

PHYSICAL CHARACTERISTICS OF THE POONTHALPADAM SOILS OF KERALA*

A. K. Krishnakumar and M. M. Koshy

College of Agriculture, Vellayani 695 522, Trivandrum, Kerala

In the previous paper the morphological features of six profile samples of *Poonthalpadam* soils of Chittoor taluk have been described. In this paper the physical characteristics of these soils are discussed.

Materials and Methods

From the six sites at Perumatty, Chittoor (proper) Chittoor (Thamarachira), Thekkedesam, Valiavallampathy and Kuttippallam soil samples were collected from depths of 0-30, 30-60, and 60-90 cm, air-dried, ground and passed through a 2mm sieve. The samples so prepared were analysed for their mechanical composition by the International Pipette method as detailed by Piper (1942). Organic carbon was estimated by Walkley and Blacks' rapid titration method as described by Jackson (1958). The apparent density, absolute specific gravity, maximum water holding capacity, porespace and volume expansion were determined by the Keen-Racskowaski box method (Wright, 1934). The stickypoint and upper and lower plastic limits were determined by the method described by Sankaram (1966).

Results and Discussion

The results are presented in Tables 1, 2 and 3. The summation curves, texture are given in the Fig. 1.

The result of the mechanical analysis (Table 1) of the profiles show that the texture of the soils varied from loam to clay in the surface layers, loam to clay loam in the intermediate layers and from sandy loam to clay in the lowest layers. The average values of clay showed the highest content in the surface layers which may be due to restrictive drainage that prevents clay migration to lower layers. The high clay content noticed in the surface layers can also be due to the deposition of the clay by flood waters.

The single value constants revealed that the apparent density was the highest (1.30) in the lowest layers. The lowest value (1.20) was observed in the intermediate layers. A negative correlation was obtained between apparent density on one hand and clay and porespace on the other. The absolute specific gravity ranged between 2.25—2.51. In mineral soils the absolute specific gravity varies within narrow limits of 2.60 and 2.75 and the lower values obtained in the present study indicates absence of heavy minerals.

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Table 1
Mechanical composition of profile samples

Location	Depth (cm)	Organic matter %	Coarse sand %	Fine sand %	Silt %	Clay %	Textural class
I Perumatty	0-30	1.7	48.3	15.9	14.1	20.0	Loam
	30-60	1.5	35.0	18.8	26.0	18.8	Silty loam
	60-80	1.3	56.3	13.3	10.4	18.8	Loam
II Chittoor (proper)	0-30	2.0	48.5	18.1	7.8	23.8	Clay loam
	30-60	2.4	48.8	19.9	4.0	25.0	Clay loam
	60-80	1.5	54.1	22.8	5.6	16.4	Sandy loam
III Chittoor (Thamarachira)	0-30	2.7	47.2	15.0	13.4	21.7	Loam
	30-60	1.6	48.3	16.1	10.2	24.0	Clay loam
	60-80	1.4	49.0	20.0	8.6	21.0	Sandy clay loam
IV Thekkedesam	0-30	2.3	26.9	10.4	16.6	43.8	Clay
	30-60	1.8	40.0	20.5	14.0	23.8	Clay loam
	60-80	2.4	30.8	11.2	18.1	37.5	Clay
V Valiavallampathy	0-30	2.4	42.5	12.4	11.5	31.3	Clay loam
	30-60	1.8	51.1	10.4	17.9	18.8	Loam
	60-80	1.6	44.3	14.1	8.1	32.2	Clay loam
VI Kuttippallam	0-30	2.1	38.3	15.0	17.4	15.3	Loam
	30-60	2.0	46.2	15.8	16.9	19.2	Loam
	60-80	1.4	43.5	14.2	16.8	24.1	Loam

