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Integrated use of biofertilizer, FYM with inorganic fertilizer on yield, nutrient content and quality of wheat

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Abstract
The field experiment was carried out for two Rabiseason 2013-14 and 2014-15 at Nawabganj Research farm C.S. Azad University of Agriculture& Technology Kanpur. There are seven treatments combination i.e. T_1- control, T_2,- $N_{150}P_{60}K_{60}$, T_3- 75% NPK+10t FYM, T_4- 75% NPK+PSB, T_5 - 75% NPK+Azotobacter, T_6- 75% NPK+PMB and T_7- 75% NPK+PSB+ Azotobacter + PMB + 10t FYM.
Result of the experiment revealed that grains and straw yield both increased due to single or combine use of biofertilizer and FYM with75% NPK over sole use of $N_{150}P_{60}K_{60}$. Maximum mean grain yield 44.47 q ha^{-1} and straw yield 55.45 q ha^{-1} were recorded at T_7 (75% NPK+PSB+Azotobacter+ PMB+10t+FYM). NPK S&B content in wheat grain significantly increased due to combined use of inorganic fertilizer FYM & biofertilizer compared to sole use of $N_{150}P_{60}K_{60}$. Maximum NPKS and B content in grain were recorded as 1.78, 0.45, 0.49 0.17 percent and 7.45 mg kg^{-1} respectively at T_7 (15% NPK+PSB+Azotobacter+PMB+10t FYM ha^{-1}). Protein content in wheat grain increased due to use of FYM, PSB, PMB &Azotobacter single or combined with75% NPK. Maximum 11.15 percent protein content obtained with combine use of biofertilizer, FYM with 75% NPK (T_7).

Keywords: Wheat, NPK SB content Azotobacter, PSB, PMB, FYM

Introduction
Wheat is the important cereal crop and rich source of protein for vegetarian. The demand for wheat in India by 2020 has been projected to be between 105 to 109 m tonnes as against 72 m tonnes production, as the land area under wheat is not expected to expand. Efficient inputs management along with varietal improvement is the two basic aspects that can help us in achieving the target. About 10-12% protein requirement is met by wheat. Mannering the application of different fertilizers could increase the productivity of the wheat crop and the protein content.
Many attempts have been tried to replace a part of those harmful fertilizers by biofertilizer. Integrated nutrient management strategies involving chemical fertilizer and biofertilizer have suggested to enhance the sustainability of crop production (Manske *et al*., 1998) [4]. Biofertilizers are able to fix atmospheric nitrogen in the available form for plant and have beneficial effect on plant growth by production of antibiotic (Zahir *et al*., 2004) [9]. Azotobacter is used as biofertilizer in the cultivation of most crops (Yasari *et al*., 2007) [8]. It can successfully grow in the rhizospheric zone of wheat, corn, rice and many other crops (Jadhav *et al*., 1987) [8].
On account of continuing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrients is assuming importance. In this endeavor proper blend of organic and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health (Pullicinoa *et al*. 2009). Therefore, present research was under taken to find out the integrated use of inorganic, organic & biofertilizer on yield, nutrient content, and quality of wheat.

Materials and Methods
The field experiment was conductedat Nawabganj Research farm, C.S. Azad University of Agri. & Tech. Kanpur during Rabi 2013-14 & 2014-15 to test the effect of integrated use of biofertilizer, FYM with inorganic fertilizer on yield, nutrient concentration in grain & quality of wheat seven treatment combinations were tested in Randomized Block Design with three replications. The detailed treatments tested in the present experiment are given under abstract. The soil (0-15cm) of the experimental plot was of alluvial origin, sandy loan in texture having

electrical conductivity (EC) of 0.26 dsm^{-1}, organic carbon (OC) 4.3 gkg^{-1}, available N 210 $kgha^{-1}$, available P 13.05 $Kgha^{-1}$ and available K 135$kgha^{-1}$. The initial Azotobacer, PSB and PMB population of each was 10x 10^3 Cfu/ gm.

Recommended dose of NPK ($N_{150}P_{60}K_{60}$) was used as per treatments full dose of P and K and 1/2 dose of N were added at the time of sowing the remaining amount of N was broadcasted in two equal splits at 3 and 6 weeks after sowing. Azotobacter PSB and PMB were applied before sowing mix with FYM in respective plots. Farm yard manure (FYM) was applied @ 10t ha^{-1} in the respective plots 15 days before sowing. At maturity the wheat crop was harvested and grain and straw yield was recorded.

For estimating Physico-chemical properties, soil samples, were collected at a defth of 0-15 cm brought to the laboratory dried in shades ground to pass on through 2 mm sieve and immediately assayed for physicochemical parameters. Soil pH was determined using soil: water ratio 1:2 by potentiometric method (Jackson 1973) [1] available P_2O_5 by Olsen's method (Olsenetal 1954) [5], available K_2O by neutral ammonium acetate extraction method (Jackson 1973) [1]. Available N by alkaline permanganate method (Subbiah and Asija 1956) [7]. Wheat grains was first air-dried and them oven dried at 60 ^{0}C to constant weight preserved in polythene bags at dry place open grinding. NPKS and B in grains were determined by standard procedure (Jackson 1973) [1].

