EFFECT OF FABA BEAN – CEREALS INTERCROPPING AND NITROGEN FERTILIZATION ON THE INFESTATION BY THE LEAFMINER *Liriomyza trifolii* (BURGESS) ON FABA BEAN PLANTS.

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ABSTRACT

Field experiments were conducted at Kafr El-Sheikh, Egypt over two winter seasons, 2006/07 and 2007/08, to evaluate the effect of faba bean-cereals intercropping and nitrogen fertilization on leafminer, *Liriomyza trifolii* (Burgess) infestation on two cultivars of faba bean *Vicia faba*. Level of leafminer infestation increased gradually from mid-December reaching maximum levels by the end of March. Larvae population increased gradually reaching a maximum level by mid-February, and then gradually decreased and completely disappeared by the end of March. Triticale intercropping with Faba bean, cv. Giza Blancka, and nitrogen fertilization (50 kg /Feddan) resulted in the lowest susceptibility to leafminer infestation during the first and second seasons. Wheat intercropping with faba bean, cv. Giza Blancka was the best treatment to reduce the population of leafminer larvae, while barley intercropping with faba bean, cv. Yossif El-Sediek resulted in the highest leafminer population.
Keywords: Faba bean; intercropping; leafminer

INTRODUCTION

Faba bean (*Vicia faba* L.) is an important legume crop, used as a human food and animal feed (Rubiales, 2011). Unfortunately, faba bean plants are susceptible to the attack of numerous insect species. Leafminer (*Liriomyza trifolii* Burgess) is considered as a serious insect that causes considerable loss to the quantity and the quality of faba bean (Abate and Ampofo, 1996; Jung, 2014). Infestation by *Liriomyza* spp. can cause both direct and indirect damage, such as; disease transmission, seedling death, crop reduction, fruit damage, and reduction of the aesthetic value of ornamental plants, in addition to plant quarantine problems (Abdul Rassoul and Al-Saffar, 2013). Difference in plant susceptibility and plant resistance to the insect attack has been reported for most faba bean cultivars (Hannou and Hegazi, 1996; Abdallah *et al*., 1996, 2000; El-Khouly *et al.*, 1997; Mohamed and Salman, 2001; Abdel-Samad and Ahmed, 2007 and Awadalla *et al.*, 2013 and 2014) . As leafminer will continue to be important pest of high value crops, insecticides will continue to be an important component for leafminer management, therefore it is imperative to continue to refine the use of insecticides that target leafminer. Improving application, timing and methods will help to conserve insecticides susceptibility and maintain efficacy by mitigating the evolution of resistance (Reitz *et al.*, 2013).

Generally, most of the control approaches are partially effective and sometimes inconsistent and affected by the environmental conditions. Intercropping is the simultaneous cultivation of more than one crop species in close association to take the advantage of biodiversity, competition and complement between the two crops (Boudreau, 1993). The simultaneous cultivation of legumes and cereals increased the protein content of the legume crop, and the forage nutritional value of the cereal crop (Strydhorst et al., 2008). The beneficial effect of intercropping and nitrogen fertilization for disease control has often been acknowledged (Finckh et al., 2000; Mundt, 2002).

This research is focusing on using some integrated pest managements methods to control leafminer on faba bean, in a way to reduce or cease insecticides use that target leafminer. The objective of this study is to test various combined treatments of cultivars, fertilization, and intercropping on the leafminer *L. trifolii*.

MATERIALS AND METHODS

Field experiments were carried out at Amya region, Kafr El-Sheikh, Egypt during two successive winter seasons of 2006/07 and 2007/08. Two faba bean cultivars; Giza Blancka (Large seeds) and Yossif El-Sediek (small seeds) were cultivated in ten treatments each. In each season, an area of about 400 m^2 was prepared and divided into 80 plots of about 4 m^2 each. Every plot was separated from other plots with two uncultivated rows (about 55cm both). Treatments were evaluated in 2 cultivars (Giza Blancka and Yossif El-Sediek) × 5 cropping systems (faba bean alone, and intercropped with oat *Avena sativa* L., cv. Aspen, barley *Hordeum vulgare* L., cv. Cory, wheat *Triticum durum* Desf., cv. Meridiano, or triticale *Triticosecale wittm*, cv. Peñarroya) × 2 fertilization levels (0 and 50 kg N/Feddan) completely randomized block design with 4 replicates. All faba bean seeds were sown on October 15^{th} of both seasons. Seeds were planted (2 seeds/hill) at 20 cm apart between hills.

