Biological Forum – An International Journal **15(3): 738-743(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Impact of using Bio-NPK and Bio-Zn together with Chemical Fertilizers on uptake of Nutrients by Soybean (*Glycine max* L. *Merrill*) in Black Soil

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(Received: 06 January 2023; Revised: 16 February 2023; Accepted: 27 February 2023; Published: 22 March 2023)
(Published by Research Trend)

ABSTRACT: Soybeans are a large oil seed crop and legume that may be produced in a variety of soils and climates. A crucial micronutrient needed by humans, animals, and plants is zinc. As there is a greater concern to sustain the deteriorating soil health due to indiscriminate use of chemical fertilizers and hence exerting the lack of beneficial microbes in the soil. Therefore, lack of essential nutrients in the soil is a global concern for the growth of food crops. The present investigation was carried out during *kharif* 2021 on Research farm of R.A.K. College of Agriculture, Sehore (M.P.) to evaluate the effect of conjoint use of Bio-NPK and Bio-Zn with chemical fertilizers on nutrient uptake of soybean. The studies have been found beneficial to fetch the more production of the crop along with improving the soil health. The experiment was laid out in Randomized Block Design with seven treatments in combinations in three replications consisting of treatments T_1: Control; T_2: 100% Recommended dose of fertilizers (RDF); T_3: 75% RDF; T_4: 75% RDF + Bio-Zn; T_5: 75% RDF + Bio-NPK; T_6: 75% RDF + Bio-Zn + Bio-NPK; T_7: 75% RDF + *Rhizobium japonicum.* Revealed that nutrient content and uptake was also increased with the inoculation of microbial cultures as compared to uninoculated control and highest N uptake was found in treatment 100% RDF (74.95 Kg ha^{-1}) and it was at par with 75% RDF + Bio-NPK, 75% RDF + Bio-Zn + Bio-NPK and 75%RDF + *Rhizobium japonicum* which uptake 69.92, 70.16 & 66.13 Kg ha^{-1}. Highest P uptake found in 100% RDF (5.61 kg ha^{-1}) however it was at par with 75% RDF + Bio-Zn + Bio-NPK which uptake 5.05 Kg ha^{-1}. Highest k uptake found in 100% RDF (57.96 kg ha^{-1}) however it was at par with 75% RDF + Bio-NPK and 75% RDF + Bio-Zn + Bio-NPK which uptake 52.62 & 50.72 Kg ha^{-1} by soybean crop at harvest and highest Zn and Fe uptake was found in 75% RDF + Bio-Zn + Bio-NPK (0.0408 & 0.0470 kg ha^{-1}) however these were at par with75% RDF + Bio-Zn which uptake 0.0371 & 0.0430Kg ha^{-1}.

Keywords: Bio-Zn, Bio-NPK, Chemical Fertilizers, Black Soil, Soybean.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is also known as Golden Bean or Miracle Crop, as they contain a complete source of protein and oil. Soybean is mainly grown for their seeds and it is the second largest oil seed after groundnut in India. Soybean seeds contain 43.2% protein, 19.5% fat, 20.9% carbohydrate and a good amount of other nutrients like calcium, phosphorus, iron and vitamins (Gupta *et al*., 2003).

The state of Madhya Pradesh is known as the "soybean state". During kharif 2018, the total area under soybean crop in India was 11.13 million hectares, with a production of 13.26 million tonnes and a productivity of 1192 kg/ha, while the total area under soybean crop in Madhya Pradesh was 5.41 million hectares, with a production of 6.67 million tonnes and a productivity of 1231 kg/ha (Anonymous, 2021).

Microbial inoculants, also known as bio-fertilizers, are able to mobilise significant nutritional elements in the soil and change their state from unusable to useful by crop plants through biological processes. Unlike chemical fertilizers, which have an adverse effect on the soil, bio-fertilizers boost soil fertility naturally. Therefore, using bio-fertilizer is essential to boosting soil productivity (Nalawde *et al*. 2015). Legumes fix atmospheric nitrogen due to the relationship that exists between legume plants and a group of soil bacteria commonly known as rhizo-bacterium. This symbiotic relationship allows the bacteria to live on the roots of the legume plant, consuming carbohydrates from the plant and providing the plant with nitrogen that the bacteria convert into plant-usable form. Without these beneficial bacteria, legumes cannot fix nitrogen. In order to ensure good nitrogen fixation by the legume, it is necessary to inoculate the legume with the proper strains of bacteria prior to planting the seeds.

