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RESISTANT LEVEL OF HOUSEFLIES TO SEVEN KINDS OF SYNTHETIC INSECTICIDES AND EFFECT OF SYNERGISTS TO THE MALATHION RESISTANT STRAIN IN SINGAPORE*1

BY

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ABSTRACT

The resistant level of the houseflies to the seven kinds of insecticides, Malathion, Sumithion, Baytex, Diazinon, DDVP, DDT and Chrysron, was examined on the 3 strains collected in Singapore. It was found that most housefly colonies in Singapore showed a higher susceptibility to those insecticides than that of the Takatsuki strain of Japan, especially to DDT. However, the resistant level to Malathion was remarkably higher than that of the Takatsuki strain.

The synergists, piperonyl butoxide, Safroxane and S-421, mixed with Malathion were effective for lowering the resistant level of the Malathion-resistant strain.

INTRODUCTION

There is no report on the resistance of houseflies to insecticides in Singapore. The authors are studying the resistant level of the houseflies to insecticides in the South Pacific area for obtaining basic data for housefly control. They already reported on the resistant level of houseflies in Indonesia, New Guinea, Philippines and Malaysia since 1974[1,2,5,6]. The survey in Singapore was made with the same purpose in 1976 and the results of the study are presented in this paper.

MATERIALS AND METHODS

Houseflies: The houseflies used in this study were collected from three places in Singapore. The adult flies were collected by sweeping nets and were kept in plastic cups, 5 cm in diameter and 10 cm in height, using breeding media for collecting eggs. The eggs laid on the media were transferred to new breeding cups and then bred to the pupae. The pupae were sent to our laboratory in Tokyo by air cargo. In the laboratory, the flies were bred and raised and then subjected to study. The flies were collected at the dumping ground, private chicken farm and market place. The Takatsuki strain was used as the standard strain for comparing the resistant level with the Singapore strains by the same method simultaneously.

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Table 1. LD_{50} values of adult female houseflies to seven kinds of insecticides (μg/fly)

Insecticides / Strains	Malathion	Sumithion	Baytex	Diazinon	DDVP	DDT	Chrysron
Chicken farm	2.50	0.178	0.051	0.057	0.029	0.79	0.011
Market place	3.23	0.162	0.058	0.071	0.046	0.85	0.023
Dumping ground	28.15	0.675	0.112	0.209	0.103	0.63	0.014
Takatsuki	0.532	0.114	0.119	0.278	0.128	39.41	0.019

Insecticides: Insecticides used in this study were as follows: Malathion (purity, 95.5%), Sumithion (98.6%), Baytex (99.2%), Diazinon (99.6%), DDVP (97.6%), DDT (technical) and Chrysron (99.0%). Piperonyl butoxide, Safroxane and S-421 were used as synergists for Malathion.

Methods: Each insecticide was diluted with acetone to the required concentration. The level of resistance was determined by the topical application method. The female flies (body weight 21–23 mg) were anesthetized by carbon dioxide, and 0.5 μg of the diluted insecticides was applied to the scutum of the fly, respectively. The treated flies were then transferred to the clean vessels with cotton balls soaked with sugar water for 24-hour mortality count under a constant temperature of 25°C. Twenty females were used for each concentration and the same tests were conducted 3 times. As a control, acetone was used in the same way.

Results and Discussion

The results of the tests on the Singapore houseflies are shown in Table 1. The results with each insecticide are as follows:

Malathion: The resistant level to Malathion was higher than that of the Takatsuki strain in each strain. The range was from 2.50 (chicken farm) to 28.15 μg per fly (dumping ground) and the value of the dumping ground strain was 11.25 times that of the chicken farm strain. If the chicken farm strain is assumed as the standard of the susceptibility to Malathion in Singapore, the dumping ground strain is the resistant strain. This value is about 53 times that of the Takatsuki strain, but lower than the Rabaul strain in Papua New Guinea (90.848 μg/fly) (Hayashi *et al.*, 1974). At the dumping ground, about 50 litres of Malathion (2%) were sprayed every month in 1975. Therefore, the resistance of the houseflies to Malathion at the dumping ground might be influenced by the spray.

