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Assessment of Physical Properties of Monoculture, Polyculture and Termitoria Soils in Pollachi, Udamalpet Taluks, Coimbatore and Tirupur Districts Tamil Nadu, India

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Abstract

The objective of this study was to determine the variation in physical properties of monoculture and polyculture soils compared with the termitoria soil from Pollachi, Udamalpet taluks, Coimbatore and Tirupur Districts, Tamil Nadu, India during March 2013 to February 2014.The Soil electrical conductivity (EC), Texture and particle size variation was observed in monoculture, polyculture and termitoria soils during the period. When compared to monoculture and polyculture soils the termitoria soil EC, Texture and particle size were favors agriculture and retain the plant nutrients. This study highlights that termite mound soil properties are generally more than the monoculture and polyculture soils. The study showed highly positive correlation between termitoria soil, monoculture and polyculture soils.

Keywords: Termites, Physical properties, Polyculture, Monoculture, Termitorium soil.

1. INTRODUCTION

The major part of in and around Pollachi, Udamalpet Taluks (Tamil Nadu) is agriculture lands. The nature of soil present in this area is red soil. We can often find the mounds of the termites and agricultural land beside each other. This very thin surface layer of the earth's pellicle is spoken of as the soil. It is distinguished from the lower layer by its mechanical and physical properties. The soil samples collected from mono culture and poly culture land soil from different areas of in and around Pollachi and Udamalpet. The monocot and dicot plants and their species should be noted. In the study area mounds are more in number. Hence the present study was assigned to know the termite mound properties which will be useful for agriculturist. Soil is a natural body composed of minerals, mixed with some organic matter. It is the loose covering of fine particles which covers the surface of the earth. Soil is useful to living organisms as habit, habitat, support, food, shelter, etc. Agriculture depends on soil and land but it is not sufficient. Hence there is need to increase land or usefulness of soil. An earthworm is the dominant member of the soil macro fauna for the soil formation processes. The termites also play the major role in the nutrient recycling, movement and transportation of soil material. Termites are ecosystem engineers built mounds, enhancing the content of organic carbon, clay and nutrients. The mound soil redistributed by erosion, affecting soil micro structure and fertility. Termites as major bio turbators, created biogenic structures that strongly influenced the physical and chemical properties of soils. Termites (Isoptera) are social insects having 3000 known species, in which 75% are soil feeding and 28 species are pests. The termite feed on non-cellular organic material mixed with clay minerals. The gut of termite is modified and adapted for rising of pH, oxygen and hydrogen which are important for soil chemical and physical modifications [1].

Termites (Isoptera) are a large and diverse group of terrestrial social insects that exert significant influence on the physicochemical properties of soils [2]. They are recognized as “ecosystem engineers” because the feeding habit, food processing and mound construction operations introduce significant modifications to the soil on which the mound is built [3].

Although the earlier workers studied the results of termite activity in soil particle size nutrient organic matter turnover, greater porosity, organo-mineral micro aggregation, aggregate stabilization, erosion effects, among others, twelve months data of present study are presented concerning mounds, monoculture and polyculture soil. Therefore this study was aimed to determining the levels of different physical properties of termites mound soil compared with monoculture and polyculture soils. The results can be applied in agriculture land to improve soil physical properties like colour, texture, EC and particle size.

2. MATERIALS AND METHODS

The research areas were identified in and around Udamalpet and Pollachi taluks. The total number of study areas was 13. Polyculture lands 3, Mono culture land 10. Termite mound soil samples were collected from 13 study areas.

2.1 Study areas

2.1.1 Polyculture land

1. Santhosh farm, Narikalpathi, 2. Thenarasu farm, Aliyar and 3. Selvam farm, Mukonam.

2.1.2 Monoculture land

1. Andikoundan farm, Narikalpathi – *Coconut,* 2. Karuparayan farm (Field - I), Venasupatty – *Mango,* 3. Karuparayan farm (Field - II), Venasupatty– *Amla,* 4. Kovil farm, Onakalloore – *Sapotta ,* 5.Selvapuram – *Eucalyptus,* 6. Jain Irrigation, Elayamuthoore (Field I) - *Cashew nut,* 7. Jain Irrigation, Elayamuthoore (Field II) – *guava*, *8.* Jain Irrigation, Elayamuthoore (Field III) – *Pomegranate* 9. Sakthi Farm Periyakottai – *Teak* and10.Madhuramakrishnan farm, Ponnalamanthurai – *Savuk*

2.2 Collection of soil samples

The mound soil, monoculture and polyculture soil samples were collected from 13 different sites of Pollachi and Udamalpet (March 2013 to February 2014). Sample was taken from different field and then digged at about 30 cm deep 'V' shaped pit and collected from margin of V shaped pit. Each of sampleswas labeled, numbered with date of collection according to standard methods [4].

