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Effect of integrated nutrient management on yield attributes, yield and economics of wheat (*Triticum aestivum* L.) under central plain zone of U.P

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Abstract
A field experiment was conducted during *Rabi* season of 2019-20 and 2020-21 at the Agricultural research farm of Rama University, Mandhana, Kanpur (U.P), to assess the response of integrated nutrient management on yield and economics of wheat. The soil of the experimental field was sandy loam with pH 7.5, 0.41% organic carbon, 0.13 dSm^{-1} electrical conductivity, having available nitrogen 227.6 kg ha^{-1}, available phosphorous 13.9 kg ha^{-1} and available potassium 173.9 kg ha^{-1}. The experiment comprised 11 treatments, *viz*., T_1-Control, T_2-100% NPK (120:60:40 kg ha^{-1}), T_3-100% NPK+ Zn (5 kg ha^{-1}), T_4-100% NPK + Zn + S (25 kg ha^{-1}), T_5-100% NPK + Zn + S + *Azotobacter* + PSB, T_6-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}), T_7-100% NPK + Zn + S + FYM (5.0 t ha^{-1}), T_8-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + *Azotobacter* + PSB, T_9-100% NPK + Zn + S + FYM (5.0 t ha^{-1}) + *Azotobacter* + PSB, T_{10}-75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobacter* + PSB, T_{11}-75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + *Azotobacter* + PSB. The experiment was laid out in randomized block design, replicated thrice. The maximum grain yield (4.72 and 4.95 t ha^{-1}) were recorded in application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobacter* + PSB (T_{10}) was statistically superior over all the treatments except T_{11} and T_8 during both the year. Application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobacter* + PSB (T_{10}) recorded higher net return (Rs 57,690 ha^{-1} and Rs 58,170 ha^{-1}) and maximum B:C ratio (1.61:1, 1.58:1) were recorded under 100% NPK + Zn + S + *Azotobacter* + PSB (T_5) during both the years.

Keywords: Azotobacter, economics, FYM, inorganic, PSB, vermicompost, wheat, yield

1. Introduction
Wheat is grown extensively in Uttar Pradesh as staple food crop and plays a pivotal role in agricultural economy of the state. Crop is crucial for food security and social stability. The productivity of wheat has been stagnant in the state during the last decade and so. In U.P. Wheat is grown under different cropping systems and occupies about 9.5 million ha of area with an average productivity of 3,432 kg ha^{-1} (Agricultural Statistics at a Glance, 2020). Productivity of wheat is relatively poor in state with narrow profit margins. Under certain situations, cost of cultivation exceeds the net realization, making it an unprofitable. Yield enhancement has been the major agronomical challenge. In order to meet the food demands on a rising population in the first decades of the 21st century, farmers must manage nutrients and soil fertility in an integrated way. Required yield increases of major crops cannot be attained without ensuring that plants have an adequate, balanced supply of nutrients.

The fertilizer consumption in India including U.P. is grossly unbalanced, 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. Apart from improved varieties and irrigation, limited use of organic manure and imbalance in use of chemical fertilizers leading to the emergence of multiple nutrient deficiencies are major constraints in realizing higher yield. Integration of inorganic and organic sources such as vermicompost, poultry manure, farmyard manure (FYM) and their efficient management has sown promise in sustaining the productivity and soil health besides meeting part of crop nutrient requirement (Chaudhary *et al*., 2014) [2]. Integrated nutrient management (INM) is an approach that seeks to both increase agricultural production and safeguard the environment for future generations. It is a strategy that incorporates both organic and inorganic plant nutrients to attain higher crop productivity, prevent soil degradation, and thereby help meet future food supply needs.

The basic concept underlying the integrated plant nutrient supply system is the maintenance of soil fertility, sustaining agricultural productivity and improving farmer's profitability through judicious and efficient use of fertilizers, organic manures and biofertilizers to the extent possible. Study was undertaken to evaluate the various integrated nutrient management package on yield attributes, yield and economics of wheat.

