

Soil fertility capability classification of Tamil Nadu Agricultural University Research station farm, Vaigaidam, Theni District, Tamil Nadu

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Abstract: Twenty soils, belonging to the soil series Karattupatti, Kandamanur, Muthalampatti, Andipatti and Vaigai Dam were grouped in 6 FCC (Fertility Capability Classification) units based on type, substrata type and condition modifiers. The FCC units will serve as the basis for conducting fertility related experiments and extrapolation of such experimental results. The condition modifiers that decide the soil and fertilizer interactions in the study are 'd' (dry condition), 'm' (magnesium deficiency), 'e' (low CEC), 'b' (free CaCO₃), V (vertic characters) and 'i' (Fe-P fixation). All the soil series except Kandamanur series 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, condition modifiers, soil series.*

Introduction

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. In the scheme of fertility capability classification proposed by Buol *et al.* (1975), the occurrence of soil fertility constraints are quantified in the form of condition modifiers. An attempt had been made to use this concept in the soil series of the present study area.

Materials and Methods

Soil samples were collected from the top two horizons from twenty representative sites of Tamil Nadu Agricultural University Farm, Vaigai Dam, Theni District, Tamil Nadu comprising five major soil series *viz.*, Karattupatti (Krp), Kandamanur (Kdr),

Muthalampatti (Mtp), Andipatti (Adp) and Vaigai Dam (Vgd) (Soil Survey Staff, 1975). Surface soil samples were collected from the upper 20cm or plough layer whichever was shallower. Subsoil samples within 50cm of the surface were collected depending on the particular horizon boundary limit. Condition modifiers which refer to soil chemical and physical properties of the ploughed layer or top 20 cm. 'Type' which is the highest category under the VCC system was determined by the mean texture of the surface soil. The substrata type which is the texture of the subsoil that occurs within 50 cm of the surface was also assessed. The soils were analyzed for the relevant properties by the routine procedures.

Results and Discussion

The relevant physico-chemical properties of the soils are presented in table 1. The condition modifiers relevant to the study are;

Table 1. Relevant properties of the soils

Location	Soil Series	Depth (cm)	Clay (%)	pH 1:2.5 soil:water	Ex.Mg	CEC	Free CaCO ₃ (%)	Fe ₂ O ₃ (%)	Available Nutrients (kg ha ⁻¹)		
					c mol (p+) kg ⁻¹					N	P
Farm - B Block A Field No.19	Karattupatti Series	0-15	19.4	7.1	1.2	6.5	0.47	7.36	264	16	146
		15-50	31.3	6.8	2.9	9.8	0.62	7.48	250	14	184
Farm - B Block A Field No.8	Karattupatti Series	0-15	18.6	7.2	1.3	6.8	0.44	7.10	258	16	146
		15-48	32.9	6.9	2.8	9.9	0.65				
Farm - B Block A Field No.12	Karattupatti Series	0-17	19.8	7.1	1.1	6.5	0.42	7.85	254	16	142
		17-51	32.0	6.9	2.7	9.5	0.63	8.33	250	14	182
Farm - B Block A Field No.29	Karattupatti Series	0-16	20.0	6.9	1.2	6.2	0.46	9.52	294	14	140
		16-53	31.7	6.7	2.5	9.3	0.63	8.42	240	14	186
Farm - B Block A Field No.20	Kandamanur Series	0-18	14.3	7.1	1.1	6.2	0.46	9.52	294	14	196
		18-48	30.8	6.8	2.3	8.9	0.58	8.40	272	12	248
Farm - B Block A Field No.6	Kandamanur Series	0-20	15.0	7.0	1.3	6.5	0.2	9.12	290	14	198
		20-46	31.8	6.8	2.5	9.3	0.56	8.67	266	12	254
Farm - B Block A Field No.50	Kandamanur Series	0-22	13.2	7.1	1.2	6.1	0.48	8.90	298	14	192
		22-50	29.3	6.9	2.2	9.0	0.57	8.12	270	10	250
Farm - B Block A Field No.50	Kandamanur Series	0-19	14.4	7.0	1.3	6.3	0.43	9.22	292	12	194
		19-48	30.3	6.8	2.3	8.8	0.58	8.62	274	12	246
Farm - S Field No.5	Muthalampatti Series	0-18	19.4	7.2	1.3	6.6	0.44	10.46	260	14	162
		18-55	31.2	7.5	2.6	9.3	0.58	11.78	216	10	280
Farm - S Field No.62	Muthalampatti Series	0-20	19.0	7.3	1.2	6.9	0.42	9.86	266	14	170
		20-50	32.5	7.5	2.4	9.5	0.63	11.83	218	10	292

Table 1. Contd....

