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Status of Macro and Micronutrients in Some Soils of Nagapattinam District in Tamil Nadu, India

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ABSTRACT

Soil fertility is one of the important factors controlling yields of the crops. Soil characterization in relation to evaluation of fertility status of the soils of an area or region is an important aspect in the context of sustainable agricultural production. Macronutrients (N,P,K) and micronutrients (Zn, Fe, Cu, Mn) are more important soil elements that control its fertility. Variation in nutrient supply is a natural phenomenon and some of them may be sufficient whereas others deficient. The stagnation in crop productivity cannot be boosted without judicious use of macro and micronutrient fertilizers to overcome existing deficiencies / imbalances. The study area covers 20 villages in Kutthalam Taluk of Nagapattinam District in Tamilnadu. The soils of the area are characterized by light in texture, moderate to high pH and low to medium in organic matter content. Soil samples numbering of 100 samples were collected from all the 20 villages keeping in view of the physiographic characteristics in different cross sections of the area. The processed soil samples were analysed for physico-chemical properties using standard procedures.

Key words: Macronutrients, Micronutrients, Nagapattinam district, Soil, Tamil Nadu.

INTRODUCTION

Of the several elements known to be essential for plant growth, macronutrients (N, P, K) and micronutrients (Zn, Fe, Cu, Mn) are important soil elements that control its fertility. Because of imbalanced and inadequate fertilizer are coupled with low efficiency of other inputs, the response (production) efficiency of chemical fertilizer nutrients has declined rapidly under intensive agriculture in recent years. The result of numerous field experiments in different parts of India have, therefore indicated "fertilizer induced unsustainability of crop productivity" (Yadav, 2003)[(1)]. Although widespread micronutrient deficiency has been observed in the soils of Tamil Nadu, specially the nutrient Zn deficiency (P.Martin Devaprasath, 2008) [(2)], the information with respect to availability of macro and micronutrients and soil characteristics of the study area was lacking. Hence, a systematic soil analysis was proposed to delineate areas of macro and micronutrient deficiencies. In this study, an attempt has been made to assess the macro and micronutrient status of 20 selected revenue

villages in Kutthalam Taluk of Nagapattinam District in Tamil Nadu.

Study area

Kutthalam Taluk (Fig.1) is one among the 8 taluks of Nagapattinam District located adjacent to Mayiladuthurai Taluk in Tamil Nadu. The study area covers an extent of 17,087 ha land area with 55 numbers of revenue villages under Kutthalam Taluk. Soil samples were collected randomly from 20 selected revenue villages of the study area. Five samples from each village, therefore a total of 100 samples were collected and analysed for soil parameters. The location map of the Kutthalam Taluk is given in Fig.1

MATERIAL AND METHODS

Surface soil samples (0-20 cm depth) numbering 100 samples representing 20 Revenue villages of Kutthalam Taluk were collected for micronutrients and the processed samples were extracted with DTPA-$CaCl_2$ – TEA solution (Lindsay and Norvell, 1978) [3]. The available Fe, Mn, Zn and Cu content in the extract was determined with the help of atomic absorption spectro photometer (ECIL, AAS-4129). Simple averaging of soil test values for each macro and micronutrient was done to get the average status in the revenue villages. The processed soil samples were analyzed for physico-chemical properties using standard procedures (Jackson, 1973) [4].

RESULTS AND DISCUSSION

The results of the macro and micronutrients of 20 villages are given in Table-1.

The relative high pH of the soils might be due to the presence of high degree of base saturation. The electrical conductivity, organic carbon, organic mineral of the soils varied from 0.30 to 0.70 dsm^{-1}, 0.20 to 0.26% and 0.44 to 0.57% with a mean value of 0.58 dsm^{-1}, 0.22% and 0.49% respectively. On the basis of the limits suggested by Muhr *et al.,* (1963) [5] for judging salt problems of soils, all samples (100%) were found to be less than one in electrical conductivity. The organic carbon content was low (<0.50%) in 100% soil samples. High temperature and good aeration in the soil increases the rate of oxidation of organic matter resulting reduction of organic carbon content.

Available N content varied from 75.0 to 350.0 Kg ha^{-1} with an average value of 219.37 kg ha^{-1}. On the basis of the ratings suggested by Subbiah and Asija (1956) [6], 60% samples were low (<250 N Kg ha^{-1}), 40% were medium (250 to 500 N kg ha^{-1}). This is because most of the soil nitrogen is in organic forms. Similar results were reported by Paliwal (1996) [7].