Table 2
Single value constants of profile samples

Location	Depth (cm)	Apparent density	Absolute specific gravity	Maximum water holding capacity %	Porespace %	Volume of expansion %
I Perumatty	0-30	1.25	2.42	45.4	53.9	10.0
	30-60	1.34	2.40	37.0	48.3	5.9
	60-80	1.28	2.26	41.7	47.0	4.5
II Chittoor (proper)	0-30	1.29	2.38	39.4	51.0	6.5
	30-60	1.29	2.40	38.6	50.1	5.2
	60-80	1.31	2.38	32.9	44.2	0.4
III Chittoor (Thamarachira)	0-30	1.29	2.35	38.3	45.1	6.1
	30-60	1.30	2.40	40.1	46.0	4.9
	60-80	1.30	2.41	39.2	44.8	2.3
IV Thekkedesam	0-30	1.26	2.41	41.8	52.6	7.2
	30-60	1.20	2.40	45.3	54.8	6.8
	60-80	1.21	2.25	37.8	51.0	5.0
V Valiavallampathy	0-30	1.28	2.41	44.8	54.4	13.7
	30-60	1.29	2.33	42.2	51.8	11.4
	60-80	1.29	2.51	39.4	49.7	15.4
VI Kuttippallam	0-30	1.32	2.40	32.7	50.1	6.8
	30-60	1.36	2.41	30.8	48.1	5.1
	60-80	1.38	2.46	31.0	48.6	5.1

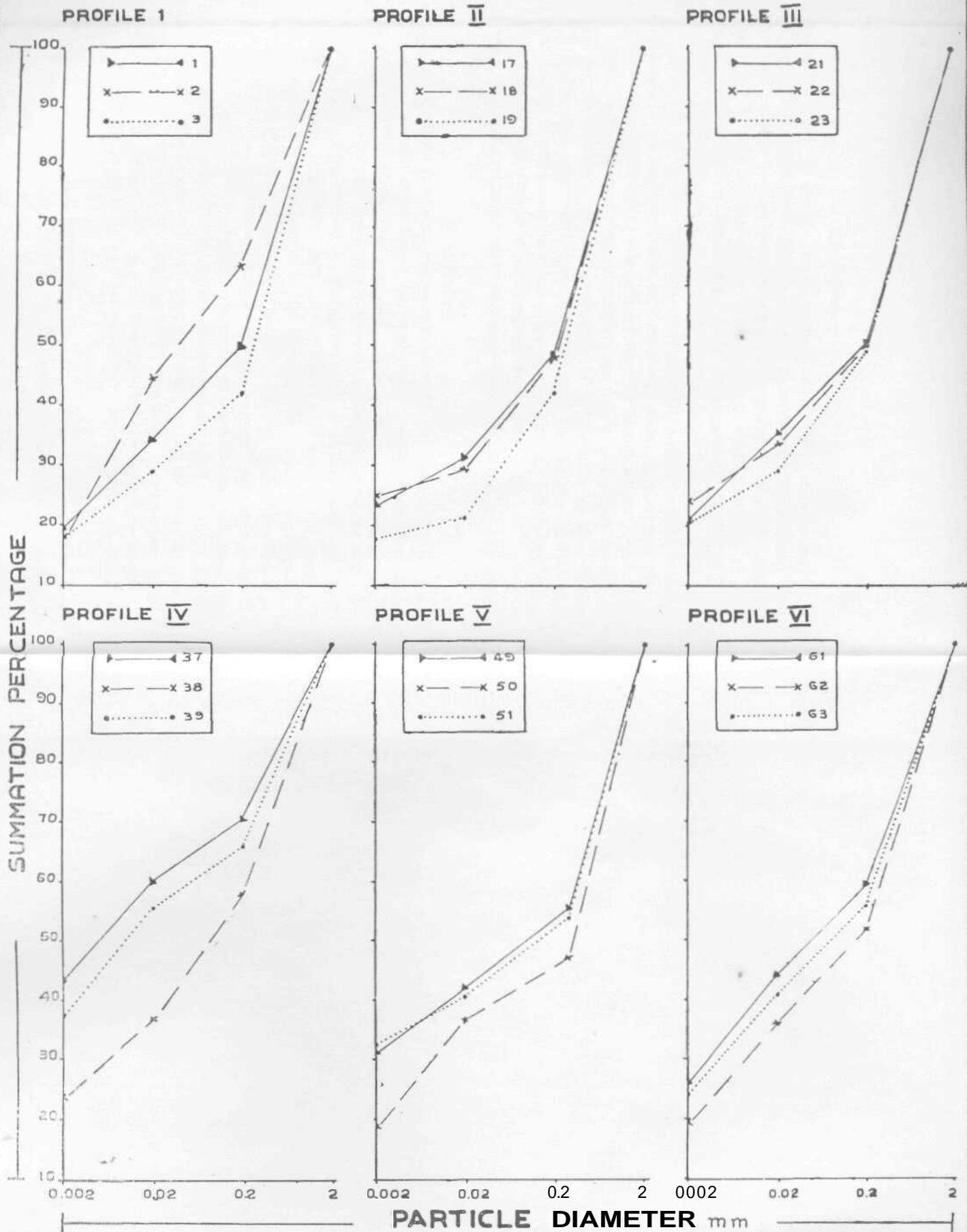
Porespace ranged from 44.21 percent to 54.81 percent in the profile samples (Table 2). The surface samples showed the highest value for porespace and it tended to decrease down the profile. Volume of expansion also showed a decrease down the profile except in profiles from Valiavallampathy and Kuttippallam. A positive correlation was obtained between maximum water holding capacity and porespace ($r = +0.64$, $r = +0.65$ and $r = +0.12$ respectively for the 3 layers, significant at 10% level for the first two layers) suggesting that porespace contributes significantly to water holding capacity, Bendixen *et al.* (1948) found that porespace determination was a reliable measure of permeability.

