Biological Performance of Certain Agrochemicals and IPM Program against Leafminers, *Liromyza trifolii* Burg on the Garden Bean

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ABSTRACT

The present study was carried out at a private farm cultivated with garden\ bean (*Phaseolus vulgaris*) var. Nepraska during the subsequent Neely seasons of 2014, 2015 and 2016 to control the leafminer, *liromyza trifolii* Burg at El-Nahada region, Alexandria Governorate, Egypt.

In the first season of 2014, Chlorantraniliprole and Abamectin were the most effective treatments against the leafminer, *liromyza trifolii* Burg corresponding to percent reduction of 90.98 and 64.04, followed by Acetampride 55.60% and Thiamethoxam- 48.30%. The least effective agrochemicals were Lambda cyhalothrin- 27.96%, Azadirachtin- 25.55% and Detergent- 12.58%.

On 2015 season, the data comfirmed that the most efficient Chlorantraniliprole 77.07% and Abamectin 64.13% followed by Acetampride and Thiamethoxam 48.56% and 38.94%, in successively. The least effective agrochemicals were Azadirachtin 29.18%, Lambda cyhalothrin 24.71% and Detergent 9.32%, respectively.

On 2016 season, the IPM model showed that the best treatment was abamectin followed by acetamprid, chlorantraniliprole and thiamethoxam while the least treatments were lambda cyhalothrin, azadirachtin and detergent.

Key words: Garden bean (*Phaseolus vulgaris*), the leafminers, *liromyza trifolii* Burg and total yield.

INTRODUCTION

The legume plants are considered a good source for protein. The garden bean, (*Phasealus vulgaris* L.) is one of the important vegetable crops in Egypt for both local as well as export markets. Garden bean is one of the main sources for protein. It is valuable for its richness in the amine acids lysine and tryptophan that are lacking in cereals and other foods (Karel and Mghogho, 1985). In Egypt garden bean is cultivated in area over than 41012 feddans for green pods production and 21533 feddans for dry seeds production, which produced about 167276 tons green pods and 29634 tons for seeds (according to the Bulletin of Agriculture statistics, Part 2, (Summer, Neely crops, and fruit), Ministry of Agriculture, Egypt, 2011).

This crop is grown in the open field in two main seasons i.e. spring and autumn, the autumn crop ends at the beginning of January and spring crop start at the beginning of April. Therefore, a gap of three months exists, i.e January, February and March with minimum production of garden bean in Egypt and in several Mediterranean countries due to the low temperature prevailing during this period at year. For instance, Temperature falls to less than 7˚c at night in January and February in Egypt. The demand for export of the Egyptian garden beans is located in the winter season. The production of garden beans is affected by factors such as rain fall, temperature, time of planting, plant density, soil fertilizer, insect infestations and diseases infection (Barakat, 2007, Mesbah *et al.*, 2011). Garden beans, *Phaseolus vulgaris* plants are attacked by different insect pests some of these are aphid, whitefly, trips, gassed, spiders' mite and leafminers that infest leaves of *Phaseolus vulgaris*. Apart from them the leafminers, *liromyza trifolii* Burg (Lepidoptera: Agromyzide) which under this study.

Leaf miner (*liromyza trifolii* Burg.) is serious pest of vegetable crops and ornamental plants worldwide. Injury is resulted when adult females puncture leaves for feeding, or oviposition and also when offspring larvae from serpentine mines (Parella *et al.*, 1985). These white tunnels interfere with the photosynthetic process, thus delaying crop development and decreasing the yield.

Integrated Pest Management (IPM) is a pest control strategy that uses a multitude of techniques to bring about effective, economic control of diseases, insects, nematodes, and weeds in snap bean fields. These techniques include cultural methods, resistant varieties, biological control, and use of chemicals (Barakat, 2007, Mesbah *et al.,* 2016).

Because of the rapid increase and spread of leafminers, growers have frequently applied large quantities of insecticides belonging to different chemical groups, some of which are evidently harmful for the beneficial insects. In addition, the applications of broad spectrum insecticides have resulted in a decrease of parasitoids abundance in the vegetable fields and an increase in the development of pesticide resistance within the fly populations, followed by an increase in leafminers density (Johansen *et al.*, 2003).

Therefore, the aim of the present study was focused on this insect pest that attacking in the field at different time of cultivations concerning with the leafminers. Also, the study evaluated some treatments as solely or in

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mixtures for controlling the leaf miners on this insect pest and to evaluate their efficacy on this harmful insect to be involved to an integrated pest management program "IPM".

