Some physiochemical properties of termite mound soil and its effect on yield and yield components of maize (Z*ea mays L.*) Under Greenhouse condition at Nekemte, western Ethiopia

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ABSTRACT: Termite mound soil amends soil fertility and utilized as an alternative to NPK fertilizers by smallholder farmers in Africa. Experiment was conducted in western Ethiopia to compare selected physical and chemical properties of mound soil (ms), Adjacent soil (AS) and non-mound soil (NMS) and the effect of these soils on maize plant growth and yield in the Greenhouse. In Limu district, Fitbako kebele, cultivated land was purposively selected for sampling. In the cultivated land, a plot of 100m x100m was delineated and three mounds within the plot were also purposively selected to collect composite soil sample for soil analysis and Greenhouse pot experiment. From each mound, 10kg soil each from bottom, middle and top (total= 30 kg) were collected and mixed to obtain working sample of 10 kg. About 30kg of adjacent soil 5m away from mound soils and Non-mound soil at the distance of 20 m away from mound soil at the depth of 0-30cm were collected and thoroughly mixed to make working sample of 10kg from each soil type. Three kilograms of mound soil, adjacent soil and non-mound soil each was put in separate plastic bucket for greenhouse pot experiment. About 100 gm of each soil type was used for selected physical and chemical properties analyses. The result obtained demonstrated that termite mound soil was significantly (P<0.05) high in bulk density (BD), moisture contents (MC), porosity (P), Soil pH, percent organic carbon (% OC) and percent organic matter (% OM). Total Nitrogen (TN), average (av.) P, av. K, Exch. Ca and Exch. Mg were also significantly (P<0.05) higher in mound soil in comparison with adjacent soil and non-mound soil. Maize plant growth traits and yield were significantly (P<0.05) high in mound soil. From the current study, it can be concluded that the use of NPK fertilizer on plots having termite mound is not recommended. However, further research is needed on how to use mound soil on large plot of land.

Key words/Phrases: Adjacent soil, Chemical property of soil, Non-mound soil, Soil texture, Termite mound soil

INTRODUCTION

Termites are considered to be one of the most destructive pests in the world, but termite mound soil amends soil fertility and utilized as an alternative to NPK fertilizers by cash constrained smallholder farmers in some parts of Africa (Abdeta Jembere *et al*., 2017). However, there is little knowledge on mound soil texture, nutritional composition and the impact it has on plant growth and yield in western Ethiopia particularly Nekemte areas where high maize production, high termite mound distribution and termite infestations exists. Termites mostly feed on dead plant matter like woodchip, decayed wood (logs), leaf litter and soil. They are considered as major pests of cereals such as maize, sorghum and teff among others (Daniel Getahun and Emana Getu, 2014). Termites are also important component of

agro-ecosystems as their mounds amend nutrient depleted soils. Termites are large and diverse group of soil fauna consisting over 3000 species in 280 genera and seven families in the world (Daniel Getahun and Emana Getu, 2014). In Africa, there are about 1000 termite species (Abdurahman Abdulahi, 1990). Termite prevalence survey conducted in western, southern, and eastern parts of Ethiopia provided basic information on termite fauna of Ethiopia (Daniel Getahun and Emana Getu, 2014). In Ethiopia, there are 61 species of termites belonging to 25 genera and four families (Abdeta Jembere *et al*., 2017). Termites live in their own mound. The density of termite in a mound depends on the size of the mound. Subterranean termites mound harbor 3,000–200,000 individual termites. Termite mound is constructed from a mixture of soil, termite saliva and dung/plant materials. The top of the mound consists of a central chimney surrounded by an intricate