Leafminers *Liriomyza trifolii* (Burgess) assessment was started one month after sowing (November 15^{th}), and was performed at 15-day intervals until faba bean plants reached the maturity stage by March 31^{st}. Ten plants per plot were randomly chosen to count the total number of plant leaflets, and number of infested leaflets. The percentage of infestation were calculated according to the following equations;

$$\frac{\text{Number of infested leaflets} \times 100}{\text{Total number of leaflets}}$$

To determine the population densities of *L. trifolii* larvae, a sample of 25 leaflets per replicate was randomly chosen form upper, middle; and lower parts of faba bean plants. The chosen leaflets were placed in polyethylene bags and transferred to the lab for inspection.

Data were analyzed using the general linear model procedure of SAS 9.2 (SAS, Inc., 2002), and means separation was performed using Duncan multiple range test (DMRT) (Duncan, 1955).

RESULTS AND DISCUSSION

Infestation percentage

Results in Tables 1 and 2 showed that the infestation percentage increased gradually in all treatments towards the end of both seasons. Most data showed that Yousef El-Seddiek cultivar is more susceptible for leafminers infestation than Giza Blancka cultivar. Oat intercropping with Yousef El-eddiek cultivar at both nitrogen levels (0 and 50 Kg N/Feddan) increased infestation percentage significantly in comparison with Giza Blancka cultivar during both seasons. A significant difference was also noticed between both cultivars when intercropping with Triticale at 50 Kg N/Feddan in both seasons. Intercropping triticale with Giza Blancka cultivar at 50 Kg N/Feddan showed the highest and significant infestation percentage in comparison with all other treatments, except with the treatment of oat intercropping with Giza Blancka cultivar at 50 Kg N/Feddan, in both seasons.

The analysis of variance of these data generally showed a significant effect of both the cultivar and the intercropping, as well as the combination effect of cultivar, fertilization, and intercropping in both seasons (Table 5).

The variation among faba bean cultivars in susceptibility to leafminer under the Egyptian environmental conditions may be related to the morphological and the anatomical characteristics, such as leaf shape and color, solidness of the leaflets, and cell wall thickness, as well as the physiological characteristics, such as repellent and attractants of the plants, and some other factors, such as the environmental conditions, location, and planting date (Hassanein, 1989; Abdallah et al., 1996; Hannou and Hegazi,1996; El-Khouly *et al.*, 1997; Abdallah *et al.*, 2000; Mohamed and Salman, 2001; Abdel-Samad and Ahmed, 2007; El-Samahy, 2008; Salman *et al.*, 2015).

The difference in leafminer infestation percentage due to intercropping may be due to the physiological characters of the intercropped plants, such as repellent and/or attractants. In this regard, Liebman and Dyck (1993) reported that intercropping can be an effective ecological method to control pests, diseases and weeds via natural competition that allows for more efficient resources utilization. Many African farmers traditionally intercrop maize or sorghum with legumes to increase crop production, achieving better returns on fertilizers, pesticides, energy and manpower resources (Fernandez-Aparicio *et al.,* 2008). Many authors applied intercropping on legumes to reduce either infestation with pests or infection with diseases. Intercropping faba bean with lupine, fenugreek, or Egyptian clover markedly reduced its infestation with root parasite *Orobanche crenata* Forsk (Bakheit *et al.*, 2002) or the obligate parasite *Orobanche foetida* (Kharrat and Halila, 2005). Intercropping of maize or sorghum with legumes was used to reduce infection by witchweed *Striga hermonthica* (Oswald et al., 2002). Also, intercropping of legumes with oat (Fernandez-Aparicio *et al.*, 2007) or with fenugreek (Fernandez-Aparicio *et al*., 2008) reduced the infestation of legumes by root parasite *Orobanche crenata* Forsk. Intercropping of bean with maize significantly reduced the incidence and the severity levels of bean common bacterial blight and rust, compared with sole cropping (Fininsa, 1996).

