Burkholderia GanoEB2 POWDER AS BIOLOGICAL CONTROL OF *Ganoderma* IN OIL PALM

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Biological control agents such as endophytic bacteria have gained significance in suppressing and controlling plant diseases. Endophytes have been isolated from several hosts, such as oil palm (Zaiton *et al.*, 2007) and banana (Pan *et al.*, 1997). The capability of colonising host tissue has made endophytic bacteria valuable as a tool to improve crop performance. The efficacy of bacteria from the genera *Burkholderia* in controlling *Ganoderma boninense*, the causal agent of basal stem rot (BSR) of oil palm was reported (Sapak *et al.*, 2008; Idris *et al.*, 2010; Bivi *et al.*, 2010). Pure culture of the endophytic bacterium *Burkholderia* isolated from oil palm has the capability of suppressing *G. boninense in vitro* and in a nursery trial (Maizatul and Idris, 2009). The utilisation of a bacterial cell suspension is impractical for large-scale field application due to difficulties faced during storage, transport and handling (Vidhyasekaran *et al.*, 1997). MPOB has formula-ted *Burkholderia* GanoEB2 in powder formulation for *G. boninense* control in oil palm.

BENEFITS OF *Burkholderia* GanoEB2 POWDER

- Control of basal stem rot (BSR) disease in oil palm caused by *Ganoderma*.
- Method of application is straightforward – no special equipment needed.
- Ability to support good growth and survival of the bacteria.
- Easy handling (light-weight carrier).
- Environmental-friendly technology.

PREPARATION OF *Burkholderia* GanoEB2 POWDER

Burkholderia GanoEB2 powder formulation was developed based on Nasyaruddin and Idris (2011). The bacterial *Burkholderia* GanoEB2 was grown in an enriched medium at 30°C for 24 hr. The bacterial cell suspension was harvested at 10^8 colony forming unit per millilitre (CFU ml^{-1}), supplemented into carrier and mixed well under sterile conditions. The powder formulation was packed and stored at room temperature (27 ± 2°C) (*Figure 1*).

Figure 1. Burkholderia *GanoEB2 powder (a) and product (b).*

QUALITY OF *Burkholderia* GanoEB2 POWDER

The quality of *Burkholderia* GanoEB2 powder was determined in terms of bacteria population by colony forming unit per gramme (CFU g^{-1}). The number of viable bacteria cells in *Burkholderia* GanoEB2 powder was 10^8 CFU g^{-1} at one to five months of storage and 10^5 CFU g^{-1} after sixth months of storage.

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NURSERY EVALUATION OF *Burkholderia* GanoEB2 POWDER AGAINST *Ganoderma boninense*

The efficacy of *Burkholderia* GanoEB2 powder as a biological control agent (BCA) for controlling BSR disease in an oil palm nursery was studied using rubber wood block (RWB) sitting technique. The effectiveness of formulated powder in controlling BSR development in oil palm seedlings was evaluated based on quantitative assessment measured as percentage of dead seedlings (DS), percentage of severity of foliar symptoms (SFS) and percentage of disease incidence (DI). Percentage of disease reduction (DR) was calculated based on area under disease progressive curve (AUDPC). The study was conducted for 10 months. At six months after treatment, DS due to *G. boninense* infection of oil palm seedlings treated with *Burkholderia* GanoEB2 powder was recorded at 26.7%, which was significantly lower compared with untreated seedlings at 80.0% (*Figure 2*). For SFS, seedlings treated with *Burkholderia* GanoEB2 powder showed significant different with 48.2% of SFS compared to untreated seedlings (86.4%). *Burkholderia* GanoEB2 powder was able to significantly reduce DI. Only 46.7% of the oil palm seedlings treated with the formulation showed *G. boninense* infection compared with the untreated seedlings which had 93.3% DI. Overall, BSR disease incidence in seedlings treated with *Burkholderia* GanoEB2 powder was reduced to 57.4% compared with untreated seedlings (*Table 1*).

TABLE 1. THE EFFECT OF *Burkholderia* GanoEB2 POWDER ON BASAL STEM ROT (BSR) DISEASE DEVELOPMENT IN OIL PALM SEEDLINGS AT SIX MONTHS AFTER TREATMENT

Treatments	AUDPC#	DR## (%)
Seedlings untreated with *Burkholderia* GanoEB2 powder and inoculated with *G. boninense* (control)	360.0	-
Seedlings treated with *Burkholderia* GanoEB2 powder and inoculated with *G. boninense*	153.3	57.4

