

## **Impact of Termites on Soil Properties: a Perspective Study from Barite Mineralized Area**

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### **ABSTRACT**

*Impact of termite activity on physical and physico-chemical characteristics of soils of termite mounds from two different rock formations in around barite mining area of Velpula, Kadapa district, Andhra Pradesh have studied and compared with corresponding adjacent termite-free soils. Termite mounds soil contain significantly lower bulk density, while higher organic matter, pH, and electrical conductivity (EC) than that of their corresponding adjoining surface soils irrespective of the type of the mound soils collected in different rock formations. The variations in the physical and physico-chemical properties of termite mound soils may attribute to the variations in associated vegetation types and the microbial activity of the termite mounds. This study showed that activity of termites induced significant physico-chemical changes in the materials that they use to build their nests. Data presented in this study indicate that the presence of termites modifies the physical and physico-chemical properties of soils.*

**Key words:** Termite mound soils, Organic matter, Bulk density, pH, Electrical conductivity

### **INTRODUCTION**

Termite commonly known as white ants, build earthen mounds of different sizes and shapes forming an important feature of the tropical landscape. 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 are common biological agents that produce significant physical and chemical modifications to tropical and subtropical soils (Mando et al., 1996). Termites break down plant debris, dead trees and wood, so digest them and apply their waste to building nests. Termites penetrate through 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 an important tool in exploration for copper (Prasad and Vijayasaraadhi, 1984), chromium (Prasad and Vijayasaraadhi, 1986), tin (Suryaprakash Rao and Raju, 1984), gold (Prasad et al., 1987), and barite (Raghu, 2007). Termite's activity increases the amount of organic matter and changes the composition of clay mineral in soils that used for building their nests (Abe, 2000).

## **STUDY AREA**

The study area, Velpula village is in Vemula Mandal and is located in Kadapa District, Andhra Pradesh. Velpula is surrounded by Pulivendula mandal towards north, Talupula mandal towards south, Vempalle mandal towards east, and Lingala mandal towards west. This village is located about 71 kms towards west from the district headquarter Kadapa, 10 kms from taluk headquarter Pulivendla and 5 kms from Vemula, the mandal headquarter. This study area comes under Lower Cuddapah super group in Cuddapah basin comprising Papaghni and Chitravati groups (Nagaraja Rao *et al.*, 1987). Geologically, this part of the area is mainly occupied by dolerites, basalts, dolomites, limestones, and shales. Earlier workers have carried out mineralogical (Krishan, 1953), petrogenetical (Prasad and Prasanna, 1976) and geochemical (Chakrapani Naidu, 1962) aspects of Cuddapah basin. In the study area, the mounds occurring on basalts are brown and those occurring on dolerites are generally dark brown. The height of the mounds is more than a few meters. The mounds are made with materials from underlying soils. The size of the termite mounds vary from 0.57m to 2.50 m in height and 0.75m to 3.20m in base diameter. The termite mounds have different shapes. The present study deals with the physical properties consisting of bulk density and organic matter; and physico-chemical properties consisting of pH and electrical conductivity of termite mounds and their neighboring ground surface soils from different geological formations in and around barite mining/mineralized area of Velpula, Kadapa District, Andhra Pradesh.

## **SAMPLE PREPARATION AND METHODOLOGY**

Along the long profile conspicuously occurring termite mounds developed on limestones and dolerites formation were selected. To study the impact of termites on chemical and physical properties of soil environment, ten soils samples were collected from different parts of the termite mound/ nest and all these soils samples were thoroughly mixed to form a composite sample. The surface soil adjacent to the termite mound in the surrounding area occurring in a radius of 5-10 m with reference to the termite mound unaffected by termites was collected from five to eight pits, and combined to represent composite sample. In this manner for each mound sample, its adjacent ground surface soil was collected for the purpose of comparison. In this way, a total twenty pairs were collected in and around barite mining area of Velpula on two different geological formations consisting of on limestones and dolerites. Each pair of samples represents a termite-affected material taken from a termite mound/ nest and the corresponding soil sample taken several meters away from closest mound without significant termite activity. These collected sample mounds include barren, monophytic and polyphytic types. Based on the associated vegetation, termite mounds are classified as barren termite mound devoid of vegetation; monophytic termite mound colonized by single taxonomic plant specie and polyphytic termite mound colonized by two or more taxonomic plant species. The termite mounds were excavated and dismantled. Samples of about 3 kg which were thoroughly mixed. They were dried for 5 days at room temperature, Samples of soils and termite mound soils were oven dried at 110<sup>0</sup> C to expel moisture. These dry soils were lightly disintegrated with porcelain mortar and pestle to break lumps if any, with care and then sieved to pass through 2mm sieve mesh. From this material, required quantity of each representative sample was obtained by coning and quartering, and, the physical properties

consisting of bulk density and organic matter; and physico-chemical properties consisting of pH and electrical conductivity were determined and the minimum and maximum values are represented in Table 1. The bulk density was determined adopting the Wax coating method of Blake (1965), organic matter was estimated by loss on ignition method (Davies, 1974). In order to know the impact of termite activity on physical and physico-chemical properties of termite soils and adjoining surface soils this study has been undertaken.

