

## Seasonal Abundance and Susceptibility of Faba Bean Varieties to Infestation with *Liriomyza trifolii* (Burgess) and *Empoasca* Spp. in Relation to Chemical and Biochemical Components

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### ABSTRACT

Field studies were carried out at the experimental farm of Sakhaa, Agricultural Research Station, Kafr El-Sheikh Governorate during 2014/2015 and 2015/2016 faba bean seasons. Results showed that population of *Liriomyza trifolii* larvae had 3-4 peaks on faba bean varieties in the first season, and 2-3 peaks in the second season. peaks occurred in January, February and March in both seasons, with the highest one in March. In the first season, the highest average number of *L. trifolii* larvae was recorded on Giza 3 variety with 58.00 larvae /30 leaflets, while the lowest one was on Misr1 variety, with an average of 45.22 larvae /30 leaflets. In the second season, an opposite the highest average number of the larvae was recorded on Misr1 variety with an average of 49.35 larvae/30 leaflets, while the lowest average number on Sakha 4 with an average 30.52 larvae /30 leaflets. Statistical analysis revealed nonsignificant and significant differences among the 6 tested varieties to infestation with *L. trifolii* larvae in the first and second seasons, respectively. Concerning leafhoppers, *Empoasca* spp. population, there were 2-3 peaks on different faba bean varieties during December, January, February or March in both seasons. The highest peak was recorded in March in both seasons. The highest average number of *Empoasca* spp. (nymphs and adults) was recorded on Giza 40 variety with an average of 58.55 indiv. /30 leaflets. the lowest average number of *Empoasca* spp. was recorded on Sakhaa 3 variety with an average of 42.88 indiv /30 leaflets in the first season. the opposite occurred in the second season, Sakha3 showed the highest average number of jassids with an average of 35.83 indiv. /30 leaflets. the lowest one was Sakha2 variety with an average of 29.38 indiv. /30 leaflets. Statistical analysis showed significant and nonsignificant differences among the 6 tested varieties to infestation with *Empoasca* spp. in the first and second seasons, respectively. Sakha4 variety showed the highest content of total carbohydrates (52.01%), Silica (2.7%) and chlorophyll (42.2 ppm) and lowest content of protein (16.7%) and lipids (0.93%) which had the lowest average of two seasons for *L. trifolii* larvae. Giza3 showed the highest content of protein (20%) and silica (2.7%) and lowest content of carbohydrates(46.8%) and chlorophyll (36ppm). Sakha2 contain the highest content of lipids (2.04%) and lowest content of silica (1.4%) and phenol (0.473%), which had the lowest average of two seasons for *Liriomyza trifolii* and *Empoasca* spp. (43larvae and 36.6 indiv./30leaflets, respectively). Giza40 showed the highest content of phenol (0.583%) which had the highest average number of two seasons for *L. trifolii* larvae (50.5larvae/ 30 leaflets). Results showed that *L. trifolii* larvae number correlated insignificantly negative with carbohydrates and chlorophyll in both seasons, in addition to protein and silica in the second season. Positive insignificant correlation with lipids and phenol in both seasons. *Empoasca* spp. population correlated positive insignificant with carbohydrates, silica, phenol and chlorophyll in the first season, but negative insignificant with carbohydrates, phenol and chlorophyll in the second season. Results revealed that the activities of antioxidant catalase enzymes (CAT) increased in leaves under insect infestation stress. The responses of CAT activity in some tolerant varieties such as Sakha2 and Sakha4 for infestation by *L. trifolii* and *Empoasca* spp. the highest activity of peroxidase enzymes (Pox) was observed in the tolerant varieties such as Sakha2 and Sakha4 varieties which possessed the highest tolerance to infestation stress among the 6 varieties for *L. trifolii* and *Empoasca* spp.. CAT enzymes showed the highest rate of activity changes under infestation stress than of Pox activity. Population of *L.trifolii* larvae correlated insignificantly positive with catalase and peroxidase enzymes in the first season, while positive significant with catalase and negative significant with peroxidase enzymes in the second season. Population of Jassids showed negative significant correlation with CAT and POX in the first season, while negative nonsignificant in the second season.

### INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the most important food crops in Egypt. It ranks the first food legume and considered the main source of plant protein. It is attacked by a large number of insect pests causing damage, among of which are the leaf miners, *Liriomyza trifolii* (Burgess) and leafhopper, *Empoasca* spp. (Metwally *et al.*, 1997, Abou- Attia, *et al.*, 2013 and Bassiony *et al.*, 2017).

Faba bean varieties differ in the susceptibility to the previous insect pests infestation due to differences in morphological and chemical characters. The resistant varieties could be used as an item in the integrated pest, management programs (Abou – Attia, 2006; Awadalla *et al.*, 2013 and Abou–Attia *et al* 2013).

The acceptance or rejection of a host plant occurs after probing process, based on its behavioral responses to plant features (Calveti & Remotti, 1998). These features may be morphological, physical and chemical (Bernays, 1999). Gamieh and El-Basuony (2001) indicated that the leaf hair density and leaf contents of photosynthetic pigments, leaf moisture, nitrogen, phosphorus and potassium and other physical and chemical properties may

have a pronounced effect in the susceptibility of soybean to infestation with sucking pests.

