

The Relationship of *Ganoderma* Infection and Termite Infestation on Oil Palm in Organic Soil Planting

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Coptotermes curvignathus is a free foraging subterranean termite preferring and selectively infesting unhealthy palms such as *Ganoderma* infected palms in the field. This study shows that about 99 per cent of the 15-year-old termite infested palms were also infected by *Ganoderma* basal stem rot.

Keywords: Subterranean termites, *Coptotermes curvignathus*, *Ganoderma*.

Coptotermes Wasmann [Blattodea (Isoptera): Rhinotermitidae] is well-known as the most economically important subterranean termite genera (Edwards & Mill, 1986; Su & Scheffrahn, 1988; Chouvenec *et al.*, 2015). In Malaysia and Indonesia, *Coptotermes curvignathus* Holmgren is the only subterranean termite species reported attacking oil palm (Wood, 1968; Sudharto *et al.*, 1991; Lim & Silek, 2001; Faszly *et al.*, 2003; Cheng *et al.*, 2008; Cheong *et al.*, 2017). The termite infestation can reach as high as 8 to 9 per cent in 3-year-old palms causing 2 to 3 per cent of palm death (Lim & Silek, 2001). It is not known exactly how subterranean termites locate sources of food, as in most subterranean termite species, the worker and soldier castes are blind. Thus, it is generally thought that the termites forage by digging a network of tunnels and come in contact with food sources in the process. The foraging range of a single termite colony is difficult to predict and depends on the size or population of the colony. The scenario of termite infestation in

oil palm is always interesting. Without any specific criteria and with free foraging method, palms next to a termite infested palm should be the logical target. However, this is not always true in the field. The authors believe that *C. curvignathus* only infest unhealthy and diseased palms when they come in contact with palms. To test this hypothesis, an investigation was carried out to determine whether there is any relationship between *C. curvignathus* infestation and *Ganoderma* infection in oil palm.

MATERIALS AND METHODS

A 100 per cent census was carried out in an area of 90 hectares of oil palm planted in 2003 on organic soil in fields G33 (00°01'12.3"N, 101°59'26.6"E), G35 (00°00'46.5"N, 101°59'24.2"E) and F32 (00°01'17.3"N, 101°58'53.7"E) from April to August 2018. A total of 159 palms (1.24 per cent of total palms planted) were detected as *C. curvignathus* infested palms. In August and

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September 2018, these palms were felled and the trunks were cut in cross sections to check for the presence of *Ganoderma* infection symptoms and termites inside the trunks.

A census was conducted to detect the presence of *Ganoderma* infection symptom (*GaIS*) as described by Turner (1981) and Ariffin *et al.* (2000). In a cross section of a *Ganoderma* affected trunk, the lesions appear as light-brown areas of rotting tissues, marked by irregular shaped darker bands with an outer edge of an irregular yellow zone (*Figure 1*). Yellow zones are the unaffected tissue, usually found between the lesion edges. The darker bands are believed to be the active zone of the pathogen. Turner (1981) named the darker bands as “reaction zones”, the result of the deposition of gum as defence mechanism of the palm. The authors’ observation is that the presence of the fruiting body (basidiomata or

sporophores) on a cross section of a *Ganoderma* infected trunk at the darker bands, confirm that the darker bands indicate the active zone of the pathogen as illustrated in *Figure 2*. In this study, the darker bands are referred to as *GaIS*.

RESULTS AND DISCUSSION

The census results are tabulated in *Table 1*. A total of 159 palms out of 12 764 palms were infested by termites, and 158 (99.37 per cent) of the 159 termite infested palms have *Ganoderma* infection symptom or *GaIS* (*Figure 3*). This clearly shows that there is a strong relationship between termite infestation and *Ganoderma* infection on oil palm planted on organic soil. It is believed that the termites are unable to detect the location of the food source precisely, as the workers are blind and