## RESULTS AND DISCUSSIONS

A comparison of the soils from termite nests with corresponding soils without activity reveals that termite activity apparently increased for organic matter, pH and electrical conductivity (EC), but decreased for the bulk density (Table 1).

The bulk density of barren termite soils on limestones vary from 1.05-1.50 gm/cc and for surface soils it ranges from 1.27 -1.44 (gm/cc), where as for barren termite soils on dolerites varies from 1.33-1.78 gm/cc and for surface soils it ranges from 1.30 -1.80gm/cc. The bulk density of monophytic termite soils on limestones varies from 1.27-1.39 gm/cc and for surface soils it ranges from 1.39 -1.53 gm/cc., while these values for monophytic termite soils on dolerites varies from 1.29-1.60 gm/cc and for surface soils it ranges from 1.49-1.68 gm/cc. The bulk density of Polyphytic termite soils on limestones varies from 1.12-1.35 gm/cc and for surface soils it ranges from 1.28-1.52 gm/cc. These values for Polyphytic termite soils on dolerites vary from 1.27-1.45 gm/cc and for surface soils it ranges from 1.30-1.65 gm/cc. The termite soils collected from barren bound on dolerites formation show maximum value (1.78 gm/cc) of bulk density and a minimum value (1.05 gm/cc) is noticed in the termite soils collected from barren bound on limestone. In the study area, it is clear that the bulk density is lower in termite soils than that of their adjacent surface soils irrespective of the mound soil collected from different rock types. This may be attributed to the termite activity (Ghilarov, 1962; Maldague, 1964) resulting increased porosity (Nagaraju et al, 2004; Chandra sekhar reddy and Ramana reddy, 2011). And also may attribute to the termite galleries and incorporation of organic matter and the influence of plants colonizing the mounds. In the study area, most of the termite mounds are colonized with vegetation.

Organic matter content was determined by placing the soils in a muffle furnace at 500 °C for three hours and measuring loss on ignition. Organic matter values of barren termite soils on limestones vary from 6.42-7.30% and for surface soils it ranges from 4.50-6.30%; whereas for barren termite soils on dolerites varies from 5.14-6.2% and for surface soils it ranges from 2.15-2.80% .These values for monophytic termite soils on limestones varies from 1.78-4.00% and for surface soils it ranges from 1.30-3.70%; while for monophytic termite soils on dolerites vary from 6.38-7.80% and for surface soils it ranges from 4.00-6.20%. Organic matter content of Polyphytic termite soils on limestones varies from 2.70-4.70% and for surface soils it ranges from 1.20-4.10% but for Polyphytic termite soils on dolerites varies from 3.70-4.70% and for surface soils on limestones it ranges from 2.00-4.50%. Significantly higher organic matter content in the termite mound compared to the surrounding adjacent surface soils have been observed in the study area (Table 1). The termite soils collected from monophytic bound on dolerites formation show maximum value (7.80%) of organic matter and a minimum value (1.78%) is noticed in the termite soils collected from monophytic

bound on limestone. In the study area, it is clearly observed that the termite soils have invariably higher organic matter than their adjoining surface soils. This may be due to the vegetative diet of termites and the use of their saliva and excreta in mound construction (Bouillon, 1970; Mermut et al., 1984). Earlier studies have revealed higher organic matter in termite soils than their adjacent soils (Lobry de Bruyn and Conacher, 1995; Chandra sekhar reddy et al., 2010). Anderson and Wood (1984). Anderson and Wood (1984) stated that the selection of large, defined food sources by termites, such as leaf litter or rotten wood, can result in a higher proportion of organic matter in the mounds.

