

## 原 著

**The Resistant Levels of the Houseflies to Several Synthetic Insecticides at Garbage Dump in Tokyo.** Akifumi HAYASHI<sup>\*,\*\*</sup>, Satoshi SHINONAGA<sup>\*\*</sup> and Rokuro KANO<sup>\*\*</sup> (\*Section of Medical Zoology, Public Health Laboratory, Chiba Prefecture, Chiba, Japan, \*\*Department of Medical Zoology, Faculty of Medicine, Tokyo Medical and Dental University, Tokyo, Japan) Received Oct. 14, 1975. *Botyu-Kagaku*, 41, 57, 1976.

10. ゴミ処理場におけるイエバエの殺虫剤感受性について 林 晃史<sup>\*,\*\*</sup>, 篠永 哲<sup>\*\*</sup>, 加納 六郎<sup>\*\*</sup> (千葉県衛生研究所医動物学研究室<sup>\*</sup>, 東京医科歯科大学医動物学教室<sup>\*\*</sup>) 50. 10. 14 受理

東京都下ごみ処理場で異常発生したイエバエの薬剤感受性の推移を追跡調査したところ、この地域のイエバエは当初より malathion や sumithion に対して高概系イエバエよりも強かった。また、malathion と sumithion の使用を中止しても抵抗性の減退は認められず、耐性の増大する傾向が観察された。しかし、DDVP や Baytex では抵抗性の発達は殆んど認められず、駆除効果の期待できる殺虫剤であることが明かになった。

この調査研究は東京都廃棄物終末処理対策協議会(武蔵野市長、羽村町長、瑞穂町長、東京都清掃局指導部、清掃局管理課で構成)の協力を得て実施した。

## Introduction

There are many dumping grounds in Hamura and Mizuho-cho where situated about 40km to the west of the central part of Tokyo. The total area is about 464,000 m<sup>2</sup>, and garbage is carried here from 10 adjacent cities and towns. During the summer, a large number of houseflies bred in this dump and the flies scattered to houses around the dump. For the purpose of the housefly control, insecticide spraying was planned by the Department of Sanitation, Tokyo Metropolitan Office. To select insecticides, resistant level was examined on the houseflies in the dump. The tests were also made after spraying insecticides and effects of insecticides were evaluated.

## Material and Methods

Resistant levels of the houseflies to the seven kinds of insecticides were tested before and after spraying insecticides. The insecticides used for housefly control were selected on the basis of the tests. Diazinon and DDVP were sprayed in 1974. The sprayings were made three times every 2 weeks. Each insecticide emulsion containing 5% active ingredient was diluted to 400 times with water for the spraying.

*Insecticides:* The insecticides used in this study were as follows: Pyrethrins (20% extract),

allethrin (technical grade), sumithion (purity 98.6%), diazinon (99.6%), Baytex (99.2%), DDVP (97.6%), and malathion (95.5%).

*Houseflies:* The houseflies used in this study were collected at the settled places of garbage dump in Hamura-cho before and after spraying the insecticides. The collected dates are as follows: 21 July (I) and 18 November (II) in 1973 and 24 June (III) and 2 October (IV) in 1974. More than 300 flies were collected every time and colonized in the laboratory. The flies in the second generation were used for experiments.

*Methods:* Topical application was adopted for the evaluation of the candidate insecticides. Each insecticide was diluted with acetone to the required concentrations. The female flies (body weight 21-23mg) were anesthetized by carbon dioxide and 0.5 μg of the diluted insecticide was applied to the scutum of flies, respectively. The treated flies were then transferred to clean vessels with cotton balls soaked sugar water for counting mortality after 24 hours under a constant temperature of 25°C, and LD<sub>50</sub> value of each insecticide was calculated. Twenty females of 4 days after emergence were used for each concentration of the insecticides and same tests were made 3 times.

The tests of susceptibility for larvae of houseflies were made by the dipping method for 24

hours. The insecticides (5% emulsion) were diluted with distilled water to the required concentration, and poured 2ml into a petri dish, 9cm in diameter, 5cm in depth, respectively. Fly larvae were released in each dish. Mortality after 24 hours was counted and  $LC_{50}$  value was calculated from the results. Thirty larvae were used each concentration and same tests were made 3 times. As a control, distilled water was treated by the same method as the insecticides.

**Results and Discussion**

The results of the tests to the houseflies from Hamura-cho, Tokyo were shown in Tables 1 and 2. The results of the tests to each insecticide are summarized as follows:

**Sumithion:**  $LD_{50}$  value of the housefly colony to sumithion was 0.818  $\mu\text{g}$  before spraying the insecticides in 1973 (I)<sup>1)</sup>. This value is about 9.2 times higher than that of the Takatsuki strain

(0.089  $\mu\text{g}$ ), but is lower than that of the Misaki strain (92.53  $\mu\text{g}$ ) which was reported by Hayashi *et al.* (1973)<sup>2)</sup>. It is supposed that the resistant value of the housefly in this area to sumithion is concerned with the history of the spraying insecticides. A large quantity of insecticides, malathion and diazinon had been sprayed in this area.

