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.

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 burying is usually done along with bagging of the yet uninsected 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, Averrhoa carambola, 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
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 (fenithion) 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 larval and pupae were replicated 12 times, arranged in completely randomized design.

**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 susceptible 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.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Larvae</th>
<th>Pupae</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. Emerged</td>
<td>% Emerged</td>
</tr>
<tr>
<td>Control</td>
<td>255</td>
<td>70.8</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>124</td>
<td>34.4</td>
</tr>
<tr>
<td>Chlordane</td>
<td>124</td>
<td>34.4</td>
</tr>
<tr>
<td>Dursban</td>
<td>86</td>
<td>23.9</td>
</tr>
<tr>
<td>Lebaycid</td>
<td>46</td>
<td>12.8</td>
</tr>
</tbody>
</table>

<sup>1</sup> 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 ≤ 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 even though 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>
<thead>
<tr>
<th>Treatments</th>
<th>No. Emerged</th>
<th>% Emerged</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>97</td>
<td>27.0</td>
<td>16.17a</td>
</tr>
<tr>
<td>Heptachlor</td>
<td>7</td>
<td>2.0</td>
<td>1.17b</td>
</tr>
<tr>
<td>Chlordane</td>
<td>7</td>
<td>2.0</td>
<td>1.17b</td>
</tr>
<tr>
<td>Dursban</td>
<td>11</td>
<td>3.1</td>
<td>1.83b</td>
</tr>
<tr>
<td>Lebaycid</td>
<td>5</td>
<td>1.4</td>
<td>0.08b</td>
</tr>
</tbody>
</table>

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

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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REFERENCES


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