The yield level of soybean is a generally low because it is less cared crop and mostly grown under rain-fed condition without bio-fertilizers. Regular depletion of nutrient resources of soil has led to emergence of several nutrients deficiencies in soil and this because of intensive production, the higher and faster are the rates of nutrients exhaustion from the soil (Jain *et al.,* 2021). There is immense scope for improving the production of this crop by use of organic manures, inorganic manures and biofertilizers (Verma *et al*., 2017), though, chemical fertilizers are playing a crucial role to meet the nutrient requirement of the crop, persistent nutrient depletion is posing a greater threat to the sustainable agriculture. Therefore, there is an urgent need to reduce the usage of chemical fertilizer and in turn, increase in the usage of organics and other products Use of organics alone does not result in spectacular increase in crop yield (Jain *et al.,* 2021). Therefore, there is an urgent need to reduce the usage of chemical fertilizer and in turn, increase in the usage of organics and other products. Use of organics alone does not result in spectacular increase in crop yield. Therefore, the foresaid consequences have paved way to grow soybean using organic manures and inorganic fertilizers along with biofertilizers. The existing blanket recommendation for crops does not ensure efficient and economic use of fertilizers, as it does not take into account of the fertility. The integrated nutrient management ensures higher productivity, minimizes expenditure on costly fertilizer inputs, improves physical properties of soil, efficiency of added nutrients and at the same time ensures good soil health and is also an environment friendly approach (Tyagi and Singh 2019).

Its deficiency in plants leads to poor growth, yield and quality, and has an effect on how well plants absorb and move water (Hafeez *et al*., 2013; Pandey *et al*., 2018). Its shortage is increasing all over the world. The North East region of India experiences low crop yield, mostly due to 60% zinc deficiency (Kumar *et al*., 2016). Zinc deficiency in this region may be brought about by slash-and-burn agricultural techniques used in the hills, leaching from heavy rains, and runoff that reduces top soil fertility (Bandyopadhyay *et al*., 2018).

Bio source mediums such as Bio-NPK Liquid Microbial Consortium contain mixed populations of N-fixing bacteria (*Azotobacter crococum*), P-solubilizing bacteria (*Paenibacillus tylopilii*), K-solubilizing bacteria (*Bacillus decoloration*), and Bio-ZN Liquid contains a single population of Z-solubilizing bacteria (*Bacillus endophyticus*). These inoculants help in meeting the nutrient demands of crops through proper nitrogen fixation by enhancing nodulation, solubilization of insoluble phosphorus, mobilizing potassium and zinc. Zinc application significantly reduced phosphorus content in black gram seeds compared to the control (Meena *et al*., 2021). Bio-fertilizers keep the soil environment enriched with all types of micro and macro nutrients through nitrogen fixation, phosphate solubilization Potash mobilization and release of plant growth regulating substances (Javaid, 2009).

The application of RDF + *Rhizobium* + PSB to soybean crop resulted in higher seed and stover yield (2634 kg ha^{-1} and 3125 kg ha^{-1}) due to the cumulative effect of auxins, cytokinins, and gibberellins on growth contributing characters and ultimately, the product, seed and stover yield (Kumawat *et al.* 2019). The increment in seed yield of soybean with the treatments of inoculation of *rhizobia* and PSB with RDF might be attributed to better nodulation, N2 fixation, crop growth and seed yield (2600 kg ha^{-1}) as compared to the un inoculated control (Kravchenko *et al*. 2013).

