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Impact of integrated use of bio NP consortium and fertilizers on yield, economics, nutrient content and uptake by wheat in loamy sand of Gujrat

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Abstract
Field experiments were carried out during *rabi* seasons of 2017-18 and 2018-19 at the Agronomy Instructional Farm, Sardarkrushinagar to study the effect of Bio NP consortium and Fe and Zn application on yield, economics nutrient content and uptake by wheat. Twelve treatment combinations comprising of two treatments of biofertilizer and six treatments of nutrients were laid out in factorial randomized block design with four replications. The experimental soils were loamy sand in texture, low in organic carbon, available N and DTPA-extractable Fe and Zn. Pooled results revealed that combined application of soil drenching of bio NP consortium @ 1L ha^{-1} + 100% RDNP and 5.00 kg Fe and 2.50 kg Zn ha^{-1} (B_2N_3) registered significantly higher grain and straw yield, P content in grain, N uptake by grain and Fe uptake by straw but it remained at par with treatment combination B_2N_4 only. The highest gross (₹ 1,30,267 ha^{-1}), net realization (₹ 92,905 ha^{-1}) and BCR value 3.49 of wheat crop was incurred from same treatment combination B_2N_3.

Keywords: yield, nutrient content, uptake, gross and net realization

1. Introduction
Today, global agriculture is at crossroads because of climate change, increased population pressure and detrimental environmental impacts. Increased population needs more food to live on the earth. Indian agriculturalists are in a position to increase our food production within the available cultivated land. Application of commercial fertilizers to soil is more expensive and also resulted in soil degradation. Therefore, vertical expansion of food production and judicious use of fertilizers is necessary. Though the benefits of green revolution have been reaped by us in terms of production, the other side of it, *i.e.*, over usage of chemical fertilizers and subsequent deterioration of soil health has been realised these days. Hence awareness of practicing microbial inoculation has been taken to various spheres and products of microbial culture are fetching up huge market.

Biofertilizers are the safe alternative to the use of chemical fertilizers because they are environmental friendly, do not have any effect on animals and human beings and they also help in the reduction of pollution in the environment and bringing down the cost of chemical fertilizers. Various free-living bacteria are beneficial for the growth of plant as well as cause of maximum yield is known as plant growth promoting rhizobacteria PGPR (Lopper, 1994) [7]. If biofertilizer applied to any crop, it improves the absorption availability of many nutrients to plant, create resistance to root diseases, it reduce 25% of nitrogen requirement to the plants (Kannaiyan, 2002) [6]. The combined application of *Azospirillum* and *Azotobacter* significantly increased all the growth characters and yield in wheat (Chauhan *et al*., 2011) [2]. The major concerns in today's agricultural world are mining of nutrients, decreasing fertilizer use efficiency, pollution and contamination of soils. Keeping in view all the beneficial effect of microorganisms, Fe and Zn the present investigation was carried out.

2. Material and Methods
The field experiments were conducted during rabi seasons of 2017-18 and 2018-19 at the Agronomy Instructional Farm (situated at 24° 32' North latitude and 72° 30' East longitude with an elevation of 154.52 meters above the mean sea level) Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar. The experimental soils were loamy sand in texture, slightly alkaline in reaction and soluble salt

content under safe limit. The soils were low in organic carbon, available N and DTPA-extractable Fe and Zn; medium in available P_2O_5, K_2O and S and having sufficient DTPA-extractable Mn and Cu status.

Twelve treatment combinations comprising of two treatments of biofertilizer *viz*., No Biofertilizer (B_1) and Soil drenching of Bio NP consortium @ 1 L ha^{-1} (B_2); six treatments of nutrients *viz*., 100% RDNP (N_1), 75% RDNP (N_2), 100% RDNP + 5.00 kg Fe and 2.50 kg Zn ha^{-1} (N_3), 100% RDNP + 3.75 kg Fe and 1.90 kg Zn ha^{-1} (N_4), 75% RDNP + 5.00 kg Fe and 2.50 kg Zn ha^{-1} (N_5) and 75% RDNP + 3.75 kg Fe and 1.90 kg Zn ha^{-1} (N_6) were laid out in factorial randomized block design with four replications. The entire quantity of phosphorus (60 kg ha^{-1}) and half quantity nitrogen (60 kg ha^{-1}) were manually applied in previously opened furrow as per treatment in the form of diammonium phosphate and urea, respectively in both the years. As per treatment the required quantity of Fe and Zn in the form of $FeSO_4.7H_2O$ (19% Fe) and $ZnSO_4.7H_2O$ (21% Zn) were applied in furrow, respectively. The remaining half amount of nitrogen (60 kg ha^{-1}) was top dressed in the form of urea at 21 days after sowing. The details of the material used, procedure followed and experimental techniques adopted during the course of the investigation are described below.

