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Potential Impact of *Lysiphlebus Fabarum* (Marshall) Parasitoid against Cowpea Aphid

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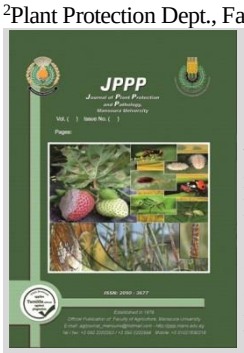

ABSTRACT

Field experiments were occurred during growing seasons of 2022 and 2023 at Kafr Saqr district, Sharkia Governorate, Egypt to assess the seasonal abundance of cowpea aphids and their parasitoid on cowpea plants and to determine the potential effects of the parasitoid *Lysiphlebus fabrum* on *Aphis craccivora* (Koch.) as a management control. Over the two seasons, *A. craccivora* populations averaged 487.65 and 531.76 individuals/20 leaves. Three parasitoid species were observed; *L. fabrum* and *Trioxys* sp. as a primary parasitoid, *Aphidencyrtus* sp . as a hyperparasitoid . Total parasitism rates(average) by *L. fabarum*, *Trioxys* sp., and *Aphidencertus* sp. were 4.56 and 6.63%, respectively, during the 2022 and 2023 seasons. The highest percentage of emergence was observed at a rate of five parasitoids/cage, but the maximum parasitism % of *L. fabrum* was attained at a rate of 20 parasitoids/cage.. Therefore, *L. fabrum* is being promoted for the management of *A. craccivora* on cowpea plants

Keywords: Cowpea aphid, parasitoids , ,Release .

INTRODUCTION

Cowpea has long been used as an economic crop, and its global relevance is growing due to its high economic significance (Saleh *et al.*, 2009 and Salman *et al.*, 2022). Cowpea is susceptible to pest infestation, which can result in significant losses (Saleh 2008 and Maghraby 2012). Piercing-sucking insects are among the insect pests that cause notable harm to sweet basil plants (Ali 2014, Kumar *et al.*, 2022) Aphids, *A. craccivora* inflict damage by directly ingesting on plant sap (EI-Defrawi *et al.*, 2000; Kolaib *et al.*, 2016) or by injecting poisonous salivary secretions and spreading viral infections (Harrison *et al.* 1997and Ali 2014) Chemical insecticide use upsets the natural equilibrium between insects and their natural enemies (Abdul Rehman and Powell (2010) and Woltz and landis 2014) and has resulted in the development of insect resistance, phytotoxicity, and environmental contamination (Saleh 2008 and Ahmad *et al.*, 2011). Biological control is an effective approach that is useful in pest control (DeBach and Rosen 1991 and Saleh *et al.*, 2009) and is a viable, environmentally friendly, and economically sound alternative to insecticide-based agricultural pest management measures (Heimpel and Mills 2017 and Saleh *et al.*,2020).

In Egypt and around the world, *Lysiphlebus fabrum* is primarily employed to control cowpea aphid (El-Naggar *et al.*, 2008 and Maghraby 2012). The goal of this research was to determine the seasonal abundance of cowpea aphid and their parasitoids. The potential impact of the parasitoid *Lysiphlebus fabarum* as an *A. craccivora* management control.

MATERIAL AND METHODS

All field and semi-field trials on cowpea were carried out in Egypt's Kafr Saqr district in growing seasons of 2022 and 2023. In the first week of June cowpea, cultivar karem 7, were sown on a half-feddan plot of land in both season. Over the period of the trial, standard agronomic procedures were followed, and no insecticides were applied.

Seasonal abundance and parasitism percentages of *A. craccivora* parasitoids

The total number of aphids per samples (20 leaves of cowpea) was determined weekly at random and divided into groups each of 100 aphid insects/ Petri dish in the laboratory with fresh sweet basil leaves to identify and determine the percentages of aphid parasitoids. The mummified aphids were counted and kept apart segregatly in Eppendorf tubes until the emergence of adult parasitoids. The emerged parasitoids were mostly counted to estimate the adult emergence percentages then preserved in 70% ethyl alcohol until identification. At the Biological Control Department of the Plant Protection Research Institute in Dokki, Giza, Egypt, all parasitoid specimens have been identified. Farrell and Stufkens (1990) provided the estimates for the parasitism percentages.