MATERIALS AND METHODS

Experimental design:

The field trials were carried out in a private farm in El-Nahada region, 25 Km south west of Alexandria, cultivated with garden bean (*Phaseolus vulgaris*) var. Nepraska during the neely season of 2014, 2015 and 2016. The seeds were sown on 3rd September in both seasons.

The selected farm is divided into many longitudinal blocks separated by buffer paths of 1 m to prevent insecticides drift. The plants were grown along distance of 15-20 cm apart and in rows of 50 cm width. The experimental area where treated according to the normal agricultural practices and recommendation guidance.

Chemicals used:

1. Abamectin (Vertemic 1.8% EC) ®
2. Acetamiprid (Mospilan 20% SP) ®
3. Thiamethoxam (Actara 25% WG)®
4. Chlorantraniliprole (Coragen® 20% SC)®
5. Azadirachtin (Achock 0.15% EC) ®
6. Lambda-Cyhalothrin (Halothrin Chema 2.5% EC)®
7. Detergent (Potassy soap)®
8. Mineral oil (kz oil 98%)®

Field experiments:

To evaluate the performance of the tested insecticides on the incidence of insect-pest population, plants were sprayed with those suggested compounds to show to what extent they might be included in an IPM program of garden beans. Treatments included the application of seven compounds plus an untreated control check. Chemicals were applied with knapsack sprayer (20 l) (200 liter water / feddan). The compounds were applied according to the recommended dose of the Egyptian Ministry of Agriculture for the control of the targeted pest. Two rows were used as a barrier between each treatment to avoid any interference of spray drift and therefore, the sampled plants would be away from each other. The evaluated chemicals with their rates of applications were shown in Table (a).

The garden bean plants received just one application of each tested compounds in both the neely season 2014, 2015 and 2016. These applications were carried out with their recommended doses against leafminers, *L. trifolii* during the vegetative growth, after 45 days from cultivation. Treatments of the garden bean plants were carried out by using some compounds such as Abamectin, Acetamprid, Azadirachtin, Chlorantraniliprole, Lambda cyhalothrin, Detergent, Thaimethoxam and mineral oil.

Sampling technique:

5 plants were taken random way from each plot (replicate) before spraying (15 plants / treatment) and after 1, 3, 5, 7 and 10 days after spraying. In each plot (replicate) for calculating the reduction percentage the number of larvae per sampled plant was recorded

Calculation of the infestation reduction:

Pre and post treatment application after 1, 3, 5, 7 and 10 days, the percentages of infestation reduction were calculated according to Henderson and Tilton's equation, 1955 as follows:

$$\text{Reduction } \% = 1- \frac{A}{B} \times \frac{C}{D} \times 100$$

Where:

A = Mean No. of larvae in treatment after spraying.

B = Mean No. of larvae in treatment before spraying.

C = Mean No. of larvae in untreated check (control) before spraying.

D = Mean No. of larvae in untreated check (control) after spraying.

Table a. The agrochemicals and the rates of applications during experimental seasons of 2014, 2015 and 2016.

Trade name	Common name	Application rate
Vertemic 1.8 %® EC	Abamectin	100 cc / Feddan
Mospilan 20 %® SP	Acetamprid	50 g / Feddan
Achock 0.15 % ®EC	Azadirachtin	400 cc / Feddan
Coragen 20%® SC	Chlorantraniliprole	60 cc / Feddan
Halothrin Chema 2.5 %® EC	Lambda cyhalothrin	250 cc / Feddan
Potassy soap ®	Detergent	1000 cc / Feddan
Actara 25%® WG	Thaimethoxam	50 g / Feddan
kz oil 98%®	Mineral oil	3 L / Feddan

EC=Emulsifiable Concentration, SP=Sellable Powder, Sc = Suspension Concentration and WG =Granules or Tablets Water Dispersible

Statistical analysis:

Data were subjected to the analysis of variance test (ANOVA) as randomized complete block design. The least significant differences (LSD) at the 5% level were determined using a computer program (Costat) and Duncan's Multiple Range testes modified by Steel and Torrie, 1981 and LSD values were used to compare the mean numbers of inspected pest infestation.

RESULTS and DISCUSSION

The performance of different evaluated Agrochemical against the inspected leaf miner (*Liriomyza trifolii*) during the subsequent neely (Seasons of 2014 and 2015) on the garden beans (*Phaseolus vulgaris*)

It is obvious that the results in Table (1) and Fig. (1) showed that Chlorantraniliprole was significant more effective and represents the highest general means of reduction [90.98%] followed by abamectin [64.04%], Acetampride [55.60%] and Thiamethoxam [48.30%]. The least effective were corresponded to Lambda cyhalothrin[27.96%], Azadirachtin[25.55%] and Detergent [12.58%].

