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ZINC FIXING CAPACITY OF RICE SOILS

R. NAGARAJAN and T. S. MANICKAM

An incubation study with labelled ^{65}Zn was conducted to study the pattern of release and fixation of added ^{65}Zn in 15 representative rice soils of Tamil Nadu at 10 levels of added ^{65}Zn viz., 0, 2.5, 5.0, 7.5, 10, 20, 30, 40, 50 and 100/u/g of soil. The result showed that the DTPA extractable ^{65}Zn was a function of added ^{65}Zn and the rate of extractability was more in coarse textured soils than in clayey soils. The rate of extractability of added ^{65}Zn had positive correlations with fine and coarse sand fractions and negative relationships with clay and organic carbon content of the soils. The Zn fixing capacity revealed an exactly opposite trend to that of Zn extractability indicating higher Zn fixing capacity in clayey soils than the sandy loam soils.

Zinc deficiency has assumed as the major malady in flooded rice soils as indicated by the "Preliminary estimates" that 8 million hectares of rice are being adversely affected by this disorder (Katyal, 1975). Among the various Phenomena outlined as the causes for this severe disorder, if is interesting to note that the submerged soil conditions favour non-availability of Zn in rice soils (Yoshida, 1981). Further the processes of surface adsorbtion precipitation and diffusion of Zn in submerged soil are contributing much more for the low availability of Zn in such conditions (Mikkelsen and Kuo, 1977). In order to assess the behaviour of added Zn with respect to fixing and availability in rice soils, a study was made to evaluate the Zn fixing capacity of rice soils using radiotracer technique and the results are discussed here under.

MATERIALS AND METHODS

Surface soil samples numbering 15 were collected from the three group viz., Haplustalfs, Pellusterts and Chromusterts representing the major rice growing areas of Tamil Nadu and were used to evaluate the Zn fixing capacities. The details of the soil samples are furnished below :

The soil samples were processed and two grams of finely sieved (100-mesh) soil samples were treated with one ml of different ppm of ^{65}Zn solutions to get the treatments viz., 0, 2.5,

Department of Soil Science & Agrl. Chemistry, Tamil Nadu Agricultural University, Coimbatore - 641 003.

Soil No.	Location	soil great group	Soil texture
S_1	Soorakkottai	Haplustalfs	Sandy loam
S_2	Anaikkadu	,,	,,
S_3	Aladikkumulai	,,	,,
S_4	Soorapallam	,,	,,
S_5	Maharajasamudram	,,	,,
S_6	Aduthurai	Pellusterts	Clayey
S_7	Nannilam	,,	,,
S_8	Marudhanallur	,,	,,
S_9	Managorai	Chromusterts	Clay loam
S_{10}	Sakkottai	,,	,,
S_{11}	Sikkal	,,	,,
S_{12}	Thirukkannangudi	,,	,,
S_{13}	Thiruppalanam	Haplustalfs	Clayey
S_{14}	Coimbatore TNAU Wetland	,,	,,
S_{15}	Coimbatore, TNAU PBS	,,	Clay loam

5.0, 7.5, 10, 20, 30, 40, 50 and 100 /ug of ^{65}Zn/g of soil. After treating the soil with the ^{65}Zn solution, the soils were incubated at room temperature for 96 hours and then extracted with 0.005*M* DTPA extractant (Lindsay and Norvell, 1969). Two ml of the extract were analysed for the radioactivity and the DTPA extractability for each level was worked out. The amount of ^{65}Zn fixed wsa calculated by subtracting the ^{65}Zn extractable from the ^{65}Zn added. Correlations were worked out between the extractable ^{65}Zn and added ^{65}Zn and also between fixed ^{65}Zn and daded ^{65}Zn and their regression equations were also comouted.

RESULTS AND DISCUSSION :

The 0.005*M* DTPA extractable ^{65}Zn and fixed ^{65}Zn at various levels of added ^{65}Zn were computed and are presented in table 1. In the present study an immaculately linear regression could be established from the data deduced and that very well confirms the concepts that Zn extractability in submerged soil is a function of added Zn (Siddhu *et al.*, 1977). From the regression equation fitted, the rate of extractability of Zn was also arrived at which indicated a higher rate in coarse textured soils (0.78 to 0.85 /ug of Zn/g, of soil) of

Table : 1 — DTPA extractable ^{65}Zn at various levels added ^{65}Zn (/u/g)

Soil No.	Levels of added ^{65}Zn /u/g of soil								
	2.5	5.0	7.5	10.0	20.0	30.0	40.0	50.0	100.0
S_1	2.4	4.9	5 6	6.3	15.6	22.9	33.3	38.8	79.4
S_2	1.4	4.4	5.7	7.9	16.0	20 9	28.1	40.2	78.3
S_3	2.1	3.8	6.6	6.8	16.8	24.5	33.4	42.5	85.2
S_4	1.0	4.3	5.5	8.5	17.9	20.6	32.4	46.6	80 6
S_5	2.1	3.7	7.0	8.4	17.9	21.6	30 9	38.6	79.3
S_6	2.4	2.7	4.4	6.7	14.1	18.2	26.2	33.1	62.5
S_7	1.7	2.7	4.7	7.5	13.0	20.0	29.4	38.4	70.0
S_8	2.2	4.3	6.0	8.3	14.8	22.2	28.3	35.8	67.6
S_9	1.0	2.4	4.7	5.7	6.8	17.0	23.5	36.8	66.5
S_{10}	1.7	4.8	5.6	5.9	13.9	17.6	28.7	37.9	66.7
S_{11}	2.3	3.7	6.1	6.3	16.5	19.1	30.3	34.7	70.0
S_{12}	1.1	2.0	6.4	8.4	16.0	20.0	29.8	36.0	70.0
S_{13}	2.2	2.7	4.5	8.7	14.6	22.1	29.5	37.1	74.1
S_{14}	2.1	4.8	5.4	8.6	16.8	19.2	25.7	36.9	66.6
S_{15}	2.0	3.9	6.2	8.7	14.8	21.2	26.2	39.2	76 9

new delta of Thanjavur district than in the fine textured soils of Cauvery old delta (0.63 to 0.74 /ug/g of soil) and Noyyal alluvium (0.66 and 0.76 /ug Zn/g of soil).

