Physical properties of termite mound soil in para rubber plantation of southern border provinces

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Abstract. Most farming areas in southern part of Thailand are predominated by the para rubber plantation and termite mound are generally found in almost plantation area. Termites have peculiar activities in the soil and also lead to the significant changes in the soil properties. The objective of this research was to study the physical properties of termite mound soils in para rubber plantations. The soil in the area of southern border provinces i.e. Pattani, Yala, and Narathiwas was investigated. Additionally, the soil samples were collected at the distance of 5 meters away from the mound base. It was found that the termite mound soil was comprised of silty and clay soils with high moisture and density. Most of the soil particles were sandy soil and had good water absorption coefficient. The termite mound soils were weakly acidic and by this reason the electrical conductivity was at a level that does not affect the growth and production of plants. For agriculture improvement, termite mound soils can be mixed with other soils to retain moisture, absorb water and nutrients.

1. Introduction

The soil is the habitat of a wide diversity of invertebrate organisms, among of these some specific groups induce changes that contribute to a wide range of essential benefits for the sustainability of natural and managed ecosystems [1]. The physical properties associated with water holding capacity and soil stability are important for soil improvement [2]. The aim of this research was to elucidate the physical properties i.e. density, pH, conductivity, moisture and permeability of termite mound soils in para rubber plantations.

2. Materials and methods

Samples were taken in March 2019. The area of sampling was show in figure 1. Soil inside termite mound was collected by iron digger. Subsequently, the soil around the mounds was sampled from the soils and termite mounds (figure 2). Samples were collected at the distance of approximately 5 m far from each mound base [3]. The electrical conductivity and pH of collected samples were measured at the collected point were as the moisture whereas the moisture content and permeability of granular soils were analysis by standard test methods [4,5]. The particle size of soils was analyzed by a series of sieves following the standard method [6] i.e. No.4 (4.75 mm), No.10 (2.00 mm), No.20 (850 µm), No.60 (250 µm), No.100 (150 µm) and No.200 (75 µm).
Figure 1. The study areas located in the southern border provinces, Thailand.

Collecting data for this research has been done in Trobon (P-1) Manangdalam (P-2) and Lahan (P-3) Saiburi district, Pattani province, Lumphai (Y-1) Thasap (Y-2) and Yupo (Y-3), Mueang district, Yala province, Bangosato (N-1), Kalisa (N-2) and Bo-ngo (N-3) Ra-ngae district, Narathiwat province in the south of Thailand. For result of classification of termites, it has been found that the termite species is *Macrotermes gillvus*.

Figure 2. (a) The field sample collection in para rubber plantation at 5 meters away from the mound base (b) schematic diagram of the sample collection section of a termite mound (top, center and base).

3. Results and discussion

The moisture content and permeability of termite mound and soil at 5 meters away from the mound base were presented in figure 3. The soil collected from termite mound soil showed the high moisture but low permeability then the soil collected from the point at 5 meters from the mound base. Since the soil around the termite mound base is mostly sand. However, the termite mound soil is mostly silt and clay, which can be determined from the particles of the soil grain (table 1).
Table 1. Conductivity, density, pH and % finer of samples collected from termite mounds and the soil at 5 meters away from the mound.

