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THE TERMITE *COPTOTERMES CURVIGNATHUS* (RHINOTERMITIDAE) SYMPTOMATOLOGY AFTER INFECTION BY ENTOMOPATHOGENIC FUNGI *ASPERGILLUS FLAVUS*

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Summary. The symptomatology of the termite *Coptotermes curvignathus*, a pest in cocoa plantations in Sumatra, after being infected with the entomopathogenic fungus (*Aspergillus flavus*) is studied. The fungus isolates were collected from primary forest at the Gunung Leuser National Park. The fungal mycelium begins to appear on the 3rd day after application; on 7th day the whole body surface was covered by fungal colony mycelium and a mummification process of termite body is finished. *Aspergillus flavus* is an effective entomopathogenic fungus for controlling termite pests in Sumatra.

Key words: termites, pests, entomopathogenic fungi, biological control, Indonesia.

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Резюме. Изучена симптоматика термита *Coptotermes curvignathus* – вредителя плантаций какао на Суматре, после заражения его энтомопатогенным грибком *Aspergillus flavus.* Изоляты грибка были получены в первичном лесу, расположенном в национальном парке Гунунг Лейзер. Установлено, что мицелий начинает появляться на покровах термитов на 3-й день после заражения, а на 7-й день тело насекомого полностью покрывается мицелием и мумифицируется. Показано, что *Aspergillus flavus* является эффективным энтомопатогеном для контроля численности термитов на Суматре.

INTRODUCTION

Termites are social insects belonging to order Isoptera; the population of a colony of termites reaches more than one million specimens (Chhotani, 1997; Pearce, 1997). In general, termites are known as pests that attack buildings made of wood, living and dead wood, as well as agriculture and plantations pests (Roonwal & Chhotani, 1989).

Coptotermes curvignathus is the most common species attacking plantation crops; the ability of this species to infect plants is classified as moderate to vicious (Kirton *et al*., 1999; Lee, 2002; Sukartana *et al*., 2009). Current termite control technology focuses on the use of termite pesticides (termitisides) which are applied directly to soil treatment, wood preservation or by termiticide impregnation into targets (Arsyad *et al*., 2020; Oi, 2022). While the technology used to control these social insects is still limited to the use of termiticides with a degree of accuracy and success that is still being debated (Siswanto et al., 2015). Beside that these strategies can have a negative impact on the environment and humans. These negative impacts can be reduced by using biological control agents. One of the biological control agents that can be used to control insect pests in plants is a fungus from the genus *Aspergillus* (Lahlali *et al*., 2022).

This study aims to determine the symptomatology of *Coptotermes curvignathus* infected with the entomopathogen of *Aspergillus flavus* as an effort to control termites at low cost and environmentally friendly.

MATERIAL AND METHODS

The test termites used in this study were the worker caste of *Coptotermes curvignathus*. The use of termites from the worker caste is because this caste is very important in each termite colony, especially to collect food and provide food for other castes. *Coptotermes curvignathus* were collected from cocoa plantations in Aceh Province (Sumatra, Indonesia). To avoid the effects of stress on the tested termites, the termites were reared for one week at the Biosystematics Laboratory Universitas Syiah Kuala.

Fungal isolation. The source of the *Aspergillus flavus* isolate obtained from the isolation of termite nests in the Suaq Balimbing Research Station Area, Gunung Leuser National Park, Sumatra, Indonesia, was propagated by inoculating it on Potato Dextrose Agar (PDA) media. Then the fungal isolates were incubated at 25°C for 4-6 days.

Identification of fungal isolates. The isolates of fungi were identified by morphological character (Watanabe, 2010). Macroscopic features included colony color, surface structure and growth pattern, microscopic characteristics were examined in the form of the spore using the Slide Culture Method.

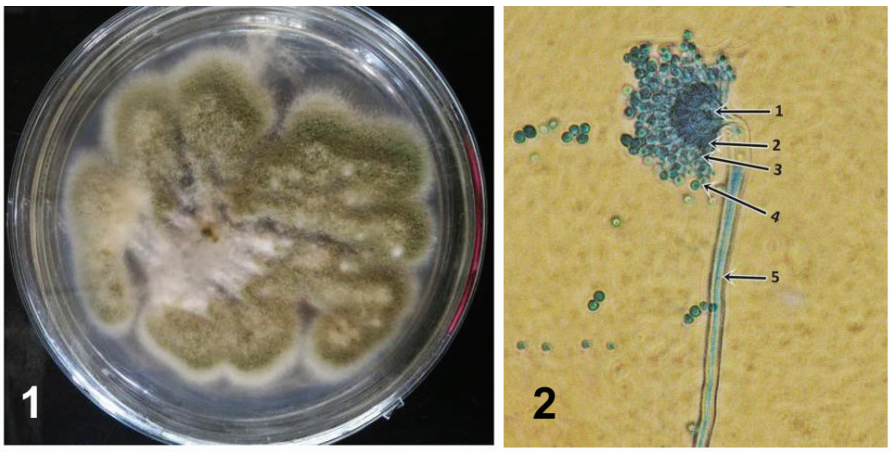
Fungal pathogenicity test. The pathogenicity test of *Aspergillus flavus* was carried out by spraying method. As much as 2 mL/treatment of the fungus suspension was put into the hand sprayer (Butt *et al*., 2001). The suspension was sprayed directly on the test termites in the Petri dish. The termite test used was *Coptotermes curvignathus* from the worker caste and the observation of symptomatology of the termites were conducted daily until 7 days. The growth of entomopathogenic fungi on termite bodies was captured using Dino Lite to identify the fungi.