Antioxidant enzymes are related to the tolerance to various abiotic stresses. To protect against oxidative stresses, plant cells produce both antioxidant enzymes such as peroxidase (Pox) and catalase (CAT) enzymes (Mittler, 2002).

Therefore, the present study aimed to throw the light on the population density of the leafminer, *Liriomyza trifolii* and leafhopper, *Empoasca* spp. on some faba bean varieties and study the relationship between chemical, biochemical components and chlorophyll content of faba bean varieties and insect pest infestation.

### MATERIALS AND METHODS

Field studies were carried out at the experimental farm of Sakhaa Agriculture Research station, Kafr El-Sheikh region during two successive faba bean seasons; 2014/2015 and 2015/2016 to study the population density and host preference of the leafminers, *Liriomyza trifolii* and leafhopper, *Empoasca* spp. on some faba bean varieties and relationship between chemical, biochemical components and chlorophyll content of faba bean varieties and insect pest infestation.

1- *Liriomyza trifolii*

Six varieties were assigned for the current study. Varieties of faba bean were Sakha 2 , Sakha 3 , Sakha 4 , Misr 1, Giza 3 and Giza 40.

The varieties were sown on 1<sup>st</sup> November in both seasons; 2014/2015 and 2015/2016. The experimental area (about one feddan) was divided into 18 plots (6 varieties X 3 replications each) in a complete randomized block design. All agricultural practices were done without pesticidal treatments throughout the two growing seasons.

Weekly samples of 30 leaflets for each variety were randomly picked up from three levels of plants. The collected leaflets were placed in paper bags and transferred to the laboratory. Numbers of harboured larvae were counted and recorded.

2- Leafhoppers, *Empoasca* spp.

To study the population fluctuation of faba bean leafhoppers, *Empoasca* spp. under field condition of Kafr El- Sheikh Region, The same area and varieties were used. Weekly samples of 30 leaflets per variety were chosen at random and number of nymphs and adults of leafhoppers were directly recorded in the field by a suitable lens.

Faba bean components:

Analysis of faba bean varieties were conducted at Mansoura laboratory, Soil, Water and Environment Research Institute,. Agric. Res. Center Egypt.

Total carbohydrates, total protein, total lipids, silica, and total phenols were calculated by the method of Hedge and Hafreites (1962). Jones et al.(1991) A.O.A.C (1984) APHA (1992) and Malick and Singh (1980), respectively .

Enzymes activity assay:

Catalase (CAT) and Peroxidase (Pox) activity were determined, in the infested and uninfested leaves of 6 faba bean varieties, as CAT enzyme activity was determined in the homogenates by measuring the decrease in absorption at 240 nm in a 3 ml of reaction mixture containing 0.16 ml of 10% w/v H<sub>2</sub>O<sub>2</sub> diluted to 100 ml with 0.067 M phosphate buffer and 0.1 ml of enzyme extract, according Sadasivam and Manickam (1996). Pox activity was spectrophotometrically measured using guaiacol / H<sub>2</sub>O<sub>2</sub> as substrate according Lobarzewski *et al.* (1990) . Chlorophyll was determined by using chlorophyll meter, model No. SPAD – 502 made by Minolta Co.

Statistical analysis:

Data were subjected to ANOVA, and variable means were compared using Duncan's Multiple Range Test (1955) at 5% level and simple correlation

RESULTS AND DISCUSSION

1.*Liriomyza trifolii* larvae

a.Seasonal abundance

Results in table (1) show the seasonal abundance of the total number of *L.trifolii* larvae on faba bean plants during of 2014/2015 and 2015/2016. Seasons

In the first season, there were 3-4 peaks on six varieties of faba bean, they occurred in December, January, February and March. The third peak (in March) was the highest one.

Table 1. Number of faba bean leafminer *L.trifolii* larvae per 30 leaflets on faba bean varieties at Kafr El-Sheikh, 2014/2015

Sampling date	Sakha 2	Sakha 3	Sakha 4	Misr 1	Giza 3	Giza 40
Dec.6	8	9	8	7	8	5
13	11	17	15	9	12	11
20	12	20	18	17	15	18
27	14	20	22	20	19	17
Jan.3	19	23	27	23	23	21
10	31	32	31	29	62	46
17	39	40	66	45	25	50
24	52	49	48	18	38	64
31	62	63	49	53	74	43
Feb.7	44	77	64	89	53	58
14	23	57	70	112	40	96
21	35	48	49	72	67	59
28	88	96	58	48	83	79
Mar.7	71	73	89	103	79	92
14	94	139	123	155	151	138
21	72	94	93	118	144	82
28	146	152	71	89	133	87
Apr.4	8	25	23	31	18	17
Total	829	1014	924	814	1044	983
Mean±	46.1±	56.33±	51.33±	45.22±	58±	54.6±
SE	6.3a	3.4 a	6.3 a	3.4 a	4.6 a	5.7 a

Means followed by the same letter are not significantly different at 0.05 level of probability (Dancun's Multiple Range Test 1955).

