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Effect of Integrated Nutrient Management on Nitrogen Uptake and Yield of Wheat Crop (*Triticum Aestivum l.)*

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Research Article

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ABSTRACT

A field experiment was conducted during the rabi season of 2013-14 and 2014-15 at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur to evaluate the different levels of INM on nitrogen uptake and yield of wheat. The experiment was comprising sixteen treatments *viz.* T1-control, T2-100%RDF, T3-100%RDF+S, T4-100%RDF+S+Zn, T5-100% R.D.F.+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T6-100% R.D.F.+25% N through F.Y.M., T7-100% R.D.F.+25% N through F.Y.M.+S, T8-100% R.D.F.+25% N through F.Y.M.+S+Zn, T9-100%R.D.F.+25% N through F.Y.M.+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T10-100% R.D.F.+25% N through vermi compost, T11- 100% R.D.F.+25% N through vermi compost+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T12-75% R.D.F., T13-75% R.D.F.+25% N through F.Y.M., T14-75% R.D.F.+25% N through vermi compost, T15-75% R.D.F.+25% N through F.Y.M.+S+Zn+bio-fertilizer (Azotobactor+P.S.B.) and T16-75% R.D.F.+25% N through vermi compost+ S+Zn+bio-fertilizer (Azotobactor+P.S.B.). Maximum accumulation of N at late tillering, milking and at harvest in grain and straw was recorded with T11 (100%R.D.F.+25%N through vermicompost+S+Zn+bio-fertilizers (Azotobactor+ P.S.B.) followed by T9 (100% R.D.F.+25% N through F.Y.M.+S+Z+bio-fertilizers (Azotobactor+P.S.B.) and minimum at control (T1) during both the years.

Highest grain yield was recorded in 46.50 and 44.70 q ha-1 with T11 (100% R.D.F.+25% N through vermin compost+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) which was 104% and 108% higher to the lowest yield 22.80 and 21.50 q ha-1 at control T1 and 32% and 34.5% higher to 100% RDF treatment (T2). The maximum cost of cultivation Rs. 32270 and Rs. 35267, gross return Rs. 89032 and Rs. 90530 and net return Rs. 56762 and Rs. 55263 with the

application of 100% R.D.F.+25% N through vermin compost+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) T11 followed by T9 (100% R.D.F.+25%N through F.Y.M.+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) and minimum was recorded with control (T1) during both year, respectively.

INTRODUCTION

Wheat (*Triticum aestivum L.*) being a major cereal crop has been cultivated in India and belong to family Poaceae. Wheat is the world's leading cereal crop cultivated over an area of about 226.45 m ha with a production of 161.9 m tones. India has 30.22 mha areas under wheat cultivation with production of 93.50 mt. Wheat grains are comparatively better source of protein consumed in India. 0 About 10-12% protein requirement is met by wheat, maneuvering the application of different fertilizers could increase the productivity of the wheat crop and the protein content. The declining response to inputs has been received to be the major issue challenging the sustainability of wheat based cropping system [1]. On account of containing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrients is assuming importance. Under this situation, Integrated Nutrient Management (INM) is a better approach for supplying nutrition to the crop by including organic and inorganic sources of nutrients. Integration of inorganic fertilizers with organic manures and bio-fertilizers will not only help sustain the crop productivity but also will be effective in improving soil health and hastening the nutrient-use efficiency [2]. The highest yields were recorded under the treatments of vermicompost at 15 t ha^{-1} and recommended dose of NPK [3]. In terms of the C storage capacity, the soil system triples the atmosphere and all living terrestrial plants Soil also contain some specific group of soil micro organisms which increase the availability of phosphate to plants, not only by mineralizing organic phosphorus compounds but also by rendering inorganic phosphorus compounds more available to plant [4,5]. PSB reside in a plant rhizosphere; increase the availability of P for the plants by solubilization of bound P in soil [6]. The application of organic manuring and crop residue had significant effects on physical properties of the soil under the rice-wheat system in Punjab [7]. Organic manures supports soil biological activities besides improving soil structure, water holding capacity and other physicochemical properties of soil. Eight years of study on INM in rice wheat at Jabalpur (Vertisols) revealed that conjunctive use of 5 t FYM and 6 t green manure with 90 kg N ha^{-1} not only sustained the productivity but also saved nearly 90-100 kg ha^{-1} yr^{-1} fertilizer N. Use of organic manures in INM helps in mitigating multiple nutrient deficiencies. Application of organic manures, *i.e.,* FYM 10 t ha^{-1} and vermicompost 5 t ha^{-1} with 60 kg P_2O_5 ha^{-1} or 40 kg P_2O_5 ha^{-1}+PSB and 40 kg S ha^{-1} produced maximum wheat grain and straw yield. Organic and inorganic fertilizers as a part of the integrated nutrient management strategy and play significant role in plant nutrition. The role of biofertilizers is perceived as growth regulators besides biological nitrogen fixation collectively leading to much higher response on various growth and yield attributing characters [8]. Thus judicious use of organic manure, biofertilizer and organic fertilizer helps in sustain production of wheat.

