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THE ROLE OF SOME BIOLOGICAL AND CHEMICAL AGENTS IN REGULATING THE POPULATION DENSITY OF THE COTTON LEAF WORM, *Spodoptera littoralis* (BOISD.) AND SOME RELATED BENEFICIAL INSECTS

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ABSTRACT

Field experiment was Conducted in TooKh district, Kalubia Governorate, during 2001 and 2002 cotton seasons to study the efficacy of insecticidal effect of some biological and chemical agents (Agrein, Cascade, Sumi -- alpha, mixture of Dursban + Atabron and Larvin) against the *S. littorals* larvae and some related beneficial insects, namely, *Scymnus spp., Chrysopa carnea, Orius spp., Coccinella undecimpunctata, Paederus alfenii* and *Syrphus spp.* The results indicated that the mixture of Dursban + Atabron formulation caused the highest effect on the cotton leafworm, *S. littoralis*. The general mean of infestation percentages, during the two successive seasons of investigation were 13.1 % in the Dursban + Atabron area followed by Sumi -- alpha (15.15 %), Agrein (16.58 %), Larvin (19.1 %) and Cascade (21.75 %), treatments.

The results indicated, also that the decreasing percentages in the population size of the predators under investigation were differed between the various treatment areas. The efficacy of the biological insecticide formulations i.e. Agrein on the cotton leafworm *S. littoralis* was higher than that on the predator populations .On the contrary, the chemical insecticides harboured high effects on both *S. littoralis* and the related predator populations.

INTRODUCTION

In Egypt, cotton plants are commonly is attacked by several insect pests. The cotton leafworm, *Spodoptera littoralis* (Boisd.) is a polyphagous and widely distributed pest on many vegetable fields and ornamental crops. It is considered one of the serious insect pests in cotton fields, causing a great damage to the yield of this economic crop. In the last decade, various research attempts have received increasing emphasis aimed to establish alternative means for controlling the cotton leafworm *S. littoralis*. The chemical control of this insect pest in the cotton field causes bad side effects on the population abundance of natural enemies inducing considerable problems in the enviromental balance between cotton pests and its related biological agents. Also entomologists seeked and developed new approaches in this respect in order to replace wide spectrum toxicants with other less or non poisonous control agents.

One of the promising approaches in the IPM program, in controlling *S. littoralis* is the use of natural products that influence insect chemosensory behaviour such as bacteria, Al - Azawi, 1964; Lowell and Ignoffo, 1971; Ignoffo and Graham,1976; McGaughey, 1979; Sneh *et al.* 1981; Abdeen *et*

al., 1986; Wool *et al.* 1987; Bai and Degheele,1992; Abd El-Halim,1993 and 1997; Romeilah and Abdel Meguid,2000 and Sondos ,2002)

The target of this work is to study the insecticidal action of some biological and chemical formulations against larval instars of *S. littoralis* and their latent effect. The effect of the tested pest control agents on some related predators was also studied.

Several authors have indicated the changes in the population densities of related predators in cotton fields and demonstrated their role in regulating the population size of cotton pests and the efficacy of some chemical insecticides on them in Egypt; Ali *et al.* 1975 and 1979; Awadalla *et al.* (1976) ; Tawfik *et al.*1976; El-Dakroury *et al.*1977; Fayad and Ibrahim 1980; Abdel -Al *et al 1979;* Ragab 1980; Hamed and Hassanein 1984; Hassanein and Hamed 1984; Pickett *et al.* 1984; El-Adl and Ghanem 1986, El-Heneidy *et al.* 1987; El-Mezayyen 1993 and Sondos ,2002

The present study was carried out, also to indicate the relationship between the biological, chemical insecticides, cotton leafworm, *S. littoralis* and the related natural enemies.

MATERIALS AND METHODS

Field experiment was carried out in Tookh district , Kalubia Governorate, during 2001 and 2002 cotton growing seasons to indicate the effect of some biological and chemical insecticides (Agrein, Cascade, Sumi - alpha, mixture of Dursban + Atabron and Larvin) on the *S.littoralis* larvae and some related predator insects, namely, *Scymnus spp.,* Chrysopa carnea, *Orius spp., Coccinella undecimpunctata, Paederus alferii* and *Syrphus spp.* One feddan was chosen, cultivated with cotton plants var.Giza 85 to carry out this experiment, and equally divided into six plots (5 treatments and one for control). Each treatment was replicated three times; and was sprayed with Knapsack sprayer using the mentioned insecticide formulations in Table (1).

