The significant improvement in straw and biological yields with the addition of vermicompost & FYM seems to be on account of grater accumulation of dry matter right from the early stage of crop growth and at 90 DAS by virtue of increased photosynthetic efficiency and nutrient accumulation.

The combined inoculation of Bio-fertisol + Azotobacter with vermicompost also gave highest values of yield attributing characters. The improvement in yield of crop was limited when these bio-fertilizers were used singly, however, a significant additive effect was observed when they were used in combination. The observed additive influence of bio-fertilizers is attributable to mutually beneficial and synergistic role played by each group of biofertilizers used (Jat et al. 2014).

The increase in grain and straw yields with this integrated nutrient management treatment might be due to better nutritional environment in low status of nitrogen and phosphorus soil as evidenced by their uptake in the plant and due to the increased supply of N, P and K and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and led to increased growth and yield parameters, resulted in increased grain and straw yield of the crop. The results of present investigation are in line with finding Upadhyay and Vishwakarma (2014), Verma et al. (2016), Dahiya et al. (2019), Kaur et al. (2020) and Parashar et al. (2020).

The increase in protein content under the application of higher dose of vermicompost coupled with optimum levels of fertilizers could be assigned to the availability of all the essential nutrients which are present in organic matter and their continuous mineralization. Nitrogen is an essential constitute of protein and increase in nitrogen content might have also led to higher protein content in seed. It could also be explained in terms of greater synthesis of amino acids which are responsible for higher nitrogen content in seed which has been reported by Roy and Singh (2006). These results are in agreement with those Jat et al. (2013) and Yadav et al. (2020a).

Table 1: Influence of integrated nutrient management on growth, yield and quality of barley

Treatments	Plant height (cm)	Number of tillers	Spike length (cm)	Number of grains per spike	Test weight (cm)	Grain yield (q/ha)	Stover yield (q/ha)	Protein content (%)
T_1	39.41	27.93	8.51	18.92	35.61	24.61	49.10	6.58
T_2	69.77	57.67	18.48	29.83	40.06	39.64	64.26	7.54
T_3	71.32	60.40	18.68	30.53	40.56	41.89	65.36	7.81
T_4	77.40	72.67	19.77	33.93	41.57	47.61	69.23	8.96
T_5	78.98	75.40	19.94	34.07	42.00	49.75	70.04	9.28
T_6	80.39	77.40	20.19	35.69	42.36	51.25	70.62	9.61
T_7	82.99	90.87	21.99	37.11	42.87	53.11	71.51	9.84
T_8	72.88	63.13	18.87	31.07	40.62	42.53	66.11	7.94
T_9	75.17	67.87	19.33	32.94	40.87	45.50	67.78	8.41
T_{10}	76.17	69.93	19.53	33.23	41.32	46.06	68.31	8.78
T_{11}	81.96	81.47	20.37	36.45	42.74	52.25	71.32	9.65
S.Em±	0.54	1.40	0.20	0.39	0.22	1.44	1.13	0.14
C.D.(P=0.05)	1.58	4.07	0.58	1.14	0.63	4.21	3.29	0.40

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