Environment and Ecology 39 (3) : 639—643, July—September 2021
ISSN 0970-0420

Influence of Integrated Nutrient Management on Yield, Economics and Nutrient Uptake of Barley Based Cropping System

Vinod Kumar, M. K. Jat

Received 30 April 2021, Accepted 31 May 2021, Published on 1 July 2021

ABSTRACT

A biennial field investigation was conducted during two consecutive years 2012 and 2013 at Regional Research Station Bawal, Haryana on loamy sand soil to effect of integrated nutrient management on yield, economics and nutrient uptake of barley based cropping system. The experiment was laid out in split plot design with thrice replications, keeping three preceding crops pearl millet (*Pennisetum glaucum* L.), cluster bean (*Cyamopsis tetragonoloba* L.) and green gram (*Vigna radiate* L.) in main plots and six treatments of nutrient management; T_1 : 100% Recommended dose of fertilizer, T_2: 75% RDF + 5 t FYM/ha, T_3 : 75% RDF + 2.5 t vermin-compost/ha, T_4 : 100% RDF + Biomix, T_5 : 75% RDF + 5 t FYM/ha + Biomix, T_6 : 75% RDF + 2.5 t vermin-compost/ha + Biomix in sub-plots. The effect of preceding crop systems on grain and yield components of barley was significantly higher than preceding crop of pearl millet. The succeeding crop barley crop produced the highest grain yield (61.5 q/ha), straw yield (82.2 q/ha) and harvest index (47.8 %) of barley under 75% RDF+ 5 T (FYM)/ha + Biomix i.e. under 75% RDF+ 5 t FYM/ha + Biomix treatment which was 19.41% more over RDF.

Keywords Barley, Cluster bean, Pearl millet, Mung bean Yield, Economics.

INTRODUCTION

Barley has the widest ecological range of adaptation among the cereals, which is grown throughout the temperate and tropical regions of the world. Barley (*Hordeum vulgare* L.) is important cereal crop of ranking just next to the rice, wheat, sorghum and maize both in terms of acreage and grain production. The major barley producing countries are China, Russia, Germany, USA, Canada, India, Turkey and Australia. In India the area under barley cultivation was approximately 0.67 million hectares with production of about 1.64 million tonnes (DAC 2020). In South-west Haryana also barley is an important *rabi* crop due to increasing demand day by malt industries. Cereal- cereal is the most important cropping system which meets the food pool of the nation. However, the cultivation of cereals in a year on the same piece of land leads to imbalance in the soil fertility, resulting in decline of both crops. To obtain an optimum yield, use of more and fertilizers every year affects the soil fertility. Legumes and crop residues assume a special significance in maintaining soil fertility. Exhaustive crops/cropping systems deteriorates the soil health by

Vinod Kumar*
Chaudhary Charan Singh, Haryana Agricultural University, Krishi Vigyan Kendra Mandkola, Haryana 121103, India

M. K. Jat
Chaudhary Charan Singh, Haryana Agricultural University, Regional Research Station, Bawal, Haryana 123501, India
Email: vndmohan@gmail.com
*Corresponding author

excessive mining native of fertility leaving hardly any crop residue which is necessary to maintain desire level of organic matter. Diverse crop rotations are an important part of sustainable agricultural systems. Pulses constitutes an important group of crops and are the main stay in Indian agriculture, as they restore soil fertility, improve physical condition of soil and provide nutritious food and fodder. Increasing yield of pulse crops should be the top priority to fill up the existing gap in the requirement and availability of pulses.