Data presented in Table (2) and Fig (2) show the number of leafminer larvae during the second season 2015/2016. The larval population in the second season was almost lowest than that recorded in the first season. The population of larvae peaked almost two or three times on all tested varieties. The Peaks occurred in January, February and March, Also, the peak of March is the highest peak of population larvae for *L.trifolii*

Table 2. Number of faba bean leafminer *L.trifolii* larvae per 30 leaflets on faba bean varieties at Kafr El-Sheikh, 2015/2016

Sampling date	Sakha 2	Sakha 3	Sakha 4	Misr 1	Giza 3	Giza 40
Dec.7	4	7	6	8	8	9
14	9	13	12	12	10	10
21	12	19	18	27	15	22
28	15	23	21	22	31	29
Jan.4	32	23	22	18	21	18
11	27	49	18	24	30	31
18	28	33	21	48	33	49
25	45	38	23	61	41	63
Feb.1	51	22	33	40	25	44
8	38	32	45	34	56	58
15	41	41	14	63	32	49
22	73	53	31	45	32	33
Mar.1	64	61	63	69	51	72
8	98	127	54	151	117	147
15	104	136	102	112	95	96
22	37	52	33	95	45	49
29	1	8	3	10	15	10
Total	679	737	519	839	657	789
Mean±	39.9±	43.4±	30.5±	49.4±	38.6±	46.4±
SE	5.1 ab	1.7 ab	5.1b	5.7a	5.7ab	2.8 a

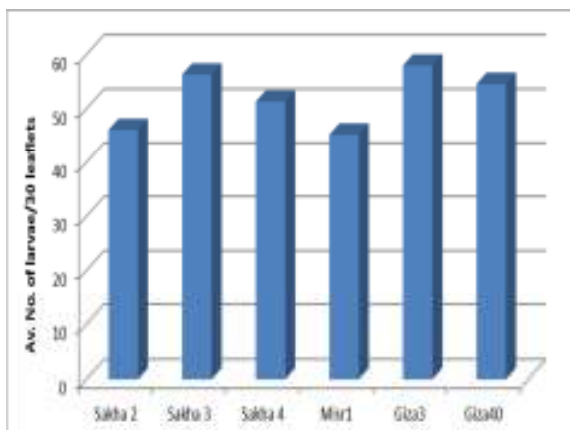
Means followed by the same letter are not significantly different at 0.05 level of probability (Dancun's Multiple Range Test 1955).

Our results are in agreement with those obtained by EL- Samahy (2008) who recorded three peaks of *L.trifolii* on faba bean plants by the second week of February and

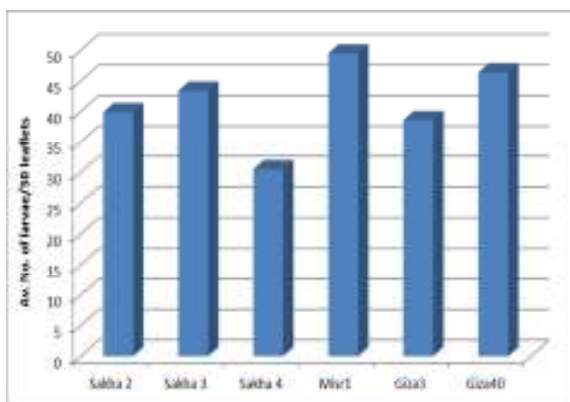
March and the fourth week of March. Also, Ibrahim (2008) reported that *L.congesta* had three peaks on faba bean. The first peak occurred during January, the second one occurred on February 23<sup>rd</sup>, while the third peak occurred on March 22<sup>nd</sup>. El-Mashaly (2013) showed that *L.congesta* larvae had two or three peaks during the first and second season. Also, Hatem (2014) showed that population of *L.trifolii* had three peaks. The first peak occurred on February and the second peak on March, but the third peak was recorded in April during the first season of the study.

**b. Susceptibility of faba bean varieties to infestation:**

Results presented in Table (1, 2) and Fig (1,2) show the average number of *L.trifolii* larvae on faba bean varieties during two seasons 2014/2015 and 2015/2016.



**Fig. 1. Average number of *L. trifolii* larvae per 30 leaflets on faba bean varieties at Kafr El- Sheikh 2014/2015 season.**



**Fig. 2. Average number of *L. trifolii* larvae per 30 leaflets on faba bean varieties at Kafr El- Sheikh 2015/2016 season.**

In the first season, the highest average number of *L. trifolii* larvae was recorded on Giza 3 variety with an average of 58.00 larvae /30 leaflets followed by Sakha 3 with average 56.33 larvae/30 leaflets and Giza 40 with average 54.61 larvae/30 leaflets. While the lowest average number of leafminer larvae was recorded on Misr 1 variety with an average of 45.22 larvae /30 leaflets. Statistical analysis showed nonsignificant differences among the 6 tested varieties to infestation with *L.trifolii* in the first season.

