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RATE OF DEVELOPMENT OF RESISTANCE TO INSECTICIDES IN THE PREDACIOUS MITE *AMBLYSEIUS GOSSIPI*

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Abstract

Susceptibility and rates of development and reversion of resistance to insecticides in *Amblyseius gossipi* (El-Badry) were studied. The parent strains collected fom different locations showed no resistance towards any of the tested compounds. Beheira strain had the highest tolerance to the chemicals tested followed by Menofia and Kafr El-Sheikh. The predatory mite *A,. gossipi* acquired resistance to dicofol in generations 6 and 8. A similar trend was observed for detamethrin but to a lesser extent. Thiodicarb produced the least resistance. All the selected strains reverted to susceptibility at different rates.

INTRODUCTION

Agricultural crops are liable to attack by several pests. The spider mite attacks cotton plants in Egypt. Recently it has become a dangerous pest on cotton. Abo El-Ghar and El-Rafie (1969) and Salama and Faraghaly (1975) reported that the develpment of injurious populations of mites is associated with the increase use of organic insecticides which are known to create mite problems by destroying their natural enemies. The repeated use of pesticides on crops has a destructive effect on beneficail arthropods (Davis and Cowan, 1974; Kinzer et al., 1977; and Salama and Farghaly, 1979).

Scientists have directed their efforts towards the control of pests with respect to their benefical arthropods to avoid the hazards of pesticides. Others are studying the development of resistance in predacious mites (Croft and Mayer 1973; Corft et al., 1976). The predatory mite, *A. gossipi* El-Badry is a very imoprtant beneficial arthropod attacking phytophagous mites. The purpose of the present work is to evaluate the susceptibility and the rate of resistance development to certain pesticiedes in the predatory mite, *A. gossipi*. The rate of reversion towards susceptibility was also studied.

MATERIALS AND METHODS

Pesticides used

Dicofol (185 g a.i./liter E.C.)

Deltamethrin (25g a.i./ liter E.C.)

Omethoate (80g a.i./ liter L.C.)

Thiodicarb (375g a.i. / liter F.L.)

Mite source

Samples of *A. gossipi* were collected from cotton fields from Kafr El-Sheikh Governorate then kept away from any pesticidal contamination for 15 successive generations. This strain was considered as the reference strain. Three strains were collected from cotton fields of Kafr El-Sheikh, Beheira and Menofia governorates. The sensitivity of the field strains was tested to several insecticides then selected for resistance to dicofol, deltamethrin, omethoate and thiodicarb.

Method of selection for resistance

The exposure method described by abo El-Ghar and Boudreaux (1958) was used. Mortality counts were recorded 24h after treatment. Natural mortalities were corrected according to Abbott's formula (1925). The Lc-p lines were fitted and all data were statistically analyzed according to Litchfield and Wilcoxon (1949).

Selection pressure was conducted at the LC_{25} level. This level produced 25% mortality of adult females every generation. For studying the level of resistance, the Lc-p lines were established every two *generations until* the end of selection. Results of dicofol, deltamethrin, omethoate, and thiodicarb selected strains were compared with those of the susceptible strain. The resistance ratio (RR) was determined according to the equation of Georgiou (1972).

Reversin of resistance was studied every other gemeration upon cessation of chemical pressure.

RESULTS AND DISCUSSION

The susceptibility of adult female *A. gossipi* El-Badry from different field locations to dicofol, deltamethrin, omethoate and thiodicarb was detemined in comparison with the susceptible strain. Data presented in Table 1 show that the collected field strains were sensitive to the chemicals tested compared with the reference strain. Beheira strain had a slight tolerance to dicofol (RR=3.24) while the resistance. ratios of the other chemicals for all strains were apparently lower.

The Beheira strain was selcted at the LC_{25} level with dicofol, deltamethrin, omethoate and thiodicarb for several generatins (Table 2).

Table 1. Susceptibility of field strains of *A. gossipi* to certain pesticides under laboratory conditions.

strain	Dicofol			Deltamethrin			Omethoate			Thiodicarb		
	Lc_{50} ppm	Slope	R.R.	Lc_{50} ppm	Slope	R.R.	Lc_{50} ppm	Slope	R.R.	Lc_{50} ppm	Slope	R.R.
Kafr El-Sheikn	400	1.31	1.90	170	1.49	1.70	48	1.75	1.71	25	1.74	1.14
Beheira	680	1.26	3.24	240	1.48	2.40	58	1.66	2.07	36	2.40	1.64
Menofia	450	1.69	2.14	180	2.39	1.80	40	1.87	1.43	27	1.43	1.23
Reference	210	1.54	-	100	1.69	-	28	1.84	-	22	4.92	-

R. R. = Resistance ratio

With regard to dicofol, the resistance rations (RR) increased gradually with selection until it reached 9.25 - folds in F6. In F8, resistance shifted to 12.86-folds then increased throughout the selected generations to reach 25.71-folds in F16.

The development of-resistance to deltamethrin was comparatively slower, but with continuous selection to F8, resistance became more evident as it reached 11-folds. *Thereafter,* resistance increased gradually to reach 27-folds at the end of selecton (F_{14}).

Resistance to omethoate underwent a slight increase in resistance ratios during the first generations of selection (F_2 - F_{14}), then increased appreciably in F10 (12.14 - folds) followed by 21.43 - folds in F14.