| positions  | soil  | conductivity (dS/m) | density (g/cm³) | pH | % finer |
|------------|-------|---------------------|-----------------|----|---------|
|            | No.4  | No.20   | No.60  | No.100 | No.200  | Pan⁴ |
| Pattani-1  | top   | 1.83    | 1.21   | 7.6   | 70.0    | 24.2 | 11.2 | 7.6 | 1.8 | 0.4 |
| (P-1)      | center| 1.93    | 1.30   | 6.6   | 73.0    | 34.6 | 23.4 | 19.2 | 6.8 | 0.6 |
|            | base  | 1.27    | 1.36   | 6.3   | 73.0    | 36.2 | 22.4 | 12.6 | 4.0 | 1.2 |
|            | 5 m   | 1.47    | 1.01   | 6.8   | 90.2    | 48.2 | 22.4 | 13.2 | 2.8 | 0.2 |
| Pattani-2  | top   | 1.67    | 1.03   | 7.3   | 87.0    | 40.0 | 21.8 | 15.8 | 7.8 | 0.8 |
| (P-2)      | center| 1.73    | 1.06   | 7.3   | 68.2    | 23.2 | 10.0 | 7.0  | 3.4 | 0.4 |
|            | base  | 1.93    | 1.07   | 7.3   | 81.8    | 35.8 | 22.8 | 18.4 | 8.6 | 0.4 |
|            | 5 m   | 1.33    | 1.00   | 7.3   | 66.2    | 27.4 | 16.8 | 13.0 | 3.6 | 0.2 |
| Pattani-3  | top   | 7.13    | 1.06   | 8.0   | 66.4    | 22.0 | 11.8 | 9.0  | 3.2 | 0.4 |
| (P-3)      | center| 7.13    | 1.01   | 7.5   | 67.6    | 26.8 | 16.4 | 12.6 | 3.0 | 0.6 |
|            | base  | 5.33    | 1.00   | 7.3   | 86.0    | 44.4 | 28.4 | 20.4 | 3.8 | 0.4 |
|            | 5 m   | 2.13    | 1.00   | 7.6   | 66.2    | 27.4 | 16.8 | 13.0 | 3.6 | 0.2 |
| Yala-1     | top   | 2.00    | 1.17   | 7.0   | 97.0    | 61.0 | 36.0 | 14.2 | 3.8 | 2.6 |
| (Y-1)      | center| 2.00    | 1.18   | 6.6   | 94.0    | 53.8 | 37.6 | 21.4 | 9.6 | 6.8 |
|            | base  | 2.67    | 1.27   | 6.6   | 94.0    | 54.7 | 31.9 | 16.9 | 9.4 | 5.8 |
|            | 5 m   | 1.33    | 1.10   | 7.0   | 99.0    | 87.8 | 61.0 | 30.8 | 7.0 | 2.0 |
| Yala-2     | top   | 4.00    | 1.11   | 6.6   | 92.6    | 63.2 | 45.2 | 24.2 | 9.2 | 3.8 |
| (Y-2)      | center| 2.33    | 1.11   | 7.3   | 91.0    | 44.0 | 30.8 | 16.8 | 8.8 | 6.2 |
|            | base  | 1.67    | 1.17   | 7.3   | 72.8    | 26.8 | 9.8  | 5.6  | 4.0 | 3.2 |
|            | 5 m   | 1.33    | 1.10   | 7.1   | 88.4    | 32.6 | 15.2 | 8.8  | 6.0 | 0.6 |
| Yala-3     | top   | 4.33    | 1.11   | 7.1   | 99.6    | 77.2 | 45.5 | 20.0 | 7.0 | 1.8 |
| (Y-3)      | center| 4.33    | 1.12   | 7.2   | 99.0    | 77.4 | 35.4 | 14.4 | 8.4 | 5.6 |
|            | base  | 2.00    | 1.11   | 7.2   | 99.2    | 73.6 | 51.4 | 20.4 | 6.6 | 2.0 |
|            | 5 m   | 1.00    | 1.00   | 7.0   | 88.4    | 32.6 | 15.2 | 8.8  | 6.0 | 0.6 |
| Narathiwat-1| top | 4.33    | 1.18   | 6.5   | 98.4    | 58.0 | 28.2 | 13.6 | 2.6 | 0.8 |
| (N-1)      | center| 3.67    | 1.12   | 6.5   | 98.8    | 59.4 | 29.0 | 14.6 | 3.2 | 0.8 |
|            | base  | 4.00    | 1.08   | 6.8   | 68.0    | 52.4 | 24.2 | 12.2 | 2.8 | 0.4 |
|            | 5 m   | 3.00    | 1.05   | 7.0   | 96.0    | 45.2 | 17.8 | 10.2 | 2.4 | 0.2 |
| Narathiwat-2| top | 4.00    | 1.28   | 7.2   | 92.8    | 41.2 | 18.0 | 9.8  | 2.2 | 1.0 |
| (N-2)      | center| 3.00    | 1.24   | 7.2   | 91.8    | 37.6 | 16.6 | 10.2 | 2.6 | 0.4 |
|            | base  | 4.67    | 1.15   | 7.3   | 89.6    | 39.8 | 18.4 | 10.4 | 2.2 | 0.2 |
|            | 5 m   | 3.33    | 1.09   | 6.2   | 98.0    | 75.4 | 30.4 | 15.4 | 4.0 | 0.0 |
| Narathiwat-3| top | 3.33    | 1.41   | 6.0   | 68.6    | 22.2 | 12.0 | 7.6  | 3.4 | 0.4 |
| (N-3)      | center| 4.00    | 1.26   | 5.8   | 66.2    | 21.2 | 10.8 | 5.2  | 2.8 | 1.6 |
|            | base  | 3.33    | 1.24   | 6.7   | 79.4    | 29.2 | 17.6 | 11.2 | 3.0 | 1.2 |
|            | 5 m   | 2.67    | 1.21   | 6.3   | 80.8    | 25.8 | 14.2 | 8.8  | 1.8 | 0.2 |

⁴ Pan is the bottom tray of the most fined grate.

Table 1 shows the particles of the termite mound soils are silt (0.004-0.0625 mm) and clay (<0.004 mm) soils with high density [7]. The results show that the density of the termite mound soil is higher than the soil around the base of the termite mound soil. The soil moisture is high thus making the condition of low permeability. The termite mound soils are weakly acidic, and their measured electrical conductivities are at a level that do not affect the growth and production of plants [8]. The electrical conductivity in the soil is in the rage of 1.00 – 7.13 dS/m which does not affect the growth and indicative of the nutrient breakdown properties required for plants. The standard values are suitable for plant growth of 2-8 dS/m. In the position of P-3, high conductivity results in a high pH, making the soil become more alkaline.
Figure 3. The termite mound and the soil at 5 meters from different locations of the mound (a) soil moisture content and (b) permeability of granular soils.

4. Conclusion

The study of the physical properties of termite mound soils in para rubber plantations of southern border provinces. The termite mound soils were silty and clay soils with high moisture and density, weakly acidic and the electrical conductivity at a level that does not affect the growth and production of plants. For the soil at 5 meters away from the mound base, most of the soil particles are sandy soil and has good water permeability. The mixing of the termite mound soil may help an increase in the available water content for crop growth, enhance the treatment of soil structural stabilization, and also increase water retention capacity.

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