In the second season, an opposite, the highest average number of *L.trifolii* larvae was recorded on Misr1

variety with an average of 49.35 larvae/30 leaflets followed by Giza 40 with an average of 46.41 larvae/30 leaflets and Sakha 3 with an average of 43.35 larvae/30 leaflets while the lowest average number of leafminer larvae was recorded on Sakha 4 with an average of 30.52 larvae/30 leaflets. Statistical analysis showed significant differences among the 6 tested varieties to infestation with *L.trifolii* in the second season.

Our results are similar to those obtained by Mesbah and Sherif (1994) who indicated that Giza 461 and Giza 3 proved to be the most susceptible varieties to infestation with *L.trifolii* with number of larvae ranging between 79.22 and 155.91 per 100 faba bean leaflets El-Mashaly (2013) showed that the highest average number of *L.congesta* larvae was recorded on Giza 3 variety with an average of 157.6 ±3.4 larvae / 100 leaflets followed by Sakha 3 variety while the lowest average number of leaf miner was recorded on Sakha 2 variety with an average of 91.6±2.3 larvae /100 leaflets. The same trend was recorded in the second season.

Bastawisy *et al.* (1998) found that Giza 3 was highly susceptible to leafminer in both seasons, while lines 1.8415/797/92 and L848/1428/92 were least susceptible.

**2. The leafhoppers, *Empoasca* spp.**

**a. Seasonal abundance:**

Results show the seasonal abundance of the total number of *Empoasca* spp. (nymphs and adults) on faba bean plants during two successive seasons of 2014/2015 and 2015/2016.

Data presented in Table (3) and illustrated in Fig. (3) in the first season 2014/2015 show that the population of *Empoasca* ssp. had 2-3 peaks on six varieties of faba bean and increased gradually forming the peaks during December, January, February and March.

**Table 3. Number of faba bean *Empoasca* spp. per 30 leaflets on faba bean varieties at Kafr El-Sheikh 2014/2015**

Sampling date	Sakha 2	Sakha 3	Sakha 4	Misr 1	Giza 3	Giza 40
Dec.7	9	10	10	11	12	8
14	22	18	16	17	15	15
21	53	39	35	41	39	47
28	28	15	13	21	19	22
Jan.4	33	29	34	22	45	43
11	54	33	68	28	51	73
18	79	42	105	98	105	112
25	88	65	83	61	67	93
Feb.1	110	32	105	44	50	120
8	26	68	71	77	70	122
15	49	81	95	115	64	92
22	66	73	81	110	54	78
Mar.1	30	38	49	140	105	46
8	55	103	62	98	88	53
15	41	62	52	59	61	59
22	32	49	33	52	19	37
29	14	16	21	32	8	34
Total	789	772	933	1026	872	1054
Mean±	43.8±	42.9±	51.8±	57±	48.4±	58.6±
SE	2.8 ab	1.1 b	5.7 ab	4.0 ab	4.6 ab	6.3a

Means followed by the same letter are not significantly different at 0.05 level of probability (Duncan's Multiple Range Test 1955).

Data in Table (4) and Fig (4) show the number of *Empoasca* spp. during the second season 2015/2016. Results revealed that the leafhopper population was almost lowest than that recorded in the first season. The population of leafhoppers had 2-3 peaks on all tested (six) varieties. Peaks occurred on December, January, February and March.

Results are in agreement with those obtained by Helal *et al.* (1997) who found two peaks for jassids on February 12<sup>th</sup> and March 16<sup>th</sup> on all tested varieties and breeding lines. El- Mashaly (2013) found one or two peaks for the leafhoppers, *Empoasca* spp. on faba bean plants. El-Gindy (2002) recorded two peaks for *Empoasca* spp. on faba bean plants at the 2<sup>nd</sup> week of December and the 3<sup>rd</sup> week of February, respectively. Hatem (2014) showed that *Empoasca* spp. had two peaks in 2010/2011 season, while in the second season (2011/2012), four peaks were recorded.

**Table 4. Number of faba bean *Empoasca* spp. per 30 leaflets on faba bean varieties at Kafr El-Sheikh 2015/2016**

Sampling date	Sakha 2	Sakha 3	Sakha 4	Misr 1	Giza 3	Giza 40
Dec.6	13	18	11	23	24	21
13	33	24	23	29	37	29
20	34	38	35	41	42	47
27	39	79	68	71	53	62
Jan.3	45	56	32	54	50	48
10	42	43	36	43	31	46
17	5	4	8	12	13	17
24	32	23	19	9	10	9
31	21	18	23	27	18	22
Feb.7	21	25	20	15	15	11
14	6	12	14	8	5	23
21	8	11	13	7	2	12
28	21	27	18	39	41	24
Mar.7	37	32	74	63	75	94
14	40	48	69	59	67	23
21	49	53	44	63	50	22
28	62	105	34	32	43	24
Apr.4	21	29	17	14	18	16
Total	529	645	558	609	594	550
Mean±	29.4±	35.8±	31±	33.8±	33±	30.6±
SE	5.1 a	2.8 a	2.8 a	4.6a	1.7a	6.3 a