Table 3
Upper and lower plastic limits and sticky point moisture of profile samples

Location	Depth (cm)	Upper plastic limit %	Lower plastic limit %	Sticky point moisture %
I Perumatty	0-30	38.2	21.3	31.2
	30-60	30.2	20.9	26.4
	60-80	28.9	19.9	27.1
II Chittoor (proper)	0-30	37.5	21.5	30.9
	30-60	29.8	19.3	26.0
	60-80	26.7	17.7	24.0
III Chittoor (Thamarachira)	0-30	33.8	20.1	29.4
	30-60	32.9	19.5	27.3
	60-80	30.1	18.6	26.3
IV Thekkedesam	0-30	46.1	28.3	39.3
	30-60	30.1	24.3	30.1
	60-80	38.5	22.1	35.0
V Valiavallampathy	0-30	40.1	27.1	33.8
	30-60	30.1	20.3	26.4
	60-80	38.5	22.1	31.3
VI Kuttippallam	0-30	38.9	20.8	32.5
	30-60	30.2	21.5	26.0
	60-80	32.1	22.4	29.0

The results of the upper and lower plastic limits and sticky point moisture (Table 3) showed that these values are the highest in surface layers of all the profiles examined. These limits are of very great importance to tillage since plastic limit represents the minimum moisture percentage at which the soil can be puddled. Positive correlation (non-significant) was obtained between water holding capacity, on the one hand and upper plastic limit ($r = +0.25$, $r = +0.57$ and $r = +0.22$ respectively for the 3 layers) and sticky point ($r = +0.50$, $r = +0.31$ and $r = +0.38$ for the 3 layers) on the other.

Fig 1 Summation curves texture



Summary

An appraisal of the physical characteristics of the *Poonthalpadam* soils reveals that the texture of the profile samples varies from sandy clay to clay. The highest clay content is found to be in the surface layers which may be either due to impeded drainage which does not permit clay migration or due to deposition of clay by flood waters on to the surface of the original soil. The apparent specific gravity ranges from 1.20 to 1.80 and the absolute specific gravity varies from 2.25 and 2.51. There exists a negative correlation between clay content and apparent specific gravity. The porosity as well as volume of expansion show a decrease down the profile except in the profiles from Valiavallampathy and Kuttippallam. The upper and the lower plastic limit and sticky point moisture are found to be the highest in the surface layer of the profiles. These limits are of importance to the tillage operation since plastic limit represents the minimum moisture percentage at which the soil can be puddled and these limits are affected by clay content, nature of clay minerals, organic matter and nature of exchangeable cations.