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network of tunnels and passages (Daniel Getahun and Emana Getu, 2014). The genus Macrotermes builds large mounds that have a characteristic feature of many grasslands and savanna woodlands in Africa. Termite genera that build mound include *Macrotermes, Cubitermes, Amitermes, Odontotermes, Procubitermes* and *Trinervitermes* (Abdurahman Abdulahi, 1990). Mound building termites are abundant in degraded low soil fertility and high soil acidity areas particularly in areas that were converted to pasture (Rückamp, 2012). Termites feed on a whole range of living and dead plant materials and decompose it to concentrate nutrients in the mound. It is with the aid of soil dwelling free living N_2 fixing bacteria, Azotobacter *and Bacillus* that termites digest the foraged materials and decompose it to organic matter (Sathiya *et al.*, 2018).These admixtures in one hand alter the natural texture of soil and on the other hand accumulate more soil organic carbon (OC), organic matter (OM), pH, Ca, K, N and Mg in mound soil (Jouquet *et al.*, 2011). Such kind of termite's mound debris/organic matter and nutrients content amends soil fertility for the better functioning of the ecosystem (Bonachela *et al.*, 2015). Termites act of bioturbation changed soil texture and make it more porous (Jouquet *et al.*, 2015). Dhembare *et al.* (2015 reported mound making termites such as *Macrotermes* and *Odontotermes* significantly influence soil properties and amend soil fertility. Nigerian savanna region farmers and others including the highlanders of resource poor farmers of southwest Ethiopia use termite mound soil as fertilizer (Abdeta Jembere *et al.*, 2017). Small holder famers use termite mound soil as a fertilizer mainly due to inflated cost of commercial fertilizer. Fageria and Baliga (2005) after testing it on improved maize variety recommended the use of mound soil in combination with NPK fertilizer as it has improved plant growth that led to high yield. Therefore, the objective of the current study was to analyze some physiochemical properties of mound soil and its effect on yield and yield components of maize in western Ethiopia under greenhouse pot experiment condition.

MATERIALS AND METHODS

Description of the study area

The Greenhouse experiment was conducted at Wollega University (WU) in East Wollega zone,

Western Ethiopia (Figure 1) from *October 2018 and June 2019*. The study was conducted at 9O5.887'N latitude, 36O34.647'E longitude and at an elevation of 2080 meter above sea level (m.a.s.l.). The maximum and minimum temperatures of the area were 21.66OC and 13.62OC, respectively. The relative humidity was 55.45% and the average annual rain fall was 1862.33mm. The study area, Nekemte town was 335km away from Addis Ababa to the West.

Termite Sampling and Identification

Mounds in the cultivated land were dug and opened with hoe. Termite soldier samples which came out of the mound for defense were hand-collected with forceps and were preserved in 80% ethanol following Abdurahaman Abdulahi (1990), and Daniel Getahun and Bekele Jembere (2006) procedures. Collected specimens were taken to Addis Ababa University, Insect Science Laboratory for identification. Morphological identification was done using Keys for the Genera of Ethiopian Termites. Moreover, books/proceedings, pictures and reference collections were used for the identification (Emana Getu *et al.,* 2008). The shape and the size of the mandible were the major features considered for the identification.

Experimental materials

Samples of termite mound soil, adjacent soil and non-mound soil were collected from cultivated land of Limu district, Fitbako *kebele* in Eastern Wollega zone. Widely grown maize variety, BH-661 and NPK fertilizer were obtained from Zone Office of Ministry of Agriculture based at Nekemte town.

Pot preparation and filling of soil in the pot

Plastic buckets having 50 litters capacity were purchased from local market. The buckets were perforated at the distance of 5cm from the bottom with nail to prevent inundation. From the stock of Mound soil (MS), Adjacent soil (AS) and Non-mound soil (NMS) three kilogram each were weighed and added to each bucket following Ezekiel *et al*. (2018) procedures. After filling the pots with appropriate soil sample based on the treatment, all buckets were kept at one-meter distance and watered two days before planting. All buckets were watered twice per day throughout the experimental period. Fertilizer was applied at

the rate of 150kg/ha following Ezekiel *et al.* (2018) procedure. Two maize seeds were planted in circular hole having 15cm depth and 30 cm diameter made with finger in each bucket. Two weeks after planting when the seedlings attained two leaves stage, one seedling was removed to minimize competition. Weeding was done by hand and deposited in their respective buckets.

Experimental design and Treatments

The experiment was laid out in a completely randomized design (CRD) with three replications. The treatments were Mound soil (MS), Adjacent soil (AS), Non-mound soil, NPK (15: 15: 15), MS+AS, MS+NPK, MS+NMS, AS+NPK, AS+NMS, NMS+NPK, MS+AS+NPK AND MS+AS+NPK+NMS.

