DEVELOPMENT OF IPM TECHNIQUES FOR CONTROL OF LEAFMINER, *LIRIOMYZA TRIFOLII* (BURGESS) ON COMMON BEAN , *PHASEOLUS VULGARIS* L.

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Abstract

The objective of this study aimed to investigate IPM techniques which would reduce leafminer, *Liriomyza trifolii* (Burgess) (Diptera : Agromyzidae) populations in common bean fields . Three IPM techniques, bean planting date, the use of seed dressing agents and the bio-insecticides, were tested. Results indicate that early planting of common bean, 1st August, significantly reduce the population of leafminer.

Seed dressing with Dinotefuran (MTI-446), Imidacloprid (Pestidor and Gaucho), significantly reduced leafminer larval in common bean fields and gave good protection up 6 weeks from sowing. Also, there is no significant differences between the effect of the three compounds.

Spraying of common bean plants with bioinsecticides significantly reduced number of leafminer larvae. Spinosad (Tracer 24% WG) was the most effective bioinsecticide followed by B.T (Agerin) and botanical insecticides Azadirachtin. Thus this bioinsecticide may be a promising component in IPM programs to control this leafminer.

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.), is considered one of the most important leguminous vegetable crops in Egypt. The vegetable leafminer, *Liriomyza trifolii* (Burgess) is a serious pest of vegetable crops and ornamental plants worldwide (Mc Donaled, 1991, Omar and Faris, 2000). Biological control of this pest has had limited success (Harris *et al*, 1990), therefore chemical control remains the most widely used method. As a result of intensive chemical use, *L. trifolii* has developed resistance to most classes of registered insecticides (Parrella and Keil, 1984 and Cox *et al*, 1995). Thus, new products with favorable environmental characteristics are required for the management of this pest in Egypt. Therefore, the objective of this study was to investigate IPM techniques for control of this leafminer in common bean based on avoiding, as much as possible, foliar spraying with synthetic insecticides. Three IPM techniques, planting date of common bean , the use of new seed dressing agents and the use of bio-insecticides as foliar sprays were tested.

MATERIALS AND METHODS

Effect of common bean planting dates on leafminer infestation :

The effect of common bean, *Phaseolus vulgaris* L., planting dates on the level of infestation by leafminer , *L. trifolii* was studied in two successive seasons of 2002 and 2003 in El– Behera Governorate . The planting dates were first , mid and end of August (The samples were taken from each block with completely randomized design). The experimental area of one feddan was divided into three equal blocks. Each block was cultivated at certain date. Each block was further divided into 4 plots (replicates). Bean plants were weekly examined after two weeks from planting until harvesting date .Twenty five infested leaves were randomly picked from each plot and transferred to the laboratory to estimate total number of larvae . The relationship between numbers of larvae and planting dates was determined.

All agricultural practices were followed and no chemicals were applied throughout the experiment. Data recorded were tabulated and statistically analyzed according to the method of Duncan (1955).

Insecticides Used:

1) Systemic insecticides : Gaucho 70 % WS , Pestidor 25 % WP., Imidacloprid, 1-(6-chloro-3-pyridinylmethyl)-N-nitro-2-imidazolidinimine and Dinotefuran, MTI – 446 20 % WP , N-methyl-N-nitro-N-[tetrahydro-3-furanylmethyl] guanidine

2) **Bioinsecticides** : Spinosad , Tracer 24% WG and Agerin 6.5% WP : *Bacillus thuringiensis* (B.t.), contains 32000 IU/mg .

3) **Botanical insecticides :** Achock 0.15% E.C Azadirachtin, .

Field Experiments :

1. Seed dressing experiment :

To evaluate the effect of three neonictonoids [gaucho 70 % WS , pestidor 25 % WP and MTI–446 20 % WP , as seed dressing on the incidence of leafminers , two field experiments were carried out during two successive seasons of 2002 and 2003 . All cultural methods and fertilizers were followed as commonly practiced .

The experiments were conducted in a randomized complete block design in four replications . Bean seeds (Bronco cv.) were treated before 6h of cultivation with the tested insecticides , at rates of 7 , 10 and 25 gm for 1kg seeds for gaucho , pestator and MTI–446 , respectively , and 4 plots were left untreated as a control . After 2 weeks from planting , a random sample of 25 leaves for each plot was taken weekly till 6 weeks from planting . The number of larvae was counted and reduction of pest numbers as percentage was calculated according to Abbot,s equation as follow :

Reduction Percent (%) = 100 [(A – B) / A] where : A = pest number in the control , B = pest number in the treatment.