MATERIALS AND METHODS

The research trial was laid out in field of R.A.K. college of Agriculture, Sehore (M.P.), during kharif 2021 on the soybean variety JS 95-60. The global position of the site was situated in the Eastern part of Vindhyan Plateau in subtropical zone at the latitude of 27°15′ North and longitude of 77º05′ East at an altitude of 498.77 m from mean sea level (MSL) in Madhya Pradesh. The average annual rainfall varies from 1000 to 1200 mm concentrated mostly from June to September. The mean annual maximum and minimum temperatures are 33.3°C and 20.2°C, respectively. Soils of the experimental site were medium black which belongs to the order Vertisol that was popularly known as "black cotton soil". The available soil status N, P and K were 220, 11.5 and 442 kg $ha^{-1}$and micro nutrients Zn and Fe were 0.443 & 4.2 ppm ha^{-1}respectively. The experiment was laid out in Randomized Block Design with seven treatments in combinations in three replications. The experiment consisting of 7 treatments T_1: Control; T_2: 100% Recommended dose of fertilizers (RDF*); T_3: 75%RDF; T_4: 75%RDF + Bio-Zn; T_5: 75% RDF + Bio-NPK*;* T_6: 75% RDF + Bio-Zn + Bio-NPK; T_7: 75%RDF + *Rhizobium japonicum.* The dose of RDF were 20:60:20:20 (N: P_2O_5:K_2O:S kg ha^{-1}) at basal dose through urea, single super phosphate and murate of potash, respectively and Seed treatment with Bio-NPK and Bio-Zn @ 250 ml and *Rhizobium japonium* @ 200 ml for the seed of one hectare**.** Nutrient content N calculated by Alkaline permanganate method (Subbaiah and Asijo 1956), P content determined by Olsen's Method (Olsen's *et al*., 1954), K content determined from Neutral Normal Ammonium Acetate (Hanway and Heidel 1952), Zn and Fe were estimated using DTPA extraction method with the help of Atomic Absorption Spectrophotometer (AAS) (Lindsay and Norvell 1978).

RESULTS AND DISCUSSION

Available N, P, K, (kg ha^{-1}) and Zn & Fe (ppm) in soil at harvest of Soybean. Available N and P were non-significantly reduced in every treatment as compare to their initial values (N-220 kg $ha^{-1}$and P-11.50kgha^{-1}, respectively) however; available K was significantly depleted from its initial value (442 kg ha^{-1}). The results (Table 1 and Fig. 1) clearly revealed that highest (T_2-227.27 kg ha^{-1}, T_7-13.69 kg ha^{-1}, T_6-447.72 kg ha^{-1}, T_6-0.59 ppm and T_6- 4.64 ppm) available N, P, K and Zn, Fe respectively by soil were obtained which had been significantly higher than other treatments and the lowest were found under absolute control. It might be because of increased uptake of nutrients due to Bio-zinc application. The increase in nutrients content in soil was attributed due to synergistic effect of Bio- NPK along with Bio-zinc on N, P, K, Zn & Fe. It is also increased nitrogen fixation by crop which increased the nutrients availability in soil over absolute control. While zinc has an antagonistic effect with phosphorus which might have decreased the phosphorus in soil at harvest of crop. It also showed that recommendation of 20:80:20 kg ha^{-1}N, P and K is not sufficient for sustaining soil health under soybean crop and need to be reviewed. Though the similar results were also reported by Dwivedi *et al.* (2007); Meena *et al.* (2017) in which they found that Response of 150% NPK was better than 100% NPK in soybean. Data further revealed that available zinc was significantly increased under Bio-zinc and Bio-NPK application as basal in soil and it might be because of sufficient availability and buffering capacity of soil to recover Zn from exchangeable pool. Similar results were also reported by Gupta and Kausik (2006); Khan *et al.* (2007); Rathod *et al.* (2012); Martinez *et al.* (2021); (Tyagi and Singh, 2019); Jain *et al.* (2021); from different experiments.

N, P, K (%) and Zn Fe (ppm) content in seed and straw of soybean. Data presented in (Table 2 and Fig. 2) clearly revealed that significantly highest nutrient content of N, P, K and Zn and Fe in seed (T_2-6.49%, T_2-0.37%, T_2-4.64%, T_6-32.73ppm and T_6-38.49ppm) and Straw (T_2-1.10%, T_2-0.22%, T_2-1.29%, T_4-8.96ppm and T_4-9.37%), respectively, followed by in Seed (T_6-6.47%, T_6-0.35%, T_6-4.62%, T_4-31.43ppm and T_4-37.31ppm) and Straw (T_6-1.08%, T_6-0.21%, T_6-1.25%, T_4-8.96pp and T_4-9.37ppm) respectively. Further it had been at par with some treatments and lowest nutrient content were obtained from absolute control. It was also found that application of Bio-NPK and bio-Zn significantly increased the nutrient content in seed and straw of soybean. The higher nutrients content were ascribed due to application of Bio- zinc which increased the photosynthesis and also increased the nutrients accumulation in plant and seeds. These findings are well supported by those reported by Kobraee *et al.* (2011); Salih (2013); Afra and Mozafar (2017); Jat *et al.* (2021) from the results of different experiments.