Data collection

Termite genera composition, termite mound soil, adjacent soil and non-mound soil selected physical and chemical properties, plant growth traits at 2, 4 and 8 weeks after planting and yield (g or kg) were some of the data that were collected.
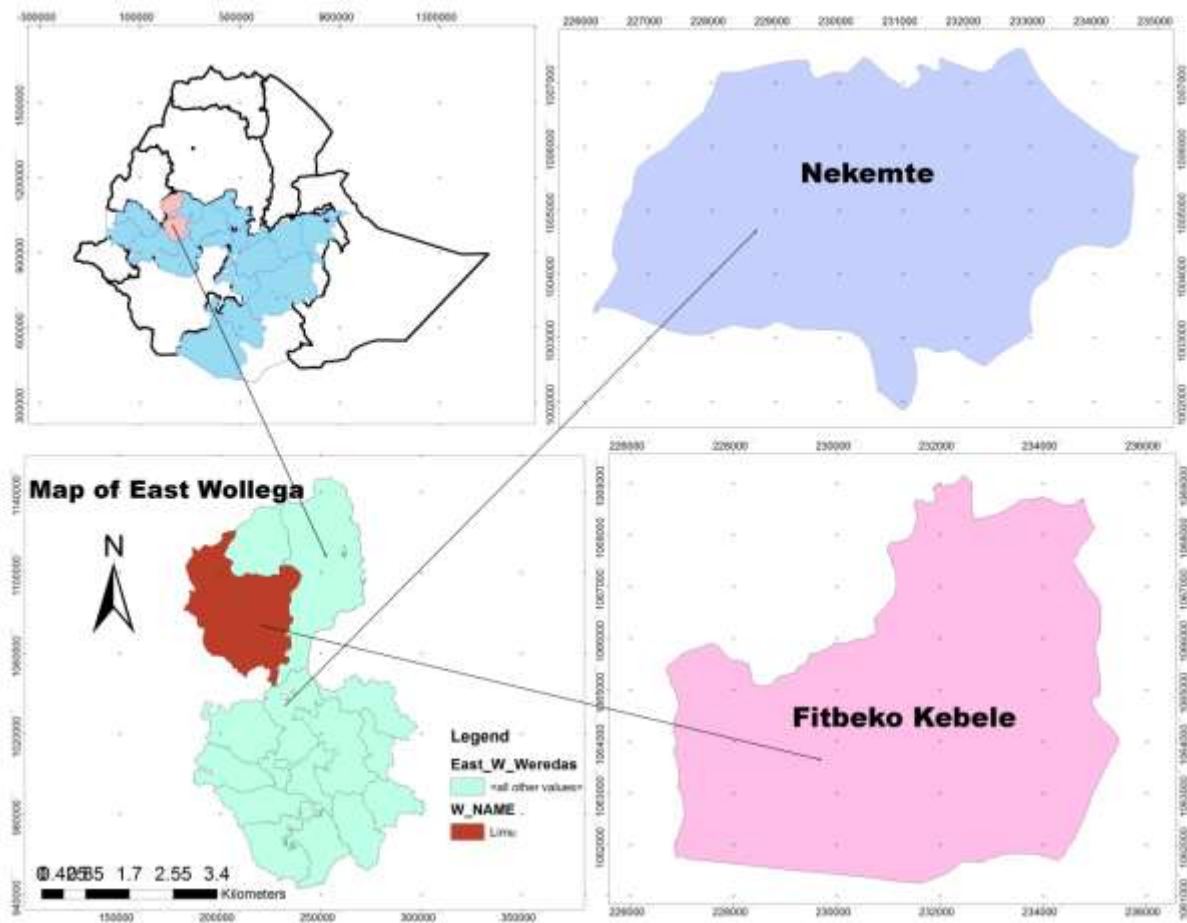

Figure 1. Map of the study area.

