**RESEARCH ARTICLE**

# EFFECT OF INTEGRATED NUTRIENT MANAGEMENT PRACTICES ON LAI AND QUALITY PARAMETERS OF *BARLEY*

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**Abstract:** The present study entitled, "Effect of integrated nutrient management practices on LAI and quality parameters of *barley*" was conducted during the *rabi* season of 2017-2018 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar to study the effect of different nutrient management practices on quality parameters 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 $ha^{-1}$). Among various combinations of nitrogen fertilizer, *biomix* and vermicompost leaf area index at 30 DAS was highest in treatment $T_{10}$, being significantly higher than other treatments but statically at par with treatment $T_8$ and $T_9$. Similarly at 60 and 90 DAS the difference in leaf area index value of barley at in treatment $T_8$, $T_9$ and $T_{10}$ were not significant but higher than other treatments. Treatment $T_{10}$ (11.74 %) being at par with treatment $T_3$ to $T_9$ resulted in significantly higher protein content of barley and treatment $T_1$ being at par with treatment $T_2$ recorded significantly higher value of malt content of barley than treatment $T_3$ to $T_{10}$. But various combinations of nitrogen fertilizer, *biomix* and vermicompost fail to influence hectoliter weight and boldness as well as thinness of barley grain.

**Keywords:** Barley, Nutrient, Rabi

## INTRODUCTION

Barley (Hordeum vulgare) has the widest ecological range of adaptation among all the cereal crops, which is grown throughout the temperate and tropical regions of the world. It has low cost of production and input requirement, so it is preferred by the resource poor farmers in the country. It is highly versatile crop which is quite hardy also and successfully grown in adverse agro-climatic conditions like drought, salinity and alkalinity.

Whole grain barley contains important vitamins and high levels of minerals like calcium, magnesium, phosphorus, potassium, vitamin A, vitamin E and niacin. The imbalanced and indiscriminate use of chemical fertilizers has developed many problems like deterioration in the quality of crop produce, decline of soil organic matter, increase in salinity and sodicity, pests and diseases attack and increase in soil pollutants (Chakarborti and Singh, 2004).Moreover, constant and sole use of inorganic fertilizers leads to create innumerable problems for example micronutrient insufficiency, imbalance use of nutrient in case of plant and soil system. Vermicompost, which are stabilized organic materials produced by earthworms and microorganisms, have been reported to improve plant germination growth and yields in greenhouse crops (Edwards *et al*., 2004). The micro-organisms play a crucial role in the life cycle of plants through number of processes such as decomposition, solubilisation, fixation and supply of plant nutrients. Being a low-cost input, biofertilizers play an important role in minimizing our dependence on synthetic fertilizers. Mixed biofertilizers are nitrogen fixing, plant growth promoting and PSB.

*Biomix* inoculation 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. The fertilizer consumption particularly in India is grossly unbalanced and tilted more towards nitrogen, followed by phosphorus. This has implications on yield response to fertilizer as it decreases the crop quality and adversely affects the overall soil fertility and productivity. Hence, judicious use of both organic and inorganic sources of nutrients will boost the crop productivity and soil health. Keeping the above aspects in view, the present investigations "Effect of integrated nutrient management practices on LAI and quality parameters of *barley*" was planned.

## MATERIAL AND METHODS

The Field experiment was conducted during *rabi* 2017-2018 at the Research Farm of Agronomy department 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

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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. Full Phosphorous and Potassium dose and half of nitrogen dose 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. Leaves separated from the plants harvested for dry matter accumulation were used to measure leaf area with the help of leaf area meter (LI-3000 Leaf Area Meter LI-COR Ltd. Nebraska, USA).The leaf area index was worked out with the help of following formula:

$$\text{Leaf area index} = \frac{\text{Total leaf area}}{\text{Total land area}}$$

