



**UNIVERSITI PUTRA MALAYSIA**

**EFFICACY OF BACILLUS THURINGIENSIS BERLINER AGAINST  
METISA PLANA WALKER AND ITS APPLICATION USING THERMAL  
FOGGER AND MISTBLOWER**

**TAN SEK YEE.**

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THERMAL FOGGER AND MISTBLOWER**

**By**

**TAN SEK YEE**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,  
in Fulfilment of the Requirements for the  
Degree of Master of Agricultural Science**

**April 2004**



To

**My Parents and Prof. Khoo**

Because of them,

“ I have a new love for that glittering instrument, the human soul.  
It is a lovely and unique thing in the universe.  
It is always attacked and never destroyed — because ‘Thou mayest.’”

East of Eden

By John Steinbeck



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Agricultural Science

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By

**TAN SEK YEE**

**April 2004**

**Chairman: Professor Yusof Ibrahim, Ph.D.**

**Faculty: Agriculture**

The effectiveness of *Bacillus thuringiensis* Berliner (*Bt*) against the bagworm, *Metisa plana* Walker and its application using thermal fogger and mistblower was studied in three-year old oil palms.

Initially, a standardized rearing protocol of the bagworm was established to produce healthy test insects. *Metisa plana* was reared on oil palm seedlings from eggs surface-sterilized for one hour in 8% formaldehyde. This sterilization regime did not affect the egg hatchability and it significantly ( $P<0.05$ ) increased the survivorship of the first to second instar larvae when compared to larvae hatched from unsterilized eggs.

Following a laboratory bioassay conducted against the third and fifth instar larvae at temperatures of 25-29°C and 50-80% relative humidity, formulations from both *Bt*



subsp. *kurstaki*: Dipel<sup>®</sup> ES, Dipel<sup>®</sup> DF, Dipel<sup>®</sup> WP and ABG-6429 FC; and *Bt* subsp. *aizawai*: Florbac<sup>®</sup> SC and Xentari<sup>®</sup> WG were shown to be effective on the bagworm.

Evaluation on the suitability and effectiveness of portable thermal fogging (PulsFog<sup>®</sup>-K10 and AgroFog<sup>®</sup> AF 35) and mistblower (Solo<sup>®</sup> Master 412) application of *Bt* (Dipel<sup>®</sup> ES<sup>®</sup>) against *M. plana* in three-year old oil palm revealed that when water was used as the diluent in spray mixtures, efficacious activity was achieved which was attributed from the formation of an adequately stable emulsion. For both types of applicators, the kill of *M. plana* was shown to be positively dependent on droplet densities and concentrations of *Bt*. In the field trial on three-year old oil palm, AgroFog<sup>®</sup> AF 35 with AFX Fogging Solution and Solo<sup>®</sup> Master 412 Knapsack Mistblower were shown to give effective horizontal throw of 6 m whereas PulsFog<sup>®</sup>-K10 was only 2 m. Under the condition of these experiments, cost effectiveness analysis showed that the use of portable fogger to apply *Bt* formulation to control *M. plana* was not as cost-effective, practical or suitable as knapsack mistblower. The predicted kill of the bagworm obtained by mistblower was satisfactory and higher (50-92%) compared to thermal fogger (38-46%) at the middle and top strata of the oil palm. The poor deposition rates from fogging application in the palm increased the usage of Dipel<sup>®</sup> ES and AFX Fogging Solution thus incurred higher cost. Furthermore, the fogging application was limited to early morning or late evening, and that also incurred higher labour cost, notwithstanding the possibility of labour shortage. Comparatively, the use of mistblower gave higher deposition rates that reduced the rates of Dipel<sup>®</sup> ES per hectare thus saved cost. Mistblower is also easily available, versatile and can be used during the daytime.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk ijazah Master Sains Pertanian

**KEBERKESANAN *BACILLUS THURINGIENSIS* BERLINER TERHADAP  
*METISA PLANA* WALKER DAN APLIKASINYA DENGAN  
ALAT PENGABUT DAN PENYEMBUR KABUS**

Oleh

**TAN SEK YEE**

**April 2004**

**Chairman: Profesor Yusof Ibrahim, Ph.D.**

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Keberkesanan *Bacillus thuringiensis* Berliner (*Bt*) terhadap ulat bungkus, *Metisa plana* Walker dan aplikasinya dengan pengabut dan penyembur kabus telah dikaji pada kelapa sawit berumur tiga tahun.

