

Historically, oil palm trunks (OPT) were burnt to make way for replanting. Burning of oil palm biomass reduces the risk of potential pests and diseases. In 1994, open burning of crop residues in Malaysia was banned due to environmental and health concerns. This led to the practice of the zero-burning technique. With extensive oil palm replanting, *Oryctes rhinoceros* infestation and *Ganoderma boninense* infection are becoming renewed problems for the industry. The rotting biomass becomes a medium for the breeding of pests such as *O. rhinoceros* (L) and diseases like *G. boninense*. Yield loss ascribed to *O. rhinoceros* infestation of oil palm cultivated areas totalling 46 444 ha is estimated at 25% within two years, whilst yield loss from *G. boninense* infection of oil palm cultivated areas covering 40 599 ha is estimated at 1.5%. Treatment of the biomass with biodegrading fungi expedites the degradation process, and prevents the rotting biomass from becoming a medium for the breeding of pests and pathogens.

OBJECTIVES

- To screen the oil palm trunk rotting capacity, as well as the lignin and cellulose consumption of rotters.
- To select for rotting fungi antagonistic to *G. boninense*.
- To determine the best fungal combinations for accelerating field decay of oil palm trunks, controlling or reducing attack by *G. boninense* and *O. rhinoceros*.

PROCESS DESCRIPTION

Laboratory Selection of Rotting Fungi

Sixty-one basidiomycetous rotting fungi, isolated from rotting oil palm trunks, were isolated and screened for their decaying performance and consumption of lignin and celluloses. The American Standard Rotting Experiment was used to quantify the rotting capacity of the

basidiomycetous rotting fungi (Figure 1). Rotters with higher decaying performance, and showing higher consumption of lignin and cellulose than the pathogen, *G. boninense*, (Table 1) as well as which are inhibitory to *G. boninense* (Figure 2) were selected for field biodegradation testing.

Field Biodegradation

Combinations of selected rotters and *Trichoderma* spp. (Table 2) were introduced onto heaps of shredded oil palm trunks (SOPT) at replanting in replicates of four. The SOPT heaps were covered with oil palm fronds and left to rot (Figure 3). Inoculation was repeated at three months during degradation (MDD) and six MDD. The extent of SOPT decay for the treatments with the rotting fungi, T1, T2, T3 and T4, showed 37%, 59%, 59% and 56% combined lignin and cellulose reduction, respectively, as compared to the untreated control, T5, which showed 15% reduction (Figure 4). Treatment with biodegradation fungi led to 57% and 61% reduction in the number of *O. rhinoceros* grubs at six MDD and 10 MDD, respectively (Figure 5). Treatments with rotting fungi inoculated every three months resulted in 100% disappearance of *G. boninense* fruiting bodies at six and nine MDD



Figure 1. Decaying oil palm trunk test-blocks, each placed on a rubberwood feeder block and inoculated and colonized by different rotting fungi in a standard rotting experiment. Each row of six bottles (from back to front) was inoculated with the same fungus. There were 22 rows of bottles inoculated with 22 different rotting fungi; they were incubated for three months.

TABLE 1. PERCENTAGE DECAY, CELLULOSE AND LIGNIN CONSUMPTION BY SELECTED ROTTERS AND *Ganoderma boninense* ON OIL PALM TEST-BLOCKS AT DIFFERENT DENSITIES

Rotter	Density of test-blocks* (g cm ⁻³)	% decay	% cellulose consumption	% lignin consumption
Brown-rot SK8/11	D1	77.36	92.98	52.37
	D2	71.60	84.54	59.64
	D3	58.85	80.67	31.82
White-rot SK7/5	D1	38.98	33.14	57.65
	D2	40.59	39.28	64.71
	D3	36.30	35.91	45.73
<i>Ganoderma boninense</i>	D1	16.50	42.02	7.05
	D2	22.66	44.72	9.67
	D3	29.60	49.04	12.27

Note: *Density of oil palm test-blocks: D1 = 0.27- 0.40 g cm⁻³, D2 = 0.41- 0.53 g cm⁻³ and D3 = 0.54-0.67 g cm⁻³.

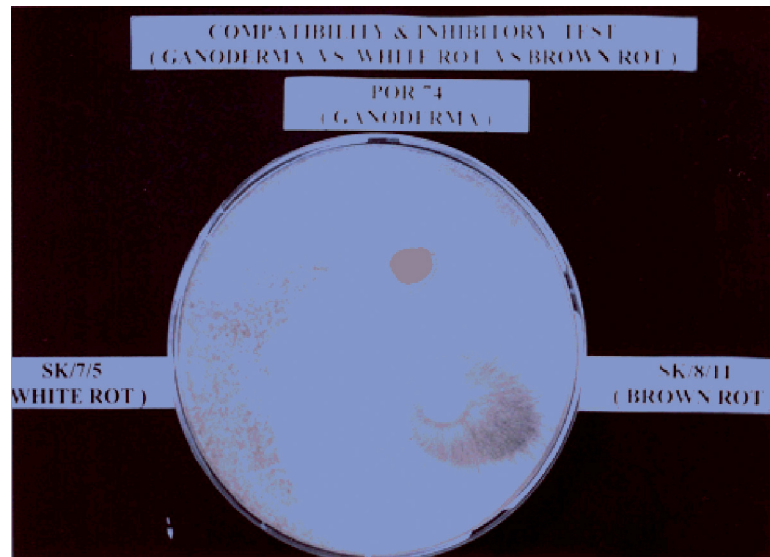


Figure 2. Brown rot, SK 8/11, and white rot, SK 7/5, are compatible and inhibitory to *Ganoderma boninense*.

