LEPCON-1: FLOWABLE CONCENTRATE OF *Bacillus thuringiensis*, MPOB BT1 FOR BAGWORM CONTROL

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Bagworm control with broad-spectrum contact insecticides has often disrupted the balance between the insect and its natural enemies - its predators, parasitoids and microbial pathogens. Most chemical insecticides also affect non-target organisms, and their residues often persist in the environment. The insecticidal proteins of *Bacillus thuringiensis* (Bt) are very target specific. Active ingredients of Bt are mixture of spores and crystals. The spores and crystals of Bt are produced aerobically via liquid fermentation. They are easily harvested and, when properly formulated, have a long shelf-life (Ghribi *et al.*, 2006a). Bt typically produces δ-endotoxins in parallel with spore formation during the stationary phase of the cell growth cycle (NPTN, 2004). The δ-endotoxins, after ingestion by susceptible insect larvae, are activated by the gut proteases (Ghribi *et al.*, 2006b). The activated toxin binds with the gut receptor and causes osmotic lysis and death of the larvae.

Flowable Bt concentrate, Lepcon-1, is produced by vacuum evaporation of fermented liquid culture at 33°C. This new Bt product has a shorter production cycle as compared to the wettable powder, Terakil-1.

OBJECTIVES

- To produce Lepcon-1 by vacuum evaporation which results in increased yield and reduced loss of active ingredients for immediate control of bagworm outbreak; and
- To reduce reliance on chemical pesticides for bagworm control.

MATERIALS AND METHODS

MPOB Bt1 was produced in a pilot plant at the Microbial Technology and Engineering Centre (MICROTEC) by batch fermentation. After 24 hr's fermentation, the Bt liquid culture was concentrated by evaporating off 20% of its water in a vacuum evaporator (*Figure 1*) at 33°C and -920 to -950 mbar. In these conditions, the boiling point of water is lowered to 50°C, so that the protein content of Bt is not denatured. The water, as steam, is drawn out by a high pressure pump via an ejector.

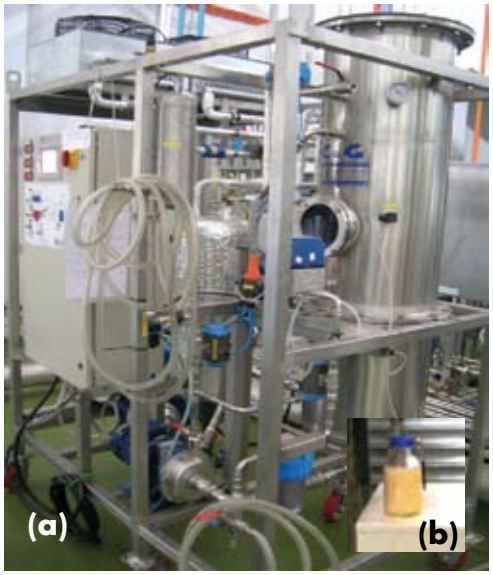

Figure 1. Pilot scale vacuum evaporator (a) and flowable Bt concentrate, Lepcon-1 (b).

RESULTS

Laboratory Bioassay

Lepcon-1 was bioassayed at five concentrations against the third larval instar of *Metisa plana* in the laboratory. At the recommended dose (C2, 6.0×10^8 cfu ml^{-1}), it caused 82% corrected mortality at nine days after treatment (DAT). The lower concentration (C1, 6.0×10^6 cfu ml^{-1}) gave 83% corrected mortality at 13 DAT (*Figure 2*).

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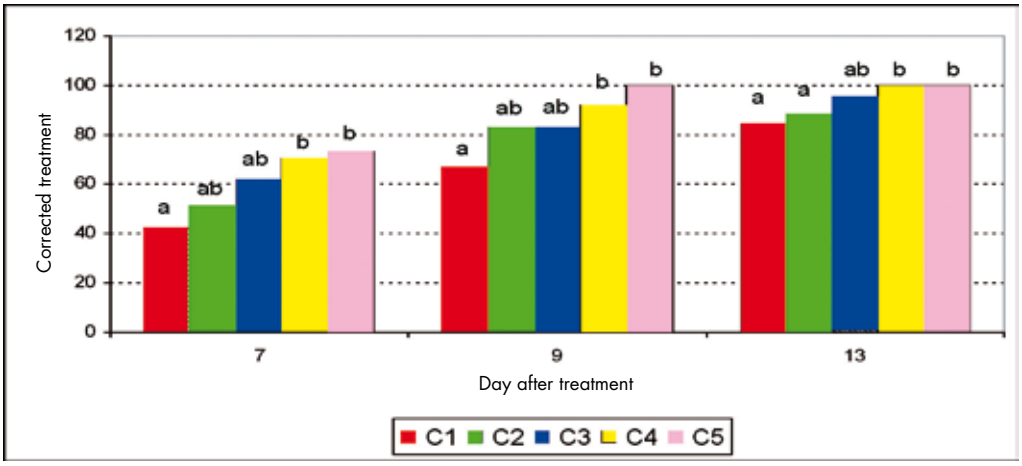

Figure 2. Average corrected mortality of Metisa plana *after spraying with Lepcon-1 propagated by liquid fermentation using Agro Nat F7 (Run 67-69). Notes: C1=6.0 x 10^6 cfu ml^{-1}, C2= 6.0x10^7 cfu ml^{-1}, C3= 6.0x10^8 cfu ml^{-1}, C4= 6.0 x 10^9 cfu ml^{-1} and C5= 6.0x10^{10} cfu ml^{-1}. Bars in a group with the same letters are not significantly different (P<0.05) in one-way ANOVA using LSD analysis.*

$$Corrected\ mortality = \left(\frac{\%\ Treatment - \%\ Control}{100 - \%\ Control} \right) x\ 100\%$$

Field Efficacy

Lepcon-1 was tested in the field at two places, FELCRA Juru 1 and 2 in August 2007. The infested areas of 10 ha and 8 ha at FELCRA Juru 1 and 2, respectively, were sprayed with Lepcon-1. Both trials were in a randomized complete block design (RCBD).

