ECOBAC-1 (EC): EMULSIFIED CONCENTRATE *Bacillus thuringiensis* FOR CONTROLLING BAGWORM OUTBREAK BY AERIAL SPRAYING

SITI RAMLAH AHMAD ALI; MOHD NAJIB AHMAD; MOHAMED MAZMIRA MOHD MASRI and MOHD BASRI WAHID

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Bacillus thuringiensis (Bt) is a gram-positive bacterium, which upon sporulation produces protein crystals toxic to certain pest insects. Strains of *B. thuringiensis* that affect the larvae of insects in Lepidoptera, Diptera, Coleoptera and other orders have been identified. Unlike most chemical insecticides, Bt are very target specific, safe to non-target organisms, and their residues do not persist in the environment. The active ingredients of Bt are mixture of spores and crystals produced aerobically during the lag phase of its growth cycle (NPTN, 2004). They are easily harvested and formulated, when ingested by susceptible insect larvae, δ-endotoxins were activated by gut proteases (Ghribi *et al.*, 2006). Several Cry proteins or δ-endotoxins have receptor proteins in gut lining of *Metisa plana* (Siti Ramlah, 2000; Siti Ramlah *et al.*, 2003; 2005; 2007). The activated toxin binds with the gut receptor and causes osmotic lyses and death of larvae.

Ecobac-1 (EC) is an emulsified MPOB Bt1 concentrate formulated for controlling bagworm outbreak. The product is suitable for the Integrated Pest Management (IPM) of bagworm applicable via aerial spray (*Figure 1*). The name, Ecobac-1 (EC) was derived from its property being ecologically safe *Bacillus spp.* Ecobac-1 (EC) is an emulsified concentrate of MPOB Bt1 which is a further enhancement of the flowable concentrate which has a shorter production cycle as compared to wettable powder, Terakil-1 (WP) (Siti Ramlah *et al.*, 2005) and suitable for aerial spray.

OBJECTIVES

- to produce Ecobac-1 (EC) oil based formulation for control of bagworm outbreak in oil palm plantation via aerial spraying.
- to reduce reliance on chemical pesticides for bagworm control.
- to minimize oil palm yield losses due to bagworm outbreak.

Figure 1. Aerial spraying of Ecobac-1 (EC) for controlling bagworm outbreak.

PROCESS DESCRIPTION

MPOB Bt1 was produced at the Microbial Technology & Engineering Centre (MICROTEC), MPOB by batch fermentation in a laboratory-prepared medium. After 48 hr fermentation, the Bt liquid culture was concentrated by evaporating 20% water in a vacuum evaporator (*Figure 2*) at 33°C and -820 to -850 mbar. Further concentration was conducted with sedimentation and aspiration process. Subsequently 10% suspending agent, 18% dispersant and 61% diluents were added to the active ingredients at concentration of 16 000 IU mg^{-1}. The mixture was mixed thoroughly in a 300 litres tank aseptically with stirrer (*Figure 3*) for 60 min prior to packing in 25 litres plastic containers (*Figure 4*).

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Malaysian Palm Oil Board, Ministry of Plantation Industries and Commodities, Malaysia
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. *Tel:* 03-87694400 *Website:* www.mpob.gov.my *Telefax:* 03-89259446

Figure 2. Pilot plant vacuum evaporator.

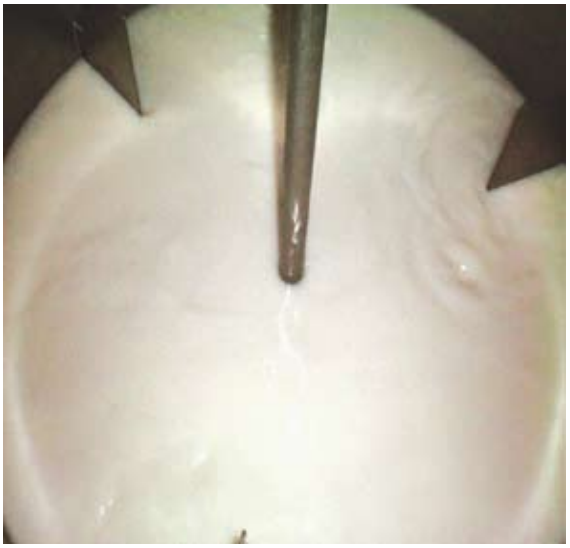

Figure 3. Ecobac-1 (EC) stirred thoroughly in a stirring tank.

