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Development of Insecticide Resistance in *Dacus cucurbitae* Coq. Serajuddin KHAN and Nawab H. KHAN (Department of Zoology, Muslim University, Aligarh, India) Received July 5, 1975. *Botyu-Kagaku* 41, 7, 1976.

2. *Dacus cucurbitae* Coq. における殺虫剤抵抗性の発現

Serajuddin KHAN and Nawab H. KHAN (Dept. of Zoology, Muslim University, Aligarh, India) 50. 7. 5 受理

Melon fruit fly 成虫を γ-BHC および carbaryl によってそれぞれ11および13代にわたって実験室内で選抜した．その結果，原系と比較して，LC_{50} 値は BHC に対し11代目で16.36倍，carbaryl に対し13代目で1.51倍に達した．

Though detected as early as 1914, the phenomenon of insecticide resistance in insects as we know it today, came on the scene with the use of organic residual insecticides in 1946. Since then the number of resistant species is increasing continuously and at present we know of at least 232 species of insects and acarines which have developed tolerance to one or the other chemical and of these 130 species are of agricultural importance[1].

That the melon fruit fly, *Dacus cucurbitae*, can develop resistance to DDT and other chlorinated compounds was shown by Ten in 1959. He exposed the adults to filter papers treated with these chemicals for 15 successive generations and observed that while the species could develop significant resistance to DDT, it failed to achieve any significant tolerance to chlordane. During the present studies an attempt was made to find out if the species can develop any resistance to gamma BHC and carbaryl when subjected to insecticide pressure under laboratory conditions.

Materials and Methods

Adults of *Dacus cucurbitae* were obtained from the normal laboratory colonies maintained at 28±1°C and 60-70 percent relative humidity. Measured drops of acetone solutions of gamma BHC and carbaryl were applied topically to the dorsum of individual flies after the manner described by Abedi[2]. The treated flies were kept in 4×2 cages made up of rice paper and card board. Mortality counts were made after 24 hours of insecticides treatments and the survivors were bred to produce the next generation which was again subjected to insecticide pressure. In this way selection with gamma BHC and carbaryl was carried on for eleven and thirteen generations respectively.

The percentage mortalities of the normal and selected strains were plotted on a probit scale and LC_{50} values and slopes were derived from dosage mortality regression lines (Fig. 1 & 2). The slope of the lines was expressed as the change in probits per ten fold change in dosage[3].

Results

The results obtained (Table 1) show that while the species developed considerable resistance to gamma BHC it failed to show any significant tolerance to carbaryl. The initial LC_{50} values of 0.00022 and 0.00195 obtained with gamma BHC and carbaryl respectively for the normal strain, when compared with the corresponding values for the selected stock suggest that *D. cucurbitae* acquired 16.36 times tolerance to gamma BHC in 11 generations but only 1.51 times tolerance to carbaryl in 13 generations of selection (Table 2). The slight shift in the dosage mortality regression line of the 13th generation without any significant change in slope and its somewhat steeper position than the dosage mortality regression line for the

