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## CHARACTERIZATION OF INJURY CAUSED BY *Coptotermes testaceus* IN *Tectona grandis* PLANTATIONS IN BRAZIL

COSTA, J. G.; SANTOS, I. C. de L.; PERES FILHO, O.; ZANETTI, R.; SANTOS, A. dos. Characterization of injury caused by *Coptotermes testaceus* in *Tectona grandis* plantations in Brazil. **CERNE**, v. 26, n. 3, p.310-314, 2020.

### HIGHLIGHTS

Stem damages caused by termites in commercial teak plants were characterized.

Injuries were detected in teak trees of diverse ages and locations.

The termites were identified as *Coptotermes testaceus* (Blattodea: Rhinotermitidae).

### ABSTRACT

*Coptotermes testaceus* (Linnaeus, 1758) is the most important species of heartwood termite of adult trees in forests planted in Brazil. This study aimed to characterize the injuries promoted by the heartwood termite *C. testaceus* in *Tectona grandis* commercial stands. Tree bark with extend carton material on the outside, forming external galleries and internal stem with a high termite infestation, was found in August 2018, in clonal plantations of *T. grandis* of 4.2 and 7.2-year of age. Internal injuries were characterized by galleries inside stem length with the presence of some soil, carton material, and termites inside the galleries. The damage by *C. testaceus* may not show external signs, and the injury was only detected during the harvesting process.

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## INTRODUCTION

*Tectona grandis* L.f. (Lamiaceae) is an Asian tropical hardwood tree with the world highest commercial value due to inherent resistance of its wood (Roychoudhury, 2012), low specific weight, high natural durability, straight trunk, dimensional stability, and aesthetic beauty (Macedo et al., 2005; Moya et al., 2014). In Brazil, this exotic species has an excellent adaptation to the edaphoclimatic conditions (Alcantara and Veasey, 2013) and has been planted since the 1960s (Cruz et al., 2008). Today, the area planted in Brazil corresponds to 87,502 hectares (Ibá, 2017) and Macedo Neto et al. (2020) have investigated teak plantations growing even in north of the country.

The production of *T. grandis* can suffer losses at any stage of its development due to insect attack (Kulkarni et al., 2009). *T. grandis* was commonly attacked by termites, which are considered important pests in forest plantations, due to their abundance and dominance in tropical forest soils (Verma et al., 2009).

In Brazil, the termite *Coptotermes* spp. (Wasmann, 1896) (Rhinotermitidae), has an economic importance status (Costa-Leonardo, 2002). This genus consists of 67 species (Krishna et al., 2013), distributed in Asia, Australia, Africa, and the Americas, being of which 23 considered of the most globally expressive insects pest of wood structures (Su and Scheffrahn, 1998; Chouvenec et al., 2015). There are five species in tropical America: *Coptotermes crassus* Snyder, 1922, *C. niger* Snyder, 1922, and *C. testaceus* (Linnaeus, 1758) are endemic, and *C. formosanus* Shiraki, 1909 and *C. gestroi* (Wasmann, 1896) are exotics (Scheffrahn et al. 2015). Heartwood termites in commercial forests are associated too with the species *Cylindrotermes* sp. and *Heterotermes* spp. (Constantino, 2002; Fialho-Junior et al. 2019), despite lower occurrences and infestation comparing with *C. testaceus*.

*Coptotermes* workers penetrate the plants by the roots and then build tunnels in the heartwood along the trunk of the tree (Evans et al., 2019). However, the termites male and female alates during the flight period can also penetrate the tree due to pre-existing damage to the trunk (eg. Pruning activity) and establish new nests (Greaves, 1962). Some species of this genus leave external signs (tube or extend carton material) of their presence in the tree (Scheffrahn et al., 2015), while others are detected only during the harvest or because the damaged tree naturally falls (Moraes et al., 2002). Several other trees surrounding a nest can also be attacked, when an attacked tree is found, the chance of finding other attacked trees in a near location is high (Tho and Kirton, 1998). The galleries of a colony of this termite can extend over an area of 0.16 ha, with galleries reaching up to 47.54m in length, and the same nest can attack 5 trees (Greaves, 1962).

*Coptotermes testaceus* is the most important species of heartwood termite in adult trees in forests planted in Brazil (Lukmandaru, 2015), mainly in eucalyptus (Moraes et al., 2002; Calderon and Constantino, 2007). However, it was recorded, causing damage to rubber trees, coconut palms, and other palm trees, citrus, and other fruit trees and cassava (Mill, 1992; Apolinário and Martius, 2004).

*C. testaceus* lodges in young plants (2-3-years) and feeds on the heartwood (Constantino, 2002). Commonly the infestation is only detected during the harvest, as was detected in eucalyptus plantations in the Cerrado ecoregion, with worldwide wood losses production around 3.76 m<sup>3</sup>·ha<sup>-1</sup> (Santos et al., 1990). There is no record of *C. testaceus* damage in *T. grandis* plants.