2.3 Soil analysis

Thirteen termite mounds and monoculture and polyculture soils were sampled. Each sample were air dried, passed through a 2mm sieve and the content of gravel (>2 mm) by weight was determined. The sand fractions were separated by wet sieving and clay and silt fractions were determined using the sieve filter sedimentation method for clay [5].

3.RESULTS AND DISCUSSIONS

General comparison of termitorium soil with monoculture and polyculture soils the physical properties was significantly favorable than the monoculture and polyculture soils. The variations in the Texture, Particle size and EC of termite mound soil, monoculture and polyculture soil samples collected from the 13 places during March 2013 to February 2014 was summarized. Soil electrical conductivity is an indirect measurement that correlates very well with several soil physical and chemical properties. EC is important indicator of soil health and measure of the salinity of soil. The higher level of EC (saline soil) affects plant nutrient availability, crop yields and activity of soil microorganisms. For certain non-saline soils, determining EC can be a convenient and economical way to estimate the amount of nitrogen (N) available for plant growth [6 & 7].

The present study investigated the potential role of EC in Terimitorium soil, monoculture and polyculture soils. Tables (1 A, B & C) should be indicated physical properties of Terimitorium soil, monoculture and polyculture soils. In polyculture soils the maximum EC value (2.62±0.097) was noticed in AP soil (Santhosh farm without Terimitorium), however the minimum values of EC (1.24±0.083 and 1.01±0.067) was observed in APT and BPT (Santhosh farm and Thenarasu farm with Terimitorium) (Table 1 A). These results indicated that study area soils are not saline condition. So, according to Dhembare[1] report the EC values are not exceeds the normal value (4ds/m) in study areas soils. In the present data revealed that the EC was distinctly decrease in polyculture with terimitorium soil than the polyculture without terimitorium soils.

Among the monoculture soils the maximum EC value (3.52±0.061) was observed in MathuRamakrishanan farm (without terimitorium) (Table 1 C), whereas the minimum value of EC (1.03 ± 0.063) was observed in CMN (Karuparayan farm without Terimitorium) (Table 1 B). It is interesting to note that, when the compared to monoculture without terimitorium soil and monoculture with terimitorium soil, the EC values are decreased in monoculture with terimitorium soils. These results indicated that the monoculture (both with and without terimitorium) soils are not saline condition. These results are similar to those reported by Getahun et al.[8].

Table 1 (a). Physical composition of the termite mounds soil and the corresponding soils (Monoculture and polyculture) without termites in pollachi and Udamalpet areas

Samples	Parameters	MONTHS											
		Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
	EC (micro mhos)	1.24±0.083	1.30±0.087	1.41±0.091	1.38±0.088	2.21±0.098	1.57±0.063	2.62±0.097	2.42±0.067	2.25±0.080	2.41±0.061	2.03±0.065	2.53±0.081
AP	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
APT	EC (micro mhos)	1.33±0.078	2.50±0.082	1.46±0.064	1.64±0.072	1.01±0.038	1.81±0.058	1.50±0.047	2.52±0.068	1.71±0.064	1.97±0.054	2.11±0.071	2.50±0.073
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
BP	EC (micro mhos)	1.45±0.064	1.52±0.049	1.71±0.061	1.67±0.056	2.31±0.072	2.32±0.057	2.40±0.052	1.41±0.044	1.20±0.056	1.10±0.067	1.11±0.057	1.20±0.074
	Texture (Silt of soil (<))	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
BPT	EC (micro mhos)	1.01±0.067	1.20±0.058	1.02±0.047	1.30±0.071	1.10±0.048	1.00±0.00	1.01±0.044	1.05±0.057	1.03±0.069	1.50±0.081	1.04±0.000	1.51±0.075
	Texture (Silt of soil (<))	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
CP	EC (micro mhos)	1.40±0.091	1.61±0.064	1.65±0.051	1.70±0.019	1.60±0.000	1.82±0.052	2.1±0.073	1.22±0.065	1.4±0.081	1.50±0.069	1.62±0.079	1.70±0.064
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
CPT	EC (micro mhos)	1.80±0.098	1.93±0.062	1.60±0.056	1.50±0.054	1.42±0.041	1.22±0.083	1.31±0.000	1.40±0.051	1.41±0.042	1.50±0.049	1.34±0.000	1.21±0.000
	Texture (Silt of	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
AMC	EC (micro mhos)	2.21±0.080	2.30±0.062	2.23±0.073	2.10±0.077	2.42±0.062	2.50±0.046	1.90±0.043	1.84±0.060	1.61±0.060	1.50±0.056	1.04±0.063	1.60±0.054
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
AMCT	EC (micro mhos)	1.30±0.060	1.41±0.087	1.50±0.068	1.55±0.069	1.40±0.084	1.52±0.058	1.30±0.049	1.21±0.084	1.30±0.071	1.20±0.081	1.11±0.058	1.01±0.061
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
BMM	EC (micro mhos)	1.40±0.059	1.52±0.071	1.60±0.081	1.65±0.070	1.60±0.072	1.51±0.060	1.50±0.058	1.67±0.057	1.52±0.062	1.50±0.070	1.30±0.061	1.26±0.057
	Texture	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
BMMT	EC (micro mhos)	1.70±0.052	1.91±0.087	2.10±0.091	2.30±0.048	2.41±0.074	2.50±0.051	2.52±0.054	2.60±0.045	2.41±0.074	2.10±0.062	2.00±0.058	2.41±0.059
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