The available phosphorus content varied from 12.5 to 37.5 kg ha^{-1} with a mean value of 23.0 kg ha^{-1} . The range is considerably large which might be due to variation in soil properties viz., pH, organic matter content, texture and various soil management and agronomic practices. On the basis of the limits suggested by Muhr *et al.,* (1963), 35% samples were low (<20 P_2O_5 kg ha^{-1}) and 65% medium (20 to 50 P_2O_5 kg ha^{-1}). This might be due to the presence of more than 50% of phosphorus in organic forms and after decomposition of organic matter as humus is formed which forms complex with Al and Fe and that is a protective cover for P fixation with Al and Fe thus reduce phosphorus adsorption/ Phosphate fixation (Tisdale *et al.,* 1997)[8].

Status of available potassium (K_2O) in the soils ranged from 320.0 to 425 kg ha^{-1} with an average of 368.25 kg ha^{-1}. According to Muhur *et al.,* (1963) 100% samples were high (>300 k_2O kg ha^{-1}) in potassium content. This might be due to creation of favourable soil environment with presence of high organic matter. Similar results were reported by Chouhan (2001) [9]. The average mean values of the macronutrients status of selected 20 revenue villages of Kutthalam Taluk are given in Fig.2.

Soil Nutrient Index

Soil test information can be compiled areawise in the form of “Soil test summaries” which indicate the number of samples falling in the category of low, medium and high status of N, P and K. This information are used to work out from Nutrient Index (NI) or Parker Index, which in turn used to develop soil fertility map of an area.

Table 1: Salient soil properties (weighted mean) of Study Area

S. No.	Name of Village	No. of samples collected	EC (ds m^{-1})	pH	OC%	OM%	N	P_2O_5 kg ha^{-1}	K_2O	Zn	Fe mg kg^{-1}	Cu	Mn
1	Kutthalam	5	0.70	7.45	0.24	0.53	162.5	27.5	355.0	0.83	6.32	1.20	4.40
2	Inamumambalapuram	5	0.45	8.0	0.23	0.50	177.5	17.5	355.0	1.0	5.56	1.14	4.30
3	Sethirabalapuram	5	0.55	7.7	0.23	0.50	170.0	22.5	362.5	0.64	6.68	2.20	2.49
4	Tholuthalangudi	5	0.60	7.5	0.20	0.44	202.5	20.0	325.0	1.0	5.79	2.70	4.40
5	Melaiyur	5	0.50	7.6	0.22	0.48	227.5	17.5	390.0	1.08	2.86	3.89	4.33
6	Senniyanalore	5	0.70	8.0	0.24	0.53	187.5	12.5	412.5	0.86	4.91	2.88	3.84
7	Thiruvalangadu	5	0.70	7.75	0.22	0.48	230.0	17.5	350.0	0.51	6.40	2.21	3.30
8	Mekkirimangalam	5	0.60	7.6	0.23	0.50	130.0	25.0	325.0	1.07	5.73	1.11	4.11
9	Thiruvaduthurai	5	0.70	7.85	0.26	0.57	125.0	37.5	350.0	0.70	6.67	1.15	4.01
10	Perumalkoil	5	0.50	7.3	0.24	0.53	75.0	20.0	375.0	1.16	4.88	2.60	4.10
11	Pandaravadai	5	0.60	7.0	0.22	0.48	150.0	30.0	412.5	1.24	6.70	2.03	2.01
12	Karuppur	5	0.30	7.95	0.21	0.46	225.0	30.0	345.0	0.81	7.0	1.67	6.50
13	Peravore	5	0.55	7.8	0.22	0.48	305.0	22.5	375.0	0.89	7.30	1.73	6.45
14	Palayakoodalore	5	0.65	7.5	0.23	0.50	350.0	27.5	387.5	0.70	7.0	1.72	6.38
15	Kokkur	5	0.70	7.3	0.20	0.44	300.0	17.5	425.0	0.70	6.10	1.58	5.01
16	Maruthur	5	0.60	7.05	0.22	0.48	275.0	30.0	400.0	1.28	6.40	1.60	6.10
17	Komal	5	0.50	7.4	0.23	0.50	287.5	15.0	387.5	0.78	7.0	1.59	6.03
18	Kanchivai	5	0.40	7.45	0.24	0.53	275.0	12.5	320.0	0.86	6.90	1.73	5.55
19	Palaiyur	5	0.65	7.85	0.21	0.46	262.5	35.0	362.5	0.82	6.65	1.72	5.36
20	Nallavore	5	0.65	7.6	0.20	0.44	270.5	22.5	350.0	0.94	6.50	1.62	6.68
	Range		0.30-0.70	7.0-8.0	0.20-0.26	0.44-0.57	75.0-350	12.5-37.5	320-425	0.51-1.28	2.86-7.30	1.11-3.89	2.01-6.68
	Mean		0.58	7.58	0.22	0.49	219.37	23.0	368.25	0.89	6.17	1.90	4.77

