PREDATORS AND THEIR ROLE IN CONTROLLING APHID POPULATION

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(Manuscript received 17 February 1997)

Abstract

Aphis craccivora Koch and *Aphis gossypii* Glover are considered as main pests of some vegetable crops as cowpea and cucumber, in Egypt. The population dynamics of the two pests and three predators associated with them were studied for the two growing seasons 1994 and 1995 in Qualyobia Governorate. The highest population of *A.craccivora* on cowpea was observed on May, while the lowest was recorded on June. As for the highest population of *A.gossypii* on cucumber, the same trend of the above mentioned aphid species obtained. Three predators, namely *Coccinella undecimpunctata*, *Scymnus interruptus* and *Orius albidipennis* were recorded associating with the aphids on both cowpea and cucumber . They caused a reduction in *A.craccivora* population by 55.64 % and 59.4% on cowpea or by 82.64% and 73.62% in *A.gossypii* on cucumber. This indicate that *C.undecimpunctata* had a strong effect in minimizing *A.craccivora* (1:67.58 or 88.90), while *Orius albidipennis* had an effective role in decreasing *A.gossypii* on cucumber (1:11.22 or 13.9). Data indicate that the most active period for the three predators on the two hosts was recorded during the second half of May uptil the end of the first week of june.

INTRODUCTION

Aphis is one of the main pests that is widely spread among most of the cultivated crops causing injurious damage either directly by sucking plant juice or indirectly by transmitting virus diseases to the plants.

In Egypt, cucurbit vegetables are subjecting to serious infestation by *Aphis gossypii* (Attia et al., 1985), while legume crops are highly infesting by *Aphis craccivora* Koch (Hegab et al., 1991, and Metwally et al., 1991). Extensive studies were carried out concerning aphids and their enemies (Ismail, 1963; Awadallah, 1968; El-Arnaotty, 1991).

The present study deals with the population dynamics of *A.craccivora* infesting cowpea and *A.gossypii* on cucumber and the associated numbers of three of their predators, *Coccinella undecimpunctata*, *Scymnus interruptus* (Coccinellidae, Coleoptera) and *Orius albidipennis* (Anthocoridae, Hemiptera).

MATERIALS AND METHODS

An area of about one feddan was planted during 1994 and 1995 seasons at Qualyobia Governorate. This area was divided into two halves each to be cultivated by cowpea and cucumber. Planting date took place during the first week of April for the two mentioned seasons.

Normal agricultural practices were followed in the experimental area without any insecticidal application. Sampling of 15 leaves each were collected at randomly, 3 weeks after planting and continued in weekly intervals until harvest. Samples were transferred to the laborartoy to examine for aphid species and its predators, as the counted numbers stands for the aphid nymphs and adults, *O.albidipennis* nymphs and adults, *C.undecimpunctata* and *S.interruptus* larvae and adults.

The simple correlation and partial regression values of the aphids species and their predators were calculated besides the combined effect of the three predators on the fluctuation of *A.craccivora* and *A.gossypii*.

RESULTS AND DISCUSSION

Population Fluctuation of Aphis craccivora Koch on Cowpea

Data in Table 1 indicate that during the two seasons of investigation, 1994 and 1995, *A.craccivora* infestation was observed from April uptil end of June.

As for the first season 1994, the population of *craccivora* ranged from 73 to 1278 individuals/15 leaves, the highest infestation 1278 individuals/15 leaves took place on the 10th of May at 25.1°C and 53% R.H., by which the population decreased gradually reaching its minimum (73 individuals) on the 14th of June at 25.8°C and 57% R.H. As for the second season, *A.craccivora* population reached a maximum population of 992 individuals on the 14th of May at 25°C and 60% R.H., the number of aphids decreased gradually by the third week of June, reaching its minimum 88 individuals/15 leaves at the 18th of June at 27.9°C and 52% R.H.

Predators

Three predators were found to be associated with *A.craccivora* on cowpea plants during the two studied seasons, i.e., *Coccinella undecimpunctata, Scymnus interruptus* and *Orius albidipennis*, Table 1.

During 1994 season, the population of C.undecimpunctata ranged from 6 to 22 individuals, when its maximum (22 individuals) took place on 7th of June (25°C and 56% R.H.), while its population ranged from 6 to 18 individuals as its maximum 18 was on 21th of May.