2. Materials and Methods

A field experiment was conducted during *Rabi* season of 2019-20 and 2020-21 at the Agricultural research farm of Rama University, Mandhana, Kanpur, U.P., which is situated at latitude of 26^0 58' N and longitude of 80^0 34' E and an altitude of 125.9 meters above the mean sea level (Arabian Sea). The soil of the experimental field was sandy loam with pH 7.5, 0.41% organic carbon, 0.13 dSm^{-1} electrical conductivity, having available nitrogen 227.6 kg ha^{-1}, available phosphorous 13.9 kg ha^{-1} and available potassium 173.9 kg ha^{-1}. The experiment comprised 11 treatments, *viz*., T_1-Control, T_2-100% NPK (120:60:40 kg ha^{-1}), T_3-100% NPK+ Zn (5 kg ha^{-1}), T_4-100% NPK + Zn + S (25 kg ha^{-1}), T_5-100% NPK + Zn + S + Azotobactor + PSB, T_6-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}), T_7-100% NPK + Zn + S + FYM (5.0 t ha^{-1}), T_8-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + Azotobactor + PSB, T_9-100% NPK + Zn + S + FYM (5.0 t ha^{-1}) + Azotobactor + PSB, T_{10}-75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + Azotobactor + PSB, T_{11}-75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + Azotobactor + PSB. The experiment was laid out in randomized block design, replicated thrice. The organic manures were applied as per their nutrient content on oven-dry weight basis. Composite samples from each manure were collected one week before application to plots and were analyzed for nutrient composition. The FYM and vermicompost contained 0.48 and 1.83% N; 0.21 and 0.62% P_2O_5; and 0.48 and 1.19% K_2O, respectively. Organic manures were applied as per treatment at sowing mixed thoroughly in top soil layer. Wheat (cv. 'K 1006') was sown during the second fortnight of November each year. Inoculation of wheat seed with *Azotobactor* and phosphorus-solubilizing bacteria were done by mixing the seed with 10% jaggery-biofertilizers solution before to sowing. Only recommended dose of N, P_2O_5 and K_2O (120:60:40 kg ha^{-1}) were applied through urea, dia ammonium phosphate and muriate of potash, respectively. Out of which full dose of nitrogen P and was uniformly applied in all the plots before sowing of wheat. Nitrogen was used in 3 equal splits, i.e. at seeding, after first irrigation and at boot stage. Need based cultural operations were followed. Soil samples were collected from the surface layer (0-15 cm) from all the plots before treatment application and after wheat harvesting. Economics of wheat cultivation as influenced by organic manures, chemical fertilizers and integrated nutrient management were calculated by considering the prevailing market price of wheat grain, straw and different inputs.

3. Results and Discussion

3.1 Yield attributes

Yield attributes of wheat, *viz*. spike length, number of spikeletes $spike^{-1}$, number of grains $spike^{-1}$ and 1,000- grain weight were significantly influenced by different nutrient management options (Table 1). Application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{10}) was recorded significantly higher values of all the yield attributes than that with rest of the treatments, however statistically at par with application of 75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{11}). Lowest values of all the yield attributes were found in control treatment (T_1) during 2019-20 and 2020-21. The enhanced early vegetative growth in terms of higher plant height, leaf area index resulted in more spike which consequently increased the number of spike bearing tillers significantly. Stimulated vegetative growth on account of adequate and prolonged supply of essential nutrients receiving organic at 75% NPK in addition to fertilizer Zn + S + vermicompost manifested itself in increased number of spikeletes $spike^{-1}$, number of grains $spike^{-1}$ and 1,000- grain weight. It is a well established fact that addition of organic manure improves the physical and biological properties of soil. Reduced bulk density (BD) causing less penetration impedance may be responsible for better root development thereby producing higher yield attributes. Singh *et al*. (2010) [9] and Chaudhary *et al*. (2014) [2] also reported beneficial effect of organics.

3.2 Yield

Different treatment combinations had marked differences in the productivity of wheat (Table 2). Application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{10}) was recorded significantly maximum grain (4.72 and 4.95 t ha^{-1}) and straw (6.36 and 6.56 t ha^{-1}) which was statistically at par with application of 75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{11}) and 100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + *Azotobactor* + PSB (T_8) during both the years. The lowest grain yield (2.94 and 3.18 t ha^1) was recorded in control (T_1). The higher values of harvest index 42.63% and 43.01% during 2019-20 and 2020-21, respectively recorded under treatment application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{10}) which was significantly higher than remaining treatments except treatment application of 75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{11}) during both the years. The lowest harvest index of 39.57% and 39.83% was recorded in control (T_1). The beneficial effect of organic manures on grain and straw yields might be assigned to the fact that after proper decomposition and mineralization, these manures supplied available plant nutrients directly to the plants and also had solublising effect on fixed forms of nutrients in soil. The organic manures also increase the adsorptive power of soil for cations and anion particularly phosphates and nitrates and these adsorbed ions are released slowly for the benefit of crop during entire crop growth period leading to higher yields reported by Singh and Singh (2005) [8], Dadnia *et al.* (2010) [3] and Gul *et al.* (2011) [4].