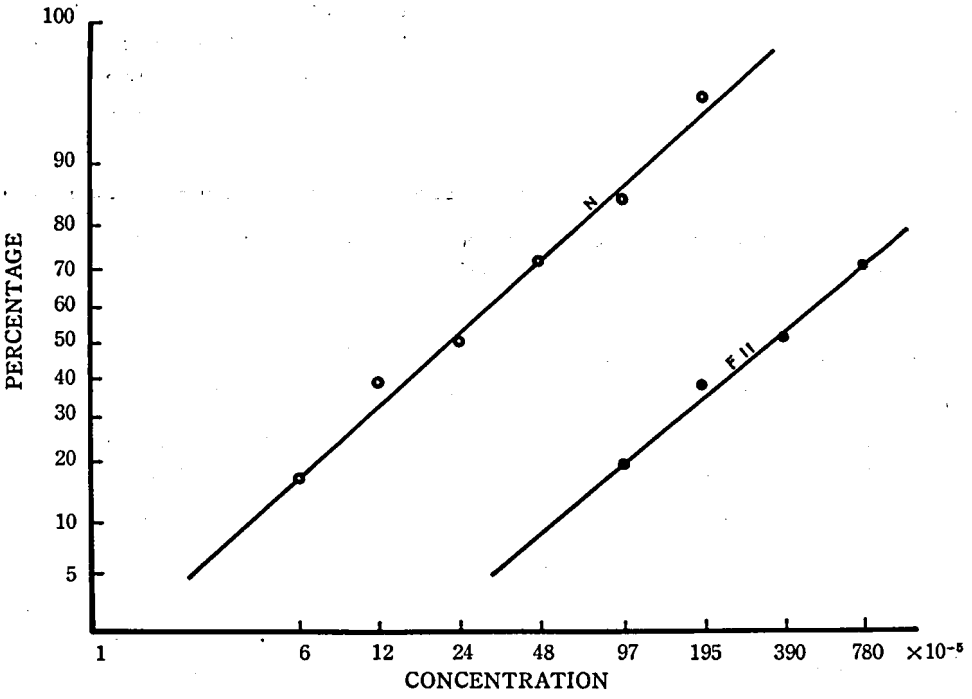

Fig. 1. Dosage mortality lines for gamma BHC shown by the normal and selected strains.

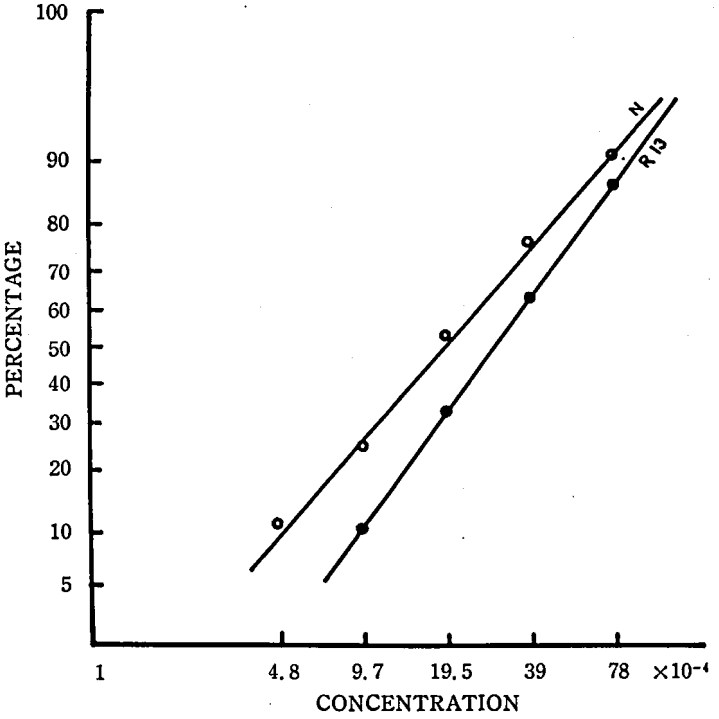

Fig. 2. Dosage mortality lines for carbaryl shown by the normal and selected strains.

Table 1. Susceptibility of normal and selected strains of *D. cucurbitae* to solutions of gamma BHC and carbaryl in acetone.*

Strain	Insecticide tested		Proportions (and percentages in parentheses) of flies killed with different concentrations							
			0.00006	0.00012	0.00024	0.00048	0.00097	0.00195	0.0039	0.0078
Normal	gamma BHC	Males	14/80 (17.5)	38/88 (43.1)	42/77 (54.5)	68/82 (83.5)	67/76 (88.1)	76/79 (96.2)	—	—
		Females	15/93 (16.1)	26/77 (33.7)	31/67 (46.2)	38/58 (65.5)	51/63 (80.9)	60/63 (95.2)	—	—
		Both	29/173 (16.7)	64/165 (38.7)	73/144 (50.6)	106/146 (71.9)	118/139 (84.8)	136/142 (95.8)	—	—
	Carbaryl	Males	—	—	—	7/65 (10.7)	19/64 (26.6)	36/54 (66.6)	62/76 (81.5)	72/79 (91.2)
		Females	—	—	—	6/49 (12.2)	11/57 (19.2)	29/69 (42.0)	40/58 (68.9)	49/55 (89.0)
		Both	—	—	—	13/114 (11.4)	30/121 (24.7)	65/123 (52.8)	102/134 (76.1)	121/134 (90.2)

Table 1. Contd.

Strain	Insecticide tested		Proportions (and percentage in parentheses) of flies killed with different concentrations					
			0.00048	0.00097	0.00195	0.0039	0.0078	0.0156
Resistant (F_{11})	gamma BHC	Males	—	19/84 (22.6)	37/87 (42.5)	53/93 (56.7)	64/82 (78.0)	89/95 (93.6)
		Females	—	12/72 (16.6)	27/81 (33.3)	43/94 (45.7)	54/85 (63.5)	66/82 (80.4)
		Both	—	31/156 (19.8)	64/168 (38.0)	96/187 (51.3)	118/167 (70.6)	155/177 (87.5)
Resistant (F_{13})	carbaryl	Males	—	9/64 (14.0)	29/76 (38.1)	45/68 (66.1)	88/96 (91.6)	—
		Females	—	5/65 (7.7)	22/79 (27.8)	48/79 (60.7)	91/106 (85.8)	—
		Both	—	14/129 (10.8)	51/155 (32.9)	93/147 (63.2)	179/202 (88.6)	—

* A drop of 0.0018 cc was applied to each fly.