Sumithion: With Sumithion, the LD_{50} values were from 0.162 (market place) to 0.675 μg per fly (dumping ground). The ratio of the maximum and minimum values was about 4:1 and the value of the dumping ground strain was about 6 times that of the Takatsuki strain. It is supposed that the resistance of the houseflies to Sumithion in Singapore is increasing.

Baytex: The LD_{50} values to Baytex were between 0.051 μg/fly (chicken farm) and 0.112 μg/fly (dumping ground), and the values showed a higher susceptibility than that of the Takatsuki strain. The resistance of the houseflies to Baytex has not increased in Singapore.

Diazinon: With Diazinon, the LD_{50} value was the highest at the dumping ground (0.209 μg/fly) and the lowest at the chicken farm (0.057 μg/fly). The values were lower than that of the Takatsuki strain (0.278 μg/fly) and resistance has not

developed.

DDVP: The LD_{50} values with DDVP were between 0.029 μg/fly (chicken farm) and 0.103 μg/fly (dumping ground). The values were lower than those of the Takatsuki strain (0.128 μg/fly).

DDT: The LD_{50} values with DDT were remarkably lower than those of the Takatsuki strain (39.41 μg/fly). Compared with the Indonesian strain, the values of the Singapore strains (0.63 to 0.85 μg/fly) were comparatively lower than those of the urban strains, i.e. Jakarta (1.54 μg/fly), Cirebon (3.75 μg/fly), Berastagi (4.24 μg/fly) and Ujung Pandang (7.25 μg/fly).

Chrysron: The LD_{50} values with Chrysron were 0.011 to 0.023 μg/fly. These values were not remarkably different from those of the Takatsuki strain (0.019 μg/fly).

Considering the susceptibility of the houseflies to the insecticides in all aspects, the level with Malathion was comparatively lower than with the other insecticides, especially the strain collected at the dumping ground. This value is higher than that of the Hamura strain in Tokyo (Hayashi *et al.*, 1974), however, if Malathion is sprayed continuously in the future, the LD_{50} value will increase soon.

There are some methods for lowering the resistant level to insecticides. One of those is to use different kinds of insectides for housefly control. Mixing the other kinds of insecticides is also effective. The other method is to add synergists to the insecticides. Hayashi *et al.* (1974) reported that adding synergists to Malathion is effective for increasing the effect of Malathion. Table 2 shows that the effects of synergists, S-421, Safroxane and pyperonyl butoxide, when mixed with Malathion or Baygon, on the houseflies of the dumping ground of Singapore. The synergists were mixed with Malathion or Baygon at the ratio of 1 to 1.

Table 2. Effect of synergists mixed with Malathion and Baygon (μg/fly)

Insecticides: Synergists		1 : 1	1 : 3
Malathion:	Unmixed	28.15	
	S-421[2)]	2.88	0.231
	Safroxane[3)]	3.64	0.446
	P. butoxide[4)]	3.98	
Baygon[1)]:	Unmixed	1.40	
	S-421	0.61	
	Safroxane	0.19	
	P. butoxide	0.97	

1) 2-Isoproxyphenyl N-methylcarbamate
2) Octachlorodipropylether
3) 4-(3', 4'-Methylenedioxyphenyl)-5-methyl-metadixane
4) 3, 4-Methylenedioxy-6-propylbenzyl n-butyl diethyleneglycol ether

However, Safroxane and S-421 were mixed experimentally with Malathion at the ratio of 1 to 3. As for Malathion, S-421 was the most effective synergist and the next was Safroxane. The effect of S-421 mixed with Malathion at the ratio of 1 to 1 was about 10 times higher, when compared with the case not mixing a synergist with Malathion. In the case the mixing ratio is 1 to 3, the effect of S-421 was more than 100 times higher, this being the same value as in the case of the susceptible strain.

As for the carbamate insecticide, Baygon with synergists was effective like Malathion.

Conclusion

As discussed above, the LD_{50} value of each strain in Singapore was comparatively lower than that of the Takatsuki strain, except Malathion and Baygon. Among the strains in Singapore, the dumping ground strain showed a high value to almost all the insecticides and the chicken farm strain showed a high susceptibility.

Synergists are effective for lowering the resistance to Malathion, especially S-421

and Safroxane being effective.

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