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DRY MATTER AND NUTRIENT ACCUMULATION IN SOYBEAN VARIETIES AT INFLUENCED BY POLASSIUM LEVELS AT DIFFERENT STAGES OF - II. EFFECT ON Fe, Zn, Cu and Mn ACCUMULATION

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Abstract: A pot experiment was conducted to study the effect of potassium levels (K_0, K_{15}, K_{30} and K_{45} mg kg^{-1}) on accumulation pattern of Fe, Zn, Cu and Mn in shoot, root and seed in five soybean cultivars (V_1-GS-1, V_2-GS-2, V_3-JS-335, V_4-JS-79 and V_5-GJS-3) at different periods of crop growth in factorial CRD with five replications. The results showed that accumulation of Fe, Zn, Cu and Mn in shoot and root at different period of crop growth and seed at harvest were found significantly highest with K_{45} treatment followed by K_{30} treatment. All the five cultivars of soybean produced a significant effect on accumulation of nutrients in shoot, root at different period of crop growth and seed at harvest.

Keywords: Fe, Zn, Cu and Mn accumulation.

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is considered a miracle crop because of its dual qualities, *viz*., high protein and oil content in seed. In India, soybean cultivation was started in 1977. It has high yield potential, wide adaptability, short duration and very high nutritional value having a vast multiplicity of uses as food and industrial products. Being a legume, it fixes a large amount of atmospheric nitrogen in soil. Therefore, soybean crop is known as "Golden Bean", "Miracle Crop", "Wonder Crop" and "Gold of Soil". The soybean crop is one of the remarkable success stories in Indian agriculture. In recent years, great interest has been evidenced in the cultivation and the use of soybean, mainly on account of its dietic, industrial and agricultural importance. In India, area under soybean cultivation was 120.327 lakh hectares and yield was 1079 kg ha^{-1} with total production of 129.832 lakh million tons during year 2013. The major growing states are Madhya Pradesh, Uttar Pradesh, Maharashtra and Karnataka.

Potassium is one of the essential nutrient for plant growth and vital for sustaining modern high yield agriculture. Plant needs large quantities of potassium which not only improves the

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crop yield, but crop quality also. The information on pattern of Fe, Mn, Zn and Cu accumulation in soybean varieties at different periods of growth as influenced by potassium levels is not available. Therefore, the present investigation was carried out to generate information on the pattern of Fe, Mn, Zn and Cu accumulation in soybean varieties at different growth stages as influenced by potassium levels.

MATERIALS AND METHODS

A bulk of surface soil sample to a depth of 0-30 was collected from the Central Experimental Station, Farm, Sagadividi, Junagadh Agricultural university, Junagadh. The soil was clayey in texture and contains 11.30, 16.80, 0.76 and 0.76 mg kg^{-1} available Fe, Mn, Zn and Cu ha^{-1}, respectively. Pots having 30 cm diameter and 45 cm height were filled with 15 kg soil. The soybean crop was fertilized with 30 N mg kg^{-1} and 60 P_2O_5 mg kg^{-1} in the form of Urea and Diammonium Phosphate, respectively. The potassium was applied in the form of murate of potash as 0, 15, 30 and 45 mg K kg^{-1}. The experiment was laid out in a factorial completely randomized design with 20 treatments combinations and repeated five times. Ten bold and healthy seeds of five varieties of soybean namely GS-1 (V_1), GS-2 (V_2), JS-335 (V_3), JS-79 (V_4) and GJS-3 (V_5) were dibbled in each pot to a depth of 5 cm and it was irrigated immediately with tap water. After one week of germination, seven healthy plants per pot maintained. The plant samples were harvested at each stage were washed with distilled water and dried at 60 to 70º C in oven. The dried samples (Shoot, Root and Seed) were ground. The di-acid (HCl_4: HNO_3 in 1:3 ratio) extract of plant samples were used for Fe, Mn, Zn and Cu determination by standard method as described by Jackson, (1974) and Lindsey and Norvell (1969), using Atomic Absorption Spectrophotometer (Model AA-3200).

RESULTS AND DISCUSSION

Nutrient uptake: Uptake of Fe, Zn, Cu and Mn by shoot, root and seed were continuously increased with advancement of crop age (Table1) and were increased significantly with K levels at all the periods of crop growth. The uptake of Fe, Zn, Cu and Mn by shoot and root at all the period of crop growth and by seed at harvest was recorded significantly higher under K_{45} treatment. However, this treatment was statistically at par with T_{30} treatment at all period of crop growth. The minimum uptake of Fe, Mn, Zn and Cu were registered with control treatment (K_0). Shipra and Pal (2005) reported that application of K_2O (0, 25, 50 and 75 kg K_2O ha^{-1}) significantly increased the uptake of micronutrients with increase in potassium rates in soybean.