Evaluation of various densities of the cowpea aphid parasitoid, *L. fabrum*

The parasitoid, *L. fabrum* and the host, *A. craccivora* were raised under laboratory and semi-field conditions. After 40 days old,25 seedlings in laboratory 20 seedlings in the field of cowpea were separately in plastic jar (2 Kg) in laboratory and caged in the field (50×50×120 cm) iron cages and covered with muslin cloth. Each plant was infested artificially with 200 aphids with different ages. Different densities of 1, 3, 5, 7 and 11 females per jar were maintained in a lab setting (21.0±1 ºC and 75±5 % RH). Meanwhile utilizing recently emerged mated females that were well fed on honey in cages circumstances (18.0±1 ºC and 65 ± 5% RH) , five, 10, 15, and 20 parasitoids/cage were introduced. The females were maintained for 24 hours before being removed and the aphids being left behind to mummify. After mummification, the

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mummies were counted to estimate the parasitism percentages and delicately placed in marked Petri dishes with pieces of plant leaves, on a moistened filter paper. The mummies were examined till the adult' emergence. Once the grown- ups emerged, they were recorded to determine their emergence percentages. There were five replicates for every parasitoid density. Costat Statistical Software 2005 was used to perform statistical analysis on the data.

RESULTS AND DISCUSSION

Seasonal abundance and parasitism percentages of *A. craccivora* parasitoids

Regarding the weekly inspections of cowpea plants, it was observed that they were mostly liable to infestation with *A. craccivora*. Infestations during the first season began in the third and fourth weeks of June in second one. Four activity peaks were detected in the 2022 season and three in the second one. The maximum individuals of cowpea aphid in first season was recorded in the last week of July by 711 individuals/20 leaves Table 1 and 840 *individuals*/20 leaves individuals/20 leaves in second week of September in second one Table2.

Over the two seasons, *A. craccivora* populations averaged 487.65 and 531.76 individuals/20 leaves (Tables 1 & 2).

While this is going on, Maghraby (2012) and Saleh (2012) found that many insect pests, including the, of *A. craccivora*, which is regarded to be a major pest of faba bean and cowpea in Egypt, attack the faba bean and cowpea.

Table 1. Parasitism % of aphid parasitoids on *A. craccivora* in season 2022.

Sampling dates	*A. craccivora*	Mummies			% Parasitism	parasitoids						Total	Average	
						Primary parasitoids				Hyper parasitoids				
		A	B	Total		*Lysiphlebus fabarum*		*Trioxys* sp		*Aphidencertus* Sp.			˚C	R.H
						N	RD	N	RD	N	RD			
Jun. 3rd	201	00	00	00	000	00	00	00	00	00	00	00	36	61
4rd	304	00	00	00	00	00	00	0	0	00	00	00	36	59
Jul. 1st	497	00	00	00	00	00	00	0	0	00	00	00	24	61
2nd	331	00	00	00	00	00	00	0	0	00	00	00	30	60
3rd	530	00	9	9	1.69	5	100	0	0	00	00	5	30	60
4th	590	00	18	18	3.05	9	100	0	0	00	00	9	30	55
5th	771	00	29	29	3.76	15	83.33	3	16.67	00	00	18	30	57
Aug. 1st	509	00	37	37	7.27	21	77.78	6	22.22	00	00	27	32	56
2nd	463	7	43	50	10.80	30	76.92	5	12.82	4	10.26	39	32	51
3rd	690	29	35	64	9.28	29	69.04	10	23.81	3	3.14	42	30	59
4th	501	43	29	63	12.59	25	55.56	12	26.67	8	17.78	45	31	56
Sep. 1st	492	30	18	48	9.76	20	58.82	8	23.53	6	17.65	34	29	57
2nd	450	47	39	86	19.11	46	69.7	13	19.70	7	10.61	66	31	64
3rd	685	51	28	79	11.53	35	74.47	7	14.29	5	10.64	47	29	58
4th	607	47	33	80	13.50	38	69.09	10	18.18	7	12.73	55	30	56
Oct 1st	372	14	10	24	6.45	7	50.0	3	21.43	4	28.57	14	27	61
2nd	297	8	5	13	4.38	4	40.0	2	20.0	4	40.00	10	28	64
Total	8290				112.77	248	924.71	79	219.32	48	151.38	411		
Average	487.65				6.63	14.58	54.39	4.65	12.90	2.82	8.9	24.18		