2.1 Grain yield (kg ha^{-1})
The produce from each net plot area was threshed separately. After winnowing from each net plot were weighed separately and recorded in kg per net plot. The grain weight of earlier threshed five plants for each treatment was also added to respective net plot for each treatment. Thereafter it was converted into kilogram per hectare.

2.2 Straw yield (kg ha^{-1})
Straw yield was obtained by substracting the grain yield of each net plot from their respective biological yield and recorded separately for each treatment along with straw yield of tagged five plants and converted into kilogram per hectare.

2.3 Net realization
The gross realization in term of rupees per hectares was worked out by considering the prevailing market price of grain and straw of each treatment. The cost of cultivation for each treatment was worked out considering the cost of all the operation right from the preparation of land to the harvesting of crop and the cost of all inputs involved. The current rates of agricultural operations and market prices of inputs were used for calculation. The net realization was worked out by deducting the total cost of cultivation from the gross realization per hectare for each treatment and recorded accordingly.

2.4 Benefit cost Ratio
The benefit cost ratio (BCR) was calculated on the basis of the following formula:

$$BCR = \frac{\text{Gross realization (₹}ha^{-1})}{\text{Total cost of cultivation (₹}ha^{-1})}$$

2.5 Nutrient Uptake
The concentration of the nutrients determined in plant samples (grain and straw) was expressed in per cent for N and P and in mg kg^{-1} for Fe and Zn on dry weight basis. The uptake of these nutrients was calculated by using the following formula.

For N and P

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%)} \times \text{Yield (kg ha}^{-1})}{100}$$

For Fe and Zn

$$\text{Nutrient uptake (g ha}^{-1}) = \frac{\text{Nutrient content (mg kg}^{-1}) \times \text{Yield (kg ha}^{-1})}{1000}$$

3. Result and Discussion
3.1 Grain yield and Straw yield
The data in respect of grain yield and straw (kg ha^{-1}) as influenced by different treatments are resented in Table 1. Combined application of biofertilizer and nutrients produced significantly higher yield attributes and yield over other treatment combinations, this might be due to synergistic effect of biofertilizer and Fe and Zn. This might be due to increasing solubility and availability of nutrients. Thus, the cumulative effect of growth and yield attributing characters under the combined application biofertilizer and nutrients (B_2N_3) might have contributed for increased in grain yield of wheat

The favorable effect of applied Fe and Zn and biofertilizer on these growth parameters may be ascribed to synergetic effect of Fe on most of the photosynthesis, physiological and metabolic processes of the plant followed by increased translocation toward yield contributing characters, which might have led to significant increase in grain and straw yield (Ali *et al*., 2014) [1]. The increase in straw yield could be also due to higher plant height and other growth parameters in above said treatments.

Table 1: Grain yield and Straw yield of wheat as influenced by biofertilizer and nutrients

Treatments	Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Biofertilizer (B)						
B_1	4452	4681	4566	5505	5631	5568
B_2	4980	5163	5071	6181	6339	6260
S.Em.±	69	71	49	96	85	64
CD (*P*=0.05)	199	204	140	277	243	181
Nutrients (N)						
N_1	4655	4812	4734	5531	5967	5749
N_2	4346	4578	4462	5275	5569	5422
N_3	5057	5274	5166	6340	6352	6346
N_4	5005	5222	5113	6204	6284	6244
N_5	4692	4884	4788	5984	6031	6007

N_6	4542	4759	4651	5722	5707	5715
S.Em.±	120	123	86	167	146	111
CD (*P*=0.05)	344	353	242	481	421	314
Interaction (B × N)						
CD (*P*=0.05)	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CV %	7.17	7.05	7.11	8.09	6.92	7.51

3.2 Economics

The details of mean gross and net realization as well as total cost of cultivation and benefit: cost ratio of different treatment combinations of wheat crop are given in Table 2.

The perusal of data given in Table 2. showed that the highest gross (₹1,30,267 ha^{-1}) net realization (₹ 92,905 ha^{-1}) and BCR value 3.49 of wheat crop was incurred from treatment combination of B_2N_3 (Biofertilizer @ 1 L ha^{-1} + 100% RDNP + 5.00 kg Fe and 2.50 kg Zn ha^{-1}), followed by treatment combination of B_2N_4 (Biofertilizer @ 1 L ha^{-1} + 100% RDNP + 3.75 kg Fe and 1.90 kg Zn ha^{-1}).

