[Vol. 68, No. 5 *Madras agric. J.* 68. (5) : 323 – 334, May 1981

Forms of Zinc and Their Distribution in Some Soil Profiles of Tamil Nadu*

K. APPAVU[1] and U. S. SREE RAMULU[2],

The distribution of total and available zinc and their relationship to different soil properties were studied in twenty three soil profiles representing seven major soil series of Namakkal Taluk of Tamil Nadu. Total zinc content varied from 12.6 to 391.3 ppm and the content generally increased with depth in red soils while irregular pattern of distribution was observed in black, alluvial and laterite soils. Alluvial soils contained higher amounts of total zinc followed by laterite, black and red soils, Total zinc content was found to be associated positively with clay and silt content.

The available zinc content varied from 0.16 to 5.14 ppm. No consistant pattern was observed in the distribution of available zinc in the soil profiles of all the soil series. The available zinc was maximum in laterite soils followed by red, alluvial and black soils. Significant positive correlation were established between available zinc and organic matter. pH and calcium carbonate were negatively correlated with available zinc.

The importance of micronutrients in crop production is gaining importance in the recent times. The intensive and exploitive agriculture with high yielding varieties under irrigated conditions may impose the problems of micronutrient deficiency particularly in those soils having marginal and submarginal levels of available micronutrients. Therefore to get increased yield of crops, the application of micronutrients alongwith major nutrients to micronutrient deficient soil has become necessary, thus indicating the necessity of assessing if micronutrient availability in the soils and demarcating the areas having the available micronutrient below the critical level. Hence the present study was taken up to find out the depthwise distribution of total and available zinc content and to delineate the soils that are deficient in available zinc.

MATERIAL AND METHODS

Soil samples collected from twenty three profiles representing seven major soil series namely Peelamedu, Upprapatti Thiruchengodu, Thulukkanur, Thondipatti, Vellalur and Kolli Hills were analysed for their mechanical composition, pH, organic matter and calcium carbonate content (Jackson 1967). Total zinc was determined in sodium carbonate fusion extracts of the soil using spectrophotometer. Available zinc was estimated by Shaw and Dean's method (1951) using a mixture of 0.01 per cent dithizone and neutral normal ammonium acetate as extractant.

* Formed part of the M. Sc. (Ag.) thesis submitted by the first author to Tamil Nadu Agricultural University, Coimbatore-3.

1 and 2 Asst, Professor and Professor of soil Scince Agri. Chemistry, TNAU.

RESULTS AND DISCUSSION

Analytical data on mechanical composition, pH, organic matter and calcium carbonate are given in Table 1, along with total and available zinc content.

Total zinc

The total zinc content varied from 12.6 to 391.3 ppm. In general total zinc content decreased with depth of the profile in Peelamedu series. Further the textural analysis of the soil showed that the clay content also got reduced with the advancement of the depth of profile. This is further confirmed by the positive correlation observed between clay content and total zinc content.

In the case of alluvial and laterite soils no consistant pattern could be observed. In red soils of all the series, total zinc generally increased with depth which might be due to lower pH and light texture in surface and relatively higher pH and heavier texture in the lower horizons and presence of calcium carbonate at lower depths which acted as precipitating agent (Kanwar Randhawa 1974; and Rajendran 1974).

Considering the soil types (Table 2) alluvial soils contained more of total zinc followed by laterite black and red soils. Similar results were also reported by Randhawa and Takkar (1975).

Available zinc

The available zinc content varied from 0.16 ppm to 5.14 ppm. Though No consistant pattern was observed between available zinc and depth of the profile in all the soils studied, the availability of zinc reduced with depth particularly upto 30 cm viz. to root zone of the majority of the crops and again it increased markedly even beyond the content of the surface soil. Moreover in the Hilly soil, reduction in available zinc content was observed with depth which might be ascribed to the reduction in organic matter content of the soil with depth. The available zinc content was high in laterite soils followed by red, alluvial and black soils. The higher values of available zinc content in laterite soils could be attributed to low pH and high organic matter content. Further in the present investigation a negative relationship between available zinc (Table 2) and pH was observed ($r = -0.242^{*}$). This is in confirmity with the results of Balasundaram *et al.* (1973). Available zinc had a positive association with organic matter content ($r = 0.390^{**}$) which was in confirmity with the results reported by Balasundaram *et al.* (1973), Mathan and Samboornaraman (1973).

