Original Research Article

Influence of combined nutrient management on growth, yield attributes and grain yield of wheat (*Triticum aestivum* L.)

ABSTRACT

The experiment was conducted at SIF of Chandra Shekhar Azad University of Agriculture & Technology, Kanpurduring Rabi season of 2017-18. It was experiment consisted eight treatments of different nutritional doses of micro nutrient, organic manure, and micro-organisms, along with major nutrient with the objective to find out the effect of vermicompost, FYM, Azotobacter, PSB with chemical fertilizer on growth, treatment combination for wheat and assess the economics of the treatments. Due to balance nutrition in wheat variety Shekhar (K-1006). The experiment was organized under RBD with three Replications. It was soil of field Analyzed medium fertility status in respect of available NPK, S and Zn status of micro nutrient. The sowing was done on 23.11.2017 and harvesting was done on 24.04.2018 The treatment T_5 (RDF + Azotobacter + PSB + vermicompost @ 5 t ha^{-1}) found superior in terms of maximum root and shoot growth, yield attributes and yield the maximum grain yield (58.75 q/ha.), under recorded in T_5 (RDF + Azotobacter + PSB + vermicompost @ 5 t ha^{-1}) treatment compared to control treatment.

KEY WORDS: Azotobacter, PSB, vermicompost, Grain Yield, Wheat

INTRODUCTION

Wheat is a very adoptable crop and is grown under a wide range of soil and climatic condition. Rapidly increasing population and shrinking land resources for agriculture production are putting tremendous pressure on land resource due to intensive cultivation. It is very excess exploitation of natural resources is resulting in the total loss health of soil. Therefore, there is importance for enhancing and sustaining the soil productivity in India (Meena *et al. 2017)*.Worldwide production of wheat was 781.31 million metric tons in 2022-23 (Statista-2023). The major five wheat producing countries are China, European Union, India, Russia and United States of America (USDA 2023).In India, the area under wheat was increased since the start of green revolution in 1967 and the production and productivity were also increased. The area under wheat has 30.45 million hectares in 2022-23; the production of wheat in the country has increased 104 million tons in 2022-23 and productivity of wheat 3400 Kg/hectare in 2022-23(USDA 2023).The major wheat producing states of India are Uttar Pradesh, Madhya Pradesh and Punjab with production of (35.5, 18.18 and17.18 MT) and the Uttar Pradesh ranked first in percentage share of wheat production (31.6%) with the second (17.4%) Madhya Pradesh and third of Punjab (14.7%) (Statista 2021-22). Organic manures hold promise to source of plant nutrient, improve of soil health and can contribute to crop production substantially. Its support he growth and proliferation of soil micro fauna & flora, thereby making the soil a living system (Meena *et al.* 2017).The long term use of inorganic fertilizers without help of organic supplement damages the soil properties such as physical, chemical and biological, and its cause's environment pollution. Organic manures out not only as a source of nutrients and organic matter, but also improve size, biodiversity an