Infestation percentages of cotton leafworm *S. littoralis*

The infestation percentages of *S. littoralis* in cotton field was evaluated. In this experiment, a number of 100 cotton leaves were sampled from each plot before treatments and examined in the laboratory, for cotton leafworm *S.littoralis* (as a control) and counted according to the degree of infestation percentages (Kasopers,1965). The same number of leaves were examined weekly for each treatment. The cotton field was sprayed three times against cotton leafworm on June,30, July,7, August,5 and on July,5,20 and August,4 during the two successive seasons 2001 and 2002. The biological and chemical formulations used, and their rates per feddan were recorded in Table (1).

Table (1): **Biological and chemical insecticides, used in cotton fields during 2001 and 2002 cotton growing seasons in Tookh district, Kalubia Governorate .**

Trade name	Common name	Rate / Feddan
Agrein 6.5 % WP	B.T. (toxin)	500 gm./ feddan
Cascade 10 % DC	Flufenoxuron	200 cm./ feddan
Sumi – alpha 5 % EC	Esfenvalerate	600 cm / feddan
Dursban 4 Tc 48 % + Atabron 5 % EC	Chlorpyrifos + Chlorfluazuron	1000 cm + 400 cm/ feddan
Larvin 37.5 % FL	Thiodicarb	1000 cm / feddan

Estimating population size of predator adults:

During the two seasons under investigation of 2001 and 2002, the number of predator adults were counted depending on the weekly counts in cotton fields treated with the previously mentioned insecticides (Table 1) and accordingly the changes in the population size was estimated.

RESULTS AND DISCUSSION

Infestation percentages

(a) - Before treatments

Data collected in Tables (2&3) indicated that the highest infestation percentage in cotton field with *S. littoralis* during 2001 cotton season was found in the Larvin area (38.5%) followed by Dursban + Atabron locality (32.1%), Cascade place (31.9%), Control plot (29.8 %), Agrein area (27.3%) and Sumi - alpha part (25.8%), while these infestations were 31.1, 30.0, 29.9, 28.6, 27.8 and 22.7 % for Larvin, Agrein, mixture of Dursban+Atabron, Control, Cascade and Sumi - alpha areas, respectively during 2002 cotton growing season.

Table (2): **Infestation percentages of *S. littoralis* larvae in cotton leaves treated with different biological and chemical insecticides in Tookh district, Kalubia Governorate. during 2001 cotton season.**

Sampling date	Treatment					
	Control	Mixture of Dursban + Atabron	Sumi-alpha	Agrein	Larvin	Cascade
Before treatment						
29/6/2001	29.8	32.1	25.8	27.3	38.5	31.9
First spray						
6/7	46.4	10.2	12.8	13.3	15.9	17.9
13/7	42.0	13.5	14.9	15.1	18.6	22.4
Second spray						
22/7	47.1	11.4	13.5	14.6	17.9	19.9
29/8	37.3	17.3	19.3	20.2	22.4	24.8
Third spray						
13/8	36.2	11.1	14.1	156	17.2	19.4
20/8	33.7	14.3	16.2	18.2	21.6	23.9

Table (3): Infestation percentages of *S. littoralis* larvae in cotton leaves treated with different biological and chemical insecticides, in Tookh district, Kalubia Governorate during 2002 cotton season.

Sampling Date	Treatment					
	Control	Mixture of Dursban + Atabron	Sumi-alpha	Agrein	Larvin	Cascade
Before treatment						
1/7/2002	28.6	29.9	22.7	30	31.1	27.8
First spray						
12/7	46.4	11.3	13.4	15.1	17.1	18.8
19/7	42.0	13.4	15.6	17.8	18.8	22.3
Second spray						
26/7	47.1	10.9	13.4	14.9	17.8	20.0
3/8	37.3	16.9	18.9	20.6	23.1	25.3
Third spra						
10/8	36.2	12.2	13.2	14.9	17.2	19.4
17/8	37.7	14.6	16.5	18.7	21.6	26.9

(b) - After the first spray:

Data recorded in Tables (2 and 3) showed that all the tested compounds revealed larvicidal action against *S. littoralis* insect. Regarding the first season, the tested compounds could be arranged descendingly according to their efficiency against *S. littoralis* larvae after one week of application as follow: Dursban+Atabron, Sumi-alpha, Agrein, Larvin and Cascade, respectively. Following two weeks later the descending order of efficiency of the tested compounds was the same as before with the exception that exchanged their places. The tested compounds decreased the infestation percentages of *S. littoralis* ranged between 10.2-13.5, 12-14.9, 13.3-15.1, .15.9-18.6 and 17.9-22.4%, regulated as Dursban+Atabron, Sumi-alpha, Agrein, Larvin and Cascade, respectively, comparing with the control (46.4-42) for 2001 cotton season.