Multiple correlation studies for available zinc (Table 3) indicated that the partial regression coefficient for silt and calcium carbonate were mainly responsible for poor availability of available zinc and organic matter and total zinc were responsible for the increase in availability of zinc to the crops indicating that the total zinc was in close association with available zinc content in these soils.

As per the critical limits fixed by Brown *et al.* (1962) and Rajagopal *et al.* (1975) (0.5 ppm of dithizone extractable zinc irrespective of soil pH) all the

depth particularly
root zone of the
and again it incre
beyond the conten
Moreover in the
in available zinc
d with depth which
to the reduction in
nt of the soil with
zinc content was
s followed by red,
soils. The higher
zinc content in
attributed to low
c matter content.
nt investigation a
between available
pH was observed
in confirmity with
asundaram *et al.*
c had a positive
nic matter content
was in confirmity
d by Balasunda-
athan and Sam-

on studies for
3) indicated that
coefficient for
arbonate were
poor availability
ganic matter and
nsible for the
of zinc to the
total zinc was
available zinc

limits fixed by
Rajagopal *et al.*
zone extracta-
soil pH) all the

soils studied were well supplied with available zinc.

REFERENCES

BALASUNDARAM, C. S., K. RAJAKANNU, C. R LAKSHMINARASIMHAN, S. SAMBOORNARAMAN and A. K. GOVINDARAJ. 1973. Zinc content of Tamil Nadu Soils. *Madras agric* J. 60: 96 - 99.

BROWN, A. L., B. A. KRANTZ and P. E. MARTIN. 1962. Plant uptake and fate of soil applied zinc. *Soil/Sci. Soc. Amer. Proc.* 26: 167-70.

JACKSON, M. L. 1967. Soil Chemical Analysis. Constable and Co. Ltd. London.

KANWAR, J. S. and N. S. RANDHAWA. 1974. Micronutrient Research in soils and plants in India (A review) I. C. A. R. Technical Bulletin (Agric) No. 50.

MATHAN, K. K. and S. SAMBOORNARAMAN. 1973. Zinc status of Nilgiris soils. *Madras agric.* J. 60: 903-06.

RAJAGOPAL. C. K., M. MOOSA SHERIFF, K. K. KRISHNAMOORTHY and G. SELVAKUMARI. 1975. Micronutrient status of Tamil Nadu soils. *S. I. S. S. T. A. Sugar.* J. 1: 1 - 6.

RAJENDRAN, G. 1974. Categorization of Red soil series of Coimbatore district (Tamil Nadu) M.Sc. (Ag,) dissertation submitted to and approved by Tamil Nadu Agricultural University, Coimbatore.

RANDHAWA, N. S. and P. N. TAKKAR. 1975. Micronutrient research in India. *Fertilizer News* 20: 11-19.

SHAW, E. and L. A. DEAR. 1951. Use of dithizone as an extractant to estimate the zinc status of soils. *Soil/ Sci.* 73: 341-47.

RESULTS AND DISCUSSION

Analytical data on mechanical composition, pH, organic matter and calcium carbonate are given in Table 1, along with total and available zinc content.

Total zinc

The total zinc content varied from 12.6 to 391.3 ppm. In general total zinc content decreased with depth of the profile in Peelamedu series. Further the textural analysis of the soil showed that the clay content also got reduced with the advancement of the depth of profile. This is further confirmed by the positive correlation observed between clay content and total zinc content.

In the case of alluvial and laterite soils no consistant pattern could be observed. In red soils of all the series, total zinc generally increased with depth which might be due to lower pH and light texture in surface and relatively higher pH and heavier texture in the lower horizons and presence of calcium carbonate at lower depths which acted as precipitating agent (Kanwar Randhawa 1974; and Rajendran 1974).

Considering the soil types (Table 2) alluvial soils contained more of total zinc followed by laterite black and red soils. Similar results were also reported by Randhawa and Takkar (1975).

Available zinc

The available zinc content varied from 0.16 ppm to 5.14 ppm. Though No consistant pattern was observed between available zinc and depth of the profile in all the soils studied, the availability of zinc reduced with depth particularly upto 30 cm viz. to root zone of the majority of the crops and again it increased markedly even beyond the content of the surface soil. Moreover in the Hilly soil, reduction in available zinc content was observed with depth which might be ascribed to the reduction in organic matter content of the soil with depth. The available zinc content was high in laterite soils followed by red, alluvial and black soils. The higher values of available zinc content in laterite soils could be attributed to low pH and high organic matter content. Further in the present investigation a negative relationship between available zinc (Table 2) and pH was observed ($r = -0.242^{*}$). This is in confirmity with the results of Balasundaram *et al.* (1973). Available zinc had a positive association with organic matter content ($r = 0.390^{**}$) which was in confirmity with the results reported by Balasundaram *et al.* (1973), Mathan and Samboornaraman (1973).