Soil Sampling and analysis

A plot of 100mx100m was delineated from cultivated land for sampling. Three mounds within the plot were marked with permanent marker randomly. Soil samples were taken from bottom, middle and top of the termite mounds and mixed up thoroughly to get composite sample of 10 kg from the three mounds. Composite soil sample collection of 10 kg was done at the depth of 0-30 cm using auger for adjacent soil 5m away from the mounds. Composite non-mound soil of 10kg at similar depth with that of adjacent were collected

20 m away from the mounds following Daniel Getahun and Emana Getu (2014) procedures. From each soil types, 3 kg were drawn and used for physiochemical analyses based on National Soil Research Centre of Ethiopia (2000) established procedure. Then some selected physical and chemical properties were analyzed. Soil particle size distribution was determined using hydrometer method. Available potassium (Av. K) was analyzed by extracting with Morgan's solution and measuring by flame photometer. Total nitrogen (TN) was determined by the Kjeldahl procedure (Gupta, 2000). Organic Carbon (OC) content was determined after wet oxidation by the dichromate method. Soil organic matter contains 58% C. Conversion of % C to % OM was done with the empirical factor of 1.724, which was obtained by dividing 100 by 58. Available phosphorus (Av. P) was determined by spectrophotometer following Olsen "method using glass electrode (Olsen, 1954). The pH of the soil was measured potention metrically on direct reading pH meter in water suspension with soil to water ratio of 1:2.5. Exchangeable basic cations (Ca, Mg, K and Na) were extracted with 1M ammonium acetate at pH 7. Exchangeable Ca and Mg were determined from this extract with atomic absorption spectrophotometer, while exchangeable K and Na were determined from the same extract with flame photometry (Abera Donis and Kefyalew Assefa, 2017). The soils were analyzed at Bako Agricultural Research Centre soil laboratory.

Statistical analysis

Analysis for the effect of Mound soil, NPK, Adjacent soil and Non-mound soil on growth trait and maize yield component were done using ANOVA using SAS software version 9.1. Significant means were separated using Tukey's Studentized Range Test (HSD) at 5% significance level (SAS, 1999).

RESULTS AND DISCUSSION

Termite diversity

Termite genera collected from Fitbako *kebele* mounds were shown in Table 1. *Macrotermes* and *Odontotermes* were the termite genera recorded. About 75% of the termites were from the Genus *Macrotermes*. *Macrotermes subhyalinus* (Rambur)

species were collected from mound1 and mound 2, while *Macrotermes herus* (Sjoestedt) were collected from mound 3.

Table 1. Termites' Genera composition of Fitbako kebele.

Termite mounds	Termites genera	
	Macrotermes	*Odontotermes*
Mound 1	25	0
Mound 2	20	0
Mound 3	0	15
Composition (%)	75	25

Selected physical properties of mound soil, adjacent soil and non-mound soil

Selected physical property of mound soil, adjacent soil and non-mound soil were analyzed from composite soil were shown in Table 2. The bulk density of mound soil was higher than adjacent soil and non mound soil. However, bulk densities of termite mound, adjacent soil and non-mound soils were at the normal value range of 1.02-1.35g/cm³ as compared to agricultural soils.

The moisture content of mound soil was higher than adjacent soil and non mound soil. This indicates the availability of sufficient water in mound soil which can be used for normal plant growth. The porosity of mound soil was higher than the adjacent soil and non-mound soil. However, the porosity values of termite mound soil, adjacent soil and non-mound soil are more than the normal soil porosity value of 50% which suffices for crop production.

Table 2. Laboratory analyses of Bulk density, moisture content and porosity of mound, adjacent soil and non-mound soil of Fitbako kebele.

Soil type	Bulk density (g/cm³)	Moisture content (%)	Porosity (%)
Mound soil	1.04	13.20	60.16
Adjacent soil	1.24	10.1	52.35
Non-mound soil	1.0	8.5	52.56

Selected chemical properties of mound soil, adjacent soil and non-mound soil

Selected chemical properties of termite mound soil, adjacent soil, and non-mound analyzed from composite soil samples are shown in Table 3. Non-mound soil had the lowest pH, while that of mound soil was the highest. Organic carbon (OC) in mound soil was the highest.

