

Effect of zinc levels and incubation with cow dung on yield and zinc uptake by soybean (*Glycine max*)–wheat (*Triticum aestivum*) sequence in *Vertisols*

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ABSTRACT

A field experiment was conducted in *Vertisols* of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during 2007-2008 to study the direct effect of Zn levels (0, 1.25, 2.5 and 5 kg/ha) alone and the Zn levels incubated with 200 kg cow dung/ha on yield of soybean [*Glycine max* (L.) Merrill] 'JS93 05' and the residual effect on wheat [*Triticum aestivum* (L.) emend. Fiori and Paol] 'GW 273'. Application of 5 kg Zn alone and 5 kg Zn + 200 kg cow dung in soybean significantly increased the Zn uptake (181.9 g/ha), grain (1.71 t/ha) and stover (2.36 t/ha) yields over control. Zn uptake and wheat grain yield significantly increased with the residual effect of 2.5 and 5 kg Zn over control. The findings further, revealed that the 5 kg Zn alone and incubated with cowdung was found beneficial for yield, uptake and Zn availability under soybean–wheat cropping system in *Vertisols*.

Key words : Cow dung, Direct and residual effect of Zn, Soybean, Wheat, Zn incubation

Soybean–wheat is one of the most prevalent cropping sequence followed in a substantial area of Madhya Pradesh, and to some extent in other parts of the country. Recently, the productivity of soybean decreased/stagnated due to increased multi nutrient deficiency (S, Zn and B) in soil. Amongst the deficient nutrients, Zn deficiency has been observed in 15–97% soil samples in various district of M.P. particularly about 80.6% in Jabalpur district (JNKVV, 2003). To ameliorate Zn deficiency, the Zn fertilizers are used but the Zn availability is less due to very high Zn fixation. Addition of organic manure is known to enhance the Zn availability of applied Zn by chelating Zn. Use of cowdung enriched 5 kg Zn/ha produced the highest pearl millet grain and straw yield (Patel *et al.* 2004). The information on different cropping sequence is not available, hence the present investigation was planned.

A field experiment was conducted during 2007-08 at Jabalpur on medium black clayey *Vertisols* having pH 7.2; electrical conductivity 0.08 dS/m; CaCO₃ 7.3 g/kg; organic carbon 6 g/kg; available NPK is 182, 16, 228 kg/ha, respectively and Zn 0.56 mg/kg. The treatments comprised of 4 level of Zn as 0, 1.25, 2.5 and 5 kg/ha alone as well

as the zinc levels were mixed and incubated with 200 kg fresh cowdung for 30 days. There were seven treatments replicated 4 times in a randomized block design. The Zn treatments were applied at the time of sowing of soybean crop only and residual effect of the Zn treatments was observed in the succeeding wheat. The recommended doses of fertilizers for soybean and wheat were applied @ 30-60-40 and 60-80-40 kg/ha as a basal dose at the time of sowing respectively. Soybean 'JS 93-05' was sown on July 9, 2007 and wheat 'GW 273' was sown on December 18, 2007. Soybean seeds were sown 40 cm row to row spacing using 100 kg/ha and wheat sown at 22.5 cm spacing using 120 kg/ha. The 60 kgN/ha was applied as a top dressing at the CRI stage of wheat. Rainfall of 956 mm received during rainy season of 2007. The grain and stover of soybean and grain and straw of wheat were collected at the time of harvesting. The soybean and wheat crop was harvested on October 24, 2007 and March 23, 2008 respectively.

The soybean grain and stover yield significantly increased with the application of 5 kg Zn/ha without or with incubation over control (Table 1). The Zn @ 2.5 kg incubated with cow dung was also found significantly superior to control for grain yield of soybean. However, 5 kg Zn incubated with cowdung was found significantly superior to 1.25 kg Zn alone for grain and stover yield. The increase of soybean yield with the Zn application might be due to response of Zn in Zn deficient soil. The cow dung

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incubated Zn levels gave higher grain and straw yield than Zn levels alone. Sharma and Bapat (2000) reported response of crop to applied Zn in the Zn deficient soil. The increased soybean yield due to cow dung application and pearl millet grain and straw yield with cow dung enriched 5 kg Zn/ha was reported by Ndaeyo *et al.* (2000) and Patel *et al.* (2004) respectively.