Multiple correlation studies for available zinc (Table 3) indicated that the partial regression coefficient for silt and calcium carbonate were mainly responsible for poor availability of available zinc and organic matter and total zinc were responsible for the increase in availability of zinc to the crops indicating that the total zinc was in close association with available zinc content in these soils.

As per the critical limits fixed by Brown *et al.* (1962) and Rajagopal *et al.* (1975) (0.5 ppm of dithizone extractable zinc irrespective of soil pH) all the

soils studied were well supplied with available zinc.

REFERENCES

BALASUNDARAM, C. S., K. RAJAKANNU, C. R LAKSHMINARASIMHAN, S. SAMBOORNARAMAN and A. K. GOVINDARAJ. 1973. Zinc content of Tamil Nadu Soils. *Madras agric* J. 60: 96 - 99.

BROWN, A. L., B. A. KRANTZ and P. E. MARTIN. 1962. Plant uptake and fate of soil applied zinc. *Soil/Sci. Soc. Amer. Proc.* 26: 167-70.

JACKSON, M. L. 1967. Soil Chemical Analysis. Constable and Co. Ltd. London.

KANWAR, J. S. and N. S. RANDHAWA. 1974. Micronutrient Research in soils and plants in India (A review) I. C. A. R. Technical Bulletin (Agric) No. 50.

MATHAN, K. K. and S. SAMBOORNARAMAN. 1973. Zinc status of Nilgiris soils. *Madras agric.* J. 60: 903-06.

RAJAGOPAL, C. K., M. MOOSA SHERIFF, K. K. KRISHNAMOORTHY and G. SELVAKUMARI. 1975. Micronutrient status of Tamil Nadu soils. *S. I. S. S. T. A. Sugar.* J. 1: 1 - 6.

RAJENDRAN, G. 1974. Categorization of Red soil series of Coimbatore district (Tamil Nadu) M.Sc. (Ag.) dissertation submitted to and approved by Tamil Nadu Agricultural University, Coimbatore.

RANDHAWA, N. S. and P. N. TAKKAR. 1975. Micronutrient research in India. *Fertilizer News* 20: 11-19.

SHAW, E. and L. A. DEAR. 1951. Use of dithizone as an extractant to estimate the zinc status of soils. *Soil/ Sci.* 73: 341-47.

TABLE 1 Forms and Distribution of Copper in Relation to soil Properties in Some Soil Series of Namakkal Taluk, Tamil Nadu.

Depth (cm)	pH 1:2 soil water suspension	Mechanical composition (in percentage)						Zinc (ppm)	
		Clay	Silt	Find sand	Coarse sand	Organic matter	Calcium carbonate	Total	Available
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Black Calcareous Soil (Peelamedu Series)					
P_1 *Aniapuram*									
0-15	8.1	23 4	3.4	47.9	19.9	0.45	6.1	178.8	4.15
15-30	8.5	46.7	11.4	23.3	14.9	0 40	12.6	132.7	0.87
30-60	9.0	41.8	8.4	24.3	14.4	0.32	11.5	62.6	1.74
60-83	9.1	40.5	11.6	25.9	11.2	0.50	13.0	56 6	2.58
83-98	9.3	23.8	7.5	20.1	40.6	0.29	12.1	83.3	0.86
P_2 *Eramapatti*									
0-15	8.6	43.6	8.7	35.9	3.3	0.47	9 0	45.4	1.71
15-30	8.6	47.4	9.2	24.6	12.8	0.37	8.6	46.1	0 80
30-60	8.8	50.9	9.6	21.0	11.0	0.40	10.4	49.4	3.51
60-75	8.8	53.5	9.7	16.3	10.9	0.49	11.5	45.9	1.77
75-90	8.8	56.2	11.9	16.3	5.5	0.65	12.3	60 8	1.69
P_3 *Ernapuram*									
0-15	8.8	35.0	8.7	27.4	21.4	0.34	6.9	32.3	2.58
15-30	8.8	40.1	8.6	25.5	20.4	0.26	7.1	40.3	3.46
30-60	9.0	32.9	7.1	27.3	25.8	0 26	7.0	35.1	0.86
60-75	8.9	33.2	6.4	24.6	27.3	0.26	7.5	50 0	0 87
75-90	9 0	30.0	6.7	25.2	30.8	0.17	7.6	34.7	0 85