However, the mound, adjacent and non-mound values are less than the standard range value of OC (>3%) for agricultural soil. The mound soil had higher organic matter (OM) with the value of 4.88% than the adjacent soil (1.30%) and non-mound soil (1.21%) present medium range of OM (3-5%) compared to crop land soil. The highest total nitrogen (TN) (0.14%) was observed in mound soil and the lowest TN (0.04%) was recorded on Non-mound soil. All the TN values recorded were lower than the range value of (TN) (0.25%). The highest concentration of 9.00 ppm was recorded from mound soil, while the lowest 7.23 ppm of P was recorded from non-mound soil. The highest exchangeable Ca and Mg values were

7.70meq/100g and 1.90meq/100g in mound soil. Mound soil had more (k) (1.97 cmol/kg soil than adjacent soil (0.96 cmol/kg soil) and non-mound soil (0.56 cmol/kg soil). However, the value of K in mound soil, adjacent soil and non-mound soil were greater than the critical level of K 0.38 cmol/kg soil for crop production. Slightly higher Mg (1.90meq/100g soil) content was found in mound soil than adjacent soil Mg =1.87meq/100g soil) and non- mound soil (Mg = 1.86meq/100g soil). However, the value of Mg in mound soil, adjacent soil and non-mound soil were greater than the critical level of Mg (0.50meq/100g soil) for the soil used for crop production.

Table 3. Selected chemical properties of Mound soil adjacent soil and Non-mound soil Fitbako *kebele.*

Categories	PH (1:1.25) H_2O	% OC	%OM	%TN	Ava. P(ppm)	Ex. K(cmol/kg soil)	Ex.Ca (meq/100gs oil)	Ex.Mg (Meq/100g soil)
Mound soil	5.44	2.83	4.88	0.14	9.00	1.97	7.70	1.90
Adjacent	5.10	0.76	1.30	0.06	7.30	0.96	7.33	1.87
Non-mound soil	4.5	0.35	1.21	0.04	7.23	0.56	7.21	1.86

Effect of termite mound soil, adjacent soil and non-mound soil on maize plant growth traits two weeks after planting

Effects of termite mound soil, adjacent soil and non-mound soil on maize growth traits two weeks' after planting were shown in Table 4. Treatments' effects were significantly different (p<0.05) two weeks after planting. The highest plant height (32cm) was recorded from the four treatments' combination i.e. MS+AS+NPK+NMS, while the lowest plant height (16.04cm) was recorded from plants grown on non-mound soil.

As shown in Table 4, termite mound soil alone and termite soil combined with other treatments significantly (P<0.05) affected plant growth. The highest stem width was observed in four combined treatments (MS+AS+NPK+NMS), while the lowest plant's stem width was recorded from non-mound soil. Plants grown with NPK and treatments' combination (MS+ AS+NPK+NMS) significantly (P<0.05) higher in number of leaves and leaf width than adjacent and non-mound soil

Table 4. Effect of termite mound soil, adjacent soil and Non-mound soil on means (±se) of maize growth traits two weeks after planting

*Treatments	Plant height (cm)	Stem width (cm)	No. of leaf	Leaf width (cm)
MS	24.1±2.7[c]	2.80±0.26[ab]	8±1.8[cd]	2.8±0.27[bc]
AS	18.0±1.8[e]	2.30±0.24[de]	7±1.8[de]	2.5±0.25[cd]
NPK	23.6±2.7[cd]	2.75±0.24[bc]	7.2±1.8[a]	2.4±0.25[ab]
NMS	16.4±1.7[f]	2.04±0.21[e]	6.0±1.8[e]	2.1±0.23[d]
MS+AS	25.0±2.7[b]	2.60±0.24[cd]	8±1.8[cd]	2.4±0.25[cd]
MS+NPK	30.0±2.9[ab]	2.87±0.26[b]	9±1.8[bc]	2.7±0.25[cd]
MS +NMS	24.0±2.7[cd]	2.70±0.24[cd]	8±1.8[cd]	2.6±0.25[cd]
AS+NPK	20..0±1.8[d]	2.50±0.24[d]	7±1.8[de]	2.5±0.25[cd]
AS+NMS	18.0±1.8[e]	2.30±0.24[de]	7±1.8[de]	2.5±0.25[cd]
NMS+NPK	17.4±1.7[ef]	2.04±0.21[e]	6.0±1.8[e]	2.1±0.23[d]
MS+AS+NMS	24.1±2.7[c]	2.80±0.26[ab]	8±1.8[cd]	2.8±0.27[bc]
MS+AS+ +NPK+NMS	32.0±2.9[a]	3.16±0.24[a]	10±1.8[a]	3.5±0.29[a]

*MS= mound soil, AS=adjacent soil, NPK: N= Nitrogen, P= Phosphorus and K= Potassium, NMS = Non-mound soil.
Means followed by the same letter (s) within a column are not significantly different from each other at 5% level, Tukey's Studentized Range Test (HSD).

