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Impact of Termite Activity on Soil Properties: A Study from Mining Area, Andhra Pradesh, South India

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ABSTRACT

Textural characteristics of soils of termite mounds from two different geological formations in around barite mining area of Vemula Andhra Pradesh are studied and compared with corresponding adjacent termite- free surface soils. Generally in the study area irrespective of the type of the mound termite soils contain higher content of sand and clay and lower content of silt than that of their adjoining surface soils. Grain-size parameters, viz., mean, median, sorting, skewness and kurtosis reveal that the median and mean behave in a similar way in all the termite soils and surface soils in two geological formations. Scatter plots of different combinations of the grain-size parameters are sensitive enough to differentiate the two geological formations and also the termite soils and surface soils.

Key words: Termite mound soils, Organic matter, Bulk density, Grain-size parameters, Barite mining

1. INTRODUCTION

Termite popularly known as white ants, commonly build earthen mounds or various sizes and shapes forming an important feature of the tropical landscape. Termites always live in communities. Their main function primarily is to maintain a constant high humidity, which is an essential requirement for the very survival of the termites especially for those that live in arid and semi-arid regions (Lee and Wood, 1971; Sen-Sarma, 1974). Termites penetrate through fissures and fractures or the sub-surface geological formation and sample them for their construction material carried in the jaws to the site and cemented with a mixture of clay and saliva. Biogeochemical studies have demonstrated that in tropical part of India these termite mounds have been used as important tool in explorations for copper (Prasad and Vijayasaradhi, 1984), chromium (Prasad and Vijayasaradhi, 1986), tin (Suryaprakash Rao and Raju, 1984), and gold (Prasad *et al*., 1987). Earlier workers studied ecological (Lee and Wood, 1971), biological (Sen Sarma, 1974), geological (Arshad, 1981) and biogeochemical (Raghu and Prasad, 1996) aspects of termite mounds have been discussed.

2. STUDY AREA

The barite deposit of Vemula region (Lat. 14^0 19’ 00’’-14^0 21’ 00’’N: Long. 78^0 19’ 00’’-22^0 21’ 00’’E) of Kadapa District, Andhra Pradesh is included in the survey of India toposheet No. 57J/7. The study area is about 65 Km from the district headquarter Kadapa/Cuddapah. Vemula barite deposit associated with basic intrusive occurs within the Vempalli stage of the Lower Cuddapah in the Southern part of Cuddapah basin (Prasad and Prasannan, 1976). This area mainly consists of conglomerates, shales, basalts, and dolomites. Earliler workers have carried out in geological (Krishna and Venkataram, 1942), mineralogical (Murthy, 1950; Krishnan, 1953), biogeochemical (Raghu, 2001, Chandrasekhar Reddy et al 2010) and hydrogeochemical

(Chandrasekhar Reddy et al 2012) aspects of this study area.

3. SAMPLE PREPARATION AND METHODOLOGY

Nine soils samples were collected from different parts of the exterior of the mound and to represent a composite sample all these soils samples were thoroughly mixed. The surface soil adjacent to the termite mound was collected from six to eight pits, and combined to represent composite sample. Thus for each mound sample, its adjacent ground surface soil was collected for the purpose of comparison. In this way, a total thirty six pairs were collected in and around barite mining area of Vemula on two different geological formations. These sample mounds include barren, monophytic and polyphytic types. Based on the associated vegetation, termite mounds are categorized as barren mound devoid of vegetation; monophytic mound colonized by single taxonomic plant specie and polyphytic mound colonized by two are more taxonomic plant species. Samples of soils and termite soils were oven dried at 110^{o}C to expel moisture. These dry soils were lightly disintegrated with porcelain mortar and pestle to break lumps if any, with care to avoid the breaking of individual and were then sieved to pass through 2mm sieve mesh. From this material, required quantity of each representative sample was obtained by coning and quartering. The bulk density was determined adopting the Wax coating method of Blake (1965), organic matter was estimated by loss on ignition method (Davies, 1974). From the particle size distribution data cumulative frequency curves were drawn and the standard statistical parameters, comprising mean, median, sorting, skewness and kurtosis determined employing the formulae of Folk and Ward (1957).

4. RESULTS AND DISCUSSIONS

4.1 Textural properties

Texture refers to the relative percentage of sand, silt, and clay in a soil. The textural properties, consisting of sand-silt-clay proportions and grain-size parameters viz., mean, median, sorting, skewness and kurtosis were estimated for the termite soils and surface soils. From the data (Table. 1), it is revealed that minimum percentage of sand, silt and clay is 75.60, 1.65, and 1.59 on barren, polyphytic termite soils of basalts and monophytic termite soils of shales respectively; while the maximum is recorded as 96.15, 17.95, and 9.81on monophytic termite soils of shales, barren termite soils of basalts and also barren termite soils of basalts respectively.