RESULTS AND DISCUSSION

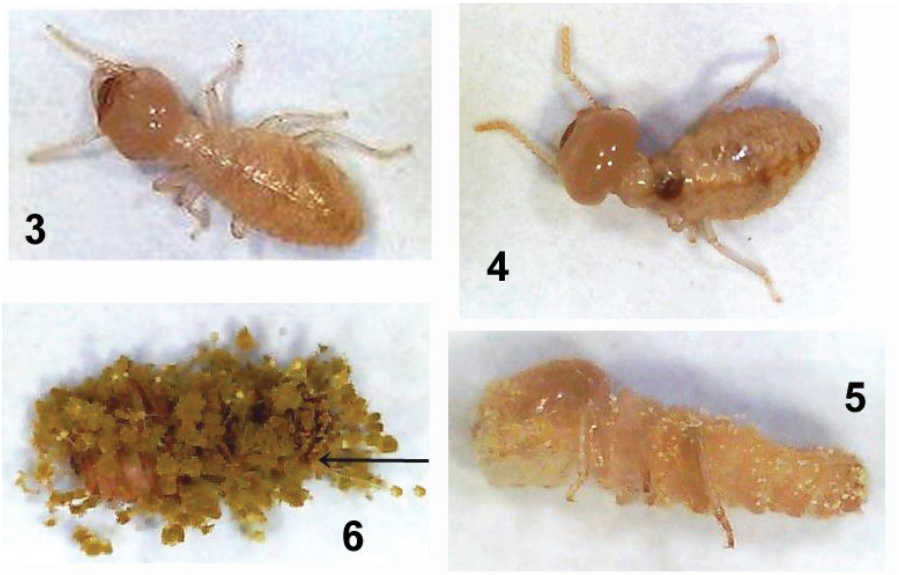
Aspergillus flavus colonies growing on PDA media produce a greenish yellow color with a velvety surface structure, with a golden yellow underside of the colony (Fig. 1). Microscopic observation of the structure of hyphae and spores in *A. flavus* culture, it was found that the structure of the conidial vesicles was semi-circular (semi-spherical) with the top of the vesicles being biseriate (Fig. 2).

Observation results of *Aspergillus flavus* against *Coptotermes curvignathus* is shown in (Figs 3–6). Fungal mycelium was not visible on the surface of the termite body on the 1st day after application, but white mycelium began to appear on the termite integumentary surface

on the 3rd day after application. The yellow-green fungus mycelium was clearly visible on the 7th day, accompanied by a change in the color of the termite's body which became darker brown. The skin of the termite worker caste, which is softer than that of the soldiers, is more easily penetrated by *Aspergillus flavus*. This is thought to be related to the less worker caste termite chitin content. The proportion of the number of worker castes that are very dominant in a termite colony, reaching 90% of the total individual colony.



Figs 1, 2. *Aspergillus flavus*. 1 – colony on Potato Dextrose Agar (PDA); 2 – morphology of conidia: (1) vesicles; (2) metula; (3) fialid; (4) conidiospores; (5) conidiophore.



Figs 3–6. Body surface morphology of *Coptotermes curvignathus* infected with *Aspergillus flavus*. 3 – negative control; 4 – 1st day after application; 5 – 3rd day; 6 – 7th day.

The colony of *Aspergillus flavus* that cover the surface of the termite body has the same color as the growth of pathogenic fungal colonies on Potato Dextrose Agar (PDA) media. Termites infected with entomopathogenic fungi will experience mummification and the body surface will be covered by fungal colony hyphae which have a color according to the color of the type of fungus colony that infects the termites.

Symptomatology of *Coptotermes curvignathus* infected with the fungus *Aspergillus flavus* showed a mummification process and the body surface was covered by fungal colony mycelium with the color of the fungus colonies corresponding to the growth color on Potato Dextrose Agar (PDA) media. The fungal mycelium that grows on the termites' bodies begins to appear on the 3rd day, and by the 7th day the entire integumentary surface of the termites is covered with mycelium. The less chitin content in the skin of the worker caste *Coptotermes curvignathus* is more easily infected by fungi. *Aspergillus flavus* is an effective entomopathogenic fungus for controlling termite pests that attack cocoa plants in Sumatra.

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