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Field evaluation of insect pests infesting *Phaseolus vulgaris* and their natural enemies in Beheira Governorate

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Abstract:

Common bean *Phaseolus vulgaris* (L.) is considered one of the most important leguminous vegetable crops in Egypt. Field studies were conducted at El-Rahmaneia region, Beheira Governorate during 2017 and 2018 seasons on common bean (*P. vulgaris*). This study aimed to evaluate certain pests infesting *P. vulgaris* and their natural enemies. The crop is sown in mid of February and harvested in June and second planting dates of the experiment were carried out from September to November. The results showed that ten insect species belonging to eight families and five orders according to feeding behavior were noticed. The results recorded the major pests during two successive summer plantation 2017 and 2018. The highest total number recorded by *Aphis craccivora* Koch (Hemiptera: Aphididae). exhibited 1100.33 individuals/25 leaves and the lowest total number recorded by *Ophiomyia phaseoli* (Tryon) (Diptera: Agromyzidae) as 64.33 individuals/ 25 leaves during summer season 2017 and 2018, respectively.The highest total number recorded during spring seasons during both 2017 and 2018, representedby *A. craccivora* being 1125.63 individuals/ 25 leaves and the lowest number of *O. phaseoli* being 74.00 individuals/ 25 leaves and the results noticed no significant difference between the two seasons. The results indicated that 12 species of predators belonging to eleven families were recorded. While the recorded parasitoids were 12 species in five families. The present work here recorded the highest mean number of total mines (occupied and empty) caused by *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) larvae were significantly represented higher in summer plantation (March) during 2017 and 2018 represented by 21.95 and 18.31 individuals/ 25 leaves, respectively. The parasitoids were recorded parasitized the leafminers were *Opius dissitus* (Muesebeck) (Hymenoptera: Braconidae), *Diglyphus isaea* (Walker) (Hymenoptera: Eulophidae) and *Halticoptera* sp. (Hymenoptera: Pteromalidae). Also the persentage of parasitism of a forementioned parasitiods was studied.

Introduction

Common bean *Phaseolus vulgaris* (L.) is an annual leguminous plant that belongs to the family Leguminaceae, common bean is the most important grain legume for direct human consumption with production more than twice that of the next most important grain legume, chickpea (Gepts *et al*., 2008). The common bean provides one of the most important sources of protein (Boudoin and Maquet, 1999 and Arulbalachandran and Mullainathan, 2009) and is rich in vitamins, 2 minerals and dietary fiber (Kelly and Scott, 1992 and Ndegwa *et al*., 2006). The immature pods of these beans are also an important food source in many locations around the world, where they are known as green beans, snap beans, french beans or string beans. They are important foods in most tropical and subtropical countries of the world and they are second only to cereals as a food source for humans and animals (Graham and Vance, 2003). Legume crops are also important for their nitrogen fixing capabilities (Piha and Munns, 1987; Keyser and Li, 1992 and Amannuel *et al*., 2000), and can be used in crop rotation systems to improve soil conditions. Nitrogen fixation by legume crops offers an alternative to nitrogen fertilizers which may present a serious environmental problem (Nason and Myrold, 1992 and Brentrup *et al*., 2001). Leguminous plant species are susceptible to many biotic stresses, including attacks by many different insect pests and diseases. Pest and disease problems are the major constraints tothe agricultural productivity of the common bean, particularly in the tropics (Graham and Vance, 2003). Worldwide, yield losses due to insect pests alone have been estimated to be from 35% to 100% annually (Singh and Schwartz, 2011). Pest problems prohibiting more extensive productionof legume crops include such diseases as brown rust, powdery mildew and insect pests such asaphids, caterpillars, leafhoppers and whiteflies. The optimum sowing date varies according to the planted cultivar; the sowing time of crop is critical factor in determining the environmental condition at planting .Sowing date can be important in determining the success of the crop and in maximizing seed yield (Dapoah *et al*., 2000). *P. vulgaris* plants are liable to be attacked by several pests. Many insects belonging to the different orders, Lepidoptera, Diptera, Hemiptera and Thysanura as well as mite pests Tetranychidae attack *P. vulgaris* (Awadalla *et al.,* 1991; Berlinger, 1986; Schuster *et al*., 1996; Cohen and Berlinger, 1986; Schuster and Everett, 1983; Parrella, 1987; Abd El-Gawwad, 2008; Parrella *et al.,* 1985 and Saleh, 2011).The two spotted spider mite, *Tetranychus urticae* Koch. (Acari: Tetranychidae) attacks the broad range of crops including soybean, cowpea and common bean and etc. (Razmjou *et al*., 2009). In Egypt, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) causing an economically significantly loses and damaged to many bean crops (Shahein and EL-Maghraby, 1988). In contrast, flower thrips start infesting at the vegetative stage and migrate later into flower buds and flowers (Kasina *et al*., 2006). This study aimed to evaluate the population fluctuation of certain pests and their natural enemies infesting *P. vulgaris*.