Considering the second season of 2002, the descending order of efficiency for the tested toxicants one and two weeks after the first spray was the same (Dursban+Atabron, Sumi-alpha, Agrein, Larvin and Cascade). The infestation percentages of *S. littoralis* larvae were decreased in treated areas comparing with that in the control plots (46.4-42 %) and ranged between 11.3-13.4, 13.4-15.6, 15.1-17.8, 17.1-18.8 and 18.8-22.3 % for Dursban+Atabron, Sumi-alpha, Agrein, Larvin and Cascade, respectively.

(c) - After the second spray:

The data registrated in Table (2) indicated that during 2001 cotton season, one week after, the second application, the infestation percentages of *S. littoralis* in the different treatments were 11.4, 13.5, 14.6, 17.9 and 19.9 in the Dursban+Atabron, Sumi-alpha, Agrein, Larvin and Cascade treatments, respectively.

They were 17.3, 19.3, 20.2, 22.4 and 24.8% after two weeks later from the spraying date, distributed in the previously mentioned areas. In the control area, the infestation percentages were 47.1 and 37.3.% after one and two weeks from treatment date, respectively.

In 2002 season, the illustrated data in the tables determined that, after one week from the second spray date, the infestation percentages were 10.9 (Dursban+Atabron), 13.4 (Sumi-alpha), 14.9 (Agrein), 17.8 (Larvin) and 20 % (Cascade), respectively. After two weeks later from the second application, these percentages were increased to be 16.9, 18.9, 20.6, 23.1 and 25.3 % distributed in the previously mentioned treatment areas comparing with the control (47.1 and 37.3 %)

(d) - After the third spray:

The recorded data in Table (2) demonstrated that, during 2001 cotton season, after one week of the third spraying date the highest infestation percentage was 19.4 in Cascade area followed by 17.2, 15.6, 14.1, and 11.1 % in Larvin, Agrein, Sumi-alpha and the mixture of Dursban+Atabron treatment areas, respectively.

sharp increase in infestation percentages took place after two weeks recording 23.9, 21.6, 18.2, 16.2 and 14.3 % in Cascade, Larvin, Agrein, Sumi-alpha and the mixture of Dursban+Atabron treatments, respectively,

During 2002 season the data in Table (3) showed that the lowest and the highest infestation percentages, after one week from the application were 12.2 and 19.4 % in the plots treated with the mixture of Dursban+Atabron and Cascade plots, respectively, while two weeks later, it is obvious that Cascade was the lowest activity, whereas the mixture of Dursban+Atabron was the most efficient insecticide. The other tested compounds occupied intermediate possitions. During the period of the third spray at the two tested seasons the infestation percentages in untreated plots were much higher than that in treated plots. .

From the previous results, it could be concluded here that, when the general mean of the infestation percentages with the cotton leafworm *S. littoralis* were estimated during the whole period of investigation, at late seasons of 2001 and 2002, together, it is clear that Dursban + Atabron formulation harboured the highest effect on the *S. littoralis* insect pest recording 13.09 % followed by Sumi-alpha (15.15 %), Agrein (16.58%), Larvin (19.10 %) and Cascade (22.58 %).

Counting predator adults in the different treatments:

According to data in Table (4), the total numbers of predators, at late of 2001 season in area treated with Agrein were as follow; 17 individuals for *Scymnus spp.*, 58 *(Chrysopa carnea)*, 195 (*Orius spp.*), 106 (*Coccinella undecimpunctata*), 48 *(Paederus alferii)* and 30 (*Syrphus spp.*) while they reached in Cascade treatment area to 34 (*Scymnus spp*), 41 (*Chrysopa carnea*), 174 (*Orius spp.*),110 (*Coccinella undecimpunctata*), 53 (*Paederus alferii.*) and 41 (*Syrphus spp.*), respectively. The total numbers of these predators in Sumi - alpha treatment plot were 22 (*Scymnus spp.),* 89 *(Chrysopa carnea),* 209 *(Orius spp.*), 149 (*Coccinella undecimpunctata*), 47