Table 2. LC_{50} levels and slopes of normal and selceted strains of *D. cucurbitae*.

Strain	Insecticide	Generation	LC_{50}	Slope
Normal	gamma BHC	—	0.00022	1.75
	carbaryl	—	0.00195	2.15
Resistant	gamma BHC	F_{11}	0.0036	1.6
	carbaryl	F_{13}	0.00295	2.65

normal strain suggests that the tolerance developed to carbaryl may be due to the accumulation of factors responsible for vigour tolerance[4].

Summary

Laboratory selection of adult melon flies with gamma BHC and carbaryl was carried for 11 and 13 successive generations. The LC_{50} values obtained for the selected and the normal strains showed that *D. cucurbitae* acquired 16.36 and 1.51 times tolerance to gamma BHC and carbaryl

respectively in 11 and 13 generations of selection.

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***In Vitro* Degradation of ^{14}C-Methyl Malathion by Organophosphate Susceptible and Resistant Smaller Brown Planthopper, *Laodelphax Striatellus* Fallén[1]**. Tadashi Miyata, Hachiro Honda, Tetsuo Saito, Kozaburo Ozaki* and Yoshitaka Sasaki* (Laboratory of Applied Entomology and Nematology, Faculty of Agriculture, Nagoya University, Chikusa, Nagoya and* Division of Phytopathology and Entomology, Kagawa Agricultural Experimental Station, Takamatsu, Kagawa) Received July 29, 1975. *Botyu-Kagaku* 41, 10, 1976.

3. 有機リン剤感受性および抵抗性ヒメトビウンカによる *in vitro* での ^{14}C-methyl malathion の分解について 宮田 正，本多八郎，斎藤哲夫，*尾崎幸三郎，*佐々木善隆（名古屋大学農学部害虫学教室，名古屋市千種区不老町，*香川県農業試験場病虫部，香川県高松市） 50. 7. 29 受理

感受性 (LE)，malathion 抵抗性 (R_m)，fenitrothion 抵抗性 (R_f) ヒメトビウンカをもちい，*in vitro* における ^{14}C-methyl malathion の代謝をしらべた．LE，R_m，R_f 系統ヒメトビウンカ雌成虫に対する malathion の24時間後の LC_{50} 値は，それぞれ 159，2,190，637 ppm であった．ヒメトビウンカの全虫体まさい液による *in vitro* での ^{14}C-methyl malathion の分解をしらべたところ，R_m および R_f 系統による分解は LE 系統のそれぞれ7倍，5倍であった．また各系統の代謝物は殆んどカルボキシルエステラーゼによるもので，フォスファターゼによるものは殆んど認められなかった．*In vitro* での ^{14}C-methyl malathion の分解におよぼす各種阻害剤，共力剤，金属イオン，補酵素等の影響についてしらべたところ，10^{-6}M の K-2 および 10^{-5}M の dichlorvos 添加により分解は殆んど100%阻害された．寒天ゲル電気泳動法によりヒメトビウンカの酵素を分離し，エステラーゼ泳動帯と ^{14}C-methyl malathion の分解作用についてしらべたところ，抵抗性に関連があると考えられている E_7 泳動帯を中心に分解作用が認められたのみで，他の泳動帯には分解作用は全く認められなかった．

Malathion resistance in the smaller brown planthopper, *Laodelphax striatellus* Fallén, was first found in Hiroshima and Okayama Prefecture, Japan in 1964[1], and since then many examples of the smaller brown planthopper resistance in other parts of the country were reported[2,3].

According to Ozaki and Kassai[4], there is a good correlation between the resistance level of the smaller brown planthopper to malathion and β-naphthyl acetate hydrolyzing activity of the E_7 band separated by thin layer agar-gel electrophoresis. And it was suggested that both esterase activity of the E_7 band and malathion resistance depend on the same factor.

In this paper, *in vitro* metabolism of ^{14}C-methyl malathion, and the relationship between β-naphthyl acetate hydrolyzing activity and ^{14}C-methyl malathion degrading activity of the E_7 band were studied.

Materials and Methods

Insect ; Female adults of the smaller brown planthopper were used. Malathion resistant (R_m) and fenitrothion resistant (R_f) strains were obtained from the susceptible (LE) strain through

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