Materials and methods

Field studies were conducted at El-Rahmaneia, Beheira Governorate during 2017 and 2018 seasons. Insect pests and their parasitoids as well as predators were sampled at approximality weekly. The experimental area of 1/4 feddan (1050 m^2) was divided into three replicates about (350 m^2 for each). Randomized complete block design with three replications was used each year. A plot was made up of five rows, 4 m long at spacing of 60 X 40 cm. Two seeds were

planted per hole and thinned after three weeks after seedling emergence. Manual weeding was done as at when found, no herbicide was applied. The seeds of *P. vulgaris* were sown in plots on the two sowing dates at the mid of February and the second date on mid of August 2017 and 2018, respectively.The crop is sown in the mid of February and harvested in June and second planting dates of the experiment was from September to November. Samples of 25 leaves/ replicate were collected randomly at early morning each weekly until the harvest. Numbers of insect stages, egg and movable stages of spider mite were counted and kept in paper bag and transferred to the laboratory to inspect and count the number of each investigated pest. The total numbers were recorded and the mean number was calculated. The insect pests encountered survey were collected and preserved as dry specimen and the specimens were identified.

1. Survey and population density of insects and their natural enemies:

All insect pests and predators were weekly counted on 25 *P. vulgaris* leaves randomly chosen. Standard sweeping insect net (35 cm in diameter cloth cone 75 cm long) was used for collecting flying insects or those existing on plant leaves. Twenty-five strokes every week were implemented. Direct observations were used to study the occurrence of lady bird beetles (Coleoptera: Coccinellidae), syrphid flies (Diptera: Syrphidae) and spiders (Arachnida: Araneae). The sampling procedures indicated previously for predators continued through the plant growth stages. The trapped arthropods were transported to the laboratory in polyethylene bags and spread on a white paper sheet for identification, counting, stage and status of existing on *P. vulgaris* plants.

2. Population fluctuation of the leafminers as amajor pests of *Phaseolus vulgaris* and their parasitids:

Stems, upper andlower surfaces of all the leaves of the selected plants were carefully examined for leafminers during 2017-2018 seasons. Both the immature and adults were counted. The number of leafminers was also recorded on 25 leaves. The leaves bearing the leafminers were collected and placed separately in semi-transparent plastic boxes. The organisms were reared in the laboratory at room temperature.The samples were reared of 1-2 weeks until the adult parasitoids emerged from their host *L. trifolii* or *Ophiomyia phaseoli* (Tryon) (Diptera: Agromyzidae). The emerged wasps were carefully collected and transferred into 96 % ethanol for later identification. The number of leafminers (mines and larvae) was recorded. The number of pupae from each replicates was recorded and counted. The adult emergence of leafminers or parasitoids are collected and identified as *Opius dissitus* (Muesebeck) (Hymenoptera: Braconidae), *Diglyphus isaea* (Walker) (Hymenoptera: Eulophidae) and *Halticoptera* sp. (Hymenoptera: Pteromalidae).

The emerging parasitoids were counted and the percentage of parasitism was calculated as followed Par. % =NP/T x 100 Where NP. = number of parasitized larvae (pupa), T. = total number of larva or pupa.

Twenty-five double net strokes were taken weekly. The trapped parasitoids were transported to the laboratory in polyethylene bags, separated on a white paper sheet for identification and counting.

3. Specimens identification:

Specimens' identification was done at the Biological Control Laboratory at Rice Research and Training Center, Sakha Agricultural Research Station, Kafr El-Sheikh and Taxonomy Department, Plant Protection Research Institute, Dokki, Giza**.**

4. Statistical analysis:

The analysis of variance and Duncan's Multiple Range Tests (DMRT) were used (SAS, 2003).