(*Paederus alferii)* and 46 *(Syrphus spp.)* respectively, while these were (in Dursban+Atabron treatment areas) 43 (*Scymnus spp.*), 107 (*Chrysopa carnea*), 264 *(Orius spp)*, 192 (*Coccinella undecimpunctata*), 60 (*Paederus alferii)* and 46 (*Syrphus spp.*). In area treated with Larvin the total numbers of related predators reached 57 (*Scymnus spp.),* 114 (*Chrysopa carnea*), 286 (*Orius spp.*), 138 (*Coccinella undecimpunctata*), 82 (*Paederus alferii.*) and 62 *(Syrphus spp.)*. For the untreated Control area, the total numbers of predator individuals were 116 (*Scymnus spp),* 236 (*Chrysopa carnea*), 485 *(Orius spp),* 367 (*Coccinella undecimpunctata*), 178 (*Paederus alferii*) and 147 (*Syrphus spp.*), respectively.

The data in Table (4) indicated also that the total numbers of predator individuals in whole treatments, collected, during 2001, reached 292 (*Scymnus spp*) (lowest number), 645 *(Chrysopa carnea),* 1613 (*Orius spp.*) (highest number) 1005 (*Coccinella undecimpunctata*), 468 (*Paederus alferii)* and 372 (*Syrphus spp*).

Data demonstrated that the biological insecticide formulations resulted lower effect on the predator insects than that of chemical one during 2001 cotton season. So, the numbers of predator individuals were higher in the biological insecticide treatments than that of chemical insecticides.

For 2002 cotton season, the data recorded in Table (5), indicated that the total numbers of *Scymnus spp.* at late season were as following: 123 individuals in control area (the highest collected number), 25 (the lowest collected number) in Agrein, 47 (Sumi-alpha), 63 (Larvin), 38 Cascade) and 92 (mixture of Dursban+Atabron) treatment areas, respectively, while the total collected numbers of *Chrysopa carnea* individuals in the different treatments were 69 in Agrein; 75 in Sumi-alpha; 115 in Larvin; 63 in Cascade; 126 in mixture of Dursban+Atabron and 268 (highest number) in the untreated control treatment areas, respectively. In the same time, the total number of *Orius spp.* reached 230, 252, 380, 198, 135 (lowest number) and 563 (the highest number) individuals in Agrein, Sumi alpha, Larvin, Cascade, mixture of Dursban+Atabron treatments and Control areas, respectively. These numbers, for *Coccinella* undecimpunctata , were 105 (lowest one), 168, 157, 129, 208 and 373 (the highest number) in Agrein, Sumi alpha, Larvin, Cascade, mixture of Dursban+Atabron treatments and control areas, respectively.

For *Paederus alferii,* the total numbers of insects at late season of 2002 cotton season reached 51 (lowest number), 60, 91, 61, 63 and 213 (highest one) in Agrein, Sumi alpha, Larvin, Cascade, mixture of Dursban+Atabron treatments and Control areas, respectively while the total collected numbers of *Syrphus spp.* at the late season of 2002 reached 36 (the lowest one), 53, 67, 54, 43 and 164 (the highest number) individuals in the previously mentioned treatments and control areas respectively.

Decreasing percentages in predator numbers:

As indicated in Figs.1 and 2, the decreasing percentages in the population size of the predators under study were differed between the different treatment areas. It is clear, also, from the figures that the effect of the tested biological insecticides formulations on the predator populations was lower than that of the chemical insecticides.

Table (4) :Number of the predators before and after treatments with biological and chemical insecticides in Tookh, Kalubia Governorate during 2001 cotton season.

Treatment	Number of predators before treatment (29/6/2001)						Number of predators after treatment First Spray (6/7/200001											
							After 7 days						After 14 days					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Agrein	6	14	44	26	12	8	2	8	24	12	5	2	3	8	27	15	6	5
Cascade	8	12	40	31	16	11	5	5	18	12	6	3	6	8	24	14	7	7
Sumi alpha	4	21	59	33	11	11	1	12	28	17	4	4	3	15	32	21	7	6
Dursban + Atabron	10	26	65	45	15	9	6	16	33	21	7	2	8	17	39	26	8	8
Larvin	12	30	69	36	17	12	4	15	34	13	9	5	8	18	44	18	11	10
Control	15	35	75	59	25	19	13	29	64	41	22	15	15	33	71	50	25	18

