BIOLOGICAL CONTROL OF *APHIS CROCCIVORA* KOCH ON *PHASEOLUS VULGARIS* L. PLANTS AT FAYOUM GOVERNORATE

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ABSTRACT

A study was carried out to estimate population density of cowpea aphid, *Aphis craccivrora* Koch and its predators associated bean plants.

Population fluctuation of *A. craccivrora* and its three predators, i.e., *Coccinella undecimpunctata* L., *Chrysoperla carnea* Steph and *Syrphus corollae* F. were studied and released on bean which surrounded by cabbage plants as compared with other fields un-surrounded at Sennoris district, Fayoum Governorate during summer plantation 2011/2012.

The obtained results showed that the population density of three predators at bean fields surrounding by cabbage more than twice (<100%) neighboring ones by mean counts by mean counts were 101.8 and 42.3 predators /20 plants, respectively. Statistical analysis showed highly significant differences between the tested field and the neighboring ones.

The obtained results indicated that there was reduction in aphid population ranged between 9.53 to 75.20 by mean 47.79% concerning the number of the predators. Results also revealed that there were highly significant increase in bean green yield over neighboring check field (control) of about 70.0 % in bean plots inter-cropped with cabbage plants .

Key words: Population density**,** *Aphis craccivrora***,** bean, predators**,** *Coccinella undecimpunctata*, *Chrysoperla carnea* and *Syrphus corollae***,** released**,** surrounded, un-surrounded, cabbage, summer plantation**,** green yield, inter-cropped.

INTRODUCTION

Bean plant, *Phaseolus vulgaris* L. is one of the most important and popular leguminous vegetable crops in Egypt. Cultivated area of bean in Egypt has increased during the last two decades, especially in winter plantation, to cover needs of local consumption and export **(Allam *et al*., 2009).** In Fayoum governorate, the cultivated area of this crop reached 300 fed., in winter plantation, 360 fed. in nili plantation and 126 fed. in summer plantation in 2012, by a production averaged 4.5; 4.2 and 4.2 ton/fed., for the three plantations, respectively **(Ministry of Agricultural report, Fayoum Governorate Information Center of Agriculture, 2012).**

Several pests attack this crop and effect the quality and quantity of both green pods and dry seeds, whiteflies, aphids, thrips and leafminers are usually infested bean plants and causing high damage **(Golam (2002).**

The cowpea aphid, *Aphis craccivrora* Koch, damage to the crop, has been estimated in some seasons to reach about 50-80% reduction in different yield components **(Bishara *et al*., 1984) and Abd El-Wareth (2005).**

Recently, with the heavy application of pesticides, the role of biological control agents has been badly affected. The role of natural enemies in regulating aphid populations, has been extensively reviewed and there are many examples of natural enemy actions significantly reduced aphid populations according to **(Lokhande and Mohan, 1990)**.

Efficiency of a natural enemy depends upon a complexity of factors, involving characteristics of the natural enemy, aphid population growth stage, condition of the host plant, as well as climatic factors.

However, the impact is likely to be greater when a natural enemy synchronizes with early establishment of aphid colonies and either completely destroys the colonies or severely checks the initial rapid reproduction on which build-up of large colonies depends **(Milne, 1971)**.

The present study aims to estimate the efficiency of three predator species on the cowpea aphid (*A. craccivora*) population on *P. vulgaris* under field conditions without using insecticides.

MATERIAL AND METHODS

The present study was carried out on bean plants (*P. vulgaris* branco cv.) cultivated at Sennoris district in Fayoum governorate during the summer plantation (2011/12). An area of about 1400 m² was divided into 12 equal plots (plot area 100 m²), surrounded by cabbage plants, cultivated at the periphery of each plot, using the randomized complete block design.

Date of sowing:

Cabbage was planted on 2/9/2011. Space between holes was 30cm, the length of line was 10m, the width was 0.6m at the rate of 14000 cabbage plants/ fed. One month old cabbage plants were naturally infested with the cabbage aphid, *Brevicoryne brassicae* L. cabbage plants were transplanted around bean plots (as a source of prey).