activity of the microbial population in soil, influence soil structure, nutrient turnover and many other changes related to soil properties parameters (Albiach*et al*. 2020).Nitrogen is an important metabolic element for growth and development of plant. It is considered as essential for synthesis of protein and other biochemical products of plant such as protoplasm which is the basis of life. Phosphorus is second important major plant nutrient for crop production. It has been called as "Bottleneck of world hungers". It is a structure component of cell membranes, chloroplast and mitochondria. Potassium plays an important role in the maintenance of cellular organization by regulating the permeability of cellular membranes and keeping the protoplasm in a proper degree of hydration by stabilizing the emulsion of high colloidal properties. Sulphur is a major constituent of amino acid like methionine, cysteine and vitamins lipoid acid and acetyl co-A. Sulphur is associated with aromatic compound and creates a type of fragrance, aroma and smell. Zinc an essential component of various enzyme systems for energy production, protein synthesis and growth regulation. Zinc also influence the translocation and transport of phosphorus in plant. Under zinc deficiency excessive translocation of phosphorus occur resulting in toxicity.FYM is also important component of sustainable agriculture. Besides it has manorial properties and it has valuable physical effect on soil texture and improves water holding capacity of the soil.Vermicompost is the compost that is prepared with the help of earth worms. Vermicompost is an excellent base for the establishment of beneficial free living and symbiotic microbes. Application of vermicompost increases the total microbial population of nitrogen fixing bacteria. These bio-fertilizers are used to inoculate cereal crop for increasing the growth, yield attributes and yield. These bio-fertilizers are important aerobic asymbiotic bacteria to fixing atmosphere nitrogen in cereal crops of family poaceae (Aghai*et al.,* 2003). The rate of N-fixation is in the range of 3-15 kg N/ha per year. (singh*et.al.*2004; Dhawan*et al.*2005; Shavarkar and joshi 2000; kachroo and Razdon2006).PSB (phosphorus solubilising bacteria) belong to the genera pseudomonas and Bacillus posses the availability to solubilise the bound phosphates in soil and increase its ability to plants. The common phosphates solubilising bacteria are *Pseudomonas strita* and *Bacillus polymixa*. Inoculation of seeds with microphosphate fertilizer can provide 30 kg. Phosphorus/ha. The combined supply and use of plant nutrients from chemical fertilizers and organic manures has been shown to produce higher crop yield than when each is applied alone. Their appropriate combinations to a production system for optimum and balanced nutrient supply depend on the land use, ecological, social and economic conditions. (Nayak *et. al.*, 2011; Walia *et al.* 2010).

MATERIALS AND METHODS

The field experiment was carried out in a well-established field at 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 indogangatic alluvial tract and are irrigated by tube well. The university is situated in indogangetic 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 by the "International Pipette Method" as described by Wright (1939). The soil was sandy loam and neutral with low organic carbon (4.2 g/kg), low available N2 (189 kg/ha), medium available P2O5 (12 kg/ha), medium available K2O (176 kg/ha), alkaline soil pH (8.19) and bulk density of the soil before the conduct of experiment was 1.36 mg/cm3 of 0-6 cm soil depth.

Eight treatments, having 7 different integrated combination organic and chemical fertilizer and one chemical fertilizer recommended dose of fertilizer treatment viz.; T1, Recommended dose of fertilizer (RDF) (120:60:40:30:5 N:P:K:S:Zn); T2, RDF + Azotobacter + PSB; T3, RDF + Azotobacter + PSB +Vermicompost @ 3.0 t/ha; T4, RDF + Azotobacter + PSB +Vermicompost @ 4.0 t/ha; T5, RDF + Azotobacter + PSB +Vermicompost @ 5.0 t/ha; T6, RDF + Azotobacter + PSB + FYM @ 4.0 t/ha; T7, RDF + Azotobacter + PSB + FYM @ 8.0 t/ha; T8, RDF + Azotobacter + PSB + FYM @ 12.0 t/ha were tested in RBD (Randomized block design) replication three with a plot size of 5.0 m X 3.0 m. ridge size of 30 cm height was made between replication and individual plots to check the out-flow of nutrients and reduce the border effect. Seed of wheat variety K-1006 was sown at row spacing 20 cm. and line sowing of seed is inoculated with a culture of Azotobacter & PSB @ 20 g/kg of seeds and total no. of 5 irrigations were provided to the crop throughout the cropping period. The harvesting of the entire plots was done when all the Plants started becoming dry and brittle i.e. crop reached maturity. It was done on 24th April 2018. Initially, two rows from both sides of every plot and 25cm inside from the other two ends were harvested and removed. The remaining net plot was harvested, after the crop had been sun-dried for over a week, it was threshed on 1st May 2018. The cleaned grain was weighed in each net plot with the help of physical balance.