Table 2. Parasitism % of aphid parasitoids on *A. craccivora* season 2023 .

Sampling dates	*A. craccivora*	Mummies			% Parasitism	parasitoids						Total	Average	
						Primary parasitoids				Hyper parasitoids				
		A	B	Total		*Lysiphlebus fabarum*		*Trioxys* sp		*Aphidencertus Sp.*			˚C	R.H
						N	RD	N	RD	N	RD			
4th	370.0	00	00	00	00	0	00	00	00	00	00	00	29.0	59.0
Jul. 1st	410.0	00	00	00	00	0	00	00	00	00	00	00	40.0	56.0
2nd	394.0	00	00	00	00	0	00	00	00	00	00	00	40.0	67.0
3rd	500.0	00	00	00	00	0	00	00	00	00	00	00	40.0	63.0
4th	650	00	00	00	00	0	00	00	00	00	00	00	380	59.0
5th	442	00	4	4	0.90	2	100	00	00	00	0	12	34.0	59.0
Aug. 1st	581	00	22	22	3.79	12	100	00	00	00	00	12	37.0	59.0
2nd	554	00	25	25	4.51	13	86.67	2	13.33	00	00	15	37.0	58.0
3rd	767	00	43	43	5.61	19	67.90	9	32.14	00	00	28	36.0	61.0
4th	507	00	38	38	7.50	17	73.91	5	21.74	00	000	22	36.0	55.0
Sep. 1st	595	6	46	46	7.73	20	64.52	9	29.03	2	6.45	31	32.0	62.0
2nd	840	15	41	56	6.67	22	62.86	7	20	6	17.14	35	34.0	63.0
3rd	651	33	20	53	8.14	20	64.52	6	19.35	5	16.13	31	34.0	60.0
4th	570	19	27	46	8.07	15	55.56	4	14.81	8	29.63	27	35.0	55.0
Oct 1st	500	39	30	69	13.8	20	51.28	9	23.07	10	25.64	39	37.0	60.0
2nd	394	11	15	26	6.6	5	33.33	3	20	7	46.67	15	33.0	57.0
3rd	315	5	8	13	4.13	2	28.57	1	14.29	4	57.14	7	30.0	62
Total	9040				77.45	167	63.26	55	20.83	42	15.91	264		
Average	531.76				4.56	9.82	3.72	3.24	1.22	2.47	0.93	15.53		

Salman *et al.,* (2022), on the other hand, found that the cowpea aphid population density started to increase after 15 days of seeding and continued to do so until the end of March. The beginning of warmer seeding appears to be the ideal environment for the cowpea aphid to grow and multiply.

During the current experiment, three major hymenopterous parasitoid species a primary parasitoid (*Lysiphlebus fabarum* and *Trioxys* sp.) and a hyperparasitoid species (*Aphidencyrtus* sp.) emerged from the mummified aphid.

