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EFFECT OF FOLIAR APPLICATION OF ZINC AND BORON AT DIFFERENT INTERVALS OF DAYS ON SOIL HEALTH OF INCEPTISOLS IN COWPEA

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Abstract– Cowpea [*Vigna unguiculata* (L.) is the most widely cultivated pulse crop of India. Deficiencies of micronutrients viz., Zn and B are a common problem in cowpea. Foliar Application is very effective to correct the micronutrient deficiencies in pulses, but it is too laborious. The Present Research was held at Research Farm, Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj a field experiment was undertaken in the *Zaid* season 2021, With 9 treatments and 3 replications, the experiment was set up in a Randomized Block Design (RBD) results includes, the physico-chemical properties ranged optimum range and the available Zinc was found 0.46 to 0.38 in 0-15 mg kg^{-1} cm depth and 0.33 to 0.23 mg kg^{-1} in 15-30 cm depth. Available Boron was found 0.62 to 0.53 mg kg^{-1} in 0-15 cm soil depth and 0.36 to 0.29 mg kg^{-1} in 15-30 cm depth. Post-harvest available Zn and B content registered lower. This might be due to the antagonistic effect of Zn on B. And may be attributed to the fact that by the foliar application at 4^{th} and 6^{th} week, maximum nutrient was readily used up by the plant parts.

INTRODUCTION

Pulses are of great importance for protein sources in the human diet Use of micronutrients helps in good seedling growth and enhances crop productivity in many cases (Farooq *et al.,* 2012). Management of crop nutrition by applying macro and micro-nutrients is important to obtain a high yield. Management of crop nutrition is important to achieve higher yields. Farmers are still continuously ignoring the usage of micronutrients. Deficiency of micronutrients was observed due to the intensive cropping with continuous use of high analysis micronutrient-free chemical Fertilizers, nona-pplication of organic manures, and improper agronomic practices. This has become a limiting factor for the high productivity of oilseed crops. Therefore, it is imperative to apply balanced micronutrients to deficient soil for the high productivity of oilseed crops. Among the micro-nutrients, Zinc and Boron play an important role in legumes and oil seed crops' productivity. The application of foliar nutrients immediately provides necessary nutrients to the plants. Sprayed nutrients may provide efficiency from 10-20 times than soil application (Zaman and Schumann, 2006).

The available Zn content in Indian soils varied from traces to 22mg kg^{-1} and 47 percent of Indian soils were known to be deficient in Zn. Zinc plays an outstanding role in the synthesis of chlorophyll, and protein and also regulates water absorption (Samant *et al*., 2009). Zn acts as a cofactor in many enzymes such as superoxide dismutase, alcohol dehydrogenase, RNA polymerase, and carbonic anhydrase therefore Zinc deficiency may limit protein synthesis in plants. Zn sprays meaningfully enhanced the yield of legumes (Sarkar *et al*., 2007). The Effect of Boron on pulses and determined that it has an integral part in protein synthesis (Kaisher *et al*., 2010).

MATERIALS AND METHODS

The present investigation was carried out at Central Research Farm, NAI, SHUATS' Prayagraj. Cowpea Ankur Gomoti variety was cultivated during *Zaid* 2021. The Experiment layout in Randomized Block Design with three replications Recommended dose of fertilizer for chickpea (50:75:75 kg ha^{-1} NPK). Foliar spray of Zinc and Boron was taken at 45 days after sowing and spray Zn @ 500 ppm/ 3L Water, B@ 1500 ppm/ 1L water. The experiment comprised of Nine treatments. The treatment details are T1: Absolute control Control (RDF), T2: Zn@1ppm + B@1ppm at 4^{th} week, T3: Zn@2ppm + B@2ppm at 4^{th} week, T4: Zn@1ppm + B@2ppm at 4^{th} week, T5: Zn@2ppm + B@1ppm at 4^{th} week, T6: Zn@1ppm + B@1ppm at 6^{th} week, T7: Zn@2ppm + B@2ppm at 6^{th} week, T8: Zn@1ppm + B@2ppm at 6^{th} week, T9: Zn@2ppm + B@1ppm at 6^{th} week. The Source of zinc as zinc sulphate and boron was Borax. RDF of NPK (50:75:75) Kg ha^{-1}, RDF of Zn 500ppm / 3L Water, RDF of B 1500ppm / 1L Water.

