Arboreal Crop Tree Termites in the Komkom Community Oyigbo Local Government Area in Port Harcourt, Nigeria

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Termites cause major economic losses by destroying agricultural crop trees. This study aims to survey the arboreal crop tree termites in Komkom community of Oyigbo in the Niger Delta. The study area was divided into 10 zones and 306 trees were examined for the presence of termite nests, hollow sounds and mud tubes. Samples of termites with its nest, hollow, mud tube and tree cuttings were collected from infested trees using metal spatula, sorted and identified. Approximately 9.5% of the sampled trees had some termite presence as arboreal nests, hollowness or mud tubes. The trees most affected were *Gmelina arborea* (Gmelina), *Dacryodes edulis* (Native pear), *Persea americana* (Avocado), *Citrus sinensis* (Orange), *Chrysophyllum albium* (African star apple), *Cocos nucifera* (Coconut), and *Mangifera indica* (Mango). The termites identified were *Odontotermes oblongatus*, *Microcerotermes annandalei*, *Microtermes sp* (new), *Microcerotermes paracelebensis*, *Neotermes spp*, *Glyptotermes kachongensis* and *Microcerotermes crassus*. Eight crop trees - *Anacardium occidentale* (Cashew), *Moringa oleifera* (Moringa), *Annona muricata* (Soursop), *Theobroma cacao* (Cocoa), *Psidium guajava* (Guava), *Irvingia gabonensis* (Bush mango), *Syzygium samarangense* (Java apple), and *Elaeis guineensis* (Oil Palm) had no termite infestation in the study area. The result obtained in this study indicates the termite species that are pests of crop trees in the area.

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1. INTRODUCTION

Termites belong to the insect Order Isoptera, made up of about 2500 species and are social insects living in colonies. Both winged and wingless individuals occur in a colony [1]. They are eurytopic and distributed throughout the temperate, tropical and subtropical regions of the world, with the highest diversity found in tropical forests [2]. Termite’s colonies have different individuals called castes in their nests [3]. They are a prime example of insects that display decentralised self-organised system, swarm intelligence and co-operation among colony members to exploit food source and environment that could not be available to any single insect acting alone [4]. A typical colony contains eggs, nymphs, workers, soldiers or reproductive individuals (alates) and the workers till long hours tending to the queen, building the nest, or gathering food [3]. Termites are essential members of the soil ecosystem and are found throughout the world [5]. They feed on decomposing organic wastes of leaves, trees, animal dung, and living or dead wood [6]. Termites cause major economic losses by destroying agricultural crops, live trees, and wooden structures in the houses [7,8]. They also feed on and often destroy various other structures or materials that people use e.g., wooden portions of buildings, furniture, books, wooden utility poles, wooden fence posts, many fabrics, and other useful materials [9]. Termites are one of the most damaging pests in the tropics and cause considerable problems in housing, agriculture and forestry [5]. Some have their nests underground, others in wood, for example, some termites hollow out trees while some build mounds and mud tubes. Species of Microtermes and Odontotermes have been found to damage different crops [10,11]. This damage may also extend to household furniture, paper products, many synthetic materials and food substances. Each year hundreds of thousands of structures such as wooden bridges, dams, decks, homes, retaining walls, roads, wooden utility poles, and underground tubes for cables and pipes require treatment against termites [12]. The number of species causing damage to building is between 70 to 80, out of which 50 species are serious pests that require management [7,13]. More than 1,000 of the 2,600 recognized species of termites are found in Africa [12]. Many of the economically important wood feeding species of termites found in the tropics, sub-tropics and temperate regions are in the genera Coptotermes, Odontotermes, Macrotermes, Microcerotermes, Microtermes, Reticulitermes, Ancistrotermes, Schedorhinotermes and Pseudacanthotermes [14,15]. Trees are sources of food and shelter to both termite and humans. Effects of termites on trees are severe including degradation of timber, reduced or complete loss of economic yield from fruit trees like mangoes, oranges etc. Termites can equally lead to loss of roots, bark, leaves and flowers of medicinal plants like Azadirachta indica (Indian lilac - Dogonyaro) and could in severe cases lead to mortality of trees. However, termites have beneficial values such as organic matter recycling, improving soil fertility and serving as food sources for other animals [12, Changlu et al., 2009]. Noting the benefits and severe economic losses associated with termites, it is therefore, necessary to do a survey of arboreal crop termite infestations in the Komkom community of Oyigbo, Rivers State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study area was the Komkom community (Fig. 1) in Oyigbo Local Government Area of Rivers State, Niger Delta, Nigeria, made up of residential areas, agricultural establishments, institutions, markets and other corporate organizations. There were an assortment of trees such as Dacryodes indica, Cocos nucifera, Pterocarpus miliarelli, Moringa oleifera, Psidium guajava, Persea americana, Citrus sinensis, Annona muricata, Elaeis guineensis, Gmelina arborea and others in the area.