In the second neely season of 2015, the same trend was confined Chlorantraniliprole gave [77.07%] followed by Abamectin [64.13%] Acetampride [48.56%] and Thiamethoxam [38.94%]. The least effective results were obtained by Azadirachtin [29.18%], Lambda cyhalothrin [24.71%] and Detergent [9.32%], (Table, 2 and Fig. 2).

In fact these findings of results agree to a great extent with those obtained by Leibee (1988) who reported that abamectin was very effective against larvae of *Liriomyza trifolii* under laboratory conditions. Kotb (2000) stated that abamectin was effective against the leafminer, *L. trifolii.* Abd El-Zaher (2005) confirmed that abamectin was effective against the leafminer, *L. trifolii* giving 77.57 % reduction in neely season of 2004. In addition he stated that Detergent and Lambada cyhalothrin would not be recommended to be involved in a chemical program for controlling the leafminer, *L. trifolii* of the garden bean. Therefore, it is calculated that Chlorantraniliprole, abamectin and Acetamprid are good candidates to be included in an integrated pest management (IPM) program in leafminer, *L. trifolii*.

Biological performance of different adopted models for the tested chemical insecticides against the leaf miners (*Liriomyza trifolii*) during neely Seasons 2016 infesting the garden beans (*Phaseolus vulgaris*)

The results in Tables 3, 4 and 5 and Figs. 3, 4 and 5 showed that the efficiency of the tested insecticides through the different adopted models against the insect-pest compared to the untreated check

Table, (3) and illustrated in Fig. (3) proved that that there were significant difference regarding the general mean of reduction percentages among the tested treatments. In this context, the highest general means of reduction resulted from abamectin 68.96. Meanwhile both of acetamprid and lambda cyhalothrin gave reduced values of reduction comparised 47.88, 47.78% in respects. Table, (3)

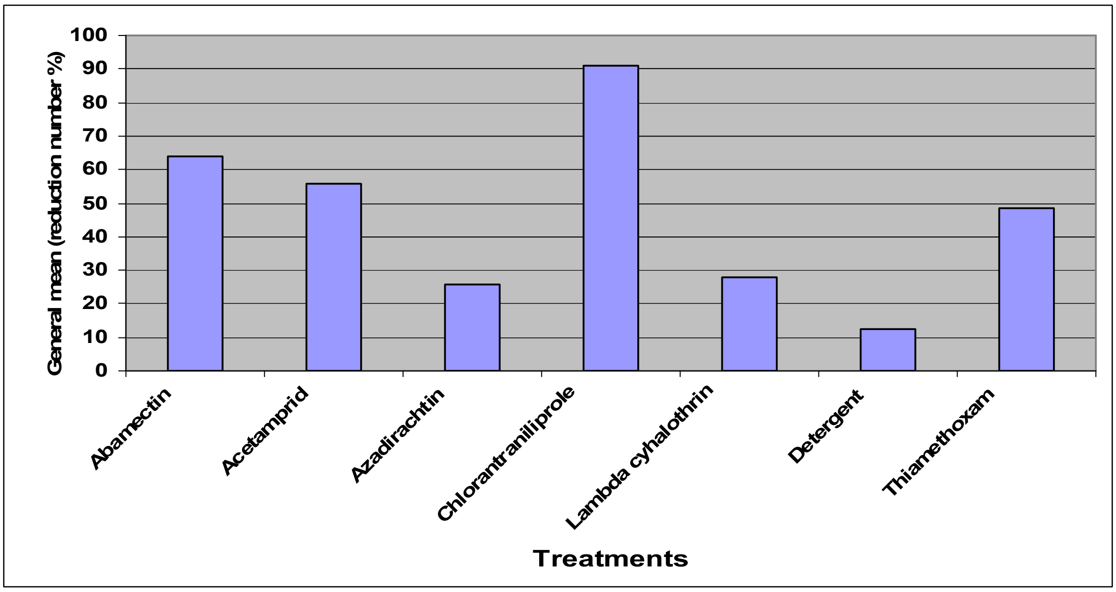

Fig. 1. Efficiency of tested compounds against *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2014.

