

**Inheritance of Sevin-Resistance in the Housefly, *Musca domestica nebulo* Fabr.** Musharraf A. Ansari (Department of Zoology, Aligarh Muslim University, Aligarh (U.P.), India.) Received May 26, 1972, *Botyu-Kagaku* 37, 83, 1972.

11. イエバエ *Musca domestica nebulo* におけるセビン抵抗性の遺伝 Musharraf A. Ansari (Aligarh Muslim 大学 動物学教室) 47. 5. 26 受理

イエバエのセビン抵抗性の遺伝を、抵抗性系統、感受性系統の個体間で、またグループの間で正逆交雑を行なってしらべた。

F<sub>2</sub> 子孫にたいして得られた死亡率は、感受性系統と抵抗性系統の差が 1:3 の予期したメンデル単遺伝子遺伝の法則に従っていることを示した。戻り交雑の結果も子孫に二つの遺伝子型があることを示している。従って、イエバエのセビン抵抗性は、単遺伝子に起因していると結論されよう。

Several workers have studied the inheritance of carbamate resistance in the housefly, *Musca domestica domestica*. Georghiou and Graber (1965) have reported that resistance to isolan and sevin plus piperonyl butoxide was inherited in an isolan resistant strain through a single partly dominant factor. In contrast, the resistance to isolan and to combination of sevin and piperonyl butoxide in a strain selected with ronnel was controlled by polygenic system. Kasai and Ogita (1965) made reciprocal crosses between resistant and susceptible flies and concluded that the factors governing resistance to sevin and BHC were situated on the fifth and second chromosome respectively. Similar results were obtained by Plapp and Hoyer (1967), Tsukamoto *et al.* (1968)

and Plapp (1970) who found that the genes controlling carbamate resistance were located on the fifth chromosome and, in some cases, also in the second chromosome.

The investigations cited above relate to *M. d. domestica* and the author is unaware of any published record concerning the inheritance of sevin resistance in the predominant form of Indian housefly, *Musca domestica nebulo*. It was, therefore, considered desirable to find out the genetic nature of sevin resistance in this form of fly.

#### Materials and Methods

##### *Experimental procedure*

Reciprocal crosses were established between a

Table 1. Percentage mortality of normal and resistant parents with different concentrations of sevin solutions in ethanol.

| Concentration | Normal |         |         | Resistant |         |         |
|---------------|--------|---------|---------|-----------|---------|---------|
|               | Males  | Females | Average | Males     | Females | Average |
| 0.0039        | 26.7   | 12.5    | 18.8    | —         | —       | —       |
| 0.0078        | 30.6   | 18.2    | 23.8    | —         | —       | —       |
| 0.0156        | 50.0   | 15.1    | 29.8    | —         | —       | —       |
| 0.03125       | 65.8   | 27.05   | 46.4    | —         | —       | —       |
| 0.0625        | 70.5   | 42.1    | 53.9    | —         | —       | —       |
| 0.125         | 81.6   | 41.5    | 63.7    | 4.3       | 0.0     | 2.04    |
| 0.25          | 87.6   | 51.02   | 73.7    | 11.1      | 0.0     | 5.3     |
| 0.5           | 92.4   | 65.6    | 78.1    | 24.2      | 5.7     | 14.7    |
| 1.0           | 95.3   | 69.7    | 82.8    | 29.0      | 19.7    | 24.6    |
| 2.0           | 96.1   | 81.08   | 88.6    | 56.1      | 22.4    | 33.7    |
| 4.0           | 100.0  | 100.0   | 100.0   | 51.6      | 25.2    | 38.04   |
| 6.0           | —      | —       | —       | 69.7      | 23.7    | 46.4    |

A drop of 0.0018 cc. applied to each fly.

sevin-resistant and a susceptible strain from flies obtained from pupae kept individually in glass vials. Two sets of experiments were performed, one in which individual flies were crossed and the other in which mass crosses were made between resistant and normal strains. The adults were fed on milk soaked cotton and each family were kept separately in a small cage 3×3" in size constructed of wire frame covered over with mosquito netting. In this way ten pairs were established (five each of the ♂R×♀N and ♂N×♀R) from which adults sufficient to be tested with different concentrations of sevin were obtained. As the differences between the suscep-

ptibility levels of the F<sub>1</sub> progeny of families belonging to the same type were insignificant, only two families from each type were chosen to produce the F<sub>2</sub> generation. Back crosses between the F<sub>1</sub> hybrids and susceptible parents were also made.

