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Sandeep Kumar
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Meena Sewhag
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Shweta
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Neelam
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Uma Devi
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

Correspondence
Sandeep Kumar
Department of Agronomy, CCS Haryana Agricultural University, Hisar, Haryana, India

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Yield and yield components of barley as influenced by various combinations of nitrogen fertilizer, vermicompost and biomix

Sandeep Kumar, Meena Sewhag, Shweta, Neelam and Uma Devi

Abstract
The present study entitled, **"**Integrated nutrient management in barley**"** was conducted during the *Rabi* season of 2017-2018 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar with the objective to study the effect of different nutrient management practices on yield and yield components of barley. The soil of the experimental field is sandy loam in texture, slightly alkaline in reaction, low in organic carbon and nitrogen, medium in available phosphorus and potassium. The experiment was laid out in Randomized Block Design replicated thrice with ten different treatments viz. T_1(Control), T_2 (*Biomix*), T_3 (Vermicompost @ 5 t ha^{-1}), T_4 (*Biomix* + Vermicompost @ 5 t ha^{-1}), T_5 (50 % RDN + *Vermicompost* @ 5 t ha^{-1}), T_6 (75 % RDN + *Vermicompost* @ 5 t ha^{-1}), T_7 (50% RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}), T_8 (75 % RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}), T_9 (RDN) and T_{10} (RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}). Overall results depicted that among nutrient management practices treatments T_{10} recorded significantly higher yield attributing characters [Number of grains per spike and spike length], grain, straw and biological yield (kg ha^{-1}), of barley. Performance in terms of yield of barley in treatment T_8 (75 % RDN + *Biomix*+ Vermicompost @ 5t ha^{-1}) was at par with treatment T_9 (RDN) and T_{10} (RDN + *Biomix* + Vermicompost @ 5t ha^{-1}). Various combinations of nitrogen fertilizer, *biomix* and vermicompost failed to produce any significant variation in test weight of barley.

Keywords: nitrogen fertilizer, vermicompost, biomix

Introduction
Barley (*Hordeum vulgare* L.) is not only one of the most important foods and feed crop of the world but also industrial crop which is the oldest cereal on the earth. It is the world's fourth most important cereal crop after wheat, rice and maize. Barley is grown throughout the temperate and tropical region of the world. It is versatile crop which is quite hardy also and successfully grown in adverse agro-climatic conditions like drought, salinity and alkalinity. Barley is not only used for human food and feed for livestock but also used in the manufacture of malt extract which is further utilized for brewing, distillation and baby foods, cocoa malt drinks and also in Ayurvedic medicines. Indian barley compares well with the Egyptian and Californian barley in malting and brewing. Barley is gives higher response to nitrogenous fertilizers than wheat but in case of barley fertilization, one cannot go for higher doses of nitrogen. In India increasing dose of nitrogen results in increasing absorption of nitrogen by the barley plants and consequently higher protein content in grain, which is an undesirable feature from point of view of malting quality.
Today, barley accounts for 15 per cent of world coarse grains in use. In world, about 70 per cent of barley is used for animal feed, 20 per cent for malting and 5 per cent for direct food use.
Biofertilizers are the preparations containing living cells or latent cells of efficient strains of microorganisms that helps in uptake of nutrients by their interaction in the rhizosphere when applied through seed or soil. There are various types of biofertilizers like *Rhizobium*, *Azotobacter*, *Azospirillum*, *Blue green algae* and *Azolla*. Biofertilizers add nutrients through

the natural processes of N_2 fixation, solubilizing phosphorus, and stimulating plant growth through the synthesis of growth-promoting substances (Singh *et al*. 2017a; Singh *et al*. 2017b; Singh *et al*. 2017c; Singh *et al*. 2018; Tiwari *et al*. 2018; Tiwari *et al*. 2019a; Tiwari *et al*. 2019b; Kour *et al*. 2019; Singh *et al*. 2019) [10-18]. Biofertilizers play an important role in the plant growth as well as they bring down the cost of chemical fertilizers e.g nitrogen phosphorous, and potassium. The microorganisms in biofertilizer restore the nutrient cycle and build up soil organic matter. Inoculation of bacteria like Azotobacter, Pseudomonas and Bacillus has synergic and additive effects on plant growth besides reducing the cost of cultivation.