Protein content (%) in grain from each plot was calculated by multiplying the percentage of nitrogen in grain with 6.25. Hectoliter weight was measured with the hectoliter weight equipment at wheat-barley laboratory at College of Agriculture, CCS HAU, Hisar. The instrument uses 100 ml volume of barley grain. Weight of measured quantity of grains gives the value in kg/hectolitre. Bold and thin grain was determined by using sortimeter. 100 grains of barley of each sample were taken and they were allowed to pass through the sieve of size of 10 mm. The thin grains were passed out in the container and the bold grains were left on the sieve. Thus the percentage of bold and thin grains was calculated. Malting process of barley grains were carried out as per the method suggested by (Singh and Sosulski, 1985). Properly cleaned, weighted samples of barley grains were steeped in water at 15°C in an incubator for a period of 60 hours. Water was changed every 8-10 hours and an air rest of 1 hour was given after 24 hours during steeping. Then steeped samples taken in a muslin cloth were placed in a wooden box with wire mesh bottom for germination in an incubator at 15°C and relative humidity of more than 90 percent. They were allowed to germinate for a period of 5 days. Then the green malt was kilned in an oven at 45°C for 4 hours. Roots from the kilned malt were removed. Weight of malt and roots was recorded separately to calculate malt yield.

$$\text{Malt content}(\%) = \frac{\text{Malt weight}}{\text{Sample weight}} \times 100$$

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

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.

## RESULTS AND DISCUSSION

Leaf area index is an important parameter of photosynthesizing surface of plant and has pronounced effect on crop growth and yield. Among various combinations of nitrogen fertilizer, *biomix* and vermicompost leaf area index at 30 DAS was highest in treatment $T_{10}$, being significantly higher than other treatments but statically at par with treatment $T_8$ and $T_9$. Seed inoculation with *biomix* might also have positive influence on barley growth which may be attributed to the hormone production by these bacteria to increase the nutrient uptake by inoculated roots hence contributing more leaf area. This might be due to combined effect of vermicompost, *biomix* and chemical fertilizers in

balanced proportion played a very crucial role in decomposition and easy release of different nutrients and their uptake by the barley crop which led to higher dry matter production and its translocation in different plant parts of growth and yield parameters, which in turn resulted into higher yield. These results are in complete agreement with those of Ram and Mir (2006) and Kakraliya *et al.* (2016). The findings confirmed with the results found by Malik (2017) who reported that among different combination of biofertilizers, seed inoculation with *biomix* recorded highest value for leaf area index and lowest was recorded in uninoculated treatment.

A perusal of data revealed boldness as well as thinness of barley grain is genetic in nature and various combinations of nitrogen fertilizer, *biomix* and vermicompost fail to influence boldness as well as thinness of barley grain. The range of bold grain (%) was between 77.08 ($T_1$) to 78.83% ($T_{10}$) while range of thin grain (%) was between 5.06 ($T_1$) to 5.56% ($T_{10}$).

Similarly hectoliter weight of barley grain was not affected significantly due to various combinations of nitrogen fertilizer, *biomix* and vermicompost on hectoliter weight of barley. It might be due to the fact that boldness as well as thinness and hectoliter weight are genetic characters of barley and hence not affected by external factors like nutrient management strategies by Malik (2017).

Optimum nitrogen levels were effective in producing better yield and quality of barley grain. A proper supply of nitrogen in barley helped to accumulate protein in seeds and increase in grain weight. Treatment $T_{10}$ (11.74%) being at par with treatment $T_3$ to $T_9$ resulted in significantly higher protein content of barley. Least value for protein content was recorded in treatment $T_1$ (8.50%). However, the difference in protein content of barley in treatment $T_1$ (Control) and treatment $T_2$ (*Biomix*) were not significant. This increase in protein content is due to increase in nitrogen levels with increasing fertilizer levels. Malik (2017) also reported that barley grain protein content increased with increasing rates of N application and seed inoculation with *biomix* produced highest protein content followed by seed inoculation with *Azospirillum + PSB and Azotobacter + PSB* in barley at Hisar. These results were in unison with Mehrvarz and Chaichi (2008) also who reported that *PSB* had a significantly positive influence on increasing the percentage of grain protein. *Biomix* inoculation along with 75% RDF improved both protein content and protein yield (Yamank 2017 and Kumar *et al.* 2007). The increase in protein content in grain under *biomix* inoculation treatment might be due to more availability of nitrogen and solubilization of fixed phosphorous under inoculation treatment (Satyajeet *et al.*, 2007).

