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Laboratory and Field Effectiveness of Selected Insecticides in Preventing Adult Emergence of *Dacus dorsalis* Hendel (Diptera: Tephritidae)

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Key words: *Dacus dorsalis* **Hendel; Adult emergence.**

RINGKASAN

Kesan empat racun serangga telah diuji di makmal dan di ladang keatas larva dan kepompong Dacus dorsalis *Hendel. Kesemua racun-racun serangga itu didapati berkesan kepada larva dalam kajian di makmal. Walaubagaimana pun kesan racun-racun ini berkurangan terhadap kepompong dalam menghalang penjelmaan peringkat dewasa serangga ini. Pada keseluruhannya rawatan racun-racun serangga ini di ladang berupaya mengurangkan penjelmaan peringkat dewasa berbanding dengan rawatan di makmal.*

SUMMARY

Four insecticides were tested in the laboratory and field on their relative efficacy against the larvae and pupae of Dacus dorsalis *Hendel. In the laboratory studies all the insecticides were found to be effective against the larvae although they were comparatively less effective against the pupae in preventing adult emergence. In general, field insecticidal treatments resulted in lower numbers of adult emergence as compared to the laboratory treatments.*

INTRODUCTION

The oriental fruit fly, *Dacus dorsalis* Hendel, has always been a threat to fruit industries in Malaysia and the neighbouring Southeast Asian countries. Various methods of control are currently being practiced. Destruction of infested fruits by burning and burrying is usually done along with bagging of the yet uninfested fruits. These methods are, however, laborious and are confined only to small orchards. Chemical control has been the principal approach. It includes baiting of adults using protein hydrolysate mixed with insecticide (Steiner, 1952), and also the use of methyl eugenol as attractant for trapping (Steiner *et al*, 1961). However, the application and effectiveness of these methods of control in Malaysia are yet to be determined (Yunus and Balasubramaniam, 1975). Chemical insecticides are widely used in the control as foliar sprays. However, they have been known to accumulate as residues on the fruits, especially when sprayed at the ripening stage, and are thus hazardous to consumers.

The fruit fly is known to complete its life-cycle by pupating in the soil. As such studies were undertaken to determine the effectiveness of several chemicals as soil insecticides against the fruit flies. A few chemicals were found to be effective (Shaw and Riviello, 1961; Christenson, 1953; and Steiner *et al*, 1961). This method, however, has not yet been practiced in Malaysia.

The current study was undertaken to determine the susceptibility of the late third instar larvae and the pupae to several chemicals topically applied in the laboratory and applied as soil insecticides in the field. The outcome of this study would hopefully help in the choice of insecticides for soil treatment. The pest population in a particular area may consequently be reduced without having to treat the plants or fruits directly.

MATERIALS AND METHODS

Collection and rearing of test insects

The test insects *Dacus dorsalis* Hendel were obtained from infested carrambola fruits, *Avarrhoa carrambola,* collected from the Universiti Pertanian Malaysia farm. They were reared by placing the fruits in metal trays containing loose, friable, moist soil, 3 cm deep with ambient laboratory

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temperature of *ca.* 28°C. The soil was used to absorb the juice from the rotting fruits which could otherwise drown the larvae. Late third instar larvae that leave the fruits to pupate were collected. These larvae were then either exposed to the appropriate chemical treatments, or were allowed to pupate in another tray containing 4 cm deep of soil. The pupae were collected five days later for exposure to similar experimental treatments.

Laboratory treatment

Four formulated materials were used in the study, namely Dursban 75EC (chlorpyrifos) at 0.35 kg. ai/ha, Lebaycid 500EC (fenthion) at 0.67 kg. ai/ha, Heptachlor 2E at 1.62 kg. ai/ha, and Chlordane 30 at 0.69 kg. ai/ha. Water was used as the control.

The insecticide mixtures were topically applied using a Hamilton hand microapplicator fitted with a Hamilton syringe (no. 705). One microliter of insecticide solution in water was topically applied to each test insect.

Larval treatment: Thirty larvae were exposed to each treatment. The chemical was applied to the abdominal region of each larva. The larvae in each treatment were then released into a cylindrical plastic cage with aluminium base and top, containing 4 cm deep of loose, friable, moist soil (Serdang Series: Top soil).

Pupal treatment: Twenty pupae were used for each treatment. The chemical was applied directly onto the puparium. The treated pupae were first placed on a layer of the soil of 1 cm deep and then further covered with another layer of soil 3 cm deep to simulate the natural pupation conditions (Ibrahim and Mohamad, 1978).

Each of the above treatment of the larvae and pupae were replicated 12 times, arranged in completely randomized design.

Observation and recording: Observations for adult emergence were made daily after the treatment. The number of adults that emerged were recorded starting from the first day of emergence and was continued until one week later. Pupae that did not emerge as adults one week after the first recorded emergence were assumed to be dead since adult emergence only occurs within four days (Gudom, 1976).