Table 1 (b). Physical composition of the termite mounds soil and the corresponding soils (Monoculture) without termites in pollachi and Udamalpet areas

Samples	Parameters	MONTHS-2013 -2014											
MN		Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
	EC (micro mhos)	1.40±0.083	1.04±0.048	1.03±0.063	1.51±0.031	2.60±0.025	2.72±0.018	2.81±0.028	2.60±0.071	2.10±0.030	2.21±0.060	2.11±0.051	2.00±0.053
	Texture	0.250		0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

CMNT	EC (micro mhos)	1.30±0.056	1.35±0.071	1.00±0.057	1.40±0.070	2.22±0.036	2.41±0.019	3.00±0.081	2.54±0.061	2.42±0.043	2.31±0.020	2.27±0.030	2.14±0.029
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
DMS	EC (micro mhos)	2.30±0.00	2.53±0.049	3.00±0.098	3.18±0.070	3.06±0.059	2.32±0.049	2.67±0.037	2.73±0.060	2.90±0.079	2.82±0.053	2.71±0.060	3.00±0.050
	Texture (Silt of soil (<))	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.250	0.250	0.250	0.250	0.250
DMST	EC (micro mhos)	2.00±0.098	2.29±0.070	2.83±0.076	2.25±0.043	1.90±0.040	2.17±0.053	2.28±0.058	2.91±0.071	2.42±0.060	2.30±0.040	2.54±0.041	2.82±0.043
	Texture (Silt of soil (<))	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
EME	EC (micro mhos)	3.10±0.080	3.00±0.051	3.20±0.048	3.34±0.073	3.16±0.028	3.41±0.052	2.82±0.036	2.72±0.059	2.67±0.070	2.54±0.040	2.11±0.051	1.91±0.059
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
EMET	EC (micro mhos)	2.85±0.098	2.25±0.068	2.70±0.087	2.81±0.093	3.00±0.068	2.73±0.069	2.54±0.062	2.33±0.078	2.28±0.090	2.31±0.092	2.00±0.071	1.83±0.039
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
FMC	EC (micro mhos)	2.78±0.060	2.58±0.051	2.30±0.039	2.63±0.031	3.19±0.071	3.22±0.055	3.52±0.036	2.53±0.030	2.43±0.010	2.00±0.031	2.41±0.040	1.82±0.054
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
FMCT	EC (micro mhos)	2.30±0.063	2.42±0.053	2.08±0.049	2.02±0.048	2.84±0.050	2.81±0.060	3.12±0.050	3.19±0.041	2.11±0.030	2.27±0.059	2.03±0.030	2.39±0.059
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

Table 1 (c). Physical composition of the termite mounds soil and the corresponding soils (Monoculture) without termites in pollachi and Udamalpet areas

