

## Morphological and physiological properties associated with pirimicarb resistance in cotton aphid, *Aphis gossypii* Glover [Homoptera: Aphididae]

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### Abstract

The present work was carried out to study the toxicity of pirimicarb to *Aphis gossypii* Glover collected from Assiut and New Valley. The toxicity of the insecticide was build up and the selection was carried out through two years. It was found that Assiut aphid seemed to be more tolerant to pirimicarb than those of the New Valley. The resistance rations (RR) to the same insecticide were increased for both colonies. It was found that the New Valley aphid population developed resistance faster than those of Assiut one. In case of Assiut aphids, after two years of selection, the RR of dark colored individuals became higher (two folds) than those of the mixed colored populations. The RR of mixed and dark colored individuals of the New Valley aphids, were nearly the same. Slope of the toxicity lines of mixed colored population did not changed through the years of selection. Slope of toxicity line of dark colored individuals of the same population increased about 2 fold. The difference in resistance (RR) seemed to be due to aphid population, homogeneity of indi-

viduals, and area of study subsequently the recurrent of insecticide applications.

### Introduction

Cotton aphid, *Aphis gossypii* Glover is a polyphagous pest causing extensive damage to cucurbitaceous crops. Both nymph and adult suck sap from the underside of leaves and shoots resulting in reducing fruit yield. The body of the apterous parthenogenetic is quite variable in color: light green mottled with dark green in most common, but also occurring a red whitish, yellow, pale green, and dark green forms (Capinera 2001). Many of insecticides are being used against the cotton insect pests all over the world (Bohlen 1985). The recurrent use of insecticides has caused the onset of resistance phenomena in many insects, including aphids. Resistance to insecticides was found in at least 20 species of aphids include *A. gossypii*. (Georghiou 1981). With regard to *A. gossypii*, resistance to carbamate was first reported by (Kung *et al* 1964). Resistance of aphids to insecticides were found to be associated with some morphological and physiological

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characteristics. O'Brien and Graves (1992) reported that the *A. gossypii* resistant to organophosphates had a higher reproduction rate in the first and second day of life than susceptible individuals. Moreover, in the presence of pirimicarb the reproductive capacity increased up to 30% as compared with control (Rongai et al 1998). On the other side Kerns et al (1998) found that the red-colored individuals of green peach aphids, *Myzus persicae* (Sulzer) where consistently resistant to endosulfan than green-colored aphids collected from the same field. The purpose of this paper was to find out one or more of distinguish characters related to insecticide resistance in *Aphis gossypii* to be one of the important elements in integrated pest management of aphids.

#### Materials and Methods

Two populations of *A. gossypii* were collected from cucurbitaceous plant grown in Assiut

#### Results and Discussion

Table (1): Toxicity of pirimicarb against *A. gossypii* populations collected from Assiut and New-Valley localities.

Aphid populations \ Localities	Assiut population			New Valley population		
	LC <sub>50</sub> (ppm)	Slope	RR	LC <sub>50</sub> (ppm)	Slope	RR
Base line	390	3.08	-----	180	2.65	-----
After a year	2550	3.2	6.54	1950	3.29	10.83
After two year						
Mixed colored	3100	3.55	7.95	2750	5.57	15.28
Dark colored	5800	5.27	14.87	2800	5.6	15.56

Data in table (1) and the corresponding figures 1-4 show the LC<sub>50</sub> and slope values that calculated from the toxicity data. LC<sub>50</sub>

and the New Valley governorates. These two groups were brought into the laboratory and used as base line of pirimicarb resistance. Aphid individuals were maintained on squash plants in isolated boxes to keep them free from invader predators and parasites. Pirimicarb LC<sub>50</sub> base line was determined by the dipping technique in successive concentrations of the trade form of pirimicarb in water. The LC<sub>25</sub> was used for the selection every month through two years. The insecticide selection was stopped wherever the aphid population seemed to be in stress. The LC<sub>50</sub> lines were carried out four times through the two years of the study and the LC<sub>50</sub> values, slopes, and resistant ratios (RR) were calculated each time. By the end of the selection period, the dark colored individuals of the two aphid groups were isolated to determine their resistance ratio.

values of pirimicarb against the base line populations of *A. gossypii* collected from Assiut and New Valley were 390 ppm and

180 ppm. These values were 2550 and 1950 ppm after one year of selection for the same corresponding populations. After two years of selection the LC<sub>50</sub> values for mixed colored aphids were 3100 and 2750 ppm for Assiut and New Valley populations. While the LC<sub>50</sub> values for the dark colored aphids after two years of selection were 5800 and 2800 ppm for the same corresponding populations. These data indicated that Assiut population

of cotton aphid seemed to be more tolerant (2.17 fold) to pirimicarb than New Valley population. This slight difference in susceptibility of the two populations may be due to the different back history of using pesticides in controlling agricultural pest in the two governorates. The slope values of the toxicity line populations were close to each other representing 3.08 and 2.65 for Assiut and New Valley populations.

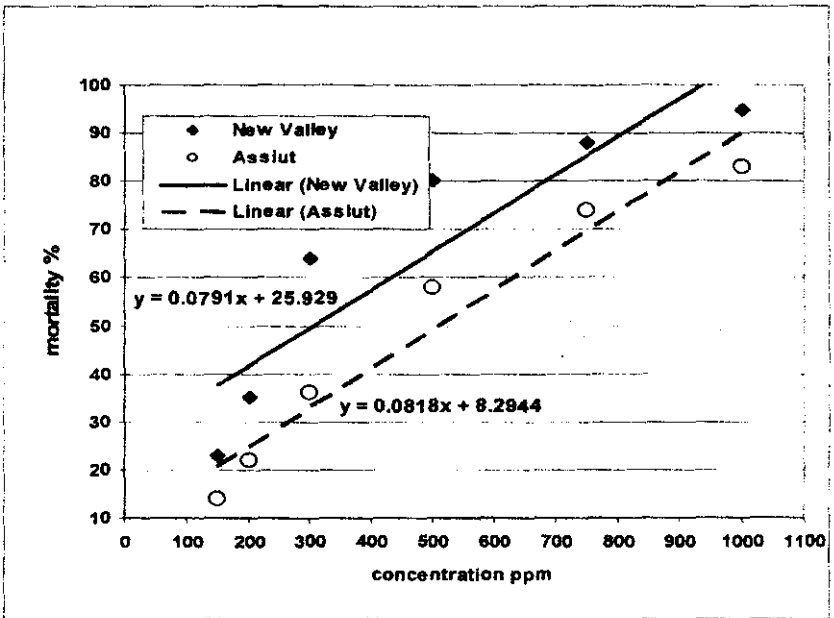


Fig.(1) Toxicity of pirimicarb to base line of cotton aphids collected from New Valley and Assiut regions

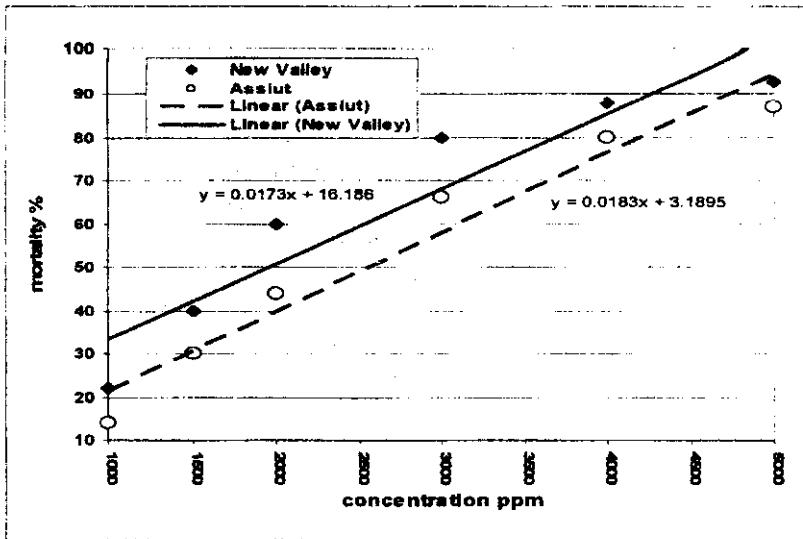


Fig.(2) Toxicity of pirimicarb after one years of selection

After selection pressure with pirimicarb for one year (Fig. 2) using  $LC_{25}$  every month,  $LC_{50}$  values became 2550 and 1950 ppm for Assiut and New Valley populations. These values represent resistance ratios of 6.54 and

10.83 fold for the same corresponding populations, using the base line populations as reference. The slope values of the toxicity lines of both populations after one year of selection were almost the same (3.2 and 3.29).

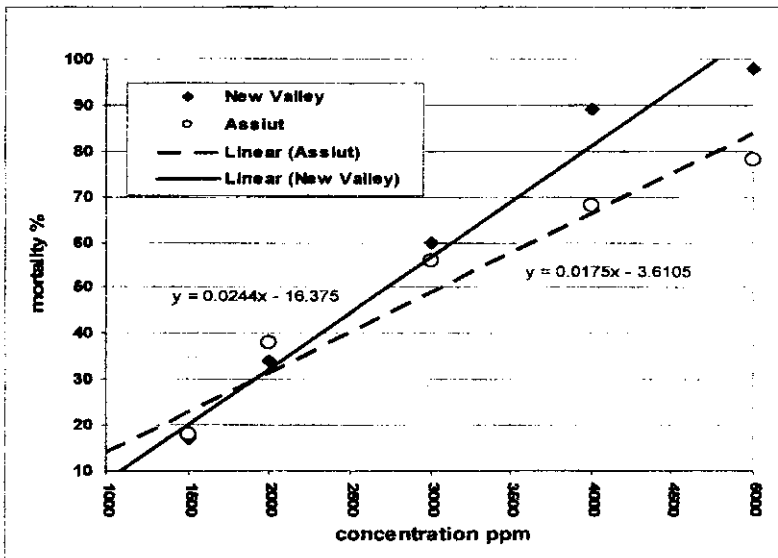


Fig.(3) Toxicity of pirimicarb after two years of selection

After two years of selection with pirimicarb (Fig.3) the LC<sub>50</sub> values for mixed colored aphid for Assiut and New Valley populations were 3100 and 2750 ppm, representing 7.95 and 15.28 fold resistance for the same corresponding populations. The slope values of toxicity lines of mixed colored individuals indicated higher homogeneity in New Valley population (slope = 5.57) as compared with Assiut one (slope

= 3.55). The dark colored aphids exhibited high LC<sub>50</sub> value in Assiut populations (5800ppm) representing 14.87 fold resistance as compared with the base line population. According to LC<sub>50</sub> and slope values for the New Valley population after two years of selection, the dark colored and mixed colored aphids showed the same susceptibility and homogeneity toward pirimicarb.

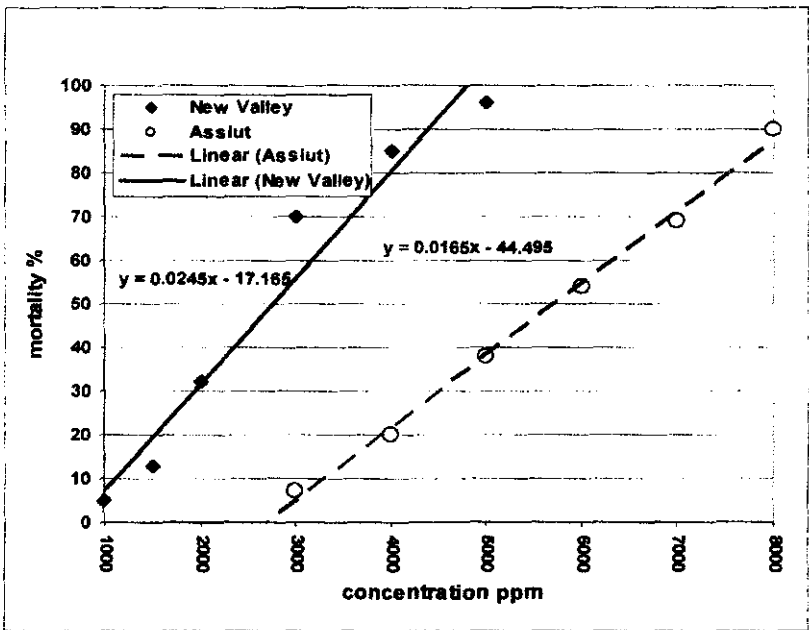


Fig. (4) Toxicity of pirimicarb after two years of selection (dark green colored aphids)

Multiple mechanisms for insecticide resistance have been reported in the cotton aphid, *A. gossypii*, from China (Yun-Qi *et al.*, 1987) and in *Myzus persicae* (Sulzer) from Australia (Hamilton *et al.*, 1981). Reduced cuticular penetration, mixed function

oxidase, carboxylesterase, glutathion-s-transferase and acetylcholinesterase insensitivity were all implicated (Kers and Gaylor, 1992). In the present study, the high susceptibility of aphid population collected from New Valley as compared with Assiut one may

be due to the absence or wide usage of insecticides in the New Valley. This may lead to the loss of some/all resistance mechanisms in the population. This phenomenon may be, answered the question of why New Valley aphid population developed resistance faster than those of Assiut. Many authors (Sawicki *et al.* 1978; Ffrench-Constant *et al.* 1988; Field *et al.* 1989 and Ezzeldin 1997) have reported a spontaneous loss of resistance to organophosphates and carbamates in parthenogenetic aphids when they reared away from insecticide selection pressure.

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## الخصائص المورفولوجية والفسولوجية المصاحبة لصفة المقاومة للمبيدات في من القطن لمبيد البريميكارب

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اجري هذا العمل لدراسة سمية مبيد البريميكارب على حشرة من القطن التي تم جمعها من محافظتي أسيوط والوادي الجديد. تم عمل خط لسمية المبيد لكلا المجموعتين وتم انتخاب السلالتين بالمبيد لمدة عامين. ولقد تبين أن المن السذي جمع من محافظة أسيوط كان أكثر تحملا للمبيد من المن الذي جمع من الوادي الجديد. وتبين من هذه الدراسة أن من القطن الذي جمع من الوادي الجديد كان أسرع لاكتساب صفة المقاومة من هذا الذي جمع من محافظة أسيوط. وأوضحت الدراسة أن معدل المقاومة RR للمن الداكن اللون في مجموعة أسيوط كان اكبر وكان ميل خط السمية اكبر من المن المختلط اللون من نفس المجموعة أما بالنسبة لمجموع الوادي الجديد فلم يختلف المن الداكن اللون عن المن المختلط اللون في معدل المقاومة أو في ميل خط السمية وذلك بعد عامين من الانتخاب. وقد أعزى سبب هذه الاختلافات في سمية مبيد البريميكارب لمن القطن إلى الاختلاف بين أفراد المن والمنطقة وبالتالي إلى تكرار رش المبيدات في المنطقة.