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The *Odontotermes* spp and *Macrotermes* spp associated with damage in maize crops and trees of economic importance in Arusha, Tanzania

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Abstract

Termites are among the insect pests which constrain agricultural crop yields and tree production. The aim of this study was to identify termite species devastating maize crops and trees of economic values. Quadrats were conducted to collect termites from infested fields of maize crops and trees of economic importance. The termites collected were put in 70% alcohol prior to identification. Also leaves and flowers were collected from all infested trees for identification. The experimental identification was carried out at Tropical Pesticides Research Institute, Arusha. The results obtained confirmed that termite species of Odontotermes and Macrotermes are the most problematic ones which hinder maize crop and tree production. The Macrotermes spp were found to cause a great loss in maize crops where as Odontotermes spp affected Gravillea robusta, Terminalia mantale, Moringa oleifera, Jacaranda mimosifolia and Acrocarpus fraxinifolius intensively. Currently, there are no any practical control strategies of termites in the study site. Therefore, this study proposes to adopt sustainable management strategies involving integrated pest management (IPM) for the small scale farmers so that to improve their maize crops and tree production.

Keywords: Damage, loss, maize crops, termites, trees..

Introduction

Termites play a great role in the ecosystems especially in the decomposition of wooden components[1]. Their social activities result into excellent soil aeration, porosity and addition of macronutrients such as Carbon and Nitrogen[1,2]. Nevertheless, termites cause serious damage in crop plants and trees of economic values[3]. The most species recognized as economic termite pests in crop plants and forests are *Heterotermes, Psammotermes*, *Coptotermes*, *Hodoterme*, *Anacanthotermes*, *Neotermes*, *Syntermes, Procornitermes, Odontotermes, Microtermes, Macrotermes, Cornitermes, Ancistrotermes* and *Amitermes*[4,5].

These species are highly reported to cause economic loss in crops and tress due to damage. For example, research findings according to Sileshi *et al.* demonstrated that there is a yearly loss of 20 to 30% to pre harvest of maize crops in Malawi and Zambia[6]. This is in agreement with the report of Sekamatte which documented that termites can cause 50–100% loss of millets, sorghum and groundnuts to small scale farmers in Uganda[7]. In addition, the destruction by termites on the 1 to 2 years grown Eucalyptus trees is at most 100% in Ethiopia[3]. In Tanzania, the greatest termite damage effects in maize crops and trees of economic values particularly in Arumeru district of Arusha. This is the reason which inspired the researchers to conduct this study so that to understand the extent of crop loss and tree production constraints caused by termites. Currently there are no any management methods applied in the area by the farmers. Because the farmers have not yet used synthetic pesticides and therefore this study suggests to use integrated pest management (IPM) like biological control and application of pesticidal plants so that to maintain other non-targeted beneficial insects and other organisms.

Materials and methods

Study site description: The study was conducted at Kikwe Ward in Arumeru district of Arusha region, Tanzania. The termite sampling activity started from May to October of 2018. In Kikwe Ward, the sampling work was carried out on four locations thereby two were cultivation sites (maize farms) and two sites of trees of economic importance. The locations were selected purposively after noticing a great damage by termites in trees of economic importance and maize farms during surveying as depicted in the Figure-1.

Termite sampling, collection of leaves and flowers from infested trees: The sampling process was categorized into maize fields and fields of trees of economic importance. Quadrats of 5 m x 2 m and 10 m x 10 m were adapted from Jones and Eggleton and Coulibaly *et al.* with modifications[8,9].

Termite sampling in the maize fields: Two transects of 200 m long were set in the maize fields at 10m apart. Then quadrats of 5mx2m were conducted twenty times along the 200m transect at interval of 5m in the maize fields. In each quadrat, three lines were created at 40cm apart. Along each line, holes at 1 m separate were dug out to depth of 20–30cm to search for termites. From each quadrat 20 termites were collected and put into 70% alcohol prior to identification as shown in the Figure-2. For single transect 20 termite samples were collected and the total of 40 termite samples for two transects per location.

