

# GanoEB1 - A BACTERIAL BIOCONTROL AGENT FOR *Ganoderma* IN OIL PALM

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**B**asal stem rot (BSR) disease can cause considerable damage in oil palm by basidiomycete fungi identified as *Ganoderma* spp. (Idris, 1999). Biological control in *Ganoderma* disease management has been extensively explored in recent years. Biological control is the use of natural or modified organisms, genes and gene products to reduce the effects of plant pathogens and to favour cultivated crops (Ownley and Windham, 2003). Biological control agents using microorganisms such as endophytic bacteria (Zaiton *et al.*, 2008) and *Trichoderma* spp. (Shamala and Idris, 2009) have been reported to suppress *Ganoderma* infection in oil palm. Endophytic bacteria are organisms inhabiting plant tissues that at some time in their life cycle can colonize the internal plant tissues without causing apparent harm to the host (Azevedo *et al.*, 2000). The capability of colonizing host tissue has

made endophyte bacteria valuable for agriculture as a tool to improve crop performance compared to other biological agents. Potential endophytic bacteria were investigated through *in vitro* and nursery trials against *Ganoderma boninense*.

## ISOLATION AND *in vitro* SCREENING OF ENDOPHYTIC BACTERIA AGAINST *Ganoderma boninense*

A total of 581 isolates were successfully isolated from healthy oil palm roots and stem tissues. All isolates were screened for antagonistic activity against *G. boninense* by dual culture and culture filtrate tests. Based on the percentage inhibition of radial growth (PIRG) of these isolates, isolate GanoEB1 (Figure 1a) was selected, having achieved 70% PIRG (Figure 1b), and exhibited greater activity in the culture filtrate test (Figure 1c) compared to the control (Figure 1d).

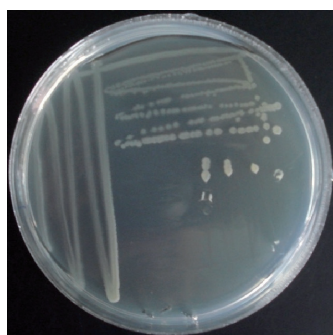


Figure 1a. Culture GanoEB1.

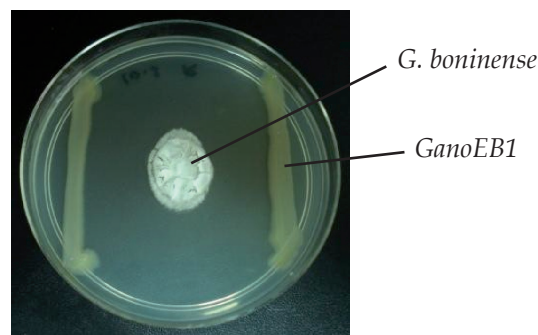


Figure 1b. Dual culture test for GanoEB1 against *G. boninense*.

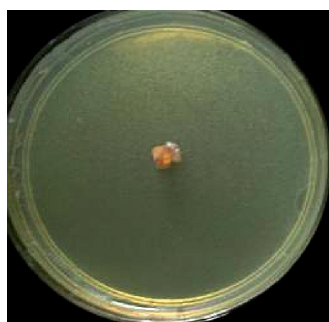


Figure 1c. Culture filtrate test for GanoEB1 against *G. boninense*.

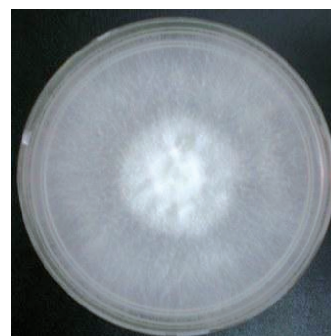


Figure 1d. *G. boninense* in control plate.

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## NURSERY EVALUATION OF GanoEB1 AS A BIOLOGICAL CONTROL AGENT AGAINST *Ganoderma boninense*

GanoEB1 was further studied for its efficacy as a biological control agent (BCA) and in subsequent disease suppression in oil palm seedlings against *G. boninense*. The effectiveness of GanoEB1 in suppressing BSR development in oil palm seedlings was evaluated based on quantitative assessment measured as percentages of disease incidence (%DI), severity of foliar symptoms (%SFS) and dead seedlings. This study was repeated twice over a period of 12 months. At six months after treatment, seedlings treated with GanoEB1 showed a significant difference in %DI at 33.3% and 40.0% compared to untreated seedlings at 86.7% and 93.3% respectively (Figure 2).

GanoEB1 significantly reduced %SFS in oil palm seedlings caused by *G. boninense* infection (Figure 3). Meanwhile, seedlings treated with GanoEB1 showed a significant reduction in percentage of dead seedlings compared to untreated seedlings (Figures 4 and 5). Overall, between 62% and 74% of BSR disease incidence was reduced in seedlings treated with GanoEB1 (Table 1).