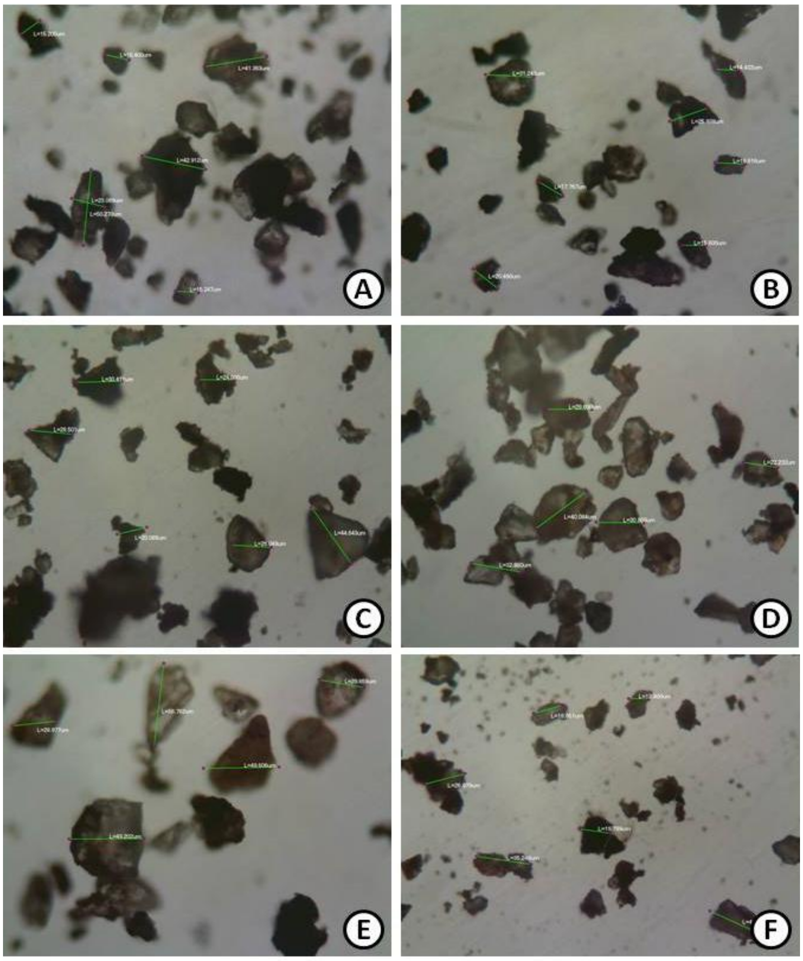
Samples	**Parameters**	**MONTHS**											
		Mar.	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec**	**Jan.**	**Feb.**
GMG	EC (micro mhos)	1.41±0.049	1.52±0.056	1.66±0.040	1.74±0.053	2.06±0.050	2.39±0.052	2.75±0.051	2.41±0.041	2.51±0.049	2.37±0.031	2.48±0.034	2.31±0.046
	Texture (Silt of soil (<))	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
GMGT	EC (micro mhos)	1.24±0.063	1.07±0.043	1.48±0.059	1.53±0.068	1.84±0.060	1.91±0.070	2.42±0.060	1.96±0.041	1.91±0.030	1.70±0.039	1.63±0.030	1.91±0.029
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
HMP	EC (micro mhos)	2.52±0.059	2.13±0.087	2.38±0.061	2.69±0.040	3.16±0.060	2.62±0.038	3.00±0.041	3.25±0.041	2.96±0.069	2.59±0.080	2.34±0.073	3.47±0.068
	Texture (Silt of soil (<))	0.250	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
HMPT	EC (micro mhos)	2.22±0.063	1.92±0.063	1.90±0.059	2.23±0.058	2.84±0.060	2.39±0.050	2.62±0.048	2.59±0.041	2.41±0.030	2.27±0.039	2.17±0.030	2.19±0.029
	Texture (Silt of soil (<))	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
IMT	EC (micro mhos)	1.36±0.065	1.49±0.058	1.32±0.053	1.48±0.042	1.09±0.056	1.36±0.055	1.19±0.069	1.25±0.054	1.06±0.050	1.26±0.057	1.02±0.046	1.80±0.058
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
IMTT	EC (micro mhos)	1.12±0.063	1.60±0.063	1.43±0.059	1.62±0.058	1.29±0.050	1.46±0.060	1.52±0.030	1.48±0.041	1.13±0.050	1.57±0.059	1.42±0.050	2.11±0.059
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
JMS	EC (micro mhos)	2.58±0.063	2.65±0.080	2.80±0.071	3.18±0.059	3.52±0.061	3.28±0.057	2.85±0.043	3.08±0.050	2.81±0.040	2.93±0.053	3.12±0.061	2.93±0.053
	Texture	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
JMST	EC (micro mhos)	2.12±0.053	2.30±0.058	1.98±0.059	2.92±0.068	2.65±0.061	3.09±0.062	2.32±0.050	1.93±0.041	2.40±0.058	2.61±0.069	3.00±0.057	1.82±0.059
	Texture (Silt of	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250

The texture of the termatorium soil, monoculture and polyculture soil are < 0.250 mm and < 0.500 mm respectively (Table 2).