Results and discussion

1. Survey and population density of insects:

Data presented in Table (1) showed that nine insect species belonging to eight families and five orders according to feeding behavior were identified.These results agree with those of Daiber (1994) who found that the foliage *P. vulgaris* sown in autumn is damaged by the larvae of *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae) and larvae of *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) and the pods sown during spring and summer are attacked by larvae of *H. armigera*, *Thrips* sp. and *Megalurothrips sjostedti* Trybom (Thysanoptera: Thripidae); Ibrahim (1999) found that *P. vulgaris* plants are attacked by several insect pests and the most serious pests are *Aphis crassivora* (Koch.) (Hemiptera: Aphididae) and *Bemisia tabaci* (Genn.) (Hemiptera: Aleyrodidae); Gamila *et al*. (2016) recorded insects attacked *P. vulgaris* plants, *T. urticae, A. craccivora, L. trifolii, B. tabaci, Empoasca decipiens* Paoli (Hemiptera: Cicadellidae)*, Thrips tabaci* Lindeman (Thysanoptera: Thripidae)*, A. gossypii*. Magouz *et al*. (2011) evaluated that certain *P. vulgaris* varieties and in order to breeding lines of bean, *P. vulgaris* for their relative susceptibility to spider mite *Tetranychus cucurbitacearum* Sayed and whitefly *B. tabaci*. *P.vulgaris* was suitable host to development of aphid and *T. urticae*. The incidences of the four studied pests were significantly and positively correlated with maximum temperature and maximum relative humidity (Hanafy *et al*., 2014).

Table (1): Insect pests recorded from *Phaseolus vulgaris* plant during 2017and 2018 seasons.

Order	Family	Scientific name
Hemiptera	Pentatomidae	*Nezara viridula* (L.)
	Aphididae	*Aphis craccivora*(Koch.) *Aphi sgossypii* (Glover)
	Cicadellidae	*Empoasca decipiens*(Paoli)
	Aleyrodidae	*Bemisia tabaci*(Gen.)
Lepidoptera	Noctuidae	*Spodoptera litoralis* (Bosi.)
Thysanoptera	Thripidae	*Thrips tabaci*(Lin.)
Tetranychidae	Acarididae	*Tetranychus urticae*(Koch.)
Diptera	Agromizidae	*Lirimyza trifolii* (Burgess) *Ophiomyia phaseoli*(Tryon)

Data summarized in Table (2) recorded the main pests during two successive summer seasons mid of February plantation (2017 and 2018).Total number of *A.gossypii* 80.67 individuals/ 25 leaves, *B. tabaci* (immature stages) represented by 222.33 individuals/ 25 leaves, *A. craccivora* 1100.33 individuals/ 25 leaves, *T. tabaci* 112.66 individuals/ 25 leaves, *E. decipiens* 339.33 individuals/ 25 leaves, *O. phaseoli* 64.33 individuals/ 25 leaves, *T. urticae* 923.67 individuals/ 25 leaves, *L. trifolii* 427.33 individuals/ 25 leaves, *N. viridulla* 183.33 individuals/ 25 leaves, *Spodoptera littoralis* (Boisduval) (Lepidoptera: Noctuidae) 126.00 individuals/ 25 leaves. Moreover, there was a highly significant difference between the number of insects collected by using sample plant and sweep net during summer planting date in two seasons. The resultsare in agreement with of El -Gindy (2002) and Hashem (1997) who mentioned that both of *A. craccivora* and *A. gossypii* has two generation on bean plants and Abd El-Gawwad (2008) indicated that the mean number of *L. trifolii* population on *P.vulgaris* plants reached its maximum on April during the two seasons, 2005 and 2006 in summer plantation and EI-

Sayed *et al.* (1991) showed that highest rate of infestation with *B. tabaci* (immature stages) on bean leaf in all plantations (early summer, summer and winter). Also, El-Khayat *et al.* (1994) estimated the relative population density of *B. tabaci* stages on leaves of summer vegetable crops at two locations in Qalubiya Governorate. Amaar *et al.* (2014) revealed that minimum and maximum temperatures had no significant negative effects on the seasonal fluctuation of *T. urticae* during 2011, but in the second season recorded significant negative effects for the tested factors, respectively. While the mean percentages of relative humidity had insignificant positive effect in both seasons and Abo-zaid (2011) who showed that the main pests infesting green bean plants during three successive seasons 2008, 2009 and 2010 during summer plantation were *T. urticae* which the most abundant pest in first season, followed by *L. trifolii, A. craccivora, B. tabaci* and *E. discipiens*.

