Table 3. Effect of GA_3 and thiourea on total chlorophyll content in leaves of *anola* seedling (mg/g fresh weight)

Treatments	Stages		
	Ist	IInd	IIIrd
Control	0.441	1.074	1.436
Distilled water	0.450	1.047	1.484
GA_3 250ppm	0.750	1.568	1.755
GA_3 500ppm	0.712	1.456	1.701
GA_3 750ppm	0.691	1.541	1.622
Thiourea 250ppm	0.685	1.392	1.586
Thiourea 500ppm	0.664	1.371	1.532
Thiourea 750ppm	0.627	1.293	1.584

with GA_3 250 ppm at all three stages and minimum level under distilled water at stage second and control at stage first and third. Similar variation in chlorophyll status was also reported by Shinde *et al.* (1989).

REFERENCES

CHETAL, S. and NAINAWATEE H.S. (1976). Some enzyme changes associated with water stress in germinating paddy and barley seeds. **Plant Biochem. J., 3:** 105-10.

KEY, J.L. (1969). Hormones and nucleic acid metabolism. Ann. **Rev. Pl. Physiol., 20:** 449.

RAM, S. (1983). Anola (*Emblica officinalis* Gaertn.)-Uses, botany and cultivation. **Res. Bull. No.110. Directorate of Expt. Sta. G.B. Pant Univ. of Agril. and Technol.,** pp.1-26

RAO, A.S. (1975). **Studies on Some Enzymatic and Amino Acid Levels in Water Stressed Wheat Seedlings.** M.Sc. Thesis. HAU, Hisar.

SHINDE, S.S., BHALERAO, R.K., RAUT K.H. and SHINDE S.D. (1989). Effect of growth regulators on yield and some physio-chemical parameters in sorghum. **J. Maharashtra Agric. Univ., 14** : 360-361.

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SOIL FERTILITY CAPABILITY CLASSIFICATION OF PROBLEM SOILS OF TIRUNELVELI, TUTICORIN AND KANYAKUMARI DISTRICTS OF TAMIL NADU

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ABSTRACT

Surface and sub surface soil samples pertaining to 7, 9 and 4 soil sub groups in Tirunelveli, Tuticorin and Kanyakumari districts respectively were studied during July - September 1994 for the assessment of fertility level and the preparation of the soil fertility capability classification. The main condition modifiers selected were 'e', 'k', 'b', 's', 'h', 'n' and 'g' for Tirunelveli district and 'e', 'k', 'b', 's', 'v', 'h', 'g' and 'n' for Tuticorin district and 'h', 'e', 'g', 'b' and 'k' for Kanyakumari district. All the soils of three districts are low in available nitrogen and hence in addition to the above modifiers, the low available N status was also considered to be the local modifier.

KEY WORDS : Fertility capability classification, problem soils, soil fertility.

The soil fertility capability classification (FCC) system was designed to group soils having similar limitations of fertility management (Buol, 1972). It provides a guide for the extrapolation of the fertilizer response experience. Among the various approaches in providing information on the potential of the soil for crop production, soil fertility capability classification is one which lays emphasis on the components of soil fertility within 50 cm layers from the surface. An attempt has been made to use this concept for the problem soils of three southern districts of Tamil Nadu *viz.*, Tirunelveli, Tuticorin and Kanyakumari.

MATERIALS AND METHODS

Seven representative sites of problem soils in Tirunelveli, nine in Tuticorin and four in Kanyakumari districts were selected during July - September, '94 for this purpose. Samples were collected from upper 20cm or plough layer whichever was shallower. Subsoil samples within 50 cm of the surface were collected depending on

the particular horizon boundary limit. The condition modifiers which indicate the specific fertility limitations were quantitatively assessed in plough layers or top 20 cm. Substrata type which is the texture of the subsoil that occurs within 50 cm of the surface was assessed. Type which is the highest category was determined by the mean texture of the surface soil. The above three levels *viz.*, type, substrata and condition modifiers form the soil fertility capability system (Boul *et al.*, 1975). Mechanical analysis, soil reaction, electrical conductivity, calcium carbonate, cation exchange capacity, exchangeable calcium and magnesium, exchangeable sodium and potassium, available nitrogen, available phosphorus, and available potassium were estimated by routine methods.

