

# Amphinema GanoEF2 POWDER AS BIOLOGICAL CONTROL OF *Ganoderma* DISEASE IN OIL PALM

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Over the past years, microorganisms have been isolated and tested as biological control agents against diseases caused by soil borne plant pathogens.

It was reported (Noor Haida and Idris *et al.*, 2009) that conidial suspension of GanoEF2 has the potential in suppressing *Ganoderma* infection in oil palm seedlings. A study was conducted to develop *Amphinema* GanoEF2 into powder formulation for controlling *Ganoderma* disease in oil palm.

## PREPARATION OF *Amphinema* GanoEF2 POWDER

The powder formulation of *Amphinema* GanoEF2 was prepared using sterilised vermiculite as a carrier based on the method described by Nasyaruddin and Idris (2011) with modifications. Fungal spores were propagated in liquid media consisting of potato dextrose broth (PDB). The spore suspensions were harvested at  $10^8$  colony forming unit per millilitre (CFU ml<sup>-1</sup>) and was added into the carrier and mixed well under sterile conditions. The powder was stored at room temperature ( $27 \pm 2^\circ\text{C}$ ) (Figure 1).

## QUALITY OF *Amphinema* GanoEF2 POWDER

The viability of *Amphinema* GanoEF2 powder was assessed in terms of population as colony-forming units per gramme (CFU g<sup>-1</sup>). The powder formulation was stored at room temperature and the viability test of *Amphinema* GanoEF2 in the powder formulation during storage was conducted over a seven-month storage period. The initial population of the fungal in the powder formulation was  $10^8$  CFU g<sup>-1</sup>. The population remained at  $10^8$  CFU g<sup>-1</sup> after three months of storage. After four and seven months of storage, the viability declined to  $10^7$  CFU g<sup>-1</sup> and  $10^5$  CFU g<sup>-1</sup>, respectively.

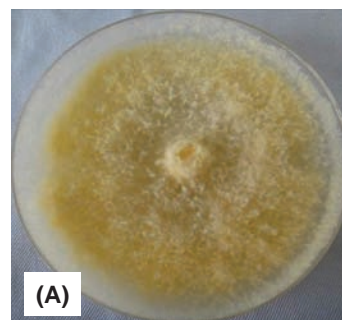


Figure 1. *Amphinema* GanoEF2; pure culture on potato dextrose agar (PDA) (A), powder formulation (B) and product packaging (C).

## BENEFITS OF *Amphinema* GanoEF2 POWDER FORMULATION

- Effective control of *Ganoderma* disease in oil palm.
- Easy to produce.
- Easy application for end-user.
- Easy storage.

## NURSERY EVALUATION OF *Amphinema GanoEF2* POWDER AGAINST *Ganoderma boninense*

Effectiveness of *Amphinema GanoEF2* powder in controlling *Ganoderma* disease was assessed at monthly intervals based on nursery trial conducted over 10 months (Figure 2). At six months after treatment, seedling treated with *Amphinema GanoEF2* powder resulted in a significant reduction in disease incidence (DI) at 53.3% compared with untreated (control) seedlings at 100%. The severity of foliar symptoms (SFS) of the seedlings treated with *Amphinema GanoEF2* powder showed significantly lower severity of 64.9% compared with the untreated seedlings with SFS of 93.0%. The seedlings treated with *Amphinema GanoEF2* powder had significantly less dead seedlings (DS) at 45.8% compared with untreated seedlings having DS of 85.0%.

The area under disease progress curve (AUDPC) was also used to evaluate disease development. A low AUDPC value indicates effectiveness of endophytic fungus to reduce incidence of *Ganoderma* disease. The ability of the *Amphinema GanoEF2* to suppress basal stem rot (BSR) disease incidence was calculated as the percentage of disease reduction (DR) from the values of AUDPC. Seedlings

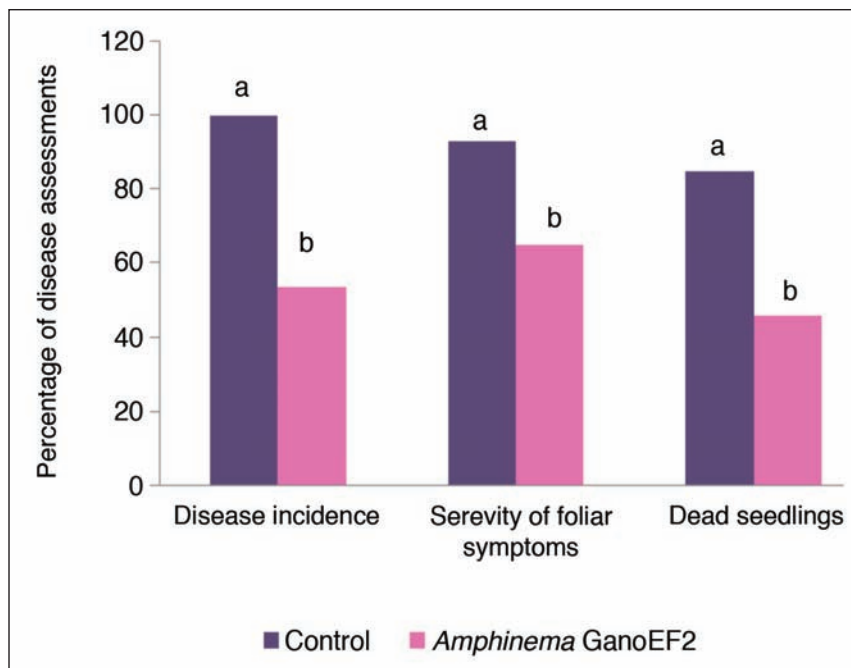
treated with *Amphinema GanoEF2* powder gave a lower AUDPC value of 160.0, compared with the untreated seedlings with AUDPC of 277.8 (Table 1). About 42.4% of BSR disease incidence was reduced in treated seedlings compared to untreated seedlings.

### ECONOMIC ANALYSIS

The fixed cost of a pilot plant for producing *Amphinema GanoEF2* powder is estimated at RM 5 200 000. 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 320 646.40. The benefit: cost ratio (B:C) for the discount rate of 10% is 1.45 and the return on the investment (ROI) is 32.5%. As the B:C is >1, the NPV is positive and IRR is greater than the opportunity cost of capital; the investment is financially feasible.

### CONCLUSION

The results indicated that the application of *Amphinema GanoEF2* powder could significantly inhibited the growth of *G. boninense in vitro*, and significantly reduced *Ganoderma* infection in oil palm. The use of *Amphinema GanoEF2* powder gave a promising sustainable approach in controlling *Ganoderma* disease in oil palm.



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

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

**TABLE 1. EFFECT OF *Amphinema GanoEF2* POWDER ON BASAL STEM ROT (BSR) DISEASE DEVELOPMENT IN OIL PALM SEEDLINGS AT SIX MONTHS AFTER TREATMENT**

Treatments	AUDPC <sup>#</sup>	DR <sup>##</sup> (%)
Seedlings untreated with <i>Amphinema GanoEF2</i> powder and inoculated with <i>G. boninense</i> (control)	277.8	-
Seedlings treated with <i>Amphinema GanoEF2</i> powder and inoculated with <i>G. boninense</i>	160.0	42.4

Note: <sup>#</sup>area under disease progress curve.  
<sup>##</sup>Disease reduction.

## REFERENCES

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