Biomix which is a low cost input technology that contributed to pollution free atmosphere. It contains a combination of Nitrogen fixers, Phosphorus solubilisers and PGPR found to enhance the growth of cereals, oilseeds and legumes better and save about 20-25% inorganic fertilizers such as nitrogenous and phosphorus in case of rice, cotton, chilli, groundnut, soybean and pulses.

Due to prolonged cultivation of crops with recommended dose of chemical fertilizers alone, the productivity of soils has declined and time has come to figure out the right and well matched level of chemical fertilizers with these inoculations in case of barley production. Keeping the above aspects in view, the present investigations "Yield and yield components of *barley* as influenced by various combinations of nitrogen fertilizer, vermicompost and *biomix*" was planned.

Material and Methods

Field experiment was conducted during *rabi* 2017-2018 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar which is situated at latitude of 29°10' North, longitude of 75°46' East and elevation of 215.2 m above mean sea level in the semi-arid, subtropical climate zone of India. The experiment was laid out in sandy loam (62.8% sand, 19.5 % silt and 16.9 % clay) soil which is slightly alkaline in reaction, low in organic carbon and nitrogen, medium in available phosphorus and potassium. The experiment was laid out in Randomized Block Design replicated thrice with ten different treatments viz. T_1(Control), T_2 (*Biomix*), T_3 (Vermicompost @ 5 t ha^{-1}), T_4 (*Biomix* + Vermicompost @ 5 t ha^{-1}), T_5 (50 % RDN + *Vermicompost* @ 5 t ha^{-1}), T_6 (75 % RDN + *Vermicompost* @ 5 t ha^{-1}), T_7 (50% RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}), T_8 (75 % RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}), T_9 (RDN) and T_{10} (RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}). Prior to sowing, the seed pertaining to inoculated plots was treated with *Biomix* culture obtained from Department of Microbiology, CCS Haryana Agricultural University, Hisar, as per treatment. The seed was wetted with sugar solution and 50 ml of bio inoculants was used as per the recommendation. The treated seed was kept in shade for the completion of inoculation. Both treated and untreated seeds were sown as per the treatments. Sowing of barley was done manually with the help of hand plough by *pora* method on 1st December 2017 at about 5.0 cm depth by drilling in rows using 90 kg seed $ha^{-1}$and spacing of 22 cm between rows.Pre-sown irrigation of 5 cm depth was applied on 18th November 2017. One post sown irrigation was applied on 16th January 2018. Harvesting was done with the help of sickles manually by cutting the plants from the net area of each plot separately on 20th April 2018. Full dose of Phosphorous and Potassium and half of nitrogen as per treatment were applied as broadcast and mixing in soil through DAP, MOP and urea, respectively before sowing of barley at the time of field preparation. Remaining half of nitrogen was top dressed at first irrigation. Vermicompost @ 5 t ha^{-1} was applied as per treatment by incorporation in soil before sowing of barley crop. The other cultural practices were carried out as recommended for the crop. Five representative plants from each plot were selected randomly and tagged for recording the effect of different treatments on yield attributes. All yield attributes were recorded periodically on these randomly selected and tagged plants. Grain yields were converted into kg ha^{-1} on the basis of net plot area. Straw yields were recorded by subtracting grain yield from biological yield of respective plot. Quality parameters protein content was estimated by Protein % = N % in grain/straw X 6.25.The experimental data for various growth, yield, yield attributing characters, nutrient contents uptake and quality parameters was statistically analyzed by the methods of analysis of variance (ANOVA) as described by Panse and Sukhatme (1985) [8]. The significance of treatment effects as well as significance of differences between means of two treatments was computed with the help of "F" (variance ratio) test. Critical differences (CD) were sorted out as described by Gomez and Gomez (1983) [4] as follows:

$$CD = \sqrt{\frac{EMS \times 2}{n}} \times \text{t-value for error d.f. at 5\% level of significance}$$

Where,

CD = Critical difference

n = Number of observations of that factor for which CD is to be calculated.

t = Value of Fisher's table for error degree of freedom at 5% level of significance.

