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ESTIMATION OF CERTAIN COMPOUND AGAINST COTTON LEAFWORM, *Spodoptera littoralis* (BOISD.) ON SUGAR BEET PLANTS

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ABSTRACT

A field study was conducted to compare the efficiency of the biocides, insecticides and insect growth regulators (IGR's) against cotton leafworm *Spodoptera littoralis*, whereas the results appeared that Virust was the most effective compound as it recording 63.64% reduction in the initial kill after five days achieved. Followed by Agerin and Brofect this gave 51.61, 46.38% reduction. While, Protecto was the least efficient compound, as it gave 27.14% reduction only. but about insecticides as lannate and Cord in eleven days after treatment it have a high efficiency in reduction (100%), while Flaxe was the lowest effective one which revealed 83.08 % reduction. On the other hand IGR'S, Toporon and Runner were gave (88.87 and 88.44 % reduction) and Demelin was the lowest effective (63.12 % reduction) after one day of treatment. As for the residual effect also Runner, Toporon, Virtue, keleron and Nomolt induced the best results, recording 100, 99.28, 99.08, 97.57 and 97.47 reduction percentages, respectively. Whereas, Demelin was the lowest effective one, which revealed 87.46% reduction during the period from 10^{th} to 15^{th} days after sprays application in the first season. While, in the second season Runner, Nomolt, Coragen and Virtue were the most effective insecticides they caused 85.73, 77.65, 77.17 and 73.01 % reduction, after five days of spraying (initial kill), respectively. On the other hand, Demelin and Diberone induced a low residual effect, where it showed only 89.49 % and 86.65 % reduction after 15 days of treatment.

Key words: biocides, insecticides, IGR'S, *Spodoptera littoralis* and sugar beet.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is one of the most important sugar crops in the world. It produces annually about 40% of sugar production all over the world. This crop is attacked with many insect pests throughout the growing season (Fouad *et al*. 2011). The Cotton leafworm larvae, *Spodoptera littoralis* (Boisd.) is considered as one of the important insect on sugar beet. It is active almost all the year round. It is a polyphagous insect having 112 host plants the larval stage feeding on many field and vegetable crop (Meisner and Nemny 1992, El-Maghraby *et al*. 1999, Khidr *et al*. 2003 and Sherief *et al*. 2009). Usually, this pest is controlled by using many conventional insecticides which often result many bad and undesirable side effects such as environmental pollution, resistance appearance in the target pests.

Radwan *et al.* (2004) used biocides for control *S. littoralis*; these materials may not cause any kind of pollution on the environment. Also, others reported from this investigation that the bioinsecticide (Xentari) demonstrated the least harmful effect on entomophagous insect population which was significantly lower than those counted in control. The safety of bacterial bioinsecticides to insect predators was studied by Kares (1991) and to insect parasitoid population by Atwood *et al.* (1997).

The aim of this investigation is to evaluation the efficiency of certain chemical and bioinsecticides against *S. littoralis* on sugar beet plants in the field.

MATERIALS AND METHODS

This experiment was conducted at Kafr El-hamam village, Zagazig district, Sharkia Governorate, during 2009/2010 season. Experiment area 1680 m^2. The sugar beet variety used was Baraca, sowed at 20 of September. This area divided into eight treatments. Each treatment has been divided into five replicates including control. The area of each replicate was 42 m^2 (6 x7 m^2); so that the area of each treatment was 210 m^2 (5 x 42 m^2). Date of spray in 2 of November on sugar beet seedlings. Five sugar beet plants were chosen randomly from each replicate (25 plants per treatment) to estimate the number of *S. littoralis* larvae before spray and at the following dates 2, 5, 7, 9 and 11 days after spraying.