Table (2): Total number of the main pests recorded on *Phaseolus vulgaris* plants during summer seasons during 2017 and 2018.

Pest species	Summer 2017		Summer 2018		General
	Plant samples	Sweeping net	Plant samples	Sweeping net	Total number
***Aphis gossypii* (Glover)**	36. 33±2.082aa	4.33±1.528b	33.33±3.512aa	6.67±.2.082bb	80.67
***Bemisia tabaci* (Gen.)**	125.00±4.509a	0.00±.000cc	97.33±2.517b	0.00±.000c	222.33
***Aphis craccivora* (Koch.)**	569.33±8.505a	35.33±4.509cc	469.0±123.964b	26.67±5.859c	1100.33
***Thrips tabaci* (Lin.)**	54.33±5.132a	0.00±.000bb	58.33±5.508aa	0.00±.000b	112.66
***Empoasca decipiens* (Paoli)**	68.33±1.528c	125.67±5.508a	58.0±2.000d	87.33±2.517b	339.33
***Ophiomyia phaseoli* (Tryon)**	0.00±.000cc	36.00±2.000a	0.00±.000c	28.33±3.512b	64.33
***Tetranychus urticae* (Koch.)**	591.67±52.994a	0.00±.000cc	332.0±262.092b	0.00±.000c	923.67
***Lirimyza trifolii* (Burgess)**	232.0±2.000a	0.00±.000cc	195.33±10.504b	0.00±.000c	427.33
***Nezara viridula* (L.)**	65.67±5.508aa	30.33±9.504bb	58.0±3.000a	29.33±4.041b	183.33
***Spodoptera litoralis* (Bosi.)**	46.67±3.055aa	16.33±4.041bb	40.33±10.504a	22.67±3.055b	126.00
Total	1789.33	248.00	1341.66	201.00	1579.98

Data expressed as Mean ± S. D.
Values followed by the same letter (s) with in a column are not significantly different from eachother at P=0.05.

Data shown in Table (3) recorded the main pests during two successive spring seasons of 2017 and 2018. The Total number of *A. gossypii* was 94.33 individuals/25 leaves , *B. tabaci (*immature stages) represented by 236.33 individuals/25 leaves, *A.craccivora* 1125.63 individuals/25 leaves, *T.tabaci* 113.66 individuals/25 leaves, *E. decipiens* 302.66 individuals/25 leaves, *O.phaseoli* 74.00 individuals/25 leaves, *T. urticae* 1450.00 individuals/25 leaves, *L. trifolii* 453.67 individuals/25 leaves, *N.viridulla* 221.99 individuals/25 leaves, *S.littoralis* 133.00 individuals/25 leaves. Moreover, there was a highly significant difference between the number of insects between sample plant and sweep net during spring planting date during two seasons.

These results are accordance with Mahmoud *et al.* (2011) who studied the population fluctuation of the leafhopper *E. decipiens* on some plantations such as broad bean, green bean, pea, lupine, potato and squash during winter season of 2008-2009 at El-Kanater El-Khairia farm, Kalubia Governorate. The data indicated that *E. decipiens* had two peaks during its winter activity.

Table (3): Total number of the main pests recorded on *Phaseolus vulgaris* plants during spring seasons during 2017 and 2018.

Pest species	Spring 2017		Spring 2018		General
	Plant samples	Sweeping net	Plant samples	Sweeping net	Total numbers
***Aphis gossypii* (Glover)**	44.33±8.505aa	6.33±2.517bb	38.67±3.512a	5.0±2.000b	94.33
***Bemisia tabaci* (Gen.)**	136.33±6.506a	0.00±.000cc	100.0±10.000b	0.00±.000c	236.33
***Aphis craccivora* (Koch.)**	580.0±10.000a	42.33±2.517cc	470.0±20.000b	33.3±3.512c	1125.63
***Thrips tabaci* (Lin.)**	59.33±2.517a	0.00±.000cc	54.33±4.041b	0.00c	113.66
***Empoasca decipiens* (Paoli)**	67.33±3.055cc	105.0±5.000a	46.0±6.000c	84.33±4.041b	302.66
***Ophiomyia phaseoli* (Tryon)**	0.00±.000cc	40.33±5.508a	0.00±.000c	33.67±3.51b2	74.00
***Tetranychus urticae* (Koch.)**	786.67±77.675a	0.00±.000cc	663.33±60.277b	0.00±.000c	1450.00
***Lirimyza trifolii* (Burgess)**	250.67±11.015a	0.00±.000cc	203.0±2.646b	0.00±.000c	453.67
***Nezara viridula* (L.)**	75.0±5.000a	42.33±2.517cc	65.33±5.033b	39.33±4.041c	221.99
***Spodoptera litoralis* (Bosi.)**	55.0±5.568aa	26.33±3.512b	51.67±7.638a	34. 67±4.509bb	133.00
Total	2054.66	262.65	1692.33	195.63	4225.27

