UNIVERSITI PUTRA MALAYSIA

INSECTICIDE APPLICATION PRACTICES AMONG LOWLAND AND HIGHLAND CRUCIFEROUS VEGETABLE FARMERS AND THEIR RELATIONSHIP UPON PLUTELLA XYLOSTELLA L. RESISTANCE DEVELOPMENT

CHIA MEEI KEE

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By

CHIA MEEI KEE

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

October 2010

To

My Parents with love

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

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October 2010

Chairman: Professor Dzolkhifli Omar, PhD

Faculty: Agriculture

This study aimed to evaluate the insecticides resistance development of diamondback moth (DBM), *Plutella xylostella* L. in relation to insecticide application practices. A study was initiated with a survey to assess the current insecticides application practices for controlling DBM in the highland and lowland areas in Malaysia. Survey data were analyzed with SPSS statistical software using Independent-samples T-test and Pearson correlation where appropriate. The survey showed complete reliance on insecticide mixtures to control DBM. A total of 11 and 14 active ingredients of insecticides were found to be commonly used in the lowland and highland respectively. The percentage of highland farmers used indoxacarb, spinosad, pyridalyl and fipronil was higher than lowland farmers, while lowland farmers recorded higher usage of chlorfenapyr than highland farmers. Besides that, a comparative usage for emamectin benzoate was reported, with slight greater use in the lowland (53%) than highland (41%). Highland farmers were found to apply significantly higher spray volume at 3.8-fold greater than lowland farmers (t = 7.361;

P<0.05). Majority of insecticides were applied at tank concentrations below recommended doses. Highland farmers were found to apply significantly lower doses of emamectin benzoate compared to lowland farmers.

A leaf-dip bioassay was conducted to investigate the susceptibilities of two DBM field strains to the six selected commonly used insecticides among the cruciferous vegetable farmers namely emamectin benzoate, spinosad, indoxacarb, fipronil, pyridalyl and chlorfenapyr. Results from the bioassays showed inter-population genetic variation in susceptibility between the two field strains of DBM. Higher LC values for all the insecticides except chlorfenapyr were reported on the Highland strain indicating that the Lowland strain is more susceptible to most of the insecticides tested. Comparison of LC_{50} values between the two strains showed that the Highland strain is significantly (*P*<0.05) less susceptible to spinosad and pyridalyl than lowland strain. On the other hand, Lowland strain was significantly (*P*<0.05) less susceptible to chlorfenapyr. The reported higher LC_{50} values were consistent with greater uses of the insecticides in respective location and the inter-population variation in susceptibility of DBM is due to local insecticide selection. With a lower usage but significantly higher LC_{90} for emamectin benzoate, the results suggested that reduced doses of emamectin benzoate practiced by the highland farmers accelerated the rate of resistance development in DBM.

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

AMALAN PENGGUNAAN RACUN SERANGGA DI KALANGAN PETANI SAYUR-SAYURAN KRUSIFER TANAH RENDAH DAN TANAH TINGGI SERTA HUBUNG KAITNYA DENGAN PERKEMBANGAN KERESISTENAN *PLUTELLA XYLOSTELLA* L.

Oleh

CHIA MEEI KEE

Oktober 2010

Pengerusi: Profesor Dzolkhifli Omar, PhD

Fakulti: Pertanian

Kajian ini bertujuan untuk menilai perkembangan keresistenan rama-rama intan (DBM), *Plutella xylostella* L. berhubungkait dengan amalan penggunaan racun serangga. Satu kajian dimulakan dengan soal selidik bagi meneliti amalan penggunaan semasa racun serangga untuk mengawal DBM di kawasan tanah tinggi dan tanah rendah di Malaysia. Data-data soal selidik dianalisis dengan perisian statistik SPSS menggunakan ujian T sampel bebas (*Independent-samples T-test*) dan korelasi Pearson (*Pearson correlation*) di mana yang sesuai. Kajian soal selidik memperlihatkan kebergantungan sepenuhnya pada campuran racun serangga untuk mengawal DBM. Sebanyak 11 dan 14 jenis perawis aktif racun serangga didapati kerap digunakan di tanah rendah dan tanah tinggi masing-masing. Peratusan petani tanah tinggi menggunakan indoxacarb, spinosad, fipronil dan pyridalyl adalah lebih tinggi daripada petani tanah rendah, sedangkan petani tanah rendah menunjukkan penggunaan yang lebih tinggi untuk chlorfenapyr. Di samping itu, penggunaan emamectin benzoate yang setanding juga dilaporkan, dengan penggunaan yang lebih

tinggi di tanah rendah (53%) berbanding tanah tinggi (41%). Petani tanah tinggi didapati menggunakan isi padu semburan yang nyata lebih tinggi, pada kadar 3.8-kali lebih tinggi daripada petani tanah rendah (t = 7.361; P<0.05). Kebanyakan racun serangga disembur pada kepekatan tangki di bawah sukatan yang disyorkan. Petani tanah tinggi juga didapati menggunakan emamectin benzoate pada sukatan jauh lebih rendah daripada petani tanah rendah.

Satu teknik bioassai celup-daun dijalankan untuk mengkaji kepekaan kedua-dua strain ladang DBM terhadap enam jenis racun serangga terpilih yang kerap digunakan di kalangan petani sayur-sayuran krusifer iaitu emamectin benzoate, spinosad, indoxacarb, fipronil, pyridalyl dan chlorfenapyr. Keputusan bioassai menunjukkan variasi genetik inter-populasi dalam kepekaan antara dua strain ladang DBM. Nilai-nilai LC yang lebih tinggi untuk semua racun serangga, kecuali chlorfenapyr dilaporkan pada strain Tanah Tinggi menunjukkan strain Tanah Rendah adalah lebih peka kepada kebanyakan racun serangga yang diuji. Perbandingan nilai-nilai LC_{50} antara kedua-dua strain menunjukkan strain Tanah Tinggi adalah nyata (P<0.05) kurang peka kepada spinosad dan pyridalyl berbanding strain Tanah Rendah. Sebaliknya, strain Tanah Rendah pula jauh (P<0.05) kurang peka kepada chlorfenapyr. Laporan nilai-nilai LC_{50} yang tinggi adalah seiring dengan lebihan penggunaan racun serangga di lokasi masing-masing dan variasi inter-populasi dalam kepekaan DBM adalah disebabkan pemilihan racun serangga setempat. Dengan penggunaan yang lebih rendah tetapi LC_{90} yang jauh lebih tinggi bagi emamectin benzoate, keputusan menganjurkan bahawa pengaplikasian sukatan emamectin benzoate yang lebih rendah oleh petani tanah tinggi mempercepatkan kadar perkembangan keresistenan bagi DBM.

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unsprayed vegetable plots for the breeding sites of DBM. It's really a challenging task to obtain field strains for bioassays!

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I certify that a Thesis Examination Committee has met on 7 October 2010 to conduct the final examination of Chia Meei Kee on her thesis entitled "Insecticide Application Practices among Lowland and Highland Cruciferous Vegetable Farmers and their Relationship upon *Plutella xylostella* L. Resistance Development" in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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Date: 13 January 2011

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any degree at Universiti Putra Malaysia or at any other institution.

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CHIA MEEI KEE

Date: 7 October 2010

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