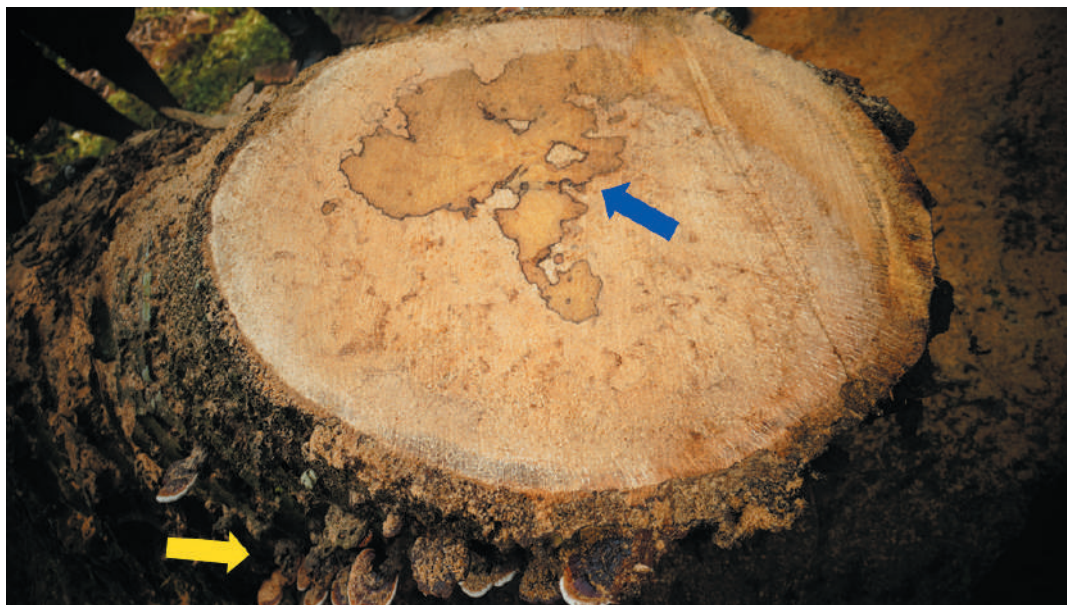


Figure 1 A cross section of *Ganoderma* infected trunk, showing the irregular zonation which demarcates the active infection zone of the pathogen and the reaction of the defence mechanism of the palm to the infection (blue arrow). Yellow arrow shows the presence of the *Ganoderma* basidiomata or sporophores.

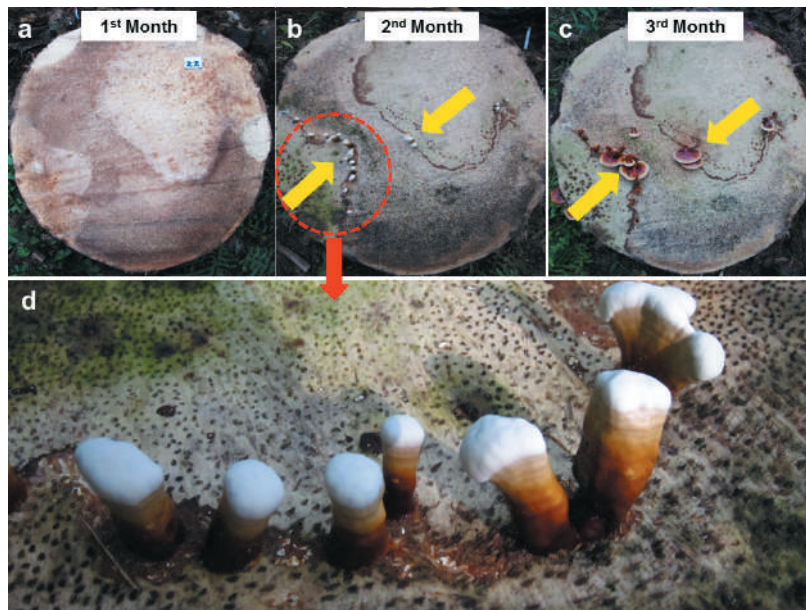


Figure 2 Development of sporophores (yellow arrow) on a cross section of *Ganoderma* infected trunk (a) first month, (b) second month and (c) third month after cutting with a chainsaw. (d) The small, white buttons of basidiomata or sporophores only emerged from the dark line, the active infection zone of the pathogen.