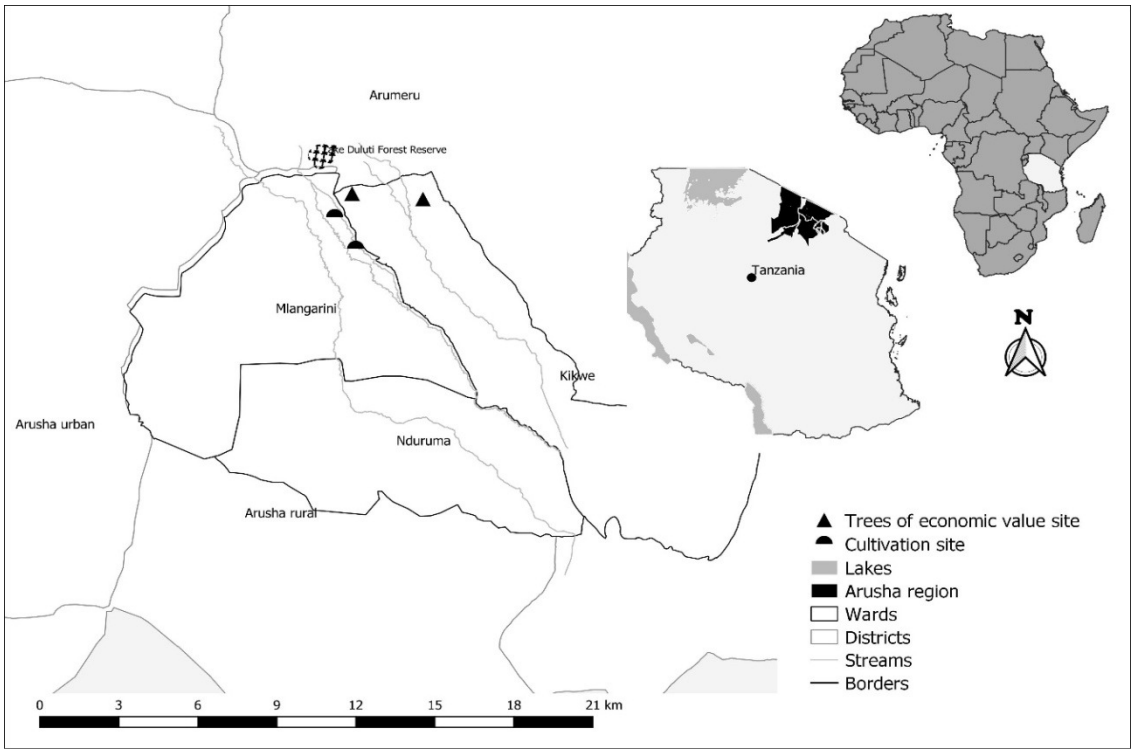

Figure-1: Study site.

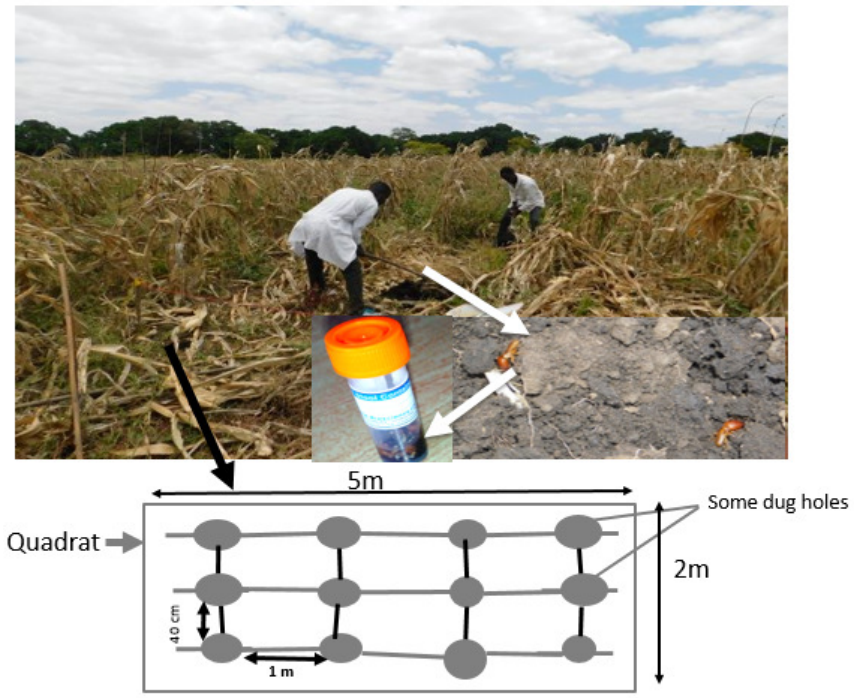

Figure-2: Termite sampling in the maize fields.

