

## Laboratory Evaluation of *Metarhizium Anisopliae* (Deuteromycete) as a Soil Biopesticide against *Coptotermes Curvignathus* (Isoptera: Rhinotermitidae)\*

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### Introduction

Termites are common insects in the tropic. They can be found wherever there are plant debris and cellulosic materials on which they feed on. Majorities of termite species are beneficial to the ecosystem. They decompose plant materials and incorporate them back into the soil (Wood et al., 1978). Thus, they are very important in nutrient cycling process. Some termites, however, attack trees and structural timber. They have been reported to cause serious problems to homeowners and farmers. With the rising cost of houses, labour and planting materials, the cost for house repair and tree replanting have increased accordingly. One of the termite species that can incite costly damages to buildings and plantations is a subterranean termite *Coptotermes curvignathus* Holmgren (Rhinotermitidae). *C. curvignathus*, the most economically important termite species in Malaysia, is a serious pest of structural timber in and outside buildings (Sajap et al., 1997). Like in other species of Rhinotermitidae found in Malaysia, colonies of *C. curvignathus* do not build mound and their cryptic habit makes their presence in an area very difficult to detect. Their presence could only be realised when the damage done had been too severe for treatment. Thus like in most parts of the world, soil barrier treatments with termiticides offer the simplest prophylactic control against subterranean termites in Malaysia. Very often, these liquid termiticides are being excessively applied to the soil and this results in contamination of beneficial soil flora and fauna as well as water resources. This problem has led many researchers to search for new techniques for controlling termites, which are environmentally safe and efficient. One microbial control agent with a

potential use in controlling termites is an entomopathogenic fungus, *Metarhizium anisopliae*. *M. anisopliae* is common soil fungus that has been tested in laboratory with positive results against termites such as *Nasutitermes exitiosus* (Hanelet al. and Watson, 1983) and *C. curvignathus* (Sajap et al. and Kiranjeet, 1990). Like Gillespie and Moorehouse (1989) we concur that soil is suitable medium for fungal growth as moisture level seldom limits conidial germination and growth. In this study, we examined the effectiveness of several strains of locally isolated *M. anisopliae* in soil mixtures against *C. curvignathus* in the laboratory.

### Materials and Methods

*Metarhizium anisopliae* strains previously isolated from various localities in Peninsular Malaysia were cultured on cooked rice. The rice packed in plastic bags was inoculated with the selected isolates. The bags were kept in the dark for two weeks. The rice-bearing conidia ground using a hand grinder and the rice-conidia powder was sieved through a mesh. The rice-conidia powder was then mixed with autoclaved-garden soil at the ratio of 1:99 and 10:90. Treated soils were packed into a 50-mm column in a plastic tube with 70 mm long and 10 mm diameter. The tube was connected to two clear plastic cups containing 20 g of sterilised fine sand. Twenty-four hours later, 100 worker termites were introduced into the cup at one end and a pine wood block, *Pinus caribaea* (15 × 15 × 15 mm) at the other end. These experimental units were kept in the dark at 28°C and examined daily. The time required to obtain 100% mortality was recorded and the distance of tunnelling activity was recorded. All treatments were replicated four times.

### Results and Discussion

The result showed that the termites were able to tunnel all the way through the treated soil. They did not seem to be repelled by the conidia in the soil. They moved back and forth from the point they were released to the food source, a pine wood block. While passing through the conidia-treated soil, the termites picked up the conidia from the soil and these conidia could be passed onto other individuals through their normal grooming habit or accidental body contact. Figure 4 shows an infected worker covered with *M. anisopliae* mycelia. Even though all isolates were able to kill the termite, there were however, significant differences between isolates and conidia-soil ratios in the time required to obtain 100% mortality. As expected, the soils that had been treated with higher ratio of conidia killed the termites faster than that of the lower ratio. At a higher ratio, all the termites died within 3 to 6 days. At a lower ratio, they all died within 5 to 8 days. Among the five isolates, PR1 consistently killed the termites faster than the other isolates. SB2T appeared to be the least virulent isolate.

### Conclusions

This preliminary result suggested that conidia of *M. anisopliae* can be incorporated in soil to protect crops, trees and wood structure from termite infestations. The conidia can be mixed with potting mixtures or composts for preventing garden plants from termite attack. However, before the fungus could be used successfully in the field, an understanding of its life cycle and ecological factors affecting its viability and effectiveness should be thoroughly studied.

### Benefits from the study

*Metarhizium anisopliae* is a common soil fungus, which is pathogenic to many insect pests. This fungus has been developed as a biopesticide for a wide range of insects. Soil with *M.anisopliae* conidia may be used as potting mixtures or incorporated in the garden beds for preventing plants from attack by soil insects.

### Literature cited in the text

- Hanel, H. and Watson, J.A.L. 1983. *Bull. Entol. Res.* 73: 305-313.
- Sajap, A.S. 1997. Termites from selected building premises in Selangor, Peninsular Malaysia. *The Malaysian Forester.* 60(4): 203-206.
- Sajap, A.S. and Kiranjeet, K. 1990. Histopathology of *Metarhizium anisopliae*, an entomopathogenic fungus,

infection in the termite, *Coptotermes curvignathus*. *Pertanika* .13(3): 331-334.

Wood, T.G. 1978. In Brian, M.V. 9ed) Production ecology of ants and termites. Cambridge Univ. Press. London. Pp 55-80.

### Project Publications in Refereed Journals

- Faujan, B.H., Sajap, A.S., Hamdan, S., Sahri, H.M. and Yarmo, M.A. 2000. Chemical constituents from the body of subterranean termite, *Coptotermes curvignathus* (Holm) (Isoptera: Rhinotermitidae). *ACGC. Chemical Res. Comm.* 10:40-44.
- Sajap, A.S. 1999. Detection of foraging activity of *Coptotermes curvignathus* (Isoptera: Rhinotermitidae) in an *Hevea brasiliensis* plantation in Malaysia. *Sociobiology.* 33:137-143.

Sajap, A.S. and Lardizabal, M.L.T., Faujan, A.B. and Sahri, M.H. 2001. Susceptibility of *Azadirachta excelsa* (Jack) Jacobs, to subterranean termite, *Coptotermes curvignathus* Holmgren (Isoptera: Rhinotermitidae). *J. Trop. For. Sci.* (accepted).

Sajap, A.S., Amit, S. and Welker, J. 2000. Evaluation of hexaflumuron for controlling subterranean termite, *Coptotermes curvignathus*. *J. Econ. Entomol.* 93:429-433.

### Project Publications in Conference Proceedings

None.

### Graduate Research

None.

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