Bean was planted on 2/10/2011. Space between holes was 15cm, the length of line was 10m, the width was 0.6m at the rate of 28000 bean plants/ fed.

Predators collecting method:

Predators individuals were collected by using a standard sweeping net (a wooden handle 100 cm. long attached to a cone-shaped piece of muslin cloth 30 cm. diam. and 90 cm. deep.) i.e., *Coccinella undecimpunctata* L.; *Chrysoperla carnea* Steph ; *Syrphus corollae* F.; *Symnus syriacus* Mars.; *Paederus alfierii* Kock; *Orius* spp. and true spiders from vegetable crops such as, Eggplant; Pepper; Cucumber etc. One hundred double strokes were taken from each host plant over a suitable height.

Mass rearing:

Three species of each all predators i.e., *C. undecimpunctata*; *C. carnea* and *S. corollae* were transferred to the laboratory and put on faba bean plants(infected by aphids) cultivated in a small plastic pots from two generation using adult and larval stages. *A. craccivora* was reared on faba bean plants as a prey for the three predators inside wooden cage (three cages were used for predators) (1m. length x 1m. width x 60 cm. high) under room conditions 25±3Cº and 70± 5% R.H to get a lot of predator numbers to release.

Predator releasing:

The three species of predators were released to the open field separately on tested bean and neighboring fields by rate 5 predator /m² **El- Defrawi, *et al.*, (1995)**. All agricultural practices were carried out regularly. the common aphidophagous predators, *Coccinella undecimpunctata* L.; *Chrysoperla carnea* Steph. and *Syrphus corollae* F. were released for four times during twenty days in the tested and neighboring fields. With respect to *C. undecimpunctata* and *C. carnea* were release by adults between aphid colonies. Whereas *Syrphus* was released at larval and adult stage. For evaluating the role of the predaceous insects, three criteria were conducted; aphid and different predator numbers population densities were estimated on 20 bean selected randomly with four replications inside the experimental field after the last releasing. Green green yield was estimated at the end of the plantation. Data were collected and compared with the check bean fields.

Sampling:

Weekly samples of tested bean and neighboring fields (20 plants at rate 5 of plants/plot) were counted aphids and predators individuals by actual count method described by **Hafez (1964)**.

Data obtained were subjected to statistical analysis using T tests for finding the variations **(Duncan, 1955)**.

Table (1): Weekly counts of predator insects associated with *Aphis craccivora* Koch per 20 bean plants within fields surrounded with cabbage (S) and neighboring un-surrounded fields (U) at Sennouris district, Fayoum Governorate, during summer plantation season 2011/2012.

Sampling dates	Number of insect predators/20 plants					
	Coccinella undecimpunctat		*Chrysoperla carnea*		*Syrphus corollae*	
	S	U	S	U	S	U
15 Nov.	14	5	4	3	0	0
22	21	9	9	4	0	1
29	45	26	15	10	2	2
6 Dec.	83	45	21	12	6	4
13	97	63	11	5	10	0
20	104	72	5	2	6	1
27	95	35	2	3	2	5
3 Jan.	41	18	1	8	1	6
10	29	22	4	12	0	9
17	46	36	16	17	2	3
24	86	28	28	25	11	2
31	92	55	44	10	8	1
7 Feb.	57	41	20	2	3	0
Total	810	455	180	113	51	34
Mean ±SE	**62.3^{a}±5.04**	**35.0^{b}±2.23**	**13.8^{a}±1.08**	**8.7^{b}±0.69**	**4.0^{a}±0.41**	**2.6^{b}±0.22**

S : Surrounded **U: Un- Surrounded**

Duncan's Multiple Rang Test P<0.01

Table (2): Impact of predators on of *A. craccivora* density on bean plants fields at Sennouris district, Fayoum Governorate, during summer plantation season 2011/2012.