Location	Soil Series	Depth (cm)	Clay (%)	pH 1:2.5 soil:water	Ex.Mg	CEC	Free CaCO ₃	Fe ₂ O ₃ (%)	Available Nutrients (kg ha ⁻¹)		
					c mol (p+) kg ⁻¹		(%)		N	P	K
Farm - S Field No.33	Muthalampatti Series	0-18	19.8	7.4	1.3	6.8	0.43	10.52	270	14	166
		18-40	32.7	7.6	2.5	9.4	0.61	11.98	212	12	282
Farm - S Field No.5	Muthalampatti Series	0-22	18.6	7.2	1.4	6.7	0.41	10.51	268	14	172
		22-45	31.1	7.5	2.4	9.3	0.64	11.61	210	10	290
Farm - S Field No.53	Andipatti Series	0-28	19.5	7.7	1.6	6.7	0.58	7.36	268	16	128
		28-67	30.1	8.1	2.1	8.2	0.81	6.40	188	14	164
Farm - S Field No.83	Andipatti Series	0-26	18.3	7.8	1.6	6.7	0.56	7.12	264	16	124
		26-71	31.9	8.3	2.0	8.3	0.83	6.80	194	12	168
Farm - S Field No.67	Andipatti Series	0-30	19.5	7.6	1.5	6.8	0.59	7.10	270	16	130
		30-72	30.8	8.2	1.9	8.2	0.79	6.46	190	12	170
Farm - S Field No.74	Andipatti Series	0-25	19.7	7.7	1.7	6.9	0.55	7.44	262	16	126
		25-68	32.0	8.1	2.0	8.4	0.82	6.92	186	14	162
Farm - S Field No.57	Vaigaidam Series	0-10	37.3	7.6	1.8	6.7	0.51	6.16	260	10	152
		10-50	42.8	7.9	2.1	9.2	0.81	7.20	202	8	270
Farm - S Field No.62	Vaigaidam Series	0-18	39.5	7.7	1.4	6.9	0.54	6.45	256	9	148
		18-55	45.0	8.0	2.2	9.4	0.85	7.85	196	12	148
Farm - S Field No.33	Vaigaidam Series	0-16	37.3	7.9	1.3	6.6	0.52	6.42	254	9	156
		16-57	41.4	8.0	2.1	9.1	0.82	8.13	194	11	274
Farm - S Field No.3	Vaigaidam Series	0-19	38.6	7.7	1.4	6.8	0.53	6.92	256	8	150
		19-23	43.5	7.9	2.0	9.3	0.83	7.86	200	8	272

(1) dry condition 'd' (2) magnesium deficiency "m". (3) low CEC 'e'. (4) free CaCO_3 , upto 50 cm of soil surface 'b' (effervescence with HCL). (5) vertic characters 'v' with more than 35 per cent clay and (6) Fe-P fixation 'i'.

The condition modifier 'd' was used in the present study because 'ustic' moisture regime was computed from the climatic data of the study area (Soil Survey Staff, 1975). The inclusion of this modifier suggests the need for supplemental irrigation during the growing period of crops. Generally only one rainfed rice crop can be grown a year. Irrigated rice during the dry season has higher yield potential and responds to higher N rates.

The 'm' modifier for these soils with low exchangeable magnesium (less than 2.3 c mol (p^+) kg^{-1} soil) was also considered in this study in all the soil series. This modifier indicates that the soils will have low ability to supply Mg and availability of this nutrient should be monitored. From the magnesium fertilization studies conducted in magnesium deficient soils by Mathan *et al.* (1973) magnesium application at the rate of 50 kg ha^{-1} as magnesium sulphate was optimum in increasing the yield of crops, especially potato tuber yield by 17.6 q ha^{-1} over control.