The major *L. fabarum* parasitism phase lasted from the third week of July to the 2nd week of October in the 2022 and 2023 seasons, respectively. The 2nd week of September had the largest discovery (46 and 22 parasitoids

in two seasons). *Trioxys* sp. initially emerged 2022 in the last week of July to the 2nd week of October, and in 2023 from the 2nd week of August to the 3rd week of October. *Aphidencyrtus* sp. emerged briefly and in small numbers. Beginning at 1.69%, the parasitism rate gradually rose to a maximum of 19.11% in the second week of September before declining until the end of the first season. The second season's *L. fabarum* existence was first noted between July and October, with the maximum mean number of occurrences being reported during the second week of September and *Trioxys* sp. appearing from August to October. *Aphidencyrtus* sp. only occasionally showed up in small numbers, and its parasitism levels ranged from 0.9% to 13.80% (Tables 1 & 2).

During the 2022 and 2023 seasons, respectively, *L. fabarum Trioxys* sp. and *Aphidencyrtus* sp. individuals together had parasitism rates of 6.76 and 4.62%. The dominant percentages (%) parasitoids were discovered in *A. craccivora* mummies that were taken from cowpea plants in seasons of 2022 and 2023. *L. fabarum* and *Trioxys* sp. were the two species with the largest proportions of dominating levels (69.09 and 19.22% in 2022 and 63.26 and 20.83% in 2023). *Aphidencyrtus* sp. had the lowest dominance degrees (11.69 and 15.91%) in 2022 and 2023, respectively (Tables 1 & 2).

According to Saleh *et al.,* (2009) and Maghraby (2012), who showed that *D. rapae, L. fabarum,* and *Ephedrus* sp. were parasitoids on *A. craccivora* in Egypt, the current findings are consistent with earlier studies. On several faba bean varieties, *L. fabarum, A. matricariae,* and *Trioxys* sp. were seen attacking *A. craccivora* (Abdel-Samad1996 and Salman *et al.,* 2022). The current results are consistent with those of Cruz *et al.,* (1992), Stary and Erdelen (1987), all of which were carried out in Yemen and reported that *A. colemani* was the parasitoid developed from *A. craccivora* .

According to the same findings, *L. fabarum* was the most prevalent species of cowpea aphid in Iran, followed by *B. acalephae* and *L. confused* (Rakhshani *et al.* 2005).

Evaluation of various densities of the cowpea aphid parasitoid, *L. fabrum*

In the laboratory:

The rates of parasitism were impacted by the parasitoid density; for *L. fabarum*, the maximum percentage was 34.10 % when kept at a rate of 11 parasitoid / jar, while the lowest percentage was 7.10% when kept at one parasitoid / jar. At all densities, there were noticeable variations in the overall numbers of parasitized aphid and the overall percentage of parasitism. A minimum of 13.20 % parasitized aphids were reported at one parasitoid / jar, and a maximum of 62.20% were recorded at 11 parasitoids / jar. The rate of adult emergence for *L. fabarum* was 76.32% percent at one parasitoid / jar and 50.9 % at 11 parasites each cage. (Fig 1 &Table 3).

In the semi-field:

The percentages of parasitism were impacted by the parasitoid density; for *L. fabarum*, the maximum percentage was 81.0% when kept at a rate of 20 parasitoid females / cage, and the lowest percentage was 49.10% when kept at five parasitoid / cage. There were significant differences in the total numbers of parasitized aphid and the total percentage of parasitism at all densities.

With 20 parasitoids / cage, *L. fabarum* was able to parasitize the most aphids (164.00), while five parasitoids / cage resulted in the fewest (101.60). The percentage of adult emergence for *L. fabarum* ranged from 72.13 % at five parasitoids / cage to 61.3 % at 20 parasitoids / cage (Fig. 2 and Table 4).