The tested compounds:

1-Biocides:

a. Agerin (6.5% WP):

Common name: *Bacillus thuringiensis Egypt.* (B.t).

b. Protecto (9.4% WP):

Common name: *Bacillus thuringiensis kurstaki.* (B.t).

c. Profect (2+5% WP):

Common name: *Spodoptera littoralis* Nuclear Polyhydrosis Virus (NPV).
+ *Bacillus thuringiensis kurstaki* (B.t).

d. Virust:

Common name: *Spodoptera littoralis* Nuclear Polyhydrosis Virus (NPV).

2-Insecticides:

a. Lannate (90% SP):

Common name : methomyl.
Chemical name: *S*-methomyl -*N*-(methylcarbamoyloxy) thioacetimidate.

b. Cord (72% EC):

Common name : profenofos.
Chemical name: *O*-(4-bromo-2-chlorophenyl) *O*-ethyl *S*-propyl phosphorothioate.

c. Radical (0.5% EC):

Common name : emamectin benzoate.
Chemical name: (4"*R*)-5-*O*-demethyl-4"-deoxy-4"-(methyl amino) avermectin A_{1a} + (4"*R*)-5-*O*-demethyl-25-de (1-methylpropyl)-4"-deoxy-4"-(methyl amino)-25-(1-methylethyl) avermectin A_{1a} (9:1).

d. Flaxe (15% SC):

Common name: indoxacarb.

Chemical name: methyl (*S*)-7-chloro-2,5-dihydro-2-[[(methoxycarbonyl)[4 (trifluoromethoxy)phenyl]amino]carbonyl]-indeno[1,*e*] [1,3,4]oxadiazine-4a(3*H*)-carboxylate.

3-Insect growth regulator (IGR's):

This experiment was conducted at Zagazig district, Sharkia Governorate, during the two successive seasons, 2009/2010 and 2010/2011. Experiment area 1680 m^2. This area divided into eight treatments. Each treatment has been divided into five replicates including control. The area of each replicate was 42 m^2 (6 x7 m^2); so that the total area of each treatment was 210 m^2 (5 x 42 m^2). Each compound was used separately in a single treatment contain four replicates. Date of spray in 28 of October on sugar beet seedlings. Five sugar beet plants were chosen randomly from each replicate (25 plants per treatment) to estimate the number of *S. littoralis* larvae before spray and at the following dates 5, 10 and 15 days after spraying.

Reduction percentage (R %) was estimated according to the formula of Henderson and Tilton (1955) as follows:

$$\%\,R = 1- \left(\frac{\text{Insect No in control before spray}}{\text{Insect No in control after spray}} X \frac{\text{Insect No in treatment after spray}}{\text{Insect No in treatment before spray}} \right) X\ 100$$

4. Statistical analysis

Statistical analysis were carried out to determine the differences between treatments and days after spraying by using one way analysis of variance (ANOVA) (Costat, 1990) and Duncan's multiple range test (Duncan, 1955) was applied at 5% probability level.

RESULTS AND DISCUSSION

Biocides and insecticides:

Results are presented in Table (1) cleared that Virust was the most effective compound against the larvae. During the first five days after treatment (63.64% reduction), followed by Agerin and Brofect that gave 51.61, 46.38% reduction, while, Protecto was the least efficient compound, it gave 27.14% reduction only as initial kill after five days from treatment.

Residual effect of Protecto induced the best results, recording 77.05 of reduction percentages in *S. littoralis*, whereas, Brofect was the lowest effective one, which revealed 72.85% reduction during the period from 5^{th} to 11^{th} days after spray application.

All tested pesticides were significantly affected on population of the cotton leafworm *S. littoralis* at the indicated days after application Table (2). Data revealed that all the tested pesticides induced an obvious initial kill, where they exhibited from 38.69 to 81.04 % reduction in population. Eleven days after treatment, Lannate and Cord gave a high efficiency in reduction the cotton leafworm population (100%). While, Flaxe was the lowest effective one which revealed 83.08 % reduction.

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Concerning residual activity, the tested pesticides can be arranged in descending order as follows: Lannate, Cord, Radical and Flaxe recording 94.93, 92.39, 75.99 and 62.90 % reduction, respectively.