$$NI = \frac{Nl + 2Nm + 3Nh}{Nl + Nm + Nh}$$

Where Nl, Nm and Nh are the number of samples falling in the category of low, medium and high nutrient status and are given weightages of 1, 2 and 3 respectively. Considering the concept of "Soil Nutrient Index" the soils of study area were found in category of "medium fertility status" for nitrogen and phosphorus and 'high' with respect to potassium. The values worked out from nutrient Index for nitrogen, phosphorus and potassium were 1.28, 2.67 and 3.0 respectively, against the Nutrient Index values < 1.5 for low, 1.5 to 2.5 for medium and > 2.5 for high fertility status.

The content of Zn, Fe, Cu and Mn varied from 0.51 to 1.28, 2.86 to 7.30, 1.11 to 3.89 and 2.01 to 6.68 mg kg^{-1} with mean values of 0.89, 6.17, 1.90 and 4.77 respectively. On the basis of critical limits suggested by Takkar and Mann (1975) [10] for

Kutthalam Taluk in Nagapattinam District

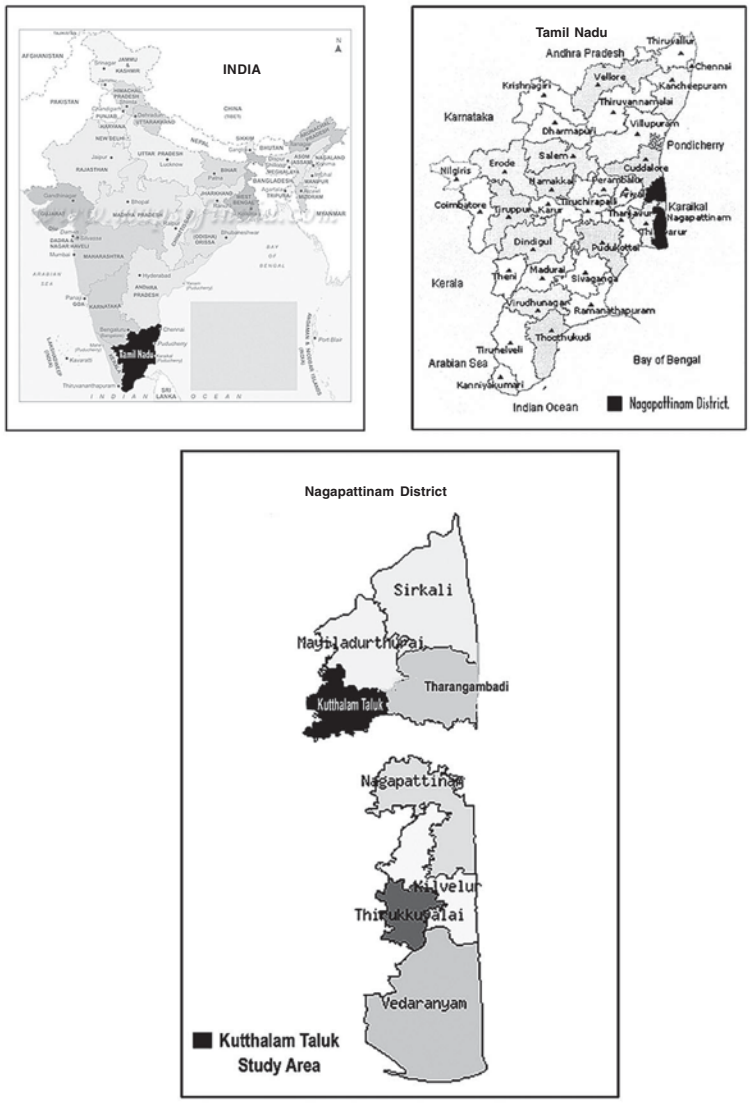

Fig. 1: Location map

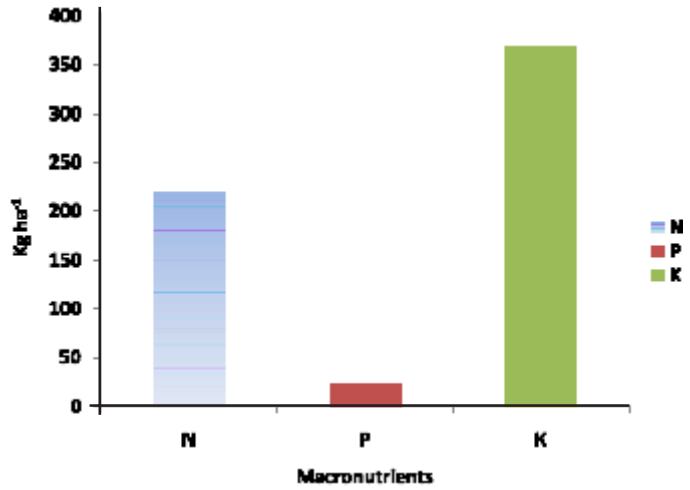

Fig. 2: Average mean value of Macronutrients

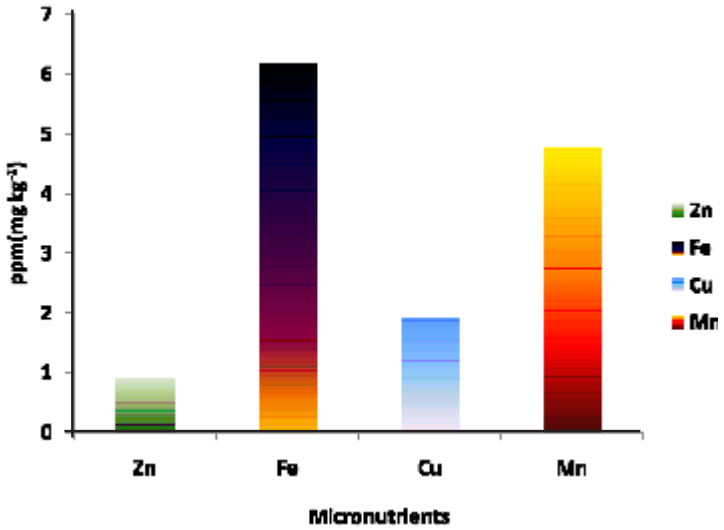

Fig. 3: Average mean value of Micronutrients status