Figure 4. Ecobac-1 (EC) in a 25-litre container.

LABORATORY BIOASSAY

Ecobac-1 (EC) from different batches was bioassayed at the highest concentration against early larval instar of *Pteroma pendula* (*Figure 5*). At the highest dose (4.4 x 10^{11} cfu ml^{-1}), Ecobac-1 (EC) resulted in 100% corrected mortality at 13 days after treatment (DAT).

FIELD EFFICACY

Ecobac-1 (EC) was tested in the field at smallholding Block B, Hutan Melintang in October 2008. The total infested area was 419.6 ha., with initial level of infestation recorded at 370 larvae per frond (LPF). An aircraft, model 402 was supplied by Systematic Aviation System Sdn Bhd. Fifty litres of Ecobac-1 (EC) was mixed with 1000 litres of water for aerial spray (*Figure 6*).

Application of Ecobac-1 (EC) led to a significant reduction of the larval population from 370 LPF at 0 DAT to 50 LPF at 3 DAT and down to 40 LPF at 15 DAT, implying that Ecobac-1 (EC) was effective for controlling bagworm via aerial application. Ecobac-1 (EC) was significantly effective ($P<0.05$) when tested against first larval instar of *Pteroma pendula* at 3, 7, 15 and 30 DAT (*Figure 7*).

ECONOMIC ANALYSIS

The fixed cost for MICROTEC building, equipments and raw materials is RM 10 million. The payback period is seven years with an internal rate of return (IRR) of 16%. The net present value (NPV) at 10% discount rate is RM 4.73 million, with a benefit cost ratio (B:C) of 1.38.

BENEFITS

Ecobac-1 (EC) is environmental-friendly, and can be aerial sprayed using aircraft to cover a large area of up to several thousand hectares of bagworm outbreak. Ecobac-1 (EC) activity persists one week on the foliage for good bagworm control. The cost is less than using chemical pesticides.

CONCLUSION

Ecobac-1 (EC) is recommended for use to reduce the reliance on chemical pesticides. It can be applied via aerial spray effectively for controlling a large area infested with bagworm outbreaks in oil palm plantation.

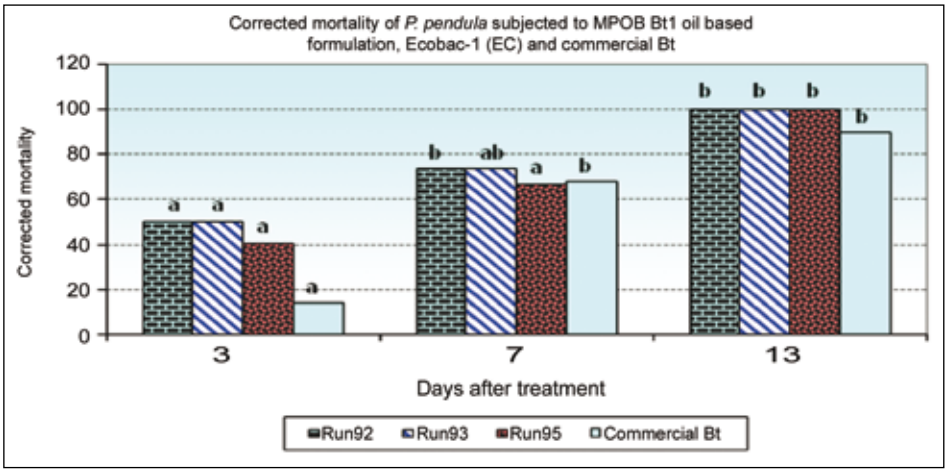

Figure 5. Average corrected mortality of Pteroma pendula *after spraying with Ecobac-1 (EC) derived from Run 92, 93 and 95.*

Note: Run 92=C5=4.4 x 10^{11} cfu ml^{-1}, Run 93=C5=4.6 x 10^{11} cfu ml^{-1} and Run 95=C5=2.0 x 10^{11} cfu ml^{-1}. Bars in a group with the same letters are not significantly different (P>0.05) in one-way ANOVA using LSD analysis. Corrected mortality = $\left(\frac{\%\text{Treatment} - \%\text{Control}}{100 - \%\text{Control}} \right) \text{x}100\%$