RESULT AND DISCUSSION

The plant height differed significantly in all observationrecorded at 60 DAS (Table No.1). The highest of plant height of 60 DAS (56.66 cm) was recorded under treatment i.e. RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha and lowest of plant height was recorded under treatment T_1 RDF (120:60:40:30:5 NPK, S, Zn kg/ha)60 DAS (48.83 cm) respectively.Vermicompost being a source of organic manure it improves all the properties of the soil. Therefore crop plant attain better of growth. Similar finding were also reported by (saren *et al.* 2004;channabasavanna *et al.* 2002;Kachroo and Razdon 2006; Hasina *etal.*2011). The highest productive tillers were recorded in RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha (4.00) and lowest number of tillers were recorded in RDF (120:60:40:30:5 NPK, S, Zn kg/ha) (3.00) control. Vermicompost being a source of organic manure it improves all the properties of the soil. Therefore crop plant attain better of growth.The highest of fresh weight at 60 DAS (39.45 g) was recorded under treatment RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha and the lowest of fresh weight was recorded under T_1, (28.13) RDF (120:60:40:30:5 NPK, S, Zn kg/ha).The highest dry weight of plant at 60 DAS was recorded in treatment RDF+ Azotobacter + PSB + Vermicompost @ 5.0 t/ha (13.15 g) and lowest dry weight of plant was recorded under the treatment T_1 RDF (120:60:40:30:5 NPK, S, Zn kg/ha) (8.83g).

Table-1: Effect of treatments on growth parameters at 60 DAS in wheat

Sl. No.	Treatments	Plant height (cm)	Productive Tillers (m^2)	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	48.83	336.99	28.13	8.83
2.	T_2 RDF + Azotobacter + PSB	49.70	342.99	30.46	10.21
3.	T_3RDF + Azotobacter + PSB + Vermicompost @ 3.0 t/ha	52.50	426.97	35.03	11.66

4.	T_4RDF + Azotobacter + PSB + Vermicompost @ 4.0 t/ha	53.66	433.09	35.03	11.67
5.	T_5RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha	56.66	476.00	39.45	13.15
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	50.33	419.65	30.46	10.15
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	52.00	425.77	32.62	10.87
8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	53.00	428.22	35.03	11.67
	S.E. (d)	**1.11**	**0.27**	**0.02**	**0.30**
	C.D. at 5%	**2.38**	**0.12**	**0.08**	**0.64**

The highest length of spike (13.10 cm) was recorded under the treatment (RDF + Azotobacter + PSB +Vermicompost @ 5.0 t/ha). And the lowest length of spike (11.80 cm) was received under the treatment T_1 RDF (120:60:40:30:5 NPK, S, Zn kg/ha) (Table No. 2). Similar findings were also reported by (Yadav *et al.* 2000; Ali *et al*. 2004; Kachroo and Razdon 2006; Hasina *et.al.* 2011). The maximum number of grains/spike (45.79) was recorded under the treatment (RDF+ Azotobacter + PSB + Vermicompost @ 5.0 t/ha) and lowest number of grains per spike (42.75) was recorded under treatment Ti RDF (120:60:40:30:5 NPK, S, Zn kg/ha). It might be duo to application of organic manure (vermicompost) which improves physical, chemical and biological properties of soil. It also improves water holding capacity of soil along with nutrients uptake capacity of the plant and maintain the temperature of the soil therefore, plant attain better growth and development and yield attributes of the crop. Similar findings were also reported by (Singh *et al*. 2000;Akram *et al*. 2012). The maximum grain weight per spike (2.69 g) was recorded under the treatment (RDF+ Azotobacter + PSB + Vermicompost @ 5.0 t/ha) and the lowest grain weight per spike (1.82 g) was recorded under the treatment T, RDP (120:60 40:30:5 NPK, S, Zn kg/ha). Similar findings were also reported by (Patel *et al.*1991; Patel and Upadhyay 1993). The maximum test weight (40.47 g) was recorded under the treatment (RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha) and the lowest value of the test weight (36.70 g) was recorded under the treatment T1 RDF (120:60:40:30:5 NPK, S, Zn kg/ha) (Table 2). Vermicompost improves physical, chemical and biological properties of soil. It also improves water holding capacity of the plant therefore, plants attain better growth, development aswell as yield attributes of the crop. Similar finding was also reported by (Zeidan and kramany 2001; Hussain *et al.*2008).