The resistant level to sumithion increased after spraying diazinon and DDVP in 1973 (II) and before spraying in 1974 (III). The value showed 9.4 times (7.659  $\mu\text{g}$ ) higher than that before spraying in 1973 (I). It is considered that the development of resistant to sumithion is under the influence of cross resistance among the organophosphorous insecticides.

**Diazinon:** The value to diazinon in the first test (I) was lower than that of the Takatsuki strain (0.278  $\mu\text{g}$ ). On the basis of the test, diazinon was used for the housefly control in

Table 1.  $LD_{50}$  values of 7 insecticides to 4 colonies of the houseflies collected from garbage dump in Tokyo

Insecticides	Strains Takatsuki	Hamura $LD_{50}$ ( $\mu\text{g}/\text{female}$ )			
		(I)	(II)	(III)	(IV)
Sumithion	0.089	0.818	2.385	3.311	7.656
Diazinon	0.293	0.278	1.855	2.750	2.042
Baytex	0.136	0.483	0.854	2.213	1.398
DDVP	0.076	0.193	0.185	0.436	0.398
Malathion	0.455	129.000	250.000	137.400	229.000
Allethrin	0.481	0.545	0.837	1.574	1.250
Pyrethrins	0.387	0.322	0.345	0.427	0.417

Table 2.  $LC_{50}$  values of 5 insecticides to 4 colonies of the housefly larvae collected from garbage dump in Tokyo

Insecticides	Strains	Hamura $LC_{50}$ (ppm)			
		(I)	(II)	(III)	(IV)
Sumithion		2,340 (21.367)	777 (64.22)	513 (97.44)	777 (64.22)
Diazinon		1,410 (35.602)	871 (57.40)	264 (185.60)	777 (64.22)
Baytex		102,000 (4.901)	5,500 (9.09)	2,090 (23.92)	3,020 (16.56)
DDVP		14,500 (3.448)	5,130 (9.74)	2,820 (17.73)	3,236 (15.45)
Malathion		166 (301.204)	214 (233.64)	107 (467.28)	100 (500.00)

this area. However, resistant level increased after spray (II) and it showed 6.6 folds of the value before spray. The values increased and showed 7 to 9 folds resistance to diazinon than that of the first tests to diazinon in 1974.

*Baytex*: From the first time, the resistant level to Baytex was 3.5 fold comparing with Takatsuki strain. However, resistant level to Baytex increased after spray (II) and the level more increased in next year (III). The values showed about 5 folds resistance to Baytex than that of the first test to Baytex in 1973 (I).

*DDVP*: The LD<sub>50</sub> value to DDVP was 0.193 $\mu$ g in the first test, and it was about 2.5 times that of Takatsuki strain. This is not high value comparing with other organophosphorous insecticides. The LD<sub>50</sub> value to DDVP was not exceeded 6 times that of the Takatsuki strain in spite of continuous use of this insecticide. It indicates that the resistance to DDVP is hardly obtained by the houseflies.

*Malathion*: LD<sub>50</sub> to malathion showed very high value in each test. The values of first to fourth tests were 129.0, 250.0, 137.4 and 229.0  $\mu$ g, respectively. It is supposed that the resistance of the houseflies to malathion in this area did not decrease in a long term, as an example of Sapporo strain which showed high resistance to malathion was keeping the value even in 48 generations after stop of selection.

*Pyrethroids*: Resistant levels to the pyrethroidal insecticides, allethrin and pyrethrins, were a little tolerant than those of Takatsuki strain. In this area, no pyrethroidal insecticides have been sprayed in the past time. It is still unknown on the development of the resistant level to the pyrethroids.

From the results of this study, use of malathion for the housefly control should be avoided. We must carefully spray sumithion in the garbage dump, because the resistance of houseflies will easily develop to this insecticide. For the housefly control in this area, we have to use insecticides in combination of two insecticides, such as DDVP and Baytex, or pyrethroids and Baytex, etc.

Resistant levels of the larvae to the insecticides have increased after spray in 1974 (IV), except for Baytex (16.56 ppm) and DDVP (15.45 ppm), especially LC<sub>50</sub> value of malathion before spray in 1973 was 301.204 ppm, however, it increased to 500 ppm in 1974 (IV). In the present time, control of housefly larvae using malathion in this area is not effective as in adults.

#### References

- 1) Hayashi, A. and R. Kano: *Botyu-Kagaku*, 39 (2), 61 (1974).
- 2) Hayashi, A., M. Hatsukade and K. Moriya: *Botyu-Kagaku*, 38 (1), 35 (1973).