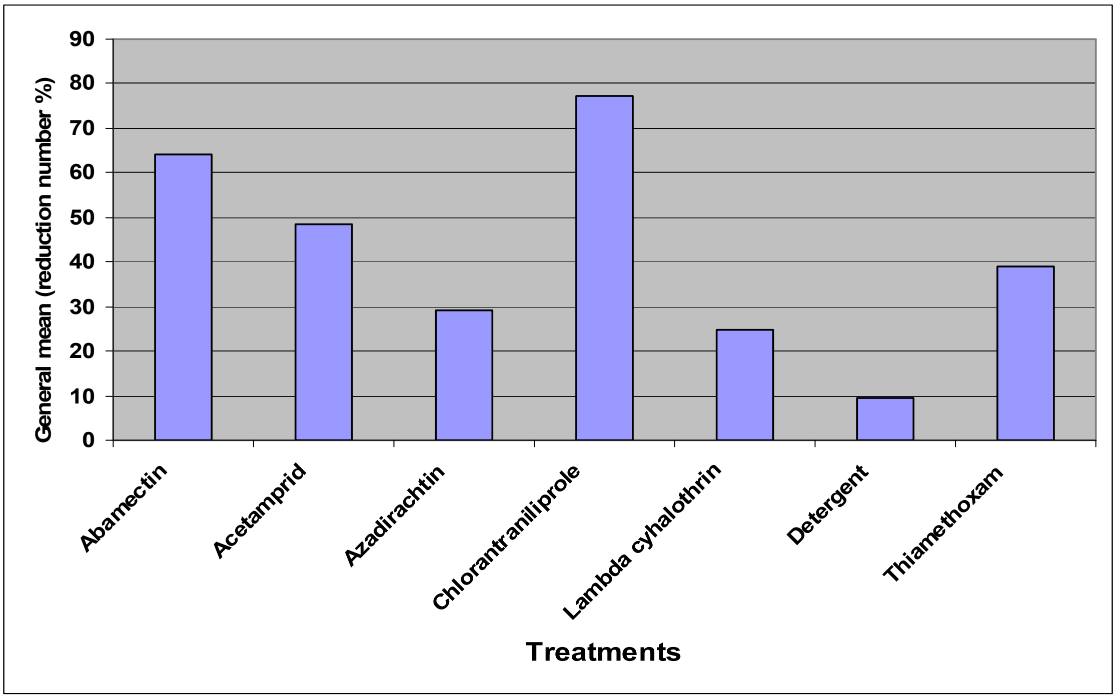

Fig. 2. Efficiency of tested compounds against *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2015.

