原　著

Response of Adult Housefly to Certain Volatilized Insecticides. Insect Repellents and Attractants. IV. Yasunosuke IKEDA (Takamine Laboratory, Sankyo Co., Ltd. Yasu-cho, Shiga Pref.). Received May 27, 1958. *Botyu-Kagaku* **23**, 99, 1958.

18. 殺虫剤に対する家蠅の忌避性　忌避剤・誘引剤について　第4報*

池田安之助（三共株式会社　高峰研究所）

33. 5. 27 受理

自然温度における殺虫剤の揮散臭に対してイエバエがどのような反応を示すかを知るため，嗅覚計を用いて室内的に実験した．その結果，実験的に多量の薬剤を使用した場合にはイエバエは若干の忌避性を示したが，通常散布時における表面付着量からの臭に対してはイエバエは反応を示さず，DDT にはかえって誘引される傾向が見られた．

The repellent properties of certain residual insecticides have long been considered as a matter of great importance, since the repellency is sometimes of considerable moment in increasing or decreasing the effectiveness of an insecticide. If an insecticide has a strong repellent power, insects will leave the material before they take up lethal doses, or, they won't even approach the sprayed materials, so as to decrease the insecticidal efficiencies of the named drugs.

It has already been recognized that the chlorinated hydrocarbon insecticides act as repellent or attractant to houseflies[4,10] and thrips[11]. γ-BHC was found to be repellent to larvae of blowfly[11] and ants[1]. DDT was acting as a termite repellent, and wood samples which had been soaked in 2% benzene solution of DDT were immune from termite attack for as long as one year[15]. With reference to natural derivatives such as pyrethrins, it was found that pyrethrum reduced the biting and landing of mosquitoes[9] and tsetse flies[5] when applied on the skin, as well its vapors deterred *Anopheline* mosquitoes from entering sprayed huts[13]. In the previous papers[6—8], the author reported that certain insecticides were highly effective in repelling adult houseflies. Some insecticides, such as pyrethrins, retained their repellency for extended periods. In the experiment, the repellent effects were measured gustatory or olfactory by using the lactose pellets.

In the present paper, the author has dealt with the olfactometric tests for vapors of the named insecticides against adult houseflies.

The author wishes to express his appreciation to Dr. O. Shinoda, Prof. in Osaka University of Liberal Arts for his kind guidance and encouragement given him during the course of the present work. The author is also deeply indebted to the director N. Kumasawa of this laboratory and Mr. Y. Hamada, the chief of chemical laboratory of this company for their helps.

Methods and Materials

The insect used was the adults of the common housefly, *Musca domestica vicina* Macq., which have been bred in the laboratory.

In the case of the test, 20 female flies of 2 to 3 days old were used for each test.

The insecticides adopted for test were DDT (tech. pure, recrystallized), γ-BHC (pure), dieldrin (tech. pure), chlordane (tech. pure), *o*-dichlorobenzene (tech. pure), sulfoxide (tech. pure), pyethrum extract (containing 17.4% of pyrethrins), allethrin (tech. 97.7%), and Crag fly repellent, butoxypolypropylene glycol, one of the fly repellent widely used.

Test formulations were made by dissolving each material in acetone at a rate of 25, 50, 100 and 200 mg in each of 1 cc of test solution respectively. Only *o*-dichlorobenzene was used as pure state, since it escapes in vapor with the evaporation of acetone in a very short time.

The olfactometer employed was the T-tube type, as shown in Fig. 1, according to the principle

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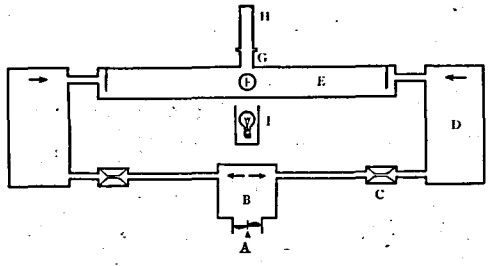

Fig. 1. Diagram of an olfactometer for houseflies and other smaller insects :
(A) air inlet, (B) blower, (C) flow-meter, (D) saturation chamber, (E) test chamber, (F) air outlet, (G) insect entrance, (H) annexed insect chamber, and (I) light. To set off the experiment, flies which are contained in tube (H), are drawn into test chamber by an electric lamp at (I).

of McIndoo's Y-tube[2,12]. A glass tube 3.4 cm in diameter and 48 cm long with an air outlet vertically upward and an insect entrance attached at the center of the tube. The saturation chamber consisted of glass bottle of 500 cc capacity. The bottle was closed with a cork stopper, and was connected to both ends of the T-tube by a short glass tubing.