As for *S.interruptus*, the population ranged from 12 to 42 individuals giving a maximum on 7th of June, at 1994, while it ranged from 10 to 42 individuals during 1995 with a maximum of 42 on the 28th of May. The third predator associated with *A.craccivora* was *O.albidipennis*, its population ranged from 8 to 33 individuals during season 1994 with the maximum on 24th of May (22.9°C and 52% R.H.), compared with 7 to 22 at 1995, its population ranged from 7 to 22, giving a maximum on 28th of May (25.1°C and 51% R.H.), while its minimum (7 individuals) took place on 23 rd of April.

a. The effect of *Coccinella undecimpunctata*

The simple correlation (r) and partial regression (b) values of *A. Craccivora* and the population of *C.undecimpunctata* in the two seasons, together with their level of probability are shown in Table 2. There is a negative significant relation between the population of *A.craccivora* and *C.undecimpunctata* (-0732, -0.813), during the two seasons, respectively. Depending on the (b) values (-67.58, -88.9) for the seasons 1994 and 1995, respectively, it could be said that the increase of one individual of the predator may decrease the population of the pest by 67.58 or 88.9 individuals as the (b) values were negative and significant for the two seasons.

b. The effect of *Scymnus interruptus*

Statistical analysis revealed that there is a negative significant relation between the population of *A.craccivora* and *S.interruptus* during the two seasons as the (r) values were -0.692, -0.663, respectively, Table, 2. Regarding the (b) values, it is clear that the relationship was negative and significant during the first season (-12.23), while it was positive during the second season (11.87). Thus, it can be concluded that the raising in the *S.interruptus* population by one individual may give a reduction in the pest population by 12.23.

c. Effect of *g*

Data in Table 2 show that the simple correlation was negative and insignificant during the two seasons (-0.615, -0.566). For the partial regression, the obtained

Table 1. Numbers of *Aphis craccivora* and associated predators on cucumber plants during seasons 1994 and 1995.

No. of *A.craccivora* and its predators during season 1994					No. of *A.craccivora* and its predators during season 1995				
Date	No. of *A.craccivora*	No. of *C.undecimpunctata*	No. of *S.interruptus*	No. of *O.albidipennis*	Date	No. of *A.craccivora*	No. of *C.undecimpunctata*	No. of *S.interruptus*	No. of *O.albidipennis*
26.4	1189	7	12	8	23.4	725	6	10	7
3.5	1077	6	14	15	30.4	888	10	10	9
10.5	1278	6	22	11	7.5	979	9	15	13
17.5	858	16	23	23	14.5	992	11	22	12
24.5	923	14	27	33	21.5	220	18	37	21
31.5	576	19	39	28	28.5	640	14	42	22
7.6	91	22	42	27	4.6	110	16	32	20
14.6	73	15	24	24	11.6	93	13	30	18
21.6	152	17	29	21	18.6	88	15	39	15

Table 2. Simple correlation and partial regression coefficient of three predators on the population density of *Aphis craccivora* infesting cowpea plants during 1994 and 1995.

Season	Predators	r	b	E.V. %	F
1994	*Coccinella undecimpunctata*	-0.732*	-67.58	55.64 %	3.76*
	Scymnus interruptus	-0.692*	-12.23		
	Orius albidipennis	-0.615	21.86		
1995	*Coccinella undecimpunctata*	-0.813*	-88.9	59.4%	4.4*
	Scymnus interruptus	-0.663*	11.87		
	Orius albidipennis	-0.556	13.06		

r : Simple correlation coefficient value
b : Partial regression coefficient value
E.V. : Explained variance.

(b) values were insignificant and positive during the two seasons (21.86, 13.06). These results indicated that the raising of *A.craccivora* population is followed by a raising in the population of *O.albidipennis*.

d. The combined effect of the three predators

As expected, the percentage of explained variance for the number of three tested predators was significant ($F_{0.05}$ = 3.76, 4.4) for the two studied seasons, respectively.

In 1994, the influence of the three predators was high (55.64 %) and statistically significant at 5% level of probability. This could due to the strong effect of *C.undecimpunctata* and *S.interruptus* as each of them had a negative and significant relationship on the *A.craccivora* population. On the other hand, the combined effect of these predators was 59.4% during the second seasons 1995.

The Population of *Aphis gossypii*

As mentioned before, cucumber plants, is heavily infested by *Aphis gossypii*, during its developmental stages.