Field treatment

Sixty larvae were introduced into each wooden box (treatment plot), 46 cm × 46 cm × 15 cm, filled with loose, friable soil (Serdang Series: Top soil). The boxes were randomized in an open field at the Universiti Pertanian Malaysia. The treatments were done 24 hours after the larvae were introduced. One hundred milliliter of each insecticide mixture was sprayed to the soil with a hand sprayer (killaspray) fitted with a cone nozzle. The boxes were covered with nylon netting mounted on wooden frames 46 cm × 46 cm × 31 cm. Coconut palm leaves were placed over the cages to avoid excessive loss of moisture from the soil. Each treatment was replicated six times and the treatment plots were completely randomized.

The number of adults that emerged were recorded daily starting from the first day of emergence and continued for one week.

RESULTS AND DISCUSSION

Laboratory treatment

All insecticides administered topically to the larvae in the laboratory gave a highly significant kill when compared to the control (Table 1). Less than 50% emergence of adults were obtained in all insecticide treatments. The larvae were noted to be most susceptable to Lebaycid and Dursban. However, mortality of the latter was not significantly different when compared to Chlordane and Heptachlor.

TABLE 1

Emergence of adult *D. dorsalis* Hendel after topical insecticide treatments on the larvae and pupae. UPM 1977.

Treatments	Larvae			Pupae		
	No. Emerged	% Emerged	Mean[1]	No. Emerged	% Emerged	Mean[1]
Control	255	70.8	21.25a	217	90.4	18.08a
Heptachlor	124	34.4	10.33b	190	79.2	15.83a
Chlordane	124	34.4	10.33b	161	67.1	13.42b
Dursban	86	23.9	7.17bc	161	67.1	13.42b
Lebaycid	46	12.8	3.83c	159	66.3	13.25b

[1] Means in the same column followed by the same letter are not significantly different at 1% level of probability (DMRT).

Topical treatments to the pupae in the laboratory, however, showed that these insecticides were less effective in preventing adult emergence than when they were treated to the larvae (Table 1). Significant kill ($P \leqslant 0.01$) was obtained with Lebaycid, Dursban and Chlordane when compared to the control although the mean numbers of adults that emerged were comparatively high. Heptachlor, on the other hand, did not significantly affect adult emergence.

Field treatment

In general it seems that the trend in the reduction of adult emergence in the field and laboratory trials was similar eventhough the field situation apparently gave a lower percentage of adult emergence. This situation suggests a higher rate of mortality in the natural environment. However, spraying of insecticides to the site of pupation also gave highly significant affects when compared to the control (Table 2). No significant difference in effectiveness was obtained among the insecticides tested.

TABLE 2

Number of adult *D. dorsalis* Hendel which emerged after soil insecticidal treatments. UPM 1977

Treatments	No. Emerged	% Emerged	Mean
Control	97	27.0	16.17a
Heptachlor	7	2.0	1.17b
Chlordane	7	2.0	1.17b
Dursban	11	3.1	1.83b
Lebaycid	5	1.4	0.08b

Means followed by the same letter are not significantly different at 1% level of probability (DMRT).

The application of insecticides in the field, as shown by percent emergence, gave better reduction of adult emergence than topical application of the same insecticides in the laboratory. This could probably be due to a higher toxicity in the natural environment. Harris (1972) noted that a higher soil temperature and soil moisture content resulted in a higher toxicity and bioactivity of an insecticide in the soil. Although no direct measurement of soil temperature and moisture content was taken in the present study, the higher temperatures in the open field were expected to have caused a higher toxicity, thus lowering the number of adults which emerged in the field as compared to that in the laboratory. Furthermore, since the field experiment was conducted during the rainy season, the higher moisture content could have enhanced the efficacy of the insecticides tested.

The trials, however, showed no significant difference when Lebaycid was compared to other insecticides although significant differences were observed when comparison was made with Heptachlor and Chlordane in the laboratory trials. This could be attributed to the fact that the activity of Heptachlor and Chlordane was enhanced when exposed to higher temperature and moisture content than was the case with Lebaycid.

The insecticides were also found to be less toxic to the pupae when topically treated in the laboratory than when administered in the same manner to the larvae or when sprayed directly to the soil in the field condition. This could perhaps be due to the protection afforded by the sclerotized puparium. Since insecticide treatments in the field were done 24 hours after the larvae were introduced, it was expected that the pupal cuticle (soft and creamy white) was still permeable enough to result in higher pupal mortality compared to the five day old cuticle (sclerotized and brownish black) of pupae treated in the laboratory.

Since the field studies did not show any significant difference in mortality between the four chemicals, there was thus little to choose from the range of chemicals to be specifically recommended as a soil drench.

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