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# Resistance Pattern of a Fluoroacetate-Resistant Fly Strain.

Alexander S. Tahori Israel Institute for Biological Research, Ness-Ziona, Israel

## Abstract

A susceptible strain of the housefly (Musca domestica L.) was selec- ted for its fluoroacetate resistance. Resistance patterns obtained after selection with fluoroacetate for-25 generations have been reported (Tahori, 1963) It is the purpose of this paper to present and discuss the results of selection for an additional 32 generations.

## Materials and Methods

The methods for selection and the tests employed have been described in full (Tahori, 1963). In short, selection consisted of supplying adult flies with sugar and a toxicant solution instead of with pure water. Whereas at the 25th generation of selection the fluoroacetate solution had a concentration of 200 ppm and was offered for 6 days, at the 57th generation, the concentration could be raised to 1500 ppm and the exposure period to 8 days.

The following fly strains were used for comparison:- "S"

Musca domestica DDT-susceptible Stauffer strain.

"FT" selected from "S" for fluoroacetate resistance for 17 generations and then reared without any further selection.

"F" selected from "S" for fluoroacetate resistance for up to 57 generations.

The following insecticides, all of technical grade, were used: DDT, methoxychlor, lindane and dieldrin2....)

The insecticides in acetone solution were applied to the ventral thorax of two-day-old female flies, by means of an "Agla" microsyringe. Resistance to fluoroacetate was measured by drop-feeding flies, starved for 24 hours, with known amounts of the toxicant

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2) These insecticides were supplied by Messrs. Machteshim Chemical Works, Beer Sheba.

## Results

Data presented in Table 1 show that after 17 generations of exposure to fluoroacetate, resistance to DDT increased 60-fold. This high level was maintained for approximately two years whether selection was continued or whether the flies were reared without any further selection. For methoxychlor, the picture was similar, except for the following difference: the highest level of resistance obtained was only about 12-fold, declining gradually to about 6-fold at the end of these series of experiments.

With dieldrin, quite a different picture was evident. A 400-fold increase was obtained after 17 generations of selection with fluoroacetate.

Table 1. Response of fly strains to topical application of various insecticides.

24-Hour topical $LD_{50}$ in µg/female fly strain shown

| | | (1) FT Strains Number of generations | | | | (2) FT strains Number of generations | | | |
|---|---|---|---|---|---|---|---|---|---|
| | S | 8 | 20 | 30 | 40 | 25 | 44 | 50 | 57 |
| DDT | 0.15 | 9.8 | 8.7 | 9.0 | 9.5 | 10.0 | 9.0 | -- | 9.0 |
| Methoxychlor | 0.5 | 6.0 | 3.4 | 3.4 | 3.0 | 6.2 | 4.5 | -- | 4.4 |
| Lindane | 0.05 | 1.3 | 1.1 | 0.9 | 1.1 | 1.3 | 0.6 | -- | 0.16 |
| Dieldrin | 0.2 | 66.0 | 44.0 | 20.0 | 20.0 | 80.0 | 0.65 | -- | 0.35 |
| Fluoroacetate by Feeding | 0.6 | 1.7 | 1.0 | 1.2 | 1.2 | 4.2 | 3.0 | 3.4 | 4.0 |

(1) selected with fluoroacetate for 17 generations, and reared without further exposure for number of generations.

(2) selected continuously with fluoroacetate for number of generations.

When selection with this compound was continued, resistance to dieldrin was practically eliminated. On the other hand, in the populations where no further selection was practiced, the high level of dieldrin resistance was maintained. For lindane the pictures was similar to that of dieldrin.

Resistance to fluoroacetate decreased after the 25th generation of selection, in spite of continous selection. After the 44th generation it rose again slowly, reaching approximately the previous highest level after the 57th generation. When selection was discontinued after the 17th generation, the level of resistance fell immediately, and later levelled off at about twice the level of the susceptible strain.

Discussion

A possible explanation for the high levels of DDT resistance after initial or continous exposure to fluoroacetate is, that during the first stages of selection to fluoroacetate, a concurrent selection for DDT took place. Such a phenomenon has been shown to occur regarding resistance to lack of food and water ( Tahori, 1963).

The dosage-mortality regression lines in the case of dieldrin resistance were always very shallow, indicating the monofactoral character of dieldrin resistance (Brown, 1959).

Dieldrin resistance has been extensively studied in anopheline mosquitoes. There it is either monofactoral and semidominant as in A. gambiae from Northern Nigeria ( Davidson & Jackson, 1961), A. albimanus from El Salvador ( Davidson, 1963), and A. quadrimaculatus ( Davidson, 1963b); or dependent on a single dominant factor as in A. gambiae from Gaoulou, Ivory Coast (Davidson & Hamon, 1962), or in A. albimanus Wiedemann (Rozenbook & Johnson, 1961). This dominance would explain the very high level of dieldrin resistance obtained after relatively few generations of selection. While the selecting agent in our case was not dieldrin, but a completely unrelated compound- sodium fluoroacetate - , it appears that either the genes responsible for resistance to these compounds are closely linked, or else the method used for selecting for fluoroacetate also induced dieldrin resistance.

Hamon and Garrett-Jones (1963) found that dieldrin resistance in A. gambiae Giles appeared very quickly in the field after the use of dieldrin and remained at a high level without any further insecticide pressure. In addition , no loss of resistance was reported by Rozeboom (1963) for A. albimanus after about 3 years of laboratory rearing without further selection pressure, indicating that in both cases a homozygous dieldrin-resistant population was obtained. While we observed a very high degree of dieldrin resistance, its very quick loss in the F strain would indicate that the population still contained a few heterozygous or dieldrin-susceptible homozygous individuals. Further selection with fluoroacetate gave predominance to these individuals, and dieldrin resistance was quickly lost. In the populations where selection with fluoroacetate was discontinued, dieldrin resistance was maintained, although at a somewhat lower level. This was probably due to the presence of a few heterozygous individuals.

Since in the first paper (Tahori, 1963) no resistance to organic-phosphate insecticides or carbaryl (Sevin) was observed, resistance tests with these compounds were discontinued.

Studies on the biochemistry of fluoroacetate resistance in houseflies are reported elsewhere (Zahavi, Tahori & Kindler 1964).

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