The parallel streams of air are passed through a set of two 500 cc bottles, one of which is empty while the other contains an insecticide to be tested. The air flow in the T-tube averages 1,800 cc per hour. The test is carried out at the room temperature. The air is passed through a saturated NaCl solution, so as to keep the humidity relatively constant.

A folded filter paper of 7.5×12 cm (90 cm^2) is soaked with 1 cc of acetone solution of a given amount of the test insecticide. The impregnated paper is exposed in air to let certain solvent evaporate up, and is placed in the saturation bottle. Air is flowed for ten minutes before flies are introduced into the test chamber. They are drawn into the chamber by an electric lamp from opposite side of the chamber out of the container, after which tests are carried on in a dark, the T-tube being examined under dim light at intervals 30 minutes.

The criterion of reaction was based on the reaction of insects to odorous air diffusing through one arm from a saturation bottle containing the test insecticide and odorless air through the other.

Results and Discussion

The evaluation of repellence or attraction is based upon the numbers of flies which enter in either the odorless (check) arm or the odorous (test) arm. The results are shown in Table 1 and 2.

Table 1. Reaction of the female houseflies, *Musca domestica vicina* Macq., to the odors of certain insecticides in an olfactometer. At 21.0—24.0°, relative humidity 72.0—80.0 %. Results of five replicates.

Material	Dosage mg per 90 cm^2	Reaction Percent								
		Tendency*			After 30 mins.			After 60 mins.		
		Attraction	Neutrality	Repellence	Attraction	Neutrality	Repellence	Attraction	Neutrality	Repellence
p,p'-DDT	200	80.0	—	—	72.0	—	—	80.0	—	—
	100	95.0	—	—	100.0	—	—	95.0	—	—
	50	75.0	—	—	96.0	—	—	96.0	—	—
	25	58.0	—	—	80.0	—	—	85.0	—	—
γ-BHC	200	—	50.0	—	62.0	—	—	53.0	—	—
	100	—	50.0	—	90.0	—	—	94.0	—	—
	50	—	50.0	—	85.0	—	—	85.0	—	—
	25	—	50.0	—	—	50.0	—	—	50.0	—
Dieldrin	200	60.0	—	—	62.0	—	—	60.0	—	—
	100	58.0	—	—	60.0	—	—	57.0	—	—
	50	—	50.0	—	84.0	—	—	84.0	—	—
	25	—	50.0	—	—	50.0	—	—	50.0	—
Chlordane	200	—	—	85.0	—	—	53.0	—	—	57.0
	100	—	50.0	—	—	50.0	—	—	50.0	—
	50	—	50.0	—	—	50.0	—	—	50.0	—
	25	—	50.0	—	—	50.0	—	60.0	—	—
o-Dichlorobenzene	200	—	—	100.0	—	—	100.0	—	—	100.0
	100	—	—	100.0	—	—	100.0	—	—	100.0
	50	—	—	100.0	—	—	90.0	—	—	95.0
	25	—	—	75.0	—	—	68.0	—	50.0	—

* Reaction at first instant of flies were drawing into the test chamber where circulation of the air was in operation.

Table 2. Reaction of the female houseflies, *Musca domestica vicina* Macq., to the odors of certain insecticides in an olfactometer. At 21.0—24.0°, relative humidity 72.0—80.0%. Results of five replicates.

Material	Dosage mg per 90 cm²	Reaction Percent								
		Tendency*			After 30 mins.			After 60 mins.		
		Attraction	Neutrality	Repellence	Attraction	Neutrality	Repellence	Attraction	Neutrality	Repellence
Sulfoxide	200	—	50.0	—	80.0	—	—	72.0	—	—
	100	—	50.0	—	—	50.0	—	60.0	—	—
	50	—	50.0	—	80.0	—	—	—	moved	—
	25	—	moved	—	—	moved	—	80.0	—	—
Allethrin	200	60.0	—	—	72.0	—	—	72.0	—	—
	100	—	50.0	—	90.0	—	—	90.0	—	—
	50	—	50.0	—	60.0	—	—	74.0	—	—
	25	—	moved	—	—	50.0	—	—	50.0	—
Pyrethrins	200									
	100	—	50.0	—	70.0	—	—	62.0	—	—
	50	—	50.0	—	61.0	—	—	60.0	—	—
	25	60.0	—	—	—	50.0	—	—	moved	—
Crag fly repellent	200	—	50.0	—	—	50.0	—	—	50.0	—
	100	—	50.0	—	—	—	70.0	—	—	85.0
	50	—	50.0	—	—	—	60.0	—	—	60.0
	25	—	moved	—	—	50.0	—	—	50.0	—

DDT. DDT seems to be significantly attractive to the flies but, when the usual dosage (25 mg/90 cm²) is used, their response to the odor is thickskinned.