Treatment	Number of predators after treatment Second Spray (22/7/2001)												Number of predators after treatment Third Spray (13/8/2001)											
	After 7 days						After 14 days (						After 7 days						After 14 days					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Agrein	1	7	20	10	5	0	2	8	29	16	7	7	0	5	18	10	5	0	3	8	33	17	8	8
Cascade	4	3	17	10	3	2	5	5	26	17	9	8	0	2	19	9	3	2	6	6	30	17	9	8
Sumi alpha	2	11	26	13	2	2	3	13	33	25	9	9	2	7	17	11	3	1	7	10	34	29	11	13
Dursban + Atabron	3	13	28	18	5	1	5	15	44	30	10	11	2	6	16	16	4	3	9	14	39	36	11	12
Larvin	2	11	29	9	7	3	6	16	48	24	14	13	4	6	11	8	6	4	11	18	51	30	18	15
Control	16	32	69	46	25	15	18	36	66	57	30	21	16	33	69	50	30	19	23	38	71	64	37	30

(A) = Scymnus spp. (B) = Chrysopa carnea (C) = Orius spp. (D) = Coccinella undecimpunctata (E) = Paederus alferii (F) = Syrphus spp.

Table (5) :Number of the predators before and after treatments with biological and chemical insecticides in T⊃okh, Kalubia Governorate , during 2002 cotton season.

Treatment	Number of predators before treatment (1/7/2002)						Number of predators after treatment First Spray (12/7/2002)											
							After 7 days						After 14 days					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Agrein	5	17	55	20	11	8	2	8	27	12	5	2	4	11	33	16	8	6
Cascade	9	15	49	35	15	14	4	9	23	14	7	8	6	16	27	18	10	8
Sumi alpha	15	22	63	41	17	11	8	11	33	19	5	6	5	15	36	24	7	10
Dursban + Atabron	13	31	70	44	13	12	6	19	28	28	7	4	8	21	39	33	8	11
Larvin	15	37	79	38	20	10	9	14	42	17	11	6	12	18	46	20	14	14
Control	19	39	88	60	27	22	20	33	82	57	25	22	15	39	90	61	30	19

Treatment	Number of predators after treatment Second Spray (26/7/2002)												Number of predators after treatment Third Spray (10/8/2002)											
	After 7 days						After 14 days						After 7 days						After 14 days					
	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Agrein	3	8	22	10	4	1	4	10	33	18	8	5	3	5	21	10	5	3	4	10	39	19	10	11
Cascade	3	4	19	11	3	2	6	7	26	20	13	7	3	3	19	9	4	2	7	9	35	22	9	13
Sumi alpha	4	13	24	11	3	3	6	17	35	29	14	6	2	7	22	11	3	3	7	10	39	33	11	14
Dursban + Atabron	1	13	26	15	6	0	5	18	49	35	10	3	5	8	18	16	6	2	11	16	42	37	13	11
Larvin	3	11	27	10	8	4	9	15	58	29	14	10	4	10	13	8	6	4	11	20	55	35	18	19
Control	17	35	74	51	29	18	18	39	71	62	33	21	21	39	77	50	30	19	23	44	81	73	39	32

(A) = Scymnus spp. (B) = Chrysopa carnea (C) = Orius spp. (D) = Coccinella undecimpunctata (E) = Paederus alferii (F) = Syrphus spp.

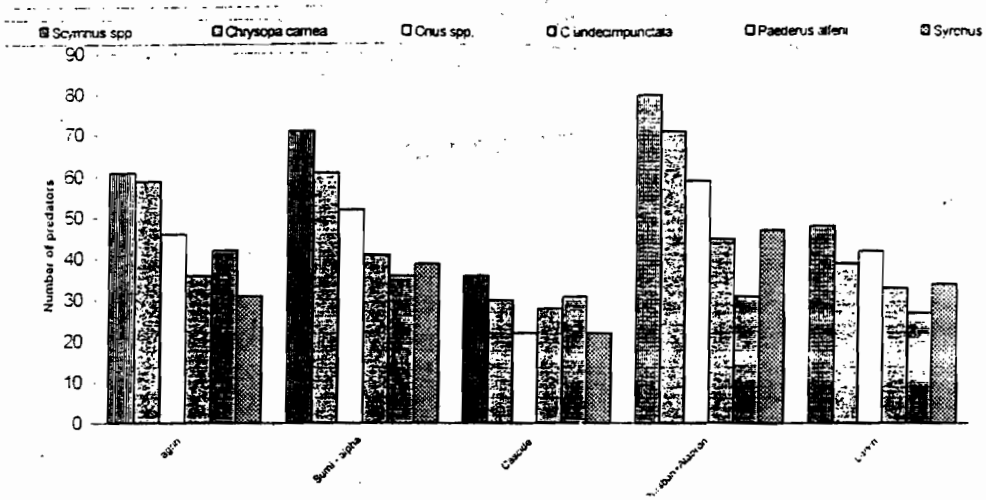

Fig.1: Decresing percentage in the number of predators by using different biological and chemical insecticides in cotton field during 2001 cotton season at Tookh, Kalubia Governorate.