Population fluctuation of leafminer

Results in Tables 3 and 4 showed that the larvae of leafminer were found on all treatments during the same time of the growing season on December 15 of both seasons. The population of larvae gradually increased with the progress of the season, and reached the maximum level on February 15, and then decreased gradually until disappeared by the end of March in both seasons. The number of larvae per 25 leaflets counted on Yousef El-Sediek cultivar was generally higher than that on Giza Blancka cultivar, and a significant difference between both cultivars was noticed at the control treatment, intercropping with triticale at 0 Kg N/Feddan, and intercropping with barley, wheat, or triticales at 50 Kg N/Feddan in both seasons.

Like the infestation percentage, the analysis of variance of results of both seasons showed a significant effect of the cultivar, and the interaction of cultivar, fertilization and intercropping on the number of larvae per 25 leaflets, but no significant effect was noticed in regards to the intercropping (Table 5).

These results are in agreements with the findings of Hannou and Hegazi (1996), El-Khouly *et al.* (1997), Abdallah et al. (2000), Mohamed and Salman (2001), Ebadah *et al.* (2006), Abdel-Samad and Ahmed (2007) and El-Samahy (2008) who concluded that the preference of leafminer to a cultivar than another may be related to cell wall thickness and solidness of the leaflets, as well as the repellent effect or the attraction of the plant to the insect.

Table (1):Effect of intercropping and nitrogen fertilization on the percentage of leafminer *L. trifolii* infestation on Faba bean plants during the first season 2006/07.

