TABLE 4.

Performance of FS. 391 in MLT. (Green fodder yield t/ha/yr) of two yrs.

S.No.	Location	Mean of two yrs. Control	FS. 391	% on Control
1.	Coimbatore	24.13	38.14	158.1
2.	Erode	21.37	30.15	141.1
3.	Pottaneri	9.18	13.22	144.0
4.	Paiyur	32.90	42.80	130.1
5.	Kattupakkam	22.61	30.05	133.9
6.	Vellore	14.75	17.21	116.7
7.	Killikulam	8.13	20.95	257.7
8.	Aruppukottai	15.58	23.17	139.7
9.	Overall Mean	18.71	26.96	144.1

TABLE 5.

Preliminary trial of Mixed cropping (1983-85)

Pure/Mixed Crop	Dry Matter (%)	Crude protein (%)	Green fodder yield (t/ha/yr)	Dry Matter yield (t/ha)	Crude Protein yield (kg/ha)	Percentage of increase over Fs 391 DM Yield	CP Yield
FS. 391 Pure crop	28.0	9.0	29.00	8.12	731	-	-
FS. 391+ horse gram (3:1)	28.0 18.0	9.0 15.0	26.31	6.71	675	-	-
FS. 391 + Clitoria (3:1)	28.0 33.8	9.0 21.2	19.93	5.87	734	-	0.39
FS. 391 + Siratro (3:1)	28.0 20.5	9.0 16.2	32.78	6.72	725	-	-
FS. 391 + Desmodium(3:1)	28.0 22.8	9.0 19.3	25.62	6.84	766	-	4.80
FS. 391 + *S.scabra* (3:1)	28.0 33.1	9.0	30.58	9.15	940	20.8	28.55

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DISTRIBUTION OF MANGANESE IN SOIL

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ABSTRACT

The distribution of total and available manganese (exchangable + water soluble forms) and their relationship to different soil properties were studied in twenty three soil profiles, representing seven major soil series of Namakkal taluk in Tamil Nadu. The total manganese content varied from 206 to 792 ppm. The content increased with depth in black and red soil series, while irregular pattern of distribution was observed in alluvial and laterite soil series. Black soils contained more of total manganese than alluvial, red and laterite soils. Total manganese content was closely related to clay, calcium carbonate, fine sand and coarse sand. The available manganese content varied from 0.63 to 26.64 ppm and the content decreased with depth in alluvial and

laterite soil series while irregular pattern of distribution was observed in black and red soil series. Laterite soils contained more of available manganese thanalluvial, black and red soils. Available manganese was positively related to clay and organic matter and negatively with finer and coarser fractions of the soil.

KEY WORDS: Available Manganese, Soil Properties.

Due to the intensive cultivation of high yielding varieties with use of high analysis fertilizers, the need for manganese for various crops as a micronutrient is being felt recently among the agricultural scientists. Manganese content of the soils varies very widely and the manganese supplying capacity of soils for the plants also varies regardless of the total amounts present depending upon the soil reaction, organic matter content, calcium carbonate and texture of the soil. Information about the manganese status and its distribution pattern of the soils of Tamil Nadu is very scanty. Hence an attempt was made in the present study to assess the total manganese and its availability to crops.

MATERIALS AND METHODS

Soils samples collected from twenty three profiles representing seven major soil series namely Peelamedu, Upparapatti, Thiruchengodu, Thulukkanur, Thondipatti, Vellalur and Kolli Hills were analysed for their mechanical composition, pH,organic carbon and calcium carbonate (Jackson, 1962).Total manganese was determined by sodium carbonate fusion extract of the soil using spectrophotometer. Available manganese was estimated by Sherman and Harmer (1942) method using normal ammonium acetate pH 7.0 extractant.

RESULTS AND DISCUSSION

Mean analytical data on mechanical composition, pH, organic matter and calcium carbonate, total manganese and available manganese content are given in Table 1.

The total manganese content varied from 206 to 792 ppm. In black soil series, the total manganese content increased with depth, which might be due to the increase in finer fractions and also calcium carbonate content with depth. Similar results have been reported by Biswas (1953) and Gopalswamy and Soundarajan (1969) in Indian black soils. The distribution of total manganese with depth was irregular in all the alluvial soils studied, though decrease in total manganese with depth was reported by Balaguru and Dhanabalan Mosi (1972) and increase in total manganese with depth was reported by Gopalswamy and Soundararajan (1969) in alluvial soils of Tamil Nadu.

The increase in total manganese with depth in red soil series might be due to leaching of manganese compounds from upper horizons to lower horizons and subsequent oxidation to higher valency status and consequent immobilosation (Balaguru and Dhanabalan Mosi, 1972). In laterite soil series, the total manganese was found to decrease when upper and lower most horizons are compared. Biswas (1953) reported that the lower total manganese content with depth of certain lateritic soils of India was due to leaching action of drainage water.

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Table 1. Physico - chemical properties of the soils (Mean values)

S. No.	Soil types	No. of samples	Mechanical composition (per cent)				pH	Organic matter (per cent)	Calcium carbonate (per cent)	Manganese (ppm)	
			Clay	Silt	Fine sand	Coarse sand				Total	Available
1.	Black soil	19	38.3	88.2	24.7	20.4	8.7	0.372	9.0	580	1.88
2.	Alluvial soil	18	25.3	12.4	28.1	29.2	8.7	0.531	3.2	419	5.88
3.	Red soil	59	14.5	4.8	35.9	42.1	7.9	0.282	1.8	370	1.82
4.	Laterite soil	13	45.8	11.4	15.4	24.1	5.4	1.109	Nil	349	13.84

The total manganese content was higher in black soils followed by alluvial, red and laterite (Balaguru and Dhanabalan Mosi, 1972). Besides the difference in mineralogy of the soils, presence of montmorillonite type of clay minerals in black soils and kaolinitic type of clay minerals in red and laterite soils and the resulting variation in adsorption in total manganese content among the different soil types might account for the higher content in black soils.

