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Study on Bio-Efficacy of Zinc Fortified SSP in Soybean

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A B S T R A C T

A field experiment was carried out to study the bio-efficacy of zinc fortified SSP on growth and yield of soybean at Regional Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Amravati, Mahrashtra during *kharif* season of the year 2016. A set of six treatments regular SSP, Zincated SSP, regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application, zincated SSP + 1 foliar spray of zinc sulphate (Zn 21%), Zincated SSP + 2 foliar spray of zinc sulphate (Zn 21%) and regular SSP + 2 foliar spray of zinc sulphate (Zn 21%) were taken under Randomized Block Design with four replication to evaluate bio-efficacy of zinc fortified SSP in soybean. The experimental results revealed that application of treatment zincated SSP + 1 foliar spray of zinc sulphate (Zn 21%) was recorded significantly highest seed yield (2137 kg/ha) over treatment regular SSP (1887 kg/ha) but found at par with zincated SSP, regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application, and zincated SSP + 2 foliar spray of zinc sulphate (Zn 21%). Similar trend was also observed in respect of straw yield. Treatment zincated SSP, regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application, zincated SSP + 1 foliar spray of zinc sulphate (Zn21%) and zincated SSP + 2 foliar spray of zinc sulphate (Zn21%) recorded significantly higher GMR over regular SSP whereas in case of B:C ratio regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application recorded highest B:C ratio followed by treatment zincated SSP, zincated SSP + 1 foliar spray of zinc sulphate (Zn 21%) and zincated SSP + 2 foliar spray of zinc sulphate (Zn 21%).

Introduction

Soybean has emerged as one of the major oilseed crop and revolutionized rural economy and lifted the socio economic status of soybean farmers. However, the increase in the productivity over the years did follow the same place, and it is not more than half of the world average, hence there is tremendous scope to increase soybean production by enhancing productivity. There are several constraints in the soybean cultivation one of them is nutrient management particularly micronutrients.

Zinc is an important component of various

enzymes that are responsible for driving many metabolic reactions in all crops. Growth and development would stop if specific enzymes were not present in plant tissue. Carbohydrate, protein, and chlorophyll formation is significantly reduced in zinc-deficient plants. Therefore, a constant and continuous supply of zinc is needed for optimum growth and maximum yield.

Zinc (Zn) is an essential micronutrient for plant life. In Minnesota, while some soils are capable of supplying adequate amounts for crop production, addition of zinc fertilizers is needed for others. Zinc is a recommended micronutrient in fertilizer programs for production of soybean. Keeping all this in mind, the studies was conducted to find out the bio-efficacy of zinc fortified SSP on growth and yield of soybean.

Materials and Methods

A field experiment was carried out at Regional Research Centre, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Amravati, Mahrashtra during kharif season of the year 2016. A set of six treatments regular SSP, Zincated SSP, regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application, zincated SSP + 1 foliar spray of zinc sulphate (Zn 21%), Zincated SSP + 2 foliar spray of zinc sulphate (Zn 21%) and regular SSP + 2 foliar spray of zinc sulphate (Zn 21%) were taken under Randomized Block Design with four replication to evaluate bio-efficacy of zinc fortified SSP in soybean. Two sprays were given 30 and 60 DAS. The soil of experimental field was medium deep black. The crop (Variety JS-335) was raised using nutrient dose @ 30 kg N, 70 kg P_2O_5 and 30 kg K_2O per hectare at the time of sowing. Seeds were sown at the rate of 75 kg ha^{-1} by dibbling method at a spacing of 45 cm x 05 cm.

The data on plant height, no. of branches per plant and no. of pods per plant were collected from randomly selected five plants per plot at the time of harvest. From the total produce of each plot, 100 grains were counted and weighed to express test weight. The crop was harvested when the pods were matured, bundles were sun dried for few days and then threshed manually.

The data on biological and grain yield were collected at the time of harvest. The data were analysed by statistical method as suggested by Panse and Sukhatme (1954).

Results and Discussion

Treatment T2 (Zincated SSP), T3 (Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application), T4 (Zincated SSP+1 foliar spray of zinc sulphate (Zn21%)) and T5 (Zincated SSP +2 foliar spray of zinc sulphate (Zn21%)) was found significantly superior over treatment T1 (Regular SSP) for the characters plant height, Number of pods/plant, 100 Seed weight, Leaf area index.

Treatment T1 (Regular SSP) found at par with treatment T6 (Regular SSP+2 foliar spray of zinc sulphate (Zn 21%)). Any treatment in respect of Number of seeds /pod does not show significant effect (Table 1).
Significant increases in plant height was due to vigorous root and shoot growth and establishment of N-fixation by root-nodules activated and requisite level by the applied P and Zn. These results are in conformity with the findings of Wasmatkaret al (2002), Yadav (2003); Malaviyaet al (2004), Singh and Rai (2004); Tiwari *et.al*. (2006). The increase of plant height and leaf area due to Zn application have been reported by Agrawalet al (1996), Khamparia (1996) and Achakzaiet al (2002).