Treatments			Infestation (%)								
Variety	Nitrogen fertilization	Intercropping	December 2006		January 2007		February 2007		March 2007		Mean
			15	31	15	31	15	28	15	31	
Yousef El-Sediek	0 Kg/Feddan	None	23.40^{abc}	38.31^{abc}	41.20^{ghi}	56.19^{ab}	69.19^{ab}	89.79^{a}	92.31^{abcd}	100.00^{a}	63.80^{ab}
		Oat	22.11^{cdef}	43.34^{ab}	45.65^{abcde}	51.44^{abcd}	69.98^{ab}	88.68^{ab}	90.17^{bce}	99.33^{ab}	63.84^{ab}
		Barley	22.35^{cde}	42.23^{ab}	43.07^{cdefghi}	56.63^{ab}	69.19^{ab}	89.79^{a}	89.64^{cde}	99.08^{ab}	64.00^{abc}
		Wheat	22.66^{bcd}	42.27^{ab}	45.14^{abcdef}	57.23^{a}	65.28^{abcde}	88.58^{ab}	91.37^{abcde}	100.00^{a}	64.07^{a}
		Triticale	22.75^{abcd}	42.48^{ab}	44.31^{bcdefg}	55.49^{abc}	68.88^{abc}	89.23^{a}	90.76^{bcde}	100.00^{a}	64.24^{a}
	50 Kg/Feddan	None	21.17^{defg}	43.79^{a}	46.38^{abcd}	47.86^{de}	69.83^{ab}	87.96^{abc}	89.64^{cde}	99.25^{ab}	63.24^{abc}
		Oat	19.12^{h}	35.04^{c}	42.22^{defghi}	57.49^{a}	69.19^{ab}	89.79^{a}	91.74^{abcde}	100.00^{a}	63.07^{abc}
		Barley	21.90^{cdef}	39.23^{abc}	42.05^{efghi}	57.74^{a}	62.26^{def}	88.90^{ab}	90.90^{bcde}	99.18^{ab}	62.77^{abcd}
		Wheat	20.65^{efgh}	43.79^{a}	47.84^{a}	49.23^{cde}	68.37^{abc}	84.21^{c}	89.71^{cde}	98.70^{b}	62.81^{abcd}
		Triticale	23.15^{abc}	43.66^{a}	42.59^{defghi}	49.56^{cd}	68.83^{abc}	88.41^{ab}	95.00^{a}	100.00^{a}	63.90^{ab}
Giza Blancka	0 Kg/Feddan	None	24.59^{ab}	43.16^{ab}	46.38^{abcd}	50.37^{bcd}	65.37^{abcde}	87.81^{abc}	91.04^{abcde}	100.00^{a}	63.59^{abc}
		Oat	19.86^{gh}	37.24^{bc}	43.79^{bcdefgh}	50.23^{bcd}	61.99^{def}	89.14^{a}	91.37^{abcde}	100.00^{a}	61.70^{cd}
		Barley	24.67^{a}	40.34^{abc}	44.21^{bcdefg}	46.44^{def}	59.35^{f}	89.88^{a}	94.24^{ab}	100.00^{a}	62.39^{abcd}
		Wheat	23.08^{abc}d	41.82^{ab}	45.41^{abcde}	50.41^{bcd}	63.00^{cdef}	89.17^{a}	95.00^{a}	100.00^{a}	63.49^{abc}
		Triticale	23.53^{abc}	44.28^{a}	40.07^{i}	51.68^{abcd}	66.46^{abcd}	86.87^{abc}	95.00^{a}	100.00^{a}	63.49^{abc}
	50 Kg/Feddan	None	23.60^{abc}	39.96^{abc}	43.13^{cdefghi}	41.25^{fg}	64.14^{bcdef}	88.18^{abc}	92.96^{abc}	100.00^{a}	61.65^{cd}
		Oat	20.41^{fgh}	40.31^{abc}	41.84^{fghi}	47.38^{de}	66.08^{abcde}	84.75^{bc}	88.65^{de}	98.65^{b}	61.01^{de}
		Barley	22.73^{bcd}	41.576^{ab}	43.98^{bcdefgh}	56.54^{ab}	64.80^{abcdef}	87.82^{abc}	88.20^{e}	100.00^{a}	63.21^{abc}
		Wheat	21.76^{cdef}	42.23^{ab}	42.91^{defghi}	43.02^{efg}	64.19^{bcdef}	89.51^{a}	92.69^{abcd}	100.00^{a}	62.04^{bcd}
		Triticale	28.00^{h}	38.93^{abc}	40.61^{hi}	39.51^{h}	60.22^{ef}	87.95^{abc}	90/29^{bcde}	100.00^{a}	60.69^{e}
Significance			**	*	**	**	**	*	**	*	**

Means of each column followed by the same letter are not significantly different at the 5% level according to Duncan 's Multiple Range Test.
- * and ** indicate P<0.05 and P<0.01, respectively.

Table(2):Effect of intercropping and nitrogen fertilization on the percentage of leafminer *L. trifolii* infestation on Faba bean plants during the second season 2007/08.