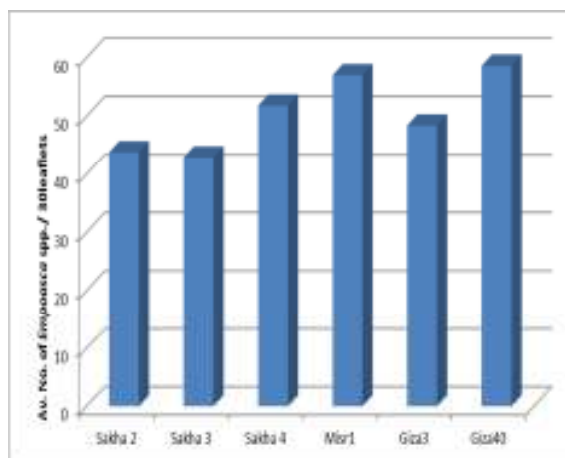
Means followed by the same letter are not significantly different at 0.05 level of probability (Duncan's Multiple Range Test 1955).

**b. Susceptibility of faba bean varieties to infestation:**

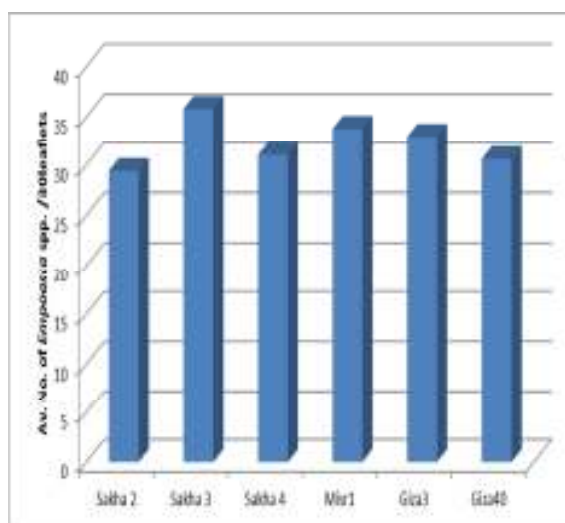
Results in Tables (3, 4) and Fig. (3,4) show the average numbers of *Empoasca* spp. (nymphs and adults) on faba bean varieties during two seasons 2014/2015 and 2015/2016.

In the first season, the highest average number of *Empoasca* spp. (nymphs and adults) was recorded on Giza 40 variety with an average of 58.55 individuals /30 leaflets followed by Misr 1 variety with an average of 57.00 individuals /30 leaflets, Sakha 4 with an average of 51.83 individuals / 30 leaflets . While the lowest average number of *Empoasca* spp. was recorded on Sakha3 variety with an average 42.88 individuals /30 leaflets. Statistical analysis indicated that significant differences among the 6 tested varieties to infestation with *Empoasca* spp. in the first season.

In the second season, an opposite, the highest average number of *Empoasca* spp (Nymphs & adults) was recorded on Sakha3 variety with an average 35.83 individuals / 30 leaflets followed by Misr 1, Variety with an average 33.83 individuals / 30 leaflets and Giza 3 variety with an average of 33.00 individuals / 30 leaflets – while the lowest average number of *Empoasca* spp. was recorded on Sakha2 variety with an average 29.38 individuals / 30 leaflets. Statistical analysis showed nonsignificant differences among the 6 tested varieties to infestation with *Empoasca* spp. in the second season .



**Fig. 3. Average number of *Empoasca* spp per 30 leaflets on faba bean varieties at Kafr El- Sheikh 2014/2015 season.**



**Fig. 4. Average number of *Empoasca* spp per 30 leaflets on faba bean varieties at Kafr El-Sheikh 2015/2016 season**

Results are similar to El-Mashaly (2013) showed that the highest average number *Empoasca* spp .was recorded on Giza3 variety with an average of 70.00 ± 8.71 individuals / 100 leaflets followed by Sakha 4 variety. While the lowest average number of leafhopper was recorded on Sakha2 variety with an average of 44.33 ± 7.88 individuals / 100 leaflets.

Hatem (2014) indicated that the highest number of *Empoasca* spp . was recorded on Sakha 1 variety with an average of 100.25 individuals / 5 plants. While the lowest

number was recorded on Giza 40 variety with an average 46.83 indiv./5 plants in the first season 2010/2011. In the second season 2011/2012 Sakha 4 variety harboured the highest number of *Empoasca spp.* with an average 105.57 indiv /5 plants, while the lowest one on Sakha 2 with an average 57.85 indiv /5 plants

**3. Effect of faba bean components on the insect pests infestation:**

Data presented in Table (5) show the analysis of faba bean varieties and all elements. The highest variety in carbohydrates content was Sakha 4 (52.01%), while the lowest one was Giza 3 (46.8%). Data show the highest variety in protein was Giza 3 (20%), while Sakha 4 contains the lowest percentage of protein (16.7%).

Concerning to lipids content, the highest percentage of lipids was recorded in Sakha 2 (2.04%) while the lowest variety in lipids content was Sakha 4 (0.93%). The highest variety in silica content was both Sakha 4 and Giza 3 (2.7%), while the lowest one was Sakha 2 variety (1.4%).

With regard to phenol content, the highest content was recorded in Giza 40 variety (0.583%), while the lowest content for phenol was recorded in Sakha 2 (0.473%).