This study aimed to characterize the damage caused by the heartwood termite *C. testaceus* (Blattodea: Termitidae: Rhinotermitidae) in clonal plantations of *Tectona grandis* L. f. (Lamiaceae).

## MATERIAL AND METHODS

Trees with soil and cellulose channels forming external galleries in the bark and high termite infestation in the trunk were found in August 2018, in 4.2-year-old clonal plantations of *T. grandis*, located in the municipality of Cáceres (57°40'44"W, 16°04'14"S and 118 meters of altitude approximately), State of Mato Grosso, and 7.2-year-old plantations, in the municipality of Capitão Poço (47°3'57"W, 01°44'47" S and 71 meters of altitude approximately), State of Pará, Brazil.

The 7.2-year-old trees presented a mean of 36 cm of total diameter and 23 cm of heartwood, while the trees of 4.2-year of age had, on average 25 cm of total diameter and 9 cm of heartwood, at a height 10 cm from ground level.

Samples of infested trees with termites were taken to the laboratory, where transverse and longitudinal cuts with a chainsaw were made, and the injuries were photographed and characterized. The termites soldiers were collected with tweezers and placed in vials containing 80% alcohol was transported to the laboratory, examined, and photographed with a stereoscopic microscopy (40x) and sent to Dr. Tiago Fernandes Carrijo in Universidade Federal do ABC, São Bernardo do Campo, State of São Paulo, Brazil, for species identification.

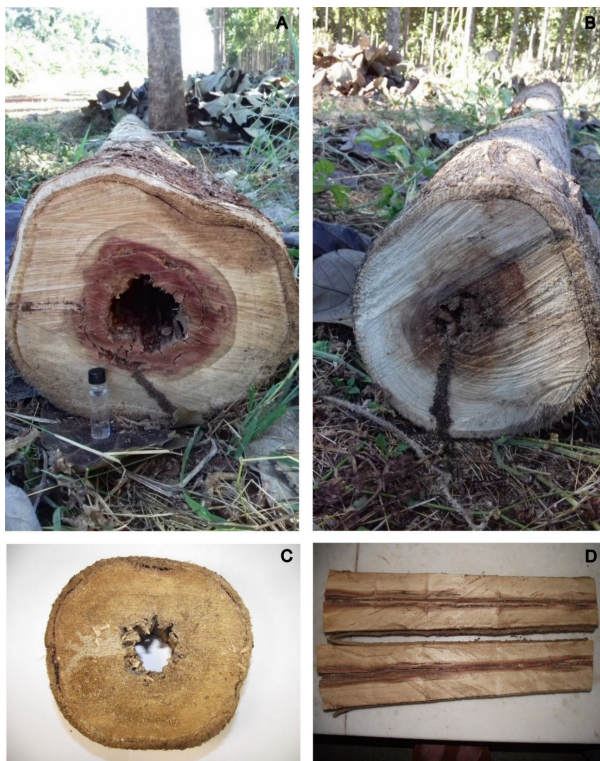
## RESULTS

The collected termites were identified as *C. testaceus* (L., 1758). The infested trees were detected by the external galleries on the stem (Figure 1), characterized by a layer of feces and soil covering (carton material) the galleries that lead to the nest inside the tree.



**FIGURE 1** External gallery of *C. testaceus* (Linnaeus, 1758) termite in the stem of 4.2-year-old *Tectona grandis* clonal plantation.

Internal damages promoted by termites were characterized by galleries along the entire heartwood stem length and by some soil, carton material and termite feces inside the galleries (Figure 2).



**FIGURE 2** Injury in the heartwood trees of 7.2-year-old *T. grandis* (A and B) and 4.2-year-old trees (C and D) caused by *C. testaceus* (L., 1758).

## DISCUSSION

Damage by *C. testaceus* on eucalyptus plants did not show in external stem signs, and the infestation was only noticed during the trees harvest (Santos et al.,

1990). *Coptotermes* genus begin their nests in living trees (Cowie et al., 1989), being *C. testaceus*, the main species of nidification of live trees in the Amazon (Apolinário and Martius, 2004). This species is distributed throughout the Neotropical region, which can be explained by the high availability of food resources and favorable environmental conditions (Scheffrahn et al., 2015).

The tree heartwood is biologically a dead tissue, being susceptible to the attack of xylophagous insects (Apolinário and Martius, 2004). In *Eucalyptus* plantations (Myrtaceae) located in João Pinheiro, Minas Gerais state, Brazil, the loss of heartwood volume by *C. testaceus* attacked was estimated at  $0.65 \text{ m}^3 \cdot \text{ha}^{-1}$  for *E. urophylla* and  $0.32 \text{ m}^3 \cdot \text{ha}^{-1}$  for *E. camaldulensis* (Zanetti et al., 2005). Other *C. testaceus* hosts are *Inga* sp. (Mimosaceae) and *Bagassa guianensis* Aubl. (Moraceae) (Corassa et al., 2014), found in the neighborhood of the studied *T. grandis* plantations.