Resistance to thiodicarb was the slowest in development as shown by the low RR values during the generations F_2-F_{12}. With the progress of selection, the resistance ration reached 13.18 - folds in F_{18}.

Table 2. Rate of resistance to several pesticides in the predaciou in the predacious mite *Amblyseius gossypii* adult females (Beheria strain).

pesticides / Generation	Dicofol			Deltamethrin			Omethoate			Thiodicarb		
	Lc_{25} ppm	Lc_{50} ppm	R.R.	Lc_{25} ppm	Lc_{50} ppm	R.R.	Lc_{25} ppm	Lc_{50} ppm	R.R.	Lc_{25} ppm	Lc_{50} ppm	R.R.
P	190	680	3.24	85	240	2.40	23	58	2.07	18	36	1.64
F_2	330	740	3.52	140	350	3.50	28	68	2.43	22	45	2.05
F_4	600	1400	6.67	150	400	4.00	37	94	3.36	26	74	3.32
F_6	800	2000	9.52	330	700	7.00	50	120	4.29	36	94	4.18
F_8	940	2700	12.86	500	1100	11.00	70	170	6.07	38	120	5.45
F_{10}	1200	3300	15.71	600	1400	14.00	80	190	6.79	44	130	5.91
F_{12}	1500	4000	19.50	900	1900	19.00	140	340	12.14	50	150	6.82
F_{14}	2200	4700	22.38	1500	2700	27.00	220	600	21.43	58	160	7.27
F_{16}	3100	5400	25.71	-	-	-	-	-	-	80	200	9.09
F_{18}		-	-	-	-	-	-	-	-	120	290	13.18
Suceptible Strain		210			100			28			22	

Resistance ratio = Lc_{50} of the selected strain / Lc_{50} of the susceptible strain

The present results showed clearly that the predacious mite *A. gossipi* can also acquire resistance to pesticides, a matter that can help develop IPM programs including biological agents and insecticides together. The development of resistance in the predacious mite might also confer cross resistance to several other chemicals, thus enabling the predator to withstand the toxic action of several insecticides.

These results are in agreement with those oftained by croft and mayer (1973), croft et al., (1976), Rouch and Hoy (1981) and Kapetanakis and cranhan (1983) . The found that predatory mites acquired resistance against dicofol fater than other compounds. The selected strains were maintained in the laboratory without further selection to study the rate of reversion of resistance. The mortality regression lines were established every other generation using the same leaf-disc spray method.

As indicated in Table 3, the level of resistance to dicofal declined from 7.94-fold in F_{16} to 1.47- fold in F_{26}.

Table 3. Rate of reversion of resistance to several chemicals in the predacious mite *Amblyseius gossipi.*

Generation	Resistant strains							
	Dicofol		Deltamethrin		Omethoate		Thiodicarb	
	Lc_{50}	R.R.	Lc_{50}	R.R.	Lc_{50}	R.R.	Lc_{50}	R.R.
F_{14}	4700	-	2700	11.25	600	10.34	160	-
F_{16}	5400	7.94	2400	10.00	400	6.90	200	-
F_{18}	5000	7.35	2000	8.33	220	3.79	290	9.06
F_{20}	4200	6.18	1150	4.79	160	2.76	180	5.63
F_{22}	3300	4.85	660	2.75	130	2.24	165	5.16
F_{24}	1900	2.79	370	1.54	90	1.55	140	4.38
F_{26}	1000	1.47	-	-	-	-	125	3.91
F_{28}	-	-	-	-	-	-	100	3.31
Parent	680		240		58		36	

R. R. = Lc_{50} of generation/ Lc_{50} of reference strain

In case of deltamethrin, omethoate and thiodicarb resistance, the selected strains reverted to normal susceptibilty after about ten generations from cessation of chemical pressue. These results are in agreement with those of Kong and Hassan (1986) who found that the strain of the predacious mite, *Phytoseiulus persimilis* resistant to pirimiphos-methyl decreased repidly after the selection pressure had stopped, while resistance to Afugan (phrazophos) was comparatively stable.

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تطور المقاومة للمبيدات ورجوعها لحد الحساسية في العنكبوت المفترس *Amblyseius gossipi*

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أجريت دراسة على تطور صفة المقاومة للمبيدات الدايكوفول ، الدلتامثرين ، الأومثويت ، والثيوديكارب فى العنكبوت المفترس *Amblyseius gossipi* وأظهرت النتائج عدم وجود مقاومة فى الأباء التى جمعت من أماكن مختلفة تجاه هذه المركبات كما أوضحت النتائج أن سلالة محافظة البحيرة كانت أكثر تحملاً للمبيدات تليها سلالة المنوفية ثم سلالة كفر الشيخ.

تم إختيار سلالة البحيرة لدراسة تطور المقاومة وأظهرت النتائج أن الأفراد المختبرة إكتسبت مقاومة خلال الجيل السادس والثامن لكل من الديكوفول والدلتامثرين على الترتيب ، بينما كان تطور المقاومة بطيئاً بالنسبة لمركب الثيوديكارب.

كل السلالات المقاومة رجعت الى حد الحساسية عندما رفع عنها الضغط الإنتخابى للمبيد.