The data pertaining to the Zn extractability were applied to arrive at the degree of Zn fixing capacity of various soils (Table 2) tested and the values were fitted in a regression equation with added ^{65}Zn. The resulting curve also indicated that the Zn fixing capacity was also a function of added Zn (Table 3). This curve was exactly superimposable over Zn adsorption curves of shuman (1975) and Kuo and Mikkelsen (1979). The rate of Zn fixing capacity of rice soils (0.15 to 0.37 /ug Zn/g of soil) revealed exactly an opposite trend to that of Zn extractability. The Zn fixing capacity is higher in the soil of Cauvery old delta and Noyyal alluvium than the coarse textured soils of new delta. This fact could further be confirmed by the significant negative correlations obtained between the rate of Zn fixing capacity (coefficient 'b') and fine sand

Table : 2 Quantity of ^{65}Zn fixed in soil at various levels of added ^{65}Zn (/ug/g)

Soil No.	Levels of added ^{65}Zn /ug/g of soil								
	2.5	5.0	7.5	10.0	20.0	30.0	40.0	50.0	100.0
S_1	0.1	0.1	1.9	3.7	4.4	7.1	6.7	11.3	20.6
S_2	1.1	0.6	1.8	2.1	3.2	9.1	11.2	9.8	21.7
S_3	0.4	1.2	0.9	3.2	3.2	5.5	6.6	7.5	13.8
S_4	1.5	0.7	2.0	1.5	2.1	9.4	7.6	3.4	19.4
S_5	0.4	1.3	0.5	1.6	2.1	9.4	9.2	11.3	20.7
S_6	0.1	2.3	3.1	3.3	5.9	11.8	13.8	16.9	27.5
S_7	0.8	3.3	2.8	2.5	7.0	10.0	10 6	11.6	30.0
S_8	0.3	0.7	1.5	1.2	5.2	7.8	11.7	14.2	22.4
S_9	1.5	2.6	2.8	4.3	13.2	13.0	16.5	13.2	33.5
S_{10}	0.18	0 2	1.9	4.1	6.1	12.4	11.3	12.1	33.3
S_{11}	0.2	1.3	1.4	3.7	3.5	10.4	9.7	15.3	30.0
S_{12}	1.4	3.0	1.1	1.6	4.0	10.0	10.1	14.0	30.0
S_{13}	0.3	2.3	3.0	1.3	5.4	7.9	10.5	12.9	25.0
S_{14}	0.4	0.2	2.1	1.4	3.2	10.9	14.3	13.1	33.4
S_{15}	0.5	1.1	1 3	1.3	5.2	8.8	13.8	10.8	23.1

($r = -0.68^{**}$) and coarse sand (-0.64) and positive relationships with organic carbon ($r = 0.63^{*}$) and clay (0.18^{**}). Earlier investigations in this direction pronounce the very same opinion and the recent investigations by Krishnaswamy (1982) with Tamil Nadu upland soils indicated similar results.

Since the results clearly indicated that Zn fixing capacity of the rice soils is a function of added Zn and also controlled by the factors such as texture and organic carbon conent of the soils and these aspects are to be considered while formulating the Zn fertiliser recommendation so that the maximum benefit could be obtained through fertilisation.

Table : 3 — Correlation Studies.

Soil No.	Correlation Coefficient between DTPA ^{65}Zn and added ^{65}Zn	Regression equation	Correlation Coefficient between fixed ^{65}Zn and added ^{65}Zn	Regression equation
S_1	0.999	Y=0.24 + 0.80X	0.999	Y=0.24 + 0.20X
S_2	0.998	Y=0.32 + 0.78X	0.998	Y=0 32 + 0.22X
S_3	0.978	Y=0.18 + 0.85X	0.978	Y=0.18 + 0.15X
S_4	0.995	Y=-0.05 + 0.82X	0 998	Y=-0.06 + 0.18X
S_5	0.979	Y=0.26 + 0.78X	0.979	Y=0.26 + 0.22X
S_6	0.999	Y=0.47 + 0.63X	0 999	Y=0.47 + 0.37X
S_7	0.998	Y=-0.20 + 0.72X	0.998	Y=-0.20 + 0.28X
S_8	0.999	Y=1.34 + 0.67X	0 999	Y=1.34 + 0.33X
S_9	0.992	Y=-1.90 + 0.69X	0.992	Y=-1.90 + 0.31X
S_{10}	0.996	Y=0.40 + 0.68X	0.996	Y=0.40 + 0.32X
S_{11}	0.998	Y=0.54 + 0.70X	0 998	Y=0.54 + 0.30X
S_{12}	0.998	Y=0.43 + 0.70X	0.998	Y=0.43 + 0.30X
S_{13}	0.999	Y=-0.12 + 0.74X	0.999	Y=-0.12 + 0.26X
S_{14}	0.999	Y=1.33 + 0.66X	0.999	Y=1.33 + 0.34X
S_{15}	0.997	Y=-0.26 + 0.76X	0.997	Y=-0.21 + 0.24X

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