The control of *Coptotermes* spp. it is carried out by soil drenching around the tree (Tho and Kirton, 1992). In Brazil, there is no technical recommendation for the control of *Coptotermes* genus in forests planted with teak, however, in adult eucalyptus plantations, fipronil (phenyl-pyrazol) was used, distributed 0.30m around the trunk, and the 0.1g dose of fipronil per plant did not cause phytotoxicity the plants and protected from the attack of termites *Heterotermes tenuis* (Hagen, 1858) and *Cornitermes* sp. Wasmann 1897 for up to a year (Raetano et al., 1997). Since 2019, the fipronil was approved as a termiticide for teak in Brazil (MAPA, 2019), but studies for recommendation control for this insect species in teak forests must be conducted.

## CONCLUSION

Occurrence and damage characterization of *C. testaceus* termites in clonal plantations of *Tectona grandis*, in different ages and regions in Brazil are reported.

## REFERENCES

- ALCANTARA, B.K.; VEASEY, E.A. Genetic diversity of teak (*Tectona grandis* L.F.) from different provenances using microsatellite markers. **Revista Árvore**, v. 37, n. 4, p. 747-758, 2013.
- APOLINÁRIO, F.E.; MARTIUS, C. Ecological role of termites (Insecta: Isoptera) in tree trunks in central Amazonian rain forests. **Forest Ecology and Management**, v. 194, p. 23-28, 2004.
- CALDERON, R.; CONSTANTINO, R. A survey of the termite fauna (Isoptera) of an eucalypt plantation in central Brazil. **Neotropical Entomology**, v. 36, p. 391-395, 2007.