RESULTS AND DISCUSSION

A perusal of data (Table 1) indicates the application of foliar spray Zinc and Boron was observed that the maximum Bulk Density D_b(Mg m^{-3})was found at treatment T_7 (1.198 Mg m^{-3}) at 0-15 cm depth and (1.201 Mg m^{-3}) at 15-30 cm depth also Minimum D_b(Mg m^{-3}) was found at treatment T_1 (1.158 Mg m^{-3}) at 0-15 cm depth and (1.163 Mg m^{-3}) at 15-30cm depth. The maximum Particle Density D_p(Mg m^{-3}) was found at treatment T_7 (2.501 Mg m^{-3}) at 0-15 cm depth and (2.527 Mg m^{-3}) at 15-30 cm. Minimum D_p(Mg m^{-3}) was found at treatment T_1 (2.414 Mg m^{-3}) at 0-15 cm depth and (2.465 Mg m^{-3}) at 15-30cm. The maximum Pore space (%)was found at treatment T_7 (56.05%) at 0-15 cm depth and (48.64%) at 15-30 cm depth. Minimum Pore space (%)was found at treatment T_1 (43.58%) at 0-15 cm depth and (33.43%) at 15-30cm depth. The maximum Water Holding Capacity (%) was found at treatment T_7 (62.452 %) at 0-15 cm depth and (60.175%) at 15-30 cm depth. Minimum Water Holding Capacity (%) was found at treatment T_1 (51.631 %) at 0-15 cm depth and (48.976 %) at 15-30cm depth. This increase in water holding capacity with the application of Zinc and Boron along with RDF might be attributed to the fact that being a leguminous crop cowpea increased the Organic matter content which in turn increased the Water holding capacity of soil. The results were in accordance with (Anju *et al.*, 2021).

As represented in Table 2 the maximum pH was found at treatment T_1 (7.50) at 0-15 cm depth and (7.59) at 15-30 cm depth while Minimum pH was found at treatment T_7 (7.32) at 0-15 cm depth and (7.44) at 15-30cm depth. There is no increase in the pH of soil with the application of Zinc and Boron along with RDF, the maximum EC (dSm^{-1}) was found at treatment T_7 (0.29 dSm^{-1}) at 0-15 cm depth and (0.25 dSm^{-1}) at 15-30 cm depth. Minimum EC (dSm^{-1}) was found at treatment T_1 (0.178 dSm^{-1}) at 0-15 cm depth and (0.14 dSm^{-1}) at 15-30cm depth. This increase in the Electrical Conductivity of soil might be attributed to the fact that increased the soluble salts content in soil with the application of Zinc and boron along with RDF. the maximum OC (%) was

Table 1. Effect of Foliar Application of Zinc and Boron at different intervals of days on Physical Properties of soil after crop harvest

Unit	D_b		D_p		Pore space		WHC	
	Mgm^{-3}				%			
Depth	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	1.158	1.163	2.414	2.465	43.586	33.435	51.631	48.976
T_2	1.162	1.168	2.418	2.474	44.572	35.646	51.983	49.215
T_3	1.175	1.184	2.428	2.485	48.743	38.697	54.591	52.265
T_4	1.168	1.176	2.421	2.481	45.775	37.083	53.256	51.265
T_5	1.178	1.188	2.43	2.495	47.773	39.395	55.823	53.871
T_6	1.183	1.192	2.445	2.504	49.816	42.137	59.861	55.143
T_7	1.198	1.201	2.501	2.527	56.058	48.648	62.452	60.175
T_8	1.186	1.195	2.468	2.513	52.199	45.051	60.125	58.925
T_9	1.194	1.199	2.489	2.518	53.53	47.132	60.189	59.121
F-test	NS	NS	NS	NS	S	S	S	S
S.Em+	-	-	-	-	0.004	0.003	0.004	0.003
C.D. at 5%	-	-	-	-	0.627	0.54	0.627	0.54

found at treatment T_7 (0.37 %) at 0-15 cm depth and (0.34 %) at 15-30 cm depth. Minimum OC (%) was found at treatment T_1 (0.21 %) at 0-15 cm depth and (0.19 %) at 15-30cm depth. In general, an enhancement in organic carbon content of soil was observed in all the treatments compared to initial soil status. The enhancement in organic carbon content observed in all the treatments might be due to the uniform application of RDF which in turn increased the biological N fixation, addition of organic residues and exudation of root exudates into the soil by the crop root as well as the symbiotic N fixing bacteria associated with the crop. The results were in accordance with (Anitha *et al.*, 2005).

The results revealed that the maximum Available Nitrogen (kg ha^{-1}) was found at treatment T_7 (264.32 kg ha^{-1}) at 0-15 cm depth and (262.55 kg ha^{-1}) at 15-30 cm depth. Minimum Available Nitrogen (kg ha^{-1}) was found at treatment T_1 (242.55 kg ha^{-1}) at 0-15 cm depth and (240.73 kg ha^{-1}) at 15-30cm depth with the application of RDF. This increase in trend of available Nitrogen with the application of Zinc and Boron along with RDF might be attributed to the fact being a leguminous crop, cowpea can fix atmospheric N and tap nutrients from deeper layers, maximum Available Phosphorus (kg ha^{-1}) was found at treatment T_7 (24.36 kg ha^{-1}) at 0-15 cm depth and (22.57 kg ha^{-1}) at 15-30 cm depth. Minimum Available Phosphorus (kg ha^{-1}) was found at treatment T_1 (17.82 kg ha^{-1}) at 0-15 cm depth and (14.66 kg ha^{-1}) at 15-30cm depth. The better crop establishment and better rooting allow the crop to tap nutrients from the deeper layers. Further organic matter addition due to the falling of senescent leaves and atmospheric N fixation by the symbiotic N fixing bacteria present in the nodule also contribute to the increased available Phosphorus.