The highest variety in chlorophyll content is Sakha 4 (42.2 ppm), while the lowest variety in chlorophyll content is Giza 3 (36.00 ppm). These results are similar to those obtained by El-Mashaly (2013) and Abou- Attia *et al.*, (2013).

**Table 5. Estimating of carbohydrates, protein, lipids, silica, phenol, chlorophyll, catalase and peroxidase enzymes on faba bean varieties**

Variety	Total carbohydrate	Crude protein	Total lipid	Silica	Total phenol	Chlorophyll	Catalase unfested	Catalase infested	Peroxidase unfested	Peroxidase infested
	%									
Sakha2	47.6± 0.05b	18.4± 0.03b	2.04± 0.01a	1.4± 0.3 d	0.473± 0.00 b	36.7± 4.6 a	0.00373± 0.00 a	0.0045± 0.00 a	0.031± 0.011 b	0.0809± 0.05 a
Sakha3	48.7± 0.10 c	17.9± 0.03c	1.8± 0.03b	1.7± 0.03c	0.487± 0.00 b	37.5± 5.8a	0.00391± 0.00 a	0.0037± 0.00 ab	0.0403± 0.017 b	0.041± 0.01 c
Sakha4	52.01± 0.05a	16.7± 0.03f	0.93± 0.03d	2.7± 0.03a	0.518± 0.00 b	42.2± 5.2 a	0.0025± 0.00 ab	0.003± 0.00 ab	0.109± 0.057 ab	0.156± 0.02 b
Misr1	49.8± 0.03 b	17.4± 0.00d	1.4± 0.03c	2.04± 0.03b	0.495± 0.00 b	41.1± 6.4 a	0.0015± 0.00 ab	0.00159± 0.00 bc	0.019± 0.051 a	0.045± 0.01 c
Giza 40	48.3± 0.08 d	17.3± 0.08e	2.03± 0.02a	2.1± 0.03b	0.583± 0.02 a	37.5± 4.1 a	0.0039± 0.00 a	0.0015± 0.00 bc	0.031± 0.00 b	0.068± 0.00 bc
Giza3	46.8± 0.05 f	20± 0.01a	1.8± 0.05b	2.7± 0.03a	0.506± 0.00b	36± 6.9 a	0.0015± 0.00 b	0.0005± 0.00 c	0.022± 0.63 a	0.085± 0.00 bc

In the same column, means followed by the same letter are not significantly different at 5% level according to Duncan's multiple range test

**Correlation between faba bean components and insect pests :**

The data presented in Table ( 6 ) show the simple correlation coefficient among faba bean varieties and some components of faba bean plants and population of *Liriomyza trifolii* and *Empoasca spp.* during the first and second season. The insect population larvae of *L. trifolii* correlated insignificantly negative with total carbohydrate and chlorophyll in both seasons and addition to protein & silica in the second season. Positive insignificant correlation was recorded with lipids and phenol in both seasons, while with protein in the first season.

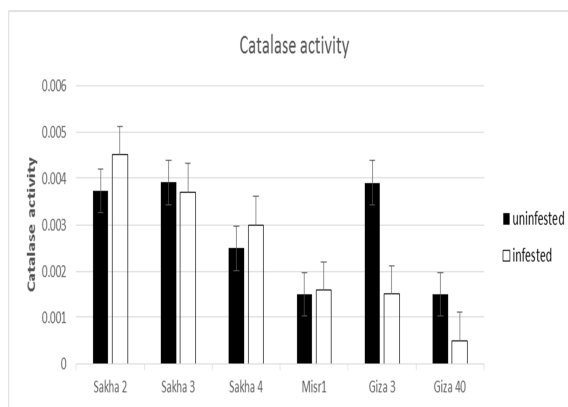
*Jassid, Empoasca spp.* population density correlated positive insignificant with total carbohydrates, silica, phenol, and chlorophyll in the first season, but negatively insignificant with total carbohydrates, phenol and chlorophyll in the second season. Results are similar to those obtained by Ibrahim (2008), El-Mashaly(2013) and Abou- Attia *et al.*,(2013).

**Analysis of physiological traits:**

**1- Analysis of catalase (CAT) activity**

The results of activity studies in Fig. (5 ) revealed that the activities of antioxidant CAT enzymes of the 6 tested faba bean varieties were increased in leaves under insect infestation stress. The responses of CAT activity in some tolerant varieties such as sakha 2, sakha 3, and sakha 4 for infestation by leafminer *Liriomyza trifolii* and Jassids *Empoasca spp.* The

infestation tolerances were higher than its activity in infestation sensitive varieties such as Giza 40, Giza3 and Misr 1 for *Liriomyza trifolii*. while Misr1 and Giza 40 in case of jassids under infestation stresses



**Fig. 5. Effect of infestation stress on catalase activity of 6 tested faba bean varieties**

**1. Analysis of peroxidase (POX) activity:**

The results in Fig. (6 ) showed that the highest activity of POX enzymes was observed in the tolerant varieties such as sakha 2 and sakha 4 varieties which possessed the highest tolerance to infestation stress among the 6 studied varieties for *L.trifolii* and *Empoasca spp.* infestation increase in POX activity under infestation condition has been linked with protection from oxidative damage. Antioxidants are directly involved in the changes

taking place in the plant under infestation stress. From previous results it possible to concluded that the CAT enzymes showed the highest rate of activity changes under infestation stress than of POX activity.