Results and Discussion

Grain and straw yield increased significantly due to different treatments over control. The yield, grain & straw both increased due to single use of FYM, PSB, Azotobacter& PMB with 75% NPK over sole use of $N_{150}P_{60}K_{60}$ but increase was statistically non-significant, this increase in yield of wheat signifies the positive influence of organic and biofertilizer inputs when applied single along with at 25% reduced level of recommended NPK fertilizers on yield of wheat crop as compared to sole NPK source (T_2). From the pooled analysis of two years data maximum grain & straw yield of wheat was obtained by combined application of 75% NPK fertilizer + PSB+ Azotobacter + PMB+ 10t fym) T_7(44.47 and 55.45q ha^{-1} grain and straw yield respectively) No significant difference was observed among the bio-fertilizer & FYM amended treatments combined with 75% NPK. Comparative influence of bio-fertilizer amendments on yield of wheat was in the order PSB, PMB, Azotobacter. FYM with 75% NPK gave higher wheat yield compared to bio-fertilizers with 75% NPK.

Table 1: Effect of Treatment on yield percent Nutrient concentration and protein in wheat grain.

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Protein percent in grain
T_1 control	27.24	34.11	9.58
T_2 $N_{150}P_{60}K_{60}$	41.80	52.25	10.24
T_3 75% +NPK+FYM	44.00	55.00	11.06
T_4 75% +NPK+PSB	42.90	54.11	10.90
T_5 75% +NPK+Azotobacter	42.52	52.61	10.96
T_6 75% +NPK+PMB	42.60	53.38	11.09
$T_7$75% +NPK+PSB+Azoto+PMB+FYM	44.47	55.45	11.15
CD(P=0.05)	2.90	3.60	0.73

Integrated use of bio-fertilizers, FYM and 75% NPK of recommended NPK dose enhanced the grain yield by 6.4 percent and straw yield 6.12 percent respectively over sole use of $N_{150}P_{60}K_{60}$. This may be due to release more nutrients from soil and steady supply of nutrients throughout whole growth period of crop.

Quality characteristics

Under quality characteristics protein content in wheat grain are computed. Protein concentration significantly increased due to different treatments over control and sole use of $N_{150}P_{60}K_{60}$(T_2).This may positively and significantly increased due to different treatments. Application of FYM, Azotobacter, PSB & PMB each with at 25 percent reduced level of NPK of recommended of NPK enhance significantly protein percent in wheat grain over recommended dose of NPK (T_2) Maximum protein, concentration. 7.45 percent was observed with conjoint use of FYM, biofertilizer and 75% NPK (T_7) where as minimum 4.70 percent registered in control (T_6). This enhancement may be due to combined synergistic effect on concentration which ultimately increased protein concentration in wheat grains.

Nutrient concentration

Application of different treatment significantly increased NPKS and B concentration in wheat grain over control Maximum concentration of NPKS and B were 1.78, 0.45, 0.49, 0.17 percent and 7.45 $mgkg^{-1}$respectively at T_7(75% NPK+ PSB+Azotobacter+PMB+FYM). The increased in concentration of nutrients due to FYM with 75% NPK as FYM is a complete food for plants and present leaching losses of nutrients, increased water holding capacity and mobilize native and applied nutrients both to the plant and ultimately concentration of nutrient enhancedin grain of wheat.

Table 2: Effect of treatments on nutrients concentration in grain of wheat (mean of two years)

Treatments	N%	P%	K%	S%	B$mgkg^{-1}$
T_1 control	1.53	0.30	0.32	0.12	4.70
T_2 $N_{150}P_{60}K_{60}$	1.64	0.42	0.35	0.14	5.20
T_3 75% +NPK+FYM	1.77	0.43	0.45	0.15	6.60
T_4 75% +NPK+PSB	1.74	0.44	0.47	0.16	6.85
T_5 75% +NPK+Azotobacter	1.75	0.45	0.48	0.17	7.25
T_6 75% +NPK+PMB	1.77	0.45	0.49	0.17	7.35
$T_7$75% +NPK+PSB+Azoto+PMB+FYM	1.78	0.45	0.49	0.17	7.45
CD(P=0.05)	0.09	0.41	0.042	0.029	0.532

Applied bio-fertilizer like Azotobacter, PSB and PMB also release more native nutrients and translocate to the plant body and create favourable condition to the rhizosphere of the plant. However concentration of nutrients increased in wheat grain. Combined application of bio-fertilizer FYM with 75% NPK gave more nutrient concentration in wheat grain but statistically effect was non-significant. This may be due to synergistic effect of all inputs when applied together for enhancing nutrient concentration in wheat grain.

Conclusion

Application of 25 percent reduced level of NPK of recommended NPK (150:60:60) with conjoint use of biofertilizer, FYM could improve yield, nutrient concentration and protein concentration of wheat grain in sandy loam soil of Gangetic Alluvial Region of Uttar Pradesh.

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