Improving the physical condition of these soils would result in increased productivity of these soils.

സംഗ്രഹം

പുത്തപ്പാടം മണ്ണിന്റെ ഭൗതികഘടനയെപ്പറ്റി നടത്തിയ പഠനത്തിൽനിന്നും പരിശോധനാപരമായ ഗുണങ്ങളുടെ വ്യാപനം മണൽ കളിമണ്ണ് തൊട്ട് കളിമണ്ണുവരെ ആണെന്നു തെളിഞ്ഞു. കളിമണ്ണിന്റെ അംശം ഏറ്റവും കൂടുതൽ കാണപ്പെട്ടത് ഉപരിതല അടുകുകലിലാണ്. ഇത് നീർവാർച്ച കുറവായതുകൊണ്ടും, താഴെയുള്ള അടുകുകലിലേയ്ക്ക് കളിമണ്ണ് സഞ്ചരിക്കുന്നതിനുള്ള തടസ്സംകൊണ്ടും വെള്ളപ്പൊക്കത്തിൽ ഉപരിതലത്തിൽ കളിമണ്ണ് അടിയുന്നതുകൊണ്ടും ആകാം. മണ്ണിന്റെ സ്മൂലസാന്ദ്രത 1.2 മുതൽ 1.8 വരെയും തരിസാന്ദ്രത 2.25 മുതൽ 2.51 വരെയുമാണ്. സ്മൂലസാന്ദ്രതയും കളിമണ്ണിന്റെ അംശവും തമ്മിൽ ഋണാനുബന്ധമുള്ളതായി കണ്ടു. ഉയർന്ന പ്ലാസ്തികതയും താഴ്ന്ന പ്ലാസ്തികതയും ഒട്ടൽസമയ ജലാംശവും ഉപരിതല അടുകുകലിലാണ് ഏറ്റവും കൂടുതൽ കാണപ്പെട്ടത്. മേൽപ്പറഞ്ഞ ഘടകങ്ങൾ നിലത്തിലെ കൃഷിപ്പണികളെ നോട്ട് ബാധിക്കുന്നവയാണ്. എന്തെന്നാൽ താഴ്ന്ന പ്ലാസ്തികതലിമിറ്റം മണ്ണ് ചളിയടിക്കുവാൻ (puddle) ആവശ്യമായ ഏറ്റവും കുറഞ്ഞ ജലാംശത്തിനെ ചൂണ്ടിക്കാണിക്കുന്നു. ഈ ലിമിറ്റുകൾ മണ്ണിലെ കളിമണ്ണിന്റെ അംശത്തെയും, കളിമൺ പരലുകളുടെ (clay minerals) സ്വഭാവത്തെയും, ജൈവാംശത്തെയും ധനായണുക്കളെയും ആശ്രയിച്ചിരിക്കുന്നു. മണ്ണിന്റെ ഭൗതികഘടന മെച്ചപ്പെടുത്തി ഈ മണ്ണിന്റെ ഉൽപാദനക്ഷമത വർദ്ധിപ്പിക്കാവുന്നതാണ്.

References

Bendixen, T. W., Hershberger, H. F. and Slater, C. S. 1948. A basis for classifying soil properties. *J. agric. Res.* 77: 157-167.
 Jackson, M. L. 1958. *Soil Chemical Analysis* Prentice Hall of India, Private Limited, New Delhi.
 Piper, C. S. 1942. *Soil and Plant Analysis*. University of Adelaide, Anstralia.
 Sankaram, A. 1966. *A Laboratory Manual of Agricultural Chemistry*. Asia Publishing House, Bombay.
 Wright, C. H. 1934. *Soil Analysis*: Thomas Murby and Co., London.