Data expressed as Mean ± S. D.
Values followed by the same letter (s) with in a column are not significantly different from each other at P=0.05

2. Survey and population density of predators:

The trend of occurrence of the predatory species at El Rahmaneia region is shown in Table (4). It was obvious that (12 species) were belonging to eleven families included *Coccinella undecimpunctata* L., *Scymnus* sp. (Coleoptera: Coccinellidae); *Orius* sp. (Hemiptera: Anthocoridae); *Ischnura senegalensis* (Rambur) (Odonata: Coenagrionidae); *Chrysoperla carnea* (Stephens) (Chrysopidae: Neuroptera); *Paederus alfieri* Koch. (Coleoptera: Staphylinidae) and some spider.

Table (4): List of abundant predator species collected from *Phaseolus vulgaris* plants during 2017 and 2018 seasons.

Family	Scientific name
Coccinellidae	*Coccinella undecimpunctata* (L.)
	Scymnus spp.
Staphylinidae	*Paederus alfierii* (Koch.)
Coenagrionidae	*Ischnura senegalensis* (Rambur)
Chrysopidae	*Chrysoperla carnea* (Stephens)
Anthocoridae	*Orius* spp.
Salticidae	*Ballus* sp.
Thomisidae	*Thomisius* sp.
Philodromidae	*Thanatus* sp.
Araneidae	*Singa* sp.
Miturigidae	*Cheiracanthium* sp.
Tetragnathidae	*Tetragnatha* sp.

The trend of the population density of the predators on *P. vulgaris* plants depends mainly on the densities of aphids. The mean number of predators fluctuated during March and April and increased gradually to reach its maximum during May at summer seasons, then decreased towards the end of the season during first June, as shown in Table (5). The mean number of predators fluctuated during September and increased gradually to reach its maximum during October and November at the spring seasons, then decreased towards the end of the season during first December as illustrated in Table (5).

Table (5): Monthly means of population density of predators on *Phaseolus vulgaris* plant during 2017 and 2018 at summer and spring seasons.

Month	Summer season			Month	Spring season		
	2017	2018	Mean		2017	2018	Mean
March	0.0	2.0	1.0	Sept.	4.0	5.45	4.72
April	2.40	3.75	3.08	Oct.	28.2	34.0	31.1
May	15.25	20.0	17.63	Nov.	23.75	30.5	27.12
June	3.0	0.0	1.50	Dec.	2.2	3.45	2.83

3. Survey and population density of parasitoid species:

Data represented in Table (6) showed that the recorded parasitoids were *Diglyphus* sp. (Eulophidae: Hymenoptera) and *Opius* sp. (Braconidae: Hymenoptera). It is cleared that the parasitize larvae of leafminer, *Chromatomyia horticola* Goureau (Diptera: Agromyzidae) in appreciable population. On the basis of relative abundance of *Diglyphus* sp. is considered as major parasitoid on bean ecosystem limiting the population of bean leafminer whereas, *Opius* sp. recorded population. The parasitoids recorded are *Sphegigaster* sp., *Halticoptera* sp., *Gelis* sp., *Ophion* sp., *Brachymeria* sp., *Trissolcus* sp., *Cotesia* sp., *Opius* sp., *Chelonus* sp., *Bracon* sp. and *Hyposter* sp. These results are agreed with Gencer (2004) who reported seven parasitoids species belonging to the Eulophidae (Chalcidoidea). Of these, *Diglyphus isaea* (Walker), *Neochyrsocharis Formosa* (Westwood) and *Neochyrsocharis arvensis* Graham were found to be the most common parasitoids of leafminers. Darvas *et al*. (1999) reported *Diglyphus begini* (Ashmead) as the dominant species on *Chromatomyia fuscula* (Zetterstedt) in south eastern Norway. Mekhlif and Abdul-Rassoul (2002) reported that *D. iseae* and *Cirrospilus vittatus* Walker were found to be dominant larval parasitoids on *C. horticola*.

