International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 2363-2365

Received: 11-07-2018
Accepted: 15-08-2018

J Choudhary
Assistant Professor and Project Incharge, AICRP on Wheat and Barley, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Urmila
Technical Assistant, AICRP on Wheat and Barley, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Mohan Lal Jat
Ph.D. Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Mohammed Mohsin
Ph.D. Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Correspondence
J Choudhary
Assistant Professor and Project Incharge, AICRP on Wheat and Barley, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Impact of integrated nutrient management in enhancing productivity of barley (*Hordeum vulgare* L.) in Southern Rajasthan

J Choudhary, Urmila, Mohan Lal Jat and Mohammed Mohsin

Abstract
A field experiment was carried out at Rajasthan College of Agriculture, MPUAT, Udaipur, to study response of barley (*Hordeum vulgare* L.) to nutrient levels and biofertilizers during the *rabi* seasons of 2015-16 and 2016-17. The experiment was conducted in split-plot design with three nutrient levels *viz.* 50% of the recommended dose (RD), 75% of the recommended dose (RD), 100% of the recommended dose (RD) in main plot and 5 biofertilizers, *viz. Azotobacter*, phosphate solubilizing bacteria (PSB), *Azotobacter* + PSB, biomix and control in sub plots. The growth attributes, yield and yield attributes were the maximum with 100% recommended dose (RD) as compared to rest nutrient levels. The application of 100% of the recommended dose (RD) also registered the maximum gross, net return and B-C ratio of barley. The application of biomix resulted in highest grain, straw and biological yield of barley as compared to control, alone and combine application with *Azotobacter* and PSB. The maximum yield of barley was recorded with the combined application of 100% recommended dose (RD) + biomix over rest of the treatment combinations.

Keywords: biofertilizer, biomix, yield, net return, B-C ratio

Introduction
Barley (*Hordeum vulgare* L.) is an important *rabi* cereal crop of India. Being the most dependable crop in areas where soils are alkali, frost or drought occurs, it is cultivated in almost all parts of the world. Barley grain is also valued for smothering and cooling effect on the body for easy digestion. Besides these conventional uses, it is an important industrial crop as it is used as raw material for beer, whisky and brewing industries. In India, barley is mainly grown in the northern plains and concentrated in the states of Uttar Pradesh, Madhya Pradesh, Haryana, Karnataka and Rajasthan. It contributes 0.86% of the total cereals production and 0.81% of the total food grains in India. In India, barley is cultivating on 0.66 mha area with 1.62 mt of production at an average productivity of 24.7 q ha^{-1}. In Rajasthan, barley is cultivating on 0.31 mha area with 0.86 mt of production at an average productivity status of 27.7 q ha^{-1} (IIWBR, 2015-16) [3].

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. This alarming situation itself has emphasized the importance of organic manures in agriculture. A sudden reversion to organic farming cannot satisfy both the hungry soil and the ever growing population. Organic manures have become scarce and green manuring seems to be infeasible under intensive agriculture. Therefore, integrated nutrient management could be quite promising in maintaining higher productivity and providing greater stability in crop production. Adequate mineral fertilization is considered to be one of the most important prerequisite in this respect. Integrated use of chemical fertilizer with bio fertilizer could be promising in maintaining higher productivity and may provide greater stability to the crop production system.

On the other hand bio-fertilizers are cheaper, pollution free and renewable source of nutrients supply. Besides providing nutrients, it also adds biomass into the soil to prevent it from deterioration. *Azotobacter* are abiotic, free living soil microbes which play an important role in the nitrogen cycle in nature and binding atmospheric nitrogen which is inaccessible to plants. Inoculation with *Azotobacter* has been found to reduce the requirement of chemical fertilizers up to 50 percent (Soleimanzadeh and Gooshchi, 2013) [10].

Phosphorus solubilizing bacteria (PSB) plays an important role in converting insoluble phosphate chemically fixed and applied phosphorus in to available forms resulting in higher crop yields (Gull *et al.*, 2004) [2]. Among the whole microbial population in soil, PSB constitute 10 to 50 percent in P solubilization potential (Chen *et al.*, 2006) [1]. The favorable effect of combined inoculation of *Azotobacter* and PSB could be attributed to synergistic interaction among phosphate solubilizing microorganism and free living organism, which lead to increased availability of nutrients (Khatkar *et al*., 2007) [6]. Plant Growth Promoting Rhizobacteria (PGPR) are a heterogeneous group of bacteria that can be found in the rhizosphere, at root surfaces and in association with roots, which can improve the extent or quality of plant growth directly or indirectly (Joseph *et al.*, 2007) [5].