Sampling dates	Weekly counts of aphids /20 plants		Total numbers of predators /20 plants		% Reduction of aphids
	Tested field	Neighboring field	Tested field	Neighboring field	
15 Nov.	1067.6	867.4	4	7	23.10
22	1342.5	1225.7	20	12	9.53
29	1125.2	1729.5	54	23	35.0
6 Dec.	1289.4	2014.8	78	49	36
13	1001.7	1955.2	194	86	48.77
20	746.5	1534.6	163	100	51.35
27	374.2	1199.2	210	81	68.79
3 Jan.	265.4	774.6	149	40	65.74
10	201.7	432.1	87	31	53.32
17	165.8	375.4	43	17	55.83
24	147.5	594.8	65	10	75.2
31	268.9	674.5	112	38	60.13
7 Feb.	175.6	285.7	144	56	38.54
Total	8572	13663.5	1323	550	621.3
Mean ±SE	**628.6^{b}±25.15**	**1051.0^{a}±42.36**	**101.8^{a}±7.14**	**42.3^{b}±3.63**	**47.79**

Duncan's Multiple Rang Test P<0.01

Results and Discussion:

Results in (Table1) show that, the common aphidophagous predators found during the observation period, transferred from the cabbage plants and maintained on bean field during summer plantation were:

1- Counts of predators

C. undecimpunctata L. (Coccinellidae: Celeopatra); *C. carnea* Stephanes (Crhysopidae: Neuropetra) and *S. corollae* F (Syrphidea: Diptera).

1.1 *C. undecimpunctata* L.

C. undecimpunctata was found preying on cowpea aphid colonies. This specie was abundant during summer plantation throughout 13 weeks. Data showed that *C. undecimpunctata* had two main periods of seasonal activity. The first was from 15^{th} of November 2011 to 10^{th} of January 2012, while the second started from 17^{th} of January to 7^{th} of February 2012. Maximum counts were found on the 20^{th} of December 2011 and the second on the 31^{st} of January 2012 when counts of 104 and 92 insects/ 20 plants on the respective dates were found on bean intercropped with cabbage plants, as compared to 72 and 55 insects/20 plants in the monocropped bean.

Statistical analysis of the data revealed highly significant difference, between the weekly numbers of the coccinellid on the tested bean plants surrounded by cabbage plants and the neighboring bean fields. The means were 62.3 and 35.0 individuals /20 plants, respectively.

***1.2 C. carnea* Stephens:**

Data in (Table1) show that *C. carnea* was active in two main periods in bean fields, the first started from 15th of November to 13th of December 2011 and the second period occurred from 17th of January till the 7th of February 2012. Maximum counts were recorded on 6th of December for the first active period, and 21 insects per 20 plants on bean surrounded with cabbage and 12 on bean without cabbage. The second maximum counts occurred on 31st of January 2012 on bean intercropped with cabbage plants (44 insects) and on 24th of January 2012 (25 insects/20 plants) in neighboring bean fields.

Results of the statistical analysis showed that differences among the weekly mean numbers of *C. carnea* individuals within bean fields intercropped with cabbage plants and the neighboring check control bean fields were significant.

***S. corollae* F.:**

Table (1) shows that high numbers of *S. carollae* were found in two main periods in bean fields from 6th to 20th of December 2011, for the first period. While, the second period started from 17th of January till 7th of February 2012 in bean intercropped with cabbage plants. On the other hand, this species appeared early from 29th of November to 13th of December 2011 for the first period. But the second period started from 20th of December 2011 till 31st of January 2012 in neighboring bean field. Maximum number of *Syrphus* on 13th of December 2011 and on 24th of January 2012 in bean fields surrounded with cabbage plants was 10 and 11 individuals/ 20 plants. In the neighboring bean fields, they were about 6 and 9 individuals/ 20 plants on 3rd and 10th of January 2012, respectively.

Statistical analysis of the data revealed highly significant differences among the weekly mean numbers of *Syrphus* in bean fields surrounded with cabbage and the check neighboring surrounded ones. The means were 4.0and 2.6 larvae / 20 plants, respectively. *Syrphus* flies are effective natural enemies of aphids in Egypt **(Tawfik *et al.*, 1974).**

The reduction in aphid population due to predators ranged between 9.36 and 75.20 (table 2). These results shed some light on the importance of restoring biological control agents. The maximum decrease in aphid number occurred in two periods, the first one was on 27thof December 2011, while the second was on 24th of January 2012 by average 68.79 and 75.20% reduction in aphid population, respectively.