MATERIALS AND METHODS

The present study was carried out by Chandra Shekhar Azad University of Agriculture and Technology, Kanpur for two consecutive years from 2013-14 and 2014-15 to evaluate the different levels of INM on yield and economics of wheat. The experiment was comprising sixteen treatments *viz.* T_1-control, T_2-100%RDF, T_3-100%RDF+S, T_4-100% RDF+S+Zn, T_5-100% R.D.F.+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T_6-100% R.D.F.+25% N through F.Y.M., T_7-

100%R.D.F.+25% N through F.Y.M.+S, T_8-100% R.D.F.+25% N through F.Y.M.+S+Zn, T_9-100% R.D.F.+25% N through F.Y.M.+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T_{10}-100% R.D.F.+25% N through vermi compost, T_{11}-100% R.D.F.+25% N through vermi compost+S+Zn+bio-fertilizer (Azotobactor+P.S.B.), T_{12}-75% R.D.F., T_{13}-75% R.D.F.+25% N through F.Y.M., T_{14}-75% R.D.F.+25% N through vermi compost, T_{15}-75% R.D.F.+25% N through F.Y.M.+ S+Zn+bio-fertilizer (Azotobactor+P.S.B.) and T_{16}-75% R.D.F.+25% N through vermi compost+S+Zn+bio-fertilizer (Azotobactor+P.S.B.). The experiment consists of randomized block design with three replications. Physio-chemical characteristics of soil of the experimental field of sand 56.80, silt 23.40%, clay 19.85, PH 8.30 and Organic Carbon (%) 0.420, plot size of the experiments was 24.5 m^2 with wheat variety PBW 550. The crop was fertilized as per the treatment. The recommended dose of fertilizers ie. N, P and K was applied @120 kg, 60 kg and 60 kg ha^{-1}, respectively. Urea, DAP, Murate of potash, elemental sulphur, zinc oxide, FYM, vermicompost and bio fertIlizer (Azotobactor and P.S.B.) were used as the source of nitrogen, phosphorus, potassium sulphur and zinc. Dose of nitrogen along with full doses of phosphorus and potassium were applied as basal dressing. Remaining dose of nitrogen was applied through top dressing after 25-30 DAS. Zinc and Sulphur were applied Organic manures and bio-fertilizer (Azotobactor and P.S.B.) were applied 15 days before sowing. The plant sample were taken at 40, 80 day's and harvesting stage from each plot were washed with running tap water to remove the sticking soil particles. It was then chaffed and was air dried first and then kept at 60-70^{0}C for 6-8 hours to make it free from moisture. Similar procedure was adopted for the analysis of grain samples also. The formula expressed below was used for the computation of uptake of the nitrogen at 40 days, 80 days and at harvest in both grains as well as straw. The crop was harvested at proper stage of maturity as determined by visual observations. Half meter length on either end of each plot and 2 border rows from each side as border were first removed from the field to avoid error. The crop in net plot was harvested for calculation of yield data. Data recorded in respect of yield and economics by the method as given by Fisher.

$$\text{Uptake of nutrient (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) X Yield (kg ha}^{-1})}{100}$$