Materials and Methods

Field experiments were conducted during *rabi* seasons of 2015-16 and 2016-17 at the Agronomy Instructional Farm, Rajasthan College of Agriculture, Udaipur (Rajasthan). The site was situated at 24º.35' N latitude, 74º.42' E longitude and an altitude of 579.5 m above mean sea level. The region falls under agro-climatic zone IVa (Sub-Humid Southern Plain and Aravalli Hills) of Rajasthan. The soil was clay loam in texture with pH 8.02, EC 0.60 dsm^{-1}, available nitrogen 292.6 kg ha^{-1}, phosphorus 20.34 kg ha^{-1} and potassium 315.21 kg ha^{-1}. The experiment was conducted in split plot design with three nutrient levels *viz*. 50% of the recommended dose (RD), 75% of the recommended dose (RD), 100% of the recommended dose (RD) and 5 bio fertilizer, *viz. Azotobacter*, phosphate solubilizing bacteria (PSB), *Azotobacter* + PSB, biomix and control in three replications. The recommended dose of fertilizers was 60:30:20 of N: P_2O_5, K_2O kg ha^{-1}, respectively. Barley variety BH 959 @ 100 kg seed ha^{-1} was sown at row to row distance of 20 cm at 4-5 cm depth on 22nd November, 2015 and 14th November, 2016 in first and second year, respectively. Nitrogen, phosphorus and potassium were applied as per treatments through urea, dia-ammonium phosphate (DAP) and sulphate of potash (SOP) respectively. Half dose of nitrogen was given as basal and remaining half was top dressed after first irrigation and phosphorus was applied at 8-10 cm depth before sowing as per treatments. The crop was grown with recommended package of practices. The seeds were treated with liquid bio fertilizers before the sowing at 5 ml kg^{-1} seed. Data of various growth and yield attributes, grain and straw yields and economic return were calculated as per the standard procedures.

Results and Discussion

Growth attributes

It is clearly shown in data (Table 1) that the impact of different fertility levels at various physiological stages shows significant effect on growth attributes. The maximum plant height (84.02 cm) and number of tillers (454.78 m^{-2}) at harvest were recorded with application of 100% of the recommended dose (RD) over 75% of the recommended dose (RD) and 50% of the recommended dose (RD). Similar findings were also reported by Prakash *et al*., 2015 [8].

The data further revealed that the inoculation of seed with bio fertilizers have significant effect on growth attributes. The maximum plant height (83.82 cm) and number of tillers (463.54 m^{-2}) at harvest were recorded under the treatment of seed inoculation with biomix. The minimum plant height and number of tillers were recorded under control and in the treatment of seed inoculation of PSB alone. These findings were found similar to the research results of Tomer *et al*., 2016 and Kumawat *et al*., 2016 [11, 7].

Yield attributes and Yield

It is evident from (Table-1) the data on different fertility levels that show significant result in term of yield contributing traits and yield in barley crop. The maximum number of grains ear^{-1} (39.93), grain yield (48.03 q ha^{-1}) and straw yield (71.90 q ha^{-1}) were observed where 100% of the recommended doses (RD) were applied, which was significantly superior to all other treatments of fertility. Although, the minimum yield was recorded in the treatment where 50% recommended dose (RD) applied to crop. The test weight and number of grains ear^{-1} remained at par with 75% of the recommended dose (RD). The straw yield was does not show significant difference with increasing fertility level of nutrients. The application of N and P fertilizers resulted in better nutritional environment for the crop in low inherent N and P soil and due to the increased supply of N and P 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 yield of the crop (Kumawat *et al*., 2016) [7].

Further examination of data revealed that the seed inoculation with liquid bio fertilizers registered significantly higher yield parameters and yield of barley. The maximum test weight (38.20 g), number of grains ear^{-1} (40.68), grain (48.55 q ha^{-1}) and straw (68.81 q ha^{-1}) yield were reported with the application of 100% of the recommended dose of nitrogen (RDN). In case of yield (grain and straw), seed inoculation with *Azotobacter* + PSB was statistically at par with seed inoculation with biomix. An increase in yield could also be attributed to synergistic interaction among *Azotobacter* and phosphate solubilizing micro-organisms which lead to increased N fixation in soil (Jain and Trivedi, 2005), reduced P fixation and solubilization of unavailable P, might have increased availability and uptake of nutrients (Singh *et al.*, 2012) [9] which reflected in higher yield.

