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INFESTATION OF SUBTERRANEAN TERMITE, *HETEROTERMES ASSU* (ISOPTERA: RHINOTERMITIDAE): A CASE STUDY IN MAUÁ CITY, SÃO PAULO, BRAZIL

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Abstract This paper describes the results of an evaluation done on the buildings and trees at Nossa Senhora das Vitorias district, located in Maua, Sao Paulo, Brazil, in order to verify the biodeterioration caused by *Heterotermes assu*, an unusual subterranean termite, in which the records of infestations in urban areas and information on their biology and control are scarce. The diagnosis was carried out through the inspection of structural timber and wood components of 497 houses and an external and an internal analysis on 289 trees and 3 palm trees, by a team which performed a detailed examination with the purpose of identifying signals of attack caused by these insects and/or to estimate the intensity of the attack on trees by a non-destructive method. This data permitted to identify the spatial distribution on the occurrences of infested buildings and trees in this district, in relation to the age of construction, and the influence of a landscape area - a cemetery.
Kew Words Biodeterioration, diagnosis, trees

INTRODUCTION

For over 40 years, the Instituto de Pesquisas Tecnológicas do Estado de São Paulo - IPT has being working in the field of wood preservation, with research and providing services in the wood-boring insect control in buildings (Lelis et al., 2001; Amaral, 2002; Romagnano, 2004).

The termite problem has usually been discussed in Brazil in relation to its geographical distribution, behavior and control methods (Milano and Fontes, 2002). However, very little exists regarding the infestation of urban dynamics, i.e. how these species were introduced, which is the size of the infestation in the built environment and the factors related to their dispersal. The characterization of a problem caused by termites begins with identifying the species involved, the knowledge of its basic biology and ecology, and an evaluation of the type and extent of infestation. With this information, it is possible to assess the magnitude of the infestation and the economic damage caused by termites (Romagnano, 2004).

In Brazil, the main problems with termites in buildings are related to subterranean species *Coptotermes gestroi*, family Rhinotermitidae (Milano and Fontes, 2002). It is known that is an important pests of eucalyptus forests and sugar cane crops, occasionally attacking rural buildings, poles and fences (Constantino, 2011). In certain regions of Brazil, some species are considered urban pests, causing significant damage in buildings (Constantino, 2011; Costa-Leonardo, 2002). Little is known about the species *Heterotermes assu*, since this is a relatively new pest and with few studies on its biology. It is assumed that this species is native from the rain forest and has being recently introduced in São Paulo and other cities as an urban pest.

This study presents a discussion about the occurrence of subterranean termites *H. assu* at Nossa Senhora das Vitórias district and its relation to a cemetery.

MATERIALS AND METHODS

The municipality of Mauá defined the study area, in response to a request for subterranean termite control presented by the residents association of the Nossa Senhora das Vitórias district. This area (23° 40’ 58, 69” S and 46° 27’ 26,39” W) contains 1825 residential lots distributed in 38 streets that form 70 blocks (Figure 1).

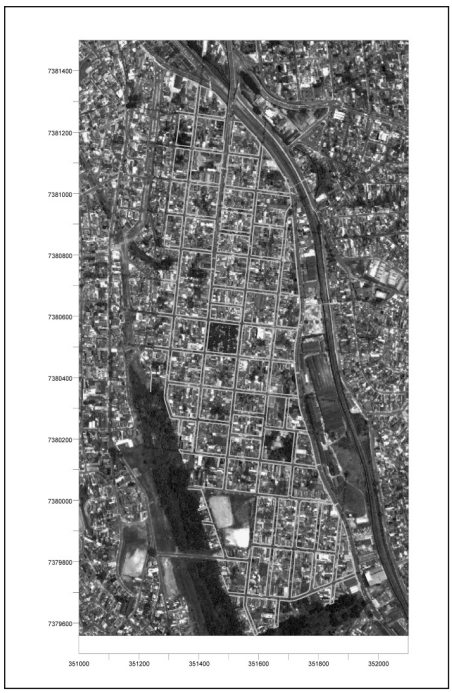

Figure 1. Study area on IKONOS satellite image (October 6, 2002).