Table-2: Effect of treatments on yield attributes in wheat

Sl. No.	Treatments	Length of spike (cm)	Weight of grain(g)/ spike	No. of grain/spike	Test weight (g)
1.	T_1 RDF (120:60:40:30:5 N:P:K:S:Zn) kg/ha	11.80	1.82	42.75	36.70
2.	T_2 RDF + Azotobacter + PSB	11.96	1.98	43.35	37.75
3.	T_3RDF + Azotobacter + PSB + Vermicompost @ 3.0 t/ha	12.20	2.24	44.65	39.19
4.	T_4RDF + Azotobacter + PSB + Vermicompost @ 4.0 t/ha	12.60	2.55	45.35	40.22
5.	T_5RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha	13.10	2.69	45.79	40.47
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	12.03	2.08	43.61	38.29
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	12.10	2.20	43.85	38.72

8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	12.53	2.39	45.18	39.77
	S.E. (d)	**0.15**	**0.06**	**0.8**	**0.31**
	C.D. at 5%	**0.23**	**0.13**	**1.7**	**0.66**

The highest significant values are yield of grain(58.75 q/ha), straw (79.31 q/ha), biological(138.06 q/ha) and harvest index(42.55 %) was observed under the treatment T_5(RDF + Azotobacter + PSB +Vermicompost @5.0 t/ha) and the lowest values yield of grain (51.25 q/ha), straw (73.21 q/ha), biological (124.46 q/ha) and harvest index (41.15 %) was recorded under the treatment T_1 (RDF 120:60:40:30:5 NPK, S, Zn kg/ha) data showing in the table-3. Similar findings were also reported by(Meena *et al.* 2017;paretaet *al.* 2009;vermaet *al*. 2015;Polara *et al*.2010).

Table-3: Effect of treatments on test weight and grainyield in wheat

Sl.No.	Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
1.	T_1 RDF (120:60:40:30:5 N:P:K:S:Zn) kg/ha	51.25	73.21	124.46	41.15
2.	T_2 RDF + Azotobacter + PSB	53.00	74.73	127.73	41.49
3.	T_3RDF + Azotobacter + PSB + Vermicompost @ 3.0 t/ha	55.45	76.52	131.97	42.01
4.	T_4RDF + Azotobacter + PSB + Vermicompost @ 4.0 t/ha	57.30	77.92	135.22	42.37
5.	T_5RDF + Azotobacter + PSB + Vermicompost @ 5.0 t/ha	58.75	79.31	138.06	42.55
6.	T_6RDF + Azotobacter + PSB + FYM @ 4.0 t/ha	54.20	75.82	130.01	41.66
7.	T_7RDF + Azotobacter + PSB + FYM @ 8.0 t/ha	54.55	75.88	130.43	41.84
8.	T_8RDF + Azotobacter + PSB + FYM @ 12.0 t/ha	55.90	76.58	132.48	42.19
	S.E. (d)	**1.33**	**0.87**	**3.29**	**0.31**
	C.D. at 5%	**2.85**	**1.86**	**7.07**	**0.66**

CONCLUSION

Application of integrated nutrient management significantly influenced growth, yield attributes and yield of wheat crop. The superior growth, yield attributes and highest grain yield (58.75) t/ha was received in RDF + Azotobacter + PSB + Vermicompost @5.0 t/ha. Application of RDF+ Azotobacter + PSB + Vermicompost @ 5.0 t/ha was found superior among rest of the treatments.

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