### CONCLUSION

GanoEB1 has the potential of inhibiting the growth of *G. boninense* *in vitro*. In addition, GanoEB1 is effective in suppressing *G. boninense* infection in oil palm seedlings. Field evaluation is being conducted to confirm the efficacy of GanoEB1 as a biological control agent against *Ganoderma* in oil palm.

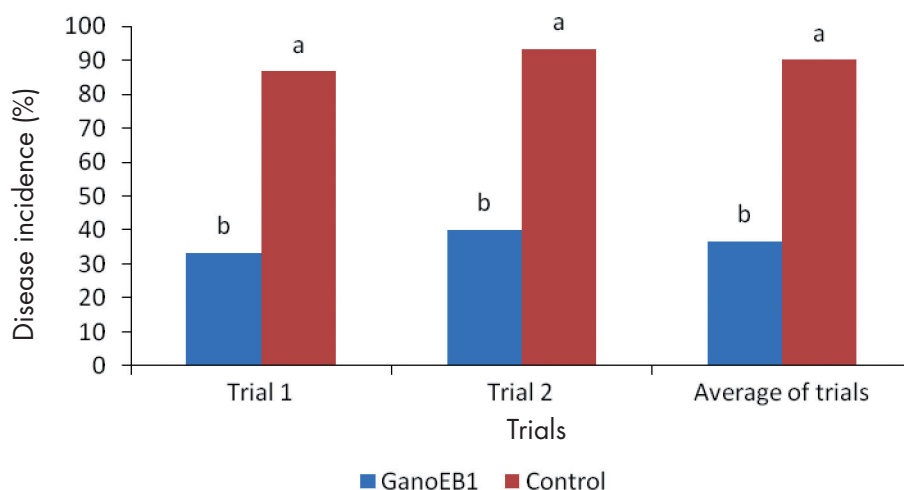


Figure 2. Percentage of disease incidence (%DI) in oil palm seedlings after inoculation with *G. boninense*. Means with the same letter within a trial are not significantly different based on the Least Significant Difference (LSD) test at  $p=0.05$ .

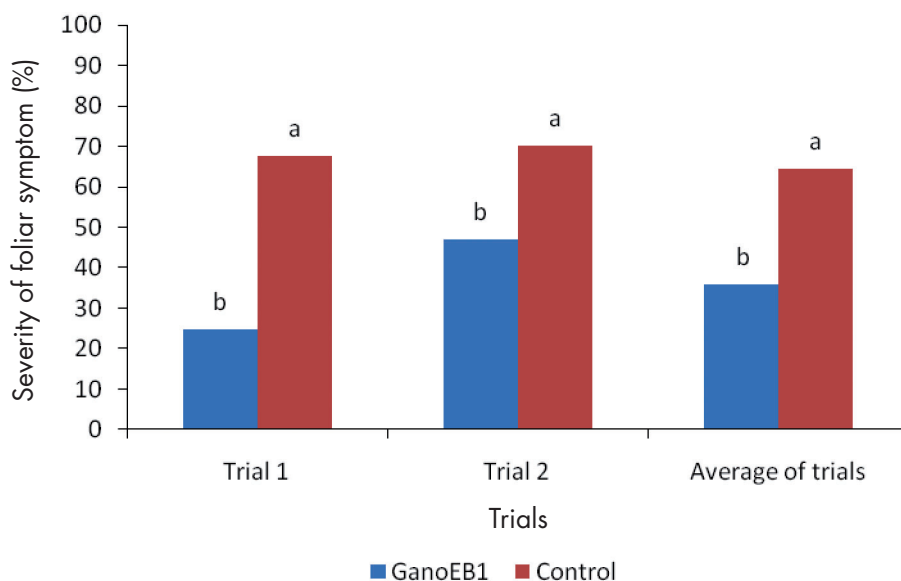


Figure 3. Percentage of severity of foliar symptoms (%SFS) of oil palm seedlings due to *G. boninense* infection. Means with the same letter within a trial are not significantly different based on the Least Significant Difference (LSD) test at  $p=0.05$ .