Table 3 shows that the population density of *A.gossypii* during 1994 ranged from 3 to 143 individuals, reaching the maximum 143 on the 10th of May at 25.1°C and 53% R.H. These numbers decreased gradually giving a minimum population (3) on the 14th of June at 25.8°C and 57% R.H. During the second season 1995, the population of *A.gossypii* on cucumber was relatively higher than the previous season, it ranged between 20 to 197 individuals. The maximum 197 took place on 7th of May at 22.9°C and 48% R.H., while the minimum 20 individuals occurred on 28th of May at 25.1°C and 51% R.H.

Predators

The same predators infesting *A.craccivora* were found to invade *A.gossypii*. The population of the three predators were studied and their numbers associating *A.gossypii* were recorded, Table 3. It is obvious that in general the number of the three predators were relatively low on *A.gossypii* infesting cucumber during *A.craccivora* infesting cowpea.

The *Coccinella undecimpunctata* population ranged from 1 to 16 individuals reaching a maximum 16 on the 17th of June, during the first season, while on the

Table 3. Numbers of *Aphis gossypii* and associated predators on cucumber plants during seasons 1994 and 1995.

No. of A.gossypii and its predators during season 1994					No. of A.*gossypii* and its predators during season 1995				
Date	No. of *A.gossypii*	No. of *C.undecimpunctata*	No. of *S.interruptus*	No. of *O.albidipennis*	Date	No. of *A.gossypii*	No. of *C.undecimpunctata*	No. of *S.interruptus*	No. of *O.albidipennis*
26.4	105	1	-	2	23.4	170	3	7	1
3.5	113	4	1	-	30.4	126	7	1	3
10.5	143	4	2	-	7.5	197	11	3	2
17.5	52	9	6	12	14.5	121	21	5	9
24.5	88	10	6	14	21.5	25	16	17	11
31.5	64	14	8	10	28.5	20	14	14	8
7.6	42	16	4	9	4.6	34	11	19	9
14.6	3	12	7	11	11.6	65	3	13	9
21.6	29	10	6	9	18.6	23	5	8	6

second season 1995, its numbers ranged from 3 to 21 reaching its maixmum on the 21st of May at 22.5°C and 60% R.H.

Number of *Scymnus interruptus* was relatively low during the first season 1994, ranging from 0 to 8 individuals, while its number ranged between 1 to 19 individuals during 1995 season, reaching the maximum number on the 4th of June at 26.3°C and 52% R.H.

Numbers of *O.albidipennis* ranged from 0 to 14 individuals giving a maximum 14 on the 24th of May at 22.5°C and 60% R.H., while its minimum was on 3rd of May at 19.5°C and 63% R.H. during season 1994, while its numbers ranged from 1 to 11 individuals during season 1995, giving a maximum on 21 st of May at 22.5°C and 60% R.H.

Statistical analysis

a The effect of *Coccinella undecimpunctata*

Table 4 gives the (r) values (00.732, -0.765) which indicate a negative and significant relation between *C.undecimpunctata* and *A.gossypii* during the two seasons 1994 and 1995.

As the (b) values (-10.57, -2.83) were negative and significant during the two seasons, respectively. Thus, it can be said that the raising of one individual of *C.undecimpunctata* reduced the population of *A.gossypii* on cucumber plants by 10.57 or 2.83 during the two seasons of work, respectively.

b. Effect of *Scymnus interruptus*

Regarding the values of the simple correlation (r) and partial regression (b) of *A.gossypii* and *S.interruptus*, it was found that (r) values (-0.715, -127) was negative and significant during the first season, while it was negative and insignificant during the second season. The (b) values (22.12, 3.18) was positive giving a result that the increasing in the pest population gave an increase in the predator's number by 22.12 or 3.18 for the two seasons of work.

c. Effect of *Orius albidipennis*

Table 4 shows the simple correlation (r) and partial regression (b) values for the numbers of *A.gossypii* and number of *O.albidipennis* together with their levels of significance during seasons 1994 and 1995.

Table 4. Simple correlation and partial regression coefficient of three predators on the population density of *Aphis gossypii* infesting cowpea plants during 1994 and 1995.

Season	Predators	r	b	E.V. %	F
1994	Coccinella undecimpunctata	-0.732*	-10.57	82.64 %	14.28**
	Scymnus interruptus	-0.715*	22.12		
	Orius albidipennis	-0.721*	-11.22		
1995	Coccinella undecimpunctata	-0.765*	-2.83	73.62 %	8.37**
	Scymnus interruptus	-0.127	3.18		
	Orius albidipennis	-0.779*	-13.9		

r : Simple correlation coefficient value
b : Partial regression coefficient value
E.V. : Explained variance.

