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BIOLOGY, DISTRIBUTION AND EFFECT OF SELECTED INSECTICIDES AGAINST WHITEFLY (*Trialeurodes vaporariorum* Westwood and *Bemisia tabaci* Gennadius) ON BRINJAL (*Solanum melongena* L.)

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Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

Whitefly, *Trialeurodes vaporariorum* (Westwood), a common insect that feeds on plants, belongs to the family Aleyrodidae of the order Homoptera. Many farmers are not interested to grow brinjal after they have gone through some bad experience due to whitefly infestations which have resulted in a total yield loss and affected the marketability of brinjal fruits. At present, information on the biology and population dynamics of whiteflies locally on brinjal is still lacking. Therefore, these studies are indeed appropriate to generate a comprehensive understanding on the insect biology, which could support an effective pest management programme and crop improvement strategy. The present studies involved field and laboratory experimentations, trials and observations on the life cycle of whitefly, its fecundity, its host preference, its specific parasitoids and its mortality rates as affected by some common insecticides. The host crops used were brinjal, tomato and tobacco plants, which are considered as high value crops. The studies were conducted at the MARDI station, the Cameron Highlands, Field Laboratory of the Faculty of Applied Science, Universiti Teknologi MARA, Shah Alam. The study on the life cycle of whitefly showed that, its developmental stages covered the eggs, larvae (instars I, II, and III), pupae, and adults. The eggs hatched within 6 to 9 days after oviposition with an average 7.6 days. In the laboratory conditions with the temperature of 24.0±2ºC, the total developmental period of whitefly, from the eggs to adults was 26.1 days and from eggs to eggs was 50.7 days. It was found that the maximum longevity recorded for the adult whiteflies on the average, was 25.3 days when they were supplied with honey and young leaves of brinjal, followed by 24.7 days when they were supplied with only brinjal leaves. An average of 102 eggs was laid in 26 days by one female adult. The study showed that whitefly had no significant preferences to host crops such as brinjal, tomato, and tobacco which belong to same family of Solanaceae. *Macrolophus caliginosus,* a predatory bug commonly found in the Cameron Highlands, significantly contributed to the control of whitefly. The total mean developmental period for predators from oviposition until the emergence of adults was 27.6 days. The whitefly larvae were killed and fed randomly by the adult predators daily. The daily predation rate of the predators has been enumerated with mean a range from 5.3 to 6.3 larvae per day. It showed that predators attacked from the first larval stage until pupal stage. The total mean whitefly larvae killed by adult predators was 5.8 larvae per day. The presence of whitefly larvae could increase the survival rate or life span of predators. It was also found that the distribution of whitefly larvae on brinjal plants covered all the plant strata except for the upper stratum. The populations of whitefly were aggregated (Taylor's Power Law Calculate) in first and second cropping of brinjal plants. Generally, the nymph predators were found on the upper and middle strata of the tomato plants. Among the common insecticides being tested for their effectiveness in controlling whitefly, it was observed that avermectin gave the best control. It recorded the lowest rate of survival of whitefly larvae compared with the control and this was followed by white oil, buprofezin, lambda cyhalothrin, and cyromazin. The study suggested that the effective chemical treatment with insecticides such as avermectin, buprofezin, and white oil would be to spray the crops at 7 days' intervals within 30 to 40 days (4 to 6 times of application) that whitefly takes to completion its life cycle. It would be desirable if any potential insecticide could be used in good combinations with some beneficial biological control agents such as *Macrolophus caliginosus* under the concept of integrated pest management programme. With a proper planning and timing of application of insecticides together with the release of

known biological control agents, it might result in the best means of controlling whitefly. This also would give a great deal of contributions to the farmers in terms of reducing the cost of vegetable production whilst at the same time increasing the profit margins as well as reducing the toxic remains in the plants or the environment.