RESULTS AND DISCUSSION

The condition modifers for three districts are given in Table 4.

Low cation exchange capacity (less than 7.0 c mol p (+) kg^{-1}) 'e' reflects low ability to retain nutrients mainly calcium, magnesium and potassium. (Table 1 - 3). Soils having this modifier will have low organic matter content. The H_2S toxicity is most likely to occur if ammonium sulphate is used as N source. Iron toxicity will also occur if adjacent uplands have iron rich minerals. This problem can be solved by the substantial addition of tank silt of neutral reaction and application of nitrogenous fertilizers should be split. This modifier is noticed in Typic Ustipsamments of all the three districts.

Exchangeable K<0.20C mol p (+) kg^{-1} represent the modifier 'k'. This modifier indicates that the soils will have low ability to supply K and availability of this nutrient should be monitored. Kawaguchi and Kyuma (1977) reported that the FCC K modifier quantitatively defines soils with low inherent potentiality as those having less than 10 per cent weatherable minerals in the sand and silt fractions within 50 cm of the soil surface. Since K soils are low in weatherable minerals, they usually fall in the Siliceous, Kaolinitic, or Halloysitic mineralogical families, but not in the richer mixed, illitic, chlortic or smectitic families. Typic ustropepts and Typic Ustipsamments of all the 3 districts have this problem. Free $CaCO_3$ upto 50 cm of soil surface (effervescence with HCL) or pH more than 7.3 'b' may induce Fe deficiency when soils are in aerobic condition and Zn deficiency under anaerobic condition. High N volatilisation loss potential may occur when N is applied by broadcast. Fixation of NH_{4+} by 2:1 clays is

Table 1. Physico-Chemical properties of problem soils of Tirunelveli district

Location	Name of soil subgroup	Depth (cm)	Clay (%)	PH 1:2.5 soil : water	EC dsm^{-1} 1:2.5	Free $CaCo_3$ (%)	Exchangeable cations cmol $p^{(+)}$ Kg^{-1}					ESP	Available Nutrients		
							Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CEC		N	P	K
													← Kgha^{-1} →		
Perumanal	Typic	0-20	2.06	7.5	0.2	0.04	0.8	0.4	0.28	0.08	1.7	16.47	81.2	4.0	30.0
	Ustipsamments	20-50	2.12	7.6	0.2	0.08	1.0	0.6	.22	0.08	1.9	11.57			
Radhapuram	Typic	0-20	17.40	8.2	3.0	0.08	3.4	0.40	2.00	0.23	6.9	28.98	168.0	6.0	102.0
	Ustropepts	20-50	18.10	8.3	3.4	0.12	3.8	0.40	2.40	0.15	7.2	33.33			
Ayyanarkulam	Typic	0-20	32.50	8.2	1.0	0.16	7.60	4.20	2.53	0.36	15.0	16.86	173.6	13.3	132.0
	Ustropepts	20-50	40.70	8.3	1.5	0.28	8.20	5.00	3.52	0.40	18.0	19.55			
Vikiramalinga-	Typic	0-20	32.50	5.4	0.4	0.72	4.00	1.60	0.25	0.06	7.3	3.42	182.0	10.0	72.0
puram	Rhodustalfs	20-50	37.50	5.4	0.5	0.64	4.20	1.80	0.25	0.08	7.5	3.33			
Ayyanarkulam	Typic	0-20	40.40	8.8	1.8	1.08	1280	8.60	4.08	0.25	26.5	15.39	145.6	16.6	380.0
	Chromusterts	20-50	50.00	8.9	2.1	1.20	16.60	9.60	4.80	0.15	32.0	15.00			
Veerakeralam-	Vertic	0-20	25.00	8.7	1.7	2.16	7.20	1.60	2.00	0.10	11.4	17.54	148.4	17.7	411.0
puthur	Ustropepts	20-50	37.50	8.8	1.7	2.32	8.80	3.10	2.53	0.15	15.0	16.86			
Kallidai	Aquic	0-20	20.40	5.9	0.7	0.20	8.60	1.60	1.08	0.15	12.3	8.78	187.6	8.0	150.0
	Haplustalfs	20-50	25.50	6.0	0.8	0.28	9.40	2.20	1.50	0.15	14.5	10.34			