2 . Foliar spray experiment:

To evaluate the efficacy of two bio-insecticides , spinosad (Tracer 24% SG) and B.t. (Agerin 6.5% WP) and one botanical compound , azadirachtin (Achock 0.15% EC) against leafminers , two field experiments were carried out during the two successive seasons of 2002 and 2003 . Growing common bean seeds variety of Bronco took place in August of both seasons, in an area of one feddan . All agricultural methods and fertilizers were followed as commonly practiced .Three different rates of Tracer 24 % S G : 30 , 20 & 10 ml /100L, Agerin 6.5 wp , 250 , 200 , 150 mg and Achock 0.15 % EC : 1000 , 750 and 500 ml/100ml . Thus, the experiment consisted of 10 treatments (including the untreated control) arranged in a complete randomized block design with 4 replicates . Each replicate was 7 x 6 m. The insecticides were applied with knapsack sprayer twice at 15 days interval.

Samples of 40 leaves (10 leaves from each replicate) were taken at random before spray and after 2 , 5 , 7 , 10 and 15 days from application. The population density of the larvae was carried out by transferring the plant leaves in paper bags to the laboratory for inspection by the aid of binuclear microscope .

To evaluate the efficiency of the tested agents against *L. trifolii* , the percentage of reduction of the population density was calculated according the formula given by Henderson and Tiliton (1955) as follow:

Reduction (%) = 100 [1 – (Ta X Cb / Tb X Ca)] Where : Tb = pre – treatment counts , Ta = post – treatment counts , Cb = counts in the control before treatments and Ca = counts in the control after treatments .

Reduction percentages were calculated after 2 , 5 , 7 , 10 and 15 days from treatment and the mean reduction percentage was based on the overall mean population within 15 days .

RESULTS AND DISCUSSION

1- Effect of planting date :

Statistical analysis revealed that planting date of common bean significantly affected *L. trifolii* larval population in both seasons of 2002 and 2003 as shown in the Table (1) . The lowest infestation occurred when common bean was sown in first of August 72.27 – 75.13 larvae / 100 leaves while the highest one was achieved when common bean was sown in mid of August 108.9 and 114.17 larvae / 100 leaves: This variation in leafminer infestation is probably due to changes in prevailed weather conditions and other ecological factors. Thus, cultural management, such as early

cultivation of common bean can reduce its infestation with leafminer , *L. trifolii* .This agrees with the results given by Roy *et al.* (1997) , and Abd El – Aziz (2001) . Therefore , the recommended date for planting of common bean is the first of August to reduce the population density of leafminer .

2- Effect of seed dressing agents :

The efficiency of seed dressing neonicotinoids, MTI-446, pestidor, and gaucho, against the leafminer larvae was investigated . Results in Table (2) show that seed dressing compounds significantly reduced leafminer larvae on common bean. According to the average means of reduction percentages within six weeks results showed that there are no significant differences between the effect of the three compounds but MTI-446 was superior (82.59 %) followed by gaucho (73.75 %) and pestidor (69.4 %). These compounds gave good protection up to five weeks from sowing .

Thus , the use of imidacloprid , the active ingredient of gaucho and pestidor , with very low application rate (7 mg / kg) , will provide the grower with an additional tool of IPM for control of *L. trifolii* on common bean plants with less environmental impact and increased applicator and consumer safety compared to standard technology (using of synthetic insecticides as foliar spray) as reported also by Mullins (1993) .

3- Effect of bioinsecticides :

Bio-insecticides are environmentally safer and more economical (Kirschbaum , 1985) .They emerged as powerful alternatives to conventional chemical insecticides (Hofte and Whiteley, 1989). Spinosad is a broad – spectrum bacterial insecticide , represent a novel class of macrocyclic lactones produced by the soil actinomycete , *Saccharopolyspora spinosa* (Mertz and Yao , 1990). Results in Table (3) revealed that spraying of bean plants with 10 , 20 and 30ml spinosad / 100 L water resulted in 74.1 , 90.8 and 95.0 % reduction , respectively, of leafminer larvae after 2 days from application.

It is important to define the minimum effective rate of spinosad for leafminer control , not only for economical reasons but also to minimize the potential impact on non – target organisms . Contact toxicity of spinosad to honey bees by Dow Elanco , (1994) and Boyd and Boethel , (1998). and predaceous hemipteran adults has been reported .

Spinosad applied to field crops generally loses activity after a week (Liu *et al.* , 1999) . This finding support the present results which indicate that the activity of spinosad against leafminer on common bean plants start to decrease after the 5th day from application. These results may be due to the degradation of spinosad by the sunlight as reported by Saunders and Bert (1997) . These findings concerning the

effects of spinosad are in agreement with the report of Agnew (2001) who stated that spinosad is the only chemistry available that provides control for *L. trifolii* .

