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SUSCEPTIBILITY OF THE DANISH HOUSEFLY, *MUSCA DOMESTICA* LINNÉ TO PYRETHROID

BY

Akifumi HAYASHI,[1),2)] Minoru YAJIMA[1)] and Rokuro KANO[1)]

ABSTRACT

The insecticidal activity of a new pyrethroid, fenvalerate, and the effects of its synergists were evaluated using the 49-s and 381-s strains from Denmark which are both resistant to pyrethroid. It was found that the effect of fenvalerate was poor on the pyrethroid-resistant strains and little was expected from the addition of its synergists. Rapid development of resistance was observed in the 49-s strain during the selection with permethrin.

Key words: Susceptibility, housefly, pyrethroid, resistance, synergist.

INTRODUCTION

A series of studies including those by Hayashi [1] and by Yasutomi *et al.* [2] have proved the falling susceptibility to every kind of low-toxicity organophosphorous insecticide of the houseflies which emerged massively at the poultry and livestock farms as well as at the garbage-filled land throughout Japan. To the pyrethroid insecticides, however, the susceptibility has been reported not to be falling in these locations in Japan. In Denmark, the resistance to the pyrethroid insecticides was reported early and the situation was made public by Keiding [3, 4].

There is a possibility that such resistance may also develop in Japan in the future. To guard against such an occurrence, an experiment was conducted using the Danish houseflies to study the effects of a new pyrethroid insecticide and its synergists and to see if resistance develops when the flies are selected.

MATERIALS AND METHODS

The strains of the housefly, *Musca domestica* Linné, used during this experiment were as follows: The Takatsuki strain bred at our laboratory for generations and the 49-s and 381-s strains, both resistant to pyrethroid, which were kindly provided in 1977 by Dr. Keiding of the Danish Pest Infestation Laboratory.

The following four insecticides were used:

Permethrin 3-phenoxybenzyl dl-cis/trans-3-(2, 2-dichlorovinyl)-2-2-dimethyl-1-cyclopropanecarboxylate

Phthalthrin (1, 3, 4, 5, 6, 7-hexahydro-1, 3-dioxo-2-iso-indolyl) methyl dl-cis/trans-chrysanthemate

Resmethrin (5-benzyl-3-furyl) methyl dl-cis/trans-chrysanthemate

*1 林 晃史・矢島 稔・加納六郎: Department of Medical Zoology (Chief: Prof. R. KANO), Faculty of Medicine, Tokyo Medical and Dental University (Tokyo Ika Shika Daigaku).

*2 Laboratory of Medical Zoology, Institute of Public Health, Chiba.

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Fenvalerate α-cyano-3-phenoxybenzyl α-isopropyl-4-chlorophenylacetate

The synergists used were butoxide and S-421 (octachlorodipropylether). Each of these synergists was mixed with each of the pyrethroid at two different ratios of 1:1 and 1:5.

The susceptibility to the chemicals was evaluated according to the usual topical application method (microscopic dripping method). The chemicals were diluted to the required concentrations with acetone and 0.5 μl was applied to the scutum of the test insects by dripping from a microscopic injector. The number of dead flies was counted 24 hours later.

The selection study was performed using the 49-s strain from Denmark and permethrin. A 0.03% acetone solution was prepared and applied to 300 flies at a rate of 0.5μl per fly with a microscopic injector. The insects which survived 24 hours after the treatment were mated by the pair and the selection was repeated from the F_1 generation onwards. The 0.03% solution was used up to the second selection and a 0.06% solution was used in the third selection.

Results and Discussion

Table 1 shows the insecticidal activities of the new pyrethroid, fenvalerate, and the synergists on the Danish houseflies. Fenvalerate is commercially unavailable at present but it has an excellent insecticidal activity against the Takatsuki strain. The LD-50 of this chemical for this strain is 0.049 μg/female according to Hayashi [1]. The activities of fenvalerate, however, fell sharply against the 49-s and 381-s strains from Denmark, being 1.549 μg and 31.623μg, respectively. These are highly resistant strains and not seen in Japan.

The synergist, S-421, enhanced the insecticidal activity of fenvalerate against the 49-s strain 1.6 times when the 1:1 mixture was used and 2.2 times with the 1:5 mixture. The enhancement was 17.8 times with the 1:1 mixture and 16.9 times with the 1:5 mixture when the 381-s strain was tested. The addition of the synergist, however, did not raise the activity of fenvalerate to the same level of effectiveness as it has against the Takatsuki strain.

Table 2 shows the results of the selection test using permethrin and the 49-s strain from Denmark. The 49-s strain used in the selection test is a product of breeding for generations without contact with the insecticides and, as a result, by 1980 when the study was conducted, its susceptibility to permethrin, resmethrin and phthalthrin was comparable to that of the Takatsuki strain.

After two selections with permethrin, the sensitivity of the 49-s strain was reduced by 10 times against permethrin, 13

Table 1. Effects of Fenvalerate and Synergists on Pyrethroid-Resistant Houseflies

Chemicals used	LD-50 value (μg/female)		
	49-s strain	381-s strain	Takatsuki strain
Fenvalerate	1.549	31.623	0.002–0.05
+ S-421 (1:1)	0.977	1.778	
+ S-421 (1:5)	0.692	1.862	
+ P. butoxide (1:1)	0.347	–	
+ P. butoxide (1:5)	0.417	–	

Table 2. Selection of Houseflies From Denmark (49-s Strain) With Permethrin and Variation of Sensitivity

Chemicals used	Takatsuki strain	Upon introduction[1]	Before selection[2]	Number of times of selection and LD-50 value (μg/female)		
				I	II	III[3]
Permethrin	0.015	0.953	0.013	0.162	0.135	0.477
Resmethrin	0.022	2.234	0.019	–	0.251	–
Phtalthrin	0.456	4.999	0.456	–	4.775	–

1) August 1977 2) January 1980 3) March 1980

times against resmethrin and 10 times against phthalthrin when compared with the susceptibility before selection. With respect to phthalthrin, the sensitivity returned to the level at the time of its introduction to Japan. Against permethrin, the sensitivity reverted to the level at the time of the introduction to Japan after three selection. These findings show that the houseflies from Denmark acquire resistance to pyrethroid with ease.

Hayashi *et al.* [5] reported on the absence of the resistance of the Japanese houseflies following the selection with allethrin. Yasutomi *et al.* [6] reported the same finding with resmethrin. These findings and the results of the present study indicate that there is some substantial difference between the Japanese housefly and the Danish housefly in the development of resistance which is not attributable to the use of different insecticides in the two countries. This study is still continuing and a report will be made when 30 generation selections are completed.

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