N, P, K, and Zn &Fe uptake by seed, straw and (Total=seed + straw) kg ha^{-1} in soybean. Data presented in (Table 3 and Figs. 3-5) clearly revealed that significantly highest nutrient uptake of N, P, K and Zn& Fe in seed in case of 100 % RDF (65.40 kg ha^{-1}, 3.73 kg ha^{-1}, 46.80 kg $ha^{-1}$and 0.0330 ppm & 0.0388 ppm), straw (9.55 kg ha^{-1}, 1.88 kg ha^{-1}, 11.16 kg $ha^{-1}$and 0.0078% & 0.0082%) respectively and total uptake in case of 100 % RDF (74.95 kg ha^{-1}, 5.61 kg ha^{-1},57.96 kg ha^{-1}, and 0.0408 ppm & 0.0470 ppm), respectively followed by in seed (61.41 kg ha^{-1}, 3.32 kg ha^{-1},43.81 kg ha^{-1},0.0298 ppm and 0.0354 ppm), straw (1.08 kg ha^{-1}, 0.21 kg ha^{-1}, 1.25 kg ha^{-1} and 0.0078ppm & 0.0076ppm) respectively. Followed by total uptake in case of 75% RDF + Bio-Zn + Bio NPK (70.16 kg ha^{-1}, 5.0 kg ha^{-1}, 53.94 kg ha^{-1}, and 8.96 ppm & 9.37 ppm) NPK Fe and Zn respectively, which had been found at par with T_5 and T_6 and the lowest nutrient content were obtained from absolute control. The results might be due to increase in nutrients uptake by application of Bio-NPK and Bio-Zn and together with the higher yield which ultimately leads to higher nutrients availability in the soil. It was also found that application of Bio-NPK and Bio-Zn have influenced the population of bacteria, N-fixers, P-solubilizers, K-solubilizers and Zinc-solubilizers and iron in the soil which increased the nutrients availability in soil but it had not been noted significant. Similar results were also reported by Afra and Mozafar (2017); Souza *et al.* (2019); Leite *et al.* (2020); Meena *et al.* (2021) from the findings of different experiments. This is ascribed due to better supply of zinc and greater yield of soybean with application of Bio-zinc.

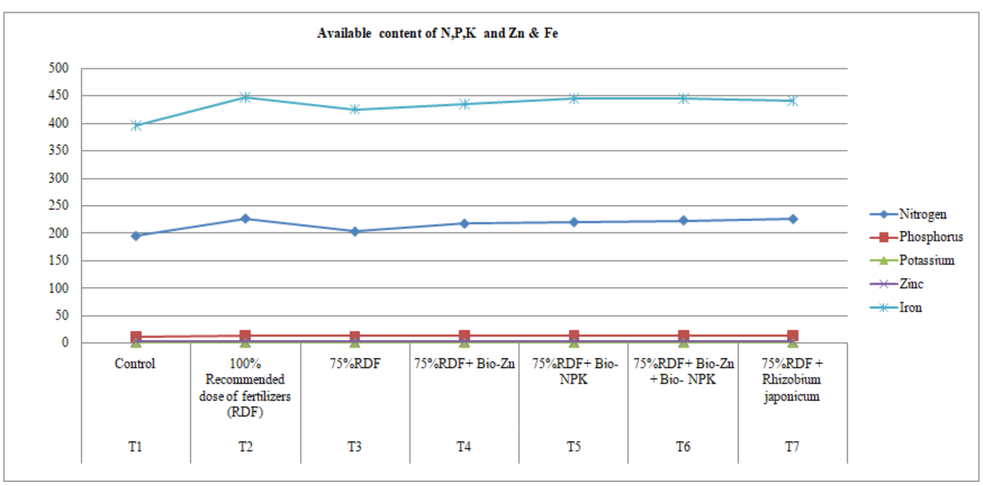

Fig. 1. Effect of different treatments on NPK (Kg ha^{-1}) Zn & Fe (ppm) after harvest of crop in soil.

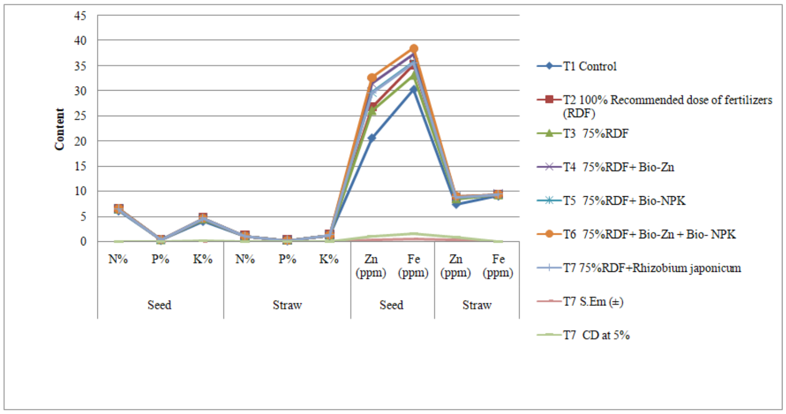

Fig. 2. Effect of different treatments on N, P, K and Zn &Fe content in seed and straw of soybean.