- CHOUVENC, T.; LI, H. F.; AUSTIN, J.; BORDEREAU, C.; BOURGUIGNON, T.; CAMERON, S.L.; SU, N.Y. Revisiting *Coptotermes* (Isoptera: Rhinotermitidae): A global taxonomic road map for species validity and distribution of an economically important subterranean termite genus. **Systematic Entomology**, v. 41, p. 299-306, 2015.
- CONSTANTINO, R. The pest termites of South America: Taxonomy, distribution and status. **Journal of Applied Entomology**, v. 126, p. 355-365, 2002.
- CORASSA, J. N.; PIRES, E. M.; ANDRADE NETO, V. R.; TARIGA, T. C. Termites associated with the degradation of five forest tree species in a decay field. **Floresta e Ambiente**, v. 21, p. 78-84, 2014.
- COSTA-LEONARDO, A. M. **Cupins-praga: Morfologia, biologia e controle**. Rio Claro: Universidade Estadual Paulista, 2002. 128p.
- CRUZ, J. P.; LEITE, H. G.; SOARES, C. P. B.; CAMPOS, J. C. C.; SMIT, L.; NOGUEIRA, G. S.; OLIVEIRA, M. L. R. Modelos de crescimento e produção para plantios comerciais jovens de *Tectona grandis* em Tangará da Serra, Mato Grosso. **Revista Árvore**, v. 32, p. 821-828, 2008.
- COWIE, R. H.; LOGAN, J. W.; WOOD, T. G. Termite (Isoptera) damage and control in tropical forestry with special reference to Africa and IndoMalaysia: A review. **Bulletin of Entomological Research**, v. 79, p. 173-184, 1989.
- EVANS, T. A.; FORSCHLER, B. T.; TRETTIN, C. C. Not just urban: The Formosan subterranean termite, *Coptotermes formosanus*, is invading forests in the Southeastern USA. **Biological Invasions**, v. 21, p. 1283-1294, 2019.
- FIALHO-JUNIOR, L. L.; NASCIMENTO, D. A.; SANTOS, I. C. L., PERES-FILHO, O., SANTOS, A. First report of *Heterotermes longiceps* (Blattodea: Rhinotermitidae) termite in teak plantations. **Floresta e Ambiente**, v. 26, n. 3, 2019.
- GREAVES, T. Studies of foraging galleries and the invasion of living trees by *Coptotermes acinaciformis* and *C. brunneus* (Isoptera). **Australian Journal of Zoology**, v. 10, n. 4, p. 630-651, 1962.
- IBÁ - Indústria Brasileira de Árvores. 2017. **Relatório anual 2017, Ano base 2016**. Indústria Brasileira de Árvores, Brasília. Available at: [https://iba.org/images/shared / Biblioteca/ IBA\\_Relatorio Anual 2017.pdf](https://iba.org/images/shared/Biblioteca/IBA_Relatorio%20Anual%202017.pdf). Accessed in November 3rd 2017.
- KRISHNA, K.; GRIMALDI, D. A.; KRISHNA, V.; ENGEL, M. S. Neo Isoptera excluding Termitidae. In: KRISHNA, K.; GRIMALDI, D. A.; KRISHNA, V.; ENGEL, M. **Treatise on the Isoptera of the World**. New York: American Museum of Natural History, 2013. p. 627-973.
- KULKARNI, N.; PAUNIKAR, S.; JOSHI, K.C.; ROGERS, J. White grubs, *Holotrichia rustica* and *Holotrichia mucida* (Coleoptera: Scarabaeidae) as pests of teak (*Tectona grandis* L. f.) seedlings. **Insect Science**, v. 16, p. 519-525, 2009.
- LUKMANDARU, G. Chemical characteristics of teak wood attacked by *Neotermes tectonae*. **BioResources**, v. 10, p. 2094-2102, 2015.
- MINISTÉRIO DA AGRICULTURA, PECUÁRIA E ABASTECIMENTO. MAPA. Ato nº 86, de 9 de dezembro de 2019. Accessed in: July 08th 2020.
- MILL, A. E. Termites as agricultural pests in Amazônia, Brazil. **Outlook on Agriculture**, v. 21, p. 41-46, 1992.
- MACEDO, R.L.G.; GOMES, J.E.; VENTURIN, N. SALGADO, B.G. Initial growth of *Tectona grandis* L.f., in different spacings in Paracatu, MG, Brazil. **Cerne**, v. 11, n. 1, p. 061-069, 2005.
- MACEDO NETO, A.A.L.M., FARIAS, P.R.S., DE MATOS, G.S.B., DA SILVA, G.B., SANTOS, A.V.F., ANHÊ, B.B. Diagnosis and spatial variability of soil fertility and crop production in a teak area in Eastern Pará State. **Cerne**, v. 26, n. 1, p. 37-47, 2020.
- MORAES, J.C.; ZANETTI, R.; AMARAL CASTRO, N.L.; ZANUNCIO, J.C.; ANDRADE, H.B. Effect of *Eucalyptus* species and soil type on infestation levels of heartwood termites (Insecta: Isoptera) in reforested areas of Brazil. **Sociobiology**, v. 39, p. 145-153, 2002.
- MOYA, R.; BOND, B.; QUESADA, H. A review of heartwood properties of *Tectona grandis* trees from fast-growth plantation. **Wood Science and Technology**, v. 48, p. 411-433, 2014.
- SANTOS, G.P.; ZANUNCIO, J.C.; ANJOS, N. DOS.; ZANUNCIO, T.V. Danos em povoamentos de *Eucalyptus grandis* pelo cupim-do-cerne *Coptotermes testaceus* Linneé, 1785 (Isoptera: Rhinotermitidae). **Revista Árvore**, v. 14, p. 155-163, 1990.
- SCHEFFRAHN, R.H.; CARRIJO, T.F.; KRECEK, J.; SU, N.; SZALANSKI, A.L.; AUSTIN, J. W.; CHASE, J.A.; MANGOLD, J.R. A single endemic and three exotic species of the termite genus *Coptotermes* (Isoptera, Rhinotermitidae) in the New World. **Arthropod systematics & phylogeny**, v. 73, n. 2, p. 333-348, 2015.
- SU, N.Y.; SCHEFFRAHN, R.H. A review of subterranean termite control practices and prospects for integrated pest management programs termites. **International Pest Management Review**, v. 3, p. 1-13, 1998.
- RAETANO, C.; WILCKEN, C.; CROCOMO, W. Controle de cupins em florestas de eucalipto com o inseticida fipronil (Regent 20 G) aplicado em cobertura. **Revista Árvore**, v. 21, n. 2, p. 289-293, 1997.
- ROYCHOUDHURY, N. Deployment of resistance in teak to key insect pests. **Indian Forester**, v. 138, n. 2, p.123-130, 2012.
- THO, Y.P.; KIRTON, L.G. A survey of termite attack in Bahau conifer plantation, Peninsular Malaysia. **Journal of Tropical Forest Science**, v. 10, n. 4, p. 564-567, 1998.

- VERMA, M.; SHARMA, S.; PRASAD, R. Biological alternatives for termite control: A review. **International Biodeterioration and Biodegradation**, v. 63, p. 959-972, 2009.
- ZANETTI, R.; AMARAL-CASTRO, N.R.; MORAES, J.C.; ZANUNCIO, J.C.; OLIVEIRA, A.C.; DIAS, N. Estimation of wood volume losses by heartwood termites (Insecta: Isoptera) in *Eucalyptus* plantations in the state of Minas Gerais, Brazil. **Sociobiology**, v. 45, p. 1-13, 2005.