

WHITE ROT FUNGI ACCELERATES OIL PALM BIOMASS DEGRADATION IN FIELD

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860

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Oil palm (*Elaeis guineensis*) production in Southeast Asia, particularly Malaysia and Indonesia, is threatened by a pathogenic fungi, *Ganoderma boninense*. Infected oil palm debris left to rot in plantations is an important source of inoculum for the pathogen. Root contact with unattended infected debris is known to be the primary source of infection that spreads in the soil. In general, numerous methods have been utilised for the management of basal stem rot (BSR) disease in oil palm plantations, including cultural techniques, mechanical, chemical and biological controls, but with little success (Idris, 2011). The oil palm biomass provides a substrate for the breeding of pest such as rhinoceros beetle (*Oryctes rhinoceros*) and serves as a source of *Ganoderma* sp. inoculum, to initiate basal stem rot infection. An alternative approach has been adopted by utilising wood degrading fungi to accelerate biomass degradation and minimise the inoculum of *Ganoderma* during replanting of oil palm.

White-rot fungi, namely *Trametes lactinea* GanoBF1 (Figure 1) occurring naturally on oil palm trunks, with antagonistic characteristic against *G. boninense* (Naidu *et al.*, 2015). The fungi is a promising wood degrader with the ability to produce lignocellulolytic enzymes simultaneously after being subjected to an *in vitro* biodegradation

assay. Interestingly, production of lignocellulolytic enzymes (laccase, manganese peroxidase, lignin peroxidase, CMCase, xylanase and amylase) were triggered under the solid-state cultivation (SSC) of agro-industrial waste with *Trametes* GanoBF1 (Naidu *et al.*, 2023).

NOVELTY OF TECHNOLOGY

The eco-friendly formulation was developed containing *Trametes* GanoBF1, a wood degrader fungi in a combination of rubberwood sawdust and vermiculite substrate, supplemented with C and N sources (Figure 1c). The formulation was patented (PI 2015702850) and demonstrated as being non-pathogenic to oil palm through artificially inoculated seedlings.

PATHOGENICITY AND TOXICOLOGY ASSESSMENTS

The pathogenicity of *Trametes* GanoBF1 and its effect on the vegetative growth of oil palm seedlings were investigated under nursery condition (Figure 2). The fronds and boles of the seedlings inoculated with *Trametes* GanoBF1 were symptomless until the end of the 18-months study without compromising the plant growth. In contrast, seedlings inoculated with *G. boninense*



Figure 1. (a) A fruiting body of *Trametes* GanoBF1 fungus, (b) antagonistic strain against *Ganoderma boninense*, and (c) mycelial growth of *Trametes* GanoBF1 on the SSC formulation using agro-waste.

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were severely infected with the infection spreading throughout the seedlings, causing BSR after nine months (Naidu *et al.*, 2018). In addition, *Trametes* GanoBF1 was graded as non-toxic based on the acute oral toxicity test on rats (SIRIM Report No. R575/15/B19/27).

***Trametes* GanoBF1 AS ECO-FRIENDLY FIELD BIOMASS MANAGEMENT**

A field-based study was conducted at the MPOB-Keratong Research Station, tested the biocontrol and biodegradation capacity of the *Trametes* GanoBF1 on oil palm trunks (Figure 3). Prior to the field study, a census and mapping of *Ganoderma* diseased palms was conducted. A total of 12 *Ganoderma* infected and healthy trunks were cut and the remaining root bole were left *in situ*. The trunks were sectioned into seven discs, treated with *Trametes* (500 g / disc) in 3-5 cm deep cuts, and arranged in a Randomised Complete

Block Design (RCBD) with 12 blocks or refer to Figure 4 for detail explanation on the application methods.

Degradation was assessed at 3, 6, 9 and 12 months using five scores: No degradation (ND), slightly degraded (SD), mildly degraded (MD), degraded (D), and highly degraded (HD). The percentages of mass loss were literally higher in BSR diseased discs treated with *Trametes* GanoBF1 with 64%, followed by healthy discs (47%) in comparison to the control discs, which were left for natural decomposition (25%), after month 12 (Figure 5).

Trametes GanoBF1 colonised the discs vertically, confirmed by ITS gene identification. Covering with green nets helped retain moisture, enhancing fungal establishment and trunk degradation. This alternative approach has been identified to potentially degrade oil palm trunks (diseased or unproductive) thus, reducing *Ganoderma* inoculum pressure in eco-friendly manner.



Figure 2. Observation of oil palm seedlings nine months after artificially inoculated with the pathogen, (a) *Ganoderma boninense* and (b) a wood degrader, *Trametes* GanoBF1. Formation of fruiting body or white mycelium at the base of oil palm seedling was indicated by an arrow.



Note: Each rack can accommodate 32 bags of the formulation. Each of the eco-friendly formulation bag weighed about 500 g.

Figure 3. Mass production of *Trametes* GanoBF1 for field evaluation.