The significantly higher accumulation of Fe, Zn, and Mn by shoot was registered with GS-2 variety at 25, 50 and 100 DAS, but at 75 DAS in GJS-3 variety, respectively. The accumulation of Cu by shoot was significantly higher observed in GJS-3 variety at 25, 75 and 100 DAS, except at 50 DAS in GS-2 variety, respectively. The accumulation of Fe, Mn, Zn and Cu in root was not significantly influenced by soybean cultivars at all period of crop growth, except Fe and Mn accumulation in root at harvest, Cu accumulation in root at 50, 75 and 100 DAS and Zn accumulation in root at 75 and 100 DAS, respectively. The accumulation of Fe, Mn by root and seed was significantly higher with GJS-3 variety at harvest and significantly higher accumulation of Zn by root was observed in GJS-3 variety at 75 and 100 DAS and significantly higher Cu uptake by root was recorded in GJS-3 variety at all the period of crop growth stages, except at 25 DAS, respectively.

CONCLUSION

Based on the results as summarized above, it can be concluded that the accumulation of Fe, Zn, Cu and Mn was increased with advancement of crop growth. The accumulation of Fe, Zn, Mn and Cu was significantly increased with increasing K levels. Different varieties of soybean produced a significant effect on accumulation of nutrients in shoot root at different period of crop growth and in seed at harvest

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Table 1: Influence of potassium levels on Fe, Zn, Cu and Mnuptake (mg plant^{-1}) by soybean crop

K levels (mg Kkg^{1})		Shoot				Root				Seed
		Days after sowing				Days after sowing				
		25	50	75	100	25	50	75	100	
K_0	Fe	0.277	0.774	1.520	1.490	0.146	0.415	0.441	0.530	0.415
	Zn	0.027	0.114	0.235	0.232	0.015	0.0318	0.0374	0.0548	0.128
	Cu	0.011	0.047	0.113	0.105	0.0049	0.0150	0.020	0.029	0.065
	Mn	0.027	0.114	0.235	0.232	0.0162	0.0524	0.0682	0.1028	0.221
K_{15}	Fe	0.285	0.810	1.550	1.510	0.151	0.428	0.493	0.542	0.454
	Zn	0.028	0.119	0.244	0.236	0.0158	0.0332	0.0426	0.0561	0.140
	Cu	0.012	0.051	0.115	0.111	0.0053	0.0166	0.023	0.032	0.071
	Mn	0.028	0.119	0.244	0.236	0.0166	0.0543	0.0766	0.1064	0.242
K_{30}	Fe	0.292	0.838	1.580	1.520	0.1540	0.437	0.534	0.553	0.482
	Zn	0.028	0.125	0.249	0.240	0.0163	0.0340	0.0464	0.0578	0.150
	Cu	0.012	0.055	0.119	0.116	0.0054	0.0170	0.025	0.032	0.076
	Mn	0.028	0.125	0.249	0.240	0.0171	0.0561	0.0832	0.1098	0.257
K_{45}	Fe	0.300	0.863	1.640	1.570	0.1600	0.448	0.538	0.568	0.500
	Zn	0.029	0.128	0.260	0.248	0.0169	0.0351	0.0473	0.0610	0.156
	Cu	0.013	0.057	0.128	0.121	0.0056	0.0174	0.026	0.034	0.080
	Mn	0.029	0.128	0.260	0.248	0.0178	0.0577	0.0840	0.1120	0.269
S. Em.±	**Fe**	**0.002**	**0.008**	**0.01**	**0.01**	**0.002**	**0.005**	**0.013**	**0.002**	**0.001**
	Zn	**0.0002**	**0.001**	**0.002**	**0.002**	**0.0003**	**0.0005**	**0.0012**	**0.0002**	**0.0006**
	Cu	**0.0004**	**0.001**	**0.002**	**0.001**	**0.0001**	**0.0004**	**0.0007**	**0.0001**	**0.0003**
	Mn	**0.0002**	**0.001**	**0.002**	**0.002**	**0.0003**	**0.0008**	**0.002**	**0.0004**	**0.0009**
C.D. at 5%	**Fe**	**0.006**	**0.027**	**0.04**	**0.04**	**0.007**	**0.017**	**0.041**	**0.006**	**0.005**
	Zn	**0.0006**	**0.004**	**0.008**	**0.006**	**0.0009**	**0.0015**	**0.0037**	**0.0006**	**0.0018**
	Cu	**0.0012**	**0.004**	**0.008**	**0.003**	**0.0003**	**0.0012**	**0.0022**	**0.0003**	**0.0009**
	Mn	**0.0006**	**0.004**	**0.008**	**0.006**	**0.0009**	**0.0025**	**0.006**	**0.0012**	**0.0027**