Effect of termite Mound soil, NPK, Adjacent soil, Non-mound soil on maize plant growth traits four weeks after planting

Maize plant growth traits were significantly (P<0.05) high on plants grown on treatments combination except number of leaves which were not statistically different (P>0.05) in all treatments four weeks after planting (Table 5). Maize plant growth traits were significantly (P<0.05) low in non-mound soil.

Table 5. The effect of termite Mound soil, NPK, Adjacent, and Non- mound soil on mean (±se) maize growth trait four weeks after planting.

*Treatments	Plant height (m)	Stem width (cm)	No. of leaf	Leaf width (cm)
MS	67.10±9.35c	7.12±1.36ab	10.0±2.2a	7.5±2.19b
AS	53.20±7.32f	5.67±0.98d	9.6±2.2a	5.6±2.19d
NPK	66.89±9.35d	7.02±1.36b	10.0±2.2a	6.98±2.19c
NMS	50.2±7.29g	4.30±0.80.e	9.3±2.2a	4.9±2.19e
MS+AS	64.30±9.35e	6.13±1.21bc	9.0±2.2a	7.0±2.19bc
MS+NPK	76.30±10.72b	7.25±1.36ab	10.0±2.2a	8±2.19ab
MS+NMS	67.10±9.35c	7.12±1.36ab	10.0±2.2a	7.5±2.19b
AS+NPK	66.34±9.35d	6.27±1.21bd	9.9±2.2a	6.9±2.19bc
AS+NMS	56.2±7.29g	4.35±0.80.e	9.3±2.2a	4.9±2.19e
NMS+NPK	53.20±7.32f	5.67±0.98d	9.6±2.2a	5.6±2.19d
MS+AS+NPK	77.30±10.72b	7.25±1.36ab	10.0±2.2a	8±2.19ab
MS+AS+NPk+NMS	80±11.41a	7.30±1.36a	10.4±2.2a	10±2.19a

*MS= mound soil, AS=adjacent soil, NPK: N= Nitrogen, P= Phosphorus and K= Potassium, NMS = Non-mound soil.
Means followed by the same letter (s) within a column are not significantly different from each other at 5% level, Tukey's Studentized Range test (HSD).

Effect of termite mound soil, adjacent soil and non-mound soil on maize plant growth traits eight weeks after planting

Plant height (cm), stem width (cm), No. of leaf and leaf width (cm) eight weeks after planting showed significant (p<0.05) variations among the treatments except for the plant height (Table 6). The highest stem width (9.2cm) and the highest leaf width (9.4cm) were recorded from four combined treatments, respectively and the lowest stem width (5.13cm) and the leaf width (5.7cm) were recorded from NMS, respectively

Table 6. The effect of termite Mound soil, Adjacent soil, NPK and Non-mound soil on mean (±se) maize growth trait eight weeks after planting.

*Treatments	Plant height (cm)	Stem width(cm)	No of leaf	Leaf Width (cm)
MS	1.32±0.17a	8.5±1.18bc	11.0±0.86ab	7.6±1.06bc
As	1.44±0.17a	5.13±1.18d	11.01±0.86ab	6.5±d1.06
NPK	1.3±0.17a	7.53±1.18d	11.8±0.86ab	6.7±1.06cd
NMS	1.3±0.17a	5.03±1.18f	11.2±0.86ab	5.7±1.06e
MS+AS	1.32±0.17a	6.5±1.18e	10.9±0.86ab	7.0±1.06c
MS+NPK	1.5±0.17a	8.9±1.18b	11.2±0.86ab	7.7±1.06b
MS+NMS	1.41±0.17a	9.2±1.18a	12.3±0.86ab	9.4±1.06a
AS+NPK	1.32±0.17a	7.5±1.18de	10.8±0.86ab	7.1±1.06c
AS+NMS	1.4±0.17a	8.9±1.18b	11.2±0.86ab	7.7±1.06b
NMS+NPK	1.5±0.17a	5.03±1.18f	11.2±0.86ab	5.7±1.06e
MS+AS+NPK	1.51±0.17a	9.2±1.18a	12.3±0.86ab	9.4±1.06a
MS+AS+NPK+NMS	1.61±0.17a	9.2±1.18a	12.3±0.86ab	9.4±1.06a

*MS= mound soil, AS=adjacent soil, NPK: N= Nitrogen, P= Phosphorus and K= Potassium, NMS = Non-mound soil.
Means followed by the same letter within a column are not significantly different from each other at 5% level, Tukey's Studentized Range test (HSD).