Table 2. Physico-chemical properties of problem soils of Tutucorein district

Location	Name of soil	Depth (cm)	Clay (%)	PH 1:2.5 soil : water	EC dsm^{-1} 1:2.5	Free $CaCo_3$ (%)	Exchangeable cations cmol $p^{(+)}$ Kg^{-1}					ESP	Available Nutri		
							Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CEC		N	P	
							← Kgha^{-1}								
Tiruchendur	Typic	0-20	2.55	7.4	0.12	0.12	1.2	0.4	0.32	0.12	2.9	11.03	64.4	6.0	4
	Ustipsamments	20-50	2.00	7.5	0.15	0.16	1.4	0.4	0.35	0.14	2.9	12.06			
Tiruchendur	Typic	0-20	2.00	8.3	3.0	0.08	1.0	0.2	0.25	0.11	1.8	13.89	70.0	5.0	4
	Ustipsamments	20-50	1.90	8.3	3.1	0.12	0.8	0.2	0.29	0.14	1.9	15.26			
Bommiya-	Typic	0-20	25.75	8.0	0.8	1.40	5.40	3.60	1.90	0.15	11.7	16.24	154.0	15.5	20
puram	Ustropepts	20-50	28.60	8.1	1.0	1.60	6.00	3.80	2.08	0.22	13.0	16.00			
Subbiahpuram	Typic	0-20	42.50	8.9	1.3	0.84	18.4	6.80	5.69	0.29	29.1	19.55	184.8	26.0	26
	Chromusterts	20-50	50.00	8.8	1.8	0.96	20.2	12.40	6.34	0.40	40.0	15.85			
Sattankulam	Calcic	0-20	17.80	8.6	1.1	1.0	6.20	3.00	2.00	0.32	12.0	16.66	319.2	24.8	39
	Ustropepts	20-50	25.50	8.7	1.2	2.80	6.80	3.40	2.47	0.36	13.7	18.02			
Kadalkudi	Typic	0-20	40.00	8.4	4.1	3.64	14.80	8.60	4.61	0.32	30.00	15.36	170.8	28.5	40
	Chromusterts	20-50	43.75	8.5	4.2	4.96	15.40	10.40	4.90	0.26	32.1	15.26			
Guruvarpatti	Paralithic	0-18	39.50	7.8	0.6	010	4.20	2.00	0.32	0.14	7.8	4.10	142.8	18.8	35
	Ustrothents	Rocky substrata	-	-	-	-	-	-	-	-	-	-	-	-	
Sirappur	Typic	0-20	7.00	5.9	0.05	0.10	1.8	0.60	0.28	0.11	3.5	8.0	72.8	6.0	6
	Ustipsamments	20-50	8.20	5.9	0.06	0.28	2.0	1.00	0.35	0.18	4.2	8.3			
Srivaigundam	Aquic	0-20	19.50	6.2	0.5	0.23	7.30	1.40	1.12	0.14	11.3	9.9	182.0	10.0	1
	Haplustalfs	20.-50	23.45	6.5	0.7	0.28	8.40	2.20	1.60	0.14	13.6	11.8			

clays is possible. Strong calcareousness fix applied phosphorus and micronutrients.

In Tirunelveli district, the soils belonging to Typic Ustipsamments, Typic ustropepts, Typic chromusterts, Vertic chromusterts, have these constraints. In Tuticorin district, all the soil subgroups except Typic ustipsamments and in Kanyakumari, the subgroup Aquic Haplustalfs have this problem. Soils with 'b' modifier require more careful N management, because of their propensity to volatilize NH_3 from surface applied urea. T efficiency of N utilisation may be enhanced incorporating N fertilizers into the puddled so Rock phosphate and other water insolu phosphate fertilizers should be avoided. The Zn a Fe deficiencies may be corrected by giv'ng foliar application of $ZnSO_4$ and FeS respectively.

