原　著

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

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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_2 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 susceptibility levels of the F_1 progeny of families belonging to the same type were insignificant, only two families from each type were chosen to produce the F_2 generation. Back crosses between the F_1 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_{50} 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_1	♂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_2	♂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_1	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_2	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 interprete 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 (0.25×53.4). 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 × 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	♂N×♀R	1.9	4.6	12.4	22.0	25.8	35.8	43.4	45.2
	♂R×♀N	2.4	6.25	13.8	19.6	35.7	36.7	41.6	50.0
F_2	♂N×♀R	12.1	18.1	26.2	34.04	37.8	49.1	51.6	65.07
	♂R×♀N	14.2	23.5	27.1	37.1	42.6	53.1	58.8	63.8
F_1	All data	1.7 (4/228)	5.07 (10/197)	13.5 (21/155)	20.7 (23/111)	31.06 (41/132)	36.4 (55/151)	42.3 (50/118)	47.8 (55/115)
F_2	All data	12.9 (14/108)	21.05 (20/95)	27.06 (36/133)	36.0 (45/125)	41.07 (46/112)	50.9 (53/104)	54.8 (62/113)	64.5 (71/100)

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

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

Acknowledgements The author is deeply indebted to Prof. Nawab H. Khan for his keen interest and constructive suggestions during the progress of the work. The author is also grateful to Prof. S. M. Alam for providing necessary facilities in the department and to Miss K. M. Wadhwani for her help in testing the flies.

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Nouvel Ester Cyclopropanecarboxylique Insecticide (No. 6) Efficacité insecticide de "Butéthrine", nouveau pyréthroide. 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

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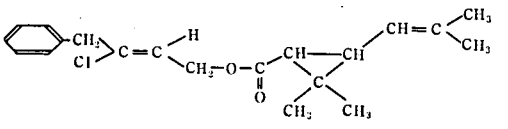
47. 5. 8. 受理

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稍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)[4]によって prothrin が，中西 (1970)[6] によって proparthrin が開発された．

butethrin は著者ら[8] 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．

本文に入るに際し，種々御指導賜った名古屋大学農学部宗像桂教授，斎藤哲夫助教授に御礼申しあげる．また，研究の遂行上御べん達いただいた当社の上原昭二副社長，実験に協力された研究室の各位に謝意を表する．

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. 142～145C°/0.12mmHg, n_D^{20} 1.5300で純度85.9%のものである．