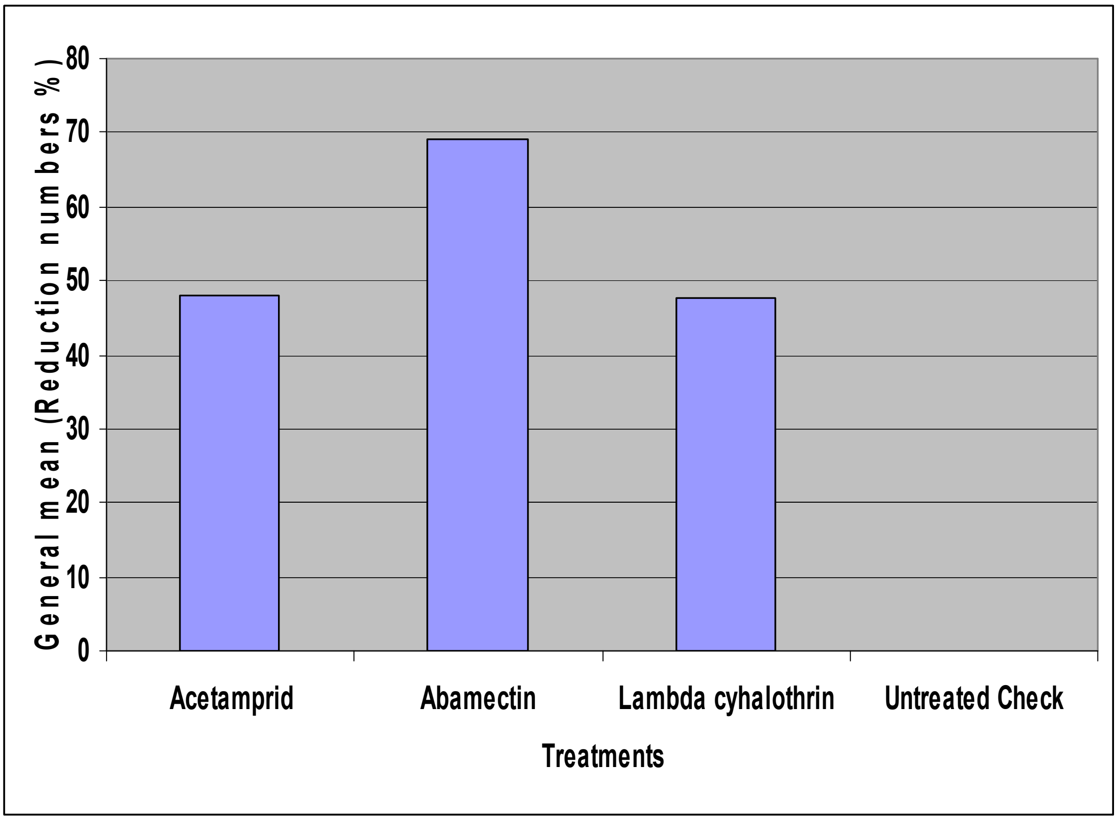

Fig. 3. Efficiency of tested pesticides against *L. trifolii* infesting *Phasolus vulgaris* leaflets in in neely cultivation of the season 2016.

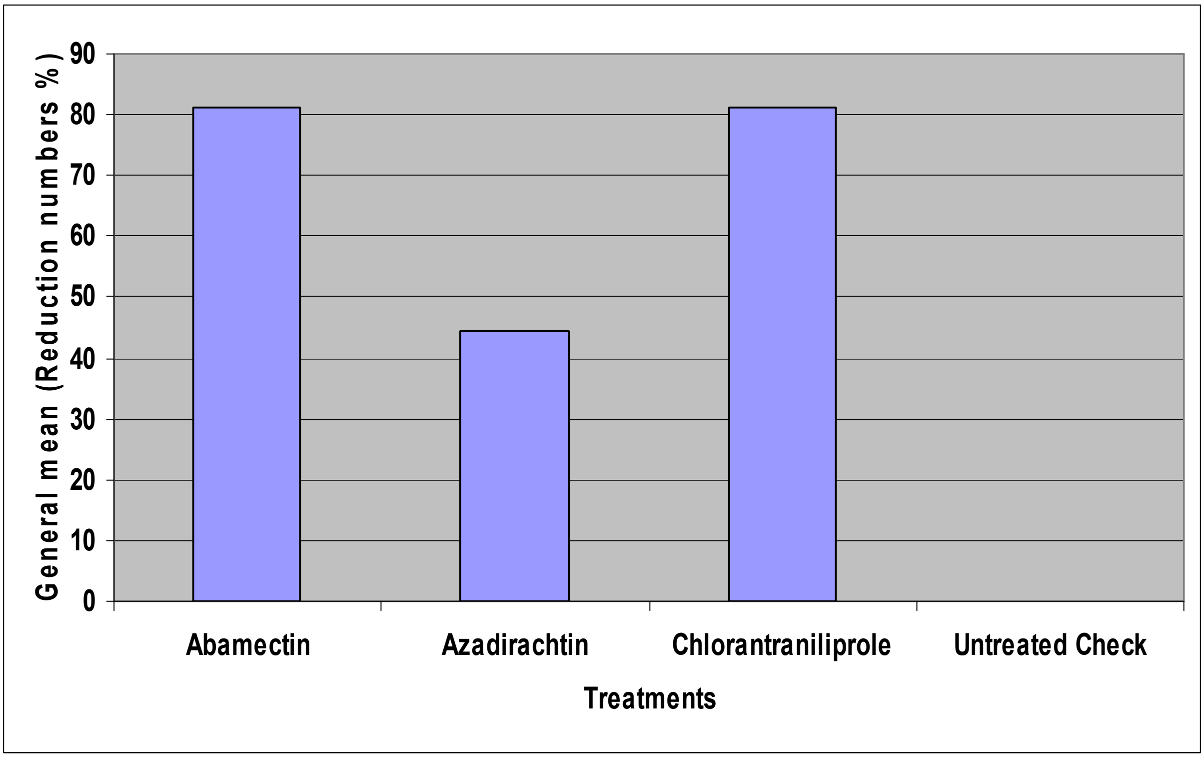

Fig. 4. Efficiency of tested pesticides against *L. trifolii* infesting *Phasolus vulgaris* leaflets in in neely cultivation of the season 2016.