**Table.1 Physical and Physico-chemical properties of termites soils (TS) and adjacent surface soils (SS) from Velpula barite mining Area**

Type of the mound	Bulk density (gm/cc)		Organic matter %		pH		Electricity conductivity (micromhos/cm)	
	TS	SS	TS	SS	TS	SS	TS	SS
Barren mound (on limestone)	1.05-1.50	1.27 -1.44	6.42-7.30	4.50-6.30	7.0-7.8	6.5-7.2	38-95	31-85
Barren mound (on dolerite)	1.33-1.78	1.30 -1.80	5.14-6.2	2.15-2.80	6.3-7.2	6.1-6.7	78-92	19-71
monophytic mound (on limestone)	1.27-1.39	1.39 -1.53	1.78-4.00	1.30-3.70	6.5-7.3	6.3-6.9	44-99	32-78
Monophytic mound (on dolerite)	1.29-1.60	1.49 -1.68	6.38-7.80	4.00-6.20	6.8-7.1	6.2-6.7	57-150	35-107
Polyphytic mound (on limestone)	1.12-1.35	1.28 -1.52	2.70-4.70	1.20-4.10	6.6-7.4	6.2-7.0	65-110	28-85
Polyphytic mound (on dolerite)	1.27-1.45	1.30 -1.65	3.70-4.70	2.00-4.50	7.1-7.3	6.5-6.9	25-115	20-94

The pH of barren termite soils on limestones varies from 7.0-7.8 and for surface soils it ranges from 6.5-7.2. The pH values of barren termite soils on dolerites varies from 6.3-7.2 and for surface soils it ranges from 6.1-6.7. The pH values of monophytic termite soils on limestones varies from 6.5-7.3 and for surface soils it ranges from 6.3-6.9. The pH values of monophytic termite soils on dolerites varies from 6.8-7.1 and for surface soils it ranges from 6.2-6.7. The pH values of Polyphytic termite soils on limestones varies from 6.6-7.4 and for surface soils it ranges from 6.2-7.0. The pH values of Polyphytic termite soils on dolerites vary from 7.1-7.3 and for surface soils it ranges from 6.5-6.9. The termite soils collected from barren bound on limestone formation show maximum value (7.8) of pH and a minimum value (6.3) is noticed in the termite soils collected from barren bound on dolerites. In the study area, in general termite soils have higher pH values than surface soils irrespective of barren, monophytic and polyphytic soils (Table 1). Several previous workers (Boyer, 1955; Watson, 1970; Mermut et al., 1984; Chandra sekhar reddy et al., 2010) have reported that the termite soils have higher pH than the adjacent soil. In most cases, the termite soils are weakly acidic to slightly alkaline, whereas most of the corresponding surface soils are weakly acidic.

The Electrical conductivity (EC) values of barren termite soils on limestones vary from 38-95 micromhos/cm and for surface soils it ranges from 31-85 micromhos/cm. The EC values of barren termite soils on dolerites varies from 78-92 and for surface soils it ranges from 19-71 micromhos/cm. The EC values of monophytic termite soils on limestones varies from 44-99 micromhos/cm and for surface soils it ranges from 32-78 micromhos/cm. These values for monophytic termite soils on dolerites varies from 57-150 micromhos/cm and for surface soils it ranges from 35-107 micromhos/cm. The EC values of Polyphytic termite soils on limestones varies from 65-110 micromhos/cm and for surface soils it ranges from 28-85 micromhos/cm. These values for Polyphytic termite soils on dolerites vary from 25-115 micromhos/cm and for surface soils it ranges from 20-94 micromhos/cm. The termite soils collected from Monophytic bound on dolerites formation show maximum value (150 micromhos/cm) of EC and a minimum value (25 micromhos/cm) is noticed in the termite soils collected from Polyphytic bound on dolerites. In the study area, in general termite soils have higher EC values than surface soils irrespective of barren, monophytic and polyphytic termite soils (Table 1). Generally, the electrical conductivity (EC) of termite soils is significantly higher than those of surface soils irrespective of type of the mound and rock (Chandra sekhar reddy 2015). Watson (1975) has reported higher EC in termite soils than their corresponding surface soils.

## **CONCLUSIONS**

The study revealed that the bulk density of termite soils is generally lower than that of their adjacent soils. The organic matter, electrical conductivity and pH of termite mound soils are higher than that of adjacent soils irrespective of the type of the mound and soils collected in different rock types. The variations in the physical and physico-chemical properties of termite mound soils are attributed to the variations in associated vegetation types and the microbial activity of the mounds. This study showed that activity of termites induced significant physico-chemical changes in the study area. During the course of construction of termite mounds, soil particles are selected, transported, repacked and cemented together with saliva and/or excreta (Mermat et al.1984). The termites with necessary adaptations control and continuously modify the physical and physico-chemical characteristics. Hence the physical and physico-chemical properties of these biologically reworked soils may differ from the source material used for mound construction.

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