Table 2: Economics of wheat crop as influenced by different treatment combinations

Treatment combinations	Grain yield	Straw yield	Gross realization (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net realization (₹ ha^{-1})	BCR
B_1N_1	4519	5541	103722	35848	67874	2.89
B_1N_2	4417	5327	101203	34751	66452	2.91
B_1N_3	4658	5717	106923	36982	69941	2.89
B_1N_4	4644	5636	106474	36704	69770	2.90
B_1N_5	4606	5608	105639	35885	69754	2.94
B_1N_6	4553	5578	104493	35607	68886	2.93
B_2N_1	4949	5957	113369	36228	77141	3.13
B_2N_2	4507	5517	103428	35131	68297	2.94
B_2N_3	5674	6975	130267	37362	92905	3.49
B_2N_4	5582	6853	128137	37084	91053	3.46
B_2N_5	4969	6406	114677	36265	78412	3.16
B_2N_6	4748	5852	109038	35987	73051	3.03

3.3 Nutrient content

It is inferred from the data (Table 3) that in pooled analysis, an application of soil drenching of bio NP consortium @ 1 L ha^{-1} (B_2) recorded significantly higher N content in grain than that of without biofertilizer (B_1). The increase in nitrogen content in grain observed in present study was since microorganisms promote the mobilization of plant nutrients and reduce the need for chemical fertilizers, especially nitrogen fixing and phosphorus solubilizing bacteria, which facilitate nitrogen and phosphorus uptake in plants (Kabeya and Shankar, 2013) [5]. Moreover, the increase in nitrogen concentration may be due to inoculation of microbial strains which fix atmospheric nitrogen, show nitrate reductase activities, and facilitate the uptake of nitrates and amino acids produced by plants (Shekhawat *et al.*, 2018) [8].

During both the years of study and in pooled data, biofertilizer application (B_2) recorded significantly higher P content in grain. The increase in P content is partially attributed to the production of a variety of organic acids by the inoculated PGPR which decrease the soil pH, leading to the conversion of non-available form of phosphorus into the available phosphorus. These results were supported by Shekhawat *et al.* (2018-19) [8]. Similar works done by Gulnaz *et al.* (2017) [4] showed that inoculation of phosphate solubilizing *P. fluorescens*has been reported to enhance growth, yield and nitrogen and phosphorus concentrations in the grain. The results of the present study are in accordance with the results obtained by Singh *et al.* (2018) [10] and Kumar and Singh (2017) [9].

Table 3: Nutrient content in wheat grain as influenced by biofertilizer and nutrient

Treatments	N content (%)			P content (%)		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Biofertilizer (B)						
B_1	1.82	1.90	1.86	0.244	0.254	0.249
B_2	1.91	1.96	1.93	0.270	0.280	0.275
S.Em.±	0.017	0.021	0.014	0.002	0.002	0.002
CD (*P*=0.05)	0.05	0.06	0.03	0.007	0.006	0.005
Nutrients (N)						
N_1	1.88	1.95	1.92	0.245	0.265	0.255
N_2	1.74	1.85	1.80	0.236	0.244	0.240
N_3	1.98	2.04	2.01	0.284	0.290	0.287
N_4	1.95	1.98	1.96	0.260	0.276	0.268
N_5	1.84	1.90	1.87	0.271	0.275	0.273
N_6	1.78	1.86	1.82	0.246	0.251	0.248
S.Em.±	0.029	0.037	0.023	0.004	0.004	0.003
CD (*P*=0.05)	0.08	0.10	0.06	0.012	0.011	0.008
Interaction (B × N)						
CD (*P*=0.05)	NS	NS	NS	Sig.	Sig.	Sig.
CV %	4.45	5.37	4.95	4.50	4.01	4.25

3.4 Nutrient uptake
The data on N and P uptake by grain and straw of wheat as influenced by biofertilizer and nutrients are presented in Table 4. The magnitude of increase in N uptake by grain due to soil drenching of bio NP consortium @ 1 L ha^{-1} (B_2) was 15.29 per cent, over without biofertilizer (B_1) on pooled data basis. The higher N uptake by grain was contributed by higher grain yield and higher N content in above said treatments might be due to possibility of better synchronization between N availability and N uptake. Since the uptake of nutrient is a function of yield and nutrient content, the increased grain yield with higher N content in grain and straw resulted in greater uptake of N in grain.

The magnitude of increase in P uptake by grain due to biofertilizer (B_2) was 22.34 per cent, over without biofertilizer on pooled data basis. It might be due to increased yield of grain and availability of P_2O_5 which was added in the soil through resources by *Azospirillum* and phosphate solubilizing bacteria. Similar results were found by Gooma *et al.* (2015) [3] and Yadav *et al.* (2014) [11].