Very few data are available on the insecticidal activity of *B. thuringiensis* based bioinsecticides against the leafminer , *L. trifolii* on common bean plants . Results in table (4) indicate that the foliar spray of common bean plants with the *B.t.* formulation , agerin, showed significant reduction in the larval numbers of this leafminer . This effect (as % reduction) was increased by the laps of time e.g. from 73.2% after 2 days to 86.5% after 15 days from application with the recommended rate (250 gm / 100 L) . Fifteen days after application with 250 , 200 and 150 gm of agerin / 100 L resulted in 86.5% , 75.6% and 66.8% reduction in larvae of the leafminer , respectively . There are no significant differences between recommended and 0.8 rates of Agerin . In this respect , Al-Amd *et al.* (2001) found that *B.t.* formulations , bactospeine and Dipel are effective against the leafminer , *L. bryoniae* and suggest their useful role in controlling this pest on vegetable crops .

Of the botanical insecticides tested to date , only neem-based insecticides are effective against different phytophagous insect pests (Weintraub and Horowitz , 1997) . Results in Table (3) revealed that foliar spray of common bean plants with azadirachtin caused significant reduction of the larval population of the leafminer , *L. trifolii* . This effect (% reduction) was increased from 71.0% after 2 days to 73.5 , 79.1 , 81.0 and 85.5% after 5 , 7 , 10 and 15 days from application respectively . Similarly, Azam (1991), Dimetry *et. al.* (1995) and Civelek *et al.* (2002) found that *L. trifolii* and the related pea leafminer, *L. huidobrensis* (Blanchard) were adversely affected by neem formulations .

In conclusion, the overall results indicate that early planting of common bean, 1st of August, seed dressing with neonicotinoids and foliar spraying of plants with the bioinsecticde, spinosad may be effective IPM stratigies for reducing leafminer population in the common bean fields.

Table 1. Effect of common beam planting date on the population density of leafminer , *Liriomyza. trifolii* during 2002 and , 2003 season.

Planting date / Plant age	Mean Number of Larvae / 100 leaves					
	First of August		Mid of August		End of August	
	2002	2003	2002	2003	2002	2003
14	11.75	16.52	28.25	31.75	31.75	30.25
21	30.0	28.75	58.25	60.20	67.75	45.00
28	64.25	50.50	80.0	180.25	101.0	29.25
35	99.0	85.00	204.0	114.25	146.0	62.75
42	121.5	118.25	102.5	127.75	66.0	119.00
49	93.0	71.25	237.75	235.00	81.5	138.75
56	72.5	110.25	185.0	204.25	183.0	160.25
63	116.5	116.50	215.5	155.00	135.0	129.5
70	112.75	189.25	85.0	79.00	112.75	133.5
77	77.5	82.75	55.0	102.50	91.25	198.00
84	53.0	19.25	26.75	47.75	61.0	83.75
91	15.5	13.25	28.75	32.00	23.25	15.5
Mean	72.27	75.13	108.9a	114.17a	90.02a	95.46ab
Average of two seasons	73.7		111.54		92.48	

F value= 5.11 for 2003 .

F value = 5.04 for 2002

Means in the same column followed by the same letter are not significantly different Dancan 1955.

Table 2. Effect of seed dressing insecticides on the population density of leaf miner , *Liriomyza. trifolii* larvae on common bean plants cultivated in 2002 & 2003 .

Treatment	Weeks after sowing										**Mean reduction(%)
	2nd		3rd		4th		5th		6th		
	A	B	A	B	A	B	A	B	A	B	
2002											
MTI-446	6	96.44	16	94.13	29	91.07	101	75.95	227	55.57	82.63a
Pestidor	19	88.75	50	81.68	83	74.46	172	59.04	280	45.20	69.82a
Gaucho	16	90.53	44	83.88	61	81.23	144	65.71	262	48.72	74.01a
Control	69	-	273	-	325	-	420	-	511	-	-
2003											
MTI-446	5	96.79	21	92.78	50	88.42	114	78.49	201	56.30	82.55a
Pestidor	18	88.46	57	80.41	91	78.93	240	54.71	265	42.39	68.98a
Gaucho	14	91.02	51	82.47	86	80.09	190	64.15	231	49.78	73.50a
Control	156	-	291	-	432	-	530	-	460	-	-
Mean of 2002 & 2003											
MTI-446	5.5	96.61	18.5	93.45	39.5	89.74	107.5	77.22	214.0	55.93	82.59a
Pestidor	18.5	88.60	53.5	81.04	87.0	76.69	206.0	56.87	272.5	43.79	69.40a
Gaucho	15.0	90.77	47.5	83.17	73.5	80.66	167.0	64.93	246.5	49.25	73.75a
Control	112.5	-	282.0	-	378.5	-	475.0	-	485.5	-	-

A: Number of larvae / 100 leaves

B: Reduction percentage according to Abbott's equation (1955) .