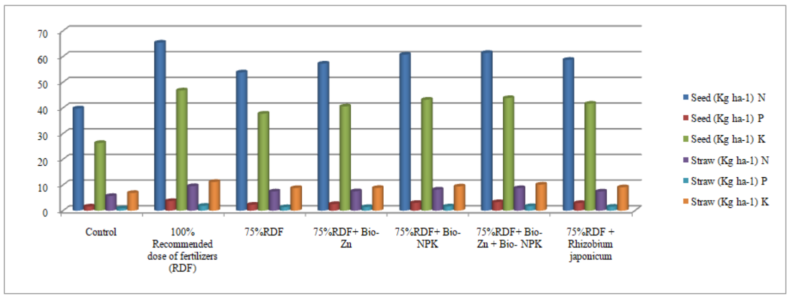

Fig. 3. Effect of different treatments on NPK uptake by seed and straw(Kg ha^{-1}) of soybean.

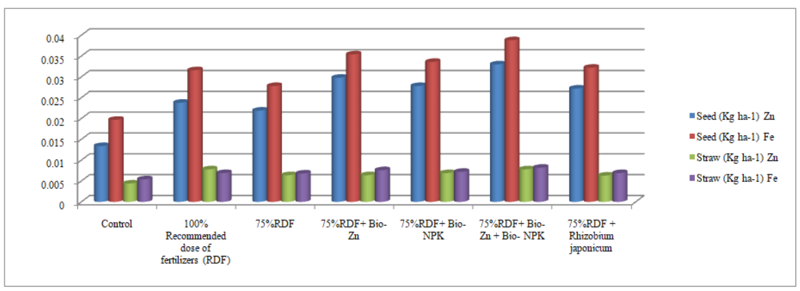

Fig. 4. Effect of Different treatments on Zn & Fe-uptake by Seed and Straw (Kg ha^{-1}) of soybean.

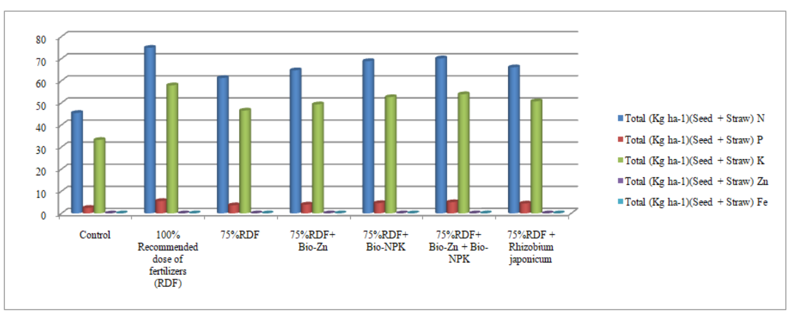

Fig. 5. Effect of different treatments on NPK, Zn and Fe uptake by seed + straw (Kg ha^{-1}) of soybean.

Table 1: Effect of different treatments on NPK (Kg ha^{-1}) Zn& Fe (ppm) after harvest of crop in soil.

Treatments		Nitrogen	Phosphorus	Potassium	Zinc	Iron
T_1	Control	195.33	11.29	396.75	0.47	4.06
T_2	100% Recommended dose of fertilizers (RDF)	**227.27**	12.87	447.72	0.52	4.56
T_3	75%RDF	203.52	12.59	426.00	0.51	4.49
T_4	75%RDF+ Bio-Zn	217.89	12.81	435.33	0.57	4.62
T_5	75%RDF+ Bio-NPK	220.80	13.21	445.80	0.55	4.59
T_6	75%RDF+ Bio-Zn + Bio- NPK	224.00	13.46	446.05	0.59	4.64
T_7	75%RDF + *Rhizobium japonicum*	226.36	**13.69**	441.12	0.53	4.57
	S.Em (±)	**1.40**	**0.21**	**1.97**	**0.02**	**0.03**
	CD at 5%	**4.32**	**0.64**	**6.08**	**0.07**	**0.11**

Table 2: Effect of different treatments on NPK (%) Zn and Fe (ppm) content in seed and straw of soybean.