Susceptibility levels of the adults were determined by applying measured drops of ethanol solutions of sevin on the dorsum of each fly with a microsyringe (Busvine, 1951). The size of the droplet applied was kept constant. The LC<sub>50</sub> values of the resistant and normal parents were 0.05 and 9.0 percent respectively; the resistance ratio being 180.0 (Table 1).

Tsble 2. Percentage mortality of flies in the progenies of various normal × resistant individual cross matings.

| Generation     | Original Type | Cross Pair No. | Percentage of flies killed by different concentrations of sevin |          |          |          |          |          |          |           |
|----------------|---------------|----------------|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|-----------|
|                |               |                | 0.0625                                                          | 0.125    | 0.25     | 0.5      | 1.0      | 2.0      | 4.0      | 6.0       |
| F <sub>1</sub> | ♂N×♀R         | 1              | 0.0                                                             | 3.5      | 12.5     | 21.4     | 23.3     | 27.8     | 38.0     | 53.2      |
|                |               | 2              | 0.0                                                             | 6.2      | 8.6      | 18.5     | 28.5     | 29.8     | 40.0     | 50.0      |
|                |               | 3              | 0.0                                                             | 2.8      | 8.0      | 10.7     | 28.1     | 35.4     | 42.5     | 47.4      |
|                |               | 4              | 1.9                                                             | 6.2      | 10.2     | 11.1     | 26.6     | 33.3     | 38.6     | 50.9      |
|                |               | 5              | 1.2                                                             | 5.5      | 13.1     | 15.6     | 32.1     | 35.0     | 36.3     | 52.08     |
|                | Average       |                | 0.9                                                             | 4.1      | 10.7     | 14.8     | 27.7     | 32.6     | 39.3     | 50.7      |
|                |               |                | (2/202)                                                         | (7/145)  | (16/149) | (19/128) | (43/155) | (48/147) | (61/155) | (104/205) |
|                | ♂R×♀N         | 6              | 0.0                                                             | 4.8      | 13.3     | 17.2     | 31.6     | 42.1     | 41.1     | 56.5      |
|                |               | 7              | 3.3                                                             | 8.6      | 11.1     | 22.2     | 29.1     | 40.9     | 37.1     | 52.9      |
|                |               | 8              | 2.3                                                             | 6.6      | 14.8     | 21.7     | 26.9     | 38.09    | 40.9     | 54.5      |
|                |               | 9              | 0.0                                                             | 5.7      | 15.7     | 26.3     | 28.2     | 32.5     | 43.4     | 49.0      |
|                |               | 10             | 5.7                                                             | 7.1      | 14.2     | 20.2     | 25.0     | 39.6     | 36.8     | 57.1      |
|                | Average       |                | 2.5                                                             | 6.5      | 14.1     | 22.2     | 28.5     | 35.4     | 42.7     | 53.2      |
|                |               |                | (4/157)                                                         | (12/188) | (21/148) | (35/158) | (44/154) | (55/155) | (77/180) | (74/139)  |

Table 2. (Contd.)

| Generation     | Original Type | Cross Pair No. | Percentage of flies killed by different concentrations of sevin |          |          |          |          |           |           |           |
|----------------|---------------|----------------|-----------------------------------------------------------------|----------|----------|----------|----------|-----------|-----------|-----------|
|                |               |                | 0.0625                                                          | 0.125    | 0.25     | 0.5      | 1.0      | 2.0       | 4.0       | 6.0       |
| F <sub>2</sub> | ♂ N × ♀ R     | 4              | 11.1                                                            | 19.6     | 25.5     | 26.08    | 36.8     | 48.0      | 50.0      | 58.8      |
|                |               | 5              | 16.6                                                            | 18.6     | 29.6     | 33.3     | 43.6     | 44.1      | 54.5      | 60.8      |
|                |               | Average        | 13.7                                                            | 18.9     | 26.3     | 29.4     | 41.3     | 47.6      | 51.9      | 60.0      |
|                |               |                | (7/51)                                                          | (18/95)  | (20/76)  | (25/85)  | (24/58)  | (40/84)   | (27/52)   | (24/40)   |
|                |               |                |                                                                 |          |          |          |          |           |           |           |
|                | ♂ R × ♀ N     | 8              | 13.6                                                            | 18.2     | 25.04    | 31.2     | 39.5     | 47.2      | 53.6      | 62.8      |
|                |               | 10             | 14.3                                                            | 20.0     | 28.6     | 32.5     | 42.8     | 51.6      | 54.5      | 63.6      |
|                |               | Average        | 13.9                                                            | 19.2     | 27.02    | 32.0     | 40.6     | 49.2      | 54.05     | 63.01     |
|                |               |                | (11/79)                                                         | (10/52)  | (10/37)  | (24/75)  | (24/59)  | (34/69)   | (40/74)   | (46/73)   |
|                |               |                |                                                                 |          |          |          |          |           |           |           |
| F <sub>1</sub> | All data      |                | 1.6                                                             | 5.7      | 12.4     | 20.6     | 28.1     | 34.1      | 41.1      | 51.7      |
|                |               |                | (6/359)                                                         | (19/333) | (37/297) | (59/286) | (87/309) | (103/302) | (138/335) | (178/344) |
| F <sub>2</sub> | All data      |                | 13.8                                                            | 19.04    | 26.5     | 30.6     | 41.02    | 48.3      | 53.1      | 61.9      |
|                |               |                | (18/130)                                                        | (28/147) | (30/113) | (49/160) | (48/117) | (74/153)  | (67/126)  | (70/113)  |

