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Effect of Zinc Application Strategies on Nutrients Content, Uptake by Soybean and Status in Post-harvest Soil

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ABSTRACT: Among the oilseed crops soybean is most important crop that having edible oil and also protein in seeds. Zinc is most deficient micronutrient in soils of India. So, it is most important to manage through applying Zn containing fertilizers. A field experiment was conducted at research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during kharif season of 2019 to evaluate zinc uptake by soybean, use efficiency and status of available Zn in post harvest soil under different strategies of zinc application. Experiment was laid under randomized block design having fourteen treatments of zinc application strategies [T_1-Absolute control, T_2-RDF + No Zn, T_3-RDF + 5.0 kg Zn ha^{-1}, T_4-RDF + spray of 0.5 % $ZnSO_4$ at 35 DAS, T_5-RDF + spray of 0.5 % $ZnSO_4$ at 35 and 55 DAS, T_6-RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ at 35 DAS, T_7-RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ at 35 and 55 DAS, T_8-RDF + Zn solubilizer as soil application, T_9-RDF + 5.0 kg Zn ha^{-1} + Zn solubilizer as soil application, T_{10}-RDF + Spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 DAS, T_{11}-RDF + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 and 55 DAS, T_{12}-RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 DAS, T_{13}-RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 and 55 DAS and T_{14}-No RDF + 5.0 kg Zn ha^{-1}] which were replicated three times. Results revealed that nutrient content, uptake, use efficiency in soybean and status in post harvest soil were significantly affected by zinc application strategies. It was also noted that RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35 and 55 DAS treatment had been found best among different treatments of Zn application strategies.

Keywords: Soybean, zinc application strategies, nutrient content, uptake and use efficiency.

INTRODUCTION

Soybean [*Glycine max* (L.) Merri.] is an important leguminous oil seed crop and due to nutritional value, it has been considered as "Protein hope of future". Generally, soybean contains 40-45% protein and 18-20% oil contents (Ibrahim and Kandil, 2007). In India, it is cultivated in 11.39 million ha with the production of 13.51 million tonnes having the productivity of 1185 kg ha^{-1} (FAI, 2019-20). Soybean plant absorbs zinc as Zn^{2+} and it is a component of synthetic and natural organic complexes. Soybean is an exclusive crop with considerable monetary worth. It is the major plant source of both animal feed protein and edible oil. It also plays a crucial role in sustainable agriculture as it fixes atmospheric nitrogen with the help of microorganisms (Hungria and Mendes, 2015). In addition, with augmented variations in climatic situations, next-generation soybean cultivars must not only be higher yielding but also more resilient to numerous abiotic and biotic stresses (Djanaguiraman *et al.,* 2019). Zn is directly and indirectly involved in many enzymatic activities, but it is not known whether it acts as a functional, structural or regulatory cofactor. Zn is an essential catalytic component of over 300 enzymes, including alkaline phosphatase, alcohol dehydrogenase, Cu-Zn superoxide dismutase, and carbonic anhydrase (Fox and Guerinot, 1998). Particularly, Zn may be limiting for the growth and development of young children for brain development (Krebs, 2013). Effect of Zn application could be variable due to application time, rate, method and presence of Zn solubilizing microbes in soil which need to be optimized for higher yield and zinc use efficiency. Fageria (2008) reported that higher yield in crops is associated with higher nutrients use efficiency. The efficiency of applied Zn in soil is only 1.0 to 3.0 % and most part of applied zinc is remained unavailable to plants due to leaching, fixation etc. which has to be optimized through standardizing rates, methods and scheduling of application which need to be enhanced by means of standardizing the rates, methods, sources and timings of application. Zinc application in soybean improves photosynthetic activity, chlorophyll synthesis, metabolism of nitrogen and develops resistance to abiotic stresses. Zinc availability from soil to plant depends on various factors which governs the sorption and desorption of zinc in the soil (Alloway, 2008). Effect of Zn application could be variable due to application time, rate and method which need to be optimized for higher productivity and Zn use efficiency in soybean. Zn is an essential micronutrient and has particular physiological functions in all living systems, such as maintenance of structural and functional integrity of biological membranes and facilitation of protein synthesis and gene expression. Among all metals, Zn is needed by the largest number of proteins. Zn-binding proteins make up nearly 10 % of the proteomes in eukaryotic cells, and 36% of the eukaryotic Zn-proteins are involved in gene expression (Andreini *et al.,* 2006). Tolerance to environmental stress necessitates higher need of Zn to regulate and maintain the expression of genes essential to protect cells from the detrimental effects of stress (Cakmak, 2000). To correct Zn deficiency, improve the productivity and optimize the nutrients use efficiency, the deep understanding about the rate, method and time of zinc application is very interpretative. Jat *et al*. (2021) reported that application of recommended dose of fertilizer along with combined application of Zn @ 5 kg ha^{-1} offered the best combination in realizing maximum yield and nutritive quality of soybean. The cumulative levels of phosphorus enriched compost and zinc upto 4 t ha^{-1} and 4 kg ha^{-1} correspondingly increased significantly the nodules $plant^{-1}$, pods $plant^{-1}$, seeds pod^{-1}, test weight, seed yield, stover yield, nutrient content (N, K and Zn) and uptake (N, P, K and Zn) in seed and stover Meena *et al*., (2021).