1) 	2) 	3) 
Trunks were pushed and cut into smaller discs	Making drain (3 drains / disc). Depth: 3-5 cm. Distance: 3-5 cm apart	Mass production <i>Trametes GanoBF1</i> for field application
4) 	5) 	6) 
Application of product formulation on the cut drains, covering the surface of the disc (indicated by arrow)	Initial establishment of <i>Trametes GanoBF1</i> on the inoculated disc, covered with green net	Further establishment of <i>Trametes GanoBF1</i> on the inoculated disc, after month 1
7(a) 	7(b) 	7(c) 
Spreading of the <i>Trametes GanoBF1</i> from top to the bottom of the discs (vertical)		

Figure 4. Application of *Trametes GanoBF1* in the field study, conducted at MPOB-Keratong Research Station. The trunk size (palm age < 20 years) = Diameter: 30 cm x Height: 35 cm. Application rate of the *Trametes GanoBF1* = 500 g/disc.

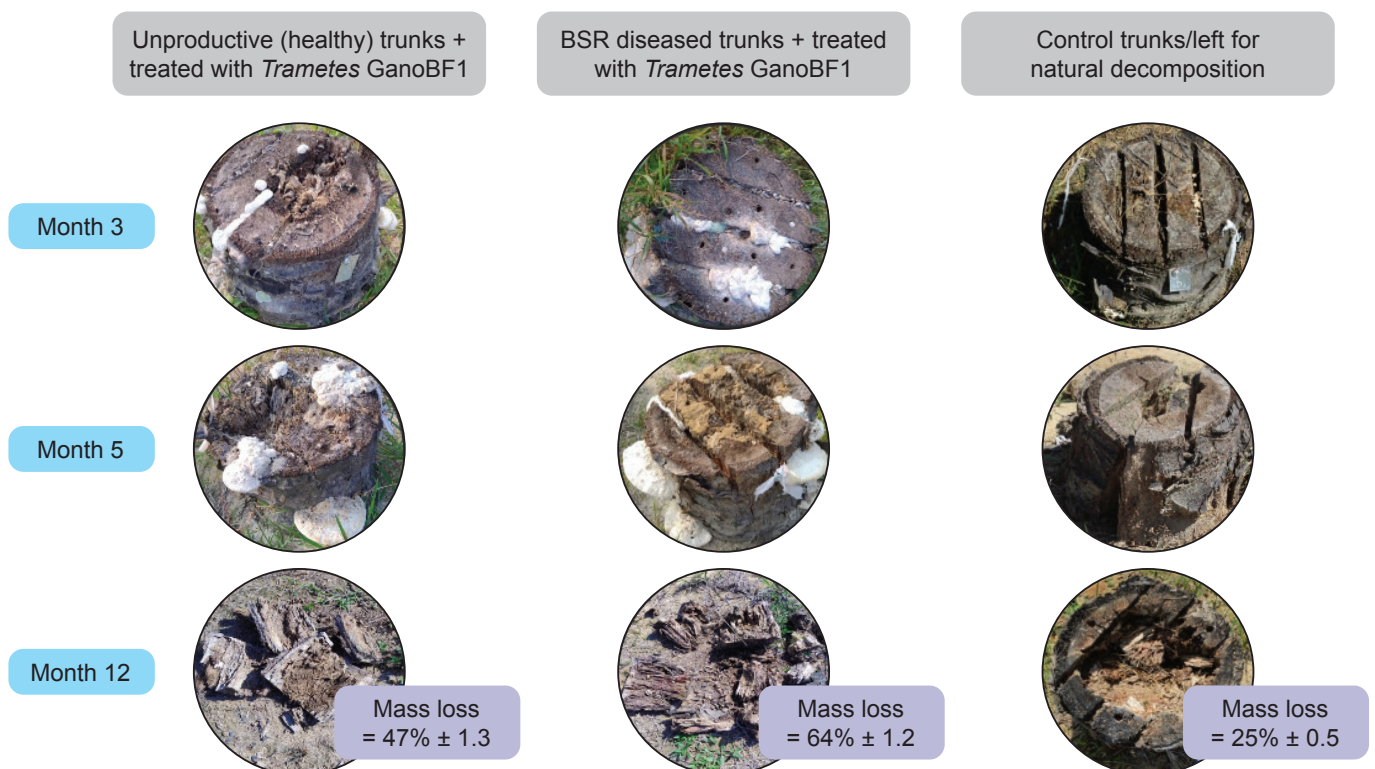


Figure 5. Percentages of mass loss in basal stem rot (BSR) diseased trunks treated with *Trametes GanoBF1*, after month 12.

BENEFITS OF THE TECHNOLOGY

- Cost effective and eco-friendly field biomass management of *Ganoderma* disease and other major pests, such as rhinoceros beetle and rats.
- Sustainable way to accelerate the recycling of root mass, stumps and trunks waste recycling.
- Added nutrients value to the soil.
- Minimise the infection of *Ganoderma* fungus and other pests.

ECONOMIC ANALYSIS

The estimated investment cost for the production of the eco-friendly formulation of *Trametes* GanoBF1 is approximately RM500,000 which is based on the capacity of 50,000 tan per year (for an established company or technology taker).

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