RESULTS AND DISCUSSION

Nitrogen uptake at late tillering stage (at 40 days after sowing) The data in regard to N uptake given in Table 1 revealed that all the treatments showed significant increase in N uptake in comparison to control. Maximum nitrogen uptake 29.40 and 28.27 kg ha^{-1} was recorded with T_{11} (100% R.D.F.+25% N through vermicompost +S +Zn+bio-fertilizers (Azotobactor+ P.S.B.) followed by T_9 (100% R.D.F.+25% N through F.Y.M.+S+Zn+bio fertilizers (Azotobactor+P.S.B.) and minimum 12.90 and 12.09 kg ha^{-1} at control (T_1) during 1st year and 2nd year respectively. Nitrogen uptake at milking stage (at 80 days after sowing) It is visualized from the data given in table 1 showed significant increase in nitrogen accumulation in all the treatments in comparison to control (T_1). Maximum uptake 65.14 and 63.14 kg ha^{-1} was recorded with T_{11} (100%R.D.F.+25%N through vermi compost+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) followed by T_9 (100%R.D.F.+25%N through F.Y.M.+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) and minimum 29.23 and 27.73 kg ha^{-1} at control (T_1) during 1st year and 2nd year respectively.

Table 1. Effect of integrated nutrient management on nutrient uptake (40 DAS and 80 DAS).

Treatment	N. uptake (kg ha^{-1}) at 40 DAS		N. uptake (Kg ha^{-1}) at 80 DAS	
	2013-2014	2014-2015	2013-2014	2014-2015

T_{1}- Control	12.90	12.09	12.90	12.09
T_{2}-100% R.D.F.	15.25	14.28	15.25	14.28
T_{3}-100% R.D.F.+S	17.95	16.77	17.95	16.77
T_{4}-100% R.D.F.+S+Zn	20.85	19.51	20.85	19.51
T_{5}-100% R.D.F.+S+Zn + Bio- fertilizers (*Azotobactor*+ P.S.B.)	22.05	20.76	22.05	20.76
T_{6}-100% R.D.F.+25% N through F.Y.M.	15.87	15.25	15.87	15.25
T_{7}-100% R.D.F.+25% N through F.Y.M.+S	23.73	22.82	23.73	22.82
T_{8}-100% R.D.F. + 25% N through F.Y.M.+ S+Zn	25.37	24.22	25.37	24.22
T_{9}-100% R.D.F.+25% N through F.Y.M. +S+Zn+Bio fertilizers (*Azotobactor*+ P.S.B.)	27.19	26.06	27.19	26.06
T_{10}-100% R.D.F. +25% N through vermicompost	19.03	18.28	19.03	18.28
T_{11}-100% R.D.F. +25% N through vermicompost +S+Zn+Bio fertilize (*Azotobactor*+ P.S.B.)	29.40	28.27	29.40	28.27
T_{12}75% R.D.F.	13.80	12.93	13.80	12.93
T_{13}-75% R.D.F. +25% N through F.Y.M.	14.29	13.39	14.29	13.39
T_{14}-75% R.D.F. +25% N through vermicompost	14.76	13.86	14.76	13.86
T_{15}- 75% R.D.F. +25% N through F.Y.M. +S+Zn+Bio-fertilizers (*Azotobactor*+ P.S.B.)	16.89	16.12	16.89	16.12
T_{16}- 75% R.D.F. +25% N through vermicompost+S+Zn+Bio-fertilizers (*Azotobactor*+P.S.B.)	19.72	18.89	19.72	18.89
S.E. ±	1.627	1.479	1.627	1.479
C.D. (at 5 %)	3.340	3.036	3.340	3.036

Nitrogen uptake in grain the data depicted in table 2 showed that N uptake in grain was found significantly higher in all the treatments in comparison to control during 1st year and 2nd year respectively [9]. Wide variation in N uptake within all the treatments was recorded during both the years. Maximum N uptake 101.37 and 96.11 kg ha^{-1} was recorded with T_{11} (100% R.D.F.+25% N through vermicompost+S+Zn+bio-fertilizers (Azotobactor+P.S.B.) and minimum 39.90 and 36.76 kg ha^{-1} in control during 1st year and 2nd year. It was also observed that 100% RDF showed significantly higher accumulation of N in grain in comparison to 75% RDF treatments during both the years.