MATERIAL AND METHODS

The experiment was conducted with soybean (cv. JS2029) at the research farm of JNKVV, Jabalpur (23°13′N latitude, 79°57′E longitude and at altitude of 393 m amsl.) during *kharif* season of 2019-2020. The soil of the experimental soil was Clayey soil comes under Vertisol belongs to *Kheri* series of fine montmorillonite hyperthermic family of *Typic Haplusterts* and popularly known as medium deep black soil. Physical and chemical parameters of soil were summarized in tabulated form.

Table 1: Physical and chemical parameters of experimental site.

Sr. No.	Parameters	Values
1.	pH	7.18
2.	EC	0.11 dSm^{-1}
3.	Organic Carbon	5.82 g kg^{-1}
4.	Available N	285.4 kg ha^{-1}
5.	Available P	19.7 kg ha^{-1}
6.	Available K	284.1 kg ha^{-1}
7.	Available Zn	0.525 $mgkg^{-1}$

Experiment was laid in random block design consists of fourteen treatments of zinc application approached which were replicated three times.

Table 2: Treatment details of experimental site.

Sr. No.	Treatments
T_1	Absolute control
T_2	RDF+ No Zn (Recommended dose of fertilizer)
T_3	RDF + 5.0 kg Zn ha^{-1}
T_4	RDF + spray of 0.5 % $ZnSO_4$ at 35 DAS
T_5	RDF + spray of 0.5 % $ZnSO_4$ at 35 and 55 DAS
T_6	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ at 35 DAS
T_7	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ at 35 and 55 DAS
T_8	RDF + Zn solubilizer as soil application
T_9	RDF + 5.0 kg Zn ha^{-1}+ Zn solubilizer as soil application
T_{10}	RDF + Spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 DAS
T_{11}	RDF + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 and 55 DAS
T_{12}	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 DAS
T_{13}	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5 % $ZnSO_4$ and 150 PPM salicylic acid at 35 and 55 DAS
T_{14}	No RDF + 5.0 kg Zn ha^{-1}

These are the treatment combinations of experimental soil which are applied with recommended doses of fertilizer (RDF) as nitrogen (20 kg ha^{-1}), phosphorus (80 kg ha^{-1}) and potassium (20 kg ha^{-1}) through urea, single super phosphate and muriate of potash at the time of sowing and zinc by zinc sulphate ($ZnSO_4.7H_2O$) contained 20.5 % Zn as per treatments. Nutrient content in soil and plant were determined using standard analytical procedures. Nutrient uptake was computed by multiplying the seed yield with total nutrient content in seed and stover, whereas use efficiency was calculated by using the following equations:

Nutrient use efficiency (%) = Physiological efficiency × Apparent recovery efficiency

Physiological efficiency =

$$\frac{\text{Total dry matter (treatment - control}}{\text{Nutrient uptake (treatment - control)}}$$

Physiological efficiency =

$$\frac{\text{Nutrient uptake (treatment - control)}}{\text{Nutrient applied}}$$

Standard agronomic practices are followed for growing soybean crop were followed except those under treatments. Standard statistical approaches, as suggested by Chandel (2002), were adopted for data analysis and test of significance were tested by using least significant difference.

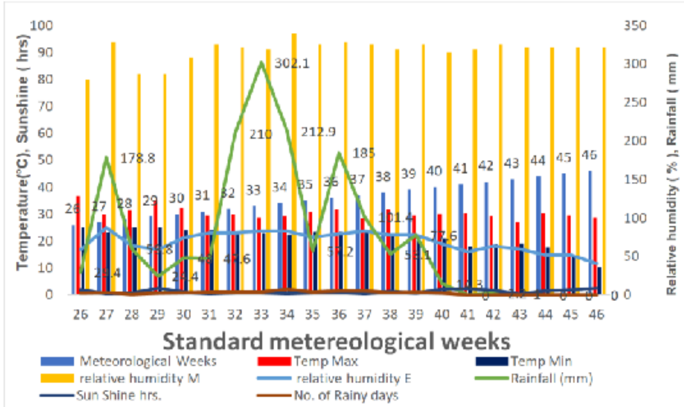

Fig. 1. Meteorological parameters during *Kharif* season, 2019.