Table 2. Soil texture of termite mounds soil and the corresponding soils (Monoculture and plyculture soils) without termites in pollachi and Udamalpet areas

	AP	**BP**	**CP**	**AMC**	**BMM**	**CMN**	**DMS**	**EME**	**FMC**	**GMG**	**HMP**	**IMT**	**JMS**
Mar.	**Silt**	Silt	**Clay**	Silt	**Sand**	**Silt**	**Sand**	**Silt**	**Clay**	**Clay**	Sand	Silt	Silt
Apr.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
May	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Jun.	Silt	Silt	Clay	Silt	Sand	silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
July	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	sand	Silt	silt
Aug.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Sep.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Oct.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Nov.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Dec.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Jan.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
Feb.	Silt	Silt	Clay	Silt	Sand	Silt	Sand	Silt	Silt	Silt	Sand	Silt	Silt
	APT	**BPT**	**CPT**	**AMCT**	**BMMT**	**CMNT**	**DMST**	**EMET**	**FMCT**	**GMGT**	**HMPT**	**IMTT**	**JMST**
Mar.	**Clay**	**Clay**	Clay	**Clay**	**Silt**	**clay**	**silt**	**Clay**	**Clay**	**Clay**	**Silt**	Clay	Clay
Apr.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
May	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Jun.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
July	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Aug.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Sep.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Oct.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Nov.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Dec.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Jan.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay
Feb.	Clay	Clay	Clay	**Clay**	Silt	Clay	Silt	Clay	Clay	Clay	Silt	Clay	Clay

The texture of the soil is more clay content in termatoria is usually 20% higher than in nearby soils, but it may be due to the termites select soil particles or soil undergoes a physical fractioning through their guts [9]. It may be possible that clay minerals are altered as soil particles are handled in their mouths or pass through their guts. In this respect [10] reported that kaolinite become less crystalline after passing through termite guts due to high pH. The texture of the soil in the field is not readily subject to change, so it is considered a basic property of a soil. Within the three broad groups of sandy soils, clayey soil and loamy soils, specific textural class names convey a more precise idea of the size distribution of particles and the general nature of soil physical properties. The 14 textural classes namely Sands, Loamy sands, Sandy loam, Fine sandy loam, Very fine sandy loam, Loam, Silt loam, Sandy clay, Silty clay loam, Clay loam, Sandy clay, Silty clay and Clay [11].Soil particles so small as to be invisible to the unaided (Fig. 1). Rather than feeling gritty when rubbed with the fingers, silt feels smooth or silky, like flour. Where silt is weather able minerals the relatively small size of the particles allows weathering rapid enough to release significant amounts of plant nutrients [11].



A - BP, B - BPT, C – EME, D – EMET, E – HMP and F - HMPT

Figure 1. Microscopic study of termites mound soil and polyculture and monoculture soils

CONCLUSIONS

The physical property of polyculture and monoculture soil can be changed favorable to agriculturist by the termites. The mound building habit of termites resulted in Symbiotic activity with agriculture soil. Many investigations of variation of soil physical properties or micro-topography within an area might be playing a vital role in determining the extent of draining of plant nutrients. The study was conducted with an aim to monitor the variation in physical properties of mono culture and poly culture soil compared with the termitoria soil. The particle size of the soil creates the physical property of the soil. This is not immediately changed by any other factor. It can be changed only by the termites when they are building their mound with the same agriculture soil. Termites change the property of soil according to their convenience, which resulted in change of physical properties like soil particle size, texture and electrical conductivity. This favours the agriculture soil which will be fit for agriculture and retain the plant nutrients of the soil. The change in physical properties resulted in change in type of soil like sandy soil into clay soil, silt soil into clay soil etc. The termite mound can be demolished and the soil can be mixed with the agriculture soil which will enhance the crop yield.

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