Economics

The application of 100% of the recommended dose (RD) registered maximum gross return, net return and B-C ratio (90607, 61926 Rs. ha^{-1} and 2.17, respectively) followed by 75% and 50% recommended dose (RD). Seed inoculation with bio mix observed maximum gross return, net return and B-C ratio (90328, 61430 Rs ha^{-1} and 2.14, respectively) followed by seed inoculation with *Azotobacter* +PSB and remained statistically at par with this combination.

Table 1: Effect of integrated nutrient management on growth, yield attributes, yield and economics of barley

Treatments	Tillers (m^2)	Plant height (cm)	Test weight (g)	Grains ear^{-1}	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B-C ratio
Recommended Dose of Nitrogen (kg ha^{-1})									
50	422.35	77.68	35.45	37.47	37.84	55.59	71048	42534	1.50
75	436.55	80.81	37.11	39.95	43.96	66.96	83305	54707	1.92
100	454.78	84.02	37.81	39.93	48.03	71.90	90607	61926	2.17
SEm±	5.21	0.80	0.26	0.43	0.69	9.69	1272	1272	0.04
C.D. (P=0.05)	14.82	2.28	0.74	1.23	1.96	NS	3616	3616	0.13
Bio fertilzers									
Azotobactor	439.72	81.44	36.32	38.60	44.07	64.92	82793	54245	1.91
PSB	428.33	79.88	35.51	38.26	42.09	63.27	79487	50909	1.79
Azotobactor + PSB	457.72	82.55	37.48	40.01	47.18	68.12	88188	59624	2.10
Biomix	463.54	83.82	38.20	40.68	48.55	68.81	90328	61430	2.14
Control	400.15	76.49	35.44	36.39	34.50	58.99	67469	39071	1.39
SEm±	1.77	0.38	0.05	0.13	0.52	0.86	648	648	0.02
C.D. (P=0.05)	5.76	1.23	0.15	0.43	1.69	2.81	2113	2113	0.08

Conclusion

On the basis of present study results it may be concluded that combination of bio mix and 100 percent recommended dose (RD) gave the highest grain yield which was statistically at par with same fertility level and *Azotobacter* +PSB combination and significantly superior over rest of the treatment combinations.

References

1. Chen YP, Rekha PD, Arunshen AB, Lai WA, Young CC. Phosphate solubilizing bacteria from subtropical soil and their tricalcium phosphate solubilizing abilities. Applied Soil and Ecology 2006; 34(1):33-41.
2. Gull M, Hafeez FY, Saleem M, Malik KA. Phosphorus uptake and growth promotion of chickpea by co-inoculation of mineral phosphate solubilizing bacteria and a mixed rhizobial culture. Australian Journal of Experimental Agriculture. 2004; 44(6):623-628.
3. IIWBR. Progress Report, All India Coordinated Wheat and Barley Improvement Project. Indian Institute of Wheat and Barley Research, Karnal, Haryana. 2015-16; 6:11.
4. Jain PC, Trivedi SK. Response of soybean to phosphorus and biofertilizers. Legume Research. 2005; 28:30-33.
5. Joseph B, Patra RR, Lawrence R. Characterization of plant growth promoting rhizobacteria associated with chickpea (*Cicer arietinum* L.). International Journal of Plant Production 2007; 1(2):141-151.
6. Khatkar R, Thomas A, Shalu AJ. Effect of biofertilizers and sulphur levels on growth and yield of blackgram (*Vigna mungo* L.). Legume Research. 2007; 30(3):233-234.
7. Kumawat S, Sharma SR, Rundala SR, Dogra P. Organics and fertility levels influences barley yield and soil properties in semi-arid region of Rajasthan. Annals of Agricultural Research New Series. 2016; 37(1):66-71.
8. Prakash J, Siddiqui MZ, Dwivedi A, Thaneshwar, Bankoti P, Singh A. Effect of irrigation and fertility balance on performance and production economics of barley (*Hordeum vulgare* L.). International Journal of Agriculture Sciences 2015; 7(13):817-821.
9. Singh J, Mahal SS, Manhas SS. Effect of sowing methods, nitrogen levels and irrigation scheduling on yield and quality of malt barley (*Hordeum vulgare* L.). Indian Journal of Agronomy. 2012; 57:259-264.
10. Soleimanzadeh H, Gooshchi F. Effect of *Azotobacter* and nitrogen chemical fertilizer on yield and yield component wheat (*Triticum aestivum*). World Applied Science Journal. 2013; 21(8):1180-2013.
11. Tomar J, Kumar P, Kumar A, Kumar A, Sandhya Kumar S, Kushwaha SR. Influence of irrigation schedules and fertilizer levels on barley (*Hordeum vulgare*) in western Uttar Pradesh. Indian Journal of Agronomy. 2016; 61(4):515-518.