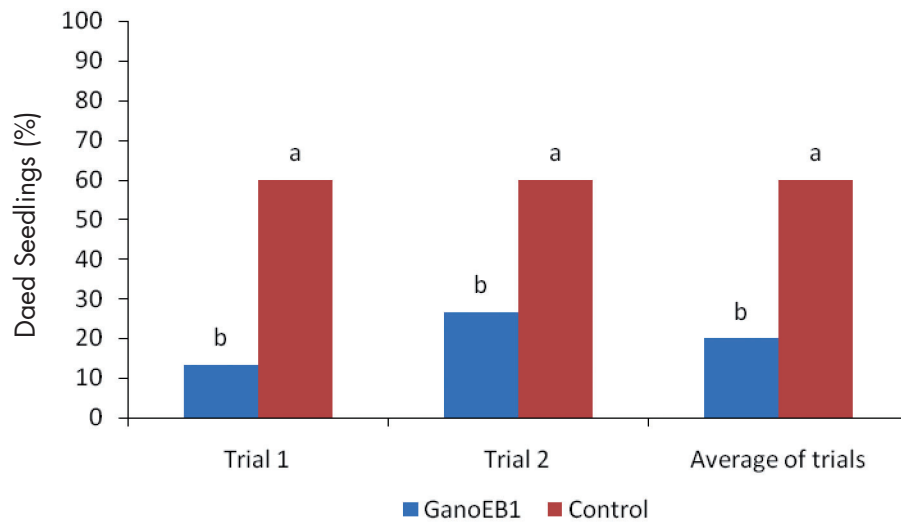


Figure 4. Percentage of dead seedlings due to *G. boninense* infection. Means with the same letter within a trial are not significantly different based on the Least Significant Difference (LSD) test at  $p=0.05$ .

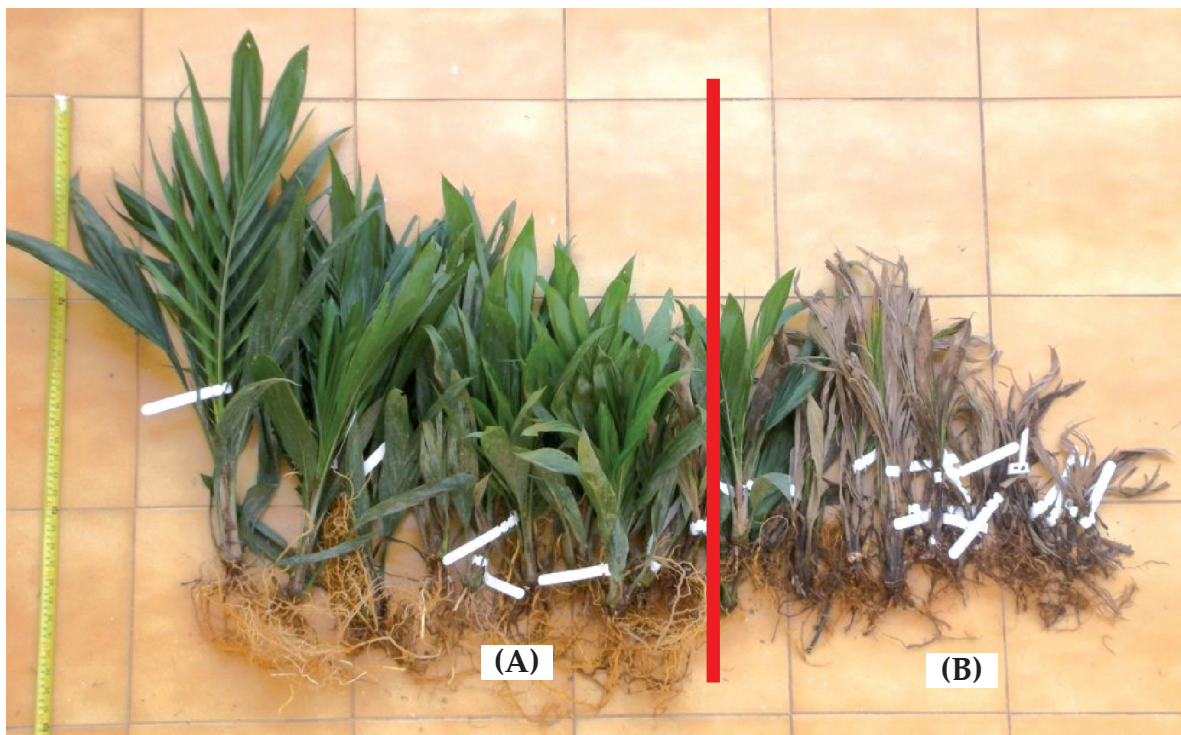


Figure 5. Oil palm seedlings treated with *GanoEB1* + inoculated with *G. boninense* (A) and seedlings untreated with endophytic bacteria + inoculated with *G. boninense* (B).

**TABLE 1. EFFECT OF GanoEB1 ON BASAL STEM ROT (BSR) DEVELOPMENT IN OIL PALM SEEDLINGS AT SIX MONTHS AFTER TREATMENT**

Treatment	Nursery Trial 1		Nursery Trial 2	
	AUDPC <sup>1</sup>	DR <sup>2</sup> (%)	AUDPC <sup>1</sup>	DR <sup>2</sup> (%)
Seedlings treated with GanoEB1 and inoculated with <i>G. boninense</i> (T1)	46.7	74.0	66.7	62.0
Untreated seedlings with bacteria and inoculated with <i>G. boninense</i> (control)	180.0	-	173.3	-

Note: <sup>1</sup> Area under disease progress curve (AUDPC). <sup>2</sup> Disease reduction (DR).  
Average disease reduction (DR) = 68%.

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