The soils with 4 dsm^{-1} of saturated extract 25°C indicates the presence of constraint 's'. The

Table 3. Physico-chemical properties of problem soils of Kanyakumari district

Location	Soil subgroup	Depth (cm)	Clay (%)	PH 1:2.5	EC dsm^{-1} 1:2.5	Free $CaCo_3$ (%)	Exchangeable cations cmol $p^{(+)}$ Kg^{-1}					ESP	Available Nutrient kg ha^{-1}		
							Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CEC		N	P	K
Thenur	Lithic	0-20	23.4	6.6	0.06	0.16	3.20	2.40	0.25	0.14	7.4	3.38	151.2	5.0	108
	Troporthents	Rocky substrata	-	-	-	-	-	-	-	-	-	-	-	-	-
Vallimaradi	Aquic	0-20	18.5	7.8	0.32	0.20	4.40	2.00	1.16	0.25	9.0	12.89	117.6	18.2	182
	Haplustalfs	20-50	25.1	8.0	0.40	0.24	5.2	2.2	2.81	0.29	11.2	25.08	-	-	-
Kakkethi	Typic	0-18	43.4	5.5	0.07	Traces	7.20	3.60	0.64	0.18	12.8	5.00	120.4	10.0	114
	Dystropepts	18-50	58.2	5.0	0.08	Traces	8.20	4.20	0.68	0.29	14.2	4.79			
Sankuthurai	Typic	0-20	2.4	6.5	0.12	0.04	1.20	0.40	0.25	0.04	3.0	8.33	64.4	4.0	72
	Ustipsamments	20-50	2.65	6.3	0.15	0.04	1.60	0.60	0.32	0.07	3.6	8.89			

Table 4. The condition modifiers selected for three districts

Location	Name of the soil subgroup	Type and substrata	Modifiers
Tirunelveli district			
Perunkinai	Typic Ustipsamments	S	ekb*1*2*3
Radhapuram	Typic Ustropepts	SL	kbs*1*2*3
Ayyanarkulam	Typic Ustropepts	LC	b*1
Vikramasingapuram	Typic Rhodustalfs	LC	h*1*2*3
Ayyanarkulam	Typic Chromusterts	C	bn*1
Veerakeralampudhur	Vertic Ustropepts	LC	bn*1
Kallidai	Aquic Haplustalfs	L	gh*1*2
Tuticorin district			
Tiruchendur	Typic Ustipsamments	S	ekb*1*2*3
Tiruchendur	Typic Ustipsamments	S	ekbs*1*2*3
Bommiyapuram	Typic Ustropepts	L	b*1
Subbiahpuram	Typic Chromusterts	C	vbn*1
Sattankulam	Calcic Ustropepts	L	bn
Kadalkudi	Typic Chromusterts	C	vbs*1
Guruvarpatti	Paralithic Ustrothents	CR	b*1
Sirappur	Typic Ustipsamments	S	ehk*1*2*3
Srivaigundam	Aquic Haplustalfs	C	gb*1*2
Kanyakumari district			
Thenur	Lithic Troporthents	LR	*1*2*3
Kakkethi	Typic Dystropepts	C	he*1*2*3
Pallimaradi	Aquic Haplustalfs	L	gb*1
Arukuthurai	Typic Ustipsamments	S	ek*1*2*3

1 - Low available nitrogen (280 kg^{-ha})
(Alk. $KmnO_4$ - N)
2 - Low available phosphorus (11 kg^{-ha})
(Olsen - P)
3 - Low available potassium (118 kg^{-ha})
(NH_4OAC - K)
s - Sandy top soils :- loamy sands and sands (by USDA definition)
l - Loamy top soils : 35 per cent clay but not loamy sand or sand
c - Clayey top soils : 35 per cent clay
r - Rock or other hard root - restricting layer.

oils have low available N status and they require pecial soil management practices. Organic mendments have to be added to reduce the pH, salt oncentration and to increase the nutrient ailability of soil. In saline soil, an increase in ain and straw yield of about 62 and 43 per cent pectively were recorded due to leaching of salts. nificantly highest yields of grain and straw were o recorded for the application of coirpith and ypsum each @ 5 t ha^{-1} followed by gypsum + ess mud/green green leaves in saline soil. Typic ipsamments and Typic chromusterts of ticorin district bear this limitation.