Treatments			Infestation (%)								
Variety	Nitrogen fertilization	Intercropping	December 2007		January 2008		February 2008		March 2008		Mean
			15	31	15	31	15	29	15	31	
Yousef El-Sediek	0 Kg/Feddan	None	24.63^{ab}	40.33^{abc}	43.37^{efg}	59.15^{a}	74.50^{a}	92.64^{abc}	97.17^{abcd}	100.00^{a}	66.47^{ab}
		Oat	23.27cdef	45.63^{ab}	48.58^{ab}	54.14^{bc}	73.66^{ab}	93.35^{ab}	94.91^{cde}	99.40^{ab}	66.62^{a}
		Barley	23.53^{cde}	44.45^{ab}	45.34^{bcdefg}	59.61^{a}	70.63^{abcd}	92.26^{abc}	94.36^{cde}	99.13^{ab}	66.16^{abc}
		Wheat	23.85^{bcd}	44.49^{ab}	47.51^{abcd}	61.03^{a}	68.72^{abcde}	93.24^{ab}	96.18^{abcde}	100.00^{a}	66.88^{a}
		Triticale	23.95^{abc}	44.72^{ab}	46.64^{abcde}	58.41^{ab}	72.51^{abc}	93.93^{a}	95.54^{bcde}	100.00^{a}	66.96^{a}
	50 Kg/Feddan	None	22.28^{defg}	46.09^{a}	49.12^{a}	49.59^{cd}	73.51^{ab}	92.59^{abc}	94.36^{cde}	99.40^{ab}	65.87^{abc}
		Oat	20.13^{h}	36.89^{c}	44.44^{cdefg}	60.52^{a}	72.83^{ab}	94.52^{a}	96.57^{abcde}	100.00^{a}	65.74^{abc}
		Barley	23.05^{cdef}	42.29^{abc}	44.27^{cdefg}	60.78^{a}	65.54^{def}	93.58^{ab}	95.69^{bcde}	99.40^{ab}	65.58^{abcd}
		Wheat	21.74^{efgh}	46.09^{a}	48.87^{ab}	52.32^{c}	71.97^{abc}	88.64^{c}	94.43^{cde}	98.77^{b}	65.35^{abcd}
		Triticale	24.37^{ab}	45.96^{a}	44.84^{cdefg}	52.17^{c}	72.46^{abc}	93.07^{ab}	100.00^{a}	100.00^{a}	66.61^{a}
Giza Blancka	0 Kg/Feddan	None	25.88^{ab}	45.43^{ab}	48.82^{ab}	53.02^{c}	68.81^{abcde}	92.43^{abc}	95.84^{abcde}	100.00^{a}	66.28^{ab}
		Oat	20.90^{gh}	39.20^{bc}	46.10^{abcdef}	52.87^{c}	65.25^{def}	93.83^{a}	96.18^{abcde}	100.00^{a}	64.29^{cd}
		Barley	25.97^{a}	42.47^{abc}	46.54^{abcde}	48.93^{cd}	62.47^{f}	94.61^{a}	99.20^{ab}	100.00^{a}	65.02^{abcd}
		Wheat	24.29$^{a\ bc}$	44.02^{ab}	47.80^{abc}	53.06^{c}	66.32^{cdef}	93.86^{a}	100.00^{a}	100.00^{a}	66.17^{abc}
		Triticale	24.77^{ab}	46.61^{a}	42.18^{g}	53.65^{bc}	69.96^{abcd}	91.44^{abc}	100.00^{a}	100.00^{a}	66.08^{abc}
	50 Kg/Feddan	None	24.84^{ab}	42.06^{abc}	45.40^{bcdefg}	43.16^{e}	67.51^{bcdef}	92.83^{abc}	97.86^{abc}	100.00^{a}	64.21^{cd}
		Oat	21.48^{fgh}	42.43^{abc}	44.04^{defg}	50.63^{c}	69.55^{abcde}	89.21^{bc}	93.32^{de}	98.70^{b}	63.67^{de}
		Barley	23.93^{bcd}	43.76^{ab}	46.29^{abcde}	59.52^{a}	68.21^{abcdef}	92.44^{abc}	92.84^{e}	100.00^{a}	65.87^{abc}
		Wheat	22.90^{cde}f	44.45^{ab}	44.93^{cdefg}	45.29^{de}	67.57^{abcdef}	94.22^{a}	97.57^{abcd}	100.00^{a}	64.62^{bcd}
		Triticale	20.29^{h}	40.98^{abc}	42.67^{fg}	41.59^{e}	63.39^{ef}	92.58^{abc}	95.04^{bcde}	100.00^{a}	62.07^{e}
Significance			**	*	**	**	**	*	**	*	**

Means of each column followed by the same letter are not significantly different at the 5% level according to Duncan 's Multiple Range Test.
- * and ** indicate P<0.05 and P<0.01, respectively.

Table (3): Effect of intercropping and nitrogen fertilization on the number of *L. trifolii* larvae/25 leaflets of Faba bean plants during the first season 2006/07.