Statistical analysis revealed a negative and significant relation between the population of *A.gossypii* and *O.albidipennis* (-0.721, -0.779). Regarding the (b) values (-11.22, -13.9), it is clear that the relationship was negative and significant during the two seasons. Thus, it can be said that increasing the predator's number by one individual may decrease the population of *A.gossypii* by 11.22 or 13.9 individual, respectively.

d. The combined effect of the three predators on the fluctuation of *A.gossypii*

The percentage of explained variance (EV. %) for the numbers of the three tested predators, Table 4, were 82.64% and 73.62% during the two successive seasons 1994 and 1995, respectively. Thus, it could be concluded that these three predators may minimize the population of *A.gossypii* by 82.64% or 73.62% as the relation was significant for the two seasons ($F_{0.05}$ = 13.28, 8.37).

From the previous data, it can be concluded that *C.undecimpunctata, S.interruptus, O.albidipennis* can give a reduction in *Aphis craccivora* and *Aphis gossypii* infesting cowpea and cucumber, for they can minimize the population of *A.craccivora* by 55.64% or 59.4% and *A.gossypii* infesting cucumber by 82.64% or 73.62%. It is obvious from the foregoing data that *Coccinella undecimpunctata* had a strong effect in minimizing *A.craccivora*. On the other hand, *O.albidipennis* had an effective role in decreasing *A.gossypii* population. Thus, it is of great importance, in an integrated control program against aphis to choose the suitable predator which help in decreasing aphid species.

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الكثافة العددية لثلاثة من مفترسات المن ودورها فى تقليل تعداد المن

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يعتبر من البقوليات Aphis craccivora ومن القطن Aphis gossypii من أهم الآفات التى تصيب محاصيل الخضر المختلفة فى مصر والتى تسبب خسارة اقتصادية فى المحصول.

درس تعداد الآفتين وكذلك تعداد ثلاثة من المفترسات المصاحبة لهما خلال موسمى ١٩٩٤ و ١٩٩٥ فى محافظة القليوبية على محصول اللوبيا والخيار ، بلغ أعلى تعداد لمن البقوليات على اللوبيا خلال موسم ١٩٩٤ (١٢٧٨) حورية فى ١٠ مايو، بينما بلغ أعلى تعداد (٩٩٢) حورية فى ١٤ مايو خلال موسم ١٩٩٥ . أما حشرة من القطن فقد بلغ أعلى تعداد له (١٤٣) حورية على الخيار خلال موسم ١٩٩٤ فى العاشر من مايو بينما فى الموسم التالى بلغ تعداد الآفة أقصى تعداد له (١٩٧) حورية فى ٧ مايو.

صاحبت النوعان من المن ثلاثة من المفترسات هى Coccinella undecimpunctata, Scymnus interruptus, Orius albidipennis وسجل تعداد كل نوع على حدة فى كل من موسمى ١٩٩٤ و ١٩٩٥ .

أوضحت الدراسه أن مفترسات *S.interruptus, C.undecimpunctata* لها أرتباط معنوى وسلبى مع تعداد من البقوليات ، مما يؤكد الدور القوى الذى تلعبه هذه المفترسات فى خفض الآفة. بينما لم يكن لتعداد النوع O.albidipennis ارتباط معنوى مما يشير الى أن دورها ليس فعالا فى خفض تعداد الآفة.

فى حين وجد أن تعداد O.albidipennis, C.undecimpunctata كان لهما ارتباط معنوى وسلبى مع تعداد من القطن، مما يؤكد دورهما الفعال فى خفض تعداد الآفة، فى حين أن S.interruptus لم يكن له ارتباط معنوى مع تعداد الآفة.

أوضحت الدراسة أن التأثير المشترك لتعداد المفترسات الثلاث على تعداد من البقوليات أدى الى خفض فى تعداد الآفتين بلغت نسبته ٥٥,٦٤٪ خلال موسم ١٩٩٤ و ٥٩,٤٪ خلال موسم ١٩٩٥ على نبات اللوبيا. بينما كان التأثير لتعداد المفترسات الثلاث على تعداد من القطن على الخيار أدى الى خفض تعداد الآفة بنسبة ٨٢,٦٤ ٪ خلال موسم ١٩٩٤ و ٧٣,٦٢٪ خلال موسم ١٩٩٥ .

من ذلك يتضح أن هذه المفترسات من الممكن ان تلعب دورا هاما فى خفض تعداد كلا من حشرتى من البقوليات ومن القطن على اللوبيا والخيار على أن يستخدم المفترس المناسب لنوع المن.