RESULT AND DISCUSSION

A. Nutrient content

Data presented in Table 3 clearly revealed that significantly highest nutrient content of N, P, K and Zn in seed (6.21, 0.44 and 3.36% and 46.0 mgkg^{-1}) and stover (2.22, 0.23 and 2.21% and 13.2 mgkg^{-1}), respectively were obtained under RDF+5.0 kg Zn ha^{-1}+ spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35 and 55 DAS treatment which had been at par with some treatments. The N content is significantly at par with T_6, T_7, T_9 to T_{12} and lowest nutrient content were obtained from control treatment. The P content is statistically at par with T_4 to T_7 and T_8, T_9, T_{11} and T_{12} and lowest is found under absolute control treatment. The K content is statically at par with T_3 to T_{12} treatments and lowest is found in absolute control treatment. It was also found that application of zinc with and without salicylic acid significantly increased the nutrient content in seed and stover of soybean. The higher nutrients content was might be due to application of zinc that increase the photosynthesis and also increase the nutrients accumulation. 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.

Table 3: Effect of zinc application strategies on nutrient content in soybean.

Sr. No.	Treatments	Nutrient content in seed				Nutrient content in stover			
		N (%)	P (%)	K (%)	Zn (mg kg^{-1})	N (%)	P (%)	K (%)	Zn (mg kg^{-1})
T_1	Absolute control	5.47	0.36	1.99	36.1	1.61	0.15	1.47	11.5
T_2	RDF (No Zn)	5.98	0.38	3.14	34.3	2.12	0.20	2.16	11.3
T_3	RDF +5.0 kg Zn ha^{-1}	6.01	0.39	3.32	42.9	2.23	0.21	2.19	12.1
T_4	RDF+spray of 0.5% $ZnSO_4$ at 35 DAS	6.03	0.40	3.21	37.4	2.19	0.18	2.17	12.3
T_5	RDF+Spray of 0.5% $ZnSO_4$ at 35 and 55 DAS	6.04	0.42	3.20	40.3	2.20	0.20	2.16	12.7
T_6	RDF+5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 DAS	6.07	0.41	3.31	45.8	2.18	0.21	2.17	12.8
T_7	RDF+5.0 kg Zn ha^{-1} + spray of $ZnSO_4$ at 35 and 55 DAS	6.10	0.40	3.32	45.3	2.21	0.20	2.20	12.6
T_8	RDF + Zn solubilizer (soil application)	6.04	0.42	3.30	40.1	2.20	0.19	2.11	11.9
T_9	RDF +5.0 kg Zn ha^{-1}+Zn solubilizer (soil application)	6.08	0. 39	3.31	43.6	2.20	0.20	2.13	12.9
T_{10}	RDF + spray of 0.5%$ZnSO_4$+150 ppm salicylic acid at 35 DAS	6.06	0.40	3.22	40.8	2.18	0.20	2.16	12.6
T_{11}	RDF + spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 and 55 DAS	6.07	0.41	3.25	41.4	2.20	0.21	2.18	12.9
T_{12}	RDF+5.0 kg Zn ha^{-1} +Spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 DAS	6.10	0. 43	3.34	45.7	2.21	0.22	2.19	13.0
T_{13}	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ +150 ppm salicylic acid at 35 and 55 DAS	6.21	0.44	3.36	46.0	2.22	0.23	2.21	13.2
T_{14}	No RDF +5.0 kg Zn ha^{-1}	5.54	0.38	2.14	43.8	1.67	0.17	1.57	12.8
SEm+		**0.053**	**0.013**	**0.052**	**0.84**	**0.024**	**0.012**	**0.037**	**0.113**
CD (p = 0.05)		**0.153**	**0.036**	**0.152**	**2.44**	**0.066**	**0.033**	**0.106**	**0.330**

B. Nutrient uptake

Data (Table 4) evidently showed that highest (145.4, 13.9 and 127.0 kg ha^{-1} and 117.69 gha^{-1}) uptake of N, P, K and Zn, respectively by soybean were obtained in RDF+5.0 kg Zn ha^{-1} + Spray of 0.5% $ZnSO_4$ +150 ppm Salicylic acid at 35 and 55 DAS treatment which had been significantly higher than other treatments and lowest were found under absolute control treatment. The results might be due to increase in nutrients availability by application of zinc and also the higher yield ultimately leads to higher nutrients uptake by crops. It was also found that application of salicylic acid increased the nutrients uptake but it had not been 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 might be due to better supply of zinc and greater yield of soybean with application of zinc.