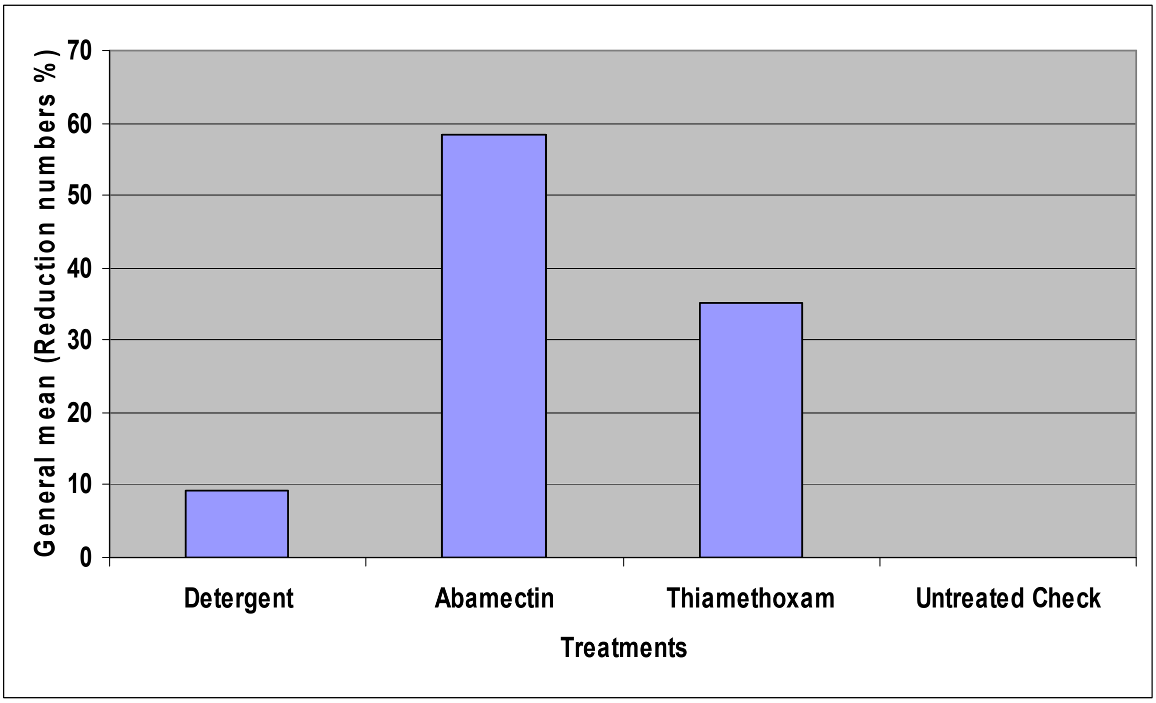

Figure 5. efficiency of tested pesticides against *L. trifolii* infesting *Phasolus vulgaris* leaflets in in neely cultivation of the season 2016.

Table 1. Efficiency of tested compounds against larvae of *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2014.

Treatments	Pre-treatment	Number of inspected leaf miners larvae after insecticides treatment										General mean of Reduction(%)
		1 day		3 days		5 days		7 days		10 days		
	A	A	R	A	R	A	R	A	R	A	R	
Abamectin	3.93b	2.66a	47.10	1.4d	53.35	0.93d	38.48	0.13g	81.30	00.00g	100.00	64.04b
Acetamprid	4.06a	2.93b	43.60	1.66c	49.79	0.8d	55.37	0.33f	64.13	0.13f	65.15	55.60a
Azadirachtin	3.2c	2.33d	43.10	1.33e	49.41	0.93d	35.24	1.53c	00.00	2.06c	0.00	25.55cd
Chlorantraniliprole	3.86b	1.93f	60.92	0.13g	94.03	00.00e	100.00	00.00h	100.00	00.00g	100.00	90.98a
Lambda cyhalothrin	2.93d	2.06e	45.06	1.13f	51.38	0.93d	23.78	0.86a	19.60	1.06d	0.00	27.96cd
Detergent	2.86a	2.33d	36.33	1.93b	26.59	2.6b	00.00	2.93b	0.00	3.3b	0.00	12.58de
Thiamethoxam	3.13c	2.66c	33.59	1.93b	43.30	1.13c	45.78	0.53e	59.22	0.33e	60.01	48.30bc
Untreated Check	2.86d	3.66a	0.00	4.13a	0.00	4.46a	0.00	5.13a	0.00	5.8a	0.00	0.00e
L.S.D $_{0.05}$	0.11	0.02		0.05		0.12		0.1		0.07		23.89

A: Mean number of larvae / plant.
R: Reduction percent of infestation after insecticide application.
* Means followed by the same letter(s) in each column are not significantly different at $P \leq 0.05$ level.

Table 2. Efficiency of tested compounds against larvae of *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2015.