TABLE 2. COMBINATION OF ROTTING FUNGI TESTED FOR FIELD BIODEGRADATION OF OIL PALM TRUNKS

Treatment	Combination of fungi
T1	Brown-rot SK 8/11 + <i>Trichoderma harzanium</i>
T2	White-rot SK7/5 + <i>T. harzanium</i>
T3	Brown-rot,SK8/11 + <i>T. reesei</i>
T4	White-rot SK7/5 + <i>T. reesei</i>
T5	Untreated or control



Figure 3. (a) Shredded oil palm trunks (SOPT) inoculated with rotting fungi. (b) Inoculated SOPT covered with fronds to enhance rotting.

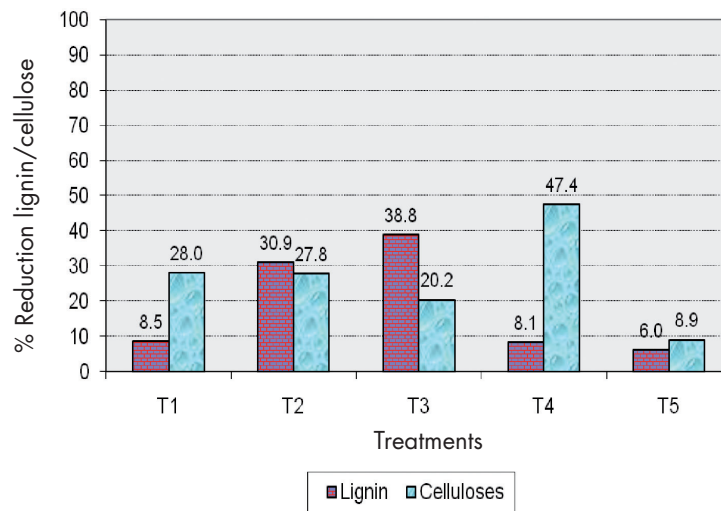


Figure 4. Reduction in lignin and celluloses under the different rotting fungi treatments. Treatments: T1 = brown-rot SK 8/11 + *Trichoderma harzanium*, T2 = white-rot SK7/5 + *T. harzanium*, T3 = brown-rot, SK8/11 + *T. reesei*, T4 = white-rot SK7/5 + *T. reesei* and T5 = untreated or control.

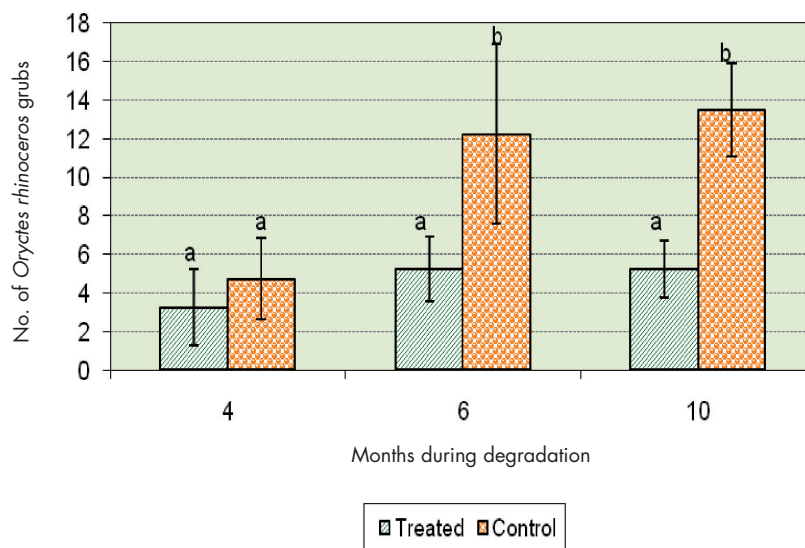


Figure 5. *Oryctes rhinoceros* grubs reduced in number with fungal treatments. T4 = treated plot using white-rot, SK7/5 and *Trichoderma reesei*. Number of *O. rhinoceros* grubs refers to count per 1 m² area. Bars in the same group with the same letter are not significantly different from one another at $p = 0.05$.

TABLE 3. PERCENTAGE PREVALENCE OF *Ganoderma boninense* FRUITING BODIES ON INFECTED, ROTTING STUMPS TREATED WITH ROTTING FUNGI

Treatment	Months during degradation (MDD)					
	0	3	6	9	12	24
T1	0	25	25	25	25	50
T2	0	25	25	50	50	25
T3	0	50	25	25	75	50
T4	0	25	0	0	25	25
T5	0	50	50	75	75	50

Note: Treatments were conducted at 0, 3 and 6 MDD on rotting oil palm stumps. Treatments: T1 = brown-rot SK 8/11 + *Trichoderma harzanium*, T2 = white-rot SK7/5 + *T. harzanium*, T3 = brown-rot, SK8/11 + *T. reesei*, T4 = white-rot SK7/5 + *T. reesei* and T5 = untreated or control.

for T4 (Table 3). A three-fold increase in rotting or reduction in the breeding sites led to a reduction in the number of *O. rhinoceros* grubs and *G. boninense* fruiting bodies.

BENEFITS

These rotting saprophytic fungi are beneficial microbes which are:

- environment-friendly bio-control agents;
- able to accelerate SOPT decay by two-to three-fold than untreated control;
- able to reduce the breeding sites of *O. rhinoceros* and *G. boninense*; and
- able to reduce the numbers of *O. rhinoceros* grubs and *G. boninense* fruiting bodies.

CONCLUSION

The selected rotting fungi are effective biological agents which accelerate the decay of SOPT, the breeding sites of *O. rhinoceros*, *G. boninense*, leading to a substantial reduction in the numbers of *O. rhinoceros* grubs and *G. boninense* fruiting bodies.

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