(Continued)

60-75	8.9	33.2	6.4	24.6	27.3		7.5	35.1	0.86
75-90	9 0	30.0	6.7	25.2	30.8	0.26 0.17	7.6	50 0 34.7	0 87 0 85

(Continued)

TABLE 1 (Contd .)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
P_4 *Nallipalayam*									
0-15	8.4	44.3	9.0	20.5	24.3	0.59	7.2	54.8	1.68
15-30	8.4	49.9	8.0	14.3	18.0	0.46	8·4	52.2	2.64
30-60	8 5	33.6	5.7	23.4	23.5	0.24	8.1	35.0	1.73
60-75	8 8	19.1	3.8	25 6	50.8	0.17	4.8	18 9	0 88
				Alluvial Galcareous soil (Upparapatti Series)					
P_5 *Ellakkattor*									
0-15	8.7	35.0	13.7	24.6	24.7	0.74	5.4	39.2	2.51
15-30	8.4	30.0	18.2	24.3	23.4	0 82	6.1	55.2	1.68
30-60	8.7	32.5	10.0	23.5	25 5	0.46	4.6	60.1	0.83
60-90	8.8	39.2	12.7	20.8	18 2	0.26	1.7	50.4	0.81
P_6 *E. N. Palayam*									
0-15	8.4	32.1	18.6	23.0	22.3	0.85	4.9	50.1	1.69
15-30	8.4	30.1	18.2	23.0	23.1	0.57	4 5	61.1	1.69
30-60	8.5	31.3	16.3	20.3	27.7	0.18	3.3	60.8	2.54
60-90	8.5	32.8	11.7	26.8	23.1	0.13	6 8	39 5	2.52
P_7 *Vellur*									
0-15	8.2	25.1	11.4	25 0	34.9	1.30	1.1	391.3	5.14
15-30	8.5	14.8	8.0	24.2	49.0	0.55	1.0	64.4	2.47
30-75	8.3	20.0	13.6	24.1	34.6	0.61	1.7	97.0	3.36
75-95	8.4	16.6	22.2	25.9	28.7	0.65	2.5	131.1	1.67

(continued)

TABLE 1 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
P_8 *Unchapalayam*									
0-15	9 0	22.7	5.1	37.2	28.4	0.70	3,7	43.7	1.64
15-25	9.0	21.1	15.4	33.4	29.9	0.59	2.2	45.3	0.81
25-30	9.1	20,3	16.4	31.3	38.2	0.40	2.1	54.2	0.83
30-60	8.9	10.3	3.8	22.0	62.3	0.51	0.3	27.9	1.62
60-90	8.8	21.1	8.0	47.6	17.6	0.17	2.5	31,0	0.83
90-120	8.8	20.7	8.8	47.9	16.3	0.17	2.3	38.9	2.49
				Red Calcareous soil (Thiruchengodu Series)					
P_9 *Paramathi*									
0-15	7.8	4.7	3.5	39.1	49.5	0.33	...	12.6	2.41
15-80	7.6	19.0	6.9	23.0	51.5	0.29	0.1	33.1	0.16
30-53	7.2	29.1	4.9	19.4	44.8	0.31	0.1	35,6	4.07
53-60	7.5	15.7	6.6	19.4	56.6	0.39	0.1	38.1	1.63
60-90	7.7	14.6	7.4	17.7	59.6	0.29	...	48.1	2.43
90-113	8.1	10.3	5.1	19.0	64.7	0.24	...	73.5	2·43
P_{10} *Marapalayam*									
0-10	7.7	4.5	4.5	44.9	49.7	0.36	...	12 8	2.46
10-25	7.4	21.9	7.7	32.5	40.9	0.34	...	33.3	3.28
25-48	7.5	29.2	6.8	23.8	39.2	0.34	0.5	33.7	1.66
48-60	8.1	14.4	4.4	22 8	58.3	0.29	0.5	58.8	3.27
60-90	8.1	7.8	4.8	20.7	62.8	0.28	4.9	63.3	0.81
P_{11} *Nallur*									
0-15	8.3	8.0	5.3	42.0	42.9	0.29	0.2	12.6	1.61
15-23	8.2	7.9	5.3	45.5	38.9	0.29	0.2	17.7	1.62
23-30	8.2	12.6	3.8	45.1	39.3	0.29	0.3	20.3	3.25
30-60	8.5	11.6	3.1	40.8	39.4	0.24	6.1	33.0	3.25

(Continued)