Treatments			Number of larvae / 25 leaflets								
Variety	Nitrogen fertilization	Intercropping	December 2006		January 2007		February 2007		March 2007		Mean
			15	31	15	31	15	28	15	31	
Yousef El-Sediek	0 Kg/Feddan	None	8.81^{ab}	23.02$^{a bc}$	23.27^{abc}	35.94^{abcdefg}	78.00^{abcd}	39.67^{bcd}	29.79^{a}	5.42^{a}	30.49^{b}
		Oat	9.08^{a}	21.26^{bcde}	25.19^{a}	31.59^{fgh}	86.13^{a}	35.75^{cdefg}	18.20^{b}	2.71^{ab}	28.74^{bc}
		Barley	8.56^{abc}	22.35^{abcd}	23.02^{abc}	37.78^{abcde}	64.46^{cde}	32.50^{defg}	10.83^{bcd}	0.00^{b}	24.94^{defg}
		Wheat	7.78^{bcd}	20.31^{cde}	22.21^{abc}	33.54^{cdefgh}	83.55^{ab}	29.79^{fg}	15.84^{bc}	0.00^{b}	26.63^{cde}
		Triticale	8.56$^{a bc}$	22.34^{abcd}	22.21^{abc}	35.10^{bcdefgh}	88.83^{a}	41.17^{bc}	10.83^{bcd}	0.00^{b}	28.63^{bc}
	50 Kg/Feddan	None	8.30^{abcd}	21.62^{abcde}	24.92^{a}	40.94^{a}	76.92^{abcd}	44.42^{bc}	16.25^{b}	0.00^{b}	29.17^{bc}
		Oat	8.56^{abc}	22.34^{abcd}	20.58^{c}	37.54^{abcde}	78.44^{abcd}	41.71^{bc}	10.91^{bcd}	0.00^{b}	27.51^{cd}
		Barley	8.91^{ab}	23.25^{abc}	23.83^{ab}	39.00^{abc}	87.21^{a}	53.63^{a}	32.50^{a}	2.71^{ab}	33.88^{a}
		Wheat	9.34^{a}	24.37^{a}	23.34^{abc}	38.61^{abcd}	86.13^{a}	45.77^{b}	13.54^{bc}	2.71^{ab}	30.48^{b}
		Triticale	9.08^{a}	23.70^{ab}	20.85^{bc}	37.78^{abcde}	84.50^{ab}	40.63^{bcd}	8.13^{cde}	0.00^{b}	28.08^{bc}
Giza Blancka	0 Kg/Feddan	None	8.30^{abcd}	21.59^{abcde}	22.48^{abc}	29.64^{h}	71.50$^{a bcd}$	30.88^{efg}	10.83^{bcd}	2.71^{ab}	24.74^{defg}
		Oat	8.75^{ab}	22.85^{abc}	20.58^{c}	33.64^{cdefgh}	81.76^{abc}	37.92^{bcd}	10.83^{bcd}	0.00^{b}	27.04^{cde}
		Barley	7.26^{d}	18.96^{e}	20.64^{c}	33.15^{defgh}	62.81^{de}	36.30^{cde}	10.81^{bcd}	0.00^{b}	23.74^{fg}
		Wheat	8.30^{abcd}	21.67^{abcde}	22.75^{abc}	34.71^{cdefgh}	81.33^{abc}	38.46^{bcde}	8.13^{cde}	0.00^{b}	26.92^{cd}
		Triticale	8.30^{abcd}	21.67^{abcde}	22.21^{abc}	33.15^{defgh}	73.13^{abcd}	30.88^{efg}	2.71^{e}	0.00^{b}	24.01^{efg}
	50 Kg/Feddan	None	8.82^{ab}	23.02^{abc}	22.48^{abc}	40.50^{ab}	77.46^{abcd}	27.62^{g}	10.83^{bcd}	0.00^{b}	26.34^{cdef}
		Oat	7.26^{d}	18.96^{e}	22.39^{ab}	29.74^{gh}	74.75^{abcd}	43.33^{bc}	16.25^{b}	0.00^{b}	26.59^{cde}
		Barley	7.78^{bcd}	20.31^{cde}	23.29^{abc}	37.05^{abcdef}	80.71^{abc}	39.00^{bcde}	8.13^{cde}	0.00^{b}	27.03^{cd}
		Wheat	8.56^{abc}	22.34^{abcd}	21.40^{bc}	31.20^{gh}	53.07^{e}	38.46^{bcde}	8.13^{cde}	0.00^{b}	22.90^{g}
		Triticale	7.52^{cd}	19.75^{de}	22.48^{abc}	32.66^{efgh}	67.71^{bcd}	41.71^{bc}	5.42^{de}	0.00^{b}	24.66^{defg}
Significance			**	**	**	**	**	**	**	**	**