Low cation exchange capacity (less than 7.0 c mol (p^+) kg^{-1}) 'e' reflects low ability to retain nutrients. Loamy and clayey soils with this modifier usually have low activity clays. 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. Soils having this modifier have limited ability to retain nutrients and 'e' modifier is indicative of a low buffering capacity. This problem can be solved by the substantial addition of tank silt of neutral

reaction and lime (Mahendran *et al.*, 1994). Soils with this modifier may have additional management limitations related to N management because of somewhat grater percolation. They are also more susceptible to nutrient imbalances, particularly among K, Ca and Mg. Fertilizer management requirements are higher in 'e' than 'non-e' soils. This modifier is noticed in all the soil series of the study area.

Calcareous soils are identified by the 'b' modifier defined by the presence of free CaCO_3 within 50 cm of the soil surface. The 'b' modifier in wetland soils may be a result of irrigation water rich in CaHCO_3 or calcareous parent materials. In most 'b' soils flooding attenuates or eliminates Fe deficiency, but may accentuate Zn deficiencies. High N volatilization loss potential may occur when N is applied by broadcast. Fixation of NH_4^+ by 2:1 clays is possible. Strong calcareousness may fix applied phosphorus and micronutrients. All the soil with 'b' modifier requires more careful N management, because of their propensity to volatilize NH_3 from surface applied urea. The efficiency of N utilization may be enhanced by incorporating N fertilizers into the puddle soils. Rock phosphate and other water insoluble phosphatic fertilizers should be avoided.

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 soils are poor aeration, high bulk density, poor drainage and permeability. This problem can be managed by application of soil amendments like FYM composted coir pith, press mud and sand. Higher P fixation by iron (% Fe_2O_3 /% clay >0.15 and more

Table 2. The condition modifiers selected for the study area.

Soil classification	Type and substrata	Modifiers
Karuppatti Series	L	dmeb ^{*1}
Karuppatti Series	L	dmeb ^{*1}
Karuppatti Series	L	dmeb ^{*1}
Karuppatti Series	L	dmeb ^{*1}
Kandamanur Series	L	dmeb
Kandamanur Series	L	dmeb
Kandamanur Series	L	dmeb
Kandamanur Series	L	dmeb
Muthalampatti Series	L	dmeb ^{*1}
Muthalampatti Series	L	dmeb ^{*1}
Muthalampatti Series	L	dmeb ^{*1}
Muthalampatti Series	L	dmeb ^{*1}
Andipatti Series	L	dmeb ^{*1}
Andipatti Series	L	dmeb ^{*1}
Andipatti Series	L	dmeb ^{*1}
Andipatti Series	L	dmeb ^{*1}
Vaigaidam Series	C	dmeb ^{*1*2}
Vaigaidam Series	C	dmeb ^{*1*2}
Vaigaidam Series	C	dmeb ^{*1*2}
Vaigaidam Series	C	dmeb ^{*1*2}

*1 : Low available N (<280 kg ha⁻¹)

*2 : Low available P (<11 kg ha⁻¹)

L - Loamy top soils : <35 per cent clay but not loamy sand or sand

C - Clayey top soils : > 35 per cent clays

than 35% clay) indicates the modifier 'i'. Soils with this modifier require high levels of P fertilizer. Sources and method of P fertilizer application should be considered carefully. This modifier is present only in Vaigaidam series of the study area.

Low available N status (<280 kg ha⁻¹) was recorded in all the series except Kandamanur series and hence it was also included as local modifier.

The above study indicated that the type and substrata of soils are loamy except the soil series Vaigaidam where the soil type and substrata are clayey. The condition modifiers 'd', 'm', 'e', 'v' and 'i' were observed in different soil series. The low available N status (<280 kg ha⁻¹) was recorded in all the soil series except Kandamanur series and so this was included as local modifier.

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