Table. 1 Textural characteristics of Soils of Termite soils (TS) and Surface soils (SS) from Mining Area

Type of the mound	Sand %		Silt %		Clay %	
	Ts	SS	Ts	SS	Ts	SS
Barren (on Basalts)	75.60-87.20	72.70-81.27	9.18-17.95	9.07-22.70	3.10-9.81	2.95-7.20
Barren (on Shales)	88.64-90.40	84.10-87.40	6.14-8.75	10.54-12.72	2.07-5.22	1.72-4.26
Monophytic (on Basalts)	88.75-96.10	83.18-90.64	2.10-7.53	4.13-12.22	1.80-9.15	1.72-3.05
Monophytic (on Shales)	89.32-96.15	86.35-91.47	2.10-6.92	6.14-10.74	1.59-3.76	1.20-2.91
Polyphytic (on Basalts)	82.10-93.75	80.60-91.10	1.65-14.72	6.25-16.30	2.98-6.50	1.28-6.00
Polyphytic (on Shales)	90.47-93.20	87.75-90.15	4.15-5.66	7.01-9.65	1.65-3.87	1.15-3.50

Table. 2 Grain-Size Parameters of Termite soils (TS) and Surface Soils (SS) from Mining Area

Type of the mound	Mean		Median		Sorting		Skewness		Kurtosis	
	TS	SS	TS	SS	TS	SS	TS	SS	TS	SS
On Basalts										
Barren	1.60 to 2.10	1.00 to 1.50	1.50 to 2.18	1.05 to 1.70	1.00 to 2.20	0.50 to 2.00	-0.04 to 0.25	-0.03 to 0.30	0.36 to 1.00	0.19 to 0.54
Monophytic	1.10 to 1.60	1.10 to 1.90	1.05 to 1.70	1.16 to 2.10	1.16 to 1.50	1.10 to 1.46	-0.15 to 0.15	-0.05 to 0.35	1.10 to 1.38	1.10 to 1.42
Polyphytic	1.00 to 1.24	1.45 to 1.90	1.02 to 1.40	1.20 to 2.20	1.06 to 2.00	1.00 to 2.15	0.32 to 0.40	-0.23 to 0.20	1.10 to 1.40	1.00 to 1.34
On Shales										
Barren	0.50 to 1.30	1.60 to 2.10	1.14 to 1.50	1.40 to 1.50	1.00 to 2.10	1.10 to 1.90	-0.05 To 0.00	0.05 to 0.45	0.60 to 1.38	0.16 to 1.40
Monophytic	1.60 to 1.86	1.00 to 2.20	1.52 to 2.10	1.06 to 2.40	1.78 to 2.18	1.82 to 2.20	-0.05 to 0.40	-0.25 to 0.30	0.24 to 0.56	0.16 to 0.50
Polyphytic	1.30 to 1.60	1.90 to 2.20	1.30 to 2.30	1.20- to 2.32	1.10 to 2.10	1.00 to 2.20	-0.25 to 0.25	0.10 to 0.20	0.24 to 0.64	0.25 to 0.82

The maximum percentage of sand (94.15%) and silt (22.70%) and the minimum percentage of sand (72.70%) and silt (4.13%) are found in the soils of basalts. The maximum value of clay (7.65%) is found in surface soils of basalts and the minimum of (1.15%) in soils of shales. In the study area from the data (Table 1) it is seen that all termite soils show higher content of sand and clay; and lower content of silt than that of their adjoining surface soils. This is the case observed irrespective of the type of the mound and the rock type on which they were developed. In this study, generally termite mound soils fall under sand field in the classification of Shepard (1954). Termites carry soil particles with their mandibles and the size of the particles in the mound is limited by a maximum size that a worker termite can carry. For many species of termite there is no precise selection of size particles (Lee and Wood, 1971). Earlier studies revealed that the role of termites on soil texture (Wood et al., 1983).

4.2 Grain-Size Parameter

Grain-Size Parameters are used to bring out the differentiation between soils and termite soils. In this study, particle size analysis of the sand sized fraction of the soil material (devoid of organic matter) consisting of thirty six pairs of soils and termite soils developed on two geological formations was carried out by sieving for 10 minutes in Ro-tap shaker (Carver, 1971). From the sieve analysis data, cumulative frequency curves were drawn and the standard statistical grain-size parameters consisting of mean, median, sorting, skewness and kurtosis are determined (Folk and Ward, 1957). From the data (Table 2) the following observations are made:

1. Barren termites developed on basalts show higher values of mean and median than those of their surface soils
2. Generally the mean, median behave in a similar way in all the termite soils and surface soils of the two geological formations
3. Kurtosis is low in monophytic termite soils developed on basalts than their surface soils.
4. Nearly 44% of the termite soils and 63% of the surface soils show negative skewness.
5. Median is higher values in polyphytic termite soils of shales than other termite soils developed on other geological formation i.e basalts.

Scatter plots of various combinations of the textural parameters are found to be sensitive enough to differentiate the termite mounds and surface soils of two geological formations i.e basalts and shales are recorded below:

1. Mean Vs. kurtosis differentiates the basalts and shales developed on three types of mounds (monophytic, polyphytic and barren mounds)
2. Sorting Vs. kurtosis differentiate the shales and basalts developed on three types of mounds (monophytic, polyphytic and barren mounds)
3. Sorting Vs. skewness differentiate the shales and basalts of barren mounds.
4. Kurtoses Vs. skewness differentiate the two types of rocks in all the three types of mounds.
5. High degree of positive correlation exists between mean Vs. median for termite soils and surface soils

5. SUMMARY AND CONCLUSIONS

In this work textural properties (sand-silt-clay ratios), and grain-size parameters

consisting of mean, median, sorting, skewness and kurtosis of termite mound soils and soils have been studied. In the study area generally termite mounds are built by sand sized particles. Termite soils show higher content of sand and clay and lower content of silt than surface soils. The scatter diagrams of different combinations of the grain-size parameters are sensitive enough to differentiate the two geological formations and also the termite soils and soils. The textural data of soils and termite soils reveal that termites control and continuously modify all these properties within their habitat in order to maintain homeostatic equilibrium.

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