Table 4: Effect of zinc application strategies on nutrient uptake by soybean.

Sr. No.	Treatments	Nutrient uptake (Kg ha^{-1})			Zn uptake (g ha^{-1})
		N	P	K	
T_1	Absolute control	81.5	7.7	57.8	68.64
T_2	RDF (No Zn)	112.7	10.8	99.3	74.64
T_3	RDF + 5.0 kg Zn ha^{-1}	123.5	11.3	107.8	99.65
T_4	RDF + Spray of 0.5% $ZnSO_4$ at 35 DAS	116.1	10.1	101.4	82.07
T_5	RDF +Spray of 0.5% $ZnSO_4$ at 35 and 55 DAS	120.0	11.2	103.8	89.39
T_6	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 DAS	126.4	11.8	109.5	100.84
T_7	RDF + 5.0 kg Zn ha^{-1} + Spray of $ZnSO_4$ at 35 and 55 DAS	126.2	11.4	110.5	99.48
T_8	RDF + Zn solubilizer (soil application)	122.8	11.1	105.5	88.08
T_9	RDF + 5.0 kg Zn ha^{-1} + Zn solubilizer (soil application)	126.5	11.7	108.8	100.27
T_{10}	RDF + spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35 DAS	118.4	10.8	102.2	80.44
T_{11}	RDF + spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 and 55 DAS	121.7	11.6	106.6	85.85
T_{12}	RDF +5.0 kg Zn ha^{-1} +spray of 0.5% $ZnSO_4$+ 150 ppm salicylic acid at 35 DAS	130.6	12.0	114.2	104.80
T_{13}	RDF+5.0 kg Zn ha^{-1}+Spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 and 55 DAS	145.4	13.9	127.0	117.69
T_{14}	No RDF +5.0 kg Zn ha^{-1}	88.3	8.9	65.5	84.76
	SEm ±	**3.58**	**0.63**	**2.96**	**3.17**
	CD (p = 0.05)	**10.74**	**1.80**	**8.76**	**9.21**

C. Nutrient use efficiency

The results (Table 5) revealed that highest use efficiency of N (53.1%), P (18.3%), K (75.7%) and Zn (2.87%) were obtained under RDF+5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 and 55 DAS treatment which had been found significantly superior over other treatments. It was also noted that application of zinc with and without salicylic acid significantly increased the nutrients (N, P and K) use efficiency in soybean, which may be due to synergetic effect of Zn on N, solubility effect of salicylic acid for P and K, and higher yield under this treatment. Similar findings were also reported by Aulakh *et al*. (2005); Rathod *et al*. (2012); Kanase *et al*. (2014); Hippler *et al*. (2015); Dimkpa *et al.* (2017); Montoya *et al.* (2020) from different experimental studies.

Table 5: Effect of zinc application strategies on nutrient use efficiency in soybean.

Sr. No.	Treatments	Nutrient use efficiency (%)			
		N	P	K	Zn
T_1	Absolute control	0.0	0.0	0.0	0.00
T_2	RDF (No Zn)	24.6	6.2	28.6	0.00
T_3	RDF +5.0 kg Zn ha^{-1}	34.8	8.7	36.8	0.70
T_4	RDF + spray of 0.5% $ZnSO_4$ at 35 DAS	26.5	6.6	28.9	0.59
T_5	RDF + spray of 0.5% $ZnSO_4$ at 35 and 55 DAS	32.3	8.1	35.0	1.61
T_6	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 DAS	39.2	9.8	42.6	0.65
T_7	RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 and 55 DAS	40.8	10.2	43.1	2.61
T_8	RDF + Zn solubilizer (soil application)	35.7	8.9	37.8	0.00
T_9	RDF + 5.0 kg Zn ha^{-1}+Zn solubilizer (soil application)	40.7	10.2	43.2	0.81
T_{10}	RDF + spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35 DAS	28.7	7.2	30.5	1.04
T_{11}	RDF + spray of 0.5% $ZnSO_4$ +150 ppm salicylic acid at 35 and 55 DAS	35.0	8.8	37.7	1.75
T_{12}	RDF +5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$+ 150 ppm salicylic acid at 35DAS	48.0	12.0	51.4	0.80
T_{13}	RDF+5.0 kg Zn ha^{-1}+ spray of 0.5% $ZnSO_4$+150 ppm Salicylic acid at 35 and 55 DAS	73.1	18.3	75.7	2.87
T_{14}	No RDF + 5.0 kg Zn ha^{-1}	0.0	0.0	0.0	0.22
	SEm±	**3.83**	**0.96**	**1.21**	**0.033**
	CD (p=0.05)	**11.14**	**2.78**	**3.52**	**0.095**