Treatments		Seed			Straw			Seed		Straw	
		N%	P%	K%	N%	P%	K%	Zn (ppm)	Fe (ppm)	Zn (ppm)	Fe (ppm)
T1	Control	6.13	0.25	4.06	0.96	0.15	1.16	20.67	30.36	7.44	9.11
T2	100% Recommended dose of fertilizers (RDF)	6.49	0.37	4.64	1.10	0.22	1.29	26.79	35.18	8.60	9.32
T3	75%RDF	6.41	0.28	4.49	1.00	0.18	1.18	26.14	33.18	8.49	9.28
T4	75%RDF+ Bio-Zn	6.44	0.29	4.56	1.03	0.19	1.21	31.43	37.31	8.96	9.37
T5	75%RDF+ Bio-NPK	6.45	0.32	4.59	1.06	0.21	1.22	29.74	35.69	8.88	9.36
T6	75%RDF+ Bio-Zn + Bio- NPK	6.47	0.35	4.62	1.08	0.21	1.25	32.73	38.49	9.02	9.40
T7	75%RDF+*Rhizobium japonicum*	6.42	0.32	4.57	1.00	0.20	1.23	29.51	35.53	8.79	9.34
	S.Em (±)	**0.02**	**0.01**	**0.03**	**0.02**	**0.01**	**0.01**	**0.36**	**0.50**	**0.27**	**0.01**
	CD at 5%	**0.07**	**0.02**	**0.11**	**0.07**	**0.02**	**0.04**	**1.10**	**1.53**	**0.82**	**0.02**

Table 3: Effect of different treatments on NPK Zn & Fe-uptake by seed, straw and seed + straw (Kg ha^{-1}) in soybean crop.

Treatments		Seed (Kg ha^{-1})					Straw (Kg ha^{-1})					(Seed + Straw) (Kg ha^{-1})				
		N	P	K	Zn	Fe	N	P	K	Zn	Fe	N	P	K	Zn	Fe
T1	Control	39.76	1.61	26.35	0.0134	0.0197	5.70	0.88	6.89	0.0044	0.0054	45.46	2.49	33.24	0.0178	0.0251
T2	100% Recommended dose of fertilizers (RDF)	65.40	3.73	46.80	0.0238	0.0316	9.55	1.88	11.16	0.0078	0.0069	74.95	5.61	57.96	0.0302	0.0384
T3	75%RDF	53.81	2.32	37.75	0.0219	0.0278	7.46	1.35	8.79	0.0064	0.0068	61.26	3.67	46.53	0.0283	0.0347
T4	75%RDF+ Bio-Zn	57.22	2.58	40.54	0.0298	0.0354	7.53	1.41	8.81	0.0064	0.0076	64.74	3.99	49.35	0.0371	0.0430
T5	75%RDF+ Bio-NPK	60.72	3.01	43.18	0.0278	0.0336	8.20	1.65	9.44	0.0069	0.0072	68.92	4.66	52.62	0.0347	0.0408
T6	75%RDF+ Bio-Zn + Bio-NPK	61.41	3.32	43.81	0.0330	0.0388	8.75	1.73	10.13	0.0078	0.0082	70.16	5.05	53.94	0.0408	0.0470
T7	75%RDF + *Rhizobium japonicum*	58.69	2.96	41.63	0.0272	0.0322	7.44	1.52	9.09	0.0063	0.0069	66.13	4.48	50.72	0.0335	0.0391
	S.Em (±)	**3.07**	**0.16**	**1.98**	**0.0014**	**0.0018**	**0.90**	**0.18**	**1.00**	**0.0007**	**0.0007**	**3.14**	**0.22**	**2.19**	**0.0016**	**0.0019**
	CD at 5%	**9.47**	**0.49**	**6.11**	**0.0042**	**0.0056**	**NS**	**0.55**	**NS**	**NS**	**NS**	**9.68**	**0.66**	**6.75**	**0.0049**	**0.0059**

CONCLUSIONS

The present study concluded that 100% RDF (20:60:20:20) is more effective in the uptake of N, P and K of the crop and 75% RDF + Bio-NPK + Bio-Zn effective in Zn and Fe uptake. Therefore, the study would definitely beneficial to produce optimum yield, quality and boost up the sustainable soil health.