TABLE 1
COPTOTERMES CURVIGNATHUS INFESTED PALMS WITH THE PRESENCE OF *GANODERMA* INFECTION SYMPTOM

Block	Ha	SPH	Number of termite infested palms with the presence of <i>Ganoderma</i> infection symptom	
			Clear sign	Without clear sign
G33	33.62	145	24	1
G35	33.19	139	88	0
F34	23.23	141	46	0
Total			158	1
Percentage (%)			99.37	0.63

Note: Ha = Hectare; SPH = Stand per hectare

they forage randomly underground. If they find a potential food source at random, they will further determine whether it is suitable as their source of food. Termites might be discriminatory

in the selection of suitable food in nature as many studies have reported differences in feeding rates and survival of subterranean termite workers in multiple-choice tests with



Figure 3 A *Ganoderma* infected palm with clear symptom of darker lines with the presence of *C. curvignathus*

different species of wood (Smythe & Carter, 1970; Morales-Ramos & Rojas, 2001). Thus, the authors hypothesise that termite forage randomly preferring *Ganoderma* infected or unhealthy palms as their food source.

Wood residues in organic soil is an inoculum for *Ganoderma* disease and also a food source for termite. For example, during palm felling prior to replanting in October 2014, a decayed log, buried under the organic soil, was found under the root of a 14-year-old palm infested by termites. The decayed log has yet to decompose completely after at least 14 years (Figure 4). The cross section of the log showed that about 60-70 per cent of the timber material has been turned into organic soil material (Figures 5 & 6), indicating that a large sized wood material will take a long time to decompose and could become the nest of subterranean termites and as an inoculum source of *Ganoderma*. Khairuddin (1990) demonstrated that *Ganoderma* colonised

rubberwood blocks measuring 432 cm³ (6 cm x 6 cm x 12 cm) were able to cause 100 per cent infection on oil palm seedlings within 11 months. His findings indicate that wood residues with suitable volume could become the source of *Ganoderma* inoculum in the field.

CONCLUSION

This study shows that there is a strong correlation between *C. curvignathus* infestation and *Ganoderma* infection in oil palm. The hypothesis is that the termites forage randomly and found the unhealthy palm (e.g. *Ganoderma* infected palm) as their suitable food source by chance in the field, in this case, 15-year-old plantings.

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Figure 4 Examining and collecting termite specimens from a decayed log buried under the organic soil for at least 14 years. The log was found under a termite infested palm when the palm was felled for replanting



Figure 5 Cross sections of the decayed log buried underground

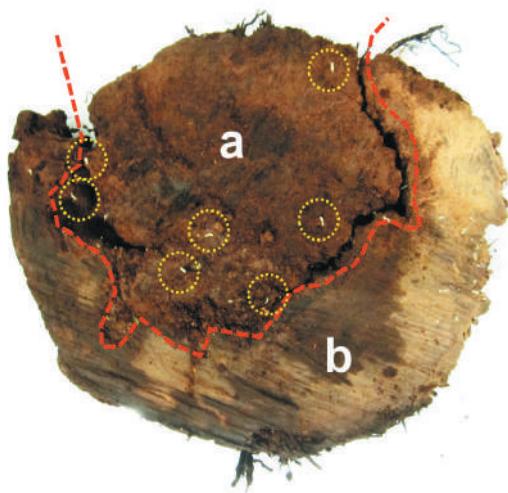


Figure 6 Cross section of a decayed log with two zones: (a) The nest of subterranean termite, *C. curvignathus* with organic soil and few termites moving around (yellow circles); (b) Solid wood material, yet to decompose