Treatments	Pre-treatment	Number of inspected leaf miners larvae after insecticides treatment										General mean of Reduction (%)
		1 day		3 days		5 days		7 days		10 days		
	A	A	R	A	R	A	R	A	R	A	R	
Abamectin	3.06e	2.2d	28.10	1.13e	51.03	0.46g	41.53	0.33g	100.00	000g	100.00	64.13ab
Acetamprid	3.26b	2.06e	36.80	1.33d	38.44	0.86d	40.49	0.53f	49.77	0.13f	77.34	48.56bc
Azadirachtin	2.93f	1.93f	34.12	1.13e	44.18	0.8e	34.84	0.66e	32.76	1.06d	0.00	29.18cd*
Chlorantraniliprole	2.8h	1.6g	42.85	0.66f	60.67	0.13h	81.87	0.00h	100.00	0.00g	100.00	77.07a
Lambda cyhalothrin	3.2c	2.06e	35.62	1.33d	38.44	0.73f	49.49	0.93c	0.00	1.33c	0.00	24.71cde
Detergent	3.13d	2.46c	21.40	1.93c	25.20	2.06b	00.00	1.2b	0.00	1.73b	00.00	9.32de
Thiamethoxam	4.06a	3.13a	22.90	2.33b	29.03	1.66c	34.43	0.86d	57.77	0.46e	50.58	38.94bc
Untreated Check	2.86g	2.86b	0.00	3a	0.00	3.26a	0.00	4a	0.00	4.33a	0.00	0.00e
L.S.D $_{0.05}$	0.05	0.01	-	0.06		0.04	-	0.02	-	0.03	-	26.74

A: Mean number of larvae / plant.
R: Reduction percent of infestation after insecticide application.
* Means followed by the same letter(s) in each column are not significantly different at $P \leq 0.05$ level.

Table 3. Biological performance of certain pesticides through first model against *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2016.

Treatments	Pre-treatment	Neely season (2016)										
		Reduction numbers % of the leaf miners, *Liriomyza trifolii* after applying insecticides										General mean (Reduction numbers %)
		1 day		3 days		5 days		7 days		10 days		
	A	A	R	A	R	A	R	A	R	A	R	
Lambda cyhalothrin	4.06a	2.60bc	38.91	1.20c	60.03	1.00b	20.78	1.33b	0.00	2.06b	0.00	23.94bc*
Abamectin	3.46b	2.06c	43.21	1.06c	55.43	0.60b	46.19	0.00d	100	0.00c	100	68.96a
Acetamprid	3.73ab	3.13b	19.96	2.00b	44.66	0.80b	61.97	0.80c	12.33	0.00c	100	47.78ab
Untreated Check	4.13a	4.33a	0.00	5.00a	0.00	5.26a	0.00	6.00a	0.00	6.33a	0.00	0.00c
L.S.D $_{0.05}$	0.52		0.67		0.54		0.64		0.44		0.27	38.48

A: Mean number of larvae / plant.
R: Reduction percent of infestation after insecticide application.
* Means followed by the same letter(s) in each column are not significantly different at $P \leq 0.05$ level.

Table 4. Biological performance of certain pesticides through second model against *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2016.

Treatments	Pre-treatment	Neely season (2016)										
		Reduction numbers % of the leaf miners, *Liriomyza trifolii* after applying insecticides										General mean (Reduction numbers %)
		1 day		3 days		5 days		7 days		10 days		
	A	A	R	A	R	A	R	A	R	A	R	
Abamectin	4.33a	2.66b	48.53	0.86c	71.34	0.13c	85.91	0.00c	100	0.00c	100	81.15a*
Azadirachtin	4.53a	2.40b	55.61	1.20b	55.68	1.33b	0.00	1.66b	0.00	2.13b	0.00	22.25b
Chlorantraniliprole	3.13b	2.53b	32.28	0.73c	74.42	0.00c	100	0.00c	100	0.00c	100	81.34a
Untreated Check	3.46b	4.13a	0.00	4.66a	0.00	5.00a	0.00	5.60a	0.00	6.06a	0.00	0.00b
L.S.D $_{0.05}$	0.61		0.76		0.29		0.42		0.41		0.29	36.32

A: Mean number of larvae / plant.
R: Reduction percent of infestation after insecticide application.
* Means followed by the same letter(s) in each column are not significantly different at $P \leq 0.05$ level.

Table 5. Biological performance of certain pesticides through third model against *Liriomyza trifolii* infesting *Phaseolus vulgaris* (Nepraska cv.) in neely cultivation of the season 2016.