2.2 Collection of Sample

Samples were collected monthly from March to July 2019. Samples of termites were collected by cutting open and collecting termites from mud tubes, nests and live trees with hollow sounds using metal spatula and placed in plastic containers.

2.3 Identification of Termite Species

Termite specimens collected from different infested trees were examined under a dissecting microscope and identified using a manual by Muzaffer [16] to a genus level based on the...
termite morphology such as head structure, segments of the thorax, shape and serrations of the mandible (Fig 2), antenna and wing venation pattern. The absence of an inventory of termites found in Nigeria and the difficulty in identification using only morphological characters limited the identification to species for some.

**Fig. 1.** Map of Rivers State showing sampling location

![Map of Rivers State showing sampling location](image)

**Fig. 2.** Head of soldier of *Microcerotermes paracelebensis*

![Head of soldier of *Microcerotermes paracelebensis*](image)
2.4 Statistical Analysis

Statistical analysis include % prevalence per tree type and for all trees and mean % abundance of caste, these tests were done using MS Excel.

3. RESULTS

3.1 Termite Species in the Study Area

Out of 306 trees that were examined, 29 had termite infestation (9.5%). The prevalence of termite-infestation of specific trees species varied from 0 to 100% (Table 1). Eight crop trees such as Anacardium occidentale (Cashew), Moringa oleifera (Moringa), Annona muricata (Soursop), Theobroma cacao (Cocoa), Psidium guajava (Guava), Irvingia gabonensis (Ogbono), Syzygium samarangense (Java apple), and Elaeis guineensis (Oil Palm tree) had neither termite nests, mud tubes nor hollow sound. All other trees had some degree of termite presence (Figs 3 and 4). All Gmelina arborea (Gmelina) examined were infested and had termite nests and mud tubes on them (Fig 4) with three termite species namely; Microcerotermes paracelebensis, Neotermes spp, Microcerotermes annandalei and Glyptotermes kachongensis. Microcerotermes annandalei was also found infesting Mangifera indica (mango) tree, Microcerotermes paracelebensis and Microtermes sp were found infesting two different trees such as Citrus sinensis (Orange) and Dacryodes edulis (Native pear “Ube”), Microcerotermes crassus was found on Chrysophyllum albidum (African star apple “Udara”) and Cocos nucifera (Coconut).

The termite species on the trees differed, Neotermes spp and Glyptotermes kachongensis were selective, they were found only on Persea americana (Avocado), Microcerotermes crassus and Odontotermes oblongatus were also selective, Microcerotermes crassus were found only on Chrysophyllum albidum (African star apple) while Odontotermes oblongatus were found only on Gmelina arborea (Gmelina) as shown on Table 2. Microcerotermes paracelebensis and Microcerotermes annandalei were found in five tree types: Citrus sinensis, Gmelina arborea, Mangifera indica, Persea americana, and Dacryodes edulis. Microtermes sp were found in 4 tree types: Citrus sinensis, Gmelina arborea, Persea americana, and Dacryodes edulis as shown in Table2.

![Fig. 3. Persea americana showing Neotermes infestation using hollow sound of the tree](image)
Table 1. Prevalence of termite infestation on examined trees and their presentations

| Common name of trees | Botanical name of trees | No. Examined | No. Infected | % Infestation | Presentation | Termites found |
|----------------------|-------------------------|--------------|--------------|---------------|--------------|----------------|
| Gmelina              | *Gmelina aborea*        | 10           | 10           | 100           | Mudtube      | *Microcerotermes annandali* |
|                      |                         |              |              |               | Nest         | *Microtermes sp* |
| Coconut              | *Cocos nucifera*        | 40           | 1            | 2.5           | Mudtube      | *Odontotermes oblongatus* |
| Orange               | *Citrus sinensis*       | 30           | 3            | 10            | Mudtube      | *Microtermes sp* |
| Native pear “Ube”    | *Dacryodes edulis*      | 41           | 4            | 9.8           | Nest         | *Microtermes sp* |
| African star apple “Udara” | *Chrysophyllum albidum* | 14           | 1            | 7.1           | Nest         | *Microcerotermes paracelebensis* |
| Avocado              | *Persea americana*      | 38           | 9            | 23.7          | Nest         | *Microcerotermes paracelebensis* |
| Mango                | *Mangifera indica*      | 20           | 1            | 5             | Nest         | *Neotermes spp,* |
| Bush mango “Ogbono”  | *Irvingia gabonensis*   | 10           | 0            | 0             | Nil          | *Microcerotermes paracelebensis* |
| Guava                | *Psidium guajava*       | 34           | 0            | 0             | Nil          | Nil |
| Moringa              | *Moringa oleifera*      | 19           | 0            | 0             | Nil          | Nil |
| Sour sop             | *Annona muricata*       | 23           | 0            | 0             | Nil          | Nil |
| Almond               | *Prunus dulcis*         | 12           | 0            | 0             | Nil          | Nil |
| Oil Palm             | *Elaeis guineensis*     | 10           | 0            | 0             | Nil          | Nil |
| Cashew               | *Anacardium occidentale*| 3            | 0            | 0             | Nil          | Nil |
| Java apple           | *Syzygium samarangense* | 2            | 0            | 0             | Nil          | Nil |
| Total                |                         | 306          | 29           |               |              |                |
Fig. 4. *Gmelina arborea* (tree) with *Microcerotermes annandalei* nest

