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ZINC - MANGANESE INTERRELATIONS IN CALCAREOUS SOILS

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Deficiencies of Zn and Mn have occurred in various crops grown on alkaline calcareous soils of Pakistan [1]. Zinc deficiency, however, has been found to be more common and thus more research was done on Zn fertilization than on other micronutrients [1–3]. Experimental methods to correct their deficiencies included soil applications of Zn- and / or Mn-containing materials. Balanced nutrient supply is essential for obtaining optimum crop yields. Correction of deficiency of an element by its unjudicious fertilization may cause considerable fall in plant yield because of the induced deficiency of other nutrient elements. Such interactions are extremely important for trace elements nutrition of crops. Recent reports by the researchers have shown Zn to strongly depress Mn uptake by upland crops [4] with Mn to play little role in Zn absorption by these crops [4,5]. Little information exists on the role of soil medium in their interaction. The present soil incubation experiment conducted on two upland soils was aimed to assess any fluctuation in their solubility as a result of their interaction in soil.

MATERIALS AND METHODS

The experiment was carried out in laboratory. Two soil samples (0–15cm) differing in texture were collected from Thikriwala and Kamalia towns of Faisalabad district. The soils were air dried and passed through a 2-mm mesh plastic sieve. Physicochemical characteristics of the soils used have been detailed previously [6]. Twenty-five g portions of the soils for each treatment were taken in flat-bottomed plastic vessels. The soils were treated with 0, 2.5, 5.0 and 10.0 ppm Zn and 0, 5, 25 and 50 ppm Mn. Zinc and Mn were applied as aqueous solutions of their sulphates by adjusting the moisture level of the soil in each vessel to 75% of its field capacity. The soils maintained at this moisture level were incubated at 30±1°C for 13 days, a period found sufficient for maximum fixation of Zn. The treatments were in triplicate. At the end of the incubation period, the soil samples were extracted with 0.005*M* DTPA and Zn,Cu, Fe and Mn in the soil extracts were determined by atomic absorption spectrophotometry [7].

All the experimental apparatus was washed successively with 0.2*M* EDTA, deionized water, 10% nitric acid and again deionized water [8].

RESULTS AND DISCUSSION

Effect of Zn on DTPA-extractable Mn. Irrespective of Zn level, DTPA-extractable Mn of both the soils

Table 1. DTPA-extractable micronutrients in two alkaline calcareous solis treated with various levels of Zn and Mn and incubated for 13 days at 30±1°C and 75% field capacity

		0.005*M* DTPA-extractable micronutrients							
Applied		Thikriwala soil				Kamalia soil			
Zn	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn
0	0	0.25	0.53	1.80	4.92	0.60	1.51	8.84	4.99
	5	0.28	0.53	1.87	5.46	0.56	1.48	8.16	4.94
	25	0.30	0.56	2.07	6.71	0.63	1.51	8.02	5.86
	50	0.28	0.55	1.87	8.85	0.62	1.51	7.89	6.56
2.5	0	1.94	0.53	1.73	4.47	2.13	1.56	8.16	4.94
	5	1.77	0.55	1.80	5.37	2.09	1.44	7.75	4.71
	25	1.77	0.53	1.73	6.89	2.16	1.53	8.02	5.70
	50	1.83	0.52	1.93	7.87	2.13	1.51	8.02	7.07
5.0	0	3.22	0.49	1.93	4.65	3.46	1.53	8.30	4.89
	5	3.22	0.53	1.87	5.45	3.40	1.48	7.75	4.66
	25	3.30	0.53	1.87	6.93	3.21	1.50	7.61	5.54
	50	3.30	0.52	2.13	8.40	3.34	1.56	8.29	7.21
10.0	0	6.40	0.56	2.07	5.63	6.23	1.50	7.75	4.39
	5	6.40	0.52	1.80	4.96	6.42	1.60	8.99	5.40
	25	6.48	0.56	1.80	6.35	6.42	1.57	8.43	5.82
	50	6.48	0.55	1.80	8.40	6.42	1.57	8.43	6.97
LSD(0.05) (Mn means)		NS	NS	NS	0.57	NS	NS	NS	0.54
LSD(0.05) (Zn means		0.11	0.02	NS	NS	0.07	0.04	NS	NS
LSD(0.05) (Mn × Zn means)		NS	0.04	0.35	NS	0.20	NS	1.15	NS

increased markedly ($P < 0.01$, Table 1) with increasing application of Mn. Zinc application had little effect on the extractable Mn contents of these soils. These studies indicate Zn compounds to play a little role in controlling Mn solubility in calcareous soils. The antagonistic effect of Zn on Mn uptake in plants, therefore, seems to operate at the transport site as observed by Singh and Stren - berg [4]. Soils seem to play little role in this antagonism.

Effect of Mn on DTPA-extractable Zn. Irrespective of Mn level, increasing rate of Zn application increased DTPA-extractable Zn of both the soils ($P < 0.01$, Table 1). Little effect of Mn additions on extractable Zn of both the soils explains that higher oxides formed from divalent Mn play a little role in influencing Zn solubility in the current soils. This may help understand little Mn effect in Zn absorption by upland crops [4].

Effect of Zn and Mn on Native Cu and Fe. Mn and Zn applications to both the soils caused a minor change in native extractable Cu while Fe remained unaffected (main effect not significant). These results thus indicate that Zn and Mn applications may have little effect on the solubility of native Cu and Fe of calcareous soils.

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