Since the possibility of horizontal expansion or putting more area under cultivation is difficult, future augmentation in yield should have to be harnessed vertically through increase in productivity by judicious management of all inputs, especially nutrients. In the post independence period, the most important challenge in India has been to produce enough food for the growing population. Hence, high-yielding varieties are being used with infusion of irrigation water, fertilizers, or pesticides. This combination of high-yielding production technology has helped the country develop a food surplus as well as contributing to concerns of soil health, environmental pollution, pesticide toxicity and sustainability of agricultural production. Scientists and policy planners are, therefore, reassessing agricultural practices which relied more on biological inputs rather than heavy usage of chemical fertilizers and pesticides. Integrated use of organic and inorganic fertilizers has been found to be quite promising not only in maintaining higher productivity, but also for providing greater stability in crop production (Nambiar and Abrol 1992). Integrated plant nutrition involve judicious and integrated use of chemical/synthetic sources of nutrients along with biofertilizers in addition to nutrient recycling through use of organic manures, green manuring and biodegradable wastes . Biofertilizers offer a low cost, low capital intensive and ecofriendly route to boost the farm productivity depending upon their activity of mobilizing different nutrients. Use of biofertilizer in crop not only fixes the biological nitrogen but also solubilizes the insoluble phosphates in soil and thus improves fertilizers-use efficiency (Gogoi 2008). These microorganisms play an important role in increasing the availability of N, P and K. Therefore the nature and selection of the preceding crops deserve greater importance, while formulating fertilizer recommendation in crop production.

Table 1. Physico-chemical properties of the experimental site (Mean of two years).

Soil properties	Mean Value
Soil texture	loamy sand
pH	8.26
EC	0.20
OC (g kg^{-1})	1.93
Available N (kg ha^{-1})	110.98
Available P (kg ha^{-1})	10.70
Available K (kg ha^{-1})	170.50

MATERIALS AND METHODS

The field experiment was conducted during the consecutive winter seasons of 2012-13 and 2013-14 at CCS HAU, Regional Research Station, Bawal. The site was situated at latitude 28.1° N, longitude 76.5° E and an altitude of 266 m above mean sea-level. The soil properties of the experimental fields (mean of two years) are presented in Table 1. The experimental site experiences a hot summers and cold winters with an average annual rainfall of 255.3 and 292.8 mm during 2012-13 and 2013-14. The study consisted of three preceding crops (pearl millet, mung bean and cluster bean) and six nutrient management treatments viz., T_1 : 100% Recommended dose of fertilizer (RDF), T_2 : 75% RDF + 5 t FYM/ha, T_3 : 75% RDF + 2.5 t vermin-compost/ha, T_4 : 100% RDF +Biomix, T_5:75% RDF+5 t FYM/ha+Biomix, T_6 : 75% RDF + 2.5 t vermin-compost/ha + Biomix . These treatments were evaluated in split-plot design with thrice replications on the preceding crops were allotted in the main plots and the nutrient management treatments in sub-plots. In pearl millet biomix includes *Azotobacter*+PSB while in cluster bean and mung bean biomix includes *Rhizobium*+ PSB. Properly decomposed FYM, containing 0.65% N, 0.50% P and 1.09% K in 2012 and 0.66% N, 0.50% P and 1.02% K in 2013 was applied during *kharif* season crops. Vermin-compost containing 1.09% N, 0.83% P and 1.35% K in 2012 and 1.07% N, 0.83% P and 1.32% K in 2013 was applied during *kharif* season crops. Barley was sown in rows 22.5 cm apart on 21 and 12 November during *rabi* season using seed rate of 77 kg/ha under irrigated

Table 2. Effect of cropping system and nutrient management on yield attributes and grain yield of barley (Pooled data).

Treatments	Plant height (cm)	Effective tillers/ m2	Grains/ spike	Seed yield of kharif crops	Test weight (g)	Gram yield of barley (q ha^{-1})	Straw yield of barley (q ha^{-1})	Harvest index (%)
				Preceding crops				
Pearl millet	97	170	54	23.1	46.3	56.4	78.5	40.62
Mung bean	99	175	57	39.7	46.7	58.0	79.1	41.36
Cluster bean	100	179	61	129.5	46.9	59.6	81.8	42.01
SEm±	0.61	1.26	0.60	4.53	1.4	0.49	0.71	–
CD (p=0.05)	1.80	3.75	1.81	16.00	NS	1.50	2.13	–
				Nutrient management				
T_1	95.6	155	52	59.8	45.9	51.5	78.1	46.0
T_2	97.5	165	54	62.0	46.7	55.6	80.4	47.3
T_3	96.7	170	56	61.0	46.2	53.4	79.2	46.6
T_4	97.1	173	59	63.8	46.9	56.6	79.9	47.4
T_5	99.6	179	61	69.4	47.3	61.5	82.2	47.8
T_6	98.4	175	59.8	68.5	47.1	58.0	81.8	47.5
SEm±	- 0.68	0.97	0.64	0.50	1.4	0.50	0.70	–
CD (p=0.05)	2.0	3.01	1.95	1.51	NS	1.5	2.05	–

condition at the same location. The plot size was 5.0 × 3.6 m. barley was sown with all recommended dose of fertilizers in all plots.