Correlation studies (Table 2) revealed that total manganese was closely related to clay content (r= 0.416) and similar results were reported by Biswas (1953) and Balaguru and Dhanabalan Mosi (1972). It is evident from this relationship that clay minerals fix appreciable amounts of manganese and prevent loss of total manganese by leaching. The positive correlation obtained between total manganese and calcium carbonate (r =0.465**) is in agreemeent with the results reported by Balaguru and Dhanabalan Mosi (1972) and this is possibly due to conversion of manganese of lower oxidation status to higher oxidation status in the presence of calcium carbonate.

The available manganese content varied from 0.63 ppm to 26.64 ppm. Irregular distribution pattern of available manganese was observed in black and red soil series. In laterite and alluvial soils, the available manganese content decreased with depth. Mehta and Patel (1967), Agarwal and Reddy (1972), Balaguru and Dhanabalan Mosi (1972) reported similar results. Available manganese was found to be high in laterite soils followed by alluvial, black and red soils and similar results were reported by Fateh Lal and Biswas (1973). The higher amount of available manganese in laterite soils might be due to the combined influence of lower pH, high organic matter and lower calcium carbonate status, which might have resulted in creating reducing conditions and thereby increasing the available manganese. The relatively higher amounts of available manganese in alluvial soils than in black and red soils could be attributed to the reduced conditions which is normally prevalent in the alluvial soils. The higher pH, higher calcium carbonate content in black soils and open texture in red soils might have reduced the availability due to the oxidation of manganese compounds.

Similar to those reported by Agarwal and Reddy (1972) and Randhawa and Takkar (1975), the present study also indicated that available manganese had negative association with pH (r = − 0.587**). A positive association between available manganese and clay content (r =0.512**) was observed. Similar to that reported by Vinayak *et al.* (1967), a significant relationship between available manganese and organic matter (r =0.724 **) was established in the present study indicating the contribution of organic matter to the available manganese status of soils. Gopalswamy and Soundararajan (1969), Agarwal and Reddy (1972) have also reported similar results. Multiple correlation studies (Table 3) clearly indicated that pH and organic matter were mainly responsible for the availability of available manganese when compared to other factors in the present study.

Sherman *et al.* (1942) and Rajagopal *et al.* (1973) considered 3 ppm of available manganese in soils to be the lower limit, below which the deficiency conditions may exist depending on crops. In alluvial and laterite

soils, the available manganese was above the critical limit while in all other soils the available manganese was mostly below the critical limit and as such certain crops are likely to suffer from manganese deficiency in black and red soils.

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TABLE 2.

Simple correlation coefficients between forms of manganese and soil properties

S.No.	Soil properties	Total manganese	Available manganese
1.	pH	0.290**	-0.587**
2.	Clay	0.416**	0.512**
3.	Silt	0.073NS	0.210*
4.	Fine sand	-0.201*	-0.246**
5.	Coarse sand	-0.418*	-0.246**
6.	Organic matter	0.120NS	0.724**
7.	Calcium carbonate	0.465*	0.149NS
8.	Total manganese		-0.0012NS

*Significant at 5 per cent level ** Significant at 1 per cent level NS Not Significant

TABLE 3.
Results of multiple correlation analysis

S. No.	Variables	Partial regression coefficient (bi)	SE bi	t and significance	
		A. TOTAL MANGANESE			
1.	pH	61.623	14.881	4.1408	R^2 = 44.36
2.	Clay	-0.335	3.727	-0.090	
3.	Silt	-8.568	4.117	-2.081	
4.	Fine sand	-5.980	3.883	-1.540	
5.	Coarse sand	-6.217	3.613	-1.720	
6.	Organic matter	50.828	30.741	1.653	
7.	Calcium carbonate	-3.123	4.537	-0.688	
8.	Available manganese	-3.755	3.338	-1.115	
		a : 386.863			
		B. AVAILABLE MANGANESE			
1.	pH	-0.977	0.464	-2.107*	R^2 = 66.716
2.	Clay	0.107	0.109	0.979 NS	
3.	Silt	9.950	0.124	0.081 NS	
4.	Fine sand	-7.701	0.116	-0.067 NS	
5.	Coarse sand	0.019	0.108	0.172 **	
6.	Organic matter	5.697	0.718	7.933 NS	
7.	Calcium carbonate	-0.078	0.134	-0.584	
8.	Total manganese	-0.350	2.924	-1.115	
		a : 7.625			

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RESEARCH NOTES

ECONOMIC WEED MANAGEMENT IN RICE –PULSE CROPPING SYSTEM

Though hand weeding is considered best, the undependable supply of relatively cheap labour in time necessitated the use of herbicides in rice. Besides, weeds cause 10-15 per cent yield loss without any visible symptoms (Rao, 1983). In India inclusion of short duration pulse after rice with the residual moisture is common. Hence this investigation was taken up to evaluate an economic weed management programme for rice-pulse crop-