0-15	8.3	8.0	5.3	42.0	42.9	0.29	0.2	12.6	1.61
15-23	8.2	7.9	5.3	45.5	38.9	0.29	0.2	17.7	1.62
23-30	8.2	12.6	3.8	45.1	39.3	0.29	0.3	20.3	3.25
30-60	8.5	11.6	3.1	40.8	39.4	0.24	6.1	33.0	3.25

(Continued)

TABLE 1 (Contd..)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				Red Cal careous Soil(Tulkukanur Series)					
P_{12} *Rasempalayam*									
0-15	8.5	11.2	4.1	37.8	45.4	0.41	2.7	23.0	3.27
15-23	8.7	15.0	4.6	32.8	42.9	0.41	5·3	48.6	1.64
23-30	8.7	14.4	4.1	31.6	41.0	0.39	9.2	33.2	1.63
30-60	8.4	14.5	5.4	24.6	39.2	0.14	17.8	23.0	0.83
P_{13} *Anangur*									
0-15	8.3	6.7	6.6	51.7	32.9	0 51	1.4	22.8	1.64
15-30	8.3	9.4	6.5	38.5	41.7	0.55	0.6	33.0	2.44
30-60	8.1	17 4	11.3	35.5	33.0	0.56	0.2	38 5	1.64
60-90	8.1	22.1	8.1	38.4	27.9	0.61	0.3	37.8	1.61
P_{14} *Sellappampalayam*									
0-15	8 3	10.7	5.9	52.7	27.7	0.82	0.4	27.9	4.96
15-30	8.3	12.1	3.1	42.9	36.9	0.19	2 6	28.0	1.63
30-60	8.3	10.1	3.1	24.4	44.3	0.29	16.3	28.0	0.81
				Red Calcareous soil (Thondipatti Series)					
P_{15} *P. N. Patti*									
0-15	8.1	19.1	6.4	35.6	34.1	0.24	0.4	51.2	3.28
15-30	8.3	13.0	5 9	29.2	49.0	0.22	0.4	35.6	2.46
30-60	8.2	20.4	3.8	35.9	38 6	0.19	0.2	30.8	2.46
60-90	8.3	18.9	5.1	33.3	42.9	0.19	0.2	28.2	1.63
90-98	8.2	18.6	3.6	38.9	43.7	0.14	3.4	28.2	0.82

(continued)

TABLE 1 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Red Calcareous Soil(Tulkukanur Series)									
P_{16} *Kalangani*									
0-15	8.2	8.3	4.7	38.1	47.3	0.19	...	22.8	1.62
15-30	7.9	16.3	5.9	39.7	37.9	0.17	...	23.0	1.64
30-45	8.2	18.4	4.8	30.8	43.1	0.22	0.8	29.1	2.04
P_{17} *Eachavari*									
0-15	8.3	9.8	4.6	47.7	31.5	0.26	0.2	22.8	2.45
15-30	8.3	11.1	4.3	43.6	36.5	0.22	0.1	33.0	4.87
30-45	8.2	17.8	5.9	41.2	32.2	0.24	0.7	35.9	2.47
45-60	8.3	22.2	8.0	20.1	51.4	0.29	0.2	25.6	3.32
60-75	8.2	26.2	4.9	27.4	39.2	0.32	0.2	30.8	0 82
P_{18} *Bodupatti*									
0-15	8.3	13.3	2.8	42.5	40.6	0.44	...	20.4	1.63
15-30	8.3	24.5	3.1	37.7	32.5	0.48	...	23.3	3.31
30-60	8.3	30.2	3.6	29.4	35.2	0.48	0.4	34.0	3.34
60-67.5	8.3	23.7	2.1	19.0	52.5	0.52	1.2	36.3	1.66
Red non-calcareous soil (Vellalur Series)									
P_{19} *Kandampalayam*									
0-15	8.4	7.2	1.3	56.7	31.4	0.11	...	22.8	1.62
15-30	8.3	7.0	0.5	54.7	37.3	0.09	...	32.8	2.42
30-60	8.1	7.0	0.5	47.0	44.0	0.08	...	35.3	1.61
60-70	8.1	10.2	2.7	41.0	43.7	0.06	...	28.0	2.44
70-85	8.3	4.7	3.6	26.6	62.8	0.06	...	22.8	2.43

(continued)

30-60	8.1	7.0	0.5	54.7	37.3	0.09	...	32.8	2.42
60-70	8.1	7.0	0.5	47.0	44.0	0.08	...	35.3	1.61
70-85	8.3	10.2	2.7	41.0	43.7	0.06	...	28.0	2.44
		4.7	3.6	26.6	62.8	0.06	...	22.8	2.43