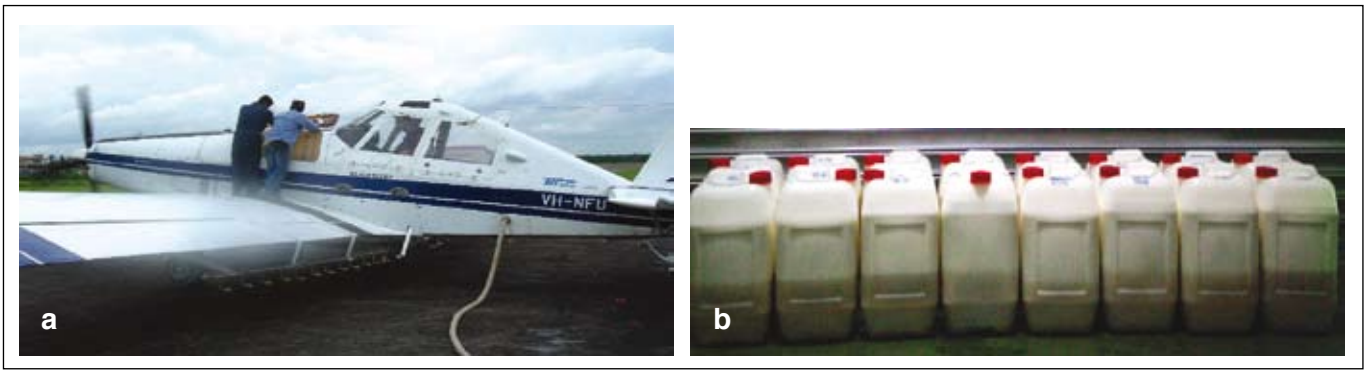

Figure 6. Water being pumped to dilute the Ecobac-1 (EC) poured inside solution tank of the aircraft (a) and (b) Ecobac-1 (EC) in 25 litres containers for field application.

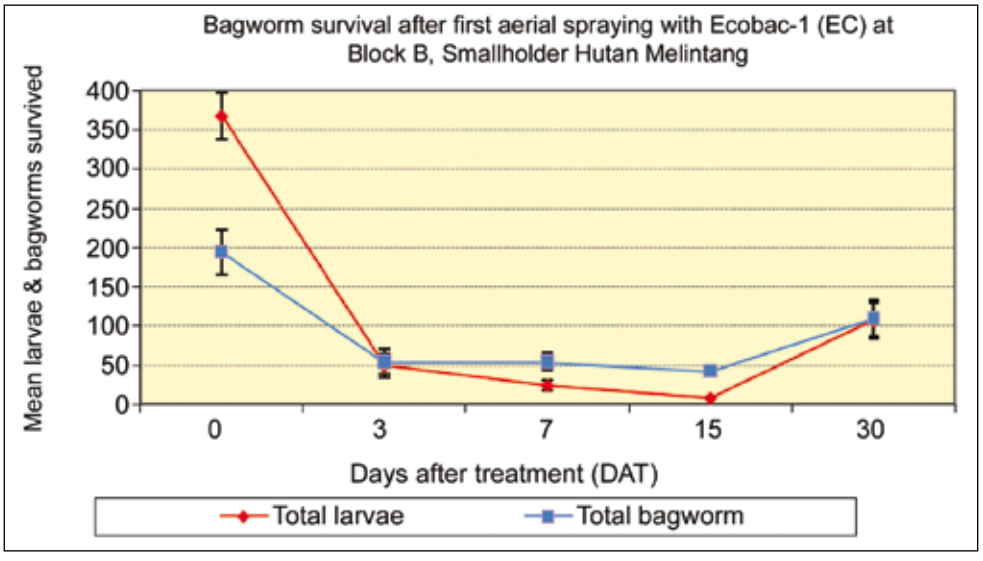

Figure 7. Bagworm survival after first aerial spray with Ecobac-1 (EC) at Block B, Hutan Melintang.

Note: Total bagworm is the total larvae plus total pupae.

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For more information kindly contact:

Director-General
MPOB
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.
Tel: 03-87694400
Website: www.mpob.gov.my