Nitrogen uptake in straw the data on N uptake in straw are given in table 2.4.21 it varied from 8.32 to 32.67 kg ha^{-1} during 1st year and 7.33 to 29.62 kg ha^{-1} during 2nd year. The uptake of nitrogen in straw was recorded higher in 1st year in comparison to 2nd year. Integration of sulphur, zinc, bio-fertilizers and organic manures showed significant increase in N uptake in straw with 100% RDF and 75% RDF treatments during both the years [10].

Nitrogen uptake in straw the data on N uptake in straw are given in Table 2. It varied from 8.32 to 32.67 kg ha^{-1} during 1st year and 7.33 to 29.62 kg ha^{-1} during 2nd year. The uptake of nitrogen in straw was recorded higher in 1st year in comparison to 2nd year. Integration of sulphur, zinc, bio-fertilizers and organic manures showed significant increase in N uptake in straw with 100% RDF and 75% RDF treatments during both the years.

Table 2. Effect of integrated nutrient management on nutrient uptake (Grain and Straw).

Treatment	N uptake (Kg ha^{-1}) grain		N uptake (Kg ha^{-1}) straw	
	2013-2014	2014-2015	2013-2014	2014-2015
T_{1}- Control	39.90	36.76	39.90	36.76
T_{2}-100% R.D.F.	68.36	64.94	68.36	64.94

T_3-100% R.D.F.+S	78.44	74.17	78.44	74.17
T_4-100% R.D.F.+S+Zn	83.82	79.03	83.82	79.03
T_5-100% R.D.F.+ S+Zn+Bio fertilizers (*Azotobactor*+ P.S.B.)	86.83	82.06	86.83	82.06
T_6-100% R.D.F.+25% N through F.Y.M.	74.92	70.88	74.92	70.88
T_7-100% R.D.F.+25 % N through F.Y.M.+ S	89.78	83.79	89.78	83.79
T_8-100% R.D.F.+25% N through F.Y.M.+S+Zn	95.23	88.51	95.23	88.51
T_9-100% R.D.F.+25% N through F.Y.M.+ S+Zn+Bio fertilizers (*Azotobactor*+ P.S.B.)	98.25	91.16	98.25	91.16
T_{10}-100% R.D.F.+25% N through vermicompost	80.36	75.41	80.36	75.41
T_{11}-100% R.D.F.+25% N through vermicompost+S+Zn Bio Fertilize (*Azotobactor*+P.S.B.)	101.37	96.11	101.37	96.11
T_{12}75% R.D.F.	57.53	54.48	57.53	54.48
T_{13}-75% R.D.F.+25% N through F.Y.M.	62.27	58.68	62.27	58.68
T_{14}-75% R.D.F.+25% N through vermicompost	65.57	61.73	65.57	61.73
T_{15}- 75% R.D.F.+25% N through F.Y.M. +S+Zn +Bio-fertilizers (*Azotobactor*+ P.S.B.)	77.36	72.90	77.36	72.90
T_{16}- 75% R.D.F.+25% N through vermicompost+S+Zn+Bio-fertilizers(*Azotobactor*+P.S.B.)	82.38	77.28	82.38	77.28
S.E. ±	6.490	6.034	6.490	6.034
C.D. (at 5%)	13.278	12.382	13.278	12.382