Table 4: Nutrient uptake by wheat grain as influenced by biofertilizer and nutrient

Treatments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})		
	2017-18	2018-19	Pooled	2017-18	2018-19	Pooled
Biofertilizer (B)						
B_1	81	89	85	10.91	11.91	11.41
B_2	95	102	98	13.46	14.46	13.96
S.Em.±	1.51	1.75	1.16	0.237	0.239	0.168
CD (*P*=0.05)	4	5	3	0.68	0.68	0.47
Nutrients (N)						
N_1	88	94	91	11.44	12.79	12.12
N_2	76	85	80	10.34	11.22	10.78
N_3	101	108	104	14.36	15.29	14.83
N_4	98	103	101	13.02	14.43	13.73
N_5	86	92	89	12.73	13.44	13.08
N_6	81	89	85	11.21	11.95	11.58
S.Em.±	2.62	3.03	2.00	0.411	0.413	0.292
CD (*P*=0.05)	7	9	6	1.18	1.19	0.82
Interaction (B × N)						
CD (*P*=0.05)	11	NS	8	Sig.	NS	Sig.
CV %	8.38	9.00	8.73	9.54	8.87	9.19

4. Conclusion
From the results of two-years experimentation, the higher grain and straw yield, nutrient content as well as uptake by grain and higher net returns can be obtained by application of 100% RDNP with 3.75 kg Fe ($FeSO_4.7H_2O$) and 1.90 kg Zn ha^{-1} ($ZnSO_4.7H_2O$) along with soil drenching of bio NP consortium @ 1L ha^{-1} at 30 days after sowing in light textured soil deficient in DTPA extractable Fe and Zn.

5. Reference

1. Ali S, Hamza M, Amin G, Fayez M, El-Tahan M, Monib M, *et al*. Production of biofertilizers using baker‟s yeast effluent and their application to wheat and barley grown in north Sinai deserts! Archives of Agronomy and Soil Science. 2014;51(6):589-604.
2. Chauhan DS, Sharma RK, Tripathi SC, Kharub AS, Chhokar RS. News paradigm in tillage technology for wheat production. Research Bulletin NO. 8, DWR, Karnal, 2011, 1p.
3. Gooma MA, Radwan FI, Kandil EE, Shawer MAM. Impact of micronutrients and bio- fertilization on yield and quality of rice (*Oryza sativa* L.)! Middle East Journal of Agriculture Research. 2015;4(4):919-924.
4. Gulnaz Y, Fathima PS, Denesh GR, Kulmitra AK, Shivrajkumar HS. Effect of Plant Growth Promoting Rhizobacteria (PGPR) and PSB on root parameters, nutrient uptake and nutrient use efficiency of irrigated maize under varying levels of phosphorus. Journal of Entomology and Zoology Studies. 2017;5(6):166-169.
5. Kabeya MJ, Shankar AG. Effect of different levels of Zn on growth and uptake ability in rice zinc contrast lines (*Oryza sativa* L.)! Asian Journal of Plant Science and Research. 2013;3(3):112-116.
6. Kannaiyan S. Biotechnology of Biofertilizers, Alpha Sci. Inter. Ltd., P.O. Box 4067 Pang Bourene R. G8, UK, 2002, 1-375.
7. Lopper JW. Plant growth-promoting rhizobacteria (other systems). In: *Azospirillum*/Plant Associations. (Ed.): Y. Okon, CRC Press, Boca Raton, FL, 1994, 137-166.
8. Shekhawat AS, Purohit HS, Jat G, Meena R, Regar MK. Efficacy of phosphorus, vermicompost & biofertilizers on soil health and nutrient content & uptake by black gram (*Vigna mungo* L.)! International Journal of Chemical Studies. 2018;6(2):3518-3521.
9. Singh A, Singh R. Effect of seed bed and integrated nitrogen management on growth and yield of sorghum (*Sorghum bicolor* L.)! International Journal for Current Microbiological Applied Science. 2017;6(12):401-407.
10. Singh A, Singh AP, Singh SK, Rai S, Kumar D. Impact of addition of biochar along with PGPR on rice yield, availability of nutrients and their uptake in alluvial soil! Journal of Pure and Applied Microbiology. 2018;20:360-363.
11. Yadav L, Verma J, Prakash J, Jaiswal Kumar D, Kumar A. Evaluation of PGPR and different concentration of P level on plant growth, yield and nutrient content of rice (*Oryza sativa* L.)! Ecological engineering. 2014;62:123-128.