Zn, (<0.6 mg kg $^{-1}$ for deficient, 0.6 to 1.2 mg kg^{-1} for marginal and > 1.2 mg kg^{-1} for sufficient) all the 100% samples were marginal in available Zn. Considering the critical limits (4.5 mg kg^{-1}) proposed by Lindsay and Norvell (1978) all the soil samples were sufficient in available Fe. Further all the soil samples were sufficient in available Cu and Mn considering 0.2 mg kg^{-1} for Cu and 1.0 mg kg^{-1} for Mn as critical limits suggested by Lindsay and Norvell (1978). Similar results were reported by Sharma *et al.,* (2003) [11]. The average mean values of the micronutrients status of selected 20 revenue villages of Kutthalam Taluk are given in Fig.3.

CONCLUSION

Considering the concept of "Soil Nutrient Index" the soils of study area were found in category of low fertility status for Nitrogen, Phosphorus and Potassium. Among the four micro nutrients available Fe, Cu and Mn were sufficiently present in all the soil samples. In all the villages Zn was found to be

marginal. Zn deficiency leads to widespread nutritional disorder in various crops. In case of field crops, soil application of $ZnSO_4$, @ 15-25 kg ha^{-1} can be done before sowing or transplanting. Foliar sprays of 0.5% $ZnSO_4$, 2-3 times at 10-15 days interval can be effective in correcting Zn deficiency in standing crops. Further, application of Zn along with organic manures may enhance the availability and efficiency of native Zn through chelation.

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