At harvest, the increase in green yield over control ranged between 10.20 to 70.61 kg/plot at an average of 39.61 kg/plot. Percentage of increase in green yield ranged between 12.7 and 225.0 % with an average of 70.0% (Table 3).

Statistical analysis of the data revealed highly significant differences among sampling of bean fields surrounded with cabbage and the check neighboring (control) at 0.01. These results are agreement with **El- Defrawi, *et al.*, (1995)**.

In the present study, using insect predators for regulating aphid populations under field conditions proved to be very effective. It was suggested that predators be released at the time of lower rates of aphid populations and before colonization and increasing the yield **(Banks, 1968 and Milne, 1971)** .

Table (3): Green yield in bean fields using biological control and compared with the neighboring check control fields at Sennouris district, Fayoum Governorate, during summer plantation season 2011/2012.

Sampling	Bean green yield (Kg/ plot)		Increasing in green yield over control	
	Field using biological control method	Neighboring fields check	Kg/ plot	%
1	120.57	70.3	50.27	71.5
2	150.83	80.22	70.61	88.0
3	110.53	50.84	59.69	117.4
4	100.60	30.95	69.65	225.0
5	100.95	80.66	20.29	25.2
6	160.45	120.37	40.08	33.3
7	100.36	50.28	50.08	99.6
8	80.47	50.77	29.70	58.5
9	80.46	60.82	19.64	33.0
10	90.71	80.51	10.20	12.7
11	110.36	90.4	19.96	22.1
12	100.83	65.67	35.16	53.5
Total	1307.12	831.79	475.33	1026.8
Mean ±SE	109.00^{a}±9.46	69.31^{b}±5.42	39.61±4.25	70.0

Duncan's Multiple Rang Test P<0.01

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المكافحة البيولوجية لحشرة من اللوبيا علي نباتات الفاصوليا بمحافظة الفيوم

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أجريت هذه التجربة لدراسة التغير في الكثافة العددية لحشرة من اللوبيا *Aphis craccivora* والمفترسات الثلاث المصاحبة له وهي أبوالعيد احدي عشرة نقطة *Coccinella undecimpunctata* وأسد المن *Chrysoperla carnea* و ذبابه السرفس *Syrphus corollae* والتي تم تربيتها وإطلاقها علي نباتات الفاصوليا (صنف برا نكو) المحاطة بنباتات الكرنب وتم مقارنتها بالحقول الأخرى الغير محاطة وذلك بمنطقة سنورس محافظة الفيوم خلال العروة الصيفية عام ٢٠١٢/٢٠١١.

وأوضحت النتائج المتحصل عليها أن الكثافة العددية لتلك المفترسات الثلاث في حقول الفاصوليا المحاطة بالكرنب أكثر من ضعف مثيلتها الغير المحاطة بمتوسط ١٠١.٨ و ٤٢.٣ فرد مفترس / ٢٠ نبات علي الترتيب. كما أوضحت النتائج وجود فروق معنوية عالية بين أعداد المفترسات في حقول الفاصوليا المحاطة والغير محاطة بالكرنب عند مستوي معنوية ٠.٠١. كما أوضحت النتائج أيضا انخفاضا في تعداد المن تراوح بين ٩.٥٣- ٧٥.٢٠ بمتوسط ٤٧.٧٩ %. وأظهرت النتائج أيضا وجود فروق معنوية عالية في إنتاجية المحصول الأخضر في حقول الفاصوليا المحاطة بالكرنب عن الحقول الغير محاطة عند مستوي ٠.٠١ والذي يقدر بـ ٧٠%.

ومن هذا يتضح مدي أهمية وضرورة التوسع في استخدام وتطبيق المكافحة المتكاملة للحد من الإخلال بالتوازن البيئي بين حشرة المن وأعدائها الحيوية المصاحبة لها بالبيئة وكذلك زيادة إنتاجية المحصول.