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Effect of alternative preys on predation upon *Aphis craccivora* (Hemiptera: Aphididae) by some aphidophagous predators larvae

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Abstract:

Effect of the presence of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) and *Empoasca decipiens* Paoli (Hemiptera: Cicadellidae) nymphs and both on the feeding potential of the predators *Coccinella undecimpunctata* L. , *Coccinella septempuncata* L. (Coleoptera : Coccinellidae) and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) larval instars on *Aphis craccivora* Koch. (Hemiptera: Aphididae) was determined in laboratory. The presence of *B. tabaci* nymphs reduced significantly the predation of *A. craccivora* by 1st and 2nd larval instars of *C. undecimpunctata* and 1st larval instars of *C. septempuncata* and *C. carnea*, meanwhile, the presence of *E. decipiens* nymphs had not any effect. On the other hand, the presence of *B. tabaci* and *E. decipiens* nymphs affected significantly on the predation of *A. craccivora* by the 3rd and 4th larval instars of *C. undecimpunctata*; 2nd, 3rd and 4th larval instars of *C. septempuncata* and 2nd and 3rd larval instars of *C. carnea*.

Introduction

Cowpea aphid *Aphis craccivora* Koch (Hemiptera: Aphididae) is considered one of the most important insect pests attacking common bean plants (El-Solimany, 2008). Common bean plants, in Egypt, were known to inhabit by piercing sucking insect pests over than *A. craccivora* as leafhopper, and *Empoasca decipiens* Paoli (Hemiptera: Cicadellidae) and *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) (Wahba *et al.*, 1986; Heyer *et al.*, 1989; El-Sayed *et al.*, 1991; Faris *et al.*, 1991 and Bachatly, 2000), which considered as alternative preys for *Coccinella undecimpunctata* L. , *Coccinella septempuncata* L. (Coleoptera : Coccinellidae) and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae). Many predatory insects found to consume a range of prey species and can thus contribute to biocontrol of pests. However, the availability of alternative prey species may affect the degree of control the predators exert over pest species (Fitzgerald and Jay, 2010).

The aim of this study is to determine the effect of *B. tabaci* and *E. decipiens* as alternative preys on *A. craccivora* by *C. undecimpunctata*, *C. septempunctata* and *C. carnea* larvae.

Materials and methods

This experiment was conducted in the laboratory of Plant Protection, Shandweel

Agricultural Research Station, Sohag Governorate. All laboratory studies were run under room condition where ambient temperature ranged between 11 and 25 ◦C, and RH. varied from 44% to 60%. The larvae of *C. septempunctata*, *C. undecimpunctata* and *C. carnea* larvae on *A. craccivora*, also, *A. craccivora* was taken from the laboratory rearing stock culture. Common bean leaflets infested with *B. tabaci* and *E. decipiens* were collected from the farm of Shandweel Agricultural Research Station, Sohag Governorate, then examined carefully under a microscope for collection of the same size nymphs. Treatments included aphid only, aphid mixed with whitefly, aphid mixed with leafhopper and aphid mixed with both preys. Petri dishes were prepared to contain 20 nymphs from each prey. The first, second, third and fourth grubs of *C. septempunctata* and *C. undecimpunctata* and first, second and third grubs of *C. carnea* were examined to the previous treatment in completely randomized design with ten replicates. After 24 hours, the consumed aphids were determined by counted the remaining individuals.

For the purpose of statistical analysis, data obtained were statistically analyzed using one – way analysis of variance. Mean values were separated by the least significant difference (L.S.D.) procedure **(Snedecor and Cochran, 1980)** at P = 5%.

Results and discussion

1. *Coccinella undecimpunctata* larvae:

Data in Table (1) revealed that the 1st larval instar of *C. undecimpunctata* predation on *A. craccivora* affected with the presence of *B. tabaci*, meanwhile, under other sets this predation reduced but insignificantly comparing with aphid treatment. The number of aphids consumed under A. *craccivora* (T1), *A. craccivora* + *B. tabaci* (T2), *A. craccivora* + *E. decipiens* (T3) and Mixture (T4) were 5.00, 3.10, 4.80 and 4.20 aphid/ larva, respectively. Comparing of the predation of the 2nd larval instar of *C. undecimpunctata*, the presence of *B. tabaci* nymphs reduced the aphid consumption by the predator larvae. T1 gave the higher number of aphids consumed followed insignificantly by T3. The mean numbers recorded were 8.10, 6.50, 7.60 and 6.40 aphids/ larva under T1, T2, T3 and T4, respectively.

The eaten aphid by the 3rd larval instar on T1, 12.10 aphids/ larva was the highest comparing with the rest treatments, 9.60, 9.50 and 10.00 aphids/ larva for T2, T3 and T4, respectively. This refer to the effect of the two preys on the predation of *C. undecimpunctata* larvae on aphid. For the 4th larval instar of *C. undecimpunctata*, the results obtained were like those of the 3rd larval instar. The mean numbers of 16.10, 14.30, 14.00 and 13.40 aphids/ larva were consumed by the 4th larval instar under T1, T2, T3 and T4, respectively.