Means of each column followed by the same letter are not significantly different at the 5% level according to Duncan 's Multiple Range Test.

- ** indicate P<0.01.

Table (4): Effect of intercropping and nitrogen fertilization on the number of *L. trifolii* larvae/25 leaflets of Faba bean plants during the second season 2007/08.

Treatments			Number of larvae / 25 leaflets								
Variety	Nitrogen fertilization	Intercropping	December 2007		January 2008		February 2008		March 2008		Mean
			15	31	15	31	15	29	15	31	
Yousef El-Sediek	0 Kg/Feddan	None	9.04ab	23.60abc	23.56abc	36.40abcdef	80.00abcd	40.69 bcd	30.56 a	5.56 a	31.18 b
		Oat	9.30 a	21.79 bcde	25.82 a	32.40 ef	88.33 a	36.67cdefg	18.67 b	2.78 ab	29.47 bc
		Barley	8.78 abc	22.91 abcd	23.59 bc	38.75 abcd	66.11 cde	33.33 defg	11.11bcd	0.00b	25.57defg
		Wheat	7.97bcd	20.82 cde	22.77abc	34.40 cdef	85.69 ab	30.56 fg	16.24 ab	0.00 b	27.31cde
		Triticale	8.77 abc	22.90 abcd	22.77 abc	36.00abcdef	91.11 a	42.22 bc	11.11bcd	0.00 b	29.36 bc
	50 Kg/Feddan	None	8.50abcd	22.16abcde	25.54 a	42.00 a	78.89abcd	45.56 bc	16.67 b	0.00 b	29.92 bc
		Oat	8.77 abc	22.90 abcd	21.10 c	38.50 abcd	80.45abcd	42.78 bc	11.19bcd	0.00b	28.21 cd
		Barley	9.13 ab	23.83 abc	24.43 ab	40.00 abc	89.44 a	55.00 a	33.33 a	2.78 ab	34.74 a
		Wheat	9.57 a	24.98 a	23.93abc	39.60 abcd	88.33 a	46.94 b	13.89 bc	2.78 ab	31.25 b
		Triticale	9.31 a	24.29 ab	21.38 bc	38.75 abcd	86.67 ab	41.67 bcd	8.33 cde	0.00b	28.80 bc
Giza Blancka	0 Kg/Feddan	None	8.50abcd	22.13abcde	23.04 abc	30.40 f	73.33abcd	31.67 efg	11.11bcd	2.78 ab	25.37defg
		Oat	8.97 ab	23.43 abc	21.10 c	34.50 cdef	83.86 abc	38.89 cde	11.11bcd	0.00b	27.73 cd
		Barley	7.44 d	19.43d	21.16 c	34.00 cdef	64.42 de	37.22 cdef	11.08bcd	0.00b	24.34 fg
		Wheat	8.51abcd	22.21abcde	23.32 abc	35.60 bcdef	83.42 abc	39.44 cde	8.33 cde	0.00b	27.60 cd
		Triticale	8.51abcd	22.20abcde	22.77 abc	34.00 cdef	75.00abcd	31.67 efg	2.78 e	0.00b	24.62 efg
	50 Kg/Feddan	None	9.04 ab	23.60 abc	23.04 abc	41.60 ab	79.44abcd	28.33 g	11.11bcd	0.00b	27.02cdef
		Oat	7.44 d	19.43 abc	22.95abc	30.50 f	76.67abcd	44.44 bc	16.67 b	0.00b	27.26 cde
		Barley	7.98 bcd	20.82 cde	23.87 abc	38.00 abcde	82.78 abc	40.00 cde	8.33 cde	0.00b	27.72 cd
		Wheat	8.77 abc	22.90 abcd	21.93 bc	32.00 ef	54.44 e	39.44 cde	8.33 cde	0.00b	23.48 g
		Triticale	7.71 cd	20.24 de	23.04 abc	33.50 def	69.44bcde	42.78 bc	5.56 de	0.00b	25.28defg
Significance			**	**	**	**	**	**	**	**	**