Grain yield

It is apparent from the data depicted in table 3 showed that all the treatments significantly influenced the grain yield over control. Highest grain yield 46.50 and 44.70 q ha^{-1} was recorded with T_{11} (100% R.D.F.+25% N through vermin compost+S+Zn+bio-fertilizers (Azotobactor+ P.S.B.) which was 104% and 108% higher to the lowest yield 22.80 and 21.50 q ha^{-1} at control T_1 and 32% and 34.5% higher to 100% RDF treatment (T_2). Integration of 30 kg sulphur with 100% RDF (T_3) produced 10.80 and 10.81% more grain yield in comparison to 100% RDF (T_2) [11]. Application of 5 kg zinc with 100% RDF+30 kg sulphur ha^{-1} (T_4) also influenced 4.6% higher grain yield in comparison to 100% RDF+30 kg sulphur (T_3). Substitution of 25% N through FYM with 100% RDF (T_6) produced 8.5% and 7.5% higher yield in comparison to 100% RDF during 1st year and 2nd year respectively. Integration of vermicompost with 100% RDF (T_{10}) also influenced grain yield 13.00% and 11.60% than 100% RDF treatment (T_2) during 1st year and 2nd year respectively. It was also observed that integration of vermicompost with 75% RDF (T_{14}) produced higher grain yield than FYM and found at par to the yield of 100% RDF (T_2)during both the years [12,13]. Integration of bio-fertilizers with 100% RDF (T_5) also influenced 2.6% and 2.4% higher grain yield in comparison to 100% RDF 30 kg sulphur+5 kg zinc (T_4) during 1st year and 2nd year respectively. It was also observed that integration of sulphur, zinc, bio-fertilizers and organic manures with 100% RDF treatment produced significantly higher grain yield in comparison to 75% RDF treatment during both the years.

Accumulation of N at all the stages of crop growth and in grain and straw was recorded higher during 1st year in comparison to 2nd year. It was also observed that uptake of N was in general higher in grain; this may be due to higher concentration of N in grain.

Table 3. Effect of integrated nutrient management on grain yield (q/ha) of wheat.

Treatment	Grain yield q ha^{-1}	
	2013-2014	2014-2015
T_{1}- Control	22.80	21.50
T_{2}-100% R.D.F.	34.70	33.30
T_{3}-100% R.D.F.+S	38.45	36.90
T_{4}-100% R.D.F.+S+Zn	40.30	38.55
T_{5}-100% R.D.F.+S+Zn+Bio fertilizers (*Azotobactor*+ P.S.B.)	41.35	39.45
T_{6}-100% R.D.F.+25% N through F.Y.M.	37.65	35.80
T_{7}-100% R.D.F.+25% N through F.Y.M.+S	42.35	39.90
T_{8}-100% R.D.F.+25% N through F.Y.M.+S+Zn	44.50	41.75
T_{9}-100% R.D.F. + 25% N through F.Y.M.+S+Zn+Bio - fertilizers (*Azotobactor*+P.S.B.)	45.70	42.80
T_{10}-100% R.D.F.+25% N through vermicompost	39.20	37.15
T_{11}-100% R.D.F.+25% N through vermicompost+S+Zn+Bio Fertilize (*Azotobactor*+P.S.B.)	46.50	44.70
T_{12}75% R.D.F.	30.60	29.45
T_{13}-75% R.D.F.+25% N through F.Y.M.	32.60	31.05
T_{14}-75% R.D.F.+25% N through vermicompost	33.80	32.15
T_{15}- 75% R.D.F.+25% N through F.Y.M.+S+Zn+Bio fertilizers (*Azotobactor*+P.S.B.)	38.30	36.45
T_{16}- 75% R.D.F.+25% N through vermicompost+S+Zn+Bio-fertilizers (*Azotobactor*+P.S.B.)	39.80	37.70
S.E. ±	3.098	2.986
C.D. (at 5%)	6.358	5.954

CONCLUSION

Nitrogen uptake at late tillering stage (at 40 days after sowing) The data in regard to N uptake given in Table 1 revealed that all the treatments showed significant increase in N uptake in comparison to control. Maximum nitrogen uptake 29.40 and 28.27 kg ha^{-1} was recorded with T_{11} (100% R.D.F.+25% N through vermicompost +S +Zn+bio-fertilizers (Azotobactor+ P.S.B.) followed by T_{9} (100% R.D.F.+25% N through F.Y.M.+S+Zn+bio fertilizers (Azotobactor+P.S.B.) and minimum 12.90 and 12.09 kg ha^{-1} at control (T_{1}) during 1st year and 2nd year respectively. Accumulation of N at all the stages of crop growth and in grain and straw was recorded higher during 1st year in comparison to 2nd year. It was also observed that uptake of N was in general higher in grain; this may be due to higher concentration of N in grain.

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