In the present experimentation perusal of data revealed that among various combinations of nitrogen fertilizer, *biomix* and vermicompost treatment $T_1$ being at par with treatment $T_2$ recorded significantly higher value of malt content of barley than treatment $T_3$ to $T_{10}$. Lowest value of malt content of barley was recorded in treatment $T_{10}$ (80.18). Dahiya (2014) reported that malt recovery (%) of barley grain decreased significantly with increase in nitrogen levels up to 105 kg N $ha^{-1}$. These results were in unison with those obtained by Edney *et al.* (2012). Higher malt extract value is normally associated with low protein content in grain , and this relation has truly been recorded in present study too. Malt extract is a key quality indicator because it reflects the amount of beer that can be produced from a given quantity of malt.

**Table 1.** Hectoliter weight, protein and malt content (%) and proportion of bold and thin grain of barley as influenced by integrated nutrient management practices

| **Treatments** | **Hectoliter weight (%)** | **Protein content (%)** | **Malt content (%)** | **Bold grain (%)** | **Thin grain (%)** |
|---|---|---|---|---|---|
| $T_1$ : Control | 53.69 | 8.5 | 84.78 | 77.08 | 5.06 |
| $T_2$ : *Biomix* | 53.9 | 9.41 | 84.15 | 77.21 | 5.14 |
| $T_3$ : Vermicompost @ 5 t $ha^{-1}$ | 54.65 | 10.07 | 83.38 | 77.61 | 5.16 |
| $T_4$ : *Biomix* + Vermicompost @ 5 t $ha^{-1}$ | 54.84 | 10.16 | 83.08 | 77.16 | 5.31 |
| $T_5$ : 50 % RDN + Vermicompost @ 5 t $ha^{-1}$ | 55.07 | 10.25 | 82.46 | 78.08 | 5.16 |
| $T_6$ : 75 % RDN + Vermicompost @ 5 t $ha^{-1}$ | 55.89 | 10.48 | 82.49 | 77.73 | 5.28 |
| $T_7$ : 50 % RDN + *Biomix* + Vermicompost @ 5 t $ha^{-1}$ | 55.95 | 10.53 | 82.1 | 78.44 | 5.34 |
| $T_8$ : 75 % RDN + *Biomix*+ Vermicompost @ 5 t $ha^{-1}$ | 56.02 | 10.78 | 82.97 | 77.81 | 5.51 |
| $T_9$ : RDN (60 kg N $ha^{-1}$) | 56.77 | 11.15 | 81.13 | 78.56 | 5.49 |
| $T_{10}$ : RDN + *Biomix* + Vermicompost @ 5 t $ha^{-1}$ | 56.88 | 11.74 | 80.18 | 78.83 | 5.56 |
| SEm ± | 1.66 | 0.59 | 1.11 | 0.82 | 0.13 |
| CD at 5 % | NS | 1.74 | 3.36 | NS | NS |