Treatments	Pre-treatment	Neely season (2016)										General mean (Reduction numbers %)
		Reduction numbers % of the leaf miners, *Liriomyza trifolii* after applying insecticides										
		1 day		3 days		5 days		7 days		10 days		
	A	A	R	A	R	A	R	A	R	A	R	
Detergent	3.80ab	3.06b	24.00	2.66b	17.53	2.86b	5.05	3.40b	0.00	4.00b	0.00	9.31bc*
Acetamprid	3.00b	2.60b	18.20	1.20b	56.21	0.93c	31.56	0.13d	86.65	0.00d	100	58.52a
Thiamethoxam	4.06ab	3.06b	28.87	2.40c	25.59	1.20c	55.84	0.86c	31.55	0.60c	34.59	35.28ab
Untreated Check	4.53a	4.80a	0.00	5.06a	0.00	5.73a	0.00	6.00a	0.00	6.40a	0.00	0.00c
$L.S.D_{0.05}$	1.09		1.17		0.34		0.62		0.45		0.38	29.02

A: mean number of larvae / plant.

R: reduction percent of infestation after insecticide application.

* Means followed by the same letter(s) in each column are not significantly different at $P \leq 0.05$ level.

In general, the data in Table (4) showed that Chlorantraniliprole and Abamectin are superior treatments, and recorded the highest general means of results 81.34 and 81.15 of reduction percent, respectively. The less effective ones was the detergent with a reduction percentage of (9.31) Table, (4) and Fig. (4).

During the third season of 2016, the same trend has been followed as the highest general mean of reduction percentages (58.52) attained by Abamectin succeeded by (35.28) for Thiamethoxam and Detergent with (9.31) a reduction percentage, in respect, Table, (5) and Fig. (5).

However, it was observed that Models of certain pesticides exhibited very high potentials than those insecticides, which were used solely to combat the leaf miners pest. These results are in agreement with those of Abdel-Zaher (2005) who found that abamectin and spinosad showed almost the same trend of efficiency against *L. trifolii* infesting green bean.

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الملخص العربي

الأداء البيولوجى لبعض الكيماويات الزراعية وبرنامج المكافحة ضد صانعات الانفاق فى الفاصوليا

عبدالفتاح سيد عبدالكريم سعد ، حسن على عبدالحميد مصباح، أحمد محمد كردى ومدحت خميس

أجريت التجربة الحالية فى مزرعة خاصة منزرعة بمحصول الفاصويا صنف نبراسكا أثناء الموسم النيلى ٢٠١٤، ٢٠١٥ و٢٠١٦ لمكافحة صانعات الأنفاق تحت الظروف الحقلية فى منطقة النهضة بمحافظة الأسكندرية، حيث قيمت بعض المعاملات لمكافحة صانعات الأنفاق التى تصيب محصول الفاصوليا فى مصر.

أوضحت النتائج خلال الموسم الأول ٢٠١٤ أن المتوسط العام لنسب خفض الإصابة خلال فترة الفحص حيث كان الكلورانترنيلبرول والأبامكتين أكثر المعاملات كفاءة ضد صانعات الأنفاق فى الفاصوليا حيث أعطت متوسط عام لخفض الإصابة يقدر بـ ٩٠,٩٨ و٦٤,٠٤% على الترتيب يليه الأسيتامبريد ٥٥,٦٠%، والثياميثوكسام ٤٨,٣٠% بينما كان أقل المعاملات لمبدا سيهالوثرين ٢٧,٩٦%، الأزديراختين ٢٥,٥٥% والصابون السائل ١٢,٥٨% على الترتيب.

لكن فى الموسم الثانى ٢٠١٥ كان أفضل المعاملات وأعلاها فى نسب الخفض كل من الكلورانترنيلبرول ٧٧,٠٧% والأبامكتين ٦٤,١٣% يلية كل م الأسيتامبريد ٤٨,٥٦% و الثياميثوكسام ٣٨,٩٤% كل على الترتيب بدون وجود فروق معنوية بينما كان أقل المعاملات كل من الأزديراختين ٢٩,١٨%، لمبدا سيهالوثرين ٢٤,٧١% والصابون السائل ٩,٣٢% كل على الترتيب بدون وجود فروق معنوية.

لكن فى الموسم الثالث ٢٠١٦ كانت أفضل المعاملات فى نسبة خفض الإصابة الأبامكتين منفرداً يلية الكلورانترنيليبرول، الأسيتامبريد والثيوميثوكسام فحين كانت أقل المعاملات فى نسبة خفض الإصابة لمبادا والأزديراختين والصابون السائل.