RESULTS AND DISCUSSION

Effect of preceding *kharif* crops on barley

The results revealed that the growth, yield and yield attributes of barley viz., plant height, effective tillers and grains per spike were significantly increased due to preceding pulse crops cluster bean and mung bean crops as compared to cereal pearl millet. Although test weight were at par in both cereals and pulses. The significant higher grain yield of barley was recorded in the preceded cluster bean (59.6 q/ha) followed by mung bean (58 q/ha) and 56.4 q/ha for pearl millet. This might be due to preceding legumes played an important role in restoring the soil fertility in terms of N and other biological parameters due to atmospheric N_2 fixation through symbiotic process, which in turn improved the yield of succeeding crop (Barley) compare with that of preceded cereal (pearl millet). These results are closely resembled with those of Usadadiya and Patel (2013). The value of harvest index of barley preceded cluster bean crop was significantly highest (42.01%) followed by mung bean (41.36 %) and 40.62 5% for pearl millet.

Effect of nutrient management on barley

Application of 75 % RDF+ 5 t FYM+ Biomix @ 10 ml/kg seed significantly influenced all the growth attributes (Table 2). The growth parameters like plant height and tillers per plant were observed more under integrated nutrient management treatments than only RDF. Grain and straw yield of barley was also noted higher under INM treatments than only RDF. Among INM treatments effect of FYM was higher than vermin-compost that may be due to lower levels of N, P, K content in vermin-compost. Similar results were also observed by Malik *et al.* (2009). Application of 75% RDF+ 5 t FYM+ Biomix @ 10 ml/kg seed had significantly on almost all attributes studied during the course of investigation. It might be attributed to the fact that FYM and biomix gave an additive effect on these growth and yiled attributes over only RDF. Application of 75% RDF+5 t FYM+ Biomix @ 10

Table 3. Effect of cropping system and nutrient management on nutrient uptake of barley (Pooled data).

Treat-ments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})			K uptake (kg ha^{-1})		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
T_1	72.13	20.60	92.73	18.70	12.40	31.1	23.50	114.15	137.65
T_2	80.20	23.23	103.43	23.00	15.07	38.07	27.20	120.00	147.20
T_3	75.80	22.70	98.50	20.80	14.07	34.87	25.00	118.30	143.30
T_4	76.05	22.63	98.68	21.60	14.97	36.57	25.90	119.30	145.20
T_5	85.17	32.83	118.00	28.60	20.57	49.17	31.90	128.60	160.50
T_6	78.90	26.60	105.50	26.30	16.17	42.47	29.50	125.60	155.10
CD (p=0.05)	3.12	1.59	3.98	1.96	1.63	2.15	1.57	2.24	3.05

ml/kg seed showed its significantly superiority of 75% RDF+ 2.5 T vermin-compost/ha + Biomix and RDF. It had recorded significantly higher plant height, number of effective tillers, grains per spike and harvest index as compared to 75% RDF+ 2.5 T vermin-compost/ha + Biomix and RDF. The maximum grain yield of barley (61.5 q/ha) and straw yield (82.2 q/ha) were produced in the 75% RDF+ 5 t FYM+ Biomix @ 10 ml/kg seed. In T_5 treatment the grain yield being the function of cumulative effect of yield attributes, increased significantly by 6% than T_6 treatment. A significant improvement in uptake of N, P and K as a consequence of organic manuring have also been reported by Meena *et al.* (2010), Jat *et al.* (2013).