(continued)

TABLE 1 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
P_{20} *Ponnaripatti*									
0-15	7 6	6.2	1.8	58.0	32 3	0.11	...	25 3	1.62
15-30	7.6	11.1	2.7	54.3	27.3	0 11	...	30.6	1.63
30-60	7.4	18.0	3.4	39.9	33.7	0.17	...	37.0	1.65
60-70	7.9	17.7	3.4	38.8	36.8	0.17	...	31.2	2.48
70-85	8.0	14.4	2.9	28.3	44.0	0.17	...	72.7	2 49
P_{21} *Vettambedi*									
0-15	7 6	12.5	2 2	46.7	34.0	0 36	...	33.3	1.64
15-30	7.9	11.7	1.0	43 6	36 1	0.27	...	43.6	0.82
30-45	7 6	18.5	2.6	39.6	34 5	0 30	...	49.0	2.48
45-60	7.5	16.1	4 6	30.4	46.4	0.33	...	28 3	0.82
60-75	7.5	15.1	3.8	25.9	51 0	0.22	...	63.5	0.81
75-90	7.6	11.5	5.4	28.1	58 8	0.14	...	43.7	0.82
				Laterite Soil (Kolli Hills Series)					
P_{22} *Karaivangadu*									
0-15	5 5	42.6	8.8	16.2	26.3	3.97	...	71.6	4.80
15-30	5.8	43.7	7.3	14.7	31.2	2.03	...	52.0	4.16
30-60	4.8	49 0	5.0	14.1	28.9	1.06	...	39.4	2.52
60-90	4 8	51.4	9.4	13 9	19.9	0.56	...	57.2	2.50
90-120	4.9	51 5	8.6	14.7	20.2	0.74	...	70.3	1.67
120-150	5.1	24.7	35.6	14.7	21.1	0.28	...	38.7	1.86
150-180	5.1	38.7	25.2	14 8	16.9	0.16	...	256.7	4.11

(Continued)

TABLE 1 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
P_{28} *Semmedu*									
0-15	5 9	44.0	7.0	18.9	27.7	1.95	...	44 3	3.34
15-30	6.0	48.3	4.6	17.3	26.5	1.45	...	49.5	2.83
30-60	4.9	55.8	5.5	14.9	22.1	0.78	...	86.8	2.48
60-90	5.6	51.6	11.2	14.7	21.9	0.64	...	70.2	1.66
90-120	5.1	51.0	9.0	14.6	23.7	0.58	...	38.7	1.68
120-135	6.1	43.8	10.6	16.9	26.4	0.22	...	67.8	1.66

TABLE 2. Simple Correlation Coefficients Between Forms of Zinc and Soil Properties

Soil proerties	Total zinc	Available zinc
pH	-0.250**	-0.242*
Clay	0.358**	N. S. 0.092
Silt	0.448**	N. S. 0.014
Fine sand	-0.343**	N. S. -0.018
Coarse sand	-0 307**	N. S. -0.071
Organic matter	N. S. 0.121	0.390**
Calcium carbonate	N. S. 0.135	-0.234*
Total zinc	...	N. S. 0.177

* Significant at 5 per cent level

** Significant at 1 per cent level

N. S. Non-significant

TABLE 3. Results of Multiple Correlation Analysis

A. *Total zinc*

Variable	Patial regression coefficient (bi)	S. E. bi	and significance	
pH	-7.974	3.867	-2.062*	
Clay	0.152	1.014	N. S. 0.150	
Silt	2.155	1.127	N. S. 1.912	
Fine sand	-0.075	1.072	N. S. -0.070	
Coarse sand	9.99	0.997	N. S. 0.010	
Organic matter	-9.421	6.861	N. S. -1.373	
calcium carbonate	1.620	1.275	N. S. 1.270	
Available zinc	6.301	2.898	2.174*	
	a = 78.333			

B. *Available zinc*

pH	0.118	0.133	N .S. 0.889	R^2=26.323
Clay	-0.093	0.053	N. S. -1.773	
Silt	-0.119	0.059	-2.012*	
Fine sand	-0.092	0.055	-1.657	
Coarse sand	-0.098	0.052	-1.894	
Organic matter	0.822	0.216	3.808**	
Calcium carbonate	-0.133	0.051	-2.637**	
Total zinc	7,675	3.271	2.346*	
	a = 10.067			