D. Nutrient status of post-harvest soil

The results (Table 6) clearly revealed that zinc application strategies significantly influenced the status of available nutrients. Available N and P were significantly reduced in every treatment as compare to their initial values (285.4 and 19.7 kg ha^{-1}, respectively). However, available K was significantly depleted from its initial value (282.1 kg ha^{-1}) only in absolute control, RDF +5.0 kg Zn ha^{-1}, RDF+5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 DAS, RDF+5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 and 55 DAS and no RDF + 5.0 kg Zn ha^{-1} treatments. It might be because of increased uptake of nutrients due to zinc application strategies. The increase in nutrients content in soil was might be due to synergistic effect of zinc on nitrogen, potassium and also increase nitrogen fixation by crop that increase the nutrients in soil over control treatment. And zinc have antagonistic effect with phosphorus that decrease 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 relooked. Similar kind of result was 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 zinc application as basal in soil and foliar sprays might be because of sufficient availability and buffering capacity of soil to recover Zn from exchangeable pool. Similar results were also reported by Barman *et al.* (1998); Gupta and Kausik (2006); Khan *et al.* (2007); Rathod *et al*. (2012); Martinez *et al*. (2021) from different experiments.

Table 6: Effect of zinc application strategies on nutrient status in post harvest soil.

Sr. No.	Treatment	Available nutrients ($kgha^{-1}$)			Zn $mgkg^{-1}$
		N	P	K	
T_1	Absolute control	259.1	15.4	272.7	0.52
T_2	RDF (No Zn)	260.8	15.1	283.9	0.51
T_3	RDF +5.0 kg Zn ha^{-1}	262.6	15.0	279.4	0.61
T_4	RDF +Spray of 0.5% $ZnSO_4$ at 35 DAS	262.6	14.9	285.3	0.59
T_5	RDF +spray of 0.5% $ZnSO_4$ at 35 and 55 DAS	263.7	14.8	282.6	0.60
T_6	RDF+5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ at 35 DAS	264.1	14.7	278.2	0.63
T_7	RDF+5.0 kg Zn ha^{-1} + spray of $ZnSO_4$ at 35 and 55 DAS	264.4	14.7	277.6	0.63
T_8	RDF + Zn solubilizer (soil application)	264.2	15.0	281.8	0.61
T_9	RDF + 5.0 kg Zn ha^{-1}+Zn solubilizer (soil application)	265.4	14.9	282.9	0.67
T_{10}	RDF + spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 DAS	264.3	14.8	281.2	0.57
T_{11}	RDF +spray of 0.5% $ZnSO_4$+150 ppm salicylic acid at 35 and 55 DAS	263.7	14.7	281.4	0.59
T_{12}	RDF+5.0 kgZnha^{-1}+spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35DAS	265.4	14.1	283.0	0.65
T_{13}	RDF+5.0 kgZnha^{-1}+spray of 0.5% $ZnSO_4$ +150 ppm salicylic acid at 35 & 55 DAS	266.1	13.8	283.7	0.66
T_{14}	No RDF + 5.0 kg Zn ha^{-1}	257.2	13.6	272.3	0.62
Sem±		**1.48**	**0.06**	**1.55**	**0.018**
CD (*p = 0.05*)		**4.31**	**0.17**	**4.50**	**0.052**
Initial value		**285.4**	**19.7**	**284.1**	**0.525**

CONCLUSION

Zinc is deficient in most of the soils of India, so need to supplement the soil with zinc containing fertilizers. The experimental study revealed that zinc application significantly increases nutrients content, uptake and use efficiencies. And also, data revealed that zinc application significantly increases nutrients status of soil after harvest of crop over absolute control treatment. From the present study concluded that application of RDF + 5.0 kg Zn ha^{-1} + spray of 0.5% $ZnSO_4$ + 150 ppm salicylic acid at 35 and 55 DAS gives better results in terms of highest nutrients content and uptake (N, P, K and Zn) and use efficiency by soybean.

FUTURE SCOPE

Present exploration needs to be further verified and similar types of experiments should be conducted with different sources of Zn for enhancing the Zn use efficiency and Zn-fortification in legumes and grain crops for fighting with Zn malnutrition.

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