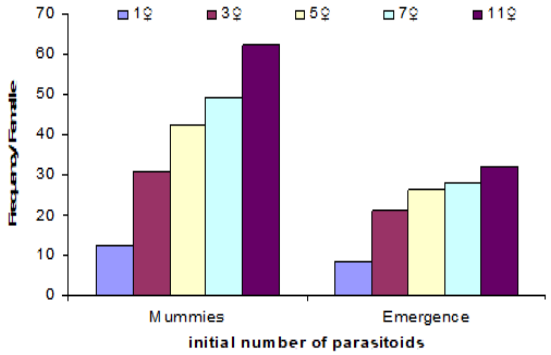

Fig. 1. Impact *L. fabarum* on the total count mummies and adult emergence

Table 3. Impact of *L. fabarum* density on % parasitism and adult emergence

Parasitoid density	% parasitism	% adult emergence
1♀	7.1± 0.31	76.32 ± 1.68
3♀	14.3 ± 0.24	67. 49 ± 2.46
5♀	20.1 ± 0.58	60.92 ± 3.23
7♀	23.80 ± 1.61	55.81 ± 3.09
11♀	34.1 ± 1.27	50.93 ± 2.12
F	*	*
$LSD_{0.05}$	2.763	3.2544

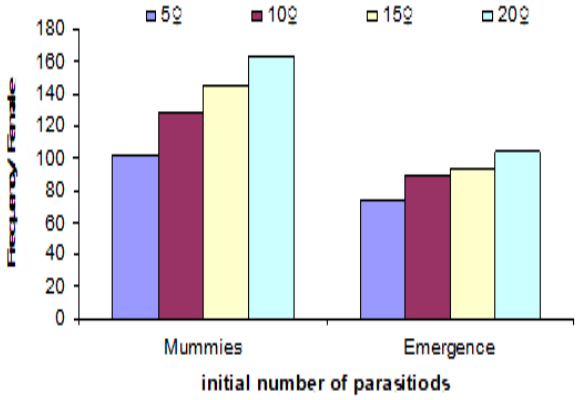

Fig. 2. Impact *L. fabarum* on number of mummies and adult emergence .

Table 4. Impact of *L. fabarum* density on % parasitism and adult emergence

Parasitoid density	% parasitism	% adult emergence
5♀	49.1d ± 0.29	72.13a ± 3.02
10♀	63.1c ±1.84	68.21b ± 3.07
15♀	71.8b ± 4.09	63.93c ± 3.66
20♀	81.0a ± 3.47	61.31c± 4.58
F	*	*
$LSD_{0.05}$	2.0056	2.1461

Numerous studies confirmed the importance of *L. fabarum* in controlling *A. craccivora*; Ragab and Ghanium (1997), Chau and Mackauer (2001), Jones *et al.*, (2003), Gently and Barbosa (2006), El-Naggar *et al.*, (2008), Abdul Rehman and Powell (2010), Saleh (2014), and Salman *et al.*, 2022 they mentioned that *L. fabarum* has been reared successfully on *A.craccivora*.

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فعالية الطفيل *Lysiphlebus fabarum* في مكافحة من اللوبيا

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الملخص

أجريت تجارب حقلية لدراسة الوفرة الموسمية لمن اللوبيا وطفيلياته و كذلك فعالية الطفيل*Lysiphlebus fabarum* في مكافحة من اللوبيا في منطقة كفر صقرمحافظة الشرقية خلال موسمي ٢٠٢٢ و ٢٠٢٣ .وبينت النتائج ان متوسط تعداد من اللوبيا٤٧٨,٦٥ و٥٣١,٧٦ فرد خلال موسمي الدراسة. و أظهرت الدراسة أيضا حصر ثلاث طفيليات *Lysiphlebus fabrium Trioxis* sp كطفيل أولي ونوع واحد من الطفيليات الثانوية *Aphidencyrtus* sp .وبينت الدراسة أن متوسط نسبة التطفل ٤,٥٦ و ٦,٦٣ % خلال موسمي ٢٠٢٢ و٢٠٢٣ علي التوالي. وأظهرت هذه الدراسة أن أعلي نسبة خروج للطفيل *Lysiphlebus fabarum* عند كثافة ٥ طفيل / قفص بينما كانت أعلي نسبة تطفل للطفيل بلغت اقصاها عند كثافة ٢٠ طفيل / قفص .وتوضح هذه الدراسة امكانية استخدام الطفيل *Lysiphlebus fabarum* في مكافحة من اللوبيا.