Acknowledgement. I would like o express my Special thanks of gratitude to my Advisor Dr. M.D. Vyas, Principal Scientist Agronomy RVSKVV Gwalior (M.P.) and department of Soil Science as well as Our Dean Dr. H. D. Verma, RAK, CoA, Sehore (M.P.) who gave me the golden opportunity to do this wonderful research on the Title- Impact of using Bio-NPK and Bio-Zn together with chemical fertilizers on soybean uptake of nutrients (*Glycine max* L. *Merrill*) in black soil.
Conflict of Interest. None.

REFERENCES

Afra, J. M. and Mozafar, M. (2017). The Effect of Phosphorus and Zinc Fertilizer on the Elements Concentration of Soybean Cultivars Seed (*Glycine max* L). *Bulletin Environment Pharmacology and Life Sciences*, *6*, 41-48.

Anonymous (2021). Directors report All India Coordinated Research Project on Soybean, Indian Institute of Soybean Researh, Indore (M.P.).

Bandyopadhyay, S. Ray, P., Padua, S., Ramachandran, S., Jena, R. K., Roy, P. D., Dutta, D. P., Singh, S. K. and Ray, S. K. (2018). Priority zoning of available micronutrient in the soils of agroecological sub-regions of north-east India using geo-spatial techniques. *Agricultural Research*, *7*(2), 15.

Dwivedi, A. K., Singh, M., Kauraw, D. L., Wanjari, R. H. and Chauhan, S. S. (2007). Research bulletin on impact of fertilizer and manure use for three decades on crop productivity and sustainability and soil quality under Soybean-Wheat system on a Vertisol in Central India. IISS (ICAR), Bhopal pp. 224-235.

Gupta, M. and Kausik, R. D. (2006). Effect of saline water irrigation and Zn application on post-harvest soil in mustard. 18 th world congress of Science, Philadelphia.

Gupta, V., Sharma, G. L, Sonakiya, V. K. and Tiwari, G. (2003). Impact of different levels of FYM and sulphur on morphological indices and productivity of soybean genotypes. *JNKVV Research Journal, 37*(2), 76-78.

Hafeez, B., Khanif, Y. M. and Saleem, M. (2013). Role of zinc in plant nutrition- A review. *American Journal of Experimental Agriculture*, *3*(2), 374-391.

Hanway, J. J. and Heidel, H. (1952). Soil analysis method as used in Lowa state College Soil testing laboratory. *Lowa State College of Agriculture, Bulletin, 57,* 1-31.

Jain, R. C., S. B. P. Singh, Chintaram, Nema, G. K., Singh, Pooja and Jain and Nimisha Raj (2021). Nutrient utilization and yield of soybean applied with jeewamrit fortified with banana peel, slacked lime and biofertilizers in black soil. *Journal of Emerging Technologies and innovative Research, 8*(10), 731-740.

Jat, G., Sharma, S. K., Meena, R. H., Choudhary, R., Choudhary, R. S. and Yadav, S. K. (2021). Studies on effect of zinc application on quality and yield of soybean (*Glycine max* L.) under Typic Haplustepts soil. *Indian Journal of Pure Applied Bioscience, 9*(1), 188-193.

Javaid, A. (2009). Growth, nodulation and yield of black gram [*Vigna mungo* (L.) *Hepper*] as influenced by biofertilizers and soil amendments. *African J. Biotechnol., 8,* 5711-5717.

Khan, U. M., Qasim, M. and Khan, I. (2007). Effect of Zn fertilizer on rice grown in different soils of Dera Ismail khan. *Sarhad Journal of Agriculture, 23*(4).

Kobraee, S., Noor, Mohamadi, G., HeidariSharifabad, H., DarvishKajori, F. and Delkhosh, B. (2011). Influence of micronutrient fertilizer on soybean nutrient composition. *Indian Journal of Science Technology*, *4*(7), 763-769.

Kravchenko, I., Kizilova, A; Titova, L. and Lutinskaya, G. (2013). Effect of microbial fertilizers on rhizospheric bacterial diversity and yield response of soybean plants, *Agricultural Sci. Development, 2*(12), 120-125.

Kumar, M., Jha, A. K., Hazarika, S., Verma, B. C., Choudhury, B. U., Ramesh, T. and Devi, M. H. (2016). Micronutrients (B, Zn, Mo) for improving crop production on acid soils of Northeast India. *National Academy of Science Letters*. *39*(2), 85-89.