Termite sampling in the fields of trees of economic importance: Two transects of 400m long were established at 10 m apart in the fields of trees of economic importance. Then quadrats of 10mx10m were conducted twenty times along the 400 m transect at interval of 10m in the fields of trees of economic importance. Furthermore, trees which were encountered within the quadrat were counted and labeled (for example 1,2,3,4 etc.). Thereafter pieces of paper were prepared according to the number of trees counted in the particular quadrat. The pieces of paper were put and mixed in the small box before withdrawing. As per each quadrat, only five trees were considered. For example, in the Figure-3, eleven trees were found in the quadrat which were labeled 1 to 11. Then pieces of paper labeled 1-11 were put and mixed in the small box followed by withdrawing five times. For instance, number 2,6,7,9 and 11 happened by chance after withdrawing from the box.A total of 20 termites were collected from each quadrat and preserved in 70% alcohol for identification (Figure-3). Also we collected 20 samples per each transect and the total of 40 samples for two transects per location. The total number of termite samples from all locations of maize fields and fields of economic importance were 160 (Table-1).

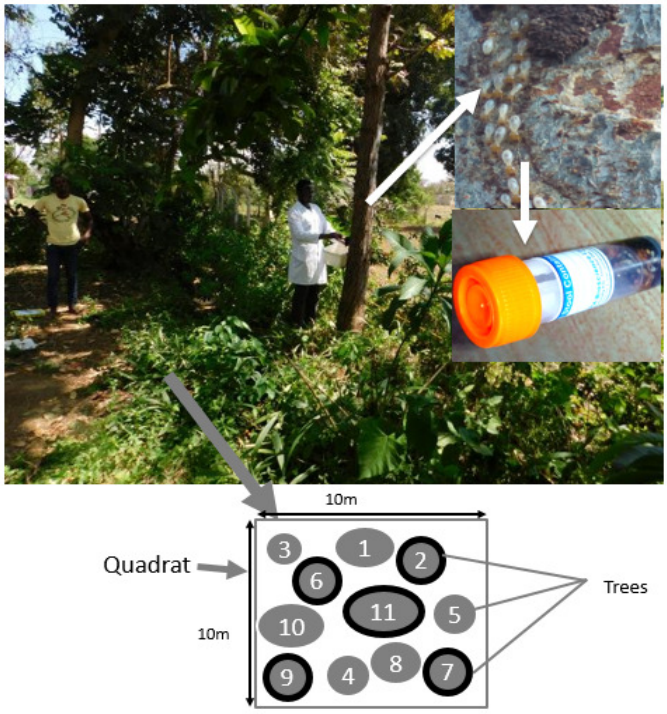

Figure-3: Termite sampling in the trees of economic importance.

Collection of leaves and flowers from infested trees: Leaves and flowers were collected from each infested trees which was encountered per quadrat. Leaves and flowers were packed in medium boxes and labeled to prior to identification.

Identification of termites: The total number of 160 termite samples was transported to the laboratory of Tropical Pesticides Research Institute (TPRI), Arusha for identification. During identification, Stereo-Microscope was used to observe morphological features. Both termite workers and soldiers were dissected for detailed observation. In addition, various referencing identification keys were used to help in confirming the genera according to Sands[10], Bouilon and Mathot[11], Pearce *et al.*[12] and Sands[13].

Identification of infested trees using leaves and flowers: Leaves and flowers were transported to National Herbarium of Tropical Pesticides Research Institute, Arusha for identification.

Results and discussion

Species of *Macrotermes* and *Odontotermes* were identified. The *Macrotermes* spp and *Odontotermes* spp were dominant in the maize fields and *Odontotermes* in the fields of trees of economic importance. Few *Odontotermes* spp and unknown termite species appeared in the maize fields while *Macrotermes* spp were not found in trees (Table-1). The species of *Odontotermes* spp (Figure-4(a)) and *Macrotermes* spp (Figure-4(b)) were the most destructive fauna in trees of economic values and maize crops respectively. The *Macrotermes* spp damaged maize crops intensively (Figure-5). For example, in the study site it was found that one hectare (10,000m^2) of about of 42,000 maize crops planted at 75cm by 30cm, approximately 31,500 maize crops were damaged by termites giving a loss of 75% maize crops before harvesting. The *Odontotermes* spp were destructive to trees of economic values. Some of these trees identified were *Gravillea robusta*, *Terminalia mantale*, *Moringa oleifera*, *Jacaranda mimosifolia* and *Acrocarpus fraxinifolius*. They were found more infested by *Odontotermes* spp. However, the *Gravillearobusta* is highly susceptible tree to *Odontotermes* spp followed with *Acrocarpus fraxinifolius* and others as presented in Figure-5 and Figure-6.