Table (6): Hymenopterous parasitoids species collected from *Phaseolus vulgaris* plants during 2017 and 2018 seasons.

Family	Genus and species
Pteromalidae	***Sphegigaster* sp.** ***Halticoptera* sp.**
Ichneumonidae	***Gelis* sp.** ***Ophion* sp.**
Chalcididae	***Brachymeria* sp.**
Platygastridae	***Trissolcus* sp.**
Braconidae	***Cotesia* sp.** ***Opius* sp.** ***Chelonus* sp.** ***Bracon* sp.** ***Hyposter* sp.** ***Diglyphus* sp.**

4. Population fluctuation of the leafminers as major pests of *Phaseolus vulgaris* and their parasitoids

Results shown in Table (7) showed that the highest mean number of total mines (occupied and empty) caused by *L.trifolii* larvae were significantly represented higher in summer plantation during 2017 than spring plantation during 2017 represented by 21.95 and 16.19 individuals/25 leaves, respectively.

Table (7): Population fluctuation of *Liriomyza trifolii* and *Ophiomyia phaseoli* larvae on *Phaseolus vulgaris* plants during 2017 season.

Investigation Date	2017						Investigation Date	2017					
	Mines		Total mines	Pupa	Adult			Mines		Total mines	Pupa	Adult	
	Empty	Occupied by larvae			*Liriomyz atrifolii*	*Ophiomyi aphaseoli*		Empty	Occupied by larvae			*Liriomyz atrifolii*	*Ophiomyi aphaseoli*
9 March	2.00	1.00	3.00	1.00	0.25	0.0	14 Sept.	2.00	1.25	3.25	1.0	0.0	0.0
16 March	6.25	3.00	9.25	2.25	0.50	0.25	21Sept.	4.25	2.0	6.25	1.75	0.25	0.0
23 March	17.25	7.25	24.50	4.00	2.25	1.0	28 Sept.	13.75	5.25	19.0	3.50	0.75	0.25
30 March	29.75	9.25	39.00	6.25	1.75	0.50	5 Sept.	22.50	4.75	27.25	2.75	0.50	0.0
6 April	19.75	9.50	29.25	7.75	2.25	0.75	12 Oct.	15.25	7.50	22.75	5.25	1.25	0.50
13 April	12.00	6.25	18.25	3.25	1.25	0.75	19 Oct.	9.50	4.25	13.75	2.50	0.20	0.0
20 April	32. 50	12.00	44.50	6.75	4.75	2.00	26 Oct.	25.25	8.0	33.25	4.25	2.25	1.25
27 April	38.25	18.75	57.00	8.00	3.00	0.75	2 Oct.	34.00	12.25	46.25	6.25	2.0	1.25
4 May;8	14.75	7.00	21.75	3.00	1.25	1.00	9 Nov.	12.75	3.0	15.75	2.0	0.75	0.0
11 May	6.75	4.0	10.75	2.25	1.00	0.75	16 Nov.	3.50	1.0	4.50	0.0	0.25	0.0
18 May	3.25	2.0	5.25	0.25	0.0	0.0	23 Nov.	2.25	0.0	2.25	0.0	0.0	0.0
25 May	1.0	0.0	1.0	0.0	0.0	0.0	30 Nov	0.0	0.0	0.0	0.0	0.0	0.0
Total	151.0	80.0	263.5	44.75	18.25	7.75	Total	145.0	49.25	194.25	29.25	8.20	3.25
Mean	12.58	6.67	21.95	3.73	1.52	0.65	Mean	12.08	4.10	16.19	2.44	0.68	0.27

Results summarized in Table (8) showed that the highest mean number of total mines (occupied and empty) caused by *L. trifolii* larvae were significantly represented higher in summer plantation during 2018 than spring plantation during 2018 represented by 18.31 and 16.10 individuals/ 25 leaves, respectively. These results are going in line with Devkota (2015), who determined the seasonal abundance and spatial distribution of *L. trifolii* on bean plants. He found that bean was planted four times from November 2013 to January 2015. *L. trifolii* recorded highest in activity on two weeks after cultivated three planting dates (November – December, 2013; May-June 2014 and September–October 2014) and the highest abundance of leafminer recorded during November, May and September planting and the lowest population seemed in December plantation. During the spring planted crop, numbers of parasitoids were significantly higher than in winter planting (Bouhssini *et al*., 2008). The results of Bassiony (2019) revealed that the average infestation caused by *L.trifolii* on *P. vulgaris* was 241 larvae/ 25 leaflet and recorded high infestation during the second of February.