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REFERENCES

- ARIFFIN, D., IDRIS, A. S. and GURMIT, S. 2000. Status of *Ganoderma* in Oil Palm. In: *Ganoderma Diseases of Perennial Crops* (J. Flood, P. D. Bridge and M. Holderness, eds.). Wallingford, Oxon, UK: CABI Publishing, CAB International. 49-68.
- CHENG, S., KIRTON, L. G. and GURMIT, S. 2008. Termite attack on oil palm grown on organic soil: identification of pest species and factors contributing to the problem. *The Planter* **84** (991): 200-210.
- CHEONG, Y. L., KRISNA C. P., SAW, E. K. and OOI L. H. 2017. The status of two species of subterranean termites, *Coptotermes curvignathus* and *Coptotermes sebangensis* in oil palm. *The Planter* **93** (1094): 357-362.
- CHOUVENC, T., LI, H. F., AUSTIN, J., BORDEREAU, C., BOURGUIGNON, T., CAMERON, S., CANCELLO, E. M., CONSTANTINO, R., COSTA-LEONARDO, A. M., EGGLETON, P., EVANS, T. A., FORSCHLER, B., GRACE, J. K., HUSSENER, C., KRECEK, J., LEE, C. Y., LEE, T., LO, N., MESSENGER, M., MULLINS, A., ROBERT, A., ROISIN, Y., SCHEFFRANH R. H., SILLAM-DUSSÈS, D., ŠOBOTNÍK, J., SZALANSKI, A., TAKEMATSU, Y., VARGO, E. L., YAMADA, A., YOSHIMURA, T. and SU, N. Y. 2015. Revisiting *Coptotermes* (Isoptera: Rhinotermitidae): a global taxonomic road map for species validity and distribution of an economically important subterranean termite genus. *Systematic Entomology* **41**: 299-306.
- EDWARDS, R. and MILL A. E. 1986. *Termites in buildings: their biology and control*. The Rentokil library, Rentokil Ltd., East Grinstead, United Kingdom. 261pp.
- FASZLY, R., IDRIS, A. B., SAJAP, A. S., NORMAN, K. and BASRI, M. W. 2003. The pattern of infestation by subterranean termite *Coptotermes curvignathus* Holmgren (Isoptera: Rhinotermitidae) on young oil palm organic. In: *Proceedings of the International Palm Oil Congress (Agriculture)– Palm Oil, the Power-House for the Global Oils and Fats Economy*. Kuala Lumpur: Malaysian Palm Oil Board. 1034-1044.
- KHAIRUDIN, H. 1990. Basal stem rot of oil palm: incidence, etiology and control. Master of Agriculture Science thesis, Universiti Pertanian Malaysia, Selangor, Malaysia. 178pp.
- LIM, K. H. and SILEK, B. 2001. Termite infestation on oil palms planted on deep organic in Sarawak: Tradewinds experience. In: *Proceedings of the International Palm Oil Congress - Cutting-Edge Technology for Sustained Competitiveness* (M. W. Basri, S., Ravigadevi, and S. S., Rabiah, S. Alwee, eds.). Kuala Lumpur: Malaysian Palm Oil Board. 355-368.
- MORALES-RAMOS, J. A. and M. G. ROJAS. 2001. Nutritional ecology of the Formosan subterranean termite (Isoptera: Rhinotermitidae): feeding response to commercial wood species. *Journal of Economic Entomology* **94**: 516-523.
- SMYTHE, R. V., and CARTER, F. L. 1970. Feeding responses to sound wood by *Coptotermes formosanus*, *Reticulitermes flavipes*, and *R. virginicus* (Isoptera: Rhinotermitidae). *Annals Entomology Society of America* **63**: 841-847.
- SU, N.Y. and SCHEFFRAHN, R.H. 1988. Intra- and interspecific competition of the Formosan and eastern subterranean termites: evidence from field observations (Isoptera: Rhinotermitidae).

Sociobiology **14**: 157-164.
SUDHARTO, P. S., SIPAYUNG, A. and DE CHENON,
R. S. 1991. Termites – A new problem on oil palm
plantation in Indonesia. In: *Proceedings of 1991
PORIM International Palm Oil Conference –
Progress, Prospects and Challenge Towards the 21st
Century, Module 1 - Agriculture*. Palm Oil Research

Institute Malaysia, Kuala Lumpur. pp. 407-417.
TURNER, P. D. 1981. *Oil Palm Diseases and Disorders*.
Oxford University Press, Oxford. 280pp.
WOOD, B. J. 1968. *Pest of Oil Palm in Malaysia and
their control*. Incorporated Society of Planters, Kuala
Lumpur. 204pp.



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