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Economics of barley as influenced by integrated nutrient management practices

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Abstract
The malting barley (*Hordeum vulgare* L.) industry is often challenged by the availability of sufficient volume and quality to meet demand. Our objective was to evaluate the effects of integrated nutrient management practices on economics of barley. The study was conducted in the *rabi* season of 2017-2018 on a sandy loam soil at Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar .The soil of the experimental field 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}). Among nutrient management practices treatments T_{10} recorded significantly higher gross returns, net returns and benefit: cost ratio of barley. Performance in terms of economics 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}). But various combinations of nitrogen fertilizer, *biomix* and vermicompost failed to produce any significant variation in harvest and attraction index of barley.

Keywords: Barley, nutrient management, *Hordeum vulgare*

Introduction
Barley (*Hordeum vulgare* L.) ranks fourth among cereals in the world and is grown annually on 48 million hectares in a wide range of environment [ICRISAT/ICARDA (2011]. Barley has the widest ecological range of adaptation among all the cereals, which is grown both in temperate and tropical regions of the world. It has very low cost of production and input requirement, so it is preferred by the resource poor farmers in the country. Barley is grown for malt for brewing and as a feedgrain. Grain meeting malting specifications can attract a price premium. Although most barley grown is from a malting variety potentially suitable for beer production, the major end use has been for livestock feed. Integrated nutrient management is a strategy that seeks to enhance agricultural production as well as safeguard the soil environment for upcoming generations. It is an approach that incorporates both organic and inorganic nutrients to attain higher crop productivity. Yadav *et al.* (2014) [4] showed that integrated nutrient treatments of 40 kg N ha^{-1} + FYM + biofertilizers recorded significantly higher gross as well as net income than treatment of 120 kg N ha^{-1}. A good nutrient management strategy genotype under modified environment may help in improving overall profitability. Using only inorganic fertilizer to meet the nutrient demand may deteriorate the soil fertility status and resulting in low yield and poor economics of barley. Therefore, the present study was undertaken to study the effect of combined application of nitrogen fertilizer, *biomix* and vermicompost farm on economics of barley in semi arid climate of Haryana. The aim of this study was to get optimum yield level of barley using integrated nutrient management practices and to reduce the cost of production.

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. Sowing of crop was done manually with hand plough by *pora* method on 1st December 2017 at 5.0 cm depth by drilling in rows using 90 kg seed $ha^{-1}$and spacing of about 22 cm between rows.Pre-sown irrigation of 5 cm depth was applied on 18th November 2017. 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. 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 Stover yield of barley crop. Thereafter, net returns were calculated after subtracting expenditure incurred on the individual treatment from the gross expenditure of the same treatment.

To ascertain the economic viability treatment wise benefits cost (B: C) ratio was calculated using the following formula:

$$\text{B: C} = \frac{\text{Gross return (Rs. ha}^{-1})}{\text{Cost of cultivation (Rs. ha}^{-1})}$$

Results and Discussion

Among various combinations of nitrogen fertilizer, *biomix* and vermicompost gross returns was highest in treatment T_{10} (85542 Rs ha^{-1}) followed by treatment T_9 (84121 Rs ha^{-1}) and T_8 (82437 Rs ha^{-1}) and highest net returns was recorded in treatment T_9 (57566 Rs ha^{-1}) followed by treatment T_{10} and T_8. The gross return of barley varied from 51520 Rs ha^{-1} (T_1) to 85542 Rs ha^{-1}(T_{10}) while net return varied from 26052 Rs ha^{-1} to 57566 Rs ha^{-1}.The benefit cost ratio was also higher in treatment T_9 (3.17) followed by treatment T_{10} and T_8. In general benefit: cost ratio of barley varied from 2.02 (T_1) to 3.17 (T_9). It might be ascribed to the higher grain and straw yield recorded due to INM treatment where vermicompost application and seed inoculation with *biomix* is done. These results were in unison with those obtained by Malik (2017) [2] and Singh *et al*. (2013) [3]. Least value for gross returns was reported in T_1 (Control). Higher B: C ratio in treatment T_2 as compared to T_1 is because of very less increase in cost of cultivation as compared to the control. Similar results were revealed by Malik (2017) [2] and Yadav *et al*. (2014) [4]. Overall Integrated Nutrient Management treatment resulted in higher gross returns, net returns and benefit cost ratio. The data pertaining to harvest index of barley as influenced by various combinations of nitrogen fertilizer, biomix and vermicompost is presented in Table 11 and Fig. 10. Perusal of data revealed that various combinations of nitrogen fertilizer, *biomix* and vermicompost did not affect the harvest and attraction index of barley significantly however, it was numerically higher in treatment T_4 followed by T_3. The range of harvest index was between 32.22 to 34.25%. The range of attraction index was between 47.98 to 52.08%.