Table (8): Population fluctuation of *Liriomyza trifolii* and *Ophiomyia phaseoli* larvae on *Phaseolus vulgaris* plants during 2018 season.

Investigation Date	2018						**Investigation Date**	2018					
	Mines		Total mines	Pupa	Adult			Mines		Total mines	Pupa	Adult	
	Empty	Occupi			*Liriomyzatri folii*	*Ophiomyi aphaseoli*		Empty	Occupied by larvae			*Liriomyzatri folii*	*Ophiomyiap haseoli*
8 Mar.	0.00	0.00	0.00	0.00	0.0	0.0	13 Sept.	1.00	0.25	1.25	0.50	0.0	0.0
15 Mar.	4.25	2.25	6.50	1.25	0.50	0.0	20 Sept.	2.75	1.50	4.25	1.00	0.25	0.25
22 Mar.	15.0	6.25	21.25	3.00	1.25	1.0	27 Sept.	11.25	6.0	17.25	3.50	1.00	0.50
29Mar.	26.75	6.25	33.00	4.25	1.50	1.00	4 Sept.	23.75	3.25	27.00	2.25	1.25	0.25
5Apr.	17.25	7.75	25.00	5.25	2.75	0.50	11 Oct.	16.75	6.75	23.50	4.75	1.75	1.50
12Apr.	14.00	8.25	22.25	4.25	2.25	0.0	18Oct.	15. 0	5.75	20.75	3.25	1.20	1.00
19Apr.	29. 50	9.00	38.50	5.75	3.25	1.00	25 Oct.	22. 50	9.25	31.75	6.75	3.25	0.50
26Apr.	30.25	16.25	46.50	6.00	2.00	0.25	1 Oct.	31.50	13.0	44.50	5.25	1.0	1.00
3May	11.75	5.50	17.25	1.00	0.25	0.25	8Nov.	9.25	5.25	14.50	3.50	0.75	0.25
10May	3.75	1.50	5.25	0.25	0.00	0.00	15 Nov.	4.00	2.0	6.00	0.25	0.0	0.0
17May	2.25	1.0	3.25	0.25	0.0	0.0	22Nov.	2.0	0.25	2.25	0.0	0.0	0.0
24May	1.0	0.0	1.0	0.0	0.0	0.0	29 Nov	0.25	0.0	0.25	0.0	0.0	0.0
Total	126.25	64.00	219.7	31.25	13.75	4.00	Total	102.50	53.25	193.25	31.00	10.45	5.25
Mean	11.48	5.33	18.31	2.60	1.15	0.33	Mean	10.25	4.44	16.10	2.58	0.87	0.44

During summer planting date (Figure, 1), the number of parasitoids (*Opius dissitus* Muesebeck, *D. isaea* and *Halticoptera* sp.) recorded 2 individuals/ 25 leaves on 9th of March 2017 and one peak of 13.25 individuals/ 25 leaves and 13.38% were recorded on 20 March its peak of 23.0 individuals/ 25 leaves and 23.23% in 27 of April (Figure, 1). During spring plantation, the number of parasitoids began with 2.25 individuals/ 25 leaves and 3.36% in14 September 2017 then it increased to reach its peak of 15.25 individuals/ 25 leaves on the second of October and 22.74% (Figure, 2). The parasitism rate of both of *O. dissitus* and *D. isaea* showed insignificant fluctuations allthrough the 12 investigation. The season started with parasitism peak for *O. dissitus* then the percentage tended to decrease till the end of the season with exception of a slight increase in the last inspection (Bassiony, 2019).

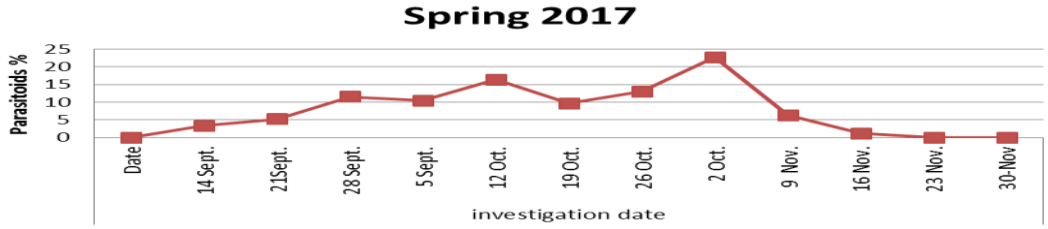

Figure (1): Parasitism percentage of *Opius dissitus*, *Diglyphus isaea* and *Halticoptera* sp. on *Phaseolus vulgaris* during summer season 2017.