The higher number of pods/plant and other yield-attributing characters may be attributed to the significant role of phosphorus and zinc

(applied as ZnSo4) in regulating the photosynthesis, root enlargement and better microbial activities (Prasad and Sanoria, 1981).

According to Thakur and Mandloi (1990) and Shinde (1995), the higher number of pods per plant may be due to the fact that applied P and Zn (with S) enhanced the metabolic activities promoting chlorophyll formation and photosynthesis at one hand and root-development coupled with accelerated 65 rhizoidal activity on the other. Moreover, application of phosphorus produced vigorous root development, better nitrogen fixation and overall better development of plant.

This ultimately resulted in increase in yield-attributing characters. Wasmatkar el al. (2002), Chandelet al (2002), Yadav (2003), Singh and Rai (2004) also supported the present results and interpreted that P and Zn (with S) enhanced the metabolic activity, promoted chlorophyll and amino acids and protein synthesis which may result in better pod characters. The increases in yield-attributes due to applied-P in soybean have also been supported by the finding of several worker (Khandweet al 2002; Patraet al 2002; Dikshit and Khatik, 2002; Yadav, 2003 Malaviya, 2004).

Treatment T4 i.e Zincated SSP+1 foliar spray of zinc sulphate (Zn21%) was recorded significantly highest seed yield (2137 kg/ha) over treatment T1 (1887 kg/ha) but found at par with T2 (Zincated SSP), T3 (Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application), and T5 (Zincated SSP+2 foliar spray of zinc sulphate (Zn21%)). Similar trend was also observed in respect of straw yield (Table 2).

Table.1 Growth and yield attributes of soybean as influenced by various treatments

Treatments	plant height (cm)	No. of branches /plant	No of Pods/ plant	No of seeds / Pod	100 Seed wt. (g)	Leaf Area Index at 60 DAS
T1 Regular SSP	9.35	3.35	9.80	2.70	9.85	3.12
T2 Zincated SSP	44.55	3.60	21.90	2.80	10.28	3.35
T3 Regular SSP+recommended dose of zinc sulphate (Zn 21%) as soil application	44.43	3.60	21.85	2.80	10.25	3.35
T4 Zincated SSP+1 foliar spray of zinc sulphate (Zn21%)	46.20	4.05	22.30	2.80	10.35	3.36
T5 Zincated SSP+2 foliar spray of zinc sulphate (Zn21%)	44.35	3.95	22.25	2.80	10.33	3.33
T6 Regular SSP+2 foliar spray of zinc sulphate (Zn 21%)	40.75	3.50	20.05	2.75	9.98	3.21
Test	**Sig.**	**Sig.**	**Sig.**	**NS**	**Sig.**	**Sig.**
SE ±(m)	1.43	0.15	0.66	0.10	0.12	0.06
CD at 5%	4.32	0.45	1.99	---	0.36	0.17

Table.2 Effect of treatments on seed yield, straw yield, dry matter accumulation, protein content and oil content of soybean

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Dry matter accumulation (g)			Protein content (%)	Oil content (%)
			30 DAS	45 DAS	60 DAS		
T1 Regular SSP	1887	1976	1.27	7.45	10.34	37.28	19.38
T2 Zincated SSP	2105	2331	1.32	8.58	14.19	38.72	20.20
T3 Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application	2103	2324	1.30	8.56	13.82	38.56	20.15
T4 Zincated SSP+1 foliar spray of zinc sulphate (Zn 21%)	2137	2518	1.31	9.11	14.31	38.96	20.35
T5 Zincated SSP+2 foliar spray of zinc sulphate (Zn 21%)	2122	2460	1.30	8.46	14.19	38.87	20.23
T6 Regular SSP+2 foliar spray of zinc sulphate (Zn 21%)	1917	2100	1.28	8.03	12.95	37.51	19.53
Test	**Sig.**	**Sig.**	**NS**	**Sig.**	**Sig.**	**Sig.**	**Sig.**
SE ±(m)	65.6	95.87	0.05	0.33	0.67	0.35	0.19
CD at 5%	197.7	288.87	--	0.99	2.03	1.07	0.57

Table.3 Effect of treatments on monetary returns and B: C Ratio of soybean

Treatments	Cost of cultivation	Gross Monetary Return	Net Monetary Return	B: C Ratio
T1 Regular SSP	30293	54857.07	24565	1.81
T2 Zincated SSP	31203	61379.57	30177	1.97
T3 Regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application	30696	61327.44	30631	2.00
T4 Zincated SSP+ 1 foliar spray of zinc sulphate (Zn 21%)	31929	62556.14	30627	1.96
T5 Zincated SSP+ 2 foliar spray of zinc sulphate (Zn 21%)	32294	62045.40	29751	1.92
T6 Regular SSP+ 2 foliar spray of zinc sulphate (Zn 21%)	30696	55858.00	25162	1.82
Test	**Sig.**	**Sig.**	**NS**	**--**
SE ±(m)	141.91	1922.01	--	--
CD at 5%	427.61	5791.48	--	--