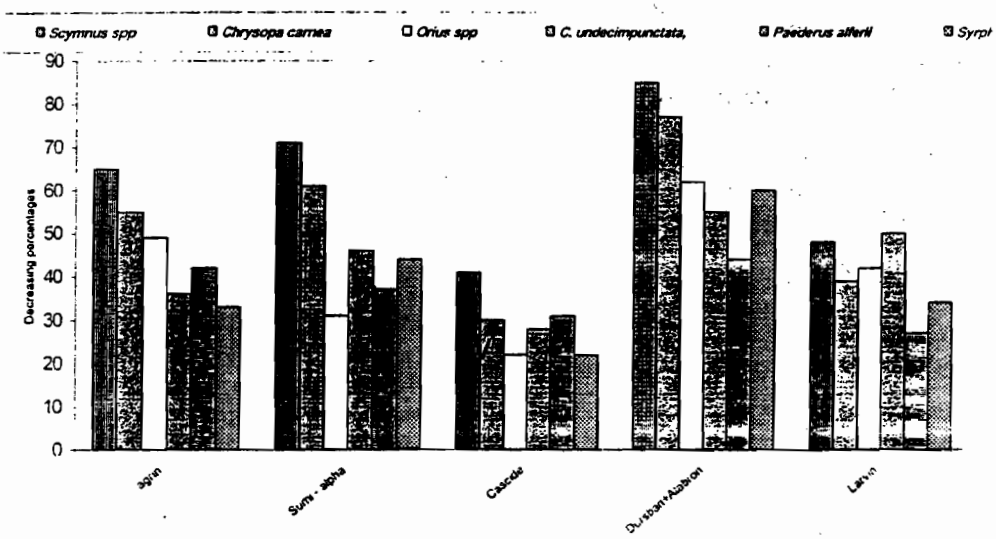

Fig.2 : Decresing percentage in the number of predators by using different biological and chemical insecticides in cotton field during 2002 cotton season at Tookh, Kalubia Governorate.

From the previously mentioned results, it could be concluded that the effect of the biological insecticide was higher on ***S. littoralis*** insect pest than that on the beneficial insects (predator insects). On the contrary, the chemical insecticides were highly effective on both ***S. littoralis*** and the related predators during the two successive cotton growing seasons of 2001 and 2002.

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دور بعض المبيدات الحيوية والكيميائية فى تنظيم مجـــاميع دودة ورق القطـــن وبعض المفترسات المرتبطة بها

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أجريت هذه التجربة بمركز طوخ – محافظة القليوبية خلال موسمى القطـــن ٢٠٠١ و ٢٠٠٢ لدراسة العلاقة بين تأثير بعض المبيدات الحيوية والكيماوية على تعداد دودة ورق القطـــن وبعض المفترسات المرتبطة بها وهى حشرة الاسكيمنس وأسد المن وحشرة الاوريس وأبو العيد ذو ال ١١ نقطة و حشرة الرواغة وذبابة السرفس . وقد أوضحت النتائج أن أكثر هذه المبيـــدات تأثيرا على دودة ورق القطن كان مخلوط من الدورسبان + الاتابرون حيث بلغ المتوسط العـــام للأصابة بدودة ورق القطن فى المساحة التى عوملت به خلال موسمى الفحـــص أقـــل مـــايمكن (١٣,١ %) – ثم يليه تأثيرا مستحضر السومى الفا (١٥,١٥ %) – مستحضر الاجرين (١٦,٥٨ %) – مركب اللأرفن (١٩,١ %) ثم مركب الكاسنيد (٢١,٧٥ %) وقد بينت النتـــائج أن هنـــاك تباين بين المعاملات المختلفة . كذلك ظهر واضحا أن تأثير المبيدات الحيوية كان كبيـــرا علـــى دودة ورق القطن وأقل نسبيا على المفترسات المرتبطة بها بينما كان تأثير المبيـــدات الكيميائيـــة شديدا على كل من الآفة وأعدائها الحيوية.