## Results

It is evident from the results (Tables 2-3) that sevin resistance in *M. d. nebulo* is inherited through a completely dominant genetic factor. The  $F_1$  progeny from all the individuals and mass cross matings behaved like resistant ones, when the adults were tested topically. The mortalities obtained in individual and mass crosses were quite close to the resistant strain at different concentrations of sevin. To interpret the results, 0.0625 percent sevin may be taken as a discriminating dose to detect the susceptible genotypes, as this concentration kills 53.9 percent of susceptible flies and only 1.6 percent of  $F_1$  hybrids. If the inheritance was monofactorial the

$F_2$  generation should show 25 percent susceptible genotypes and therefore a percentage mortality of 13.4 ( $0.25 \times 53.4$ ). The percentage mortality actually obtained in the  $F_2$  generation at this dose were 13.8 and 12.9 in individual and mass cross matings respectively. These figures do not depart considerably from the expected one. This was further assessed by allowing the  $F_1$  hybrids to mate with susceptible parents. The results (Table 4) are adequate to show the segregation into two genotypes in the back cross offsprings. The percentage mortalities obtained with the discriminating dose of 0.0625 percent sevin were 34.4, 34.7 for males; 20.8 and 21.3 for females and 27.6 and 28.0 for males plus females as

Table 3. Percentage mortality of flies in the progenies of normal  $\times$  resistant mass cross matings.

| Generation | Type of cross               | Percentage of flies killed by different concentrations of sevin |                  |                   |                  |                   |                  |                  |                  |
|------------|-----------------------------|-----------------------------------------------------------------|------------------|-------------------|------------------|-------------------|------------------|------------------|------------------|
|            |                             | 0.0625                                                          | 0.125            | 0.25              | 0.5              | 1.0               | 2.0              | 4.0              | 6.0              |
| $F_1$      | $\delta N \times \varphi R$ | 1.9                                                             | 4.6              | 12.4              | 22.0             | 25.8              | 35.8             | 43.4             | 45.2             |
|            | $\delta R \times \varphi N$ | 2.4                                                             | 6.25             | 13.8              | 19.6             | 35.7              | 36.7             | 41.6             | 50.0             |
| $F_2$      | $\delta N \times \varphi R$ | 12.1                                                            | 18.1             | 26.2              | 34.04            | 37.8              | 49.1             | 51.6             | 65.07            |
|            | $\delta R \times \varphi N$ | 14.2                                                            | 23.5             | 27.1              | 37.1             | 42.6              | 53.1             | 58.8             | 63.8             |
| $F_1$      | All data                    | 1.7<br>(4/228)                                                  | 5.07<br>(10/197) | 13.5<br>(21/155)  | 20.7<br>(23/111) | 31.06<br>(41/132) | 36.4<br>(55/151) | 42.3<br>(50/118) | 47.8<br>(55/115) |
| $F_2$      | All data                    | 12.9<br>(14/108)                                                | 21.05<br>(20/95) | 27.06<br>(36/133) | 36.0<br>(45/125) | 41.07<br>(46/112) | 50.9<br>(53/104) | 54.8<br>(62/113) | 64.5<br>(71/100) |

Table 4. Percentage mortality of flies in the progenies of various normal  $\times$   $F_1$  hybrids cross matings.