Table.4 Effect of treatments on nutrient uptake by soybean and soil fertility status

Treatments	Total Nutrient uptake (kg/ha)			PH	Ec	Available nutrient status in soil (kg/ha) at harvest			Zinc content in Seed (ppm)	Zinc content in Soil (ppm)
	N	P	K			Available N	Available P	Available K		
T1 Regular SSP	205.7	12.7	51.5	7.41	0.36	272.20	22.61	285.75	33.73	0.651
T2 Zincated SSP	235.6	16.7	63.1	7.41	0.36	273.28	23.46	286.75	45.75	0.655
T3 Regular SSP + recommended dose of zinc sulphate (Zn 21%) as soil application	234.6	16.2	63.0	7.41	0.36	273.22	23.42	286.26	45.60	0.656
T4 Zincated SSP+ 1 foliar spray of zinc sulphate (Zn 21%)	260.0	18.8	71.4	7.41	0.36	273.25	23.58	286.70	46.85	0.655
T5 Zincated SSP+ 2foliar spray of zinc sulphate (Zn 21%)	255.8	17.5	66.2	7.41	0.36	272.73	23.18	286.63	46.00	0.656
T6 Regular SSP+ 2 foliar spray of zinc sulphate (Zn 21%)	216.9	14.2	55.0	7.41	0.36	272.30	22.82	285.80	39.88	0.653
Test	**Sig.**	**Sig.**	**Sig.**	**7.41***	**0.36***	**268.00***	**21.57***	**285.18***	**--**	**0.654**
SE ±(m)	7.92	0.58	2.78	--	--	--	--	--	--	--
CD at 5%	23.85	1.74	8.78	--	--	--	--	--	--	--

Note: - * Initial status of soil

Treatment T2 (Zincated SSP), T3 (Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application), T4 (Zincated SSP+1 foliar spray of zinc sulphate (Zn21%)) and T5 (Zincated SSP+2 foliar spray of zinc sulphate (Zn21%)) was found significantly superior over treatment T1 (Regular SSP) for the characters dry matter accumulation at 45 days, protein content, oil content except treatment T6 (Regular SSP+2 foliar spray of zinc sulphate (Zn21%)).

Any treatment does not show significant effect in respect of dry matter accumulation at 30 days. For the character dry matter accumulation at 60 days all the treatment i.e. T2, T3, T4, T5 and T6 found significantly superior over treatment T1 (Table2).

The findings of Jha and Chandal (1987) at Pantnagar revealed that application of zinc increased the plant dry matter, grain yield and yield-attributes and quality (protein and oil content) of soybean grain. The increase in grain yield was mainly due to increase in pods/plant and grains/pod by zinc application. The cannelization of photosynthates during reproductive stage might have been influenced by zinc by way of its involvement in electron transfer (Bakar el al., 1982) and activation of various enzymes (Okhi, 1978).

The increased phosphorus levels also contributed to increase seed and straw yield through the increase in yield-attributing characters.

Treatment T2 (Zincated SSP), T3 (Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application)), T4 (Zincated SSP+1 foliar spray of zinc sulphate (Zn21%)) and T5 (Zincated SSP+2 foliar spray of zinc sulphate (Zn21%)) recorded significantly higher GMR over T1 (Regular SSP) whereas in case of B:C ratio T3 recorded highest B:C ratio followed by treatment T2, T4 and T5 (Table3). Vyaset al (1993) and Shinde (1995) also observed that soybean responded economically to the applied phosphorus levels.

Treatment T2 (Zincated SSP), T3 (Regular SSP+ recommended dose of zinc sulphate (Zn 21%) as soil application)), T4 (Zincated SSP+1 foliar spray of zinc sulphate (Zn21%)) and T5 (Zincated SSP+2 foliar spray of zinc sulphate (Zn21%)) found significantly superior over treatment T1 (Regular SSP) for the character N, P and K uptake except treatment T6 (Regular SSP+ 2 foliar spray of zinc sulphate (Zn 21%)). For the character zinc content in seed all the treatment i.e. T2, T3, T4, T5 and T6 found significantly superior over treatment T1 (Table 4). The results of present investigation suggests that T4 Zincated SSP + 1 foliar spray of zinc sulphate (Zn 21%) leads to highest plant height, no. of branches /plant, no. of pods/plant, 100 seed weight, dry matter accumulation, seed and straw yields of soybean with increased contents of available N, P and K in soil.

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