The expenditure incurred on individual treatment was worked out from the detail assessment of the fixed and variable costs involved such as land preparation, seed, plant protection, chemicals and labour engaged in different operations. Gross income for all treatment was calculated separately taking into consideration grain and straw yield of barley crop.

Results and Discussion

Perusal of data in table 1 revealed that spike length was highest in treatment T_{10} (7.66 cm), being significantly higher than other treatments but statically at par with treatment T_6 (6.81 cm), T_8 (7.23 cm) and T_9 (7.41 cm). Similarly number of grains/spike was recorded highest in treatment T_{10} (43.48), being significantly higher than other treatments but statically at par with treatment T_6 to T_9. Difference in number of grains per spike in treatment T_2, T_3 and T_4 were also not significant. The main reason for increased yield attributes of barley might be due to release of growth hormones by various biomix. Similar findings for yield attributes were reported by Yadav *et al*. (2014), Dhiman and Dubey (2017) and Malik (2017) [20, 2, 5]. However, various combinations of nitrogen fertilizer, *biomix* and vermicompost did not markedly differ with each other in respect of test weight.

Perusal of data in fig 1 revealed that grain, straw and biological yield of barley was significantly affected due to various integrated nutrient management practices. There was significant increase in grain and straw yield of barley with the increasing nitrogen fertilizer, however, treatment T_{10} (RDN + *Biomix* + Vermicompost @ 5t ha^{-1}) being at par with treatment T_6, T_7, T_8 and T_9 resulted in significantly higher grain yield of barley (4042 kg ha^{-1}). Among various combinations of nitrogen fertilizer, *biomix* and vermicompost straw yield was maximum in treatment T_{10}, being

significantly higher than treatment T_1, T_2, T_3 and T_4, but statically at par with treatment T_5, T_6, T_7, T_8 and T_9. Least value for grain, straw and biological yield was recorded in treatment T_1 (Control). However, the difference in grain yield of barley in treatment T_1 (Control) and treatment T_2 (*Biomix*) were not significant. Similarly treatment T_1 (Control) being at par with treatment T_2 produced straw yield significantly lower than rest of the treatments and the difference in biological yield of barley in treatment T_5 to T_{10} were not significant. Treatment T_8 (75% RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}) being at par with T_9 and T_{10} resulted in 60% higher grain yield than treatment T_1 (Control). Similar findings were reported by Dhiman and Dubey (2017) [2]. An overall increase in grain and straw yields due to combine application of chemical fertilizer and biofertilizers was also observed by Neelam (2009) and Kumar (2005) [6, 7].The main reason for higher yield of barley was mainly due to synergistic effect of different nutrient sources (Chemical fertilizer vermicompost and *biomix* inoculation). These results confirm the findings of Rehman *et al.* (2010) and Singh and Kumar (2010) [9, 19].

Table 1: Yield components of *barley* as influenced by various combinations of nitrogen fertilizer, vermicompost and *biomix*

Treatments	Spike length (cm)	Number of grains per spike	1000 grain weight (g)
T_1 : Control	5.73	29.68	41.84
T_2 : *Biomix*	6.05	32.02	41.89
T_3 : Vermicompost @ 5 t ha^{-1}	6.16	33.16	41.86
T_4 : *Biomix* + Vermicompost @ 5 t ha^{-1}	6.28	34.68	41.82
T_5 : 50 % RDN + *Vermicompost* @ 5 t ha^{-1}	6.44	37.72	42.04
T_6 : 75 % RDN + *Vermicompost* @ 5 t ha^{-1}	6.81	40.48	42.12
T_7 : 50 % RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	6.63	41.26	42.93
T_8 : 75 % RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}	7.23	42.87	43.45
T_9 : RDN (60 kg N ha^{-1})	7.41	43.07	43.81
T_{10} : RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	7.66	43.48	43.88
SEm ±	0.29	1.66	0.61
CD at 5 %	0.87	4.93	NS