Generally the second period during 2008/2009 season was not evaluated by *S. littoralis* because the population density was not reached to the level of economic threshold in the experimental area.

Another results near from data of Amal *et al.* (2003) reported that two biocides, Agerin and Ecotech at three concentrations were applied in the field on sugar beet plants to control *Spodoptera littoralis*. Where all treatments caused reduction in the numbers of *S. littoralis* larvae**.** Abo El-Ftooh (2004) who mentioned that the pesticides Profenofos was more effective on *S. littoralis* than each of the isolated bacteria and the two bio-insecticides through the experiment period. Munir *et al.* (2005) found that Emamectin proved to be the best followed by Indoxacarb in their time-oriented mortality at three concentration levels tested. Abamectin proved to be the least effective to control this pest. Hassan *et al.* (2009) Found that efficacy of a new semi-synthetic avermectin derivative Methylamine avermectin (Radical 0.5% EC) was determined against larval instars of the Egyptian cotton leafworm, *Spodoptera littoralis* (Biosd.) in the laboratory, field and semi field experiments. 2^{nd} and 4^{th} instars larvae showed greatest susceptibility to the Radical in the laboratory experiment.

Insect growth regulator (IGR's):

Data in Table (3) cleared that Toporon and Runner was the most effective (88.87 and 88.44 % reduction) Virtue, Diberone, Coragen and Keleron were moderately effective (73.17, 70.08, 68.84 and 68.12 % reduction, respectively). While, Demelin was the lowest effective one and exhibited 63.12 % reduction after one day of treatment.

Concerning the effect of the tested insecticides after 10 days of application, both Runner, Toporon and Virtue showed the highest effects (100, 98.56 and 98.16% reduction, respectively) followed by Keleron, Nomolt and Coragen (95.15, 94.95 and 93.95% reduction, respectively). However Demelin was the lowest active one and showed 85.24 % reduction. Regarding to 15 days after application Runner, Nomolt, Toporon, Keleron and Virtue were not significantly different in their effect on reduction percentage of insect infestation (100 % for ever). While, Coragen, Diberone and Demelin gave (95.01, 90.99, 89.68 % reduction, respectively) during the first season. As for the residual effect also Runner, Toporon, Virtue, Keleron and Nomolt induced the best results, recording 100, 99.28, 99.08, 97.57 and 97.47 reduction percentages in *S. littoralis*. Whereas, Demelin was the lowest effective one, which revealed 87.46% reductions during the period from 10th to 15th days after spray treatment.

The results presented in the second season Table (4) Runner, Nomolt, Coragen and Virtue were the most effective insecticides they caused 85.73, 77.65, 77.17 and 73.01 % reduction, after five days of spraying (initial kill), respectively. With the respect to residual effect, Runner was the highly effective recording 95.77 % reduction in cotton leafworm population after 10 days of pesticides application.

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On the other hand, Demelin and Diberone induced a low residual effect, where it showed only 89.49 % and 86.65 % reduction after 15 days of application. It could be concluded that, Runner, Toporon and Virtue had longest residual effect, recording 97.88, 95.53 and 95.33 % reduction, respectively.

Our results agree with that obtained by Chandler *et al.* (1992) tested the toxic effects of three insect growth regulators (Di/lubenzuron, Te/lubenzuron, and Fenoxycarb) to 1- and 7-d-old larvae of corn earworm, *Helicoverpa zea* (Baddie), and fall armyworm, *Spodoptera frugiperda* (J. E. Smith). Fenoxycarb was more active against 1- and 7-d-old corn earworm larvae compared with Di/lubenzuron or Tef1ubenzuron; all compounds were equally active against 7-d-old fall armyworm larvae. Abd El-rahman *et al.* (2007) tested the direct and latent effects of the growth inhibitor Lefenuron and the combination of Lefenuron/Deltanet on the development of *S. littoralis* larvae. Both compounds proved to be toxic to the test insect larvae. Leufenuron proved to be more toxic than Leufenuron/Deltanet, *S. littoralis* larvae suffered from more mortality when they were fed for a longer period on the treated diet. Sammour *et al.* (2008) observed that the results also indicated mat Leufenuron was eliminated two times faster than Chlorfluazuron.