In FELCRA Juru 1, the infested area was divided into two plots, A and B, of 5 ha each, and treated with cypermethrin and Lepcon-1, respectively. Ten recording sub-plots or replicates, sized 6 x 6 palms, were used for recording. Lepcon-1 was applied at the rate of 1.8 x 10^9 cfu ml^{-1} and cypermethrin at the recommended dose. A P55 turbo-mist blower mounted on a tractor was used to spray Lepcon-1 mixture in plot B.

Both Lepcon-1 and cypermethrin were not significantly different (P>0.05) in their efficacy on bagworm, first larval instar of *Pteroma pendula* at 7, 14 and 30 DAT by LSD analysis (*Figures 3* and *4*).

Another trial was done at FELCRA Juru 2 which gave very similar results to FELCRA Juru 1.

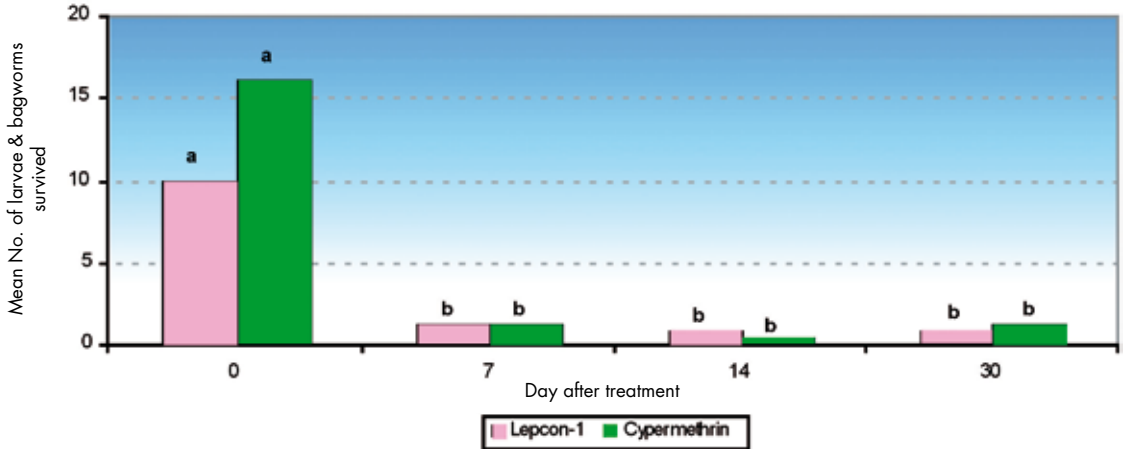

Figure 3. Mean larvae and bagworms survival per frond after one round of ground spray with Lepcon-1 and cypermethrin at FELCRA Juru 1, Pulau Pinang.

Note: Bars in a group with different letters are significantly different at P<0.05 by one-way ANOVA.

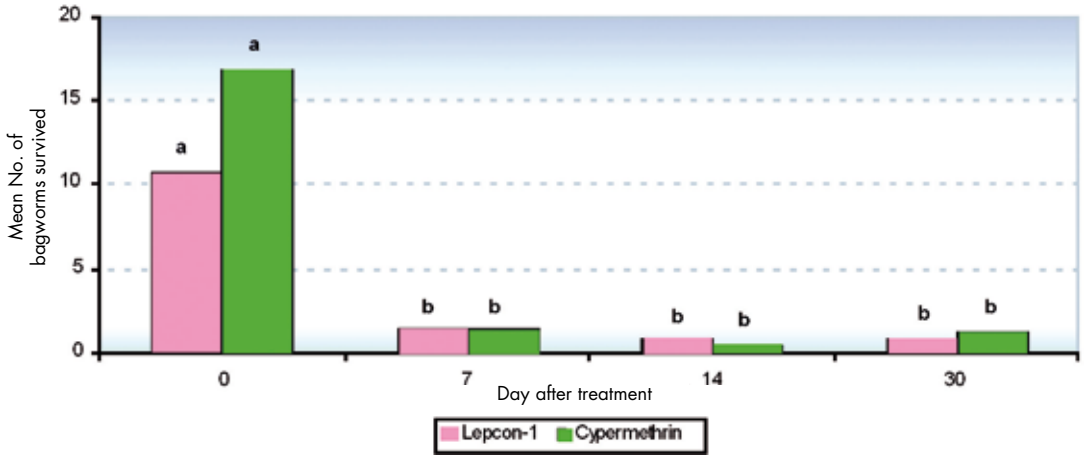

Figure 4. Mean bagworms survival after one round of ground spray with Lepcon-1 and cypermethrin at FELCRA Juru 1, Pulau Pinang.

Note: Bars in the same group with different letters are significantly different at P<0.05 by one-way ANOVA.

ECONOMIC ANALYSIS

The fixed cost for MICROTEC 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 (BCR) of 1.38.

BENEFITS

Lepcon-1 is environmentally safe, and can be sprayed from the ground (using the tractor-mounted P55 turbo mist blower) or from the air. Its activity persists sufficiently long on the foliage for good bagworm control. The cost is less than using Terakil-1 or other chemicals.

CONCLUSION

Lepcon-1 is recommended for use to reduce the reliance on chemicals. It can be applied from the ground or air to effectively control large bagworm outbreaks in oil palm.

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