Pada permulaannya, satu protokol standard untuk pembelaan ulat bungkus telah dihasilkan untuk memperoleh ulat yang sihat untuk ujian. *Metisa plana* yang menetas daripada telur yang telah disterilkan permukaannya selama satu jam dengan 8% formaldehid telah dipelihara di atas anak semaian kelapa sawit. Kaedah pensterilan ini tidak menjejaskan penetasan telur dan ia meningkatkan kemandirian ulat dengan signifikannya ( $P < 0.05$ ) daripada instar pertama ke instar kedua berbanding ulat daripada telur yang tidak disterilkan.

Berikutan bioasai di makmal yang dijalankan ke atas instar ketiga dan kelima di bawah keadaan suhu 25-29°C dan 50-80% kelembapan bandingan, formulasi daripada kedua-dua *Bt* subsp. *kurstaki* Berliner: Dipel<sup>®</sup> ES, Dipel<sup>®</sup> DF, Dipel<sup>®</sup> WP dan ABG-6429 FC; dan *Bt* subsp. *aizawai* Berliner: Florbac<sup>®</sup> SC and Xentari<sup>®</sup> WG telah didapati berkesan pada ulat bungkus.

Penilaian kesesuaian dan keberkesanan di dalam penggunaan pengabut (PulsFog<sup>®</sup>-K10 dan AgroFog<sup>®</sup> AF 35) dan penyembur kabus (Solo<sup>®</sup> Master 412) untuk menyembur *Bt* ke atas *M. plana* pada kelapa sawit berumur tiga tahun telah menunjukkan bahawa apabila *Bt* (Dipel<sup>®</sup> ES) dicampurkan ke dalam air, efikasi telah didapati oleh kerana disebabkan pembentukan emulsi yang stabil di dalam campuran semburan. Kedua-dua jenis applikasi ini menunjukkan bahawa kawalan *M. plana* bergantung secara positif kepada kepadatan titisan dan kepekatan *Bt*. Dalam applikasi penyemburan pada pokok-pokok kelapa sawit berumur tiga tahun, AgroFog<sup>®</sup> AF 35 dengan cecair pengabutan AFX dan penyembur kabus Solo<sup>®</sup> Master 412 telah memberi jarak semburan mendatar 6 m yang berkesan manakala PulsFog<sup>®</sup>-K10 hanya memberi 2 m. Di bawah keadaan kajian ini, analisis keberkesanan kos menunjukkan penggunaan alat pengabut untuk formulasi *Bt* bagi mengawal *M. plana* adalah kurang kos-berkesan, praktikal atau sesuai berbanding dengan alat penyembur kabus. Jangkaan kematian ulat bungkus yang diperolehi daripada penyemburan kabus adalah memuaskan and lebih tinggi (50-92%) berbanding dengan alat pengabutan (38-46%) di stratum tengah and atas pokok kelapa sawit. Kadar taburan titisan yang rendah dari penyemburan kabut pada pokok kepala sawit telah meningkatkan penggunaan Dipel<sup>®</sup> ES dan AFX



Fogging Solution, oleh itu kos telah meningkat tinggi. Tambahan pula, kerja pengabutan agak terhad pada waktu awal pagi atau lewat petang dan ini telah meningkatkan kos buruh, malahan berkemungkinan akan mengalami kesukaran mendapat pekerja. Akan tetapi, penggunaan penyembur kabus memberi kadar taburan titisan yang lebih tinggi yang mana mengurangkan kadar penggunaan Dipel® ES per hektar maka dengan itu, kos dijimatkan. Alat penyembur kabus juga mudah didapati dan boleh digunakan pada bila-bila masa termasuk waktu kerja siang hari.





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I certify that an Examination Committee met on 26<sup>th</sup> April 2004 to conduct the final examination of Tan Sek Yee on her Master of Agricultural Science thesis entitled “Efficacy of *Bacillus thuringiensis* Berliner Against *Metisa plana* Walker and its Application Using Thermal Fogger and Mistblower” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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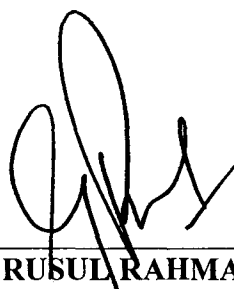
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## DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



TAN SEK YEE

Date : 10th July 2004.

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