Kumawat, K. C., Sharma, P., Sirari, A., Singh, I., Gill, B. S., Singh, U. and Saharan, K. (2019). Synergism of *Pseudomonas aeruginosa* (LSE-2) nodule endophyte with *Bradyrhizobium* sp. for improving plant growth, nutrient acquisition and soil health in soybean. *World J. of Microb. and Biotech.*, *35*(3), 01-17.

Leite, C. M., Da, S., César, F. R., Guimarães, G. G., Almeida, E. and Muraoka, T. (2020). Low efficiency of Zn uptake and translocation in plants provide poor micronutrient enrichment in rice and soybean grains. *Journal of Plant Nutrition, 43*(1), 79-91.

Lindsay, W. L. and Norvell, W. A. (1978). Development of a DTPA Soil Test for zinc, iron, manganese, and copper, *Soil Sci. Society of America J., 42,* 421-428.

Martinez-Cuesta, N., Carciochi, W., Sainz-Rozas, H., Salvagiotti, F., Colazo, J. C., Wyngaard, N. and Barbieri, P. (2021). Effect of zinc application strategies on maize grain yield and zinc concentration in mollisols. *Journal of Plant Nutrition*, *44*(4), 486-497.

Meena, M., Jat, G., Meena, R.H., Choudhary, R. Jain, D., Doodhwal, K., Jat, H. and Yadav, S. K. (2021). Effect of Phospho Enriched Compost and Zinc on Productivity and Nutrient Uptake of Blackgram (*Vigna mungo* L.) in Sub-humid Southern Hills and Aravalli Region of Rajasthan. *Legume Research, 10,* 18805/LR-4359.

Meena, S., Lahariya, G. S. and Pappu Khatik, K. (2017). Interactive Effect of Phosphorus and Zinc on Yield, Quality and Fertility Status of Soil after Harvest of Soybean. *Environment & Ecology*, *35*(2D), 1580-1584.

Nalawde, A. A. and Satish, A. Bhalerao (2015). Comparative account of Effect of Biofertilizers on the growth and biochemical parameters of *Vigna mungo* (*L. Hepper*). *International Journal of Advanced Research in Biological Sciences, 2*(5), 62–66.

Olsen, S. R., Cole, C. V., Watanable, F. S. and Dean, L. A. (1954). Estimating of phosphorus in soil by extraction with sodium bicarbonate, *USDA Circular,* 939.

Pandey, A. K. Singh, M., Kumar, S., Meena, V. K., Onte S. and Kushwaha, M. (2019). Influence of stage of harvesting and zinc application on yield and zinc uptake in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub]. *Legume Research, 42*(5), 661-665.

Rathod, D. D., Meena, M. C. and Patel, K. P. (2012). Evaluation of different zinc-enriched organics as source of zinc under wheat-maize (fodder) cropping sequence on zinc-deficient Typic Haplustepts. *Journal of the Indian Society of Soil Science*, *60*(1), 50-55.

Salih, H. O. (2013). Effect of Foliar Fertilization of Fe, B and Zn on nutrient concentration and seed protein of Cowpea "*Vigna Unguiculata*". *Journal of Agriculture and Veterinary Science*, *6*(3), 42-46.

Souza, J. A., Moraes, L. A. C. and Moreira, A. (2019). Zinc and amino acids on wheat-soybean intercropping under no-till management. *Journal of Plant Nutrition*, *42*(16), 1992-2002.

Subbaiah, B. V. and Asijo, G. L. (1956). A rapid procedure for determinations of available nitrogen in soil. *Current Sci., 25,* 259-260.

Tyagi, P. K. and Singh, V. K. (2019). Effect of integrated nutrient management on growth, yield and nutrients uptake of summer blackgram (*Vigna mungo*) *Annals of Plant and Soil Research, 21*(1), 30-35.

Verma, S. N., Sharma, N. and Verma, A. (2017). Effect of integrated nutrient management on growth quality and yield of soybean (*Glycine max*) *Annals of Plant and Soil Research, 19*(4), 372-376.

How to cite this article: Abhishek Sharma, M.D. Vyas, B.K. Sharma, R.C. Jain, Anita Shukla, B.R. Baraiya, M.K. Tarwariya and P.K. Para (2023). Impact of using Bio-NPK and Bio-Zn together with Chemical Fertilizers on uptake of Nutrients by Soybean (*Glycine max* L. *Merrill*) in Black Soil. *Biological Forum – An International Journal, 15*(3): 738-743.