Effect of termite mound Soil, adjacent and non-mound soil on yield components at harvest.

The effect of termite mound soil, adjacent soil and non-mound soil on mean number of maize yield components at harvest was shown in Table 7.There was no significant difference(p>0.05) between the plant height. However, other maize plant growth performance and yield were significantly affected (p<0.05) by application of treatments. In cob, there was significant difference among the applied treatments. However, all the recorded treatments are all most revealed similar mean number of cobs. ANOVA of grain yield per pot shows significantly difference (P<0.05) among the treatments (Table 7). As revealed in the result, the highest grain yield per pot was recorded from combined MS+AS+PK+NMS treatments and the lowest grain yield were recorded from non-mound soil.

Termites are considered to be one of the most destructive pests in the world. But, termite mound soil amends soil fertility and utilized as an alternative to NPK fertilizers by cash constrained smallholder farmers in some parts of Africa. However, there is little knowledge on mound mineral nutritional value and the impact they have on plant growth and yield in western Ethiopia particularly Nekemte areas where high maize production, high termite mound distribution and termite infestations is there. As illustrated in the result, statistically significant difference (P< 0.05) was observed in yield per pot form all treatments at harvest (Table7). The highest yields were recorded from four MS+AS+NPK+NMS combined treatments and the lowest yield per pot was observed from non-mound soil. Significant yield production was also observed in MS and further more yield was recorded from four mixed treatment MS+NPK+AS+NMS than Non –mound soil (Table 7).

Table 7. Effect of termite Mound soil, NPK, Adjacent and Non-mound soil on mean (±se) of maize yield components.

*Treatments	Plant height (m)	No of cobs per plant	Yield per plant (gm)
MS	3.53±0.01[a]	2.7±0.46[ab]	1.59±0.19[b]
As	3.57±0.01[a]	2.2±0.46[c]	1.5±0.19[bc]
NPK	3.52±0.01[a]	2.5±0.46[b]	1.4±0.19[c]
NMS	3.52±0.01[a]	2±0.46[d]	1±0.19[d]
MS+AS	3.55±0.01[a]	2.3±0.46[bc]	1.3±0.19[cd]
MS+NPK	3.54±0.01[a]	2.3±0.46[bc]	1.6±0.19[ab]
MS+NMS	3.53±0.01[a]	2.7±0.46[ab]	1.59±0.19[b]
AS+NPK	3.53±0.01[a]	2.3±0.46[bc]	1.3±0.19[cd]
AS+NMS	3.53±0.01[a]	2.3±0.46[bc]	1.3±0.19[cd]
NMS+NPK	3.53±0.01[a]	2.3±0.46[bc]	1.3±0.19[cd]
MS+AS+NPK	3.55±0.01[a]	2.3±0.46[bc]	1.3±0.19[cd]
MS+AS+NPK+NMS	3.55±0.01[a]	3±0.46[a]	1.93±0.19[a]

*MS= mound soil, AS=adjacent soil, NPK: N= Nitrogen, P= Phosphorus and K= Potassium, NMS = Non-mound soil.
Means followed by the same letter within a column are not significantly different from each other at 5% level, Tukey's Studentized Range test (HSD).