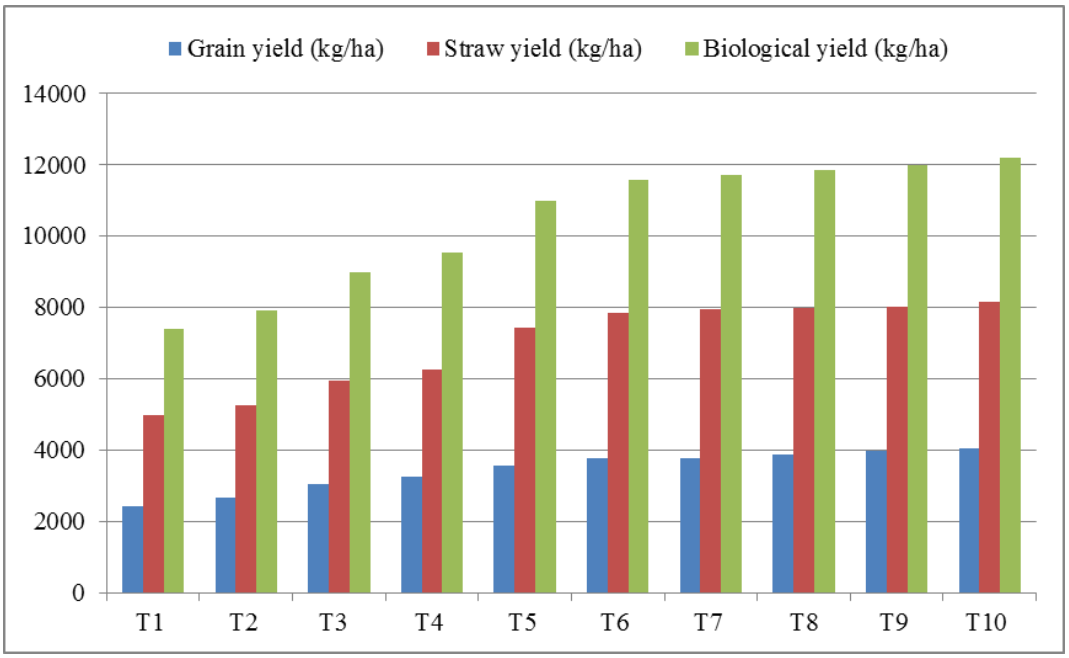

Fig. 1: Yield of *barley* as influenced by various combinations of nitrogen fertilizer, vermicompost and *biomix*

Conclusion

Performance in terms of yield and yield attributes of barley in treatment T_8 (75% RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}) was at par with treatment T_9 (RDN) and T_{10} (RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}). Hence seed treatment with *Biomix*+ Vermicompost application @ 5 t ha^{-1} can save 25% of RDN in barley crop. They can be a better supplement of chemical fertilizer to produce better yield of barley and reduces dependence on the chemical fertilizers.