Table 2. Termite species found on infected trees in study area

| Termites Family | Termite species                  | Trees Infected               |
|----------------|----------------------------------|------------------------------|
| Termitidae     | *Microcerotermes annandalei*     | *Gmelina aborea*             |
| Termitidae     | *Microtermes sp*                 | *Gmelina aborea*             |
| Termitidae     | *Odontotermes oblongatus*        | *Gmelina aborea*             |
| Termitidae     | *Microtermes sp*                 | *Cocos nucifera*             |
| Termitidae     | *Microtermes sp*                 | *Citrus sinensis*            |
| Termitidae     | *Microcerotermes paracelebensis* | *Citrus sinensis*            |
| Termitidae     | *Microtermes sp*                 | *Dacryodes edulis*           |
| Termitidae     | *Microcerotermes paracelebensis* | *Dacryodes edulis*           |
| Termitidae     | *Microcerotermes crassus*        | *Chrysophyllum albidum*      |
| Termitidae     | *Microcerotermes paracelebensis* | *Persea americana*           |
| Kalotermitidae | *Glyptotermes kachongensis*      | *Persea americana*           |
| Termitidae     | *Microcerotermes paracelebensis* | *Mangifera indica*           |

Table 3 shows the mean % abundance of caste, for termite spp. and tree type. Majorly, there was a random distribution of the termite species on the tree types in the sampled area, a few termite species however showed specificity. The alates of *Neotermes* spp and *Microcerotermes annandalei* were observed during the study period as well as the presence of nymphs in *Neotermes* spp, *Microcerotermes annandalei*, *Microtermes* spp, *Microcerotermes crassus*, and *M paracelebensis* (Table 3).

4. DISCUSSION

Seven species of termite belonging to six genera of two families were encountered in this study. The two families were; Termitidae and Kalotermitidae. The termite species were; *Odontotermes oblongatus*, *Microcerotermes annandalei*, *Microtermes sp*, *Microcerotermes paracelebensis*, *Neotermes* spp, *Glyptotermes kachongensis* and *Microcerotermes crassus*. This agrees with the works of Ugcombe et al. [17] who recorded five genera; *Amitermes*, *Microcerotermes*, *Globitermes*, *Nasutitermes* and *Glyptotermes* belonging to two families Termitidae and Kalotermitidae while, Ogedegbe and Eloka [18] that recorded five species namely; *Nasutitermes havilandi*, *Odontotermes secies*, *N. arboreum*, *Amitermes evenicfur* and *Microtermes* species as important pests of plants in Edo State, Nigeria. Termites could be identified based on their external morphology which include; venation pattern of wings of the winged reproductive or alates, antennae, mandibles, segments of abdomen and pronotum or thorax of different castes e.g. reproductive, nymph, workers, soldiers [19,9].
Table 3. Termite caste percentage abundance on trees in Komkom

| Tree type             | Termite species                  | Soldier | Worker | Alates | Nymph |
|-----------------------|----------------------------------|---------|--------|--------|-------|
| Gmelina above         | Microcerotermes annandalei       | 21.2    | 37.1   | 25.7   | 16.0  |
|                       | Microtermes sp                   | 38.1    | 61.9   | 0      | 0     |
|                       | Odontotermes oblongatus          | 35.6    | 64.4   | 0      | 0     |
| Cocos nucifera        | Microtermes sp                   | 21      | 66.1   | 0      | 12.9  |
| Citrus sinensis       | Microtermes sp                   | 37.3    | 40.8   | 0      | 21.8  |
|                       | Microcerotermes paracelebensis   | 4.2     | 95.8   | 0      | 0     |
| Dacryodes edulis      | Microtermes sp                   | 22.4    | 70.3   | 0      | 7.3   |
|                       | Microcerotermes paracelebensis   | 10.3    | 72.1   | 0      | 17.6  |
| Chrysophyllum albidum | Microtermes crassus              | 2       | 90.4   | 0      | 7.6   |
| Persea americana      | Neotermes spp                    | 25.0    | 33.0   | 17.7   | 24.4  |
| Persea americana      | Microcerotermes paracelebensis   | 14.3    | 74.3   | 0      | 11.3  |
| Persea americana      | Glyptotermes kachongensis        | 22.2    | 77.8   | 0      | 0     |
| Mangifera indica      | Microcerotermes paracelebensis   | 3.9     | 96.1   | 0      | 0     |