DISCUSSION

In the analyzed experimental result, the selected physiochemical properties of mound soil; bulk density, moisture content, porosity and soil; % OM, % OC, TN, P, pH, Ex, Ca, Mg and K were found higher and. are effective in crop production than non-mound soil. The current findings were in line with the finding of Alemu Lelago and Tadele Buraka (2019) that reported termite induce the change in physical and chemical properties of mound soil better than non-mound soil, These physicochemical variation in termite soil was attributed by foraging termites *Macrotermes* collected from majority of labeled mounds than *Odontotermes.* In accordance to this, Sutuma Edossa Wako (2015), demonstrate that each mound consisted of dissimilar colonies of termites. The result of bulk density recoded in the current study, showed higher in mound soil than non-mound soil. In accepting this, Arshad *et al.* (2010) stated that, the termite mounds had higher bulk density than the surrounding soil reveal termites repack soils with their saliva to form hard protective layers against open air and temperature fluctuation in the mounds. In current study moisture content of mound soil was greater than the non-mound soil. This is accepted by Kaschuk *et al.* (2006) who reported that, termite increase soil depth and regulate water flow into the soil for efficient use of water by crops. In selected analyzed soil chemical properties soil; % OM, % OC, TN, P, pH, Ex, Ca, Mg and K showed higher in mound soil than non-mound soil. In agreement with this, Alemu Lelago and Tadele Buraka (2019), stated, chemicals recorded in termite mound soil were found higher than those in non-mound soil, In supporting this, Daniel Getahun Debelo and Emana Getu Degaga, (2014) reported that exch. cations (Ca, Mg, Na and K), were significantly higher in termite mounds than in non-mound soil and higher values of organic matter %OM and slightly acidic pH, were also recorded in mound soil than in anon-mound soil, this result was accepted by Jouqu *et al.* (2014) who stated that the mound soil organic matter is increased significantly due to the high amount of mound soil organic matter return from organic debris or plant living tissue foraged and degraded during mound construction. In contrast to this, Susumu *et al.* (2011) reported that cations had contributed more alkaline to the mound soil and make it (slightly to moderately alkaline) values than non-mound soils. Daniel Getahun and Emana Getu (2014) in supporting, stated there is a small increase in pH of Macrotermitinae when compared with the subsoil from which the mounds are constructed but there is little difference with the topsoil

Plant growth trait; Plant height, stem and leaf width and leaves number of maize growth were significantly higher from mound soil and more growth was attained from (MS+AS+NPK+ NMS) than non-mound soil. Subsequently this growth induce cob to retain more yield per plant. In accepting this, Daniel Getahun and Emana Getu (2014) states maize grown on mound perimeter produces larger cobs and this led to subsequent increase in yield than the one grown far from mound. Because in mound soil there were significantly higher values of % TN, ex. Ca, % OM, average K and available P. In accepting this, Sileshi Gudeta *et al.* (2009), reported, significantly higher plant biomass and grass growth around termitaries compared with the ones grown far away from mounds. As revealed from the result, plant grown in non-mound soil appear yellowish and poor stand stem, while, deep green in mound soil and deeper and well performed stem in MS+AS+NPK+NMS. This is in accordance with Daniel Getahun Debelo and Emana Getu Degaga (2014) who reported that, crops grown on soils in mound perimeter were dark green while the ones grown on non-mound soil were yellowish in color. In accepting this, Rajagopal (2015) also states plants from treated plots were tall and dark green with large-sized stems and ears, whereas the plants from the untreated plots were relatively weak and lanky(tall and thin),Mixture MS+AS+NPK+NMS application were found to be highly effective on maize growth performance and resulted in better yield production than from non- mound soil, in agreement with this Ezekiel *et.al* (2018) and Olowoboko *et al.* (2017) reported that, the application of inorganic fertilizer NPK to mound soil facilitates growth of the maize crop. Fageria and Baligar (2005) also stated that, number of panicles, shoot in rice and pods in bean dry weights of shoot and grain of upland rice and common bean grown on termite mound soil were significantly increased by the application of NPK treatment.

CONCLUSION AND RECOMMENDATION

In the current study it was conceived that mound soil exceed in most of the analyzed selected physical soil; Bulk density, Moisture content, Porosity and chemical properties soil; pH, % OM, % TN, Ca, Mg, av. P and K than non-mound soil.

Physiochemical backup of mound soil was attributed by termites *Macrotermes,* and *Odontotermes* forages. From the current study it can be concluded that mound soil amends soil fertility than non-mound soil and allow effective maize growth performance, better maize growth and subsequent increase in yield/pot was attainedfrom mound soil mixed with As, NPK and NMS. The use of NPK fertilizer on plots having termite mound is not recommended. However, further research is needed on how to use mound soil on large plot of land.

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