Eco. Env. & Cons. 30 (2) : 2024; pp. (683-687)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i02.046

Assessment of the Economics with and yield by Integrated Nutrient Management on Wheat (*Triticum aestivum* L.)

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(Received 29 September, 2023; Accepted 2 December, 2023)

ABSTRACT

An experiment was conducted during the Rabi season of 2017-18 at the student instructional farm of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. The experiment consisted of integrated nutrient management in a randomized block design with three replications. The soil of field analyzed N, P, K, Zn, and S was medium-fertility status in respect of available NPK and S, but Zn status of micronutrient. The treatment (NPK + S + Zn + Azotobacter + PSB + vermicompost) treatment found superior in terms of maximum root and shoot growth, yield attributes and yield the maximum grain yield (58.75 q ha^{-1}), straw yield (79.31 qha^{-1}), Gross income (141586 Rs. ha^{-1}) and Net Income (93036 Rs. ha^{-1}) under-recorded in (NPK + S + Zn + Azotobacter + PSB + vermicompost) treatment the increment in Grain yield, Gross income and net income evaluated 12.76%, 11.34% and 11.19%, respectively under (NPK + S + Zn + Azotobacter + PSB + vermicompost) treatment compared to control treatment.

Key words: *Fertilizer, Azotobacter, FYM, Vermicompost, Yield, Economics*

Introduction

Wheat (*Triticum aestivum* L.) is the most staple and second most important crop after rice, of the country which contributes nearly one-third of the total food grain production. Wheat has been described as the "staff of life or king of cereal" and one of the most important staple food crops. Wheat contains more protein than other cereals and has a relatively high content of Niacin and Thiamine. Worldwide production of wheat was recorded at 780.59 million metric tons in 2022-23 (USDA, 2023). In India, wheat is 30.42 million hectares with total production of 107.6 million tons of wheat withtheaverage productivity of wheat is 3506 Kg ha^{-1} in 2021-22(Anonymous (2022). The increase in production of wheat has been achieved due to an expansion of area under irrigation; fertilizers and adoption of improved cultural practices of wheat. Application of bio-fertilizers are important for aerobic symbiotic bacteria to fixing atmosphere nitrogen in cereal crops of the family Gramineae (Aghaie *et al.,* 2003). If the seed is inoculated with the Azotobacter and sown with favorable weather conditions at proper sowing time with suitable varieties it shall become possible to fetch a good yield of wheat due to this bio-fertilizer are important factors in augmenting the wheat yield. The rate of N-fixation is in the range of 3-15 N kg ha^{-1}

Assistant Professor, Department of Agronomy per year. Singh *et al.*(2004), Dhawan *et al.(*2005), and Kachroo and Razdon (2006). PSB (phosphorus solubilizing bacteria) belongs to the genera *Pseudomonas* and *Bacillus* species the availability to solubilize the bound phosphates in soil and increase its ability to plants. The common PSBs are *Pseudomonas strita* and *Bacillus polymixa*. Inoculation of seeds with microphosphate fertilizer can provide Phosphorus 30 kg ha^{-1}. The productivity of wheat is not increasing in proportionate to nutrient application. Continuous use of sub-optimum doses of fertilizer in imbalance form resulted in declining in the production and productivity of wheat as well as deteriorated fertility. Besides, it also created multi-nutrient deficiency in the soil as well as in crops. Integrated use of organic + inorganic same nutrients agent the crop yield than when each is applied alone. An adequate and balanced supply of plant nutrients is of critical importance in improving the productivity of the wheat crop.