| Percentage sevin | $\delta \delta$ from $F_1 \times S$ |               | $\varphi \varphi$ from $F_1 \times S$ |              | $\delta \delta \varphi \varphi$ from $F_1 \times S$ |               |
|------------------|-------------------------------------|---------------|---------------------------------------|--------------|-----------------------------------------------------|---------------|
|                  | a                                   | b             | a                                     | b            | a                                                   | b             |
| 0.03125          | 28.7<br>(80)                        | 30.6<br>(62)  | 6.4<br>(31)                           | 5.3<br>(75)  | 17.5<br>(111)                                       | 17.9<br>(137) |
| 0.0625           | 34.4<br>(61)                        | 34.7<br>(92)  | 20.8<br>(91)                          | 21.3<br>(75) | 27.6<br>(152)                                       | 28.0<br>(167) |
| 0.125            | 40.0<br>(60)                        | 45.5<br>(79)  | 23.8<br>(88)                          | 21.5<br>(65) | 31.9<br>(148)                                       | 33.5<br>(144) |
| 0.25             | 45.5<br>(79)                        | 43.4<br>(46)  | 28.1<br>(71)                          | 22.8<br>(92) | 36.8<br>(150)                                       | 33.1<br>(138) |
| 0.5              | 47.8<br>(69)                        | 45.1<br>(62)  | 32.8<br>(73)                          | 30.0<br>(50) | 40.3<br>(142)                                       | 37.5<br>(112) |
| 1.0              | 48.3<br>(118)                       | 47.7<br>(92)  | 34.5<br>(55)                          | 34.3<br>(96) | 41.4<br>(173)                                       | 41.0<br>(188) |
| 2.0              | 49.09<br>(110)                      | 51.7<br>(116) | 38.4<br>(65)                          | 42.8<br>(84) | 43.5<br>(175)                                       | 47.2<br>(200) |

a- $F_1$  Progeny from single pair cross matings.

b- $F_2$  Progeny from mass cross matings.

against the percentage mortalities of 35.2 for males; 21.05 for females and 26.9 for males plus females expected to give 50.0 percent ratio. These figures are quite near to 50.0 percent mortality which is expected in a monofactorial inheritance. It can thus be concluded that sevin-resistance in *M. d. nebulo* is monofactorial in origin and is inherited through a single dominant autosomal gene.

### Summary

The inheritance of sevin resistance in *M. d. nebulo* was studied by making reciprocal crosses between individual as well as groups of flies of sevin resistant and a susceptible strains. The percentage mortalities obtained for the  $F_2$  progeny clearly show the segregation of the susceptible and resistant individuals in a ratio which is quite near to the expected ratio of 1:3 in a Mendelian monogenetic inheritance. The results of back crosses also showed the segregation into two genotypes in the offsprings. It is therefore, safe

to conclude that sevin-resistance in *M. d. nebulo* is monogenic in origin.

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**Nouvel Ester Cyclopropanecarboxylique Insecticide (No. 6)** Efficacité insecticide de "Butéthrine", nouveau pyréthroïde. Akifumi HAYASHI, Ichiro TANAKA et Kaoru SOTA (Société Pharmaceutique Taisho, Tokio) Reçu le 8 Mai, 1972. *Botyu-Kagaku*, 37, 86 (1972) (Avec un français résumé 91).

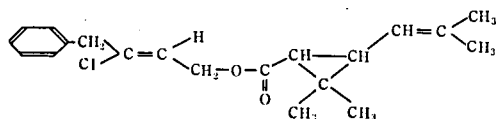
**12. 新殺虫性シクロプロパンカルボン酸エステル (第6報) 新しい合成ピレスロイド, ブテスリンの殺虫効果について** 林 晃史, 田中一郎, 曾田 馨 (大正製薬株式会社研究部) 47. 5. 8. 受理

新しい合成ピレスロイドである butethrin は数種の衛生害虫に対して allethrin や pyrethrins よりも高い殺虫力をしめした。しかし、ノックダウン効果については少々劣る傾向にあるが他剤との混用により実用性のたかまることが明かになった。

昨今、殺虫剤の人畜に対する安全性が問題にされ、人畜に低毒性で効果的な殺虫剤の開発がのぞまれている。この目的にかなうものとしてピレスロイド系殺虫剤が研究されている。

最近、本邦において勝田 (1969)<sup>1)</sup> によって prothrin が、申西 (1970)<sup>2)</sup> によって proparthrin が開発された。

butethrin は著者ら<sup>3)</sup> によって開発された新合成 pyrethroid で、次のような構造式をもつ化合物である。



ここに、衛生害虫に対する殺虫効力について実験を行い特徴を明かにしたので報告する。

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### 実験材料および方法

#### 1. 供試薬剤

実験に用いた butethrin (3-chloro-4-phenyl-*trans*-2-buten-1-yl *dl*-*cis*, *trans*-chrysanthemate) は bp. 142~145°C/0.12mmHg,  $n_D^{20}$  1.5300 で純度 85.9% のものである。