The Zn uptake by grain and stover was found significantly higher with increasing levels of Zn with or without incubation than control but the Zn levels were found at par amongst themselves for Zn uptake by grain (Table 1). Though the Zn uptake by stover successively and significantly increased up to 2.5 kg Zn with or without incubation but the difference between 2.5 and 5 kg Zn without incubation was found non-significant. However, the total Zn uptake successively and significantly increased with increasing levels of Zn with or without incubation. The increase of Zn uptake with increasing levels of Zn might be due to increase in the Zn content in grain and stover (Patidar, 2007).

Application of 2.5 and 5 kg Zn with or without incubation successively and significantly increased the available Zn content in soil. The incubation of Zn as well as increasing levels of Zn alone increased the availability of Zn in soil (Table 1). The higher Zn availability with Zn fertility was also reported by Ravanker *et al.* (2002).

Residual effect of 2.5 kg Zn incubated with cowdung (5.27 t/ha) and 5 kg Zn with or without incubation (5.40 or 5.70 t/ha) significantly increased the grain yield (Table 1) over control (4.50 t/ha). However, residual effect of 5 kg Zn incubated with cowdung was found significantly superior to 1.25 kg Zn with or without incubation for wheat grain yield but the other Zn levels were found at par amongst themselves for grain yield. The Zn treatments were found non-significant for straw yield. The increased wheat yield might be due to the beneficial residual Zn

availability in the soil (0.66 to 1.33 mg/kg) after harvest of soybean fertilized with increasing levels of Zn. The residual effect of Zn level on succeeding wheat after harvest of soybean yield also have been reported by Meena *et al.* (2006).

The residual effect of increasing levels of Zn with or without incubation significantly increased the Zn wheat content in grain over control (Table 1). However, the residual effect of 5 kg Zn with or without incubation was found significantly superior to respective 1.25 kg Zn with or without incubation. While the Zn uptake by grain, straw and total Zn uptake significantly increased with the residual effect of 2.5 and 5 kg Zn with or without incubation over control but the difference between the two treatments was found non-significant for Zn uptake by grain, straw and total Zn uptake by wheat crop. The residual effect of 1.25 kg Zn with or without incubation was found non-significant for Zn uptake by grain, straw and total uptake. The higher Zn uptake by grain, straw and total Zn uptake might be due to higher residual Zn availability. The residual effect of Zn on the uptake by grain and straw in wheat also reported by Varshney *et al.* (2008).

The findings of the present studies elucidates that the application of 5 kg Zn incubated with cowdung can enhanced the yield of crops by increasing use efficiency of Zn as well as improvement of Zn availability in Vertisols under soybean–wheat cropping sequence.

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Table 1. Effect of Zn levels with or without incubation and its residual on yield, Zn uptake and available Zn content in soil under soybean–wheat cropping system.

Zn levels (kg/ha)	Soybean						Wheat					
	Yield (t/ha)		Zn uptake (g/ha)			Av. Zn (mg/kg)	Yield (t/ha)		Zn uptake (g/ha)			Av. Zn (mg/kg)
	Grain	Stover	Grain	Stover	Total		Grain	Straw	Grain	Straw	Total	
Control	1.31	1.81	55.5	28.0	83.5	0.55	4.50	5.12	113.3	34.7	148.0	0.54
1.25	1.43	1.93	74.1	40.6	114.7	0.66	4.82	5.39	143.0	39.3	182.3	0.65
2.5	1.50	2.08	89.1	53.6	142.7	0.86	5.03	5.62	157.8	50.9	208.7	0.84
5.0	1.64	2.23	103.6	63.6	167.3	1.08	5.40	5.70	180.2	57.1	237.3	1.00
1.25 + 200 kg cow dung	1.49	2.02	82.4	42.9	125.2	0.68	4.86	5.4	147.1	40.3	187.4	0.66
2.5 + 200 kg cow dung	1.57	2.13	96.3	55.7	152.0	1.03	5.27	5.82	167.2	54.6	221.8	0.91
5.0 + 200 kg cow dung	1.71	2.36	112.2	69.7	181.9	1.33	5.70	5.88	198.3	61.1	259.4	1.19
SEm±	0.08	0.11	6.1	3.8	9.9	0.05	0.25	0.38	11.5	3.3	13.4	0.01
CD (P=0.05)	0.22	0.32	18.1	11.3	29.3	0.14	0.74	NS	34.1	9.7	39.9	0.04

- and yield of soybean as influenced by combined application of cow dung and NPK fertilizer. *Tropiculture* **18**(2): 49–54.
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