γ-BHC. It is somewhat attractive to flies, though not so significant.

Dieldrin. Experimentally, this material is slightly attractive when excessive dosage (200 mg and 100 mg/90 cm²) is used. When the usual dosage is used, it is neither attractive nor repellent to flies.

Chlordane. The repellency of chlordane is highly significant where heavy dosage (200 mg/90 cm²) is used, but for the usual dosage it is comparatively neutral in effectiveness.

o-Dichlorobenzene. This is extremely repellent to flies, but a considerable fumigant effect is also observed. When the flies perceive the odor they are highly strung, and moribundity or knockdown occur during the next 60 minutes. Knockdown or moribundity of flies observed after 60 minutes was 50% in 200 mg and 100 mg/90cm², 40% in 50 mg/90 cm² and 30% in 25 mg/90 cm² in each dosage. When a dosage of 25 mg/90 cm² is used, they excite but slightly. Thus, *o*-dichlorobenzene is highly repellent against flies, but, since it is too volatile, it may be of no use as a repellent.

Sulfoxide. Sulfoxide appears neutral in effect.

Allethrin and *Pyrethrins.* No significant effects, both repellent or attractive, are observed for allethrin and pyrethrins. Rather they may be attractive. From the results obtained, it may be somewhat considered these are not vapor phase repellent, but act upon gustatory sense organs of flies.

Crag fly repellent. In these tests, the result for Crag fly repellent was not so significant. When the flies perceived the odor, they are only slightly excited. Practically, it must act primarily as a gustatory repellent upon the flies.

From the results obtained, it may be considered that chlorinated hydrocarbon insecticides were not vapor phase repellent. Experimentally, these materials were attractive or repellent to flies where heavy dosages were used, but in the case of the usual dosage, no significant evidence of attraction or repellency can be observed for all insecticides tested.

Résumé

In the present paper, the author dealt with the olfactometric tests of certain volatile insecticides against the adult houseflies bred in this laboratory. The olfactometer employed was the T-tube type.

The repellency of chlordane is highly significant

where heavy dosage was used. *o*-Dichlorobenzene is also extremely repellent, but its activity duration is very short even if it is applied in relatively high concentration. At the same time it has fumigant effect, and about 50% of knockdown or moribundity occurred following the exposure of flies for test periods of 60 minutes.

DDT and dieldrin are significantly attractive to flies. When the flies perceived the odor, they follow the direction of source of the odor. γ-BHC is also somewhat attractive, though not so significant. Results for sulfoxide, allethrin and pyrethrins were not significant. Crag fly repellent is somewhat more repellent than the others.

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On the Repellent Efficiency of Certain Insecticides and Their Mode of Action to Adult Housefly. Insect Repellents and Attractants. V. Yasunosuke IKEDA (Takamine Laboratory, Sankyo Co., Ltd, Yasu-cho, Shiga Pref.). Received May 27, 1958. *Botyu-Kagaku* **23**, 102, 1958.

19. 家蠅に対する殺虫剤の忌避効力とその作用様式について　忌避剤・誘引剤について　第5報*

池田安之助（三共株式会社　高峰研究所）. 33. 5. 27 受理

イエバエ成虫に対する味覚，触覚，および嗅覚忌避試験ならびにこれと併行した殺虫試験の結果から，ピレトリンやアレスリンのイエバエに対する忌避作用は主として味覚（または触覚）によるもので，嗅覚忌避でないことを明らかにした．また他の殺虫剤についても同様の傾向が認められたが，その効力は顕著でなかった．

Although extensive effort has been expended to find the repellent or attractive properties of certain residual insecticides against various species of insects under laboratory conditions or in field tests, there still remained something of uncertainty in their actual mode or the physiological mechanism of repellency.

In the previous papers[4—7], the author reported on the repellency of certain insecticides to adult housefly. The term repellency was used in previous tests to refer to any complex of stimuli, gustatory, tactile or olfactory, which results in a laboratory method by using the lactose pellet.

In this paper, the author has dealt with the olfactometric tests of certain volatile insecticides to adult houseflies to find out any correlation between repellent and insecticidal efficiencies of insecticides, and also to try to answer the question,

* 本報告の概要は昭和33年3月30日～4月1日の日本応用動物昆虫学会大会（於東京大学）において発表した．