The lower available P content compared to those treatments having high Zn content. This might be due to the antagonism exists between Zn and P and also due to the formation of insoluble zinc phosphate. Maximum Available Potassium (kg ha^{-1}) was found at treatment T_7 (220.30 kg ha^{-1}) at 0-15 cm depth and (190.25 kg ha^{-1}) at 15-30 cm depth. Minimum Available Potassium (kg ha^{-1}) was found at treatment T_1 (180.66 kg ha^{-1}) at 0-15 cm depth and (153.56 kg ha^{-1}) at 15-30cm depth. This increased in available Potassium with the application of Zinc and Boron along with RDF might be because in soil H^+ and hydroxyl aluminium ion compete with K^+ ions for the exchange or adsorption sites and able to keep more K^+ ions in the solution phase and reduce their availability to the plant which in turn increased the available Potassium content in soil. The results were in accordance with (Mona 2016). The results revealed that the maximum Available Zinc (mg kg^{-1}) was found at treatment T_1 (0.46 mg kg^{-1}) at 0-15 cm depth and (0.38 mg kg^{-1}) at 15-30 cm depth. Minimum Available Zinc (mg kg^{-1}) was found at treatment T_7 (0.33 mg kg^{-1}) at 0-15 cm depth and (0.23 mg kg^{-1}) at 15-30cm depth. Post-harvest available Zn content registered lower. Maximum Available Boron (mg kg^{-1}) was found at treatment T_1 (0.62 mg kg^{-1}) at 0-15 cm depth and (0.53 mg kg^{-1}) at 15-30 cm depth. Minimum Available Boron (mg kg^{-1}) was found at treatment T_7 (0.36 mg kg^{-1}) at 0-15 cm depth and (0.29 mg kg^{-1}) at 15-30cm depth. Post-harvest available B content registered lower. This might be due to the antagonistic effect of Zn on B.maximum nutrient was readily used up by the

Table 2. Effect of Foliar Application of Zinc and Boron at different interval of days on Chemical properties of soil after crop harvest

Treatment	pH		EC		OC	
Unit	1:2.5		dSm^{-1}		%	
Depth	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	7.5	7.59	0.178	0.165	0.21	0.19
T_2	7.45	7.53	0.18	0.171	0.23	0.21
T_3	7.41	7.51	0.188	0.183	0.28	0.26
T_4	7.45	7.55	0.185	0.179	0.26	0.24
T_5	7.43	7.54	0.192	0.187	0.31	0.3
T_6	7.4	7.5	0.198	0.19	0.32	0.29
T_7	7.32	7.44	0.225	0.218	0.37	0.34
T_8	7.38	7.45	0.201	0.197	0.34	0.31
T_9	7.35	7.46	0.216	0.206	0.36	0.32
F-test	NS	NS	NS	NS	NS	NS
S.Em+	-	-	-	-	-	-
C.D. at 5%	-	-	-	-	-	-

Table 3. Effect of Foliar Application of Zinc and Boron at different interval of days onof soil chemical properties after crop harvest

Treatment	Available N		Available P		Available K		Available Zn		Available B	
Unit	Kg ha^{-1}		Kg ha^{-1}		Kg ha^{-1}		mg kg^{-1}		mg kg^{-1}	
Depth	0-15 cm	0-15 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	242.55	242.55	17.82	14.66	180.66	173.56	0.46	0.38	0.62	0.53
T_2	245.02	245.02	18.7	15.59	184.43	175.62	0.43	0.36	0.53	0.43
T_3	251.35	251.35	22.99	19.69	201.1	187.39	0.39	0.32	0.46	0.38
T_4	248.32	248.32	19.81	18.67	189.32	180.41	0.41	0.34	0.50	0.42
T_5	252.34	252.34	21.58	19.07	191.45	184.17	0.42	0.31	0.47	0.39
T_6	254.92	254.92	23.63	20.93	208.67	188.51	0.37	0.28	0.42	0.32
T_7	264.32	264.32	24.36	22.57	220.3	191.25	0.33	0.23	0.36	0.29
T_8	261.47	261.47	22.5	19.93	210.01	189.35	0.36	0.27	0.41	0.33
T_9	262.68	262.68	19.47	16.48	215.69	190.51	0.35	0.24	0.38	0.34
F-test	S	S	S	S	S	S	S	S	S	S
S.Em+	0.004	0.004	0.004	0.003	0.04	0.02	0.004	0.003	0.004	0.003
C.D. at 5%	0.627	0.627	0.627	0.54	1.23	1.05	0.627	0.54	0.627	0.540

plant parts. The results were in similar with those (Mona, 2016).

CONCLUSION

It can be concluded from the results that foliar application of Zn and B had a significant role in soil nutrient availability. Results on nutrient status of soil revealed that application of RDF along with Zn 1000 ppm and B 3000 ppm at 6th week recorded the highest organic carbon content, available N and Zn status. B and P status was the highest in the application of RDF along with Zn 1000 ppm and B 3000 ppm at the 6th week.

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