Discussion: The species of *Macrotermes* and *Odontotermes* confirmed to have intensive damage in maize crops and trees of economic values. The *Macrotermes* spp were found to be very destructive to maize crops and *Odontotermes* spp affect *Gravillea robusta*, *Terminalia mantale*, *Moringa oleifera*, *Jacaranda mimosifolia* and *Acrocarpus fraxinifolius* negatively. Our findings correspond with the study reports of other scholars. For instance, country like India the *Macrotermes* spp cause minimum loss of 25% in maize yields per year[14]. Moreover, in Uganda, 10 to 30% is a loss of maize crop due to damage by species of *Macrotermes* before harvesting[15]. This is in line with the report of Maayiem *et al.* which found that species of *Odontotermes* and *Macrotermes* can influence up to 100% damage on crops of millet, Maize, cassava, groundnuts and rice in Ghana[16]. In Uganda, *Grevillea robusta* and *Eucalyptus* species are the most susceptible plant species to *Odontotermes* spp and *Macrotermes* spp[17]. The affected trees die before reaching maturity, resulting to low timber production. In Tanzania, the documented information regarding loss caused by termites in agricultural crops and tree is less quantified. However, the potential practical report from Tanzania has

demonstrated a significant loss of cash crops. For example, the species of *Odontotermes* and *Macrotermes* are some of problematic termite species which constrain coconut production ranging from 20 to 100% destruction[4].

Table-1: Termite species encountered in the study site.

Locations	Latitudes	Longitudes	Altitudes (meters)	Crops or Trees	Termite samples collected	Samples contained *Macrotermes*	Samples contained *Odontotermes*	Samples contained unknown termite species
Kikwe	3.40887	36.79201	1175.672	Maize crops	40	36	3	1
Kikwe	3.42046	36.7992	1148.135	Maize crops	40	37	1	2
Kikwe	3.40038	36.79797	1193.815	Trees	40	0	40	0
Kikwe	3.40236	36.8222	1147.734	Trees	40	0	39	1

(a) (b)

Figure-4: Problematic termite species.

Figure-5: Current status of damage in maize crop and trees of economic importance at study site. In this site, termites affect maize crop and trees of economic values intensively. Damage by termites cause low maize crop yields and decreased timber production.

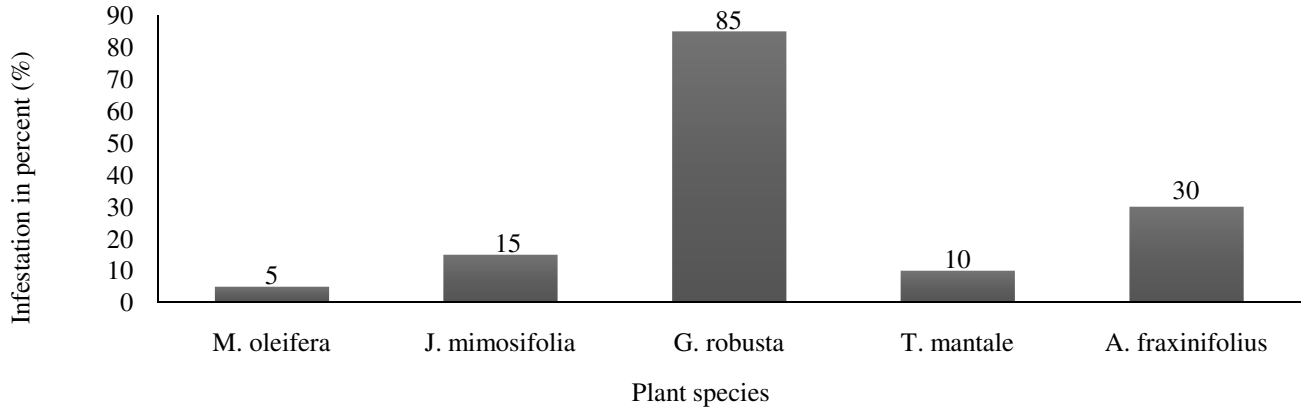

Figure-6: Damage of termites in trees of economic importance.

Conclusion

This study has demonstrated that there is a serious damage in the maize crops and trees of economic importance associated with *Odontotermes* spp and *Macrotermes* spp. So urgent action should be taken for the management of *Odontotermes* spp and *Macrotermes* spp in order to improve maize yield and timber production. Because in the area there not yet application of synthetic pesticides, this study proposes to adopt eco-friendly methods such as biological control and use of pesticidal plants so that to avoid stressing, suppressing, affecting and killing other beneficial insects and other non-targeted organisms.

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