This indicated the major role of CAT enzyme in the antioxidant defense of faba bean plants in infestation stress conditions. Population of *L.trifolii* larvae correlated insignificantly positive with catalase and peroxidase enzymes in the first season, while positive significant with catalase and negative significant with peroxidase enzymes in the second season. Population of Jassids showed negative significant correlation with CAT and POX in the first season, while negative nonsignificant in the second season.

Results are similar to Felton *et al.* ,1994, Mittler, 2002; Ralph *et al.*, 2004, Felton, 2005; Hanley *et al.* ,2007 and Chen, 2008.

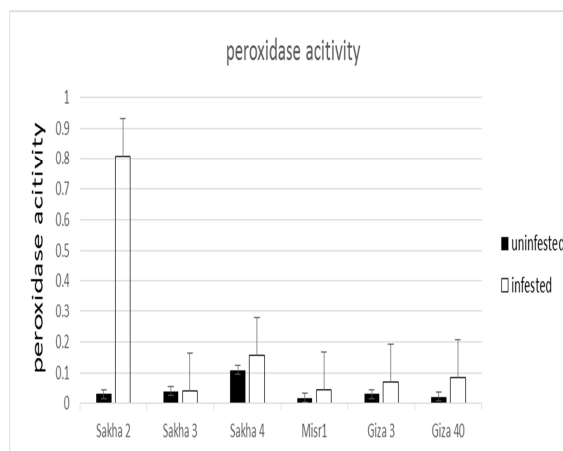


Fig. 6. Effect of infestation stress on peroxidase activity of 6 tested faba bean varieties

Table 7. Simple correlation coefficient values between faba bean insect pests and some components of faba bean varieties

Variety	Season	T. carbohydrate	C. protein	T. lipid	Silica	T. phenol	Chlorophyll	Catalase	Peroxidase
Liriomyza	2014/15	-0.314 ns	0.396 ns	0.209 ns	0.430 ns	0.368 ns	-0.464 ns	0.012ns	0.022 ns
	2015/16	-0.366 ns	-0.015 ns	0.496 ns	-0.485 ns	0.139 ns	-0.203 ns	0.0749	-0.8047
Jassid	2014/15	0.325ns	-0.455 ns	-0.253 ns	0.4005 ns	0.7308	0.4645	-0.3130	-0.0193
	2015/16	-0.0001 ns	0.1349 ns	0.1193 ns	0.0289 ns	-0.2953 ns	-0.0295ns	-0.2318 ns	-0.22604 ns

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## الوفرة الموسمية و حساسية بعض أصناف الفول البلدي للأصابة بحشرة صانعة أنفاق أوراق الفول *Liriomyza trifolii* والجاسيد *Empoasca* spp. وعلاقتها بالمكونات الكيميائية والبيوكيميائية