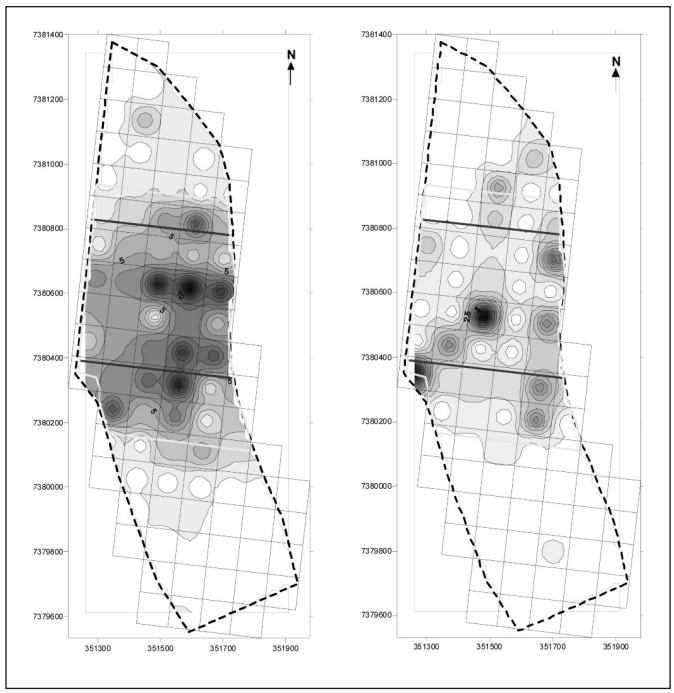

Figure 2. Occurrence areas of infestation, derived from density of buildings with termites, at left, and from the density of trees, at right, in Nossa Senhora das Vitórias district, Maua, Brazil. Broken line indicates the total studied area.

The buildings inspections were carried out by technical teams consisting of one technician of the municipality and a researcher of IPT. The main purpose of the inspection was to evaluate the presence and intensity of subterranean termites in wood structures by visual analysis; any change in the mechanical strength (attack) was done using a sharp tool. All wood structure in contact with the masonry was also inspected.

The trees in the sidewalks and in the cemetery, with diameter-to-height-of-breast (DBH) greater than or equal to 10 cm, were inspected. In an external analysis was observed the tree biological sanity, reporting the presence of subterranean termites. In order to verify the internal deterioration in the trunk, caused by xylophagous organisms, the trees with DBH greater than 25 cm, mainly at the cemetery were analyzed using a non-destructive equipment, a penetrometer (SibertÒ) (Amaral, 2002).

The distribution analysis of termite infested buildings was done in 3 areas: 1) Area A - total area of the district (70 blocks); 2) Area B - boundary area of the cemetery (19 blocks); and 3) Area C - extended area of the cemetery including the area A (35 blocks). A separate analysis of each area was done to investigate the relationship between the dispersion of subterranean termites and the cemetery proximity factor.

For spatial statistical analysis, the study area was divided into 90 grids of 100 x 100 m, which represent roughly the size of a block from the neighborhood. Each grid included four variables: number of buildings inspected, number of buildings with termites, number of trees inspected and number of trees with termites. With this structure (Romagnano, 2004) it was possible to analyze the following activities, in order to identify the pattern of infestation in that three areas: a) interpolation of variables, buildings and trees with and without termites, the method Inverse Square Distance (IQD), generating map of trends where the gray levels indicate the frequency of occurrence of each variable; b) linear correlation between variables and their distance from Cemetery to verify if there is relation of this distance with the infestation observed in district, in the three studied areas; and c) linear correlation between variables to determine the relation between buildings and trees with termites and between total buildings and buildings with termite.

RESULTS AND DISCUSSION

Building Inspection

From the total number of lots recorded (1825) in the Area A, 497 (27.2%) buildings were inspected, divided into 75 grids or 83.33% of the total area. In buildings inspection, 241 (48.5%) showed some kind of subterranean termites occurrence distributed in 46 grids or 61.33% of the area and 256 (51.5%) buildings showed no occurrence of subterranean termites. In 61 (25.3%) buildings was observed termite activity (Photos 1 and 2).