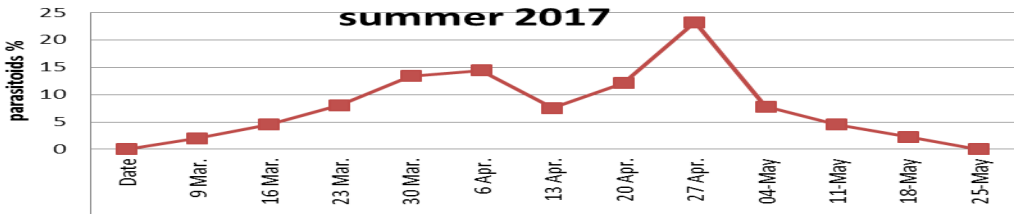

Figure (2): Parasitism percentage of *Opius dissitus*, *Diglyphus isaea* and *Halticoptera* sp. on *Phaseolus vulgaris* during spring date on 2017.

During summer planting date (Figure, 3), the number of parasitoids (*O. dissitus*, *Diglyphus isaea* and *Halticoptera* sp. recorded 3.0 individuals/ 25 leaves in 15th March 2018 and one peak of 10.5 individuals/ 25 leaves and 13.31% were recorded on 15 March its peak of 20.0 individuals/ 25 leaves and 25.97% in 26th April (Figure, 3). In spring plantation, the number of parasitoids began with 0.75 individuals/ 25 leaves and 1.09% in 13 September 2018 then it increased to reach its peak of 16.25 individuals/ 25 leaves on 31st October and 23.71% (Figure, 4). These results agreement with Bhat and Bhagat (2009) reported the occurrence of 7 hymenopteran parasitoids of agromyzid leafminer, *C. horticola* from Kashmir. The various parasitoids recorded were 5 eulophids (*Chrysocharis horticola* Mani, *D. horticola* Khan, *Pediobius indicus* Khan and *Euderus agromyzae* Gangrade) and 2 braconids (*Opius* sp. and *Dacnusa* sp.).

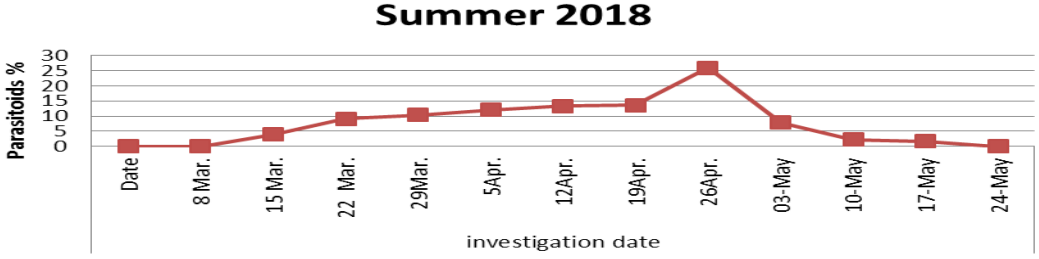

Figure (3): Parasitism percentage of *Opius dissitus*, *Diglyphus isaea* and *Halticoptera* sp. on *Phaseolus vulgaris* during summer date on 2018.

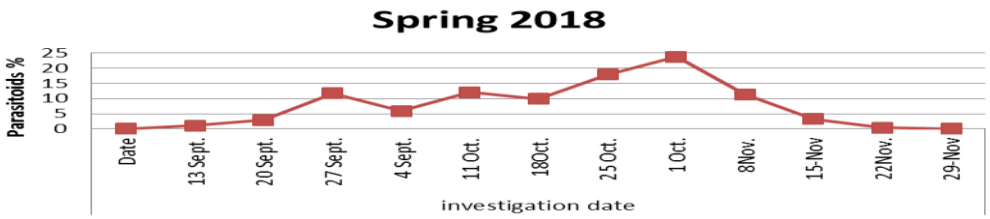

Figure (4): Parasitism percentage of *Opius dissitus*, *Diglyphus isaea* and *Halticoptera* sp. on *Phaseolus vulgaris* during spring date on 2018 season.

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