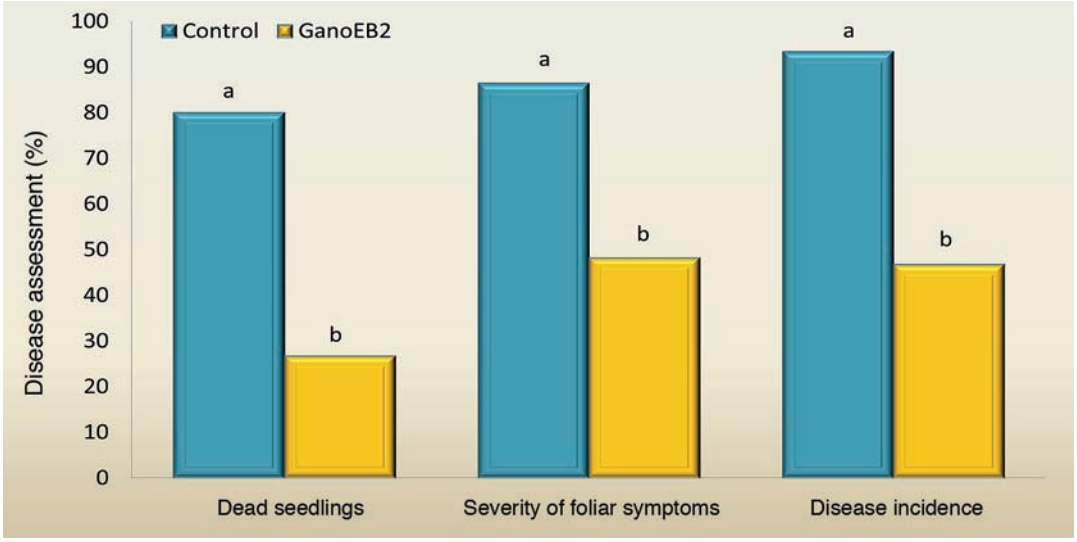
Note: #area under disease progress curve.
##Disease reduction.

ECONOMIC ANALYSIS

The fixed cost of a pilot plant for producing *Burkholderia* GanoEB2 powder is estimated at RM 5.19 million. The payback period is four years, with an internal rate of return (IRR) of 12%, while the net present value (NPV) at 10% discount rate is RM 361 418. The benefit: cost ratio (B:C) for the discount rate of 10% is 1.46 and the return on investment (ROI) is 32.7%.

CONCLUSION

Burkholderia GanoEB2 powder is effective in controlling and suppressing *Ganoderma in vitro*



Note: means within a group with different letters are significantly different at $p<0.05$ according to t-test.

Figure 2. Dead seedlings (DS), severity of foliar symptoms (SFS) and disease incidence (DI) due to Ganoderma boninense *infection at six months after treatment.*

and in nursery trial. This is useful in the integrated *Ganoderma* management (IGM) programme of oil palm.

REFERENCES

BIVI, M R; FARHANA, M S N; KHAIRULMAZMI, A and IDRIS, A S (2010). Control of *Ganoderma boninense*: a causal agent of basal stem bot disease in oil palm with endophyte bacteria *in vitro*. *International Journal of Agriculture and Biology*, *12*: 833-839.

IDRIS A S; NASYARUDDIN, M N M; MAIZATUL, S M and ZAITON, S (2010). GanoEB1- a bacterial biocontrol agent for *Ganoderma* in oil palm. *MPOB Information Series No. 500*: 4 pp.

MAIZATUL, S M and IDRIS, A S (2009). Nursery evaluation of *Agrobacterium radiobacter*, *Burkholderia cepacia* and *Pseudomonas syringae* to control *Ganoderma boninense* infection in oil palm. *Proc. of the PIPOC 2009 International Palm Oil Congress - Agriculture, Biotechnology and Sustainability*. p. 1301-1312.

NASYARUDDIN, M N M and IDRIS, A S (2011). Formulation of *Pseudomonas* GanoEB3 against *Ganoderma boninense in vitro*. *Proc. of the Third MPOB-IOPRI International Seminar: Integrated Oil Palm Pests and Diseases Management*. p. 124-128.

PAN, M J; RADEMAN, S; KUNER, K and HASTING, J W (1997). Ultrastructural studies on colonization of banana tissues and *Fusarium oxysporum f. sp. Cubense* race 4 by the endophytic bacterium *Burkholderia cepacia*. *J. Phytopathology, 145*: 479-489.

SAPAK, Z; MEON, S and AHMAD, Z A M (2008). Effect of endophytic bacteria on growth and suppression of *Ganoderma* infection in oil palm. *International Journal of Agriculture and Biology, 10*: 127-132.

VIDHYASEKARAN, P; RABINDRAN, R; MUTHAMILAN, M; NAYAR, K; RAJAPPAN, K; SUBRAMANIAN, N and VASUMATHI, K (1997). Development of a powder formulation of *Pseudomonas fluorescens* for control of rice blast. *Plant Pathology, 46*: 291-297.

ZAITON, S and IDRIS, A S (2007). Endophytic bacteria isolated from oil palm roots and their antagonistic activity against *Ganoderma boninense in vitro*. *Proc. of the PIPOC 2007 International Palm Oil Congress - Agriculture, Biotechnology and Sustainability Conference*. p. 844-851.

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