ABSTRAK

Lalat putih, *Trialeurodes vaporariorum* dari famili Aleyrodidae dan order Homoptera merupakan serangga perosak yang lazimya menyerang tanam-tanaman. Kebanyakan petani kurang berminat untuk menanam terung kerana mereka telah mengalami pengalaman teruk dari serangan lalat putih yang menjejaskan pengeluaran hasil dan pemasaran tanaman dan tersebut. Pada masa ini, masih lagi terdapat kekurangan di dalam kajian biologi dan kedinamikan populasi lalat putih. Kajian ini akan memberikan maklumat dan pemahaman yang terperinci di dalam aspek biologi lalat putih, dimana maklumat ini boleh menyumbang kepada program pengurusan perosak bersepadu. Kajian terkini dijalankan di dalam makmal dan di ladang bagi kitaran hidup lalat putih, tahap kesuburan, pemilihan perumah, parasit khusus dan kesan racun serangga ke atas lalat putih. Tanaman perumah yang digunakan dalam kajian ini adalah terung, tomato dan tembakau yang merupakan tanaman bernilai tinggi. Kajian telah dijalankan di Stesen MARDI, Cameron Highlands dan Makmal Luaran di Fakulti Sains Gunaan, Universiti Teknologi MARA, Shah Alam. Kajian ke atas kitaran hidup lalat putih meliputi aspek perkembangan di peringkat telur, larva (instar I, II dan III), pupa dan dewasa. Telur lalat putih menetas 6 hingga 9 hari selepas peneluran berlaku, iaitu ia menetas secara purata selama 7.6 hari. Kajian dalam makmal pada suhu 24±2ºC di dapati jumlah keseluruhan kitaran hidup dari telur hingga dewasa lalat putih ialah 26.1 hari, manakala dari peringkat telur hingga ke peringkat telur semula adalah 50.7 hari. Lalat putih dewasa dapat hidup selama 25.3 hari apabila diberikan madu dan daun muda terung sebagai makanan, diikuti dengan 24.7 hari apabila diberi daun terung sahaja. Seekor lalat putih betina berupaya menghasilkan purata 102 biji telur dalam masa 26 hari. Kajian menunjukkan lalat putih tidak mempunyai sebarang tarikan yang signifikan untuk memilih tanaman seperti terung, tomato dan tembakau sebagai perumah walaupun tanaman ini terdiri daripada famili Solanaceae. *Macrolophus caliginosus*, sejenis kumbang pemangsa yang biasanya ditemui di Cameron Highlands boleh menyumbang kepada pegawalan lalat putih. Jumlah purata tempoh masa perubahan bagi pemangsa ini dari peneluran sehingga menetas menjadi dewasa ialah selama 27.6 hari. Setiap hari pemangsa ini memakan larva lalat putih secara rambang. Kadar pemangsaan harian bagi pemangsa ini ialah dengan julat purata dari 5.3 hingga 6.3 larva sehari. Ini menunjukkan pemangsa menyerang dari peringkat larva pertama sehingga peringkat pupa. Jumlah purata larva lalat putih yang dimakan oleh pemangsa dewasa ialah 5.8 larva sehari. Kewujudan larva lalat putih akan meningkatkan kadar kehidupan atau jangka hayat bagi pemangsa. Didapati juga, taburan larva lalat putih pada pokok terung meliputi semua lapisan (strata) pokok kecuali bagi lapisan atas. Populasi lalat putih yang telah diagregatkan (Taylor's Power Law Calaculate) bagi tanaman terung untuk penanaman yang pertama dan kedua. Secara umumnya, nimfa pemangsa dijumpai di lapisan atas dan tengah pokok tomato. Di antara racun serangga yang biasa diuji kerberkesanannya di dalam mengawal lalat putih ini, didapati avermectin menghasilkan pengawalan yang terbaik dengan kadar kehidupan terendah bagi larva lalat putih yang dicatatkan berbanding dengan rawatan tanpa racun dan diikuti rawatan dengan white oil, buprofezin, lambda cyhalothrin dan cyromazin. Kajian ini menyarankan keberkesananan rawatan dengan bahan kimia yang menggunakan racun serangga seperti avermectin, buprofezin dan white oil adalah sesuai disembur kepada tanaman dengan sela 7 hari di dakam jangka 30 hingga 40 hari (4 hingga 6 kali semburan) iaitu masa yang diambil oleh lalat putih untuk melengkapkan kitaran hidupnya. Ia akan memberi manfaat sekiranya racun serangga yang berpotensi digunakan secara kombinasi dengan beberapa agen kawalan biologi yang