On average, 6.6 properties were inspected by grid and, at least, 3.2 had problems with termites. The proportion of homes with termite was 48.5%, with an estimated error of 4.4%. Therefore, in a range of 95%, it was observed the proportion of buildings with termite in the district varying between 44.0% and 52.0%. The relation between buildings and buildings with termite inspected by grid showed a positive linear correlation (R) of 0.76 and evidenced the infestation by subterranean termites in this district.

Photographs 1, 2. Tunnels of subterranean termites in roof structure; ceiling damaged by termites (Photos: File IPT)

In Area B, which corresponds to the limit next to the cemetery, was inspected 188 buildings divided into 20 grids, representing 37.5% of the total number of existing buildings and 95.2% of the 21 grids. The distribution of the 148 (78.7%) buildings, which showed some kind of subterranean termite occurrence took place in 20 grids. In infested buildings, 46 (24.5%) were observed termite activity. The linear correlation between buildings and buildings with termite inspected by grid was (R) of 0.93, indicating that the higher number of buildings inspected, the largest is the infestation in the area.

In Area C, which corresponds to the extended boundary of the cemetery, have been inspected 352 buildings divided into 39 grids, representing 38.9% of the total number of existing buildings at this limit and 90.6% of the grids. In buildings inspection, 225 (72.4%) showed some kind of subterranean termite occurrence. The distribution grid of buildings with termites in the extended area to the cemetery (Area C) occurred in the same way that the area near the cemetery (Area B), or in any area where the grids where buildings were inspected (39 grids), there was at least a building infested with termites. In inspected buildings, 60 (17.0%) was observed termite activity.

The linear correlation between buildings and buildings with termite inspected by grid was (R) equal to 0.87. Although the correlation of buildings and buildings with termite in Area C is lower than the Area B, it was verified that there is the same trend as higher the number of buildings inspected, higher is the number of infestation (Figure 2).

One hypothesis that can be raised about the increase in infestation in areas closer to the cemetery is in age of buildings. Considering the age of the buildings with the presence of termites, it is noted that the highest percentage (61.5% and 93.0%) of infested buildings had remained in the ages between 41 to 50 years in total area and in the near area, respectively. In the extended area, the highest percentage (85.2%) of infestation was in buildings with more than 50 years.

Trees Inspection

It was inspected a total of 144 trees on sidewalks and squares representing 49.8% of all trees distributed in 45 grids or 50.0% of the total area. In this inspection, 55 (38.2%) trees showed some signs of subterranean termites occurrence distributed in 20 grids or 44.4% of the area (Figure 2). From the trees with the occurrence of termites, 21 (38.2%) showed termite activity representing 14.6% of all trees in the district.

Photographs 4, 5. Subterranean tunnels on trees (Photos: File IPT).

In the cemetery were analyzed 127 trees belonging to 5 species and 1 palm tree. The area of the cemetery was only allocated on a grid which represents 1.1% of the total area of the district, however, 43.9% of studied trees are in this grid. From the total trees inspected, 120 (94.6%) showed some sign of occurrence of subterranean termites (Photos 4 and 5), and in the only palm tree analyzed was not observed its occurrence. From the occurrence of termites on trees, 31 (25.8%) showed termite activity, corresponding to 24.4% of all trees of the cemetery. The internal analysis was performed in 109 (85.8%) of 127 trees examined in the cemetery. Of these 66 (60.5%) were considered sound internally, 20 (18.3%) had deterioration and / or small and localized defects, 10 (9.2%) with intense deterioration and 13 (11.9%) with internal hollow.

CONCLUSIONS

The intensity of infestation observed in the buildings that correspond to the near area the cemetery and the cemetery extended area, is markedly higher when compared with results obtained in the total area of the district. The occurrence of subterranean termites in trees in the sidewalks and in the cemetery corroborates the relation of the infestation with the cemetery. In the specific case of infestation of the Nossa Sra. das Vitórias district, we need a greater knowledge of the biological characteristics of the species of termite found in the district, because information in the literature on *H. assu*, are very limited, especially considering their presence in urban areas. It should be noted that when the survey was conducted between 2004 and 2005, surely it must have been the first finding, in Brazil, the species *H. assu* with this degree of dispersion in the same district of an urban area

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