Materials and Methods

A field experiment was carried out at the Students Instructional Farm (SIF) of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India during the Rabi season 2017-18. The experiment farms fall under the Indo-Gangetic alluvial tract and are tub-well irrigated. The university is situated in the Indo-Gangetic alluvial tract of the Central Plain Zone of U.P. that comes in agro-climatic zone-V. The mechanical analysis of the soil of the experimental field was done. The soil was sandy loam in texture with a pH of 8.19 and neutral with low in organic carbon (4.2 g kg^{-1}),available N_2 (189 kgha^{-1}), medium in available P_2O_5 (12 kg ha^{-1}), and available K_2O (176 kgha^{-1}), with bulk density of the soil before the conduct of experiment was 1.36 mg/ cm^3 of 0-15 cm soil depth. The eight integrated nutrient management practices combination of Recommended dose of fertilizer (RDF) (120:60:40:30:5 N:P:K:S:Zn); T_1, RDF + Azotobacter + PSB; T_2, RDF + Azotobacter + PSB +Vermicompost @ 3.0 t/ha; T_3, RDF + Azotobacter + PSB +Vermicompost @ 4.0 t/ ha; T_4, RDF + Azotobacter + PSB +Vermicompost @ 5.0 t/ha; T_5, RDF + Azotobacter + PSB + FYM @ 4.0 t/ha; T_6, RDF + Azotobacter + PSB + FYM @ 8.0 t/ ha; T_7, RDF + Azotobacter + PSB + FYM @ 12.0 t/ha (T_8) were tested in RBD (Randomized block design) replication three times. The seed of wheat variety 'K-1006' was sown in rows of 20 cm seeds. The seed is inoculated with Azotobacter & PSB @ 20 g kg^{-1} of seeds and the wheat crop recorded four irrigations throughout the cropping period. The harvesting of the crop was done on 24th April 2018. Initially with bless and done on 1st May 2018. The cleaned grain was weighed in each net plot with the help of physical balance. The growth in height of the plant was recorded from 5 plants tagged after germination. The fresh and dry weight of the crop was recorded from a 20 cm row length plant cut at the ground level first kept for sun dry and hereafter kept inan electric oven at 68 ^{o}C temperature for 24 hrs. to attain the constant weight. The yield attributes data was recorded for 10 spikes selected randomly from plots before the harvest of a crop.

Results and Discussion

Crop fertilizer with T_5 produced significantly taller plants over the rest of the treatment, however being at par with treatments T_4 and T_8. Application of T_5 produced significantly highest dry matter of crop (19.51 g plant^{-1}), spike weight (60.66 g) and number of grains per spike (45.79 m^2) over the rest of the treatment except T_3, T_4 and T_8 for number of grains per spike (Table 1). It is further noted thatthe application of vermicompost over farmyard manure was found treatment $T_5$and produced significantly higher values of plant height, dry weight of crop, spike weight and number of grains per spike. Vermicompost applied @ 5.0 tha^{-1} or 4.0 tha^{-1} and farm yard manure either 12.0 t ha^{-1} and 8.0 tha^{-1} was on par with each other but recorded significantly higher values of plant height, dry matter accumulation, spike weight and number of spike over their lower doses. Similar higher effect of vermicompost over FYM on wheat growth and yield attributes was recorded by Tiwari *et al.* (2023), Panigrahi *et al.* (2022), Kalam *et al.* (2021), Pandey *et al.* (2020), Hari *et al.* (2017) and Maninder Kaurwalia (2010). Application of the recommended dose of fertilizer along with Azotobacter + PSB produced higher growth and yield attributes over RDF Alone. Application of RDF along with Azotobacter + PSB produced higher grain, straw and biological yield over RDF alone. Wheat fertilizer with vermicompost along with RDF + Azotobacter +PSB produced higher yields (grain, straw and biological yield) as compared to FYM along with RDF + Azotobacter + PSB. Application of vermicompost @ 4.0 t ha^{-1} or 5.0 tha^{-1} was on par with each other over but produced significantly higher growth yield vermicompost applied @ 3.0 t ha^{-1} alone with RDF + Azotobacter + PSB. However, the application of FYM @ 4.0 t ha^{-1}, 8.0 t ha^{-1} and 12.0 tha^{-1} was on par with each other. The higher grain yield with RDF + Azotobacter + PSB over RDF alone was mainly due to nitrogen fertilizer by Azotobacter and the availability of phosphorus due to PSB application. On the other hand higher response of vermicompost applied treatment over farm yard manure treatment was due to the fact that higher release of nutrients due to vermicompost enhanced the growth and yield attributes of wheat crop resulted in higher grain and straw yield. A similar trend of results for straw yield was recorded as in case of grain yield. Similar improvement in grain yield with application of vermicompost was recorded by Pandey *et al.* (2020), Patra and Singh (2018), Polara *et al.* (2010), Nayak *et al*. (2012), Mazumdar *et al.* (2014). Harvest index was significantly highest with RDF + Azotobacter + PSB + vermicompost @ 5.0 t ha^{-1} followed by vermicompost @ 4.0 t ha^{-1} and farmyard manure @ 12.0 t ha^{-1}. Higher harvest index values with RDF + Azotobacter + PSB + vermicompost @ 4.0 tha^{-1} were mains due to higher yield with these treatments. Application of RDF + Azotobacter + PSB +vermicompost @ 5.0 tha^{-1} gave the maximum gross income of 141586 Rs. ha^{-1} and net income of 93036Rs. ha^{-1}. However, RDF + Azotobacter + PSB + recorded the maximum benefit-cost ratio (2.96) followed by RDF + Azotobacter + PSB + vermicompost @5.0 t ha^{-1}. Higher grain and straw yield with RDF + Azotobacter + PSB + vermicompost @ 5.0 t ha^{-1} gave the highest gross and net income. However, lower cost of cultivation with RDF + Azotobacter + PSB as compared to RDF + Azotobacter + PSB + vermicompost @ 5.0 tha^{-1} resulted in a higher benefit: cost ratio, contrary to this, little improvement in grain yield as compared to the cost in RDF + Azotobacter + PSB + vermicompost @ 5.0 tha^{-1} gave lower