3.3 Economics

The data indicate the maximum cost of cultivation (Rs. 41,114 and 42,648 ha^{-1}) was observed under treatment application of 100% NPK (T_2) followed by treatment T_3, T_{11} and T_{10}.The lowest cost of cultivation (Rs. 31,320 and Rs. 32,975 ha^{-1}) was observed in the control plots during both the years. The data indicates that the highest gross (Rs. 94,269 and Rs. 96,854 ha^{-1}) and net (Rs. 57,690 and Rs. 58,170 ha^{-1}) returns were obtained from the application of 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{10}) followed by 75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + *Azotobactor* + PSB (T_{11}) and 100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + *Azotobactor* + PSB (T_8). The lowest gross (Rs. 64,117 ha^{-1} and Rs. 65,881 ha^{-1}) net (Rs. 32,797 and Rs. 32,906 ha^{-1}) returns were observed in the control treatment (T_1) during 2019-20 and 2020-21.

The application of 100% NPK + Zn + S + *Azotobacter* + PSB (T_5) showed the maximum benefit: cost (1.61 and 1.58), followed by treatment 100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + *Azotobacter* + PSB (T_8) and 75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + *Azotobacter* + PSB (T_{10}). The lowest benefit: cost ratio (1.05 and 1.00) was observed in the control treatment. The result on current studies showed that cost of cultivation was marginally higher when the nutrients were applied in combinations. Due to higher grain and straw yields, the gross return and net income was also higher with use of organic and inorganic fertilizers. Similar results were also reported by Gupta *et al.* (2007) [5] and Jat *et al.* (2013) [6].

Table 1: Yield attributes of wheat as influenced by integrated nutrient management practices

	Spike length (cm)		Number of spikelets spike^{-1}		Number of grains spike^{-1}		1,000 grains weight (g)	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
T_1-Control	7.32	7.55	7.65	8.00	27.47	30.82	33.17	34.12
T_2-100% NPK (120:60:40 kg ha^{-1})	9.32	8.54	13.82	14.10	34.13	34.56	37.06	37.33
T_3-100% NPK+ Zn (5 kg ha^{-1})	10.15	8.87	14.13	14.35	34.42	36.10	37.29	37.7
T_4-100% NPK + Zn + S (25 kg ha^{-1})	9.89	9.38	14.34	14.85	34.91	39.44	37.65	37.92
T_5-100% NPK + Zn + S + Azotobactor + PSB	9.84	9.62	15.05	15.13	35.14	35.35	37.91	38.09
T_6-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1})	10.00	10.50	16.13	16.03	38.56	39.12	38.21	38.42
T_7-100% NPK + Zn + S + FYM (5.0 t ha^{-1})	9.91	10.18	15.62	15.85	35.84	37.23	38.13	38.31
T_8-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + Azotobactor + PSB	10.61	10.86	16.85	17.25	40.13	42.22	38.56	38.78
T_9-100% NPK + Zn + S + FYM (5.0 t ha^{-1}) + Azotobactor + PSB	9.54	10.52	16.52	16.75	39.45	40.84	38.36	38.61
T_{10}-75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + Azotobactor + PSB	11.68	12.85	17.78	18.20	43.68	45.71	40.05	40.25
T_{11}-75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + Azotobactor + PSB	11.13	11.67	17.11	17.65	41.86	43.10	39.00	39.12
S.Em (±)	0.22	0.29	0.22	0.24	0.42	0.39	0.45	0.28
C.D. (P=0.05)	0.68	0.87	0.67	0.72	1.25	1.16	1.34	0.84

Table 2: Effect of integrated nutrient management practices on yield and harvest index of wheat

Treatment	Grain Yield (t ha^{-1})		Straw Yield (t ha^{-1})		Harvest Index (%)	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
T_1-Control	2.94	3.18	4.49	4.80	39.57	39.83
T_2-100% NPK (120:60:40 kg ha^{-1})	4.25	4.55	5.94	6.24	41.71	42.18
T_3-100% NPK+ Zn (5 kg ha^{-1})	4.33	4.60	5.97	6.27	41.81	42.31
T_4-100% NPK + Zn + S (25 kg ha^{-1})	4.39	4.63	6.01	6.29	42.18	42.37
T_5-100% NPK + Zn + S + Azotobactor + PSB	4.42	4.64	6.06	6.32	42.19	42.32
T_6-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1})	4.45	4.65	6.09	6.35	42.21	42.44
T_7-100% NPK + Zn + S + FYM (5.0 t ha^{-1})	4.41	4.65	6.13	6.41	42.41	42.59
T_8-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + Azotobactor + PSB	4.66	4.84	6.30	6.48	42.52	42.85
T_9-100% NPK + Zn + S + FYM (5.0 t ha^{-1}) + Azotobactor + PSB	4.53	4.76	6.15	6.41	42.42	42.61
T_{10}-75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + Azotobactor + PSB	4.72	4.95	6.36	6.56	42.63	43.01
T_{11}-75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + Azotobactor + PSB	4.68	4.89	6.33	6.51	42.59	42.92
S.Em (±)	0.55	0.46	0.58	0.47	0.14	0.44
C.D. (P=0.05)	1.63	1.39	1.73	1.40	0.048	0.131