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تقدير كفاءة بعض المبيدات الحشرية ضد دودة ورق القطن على نباتات بنجر السكر.

على على عبد الهادى سعيد*, فؤاد عبدالله حسام الدين شاهين*, السيد على حسن شريف و حاتم عبد المنعم محمد فؤاد**.**
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اجريت دراسة حقلية لتقيم كفاءة بعض المبيدات الحيوية, المبيدات الحشرية ومانعات الانسلاخ الحشرية ضد دودة ورق القطن حيث اظهرت النتائج ان مركب الفيروست هو الأكثر تأثيرا حيث سجل القتل الفورى بعد خمسة أيام 63.64٪, يليه مركب الأجرين والبيروفيكت حيث سجل كلا منهما 51.61٪ و 46.38٪ خفض فى التعداد. بينما كان مركب البيروتكتو هو الأخير من حيث سجل نسبة خفض 27.14٪ فقط.

اما بالنسبة للمبيدات الحشرية سجل كلا من مركبى اللانيت والكورد أعلى نسبة خفض فى اليوم الحادى عشر بعد المعاملة (100٪). بينما, كان مركب فلاكس هو اقلهم فى نسبة الخفض 83.08٪.

فى حين اخر اظهرت مانعات الانسلاخ الحشرية النتائج التالية حيث كان مركبى التوبرون والرنر هما الأكثر تأثيرا على دودة ورق القطن حيث سجلا نسبة خفض 88.87٪ و 88.44٪ على التوالى. بينما كان مركب الديميلين اقلهم فى التأثير حيث سجل نسبة خفض 63.12٪ بعد يوم واحد من المعاملة. من ناحية أخرى **خ:** تم ترتيب المركبات تبعا لتأثيرها المتبقى تنازليا كالتالى: الرنر, التوبرون, الفيرتو, الكليرون, النوملت و الديملين 100٪, 99.28٪, 99.08٪, 97.57٪, 97.47٪ و 87.46٪ على التوالى فى الموسم الأول. وفى الموسم الثانى سجلت مركبات الرنر, النوملت, الكوراجين و الفيرتو أعلى نسبة خفض بعد خمسة أيام من الرش (القتل الفورى) 85.73٪, 77.65٪, 77.17٪ و 73.01٪ على التوالى. أما بالنسبة للتأثير المتبقى سجلت مركبات الرنر, التوبرون و الفيرتو أعلى نسبة خفض 97.88٪, 95.53٪ و 95.33٪ على التوالى.

قام بتحكيم البحث

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Table (1): Efficiency of tested biocides against larvae of *Spodoptera littoralis* on sugar beet leaves during 2009/2010 at Sharkia Governorate.

Treatments	%Reduction after spraying									Mean of residual effect	General mean of % reduction	L.S.D 0.05
	before application	Initial effect after five day		Residual effect								
				7		9		11				
	Mean	Mean	%R	Mean	%R	Mean	%R	Mean	%R			
Agerin	15.50A^{a} ±3.10	7.50BC^{b} ±2.51	51.61	5.25B^{bc} ±2.75	66.13	4.25B^{bc} ±2.36	72.58	3.25B^{c} ±1.70	75.6	74.09	53.18	3.92**
Protecto	17.50A^{a} ±6.55	12.75A^{ab} ±6.39	27.14	6.50B^{bc} ±3.69	62.86	4.25B^{c} ±0.95	75.71	3.25B^{c} ±0.95	78.39	77.05	48.82	7.24**
Virust	14.25A^{a} ±2.50	5.00C^{b} ±2.16	63.64	3.50B^{b} ±2.51	74.55	3.25B^{b} ±2.62	76.36	2.75B^{b} ±2.98	76.72	76.54	58.98	3.77**
Brofect	17.25A^{a} ±3.40	9.25BC^{b} ±2.75	46.38	6.50B^{bc} ±3.10	62.32	5.00B^{bc} ±3.46	71.01	3.75B^{c} ±4.19	74.7	72.85	52.04	4.75**
Control	16.00A^{a} ±2.16	16.00A^{a} ±2.16	—	16.00A^{a} ±2.16	—	16.00A^{a} ±2.16	—	13.75A^{a} ±2.98	—	—	—	3.44N.S
L.S.D 0.05	5.84N.S	5.39*	—	4.36**	—	3.69**	—	4.22**	—	—	—	—

***Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).**

Table (2): Efficiency of tested insecticides against larvae of *Spodoptera littoralis* on sugar beet leaves during 2009/2010 at Sharkia Governorate.

Treatments	%Reduction after spraying											Mean of residual effect	General mean of % reduction	L.S.D 0.05
	before application	Initial effect after two day		Residual effect										
				5		7		9		11				
	Mean	Mean	%R	Mean	%R	Mean	%R	Mean	%R	Mean	%R			
Lannate	60.5A^{a} ±23.23	12.75B^{b} ±6.99	81.04	3.5C^{b} ±3.31	94.73	0.75C^{b} ±1.50	98.87	0.00C^{b} ±0.00	100	0.00C^{b} ±0.00	100	94.93	85.86	14.87**
Cord	50.5A^{a} ±8.22	14.5B^{b} ±1.29	74.12	5.25C^{c} ±2.06	90.54	1.5C^{c} ±1.29	97.29	0.00C^{c} ±0.00	100	0.00C^{c} ±0.00	100	92.39	83.18	5.26**
Radical	58.00A^{a} ±16.26	27.5B^{b} ±12.92	57.26	18.75C^{bc} ±10.01	70.59	14.5BC^{bc} ±8.18	77.26	9.5BC^{c} ±6.02	84.68	6.00BC^{c} ±4.54	90.19	75.99	67.21	15.53**
Flaxe	74.25A^{a} ±35.35	50.5A^{ab} ±22.78	38.69	38B^{bc} ±20.11	53.45	29.25B^{bc} ±17.15	64.17	19.75B^{bc} ±13.57	75.13	13.25B^{c} ±9.46	83.08	62.90	55.34	31.75*
Control	50.25A^{a} ±4.50	55.75A^{a} ±10.40	—	55.25A^{a} ±10.40	—	55.25A^{a} ±10.93	—	53.75A^{a} ±11.02	—	53A^{a} ±11.80	—	—	—	15.21NS
L.S.D 0.05	31.19NS	19.59**	—	17.04**	—	14.84**	—	12.46**	—	10.64**	—	—	—	—

***Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).**

Table (3): Efficiency of tested pesticides against larvae of *Spodoptera littoralis* on sugar beet leaves during 2009/2010.