Nutrients uptake

The values of nutrients uptake followed, the same pattern of yield obtained in different treatments. The N uptake by grain and straw of barley significantly increased from 92.73 to 118.00. A further increase in nitrogen uptake by barley grain and straw was recorded with RDF levels along with addition of organic sources which may be attributed to greater production of grain and straw. The highest uptake of N by grain (85.17 kg ha^{-1}) and straw (32.83 kg ha^{-1}) was recorded with 75% RDF + 5 t FYM ha^{-1} + Biomix (T_5). Similar results were reported by Chakrawarty and Kushwah (2009). The uptake of P by barley crop was significantly higher with T_5 over RDF only. This increase may be attributed to better growth and yield of barley. The relatively higher uptake of P by barley grain and straw was recorded with 75% RDF + 5 t FYM ha^{-1} + Biomix (T_5). Higher phosphorus uptake could be attributed to conversion of native phosphorus in to readily available form by organic acids released during the decomposition of FYM and consequent improvement in the available P in soil and better bio-chemical actively in the crop plants. The maximum P uptake was recorded with 75% RDF + 5 t FYM ha^{-1} + Biomix (T_5), which may be attributed to beneficial effect of FYM and biomix (Devi *et al.* 2011). The uptake of potassium increased significantly with 75% RDF + 5 t FYM ha^{-1} + Biomix (T_5) over 100% RDF which may be due to higher availability of the nutrients 75% RDF + 5 t FYM ha^{-1} + Biomix (T_5) as compared to 100% RDF (Table 3). The higher uptake of K by the barley crop was recorded with 100% RDF indicating the beneficial effect of integrated use of FYM, biomix and chemical fertilizers. The combined use of NPK + FYM +biomix proved beneficial as it increased the K uptake by barley grain and straw significantly over control and most of the treatments. This might be due to continuous release of nutrients from soil enriched with FYM and biomix. These results are in conformity with the findings of Singh *et al.* (2013) and Dadheech and Somani (2007). Gan *et al.* (2015) showed that diversifying cropping systems with pulse crops can improve soil N availability and increase system productivity.

CONCLUSION

The study investigation it can be concluded that growing cluster bean and green gram as preceding crops resulted significantly higher grain and straw yields of barley than preceding pearl millet crop. The

integration of nutrient management practices significantly enhanced the N, P and K uptakes by the crop.

REFERENCES

Chakrawarty VK, Kushwaha KP (2009) Performance of barley (*Hordeum vulgare* L.) varieties under sowing dates and nutrient levels in Bundelkhand. *Prog Res* 2 (2) : 163 —164.

DAC Agriculture Statistics at a Glance (2020) Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.

Dadheech SK, Somani LL (2007) Effect of integrated nutrient management in a soybean-wheat crop sequence on the yield, micronutrient uptake and post-harvest availability of micronutrients on typic Ustochrepts soil. *Acta Agronomica Hungarica* 55 (2) : 205—216.

Gan YH, John C O'Donovan T, Herb C, Zentner RP, Campbell Con A, Yining N, Lee P (2015) Diversifying crop rotations with pulses enhances system productivity. Scientific Reports 5, Article number : 14625.doi:10.1038/srep14625.

Gogoi B (2008) Soil properties and nutrient availability as affected by INM after rainfed cropping sequence'. MSc thesis. Assam Agricultural University, Asom, pp 66.

Jat MK, Purohit HS, Singh Bahadur, Garhwal RS, Choudhary Mukesh (2013) Effect of integrated nutrient management on yield and nutrient uptake in sorghum (*Sorghum bicolor*). *Ind J Agron* 58 (4) : 543—547.

Malik BS, Paul S, Ahlawat AK, Singh M, Anju , Shivay YS (2009) Productivity and quality of wheat spp grown with different fertilization condition. *Ind J Agricult Sci* 79 (8) : 636—640.

Meena KN, Kumar A, Rana DS, Meena MC (2010) Productivity and nutrient uptake of maize-wheat cropping system under different bio-sources and nitrogen level. *Ind J Agron* 56 : 182—188.

Nambiar KKM, Abrol IP (1992) Long term fertilizer experiments in India-An over view. *Fertil News* 34 : 11—20.

Singh V, Singh SP, Singh S, Shivay YS (2013) Growth, yield and nutrient uptake by wheat (*Triticum aestivum* L.) as affected by biofertilizers, FYM and nitrogen. *Ind J Agricult Sci* 83 (3) : 331—334.

Usadadiya VP, Patel RH (2013) Influence of preceding crops and nutrient management on productivity of wheat (*Triticum aestivum*)-based cropping system. *Ind J Agron* 58 (1) : 15—18.