References

1. Chakarborti M, Singh NP. Bio-compost: a novel input to the organic farming. Agrobios Newsletter. 2004; **2**(8):14-15.
2. Dhiman S, Dubey YP. Effect of biofertilizers and inorganic fertilizers on yield attributes, yield and quality of *Triticum aestivum* and *Zea mays* in an acid alfisols. International Journal of Current Microbiology and Applied Sciences. 2017; 6(7):2594-2603.
3. Edwards CA, Dominguez J, Arancon NQ. The influence of vermicompost on plant growth and pest incidence. In: S.H Shakir and W.Z.A. Mikhaïl, (Eds). Soil Zoology for Sustainable Development in the 21st century, 2004, 397-420p, Cairo.
4. Gomez KA, Gomez AA. Statistical procedures for agricultural research, IRRI: A Wiley Publication, New York Publication, 1983, 199-201.
5. Malik, Priti. Response of barley to fertilizer levels and different combinations of biofertilizers. Ph.D. Thesis, CCS HAU, Hisar, 2017.
6. Neelam. Compensating N and P requirement through biofertilizers in pearlmillet under rainfed situation. MSc

Thesis, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, 2009.
7. Kumar P. Effect of different nitrogen levels and biofertilizers strains on productivity and soil fertility in pearlmillet-wheat cropping system. PhD thesis, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, 2005.
8. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR, New Delhi, 1978.
9. Rehman, Sadur, khalil, Shad K., Muhammad, Fida, *et al*. Phenology, leaf area index and grain yield of wheat influenced by organic and inorganic fertilizer. Pakistan Journal of Botany. 2010; 42(5):3671-3685.
10. Singh C, Tiwari S, Boudh S, Singh JS. Biochar application in management of paddy crop production and methane mitigation. In: Singh, J.S., Seneviratne, G. (Eds.), Agro-Environmental Sustainability: Managing Environmental Pollution, second ed. Springer, Switzerland, 2017a, 123-146p.
11. Singh C, Tiwari S, Singh JS. Impact of Rice Husk Biochar on Nitrogen Mineralization and Methanotrophs Community Dynamics in Paddy Soil, International Journal of Pure and Applied Bioscience. 2017b; 5:428-435.
12. Singh C, Tiwari S, Singh JS. Application of Biochar in Soil Fertility and Environmental Management: A review, Bulletin of Environment, Pharmacology and Life Sciences. 2017c; 6:07-14
13. Singh C, Tiwari S, Gupta VK, Singh JS. The effect of rice husk biochar on soil nutrient status, microbial biomass and paddy productivity of nutrient poor agriculture soils Catena. 2018; 171:485-493.
14. Tiwari S, Singh C, Singh JS. Land use changes: a key ecological driver regulating methanotrophs abundance in upland soils. Energy, Ecology, and the Environment. 2018; 3:355–371.
15. Tiwari S, Singh C, Boudh S, Rai PK, Gupta VK, Singh JS. Land use change: A key ecological disturbance declines soil microbial biomass in dry tropical uplands. Journal of Environmental Management. 2019a; 242:1-10.
16. Tiwari S, Singh C, Singh JS. Wetlands: A Major Natural Source Responsible for Methane EmissionA. K. Upadhyay *et al*. (Eds.), Restoration of Wetland Ecosystem: A Trajectory towards a Sustainable Environment, 2019b, 59-74p.
17. Kour D, Rana KL, Yadav N, Yadav AN, Rastegari AA, Singh C *et al*. Technologies for Biofuel Production: Current Development, Challenges, and Future ProspectsA. A. Rastegari *et al*. (Eds.), Prospects of Renewable Bioprocessing in Future Energy Systems, Biofuel and Biorefinery Technologies. 2019a; 10:1-50.
18. Singh C, Tiwari S, Singh JS. Biochar: A Sustainable Tool in Soil 2 Pollutant Bioremediation R. N. Bharagava, G. Saxena (Eds.), Bioremediation of Industrial Waste for Environmental Safety, 2019b, 475-494p.
19. Singh RV, Kumar, Rajeev. Effect of organic and inorganic fertilizers on growth, yield and quality and nutrients uptake of wheat under late sown condition. Progressive Agriculture. 2010; 10 (2):341-344.
20. Yadav SM, Singh R, Kumar H, Khan N, Verma SP, Shweta *et al*. Response of late sowed wheat (Triticum aestivum) to FYM, biofertilizers and inorganic nitrogen alone and in different combinations. Plant Archives. 2014; 14(2):1127-1129.