Fig. 5. Termite mean caste percentage abundance on tree in komkom

This study shows that among the seven species of termite in the study area, Microtermes paracelebensis had the highest abundance (47.2%) but Anantharaju et al. [20] who studied species abundance observed that Hypotermes obscuriceps was the most abundant species.
having 35% of the sampled population in North eastern, Puducherry, India. The mean caste percentage abundance varied among termite caste in the study area. Workers were more abundant with Microcerotermes annandali making up 98.7% and Microcerotermes paracelabensis 98.5% mean caste percentage abundance when compared to reproductives, nymphs and soldiers. This is in line with the work of Pranesh and Harini, [9] who also studied abundance of termite castes and showed that the workers were more abundant than the other individuals that make up a caste. The presence of the alates of two species (Neotermes spp and M. annandali) may depend on the swarming period while the nymphs were found in only the species that formed nests or hollowed out the trees. The nests and hollow of the trees provided nursery grounds for their development. This work shows that termites on trees are found in mud tubes or nests and this agrees with the works of Ugborneh et al. [17] and Echezona et al. [21] who observed arboreal colonies that build nest and tunnels at various heights on trees. The total infestation of 9.8% of the trees in the study area shows that anthropogenic effects may have impacted adversely on termite homes as confirmed by some locals who were interviewed, due to felling of trees for timber, urbanization and development. Ugborneh et al. [17]) while studying arboreal termites in a university in Port Harcourt Nigeria, observed total infestation of 37.71% of the trees while this study recorded 9.5%. This could be that a university community may have fewer species of ornamental trees close planted and hardly felled, while in this Komkom community there were more tree species richness and diversity, widely separated and exploited. There was a significant association of termite distribution and tree type in this study. This contrasts with that of Ugborneh et al., [17] who observed that termite species infested trees at random. More work is required here to determine termite specificity among trees. Observed mode of termite infestation on trees were; mud tubes, nests and hollow tunnels. This agrees with the works of earlier scholars such as Echezona et al. [21] and Ugborneh et al. [17] though they did not encounter hollow tunnels in their respective works.

Termite species such as Neotermes spp and Glyptotermes kachongensis inhabiting hollow tunnels in trees seemed more destructive when compared to the other termite species encountered. Reason could be due to their attack on the internal tissues of the trees. This is collaborated by the work of Harris [22,23] while working on termite infestation on trees observed that Theobroma cacao plant infested by termite species Schedrhinotermes putorius soon died afterwards even when there was no external termite infestation.

Eight trees namely; Anacardium occidentale (cashew), Moringa oleifera (Moringa), Annona muricata (soursop), Psidium guajava (guava), Irvingia gabonensis (bush mango), Syzygium samarangense (Java apple), Theobroma cacao (cocoa) and Elaeis guineensis (oil palm) had neither termite nests, mud tubes nor hollow sound in the study area. This agrees with the work of Ugborneh et al. [17] who also observed that Psidium guajava had no form of termite infestation, but contrasts with the works of Sands [6] Haris [21,22] and Malaka [24]. Sands [6,25] and Malaka reported that all the eight trees listed above except Psidium guajava had different species of termite infesting them, while Haris [22,23] reported that Theobroma cacao was infested by Schedrhinotermes putorius [26]. Though some termites may seem to lack host specificity, Odontotermes oblongatus, Neotermes spp, Glyptotermes kachongensis and Microcerotermes crassus appeared specific. Odontotermes oblongatus was observed infesting only Gmelina aborea, while Neotermes and Glyptotermes kachongensis infested only Persea americana and Microcerotermes crassus was found only on Chrysophyllum albidum. Ugborneh et al. [17] reported that Glyptotermes species appeared specific for Chrysophyllum albidum.

5. CONCLUSION AND RECOMMENDATION

The result obtained in this study indicates that termite species are pest of trees. To prevent termite entry into trees, the environment must be cleared and treated of all signs of termite infestation, trees should be properly examined to determine infestation early, and sounded often to note hollow sounds. Research into biological and other control measures of termite species is recommended to reduce economic loss associated with the infestation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.
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