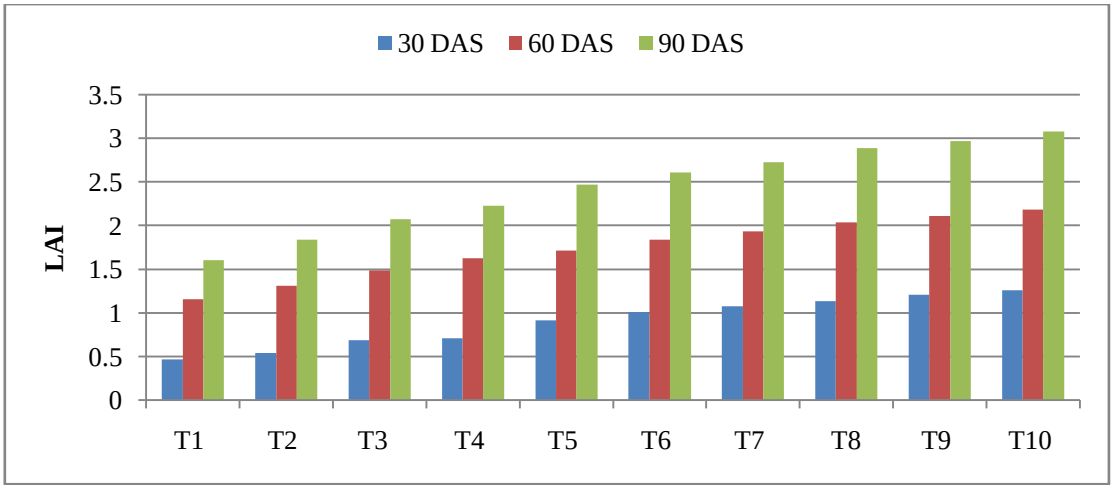


**Fig 1:** Leaf Area Index of barley as influenced by integrated nutrient management practices at different growth stages

## CONCLUSION

Based on one year study, it can be concluded that treatment $T_{10}$ (11.74 %) being at par with treatment $T_3$ to $T_9$ resulted in significantly higher protein content of barley. Among various combinations of nitrogen fertilizer, *biomix* and vermicompost treatment $T_1$ being at par with treatment $T_2$ recorded significantly higher value of malt content of barley than treatment $T_3$ to $T_{10}$. Leaf area index at 30 DAS was highest in treatment $T_{10}$, being significantly higher than other treatments but statically at par with treatment $T_8$ and $T_9$.

## REFERENCES

**Chakarborti, M. and Singh, N.P.** (2004). Bio-Compost: a novel input to the organic farming. *Agrobios Newsletter*, **2** (8): 14-15.

**Dahiya, S.** (2014). Performance of two rowed barley under various seed rate, spacing and nitrogen levels. MSc Thesis, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana.

**Edney, M.J., O" Donovan, J.T., Turkington, T.K., Clayton, G.W., McKenzie, R.H., Juskiw, P.E., Lafond, G.P., Brandt, S., Grant, C.A., Harker, K.N., Johnson, E.N. and May, W.E.** (2012). Effects of seeding rate, nitrogen rate and cultivar on barley malt quality. *Journal of the Science of Food and Agriculture*, **92**, 2672-2678.

**Kakraliya, S.K. Sutaliya, J.M. Singh, L.K. Singh, I., Jat, H.S. and Jat, M.L.** (2016). Developing portfolios of climate smart agriculture practices for a rice-wheat cropping systems in western indo-gangetic plains of south Asia. 4th *International Agronomy Congress*, Nov.22-26, 2016, New Delhi, India.**1**: 88-89.

**Kumar, M., Pannu, R.K., Singh, B., and Dhaka, A.K.** (2017). Response of irrigation frequency and nitrogen levels on relative water content, canopy temperature, water potential & chlorophyll content of late sown wheat. *International Journal of Pure & Applied Bioscience*, **5** (2), 173-179.

**Malik, Priti** (2017). Response of barley to fertilizer levels and different combinations of biofertilizers. Ph.D. Thesis, CCS HAU, HISAR.

**Mehrvaraz, S. and Chaichi, M.R.** (2008). Effect of phosphate solubilizing microorganisms and phosphorus chemical fertilizer on forage and grain quality of barely (*Hordeum vulgare* L.). *American-Eurasian Journal Agricultural* and *Environmental Sciences*, **3** (6): 855-860.

**Ram, T. and Mir, M.S.** (2006). Effect of integrated nutrient management on yield and attributing characters of wheat (*Triticum aestivum L.*). *Indian Journal of Agronomy*, **51** (3): 189-192.

**Satyajeet, Nanwal, R.K., and Yadav, V.K.** (2007). Effect of integrated nutrient management on N, P and K concentration, uptake and productivity in pearlmillet. *Journal of Maharashtra Agricultural Universities*, **32** (2), 186-188.

**Yamank,** (2017). Performance of different pearlmillet hybrids as influenced by *biomix* inoculation and chemical fertilizers. M Sc Thesis, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana.