EFFECT OF CERTAIN ALTERNATIVES AND THEIR INTERACTION WITH FENVALERATE ON SOME COTTON INSECT PESTS AND THEIR ASSOCIATED PREDATORS

BY

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ABSTRACT

An experiment was conducted to evaluate the efficiency of fenvalerate (Sumicidin) at the field recommended rate and its mixtures with Agrein (*Bacillus thuringiensis*), Biofly (*Beauveria bassiana)*, KZ oil and Atabron against the cotton aphids, *Aphis gossypii* Glover, the cotton Jassid; *Empoasca lybica* De Berg, the cotton whitefly; *Bemisia tabaci* (Genn.), the cotton leafworm; *Spodoptera littoralis* (Boisd.) and their associated predators.

Results showed that mixture of fenvalerate with Atabron, mineral oil, KZ alone and mixture of fenvalerate with KZ oil were effective against aphids (reduction means were 76.99, 74.55 and 65.05%, respectively). Fenvalerate mixed with Biofly and KZ oil, Atabron alone exhibited high reduction against jassid recording 92.19, 87.92 and 83.71%, respectively. Biofly alone gave the best result on whitefly immature stages (nymphs and pupae) recording 92.27% reduction. Fenvalerate mixed with Atabron and KZ oil gave 52.37 and 51.87%, reduction against adult of *B. tabaci*, respectively. Fenvalerate mixed with Atabron, Atabron alone and fenvalerate mixed with KZ gave a high reduction percentage against cotton leafworm recording 93.33, 82.67 and 80.0%, respectively. Fenvalerate mixed with Biofly and *B. thuringiensis* reduced 69.93 and 64.67% cotton leafworm population, respectively, as compared with fenvalerate alone (reduction 56.67%). On the other hand, the side effect of the tested materials against predators as *Paederus alfierii, Chrysoperla carnea, Orius spp and True spiders* indicated slightly reduction percentage ranged from 5.83 to 52.08%.

INTRODUCTION

The cotton insect pests; specially, the cotton aphids, *Aphis gossypii* Glover, the cotton whitefly; *Bemisia tabaci* (Genn.) and the cotton leafworm; *Spodoptera littoralis* (Boisd.) are considered among the most economic serious pests of cotton plants in Egypt. In the last few years,

aphids and whiteflies have been considered as major pests in cotton fields. These pests usually cause severe damage to cotton plants, consequently affect the quantity and quality of cotton yield. *Bacillus thuringiensis* reduced the larval and pupal weight of *Spodoptera littoralis* (Boisd.) (Aly and El-Dahan, 1987). Also, petroleum oils were used as they are less expensive and they are considered to be relatively more safe to humans and the environment. El-Sisi and El-Hariry, 1989 and El-Hariry *et al.*, 1998 used many types of petroleum oils to control aphids, also it was used against *B. tabaci* adults (Ishaaya *et al.*, 1986). Aly and El-Dahan, 1987 and Tan-WeiJia *et al.*, 1997 investigated the effect of combination of *B. thuringiensis* with fenvalerate on *S. littoralis* and *Helicoverpa armigera* larvae. The insect growth regulators (IGRs) are effective, long-lasting and cost significantly less than conventional insecticides (Ellsworth *et al.*, 1997). Several investigators studied the effect of mineral oils alone and combinations with insecticides against sucking pests and cotton leafworm such as Moustafa and Attal (1985); Cole *et al.* (1986); Megahed *et al.* (1987); El-Khawalka *et al.* (1996); Korkor *et al.* (1996); Horowitz *et al.* (1997); Rizk *et al.* (1999); Hamid (1999) and Saad (2001).

The aim of the present work was to evaluate the efficiency of fenvalerate insecticide alone and its mixtures with some commercial biological agents (*Agein* & Biofly), mineral oil (KZ) and the antimoulting agent, Atabron against some sucking pests and the cotton leafworm that infest cotton, also to study their side effects against their associated predators.

MATERIAL AND METHODS

Tested materials:

1. Insecticide:
   Fenvalerate (Sumicidin): (RS)-α-cyano-3-phenoxybenzyl (RS)-2-(4-chlorophenyl-3-S-methyl butyrate, was used at 600 ml/feddan.
2- Mineral oil: KZ oil, was used at 1.75%/feddan.
3- Biological agents.
   a. Agrein: served as the *Bacillus thuringiensis*, spores were produced by Genetic Engineering Institute, Agriculture Research Center, Ministery of Agriculture and used at 500 gm/feddan.
   b. Biofly (*Beauveria bassiana)*: (3 x 10^7 spore) was used at 100 ml./feddan.
4- Antimoulting agent:

Atabron 5% E.C.: 1-[3,5-dichloro-4-(3-chloro-5-trifluoromethyl-2-pyridyloxy) phenyl]-3-(2,6-diflurobenzoyl) urea, was used at 400 ml./feddan.

The study was conducted during 2001 cotton growing season at the Farm of Sakha Agricultural Experimental Research Station, Kafr El-Sheikh, Egypt. Cotton, *Gossypium barbadense* L. (Giza 88) was cultivated on April 1st 2001. The experimental area (1600 m^2) was divided into 24 plots, each of 67 m^2. Every compound and a check (control) was replicated three times in a completely randomized block design. Weekly samples of 30 leaves for each treatment were randomly selected from the lower, medium and upper levels of 10 plants. The immature stages of the cotton whitefly were examined on 50 square inch by the aid of a binocular sterioscope. Counting the cotton aphid; *A. gossypii*, adults; *B. tabaci*, *E. lybica*, larvae of *S. littoralis* (fourth instar larvae) and their associated predators (*Paederus alfierii, Chrysoperla carnea, Orius spp and True spiders)* were carried out visually in the field from 6 a.m. until 9 a.m. Spraying was applied on August 16th and Sept. 13th, 2001 using knapsack sprayer. Fenvalerate was used mixed with the tested materials at 1:1 ratio.

Data were statistically analyzed according to Duncan's Multiple Range Test (DMRT) (1955). The reduction percentage was calculated according to Henderson and Tilton (1955):

$$\text{Reduction percentage} = (1-\frac{Ta}{Tb} \times \frac{Cb}{Ca}) \times 100$$

Where:

Ta number of individuals after treatment in treated plot.
Tb number of individuals before treatment in treated plot.
Cb number of individuals before treatment in check plot
Ca number of individuals after treatment in check plot

RESULTS AND DISCUSSION

Data in Tables (1 to 6) elucidate the effect of fenvalerate (Sumicidin), (*B. thuringiensis)*, Biofly, KZ oil and Atabron alone and their mixtures with fenvalerate sprayed two times on cotton plant against the cotton aphids; *A. gossypii* (nymphs & adults), jassid, *E. lybica*, the cotton whitefly *B. tabaci*, the cotton leafworm *S. littoralis* and their associated predators.

I.Effect of the tested materials on; *A. gossypii*:

Results in Table (1) indicate that fenvalerate mixed with Atabron, KZ oil alone and fenvalerate mixed with KZ oil exhibited highly significant differences ($P<0.01$) compared with other treatments which occurred reduction percentages with values of 76.99, 74.55 and 65.05%, respectively. The tested materials, fenvalerate, Biofly, Atabron alone and fenvalerate mixed with Biofly gave a weak effect with a reduction percentage ranged from 36.81 to 42.89%.

Results agree with those of Rizk *et al.* (1999) who reported that mineral oil Sisi 6 gave high initial effect against aphid after one day (100% reduction). They added that mineral oil CAPL2 gave low initial effect against aphid (50.0% reduction). The mode of action of mineral oil against immature and mature stages is due to suffocation effect (De Ong *et al.*, 1927). Cole *et al.* (1986) found that, the addition of oil reduced the rate of loss of fenvalerate but had little effect with cypermethrin. Megahed *et al.* (1987) reported that addition of soybean oil and surfactants was found to increase the reinfestans of the spray deposit of fenvalerate, cypermethrin and chlorpyrifos largely.

Table (1): Reduction percentages (% R) of A. *gossypii* on cotton plants following the application of the tested materials during 2001 cotton growing season at Kafr El-Sheikh region, Egypt.

Tested materials	% R after 5 days		
	1st spray*	2nd spray **	Mean
Fenvalerate	15.38	68.43	41.91 c
Biofly	18.32	55.30	36.81 c
Atabron	30.23	54.41	42.32 c
KZ oil	60.12	88.98	74.55 ab
Fenvalerate + Biofly (1:1)	14.86	70.91	42.49 c
Fenvalerate + Atabron (1:1)	65.44	88.53	76.99 a
Fenvalerate + KZ oil (1:1)	80.01	50.09	65.05 b

Means with the same letter in the same column, are not significantly different at ($P< 0.05$) by DMRT.

* First spray application was on 16/8/2001

** Second spray application on 13/9/2001

II.Effect of the tested materials on the cotton Jassid; *E. lybica*:

Results in Table (2) indicated that fenvalerate mixed with Biofly and KZ oil, Atabron alone exhibited highly significant differences recording

92.19, 87.92 and 83.71% reduction, respectively, compared with other treatments except with Biofly alone in population of *E. lybicai* after five days.

Table (2): Reduction percentages (% R) of *E.* lybica on cotton plants following the application of the tested materials during 2001 cotton growing season at Kafr El-Sheikh region, Egypt.

Tested materials	% R after 5 days		
	1st spray*	2nd spray **	Mean
Fenvalerate	66.57	47.50	57.04 fe
Biofly	89.17	70.00	79.59 cd
Atabron	97.41	70.00	83.71 bc
KZ oil	59.29	40.00	49.65 f
Fenvalerate + Biofly (1:1)	98.37	86.00	92.19 a
Fenvalerate + Atabron (1:1)	92.36	55.00	73.68 de
Fenvalerate + KZ oil (1:1)	89.83	86.00	87.92 ab

Means with the same letter in the same column, are not significantly different at ($P< 0.05$) by DMRT.

* First spray application was on 16/8/2001

** Second spray application on 13/9/2001

III. Effect of the tested materials on whitefly; *B. tabaci*:

1. Immature stages:

Data in Table (3) indicate that Biofly alone, exhibited highly significant differences ($P \leq 0.01$) compared with other treatments on whitefly immature stages (nymphs & pupae) after five days post-treatment and recording 92.27% reduction. Fenvalerate mixed with Biofly, Atabron and KZ oil, gave 50.28, 50.00, 48.97, respectively, while KZ oil, Atabron and fenvalerate alone gave 48.97, 46.11 and 42.20% reduction, respectively.

2. Adult stage:

As indicated in Table (4) fenvalerate mixed with Atabron and KZ oil gave highly significant differences ($P \leq 0.01$) compared with fenvalerate alone and its mixture with Biofly recording 52.37 and 51.87%, reduction, respectively. after five days of application.

Results agree with those obtained by Hamid (1999) who found that mineral KZ oil caused 41.36% & 61.88% reduction of whitefly immature stages after 1 and 2 weeks post treatment at 1st spray, respectively, whereas the respective values after 2nd sprays were 45.72 & 55.65 reduction. Korkor

et al. (1996) found that, adding any mineral or plant oils and acetic acid to the half recommended rate of pyriproxyfen had no effect of the toxicity of such compounds against the mature stage of whitefly. Knauf and Wright (199-) ndicated that the strain ATCC 74040 of the insect-specific fungus *B. bassiana* controlled target insects in 10 states of the USA, whether applied alone or in combination with conventional insecticides.

Table (3): Reduction percentages (% R) of *B. tabaci* immature stages (nymphs & pupae) on cotton plants following the application of the tested materials during 2001 cotton growing season at Kafr El-Sheikh region, Egypt.

Tested materials	% R after 5 days		
	1st spray*	2nd spray **	Mean
Fenvalerate	39.39	45.00	42.20 c
Biofly	90.64	93.89	92.27 a
Atabron	77.78	14.49	46.11 b
KZ oil	52.94	45.00	48.97 bc
Fenvalerate + Biofly (1:1)	55.56	45.00	50.28 bc
Fenvalerate + Atabron (1:1)	55.00	45.00	50.00 bc
Fenvalerate + KZ oil (1:1)	52.94	45.00	48.97 bc

Means with the same letter in the same column, are not significantly different at ($P< 0.05$) by DMRT.

* First spray application was on 16/8/2001

** Second spray application on 13/9/2001

Table (4): Reduction percentages (% R) of *B. tabaci* adult stage on cotton plants following the application of the tested materials during 2001 cotton growing season at Kafr El-Sheikh region, Egypt.

Tested materials	% R after 5 days		
	1st spray*	2nd spray **	Mean
Fenvalerate	46.06	37.48	41.77 c
Biofly	33.47	57.88	45.68 abc
Atabron	49.47	40.19	44.85 bc
KZ oil	24.50	71.64	48.07 abc
Fenvalerate + Biofly (1:1)	14.66	32.95	83.81 d
Fenvalerate + Atabron (1:1)	77.05	27.68	52.37 ab
Fenvalerate + KZ oil (1:1)	66.60	37.14	51.87 ab

Means with the same letter in the same column, are not significantly different at ($P< 0.05$) by DMRT. * First spray application was on 16/8/2001

** Second spray application on 13/9/2001

IV. Effect of the tested materials on the cotton leafworm; *S. littoralis*:

Results in Table (5) indicated that fenvalerate mixed with Atabron, Atabron alone and fenvalerate mixed with KZ oil exibited a high reduction percentage against the first and second larval instars of the cotton leafworm five days after application, recording 93.33, 82.67 and 80.0%, respectively. On the other hand, fenvalerate mixed with biofly and *B. t* gave 69.93 and 64.67% reduction compared with 60.0, 56.67 and 36.67% reduction for *B.t.* fenvalerate and biofly alone, respectively. Fenvalerate mixed Agren with KZ oil gave 80.0% reduction compared with fenvalerate alone gave 56.67% reduction. It is obvious that KZ oil or *B. t.* had an important role for potentiating the efficiency of fenvalerate against cotton leafworm. Similar results were obtained by Aly and El-Dahan (1987) who reported that the combination of *B. t.* with fenvalerate (Sumicidin) increased their efficiency on *S. littoralis*. On the other hand, it decreased the amounts of insecticide released in the environment which is appreciable from the environmental safety point of view. Also, Tan-WeiJia *et al.* (1997) indicated that the toxicity of fenvalerate to susceptible and field-strains of the 2nd-larval instar of *Helicoverpa armigera* was increased by 12.9 and 34.4 fold when the pest was exposed to *Bacillus thuringiensis* at the same time, respectively.

Table (5): Mean number and reduction* percentages (% R) of *S. littoralis* on cotton plants treated with the tested materials during 1 st and 2 nd larval stans of 2001 season at Kafr El-Sheikh region.

Tested materials	*S. littoralis*	
	Mean/leaf	% R
Fenvalerate	0.65	56.67
B. t	0.60	60.0
biofly	0.95	36.67
Atabron	0.26	82.67
KZ oil	0.40	73.33
Fenvalerate + *B. t* (1:1)	0.53	64.67
Fenvalerate + biofly (1:1)	0.46	69.93
Fenvalerate + Atabron (1:1)	0.10	93.33
Fenvalerate + KZ oil (1:1)	0.30	80.0
Control	1.50	

* $\%R = \frac{\text{Control} - \text{Treatment}}{\text{Control}} \times 100$

Table (6): Mean number and reduction* percentages (% R) of associated predators on cotton plants treated with the tested materials during 2001 season at Kafr El-Sheikh region.

Tested materials	Predators**	
	Mean/leaf	% R
Fenvalerate	2.70	43.75
Agrein	4.52	5.83
biofly	4.25	11.46
Atabron	3.05	36.45
KZ oil	2.30	52.08
Fenvalerate + *Agrein* (1:1)	3.68	23.33
Fenvalerate + Biofly (1:1)	3.37	29.79
Fenvalerate + Atabron (1:1)	2.85	40.63
Fenvalerate + KZ oil (1:1)	3.15	34.38
Control	4.80	

* $\%R = \frac{\text{Control} - \text{Treatment}}{\text{Control}} \times 100$

** Mean number of predators, i.e. *Paederus alfierii*, *Chrysoperla carnea*, *Orius* spp., *Scymnus* spp. and true spiders.

V. Effect of the tested materials on associated predators:

On the other hand, the effect of the tested materials against predators are shown in Table (6) which indicate slightly reduction percentage which ranged from 5.83 to 52.08%. Similar results were obtained by Rizk *et al.* (1999) who indicated that mineral oil CAPL-2 showed slightly reduction percentage against *Coccinella* predator. They added that mineral oil solar E.C and *B. t.* showed an increase in *Coccinella* percentage. Yamamoto *et al.* (1990) found that fenvalerate and *B. t.* did not affect beneficial arthropods. Knauf and Wright (1994) indicated that the insect-specific fungi *Beauveria bassiana* and its combination with conventional insecticides had no adverse effects on beneficial insects; fish, honeybees or mammals. Ellsworth *et al.* (1997) reported that the insect growth regulators (IGRs) Applaud (buprofezin) and knack (of unspecified composition) were less environmentally disruptive alternatives to conventional insecticides and increase the opportunity for natural enemy conservation.

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تأثير بعض المركبات البديلة ومخاليطها مع مبيد الفينفاليرات على بعض حشرات القطن والمفترسات المرتبطة بها

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أجريت هذه الدراسة بمزرعة محطة البحوث الزراعية بسخا ــ كفرالشيخ ــ جمهورية مصر العربية خلال موسم ٢٠٠١م على نباتات القطن.

أوضحت النتائج المتحصل عليها أن استخدام مبيد السوميسيدين مخلوطا مع الأتابرون والزيت المعدنى KZ منفرد ومبيد السوميسيدين مخلوطا مع الزيت المعدنى KZ بالجرعة الحقلية الموصى بها كانت أكثر المركبات تأثيرا على حشرة من القطن حيث خفض التعداد بنسبة ٧٦,٩٩ ، ٧٤,٥٥ ، ٦٥,٠٥% على الترتيب. كذلك أعطى مبيد السوميسيدين مخلوطا مع البيوفلاى أو الزيت المعدنى KZ والأتابرون منفردا إنخفاضا عاليا فى تعداد نطاط أوراق القطن بنسبة ٩٢,١٩ ، ٨٧,٩٢ ، ٨٣,٧١% على الترتيب. وأعطى مركب البيوفلاى منفردا أفضل النتائج ضد حوريات وعذارى ذبابة القطن البيضاء حيث أظهر انخفاضا بنسبة ٩٢,٢٧%. كذلك أعطى السوميسيدين مخلوطا مع الأتابرون أو الزيت المعدنى KZ انخفاضا بنسبة ٥٢,٣٧ ، ٥١,٨٧% ضد الحشرات الكاملة للذبابة البيضاء على الترتيب. أيضا أعطى السوميسيدين مخلوطا مع الأتابرون والأتابرون منفردا والسوميسيدين مخلوطا مع الزيت المعدنى KZ أعلى خفض فى تعداد يرقات دودة ورق القطن حيث كان ٩٣,٣٣ ، ٨٢,٦٧ ، ٨٠% على الترتيب. أيضا أعطى السوميسيدين مخلوطا مع البيوفلاى أو الاجرين ٦٩,٩٣ ، ٦٤,٦٧% انخفاضا فى تعداد يرقات دودة ورق القطن على الترتيب بالمقارنة بالسوميسيدين منفردا حيث أعطى ٥٦,٦٧% انخفاضا فى التعداد.

ومن ناحية أخرى ، كانت لهذه المركبات تأثيرا طفيفا على الأعداء الحيوية حيث أدت المعاملة الاجرين الى خفض تعدادها ٥,٨٣% أما بالنسبة للزيت المعدنى ، فقد بلغت ٥٢,٠٨%.

يتضح من الدراسة انه يمكن استخدام الزيت المعدنى KZ منفردا بالجرعة الحقلية الموصى بها لمكافحة المن وكذا استخدام مركب البيوفلاى منفردا لمكافحة حوريات وعذارى الذبابة البيضاء وأيضا استخدام السوميسيدين مخلوطا مع الأتابرون لمكافحة دودة ورق القطن ، بالاضافة الى أن هذه المركبات كانت أمنة نسبيا وبعضها ذو تأثير بسيط نسبيا مع الأعداء الحيوية مثل الحشرة الرواغة واسد المن واوريوس واسكمنس و العناكب الحقيقية.