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أجريت الدراسات الحقلية في المزرعة البحثية بسخا – كفر الشيخ خلال موسمين متتاليين ٢٠١٤/٢٠١٥- ٢٠١٥/٢٠١٦ للفول البلدي. أوضحت النتائج ان تعداد يرقات صانعة أنفاق أوراق الفول كان لها ٣-٤ قمم علي ٦ أصناف للفول البلدي في الموسم الأول بينما في الموسم الثاني كان لها من ٢-٣ قمم. و هذه القمم حدثت في شهور يناير، فبراير و مارس في كلا الموسمين وأعلى قمة كانت في شهر مارس في كلا الموسمين حساسية أصناف الفول للأصابة بصانعة أنفاق أوراق الفول: في الموسم الأول وجد أعلى متوسط لتعداد يرقات صانعة أنفاق أوراق الفول علي الصنف جيزه ٣ بمتوسط ٥٨ يرقة/ ٣٠ وريقه بينما أقل متوسط لتعداد يرقات الحشرة علي الصنف مصر ١ بمتوسط ٤٥.٢٢ يرقة/ ٣٠ وريقه. علي العكس في الموسم الثاني وجد أعلى متوسط لتعداد يرقات الحشرة علي الصنف مصر ١ بمتوسط ٤٩.٣٥ يرقة / ٣٠ وريقه بينما أقل متوسط لتعداد يرقات الحشرة علي الصنف سخا ٤ بمتوسط ٣٠.٥٢ يرقة/ ٣٠ وريقه وأظهر التحليل الاحصائي عدم وجود فروق معنوية بين ٦ أصناف للفول للأصابة بالحشرة في الموسم الأول بينما وجد فروق معنوية في الموسم الثاني. فيما يخص نشاطات الأوراق أظهرت النتائج ان تعدادها له ٢-٣ قمم علي اصناف الفول المختلفه خلال شهور ديسمبر، يناير، فبراير و مارس في كلا الموسمين وأعلى قمة تم مشاهدتها كانت في شهر مارس حساسية اصناف الفول للأصابة بنشاطات الأوراق: في الموسم الأول وجد أعلى متوسط لتعداد نشاطات الأوراق (حوريات- حشرات كاملة) تم مشاهدتها علي الصنف جيزه ٤٠ بمتوسط ٥٨.٥٥ فرد/ ٣٠ وريقه ، بينما أقل متوسط لتعداد الحشرة وجد علي الصنف سخا ٣ بمتوسط ٤٢.٨٨ فرد/ ٣٠ وريقه من نبات الفول. علي العكس في الموسم الثاني وجد أعلى متوسط لتعداد نشاطات الأوراق علي الصنف سخا ٣ بمتوسط ٣٥.٨٣ فرد / ٣٠ وريقه بينما أقل متوسط لتعداد الحشرة علي الصنف سخا ٢ بمتوسط ٢٩.٣٨ فرد / ٣٠ وريقه أظهر التحليل الاحصائي وجود وعدم وجود فروق معنوية بين ٦ اصناف للفول للأصابة بحشرة نشاطات الأوراق في الموسم الأول و الموسم الثاني علي التوالي. المكونات الكيميائية و الكلوروفيل لأصناف الفول البلدي: أوضحت النتائج ان الصنف سخا ٤ سجل أعلى محتوى من الكربوهيدرات بنسبه ٥٢.٠١%، السيليكيا بنسبه ٢٧% و محتوى الكلوروفيل ٢٢.٢ جزء من المليون . كما سجل أقل محتوى من البروتين ١٦.٧% و الليبيدات ٠.٩٣% والذي سجل أقل متوسط للموسمين لتعداد صانعة أنفاق أوراق الفول. الصنف جيزه ٣ اوضح أعلى محتوى من البروتين ٢٠% ، السيليكيا ٢٠.٧% بينما سجل أقل محتوى من الكربوهيدرات ٤٦.٨% و الكلوروفيل ٣٦ جزء من المليون . الصنف سخا ٢ احتوي علي أعلى محتوى من الليبيدات ٢٠.٤% و أقل محتوى من السيليكيا ١.٤% و الفينول ٤٧٣.٤% و الذي استقبل أقل متوسط للموسمين لتعداد صانعة أنفاق أوراق الفول و نشاطات الأوراق بمتوسط ٤٣ يرقة ، ٣٦.٦ فرد/ ٣٠ وريقه علي التوالي. الصنف جيزه ٤ سجل أعلى محتوى من الفينول ٥٨٣.٠% والذي استقبل أعلى متوسط للموسمين لتعداد صانعة أنفاق أوراق الفول بمتوسط ٥٠.٥ يرقة / ٣٠ وريقه. العلاقة بين المكونات الكيميائية و البيوكيميائية و الكلوروفيل و الأصباغ الحشرية: أوضحت النتائج وجود ارتباط سالب غير معنوي بين تعداد يرقات صانعة أنفاق أوراق الفول و محتوى الكربوهيدرات و الكلوروفيل في كلا الموسمين بالإضافة الي البروتين و السيليكيا في الموسم الثاني. بينما وجد ارتباط موجب غير معنوي بين تعداد الحشرة و محتوى النبات من الليبيدات و الفينول في كلا الموسمين. كما أوضحت النتائج وجود ارتباط موجب غير معنوي بين تعداد نشاطات الأوراق و محتوى الكربوهيدرات و السيليكيا و الفينول و الكلوروفيل في الموسم الأول . ولكن ارتباط سالب غير معنوي بين الكربوهيدرات و الفينول و الكلوروفيل و تعداد الحشرة في الموسم الثاني. النتائج توضح تزايد نشاط الانزيمات المؤكسده (انزيم الكاتلاز CAT ) علي ٦ اصناف مختبره من الفول البلدي في الأوراق تحت ضغوط الأصباغ الحشرية . استجابته انزيم الكاتلاز في بعض الاصناف المقاومه للأصابة مثل سخا ٢ و سخا ٤ لحشرة صانعة أنفاق أوراق الفول والجاسيد. وجد أعلى نشاط لانزيم بيروكسيداز (Pox) في الاصناف المقاومه مثل سخا ٢ و سخا ٤ التي تظهر أعلى تحمل لضغوط الأصباغ بين ٦ اصناف لحشرة صانعة أنفاق أوراق الفول و نشاطات الأوراق. أظهر انزيم الكاتلاز (CAT) أعلى نسبة لنشاط التغيرات تحت ضغوط الأصباغ بالمقارنه بنشاط انزيم بيروكسيداز (Pox) . وجود ارتباط موجب غير معنوي بين تعداد يرقات صانعة أنفاق أوراق الفول ونشاط انزيمات الكاتلاز و البيروكسيداز في الموسم الأول بينما ارتباط موجب معنوي مع الكاتلاز و سالب معنوي مع البيروكسيداز في الموسم الثاني. وجود ارتباط سالب معنوي بين تعداد نشاطات الأوراق و انزيمات الكاتلاز و البيروكسيداز في الموسم الأول بينما كان الارتباط سالب غير معنوي في الموسم الثاني.