N.S.- Non-significant

Table 2: Influence of potassium on Fe, Zn, Cu and Mn uptake (mg plant^{-1}) by soybean crop

Verities		Shoot				Root				Seed
		Days after sowing				Days after sowing				
		25	50	75	100	25	50	75	100	
GS-1	Fe	0.284	0.804	1.52	1.52	0.146	0.418	0.474	0.469	0.443
	Zn	0.027	0.117	0.236	0.238	0.0154	0.0321	0.0405	0.0487	0.137
	Cu	0.011	0.051	0.112	0.109	0.0049	0.0153	0.0220	0.0270	0.069
	Mn	0.027	0.117	0.236	0.238	0.0162	0.0532	0.0732	0.0920	0.236
GS-2	Fe	0.327	0.887	1.710	1.660	0.152	0.4260	0.4860	0.4800	0.367
	Zn	0.032	0.131	0.267	0.261	0.0160	0.0331	0.0418	0.0501	0.114
	Cu	0.013	0.056	0.127	0.123	0.0053	0.0164	0.0230	0.0280	0.058
	Mn	0.032	0.131	0.267	0.261	0.0167	0.0544	0.0751	0.0940	0.196
JS-335	Fe	0.265	0.799	1.470	1.430	0.152	0.4380	0.4960	0.5630	0.450
	Zn	0.026	0.118	0.232	0.226	0.0160	0.0341	0.0426	0.0589	0.139
	Cu	0.011	0.051	0.110	0.107	0.0053	0.0169	0.0230	0.0330	0.071
	Mn	0.026	0.118	0.232	0.226	0.0168	0.0559	0.0773	0.1100	0.240
JS-79	Fe	0.252	0.769	1.460	1.360	0.156	0.4380	0.5230	0.5650	0.474
	Zn	0.025	0.114	0.230	0.214	0.0164	0.0341	0.0452	0.0594	0.147
	Cu	0.011	0.050	0.110	0.103	0.0054	0.0170	0.0250	0.0330	0.075
	Mn	0.025	0.114	0.230	0.214	0.0173	0.0560	0.0817	0.1110	0.254
GJS-3	Fe	0.316	0.847	1.710	1.630	0.158	0.4410	0.5290	0.6640	0.579
	Zn	0.031	0.126	0.269	0.258	0.0166	0.0343	0.0470	0.0700	0.180
	Cu	0.014	0.055	0.135	0.124	0.0056	0.0170	0.0260	0.0390	0.092
	Mn	0.031	0.126	0.269	0.258	0.0176	0.0562	0.0828	0.1300	0.310
S. Em.±	**Fe**	**0.002**	**0.009**	**0.016**	**0.017**	**0.002**	**0.006**	**0.014**	**0.002**	**0.001**
	Zn	**0.0002**	**0.001**	**0.003**	**0.002**	**0.0003**	**0.0005**	**0.0013**	**0.0002**	**0.0006**
	Cu	**0.0004**	**0.001**	**0.003**	**0.001**	**0.0001**	**0.0004**	**0.0007**	**0.0001**	**0.0003**
	Mn	**0.0002**	**0.001**	**0.003**	**0.002**	**0.0004**	**0.0009**	**0.0023**	**0.0005**	**0.001**
C.D. at 5%	**Fe**	**0.007**	**0.030**	**0.051**	**0.050**	**N.S.**	**N.S.**	**N.S.**	**0.007**	**0.005**
	Zn	**0.0006**	**0.005**	**0.009**	**0.007**	**N.S.**	**N.S.**	**0.004**	**0.0006**	**0.0018**
	Cu	**0.0012**	**0.004**	**0.009**	**0.004**	**0.0003**	**N.S.**	**0.0022**	**0.0003**	**0.0009**
	Mn	**0.0006**	**0.005**	**0.009**	**0.007**	**N.S.**	**N.S.**	**N.S.**	**0.0015**	**0.003**

N.S.- Non-significant