Table 3: Effect of nutrient management practices on cost of cultivation, gross return, net returns and B:C ratio

Treatment	Cost of cultivation (Rs ha^{-1})		Gross return (Rs ha^{-1})		Net returns (Rs ha^{-1})		B: C ratio	
	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21	2019-20	2020-21
T_1-Control	31,320	32,975	64,117	65,881	32,797	32,906	1.05	1.00
T_2-100% NPK (120:60:40 kg ha^{-1})	41,114	42,648	87,502	89,048	46,388	46,400	1.13	1.09
T_3-100% NPK+ Zn (5 kg ha^{-1})	40,814	41,177	88,818	89,906	48,004	48,729	1.18	1.18
T_4-100% NPK + Zn + S (25 kg ha^{-1})	36,562	37,364	89,853	91,427	53,291	54,063	1.46	1.45
T_5-100% NPK + Zn + S + Azotobactor + PSB	34,695	35,897	90,539	92,675	55,844	56,778	1.61	1.58
T_6-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1})	36,279	37,364	90,157	91,923	53,878	54,559	1.49	1.46
T_7-100% NPK + Zn + S + FYM (5.0 t ha^{-1})	35,979	38,044	90,684	92,871	54,705	54,827	1.52	1.44
T_8-100% NPK + Zn + S + Vermicompost (5.0 t ha^{-1}) + Azotobactor + PSB	36,055	38,164	93,073	95,678	57,018	57,514	1.58	1.51
T_9-100% NPK + Zn + S + FYM (5.0 t ha^{-1}) + Azotobactor + PSB	36,495	38,406	90,580	92,795	54,085	54,389	1.48	1.42
T_{10}-75% NPK + Zn + S + Vermicompost (10.0 t ha^{-1}) + Azotobactor + PSB	36,579	38,684	94,269	96,854	57,690	58,170	1.58	1.50
T_{11}-75% NPK + Zn + S + FYM (10.0 t ha^{-1}) + Azotobactor + PSB	36,795	38,817	94,321	96,569	57,526	57,752	1.56	1.49

4. Conclusion

Thus it may be concluded that the application of 100% NPK + Zn + S + *Azotobactor* + PSB (T_5) may be best option for higher productivity and profitability of wheat crop.

5. Reference

1. Agricultural Statistics at a Glance. Government of India, Ministry of Agriculture & farmers welfare, Department of Agriculture, Cooperation & Farmers Welfare,

Directorate of Economics and Statistics, New Delhi, 2020.
2. Chaudhary SK, Singh SP, Singh Y, Dharminder. Influence of integrateduse of fertilizers and manures on SRI grown rice (*Oryza sativa*) and their residual effect on succeeding wheat (*Triticum aestivum*) in calcareous soil. Indian Journal of Agronomy 2014;59(4):527-533.
3. Dadnia MR, Asgharzadeh A, Talavari F. Effect of late application of foliar nitrogen on yield of wheat. Research on Crops 2010;11(3):632-635.
4. Gul H, Said A, Saeed B, Ahmad I, Ali K. Response of yield and yield components of wheat towards foliar spray of nitrogen, potassium and zinc. Journal of Agricultural and Biological Science 2011;6(2):23-25.
5. Gupta M, Bali AS, Sharma BC, Kachroo D, Bharat A. Productivity, nutrient uptake and economics of wheat (*Triticum aestivum*) under various tillage and fertilizer management practices. Indian Journal of Agronomy. 2007;52(2):127-130.
6. Jat G, Majumdar SP, Jat NK, Majundar SP. Potassium and zinc fertilization of wheat (*Triticum aestivum*) in Western arid zone of India. Indian Journal of Agronomy 2013;58(1):67-71.
7. Patra AP, Panda D, Patra BC, Karmakar AJ. Effect of FYM, Zinc and NPK fertilizer on yield components and yield of wheat after winter rice in West Bengal. Journal of Interacademicia 1998;2(1/2):1-6.
8. Singh Jintendra, Singh KP. Effect of organic manure and herbicides on yield and yield attributes of wheat. Indian Journal of Agronomy 2005;50(4):289-291.
9. Singh Ajay, Yadav AS, Verma SK. Productivity, nutrient uptake and water use efficiency of wheat (*Triticum aestivum* L.) under different irrigation levels and fertility sources. Indian Journal of Ecology 2010;37(1):13-17.