Means of each column followed by the same letter are not significantly different at the 5% level according to Duncan 's Multiple Range Test.

- **** indicate P<0.01.**

Table (5): Analysis of variance of the effect of cultivar, intercropping, and fertilization on average leafminer *L. trifolii* infestation percentage and larvae number / 25 leaflets during the two successive seasons 2006/07 and 2007/08.

Source of Variance	Infestation percentage		Larvae number / 25 leave	
	2006/07	2007/08	2006/07	2007/08
Cultivar	*	*	**	**
Intercropping	**	**	ns	ns
Fertilization	ns	ns	ns	ns
Cultivar × Intercropping	ns	ns	ns	ns
Cultivar × Fertilization	ns	ns	ns	ns
Intercropping × Fertilization	ns	ns	**	*
Cultivar × Intercropping × Fertilization	**	**	*	*

*** Significant at $P \leq 0.05$, ** Significant at $P \leq 0.01$, ^{ns} non-significant.**

CONCLUSION

This study was part of integrated pest management research project that aimed to reduce leafminer infestation, and subsequently crop quantity and quality of faba bean. Economic damages from leafminer can be mitigated if proactive management decisions were considered to reduce the likelihood of inducing severe outbreaks of leafminer. It can be concluded that Giza Blancka cultivar showed better results than Yousef El-Sediek in terms of less plant susceptibility to leafminer infestation, and the number of larvae counted on the infested plants. Intercropping with triticale with the addition of 50 Kg N/Feddan showed the best results in that regard, which might be our recommendation to reduce leafminer effects on faba bean. Leafminer management will best be accomplished through research on, and implementation of, comprehensive integrated pest management strategies.

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تأثير التحميل والتسميد النيتروجيني على الإصابة بصانعة الأنفاق *Liriomyza trifolii* (Burgess) على نباتات الفول البلدي

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اجريت هذه الدراسة بمحافظة كفر الشيخ خلال موسمي ٢٠٠٦/ ٢٠٠٧ و٢٠٠٧ / ٢٠٠٨ لدراسة تأثير كل من التحميل والتسميد النيتروجيني على إصابة صنفين من الفول البلدي بصانعة الأنفاق.

تم تسجيل نسبه الإصابة بصانعة الأنفاق في منتصف ديسمبر، وازدادت تدريجياً حتى وصلت لأعلى مستوى للإصابة في نهاية مارس، كما بدأ تعداد اليرقات لصانعة الأنفاق في الزيادة التدريجية حتى وصل لأعلى تعداد في منتصف فبراير، ثم قل تدريجياً حتى نهايه مارس.

ولقد اظهرت النتائج أن المعاملة التي تم فيها تحميل التريتيكال مع صنف جيزة بلانكا عند مستوي تسميد ٥٠كجم/للفدان نتج عنه أقل مستوي للإصابة بصانعة الأنفاق مقارنة بباقي المعاملات خلال الموسمين.

أما المعاملة التي تم فيها تحميل القمح مع صنف جيزة بلانكا كانت هي الأقل في عدد يرقات صانعة الأنفاق، بينما نتج عن تحميل الشعير مع صنف يوسف الصديق أعلي تعداد لصانعة أنفاق الفول في الموسمي