Table 1. Effect of treatments on growth and yield parameters at 90 DAS in wheat

Sl. No.	Treatments	AT 90 DAS			Weight of spike (g)	No. of grain $spike^{-1}$
		Plant height (cm)	Fresh Weigh of Plant (g)	Dry weight of Plant (g)		
1.	T_1 RDF (120:60:40:30:5 N:P:K:S:Zn) kg/ha	91.60	40.50	12.17	49.33	42.75
2.	T_2 RDF + Azotobacter + PSB	91.83	42.64	13.50	50.66	43.35
3.	T_3RDF + Azotobacter + PSB + Vermicompost @ 3.0 t/ha	96.20	51.17	16.90	53.66	44.65
4.	T_4RDF + Azotobacter + PSB + Vermicompost @ 4.0 t/ha	97.06	57.22	18.24	56.33	45.35
5.	T_5RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha	99.36	60.04	19.51	60.66	45.79
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	94.16	45.64	14.75	50.33	43.61
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	94.43	49.24	15.37	51.33	43.85
8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	96.80	54.26	17.20	53.00	45.18
	S.E. (d)	1.26	0.04	0.01	1.25	0.8
	C.D. at 5%	2.70	1.79	0.02	2.69	1.7

Table 2. Effect of treatment on biological yield, grain yield, straw yield and harvest index in wheat:

Sl. No.	Treatment	Biological yield (q/ha)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
1.	T_1 RDF (120:60:40:30:5 N:P:K:S:Zn) kg/ha	124.46	51.25	73.21	41.15
2.	T_2 RDF + Azotobacter + PSB	127.73	53.00	74.73	41.49
3.	T_3 RDF + Azotobacter + PSB + Vermicompost + @ 3.0 t/ha	131.97	55.45	76.52	42.01
4.	T_4 RDF + Azotobacter + PSB + Vermicompost + @ 4.0 t/ha	135.22	57.30	77.92	42.37
5.	T_5 RDF + Azotobacter + PSB + Vermicompost. + @ 5.0 t/ha	138.06	58.75	79.31	42.55
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	130.01	54.20	75.82	41.66
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	130.43	54.55	75.88	41.84
8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	132.48	55.90	76.58	42.19
	S.E. (d)	**3.29**	**1.33**	**0.87**	**0.31**
	C.D. at 5%	7.07	2.85	1.86	0.66

Table 3. Effect of gross income, net profit and B:C ratio influenced by treatment:

Sl. No.	Treatment	Total cost (Rs/ha)	Gross income (Rs/ha)	Net profit (Rs/ha)	B:C Ratio
1.	T_1 RDF (120:60:40:30:5 N:P:K:S:Zn) kg/ha	42901	125523	82621	2.9
2.	T_2 RDF + Azotobacter + PSB	43549	129320	85770	2.96
3.	T_3 RDF + Azotobacter + PSB + Vermicompost + @ 3.0 t/ha	46549	134465	87916	2.88
4.	T_4 RDF + Azotobacter + PSB + Vermicompost + @ 4.0 t/ha	47549	138375	90826	2.91
5.	T_5 RDF + Azotobacter + PSB + Vermicompost. + @ 5.0 t/ha	48549	141586	93036	2..92
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	45549	131977	86427	2.89
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	47549	132554	85004	2.78
8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	49549	135276	85727	2.73
	S.E. (d)		0.04	32.21	0.001
	C.D. at 5%		0.09	66.76	0.002

benefit: cost ratio.Similar findings were also reported by Sepat *et al.* (2010)

Conclusion

Based on the findings of the research on wheat crop during 2017-18, it was possible to conclude that the application of T_5 (RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha) was suitable for obtaining higher yield attributes, yield and economics in soil of Kanpur condition. However, because these conclusion based on a one year research data.

Conflict of Interest

Authors declare no conflict of Interest.

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