Table 1: Effect of integrated nutrient management practices on economics of *barley*

Treatments	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B : C
T_1 : Control	51520	26052	2.02
T_2 : *Biomix*	55969	30461	2.19
T_3 : Vermicompost @ 5 t ha^{-1}	63756	34288	2.16
T_4 : *Biomix* + Vermicompost @ 5 t ha^{-1}	67915	38407	2.30
T_5 : 50% RDN + Vermicompost @ 5 t ha^{-1}	76314	46302	2.54
T_6 : 75% RDN + Vermicompost @ 5 t ha^{-1}	80425	50141	2.66
T_7 : 50% RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	80958	50906	2.69
T_8 : 75% RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}	82437	52113	2.72
T_9 : RDN (60 kg N ha^{-1})	84121	57566	3.17
T_{10} : RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	85542	54947	2.80
SEm ±	1073	705	0.16
CD at 5%	3238	2123	0.48

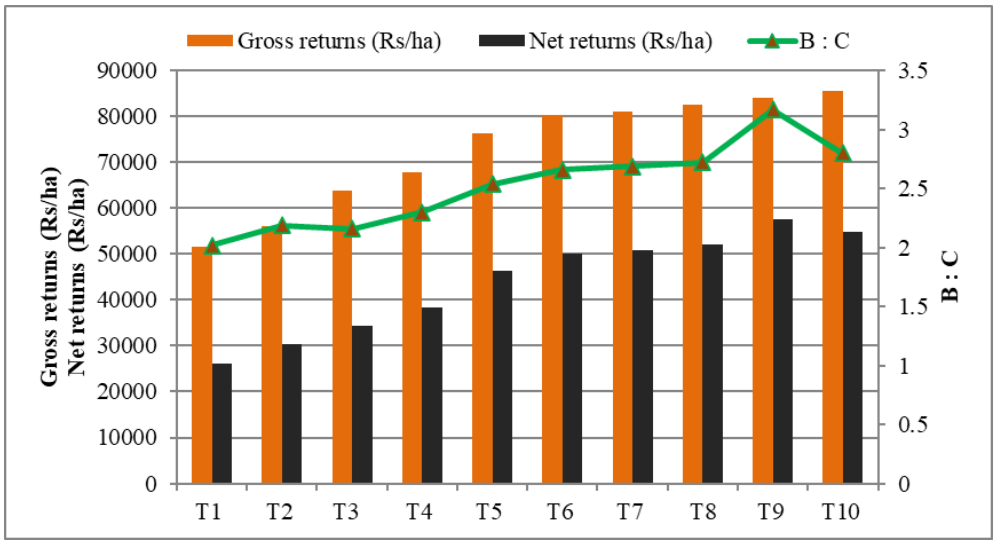

Fig 1: Effect of integrated nutrient management practices on economics of *barley*

Table 2: Effect of integrated nutrient management practices on harvest and attraction index of barley

Treatments	Harvest index (%)	Attraction Index (%)
T_1 : Control	32.61	48.39
T_2 : *Biomix*	33.65	50.71
T_3 : Vermicompost @ 5 t ha^{-1}	33.95	51.39
T_4 : *Biomix* + Vermicompost @ 5 t ha^{-1}	34.25	52.08
T_5 : 50% RDN + *Vermicompost* @ 5 t ha^{-1}	32.42	47.98
T_6 : 75% RDN + *Vermicompost* @ 5 t ha^{-1}	32.46	48.05
T_7 : 50% RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	32.22	47.54
T_8 : 75% RDN + *Biomix*+ Vermicompost @ 5 t ha^{-1}	32.57	48.31
T_9 : RDN (60 kg N ha^{-1})	33.2	49.71
T_{10} : RDN + *Biomix* + Vermicompost @ 5 t ha^{-1}	33.13	49.55
SEm ±	1.91	2.62
CD at 5%	NS	NS

Conclusion

The results of this study indicated that integrated nutrient management significantly improved economics of barley. Based on one year study, it can be concluded that gross returns were highest in treatment T_{10} (Rs 85542 ha^{-1}) followed by treatment T_9 and T_8. Among various combinations of nitrogen fertilizer, *biomix* and vermicompost highest net returns was recorded in treatment T_9 followed by treatment T_{10} and T_8. The BC ratio was also higher in treatment T_9 followed by treatment T_{10} and T_8. Overall Integrated Nutrient Management treatment resulted in higher gross returns, net returns and benefit cost ratio.

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