Treatments	before application	%Reduction after spraying						Mean of residual effect	General mean of % reduction	L.S.D 0.05
		Initial effect after five day		Residual effect						
				10		15				
	Mean	Mean	Reduct-ion	Mean	Reduct-ion	Mean	Reduct-ion			
Runner	17.75AB[a] ±2.06	2.00D[b] ±0.00	88.44	0.00C[c] ±0.00	100	0.50C[c] ±0.00	100	100	96.15	1.58**
Nomolt	18.00AB[a] ±1.70	5.25BC[b] ±1.50	69.66	0.75C[c] ±0.95	94.95	0.00C[c] ±0.00	100	97.47	88.20	2.15**
Coragen	19.75AB[a] ±1.50	6.00BC[b] ±2.44	68.84	1.00C[c] ±0.81	93.95	0.75BC[c] ±0.50	95.01	94.48	85.93	1.37**
Demelin	22.25A[a] ±3.59	8.00B[b] ±2.44	63.12	3.25B[c] ±0.95	85.24	1.75B[c] ±0.50	89.68	87.46	79.35	3.45**
Toporon	20.75AB[a] ±4.85	2.25D[b] ±1.50	88.87	0.25C[b] ±0.50	98.56	0.00C[b] ±0.00	100	99.28	95.81	3.94**
keleron	18.50AB[a] ±1.91	5.75BC[b] ±0.50	68.12	0.75C[c] ±0.50	95.15	0.00C[c] ±0.00	100	97.57	87.75	1.57**
Diberone	18.00AB[a] ±2.82	5.25BC[b] ±2.21	70.08	1.50BC[c] ±1.00	90.05	1.00C[c] ±0.95	90.99	90.52	83.70	2.96**
Virtue	16.25B[a] ±2.21	4.25CD[b] ±0.95	73.17	0.25C[c] ±0.50	98.16	0.00C[c] ±0.00	100	99.08	90.44	1.89**
Control	20.00AB[a] ±3.36	20.75A[a] ±3.30	—	17.75A[a] ±3.40	—	16.25A[a] ±2.36	—	—	—	4.84N.S
L.S.D 0.05	4.20N.S	2.54**	—	1.92**	—	1.25**	—	—	—	—

Table (4): Efficiency of tested pesticides against larvae of *Spodoptera littoralis* on sugar beet leaves during 2010/2011.

Treatments	%Reduction after spraying							Mean of residual effect	General mean of % reduction	L.S.D 0.05
	before application	Initial effect after five day		Residual effect						
				10		15				
	Mean	Mean	Reduct-ion	Mean	Reduct-ion	Mean	Reduct-ion			
Runner	36.25 A^{a} ±2.75	5.00B^{b} ±1.15	85.73	1.25C^{c} ±0.95	95.77	0.00C^{c} ±0.00	100	97.88	93.83	2.41**
Nomolt	31.25ABC^{a} ±5.96	6.75B^{b} ±3.50	77.65	2.75BC^{bc} ±1.71	89.20	0.25C^{c} ±0.50	98.79	93.99	88.55	5.50**
Coragen	34.00 A^{a} ±8.86	7.50B^{b} ±3.78	77.17	2.75BC^{b} ±1.25	90.07	1.25BC^{b} ±0.50	94.46	92.26	87.23	7.50**
Demelin	32.25AB^{a} ±8.09	9.50B^{b} ±3.69	69.51	4.75B^{b} ±2.21	81.93	2.25B^{b} ±1.50	89.49	85.71	80.31	7.16**
Toporon	28.25ABCD^{a} ±6.70	9.75B^{b} ±6.29	64.28	1.75BC^{c} ±2.87	92.40	0.25C^{c} ±0.50	98.66	95.53	85.11	7.42**
keleron	22.25CD^{a} ±3.77	6.75B^{b} ±1.50	67.13	2.25BC^{bc} ±2.21	87.01	0.00C^{c} ±0.00	100	93.51	84.17	4.75**
Diberone	19.75D^{a} ±6.39	6.25B^{b} ±4.03	67.25	2.50BC^{b} ±1.73	84.47	1.75B^{b} ±1.25	86.65	85.56	79.45	6.05**
Virtue	23.00BCD^{a} ±2.82	6.00B^{b} ±2.71	73.01	1.75BC^{c} ±0.95	90.66	0.00C^{c} ±0.00	100	95.33	87.88	3.10**
Control	29.75ABC^{a} ±1.71	28.75A^{a} ±1.71	—	24.25A^{b} ±1.71	—	19.75A^{c} ±1.25	—	—	—	2.47**
L.S.D 0.05	8.58*	5.07**	—	2.66**	—	1.20**	—	—	—	—

***Means followed the same capital letter in a column for different pesticides or small letter in row of each pesticides at different times are not significantly different at 5% level of Probability (Duncan's Multiple Rang Test).**