Aluminium saturation forms 10-60 per cent within 50 cm of soil surface and the soil may have a pH between 5.0 and 6.0, is represented by the problem 'h'. This modifier retards the growth of sensitive crops. Though this may result in optimum aerobic pH for flooded rice production, P deficiency is most likely to occur with contnuous rice cropping. This 'h' modifier problem may be corrected by lime application to bring the soil for desired pH. In Tirunelveli district the soil subgroups *viz.*, Typic Rhodustalfs and Aquic Haplustalfs have this problem. In Tutucorin district the soil subgroup Typic Ustipsamments and Typic

Dystropepts of Kanyakumari district have this limitation.

The constraint 'n' indicates the more than 15 per cent of exchangeable sodium percentage within 50 cm of soil. 'n' indicates that soils having this modifier are of alkali in nature. Presence of sodium on exchangeable sites causes dispersion of soil and lead to severe water logging. Provision of surface drainage, use of chemical ameliorants like gypsum and agricultural grade iron pyrites increased productivity of sodic soils to a significant extent. Application of pressud, coirpith @ 10 t ha^{-1} significantly improved the bulk density, hydraulic conductivity and porosity of the soil. (Gopalswamy *et al.*, 1991). This problem was observed in the soil subgroups Typic chromusterts and vertic ustropepts of Tirunelveli- Kattabomman district and Typic chromusters and Calcic ustropepts of V.O. Chidambaranar district.

Soil or mottles <2 chroma occur within 60 cm of soil surface and below all A horizons or soil saturated with water for 60 days in most years. This represents ('g') the submerged condition. Denitrification frequently occurs in anaerobic subsoil and tillage operation and certain crops may be adversely affected by excess rain unless drainage is improved by tiles or other drainage procedures. Aguic Haplustalfs which is present in all the three districts have this constraint.

Very sticky plastic clay (>35%) and 50 per cent of 2:1 expanding clays represents the problem 'v'. Tillage is difficult when too dry and too moist but soils can be highly productive. The main problems of this heavy textured soil are poor aeration, high bulk density, poor drainage and permeability. These problesm can be managed by application of soil amendments like pressmud, farm yard manure, coirwaste and sand. Typic Chromusterts of Tutucorin district have this problem.

In addition to the above mdifiers, the soil subgroups paralithic Ustorthents and Lithic Troporthents are very shallow having rocky substrata within the depth range of 10-25 cm only. It act as root restricting layer. This soil needs special attention to increase the solum depth by adding tank silt.

Low available N status (<280 kg ha^{-1}) was recorded in all the soil subgroups of three districts except Calcic Ustropepts of Tutucorin district and hence it was included as local modifier.

From the above study, it was concluded that the type and substrata of these three districts are sandy, loamy and clayey textured soils. The condition modifiers 'e', 'k', 'b', 's', 'h', 'n', 'g', and 'k' were observed in different soil subgroups of three districts. Apart from these condition modifiers, rocky substrata was observed in Paralithic Ustorthents and Lithic Troporthents soil subgroups of Tutucorin and Kanyakumari districts respectively. The available N status was selected as local modifier because of its low status for all the soil subgroups of three districts except the soil subgoup calcic Ustropepts of Tutucorin district.

REFERENCES

BUOL, S.W. (1972). Fertility capability soil classification system. In: **Soil Science Department, North Carolin State University. Agronomic - economic Research on Tropical Soils. Annual report for 1971-72.** Raleigh, North Carolina.

BUOL, S.W., SANCHEZ, P.A., CATE, R.B. and GRANGER, M.A. (1975). **Soil Fertility Capability Classification : A Technical Soil Classification System for Fertility Management** 126 pp.

GOPALSWAMY, A., RAJKANNAN, B., POONGOTHAI, S. and NATESAN, R. (1991). Efficacy of coir dust in comparison with pressmud and groundnut husk on physical properties of soil. **National Seminar on Utilization of Coirpith in Agriculture** Nov. 20th 1991. TNAU, Coimbatore.

KAWAGUCHI, K. and KYUMA, K. (1977). **Paddy Soils in Tropical Asia, Their Materia Nature and Fertility.** University Press of Hawai, Hnolulu, 258 pp.

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