KEMENTERIAN PERUSAHAAN PERLADANGAN DAN KOMODITI

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POTENTIAL GRAM-POSITIVE ENDOPHYTIC BACTERIA SPP. IN *Ganoderma* CONTROL

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A green control

NOVELTY/HIGHLIGHTS

- This technology offers gram-positive endophytic bacteria (EB) *Bacillus* spp. isolated from roots of oil palm, for an effective disease suppression of *Ganoderma boninense* in oil palm.
- The first report of EB gram positive bacteria against *G. boninense* with biocontrol characteristics.
- *Bacillus* spp. has been found to induce systemic resistance in plants and shown biological control traits such as antibiotic production and lysis activity on pathogen.
- Potentially beneficial EB residing within the oil palm are able to assist palms thrive for survival by providing protection against P&D damages.

ADVANTAGES OF EB

- A green technology that is environmentally friendly, safe, effective and economical.
- Promote the use of biological control agents (BCA) as a safer alternative in managing basal stem rot disease in the field.

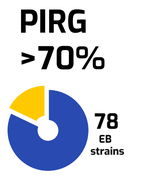
THE PROSPECT OF EB

- A sustainable control in the integrated *Ganoderma* management in oil palm.
- A preventive control.

Isolation, in vitro screening and nursery trials of gram-positive EB against *G. boninense*

95
EB strains isolated from oil palm roots

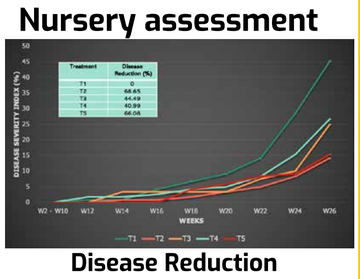
PIRG >70%



4
Potentially effective

B. cereus EB2
B. cereus EB14
B. altitudinis EB39)
Pseudomonas aeruginosa EB35
(gram-negative strain - control)

Nursery assessment



Disease Reduction

69% *B. cereus EB2*

66% *B. altitudinis EB39*

Dual culture assay

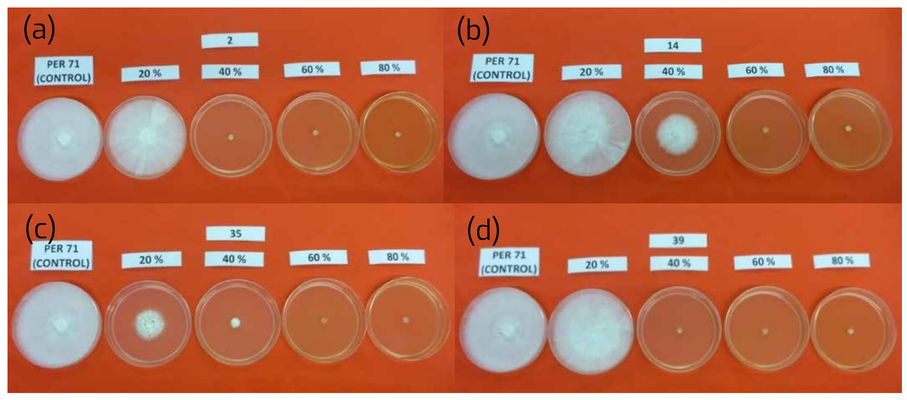


Figure 1. Percentage inhibition of radial growth (PIRG) of *Ganoderma boninense* PER71 in endophytic bacteria poisoned PDA media. (a) *Bacillus cereus* EB2; (b) *B. cereus* EB14; (c) *Pseudomonas aeruginosa* EB35; (d) *B. altitudinis* EB39.

Poison agar assay

TABLE 1. PERCENTAGE INHIBITION OF RADIAL GROWTH (PIRG) OF *Ganoderma boninense* PER71 IN ENDOPHYTIC BACTERIA POISON AGAR MEDIA

Bacteria	*Concentration of bacteria (%) in PDA*			
	20	40	60	80
EB2	0.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00
EB14	0.00 ± 0.00	58.65 ± 1.89	100.00 ± 0.00	100.00 ± 0.00
EB35	42.00 ± 1.60	96.23 ± 0.58	100.00 ± 0.00	100.00 ± 0.00
EB39	0.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00

Scanning electron microscopy (SEM)

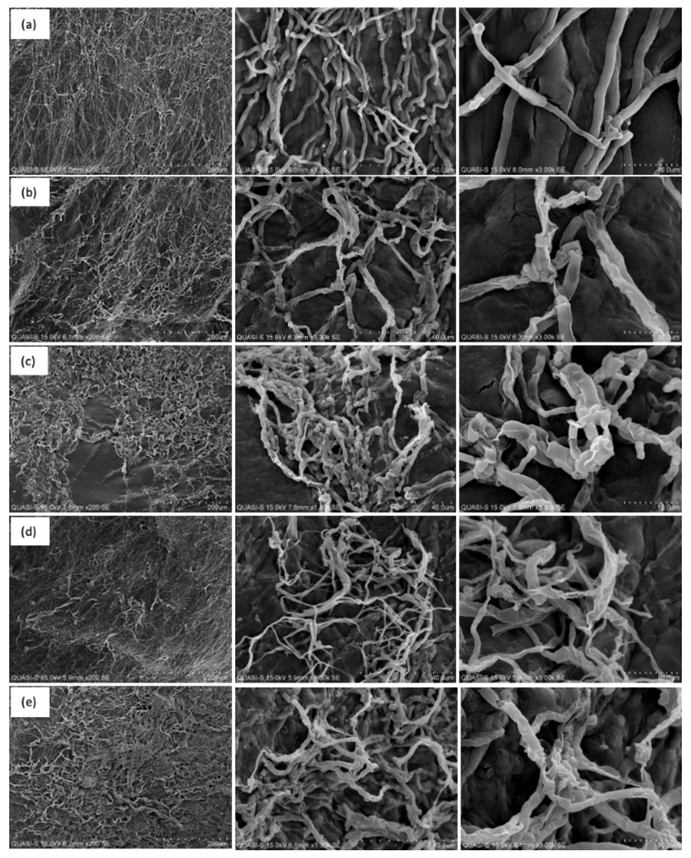


Figure 2. Effect of the culture filtrate of endophytic bacteria on the morphology and ultrastructure of *Ganoderma boninense* observing severe morphological deformation; wilting, shriveling and lysis of hyphal walls: (a) negative control (arrow showing clamp connection of hyphae); (b) *Bacillus cereus* EB2; (c) *B. cereus* EB14; (d) *Pseudomonas aeruginosa* EB35; (e) *B. altitudinis* EB39.

*Note: Same strain in a row, all images were from lower to higher magnification (left to right), scale bar = 200 μm, 40 μm, 10 μm, respectively.

COST

Economic Analysis	Value
Net Present Value (NPV)	RM5.5 million
Internal Rate of return (IRR)	20.39 %
Payback Period	3.7 years
Benefit Cost Ratio (B:C)	1.06

The clients

This technology will bevaluable for potential clients interested in developing the biopesticide products against oil palm BSR disease

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