** Mean reduction was calculated based on the overall mean reduction within 6 weeks .

Means in the same column followed by the same letter are not significantly different .

Table 3. Efficacy of some bio and botanical insecticides as foliar spray on population of leaf miner , *Liriomyza. trifolii* larvae on common bean during 2002 & 2003 seasons .

Treatment	Rate/ 100L water	Mean number and reduction (%) of leaf miner , *L. trifolii* after different days of spray											**Mean Reduction(%)
		Pre - spray	2 day		5 day		7 day		10 day		15 day		
			A	B	A	B	A	B	A	B	A	B	
Spinosad	30ml	45.7	2.7	95.0	2.0	95.7	2.5	91.6	4.2	88.4	9.5	80.8	90.2a
Spinosad	20ml	48.2	4.2	90.8	5.7	86.0	7.5	78.8	10.0	76.7	13.7	71.1	80.6a
Spinosad	10ml	57.7	13.5	74.1	16.7	67.1	16.7	63.2	21.0	61.2	27.7	54.5	64.0b
Untreated		72.2	67.2		68.2		66.2		72.5		78.5		
Agerin	250gm	42.5	11.0	73.2	8.2	78.1	6.7	83.3	6.7	83.8	6.0	86.4	80.7a
Agerin	200gm	38.5	17.0	61.9	15.0	67.6	13.0	71.7	12.7	74.4	12.0	75.6	70.1b
Agerin	150gm	50.7	21.0	55.1	19.0	59.5	17.2	61.4	16.7	64.4	15.7	66.7	61.4b
Untreated		72.5	68.0		68.7		64.2		65.5		64.5		
Azadirachtin	1000 ml	45.0	12.5	71.0	11.2	73.5	10.0	79.1	8.2	81.0	6.2	85.5	78.0a
Azadirachtin	750 ml	45.2	18.2	55.6	13.7	66.9	13.5	70.6	12.5	71.0	10.0	76.7	68.4b
Azadirachtin	500 ml	51.7	25.5	45.8	22.5	55.9	22.0	58.6	19.2	61.1	13.7	70.2	58.8b
Untreated		75.2	70.2		71.7		72.2		71		60.7		

A: Number of larvae / 40 leaves.

B: Reduction percentage according to Henderson and Tilton's equations (1955).

** Mean reduction was calculated based on the overall mean reduction within 15 days of spray .

Means in the same column followed by the same letter are not significantly different .

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استخدام أسلوب المكافحة المتكاملة لمكافحة صانعات الأنفاق *Liriomyza trifolii* (Burgess) على نباتات الفاصوليا *Phaseolus vulgaris* L.

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أجريت هذه الدراسة بمحطة البحوث الزراعية بأبيتاى البارود محافظة البحيرة خلال الفترة ٢٠٠٢/٢٠٠٣ حيث تم دراسة تكامل استخدام ثلاثة طرق متتالية للسيطرة على صانعات الأنفاق وهى تأثير مواعيد الزراعة ،معاملة البذور قبل الزراعة بالمبيدات الحشرية الجهازية ، ثم الرش بالمبيدات الحشرية الحيوية . وقد أظهرت هذه الدراسة انه انسب موعد لزراعة الفاصوليا هو أول أغسطس حيث كان مستوى الإصابة بصانعات الأنفاق اقل ما يمكن معنويا عن الزراعة في منتصف و أخر أغسطس يلي ذلك معاملة بذور الفاصوليا بأحد ثلاثة من المبيدات الحشرية الجهازية وهم Imidacloprid: (Gaucho,Pestidore)، Dinotefuran, (MYI-446) قد أدى إلي خفض تعداد الحشرة معنويا لمدة ستة أسابيع متتالية من الإنبات وتشمل الخطوة الثالثة رش نباتات الفاصوليا بأحد المبيدات الحيوية الآتية :

Spinosad (Tracer 24% wg) or Bacillus thuringiesis (Agerin 6.5%WP) or Botanical insecticide (Achock 0.15%EC)

حيث أدى استخدام هذه المبيدات إلى خفض تعداد الحشرة معنويا .وكان المركب الحيوي ترسير اكثر فعالية يلية المبيد الحيوي اخرين ثم المبيد النباتي اشوك .