Table (1): Feeding rate of different larval instars of *Coccinella undecimpunctata*, on *Aphis craccivora* in the presence of *Bemisia tabaci* and *Empoasca decipiens* nymphs for 24hrs.

Mean No. of aphids consumed/ larva				
Prey	**Instars**			
	First	**Second**	**Third**	**Fourth**
***Aphis craccivora* (T1)**	5.00	8.10	12.10	16.10
***Aphis craccivora* + *Bemisia tabaci* (T2)**	3.10	6.50	9.60	14.30
***Aphis craccivora* + *Empoasca decipiens* (T3)**	4.80	7.60	9.50	14.00
Mixture (T4)	4.20	6.40	10.00	13.40
F. Value	3.85*	5.00*	10.33*	5.69*
$LSD_{05\%}$	1.26	1.08	1.10	1.41

2. *Coccinella septempunctata* larvae:

As shown in Table (2), the presence of *B. tabaci* reduced the predation of aphid by *C. septempuncata* 1st larval instar, however the presence of *E. decipiens* nymphs had not any effect. The aphid consumption on T1 was highly significant comparing with T2 and T4 with mean numbers of 15.30, 13.80 and 14.00 aphids/ larva, respectively. For *C. septempuncata* 2nd larval instar, it is clear evident that *B. tabaci* and *E. decipiens* nymphs can play as alternative prey, T1 recoded the highest mean number of consumed aphids comparing with T2, T3 and T4 with average numbers of 18.40, 16.60, 16.80 and 15.80 aphids/ larva, respectively. The same results were obtained by 3rd and 4th larval instar of *C. septempuncata*. Mean numbers of 19.50, 18.20, 17.90 and 17.40 aphids/ larva were consumed by the 3rd larval instar under T1, T2, T3 and T4, respectively. And the 4th larval instar consumed 19.90, 18.90, 18.40 and 18.00 aphids/ larva under the previous treatments, respectively.

Table (2): Feeding rate of different larval instars of *Coccinella septempunctata* on *Aphis craccivora* in the presence of *Bemisia tabaci* and *Empoasca decipiens* nymphs for 24hrs.

Mean No. of aphids consumed/ larva				
Prey	**Instars**			
	First	**Second**	**Third**	**Fourth**
***Aphis craccivora* (T1)**	15.30	18.40	19.50	19.90
***Aphis craccivora + Bemisia tabaci* (T2)**	13.80	16.60	18.20	18.90
***Aphis craccivora + Empoasca decipiens* (T3)**	15.10	16.80	17.90	18.40
Mixture (T4)	14.00	15.80	17.40	18.00
F. Value	3.54	5.93	4.71	14.96
$LSD_{05\%}$	1.17	1.29	1.19	0.61

3. *Chrysoperla carnea* larvae:

Determined numbers of aphid consumed by the 1st larval instar of *C. carnea* on four sets differed significantly. T1 recorded the highest mean number of eaten aphids, followed insignificantly by T3, the two treatments were higher than T2 and T4, with average numbers of 14.40, 14.00, 11.80 and 12.30 aphids/ larvae, respectively. Because of the previous finding, nymphs of *B. tabaci* can considered as alternative prey to the 1st larval instar of *C. carnea* in the presence of *A. craccivora*, the inverse is correct in case of *E. decipiens* nymphs (Table, 3). In respect of 2nd larval instar of *C. carnea*, data indicated that both *B. tabaci* and *E. decipiens* nymphs reduced aphid predation by this instar. T1 gave the highest mean number of 18.20/ larva compared with the rest treatments, 16.00, 15.10 and 12.50 aphids/ larva for T2, T3 and T4, respectively.

The same trend of results was achieved for the 3rd larval instar. Treatments of T1, T2, T3 and T4 recorded mean numbers of 19.40, 17.90, 17.00 and 16.10 aphids/ larva, respectively, consumed by larvae of neuropteran predator larvae.

Table (3): Feeding rate of different larval instars of *Chrysoperla carnea* on *Aphis craccivora* in the presence of *Bemisia tabaci* and *Empoasca decipiens* nymphs for 24hrs.

Mean No. of aphids consumed/ larva			
Prey	**Instars**		
	First	**Second**	**Third**
***Aphis craccivora* (T1)**	14.40	18.20	19.40
***Aphis craccivora + Bemisia tabaci* (T2)**	11.80	16.00	17.90
***Aphis craccivora + Empoasca decipiens* (T3)**	14.00	15.10	17.00
Mixture (T4)	12.30	12.50	16.10
F. Value	4.82	32.83	14.20
$LSD_{05\%}$	1.67	1.19	1.08

These results are in agreement with Ostman and Ives (2003), they stated that indirect interactions between prey species [*Acyrthosiphon pisum* (Harris) (Hemiptera: Aphididae) and *Empoasca fabae* (Harris) (Hemiptera: Cicadellidae)] may depend upon spatial scale, because the factors affecting a predator's [*Nabis* spp.(Hemiptera :Nabidae)] diet choice on a small scale may differ from those factors affecting a predator's distribution at larger scales. The same results obtained by Koss *et al.* (2004), they suggested that both *Nabis* spp. and *Geocoris* spp. (Hemiptera: Lygaeidae) bugs predators exhibited weakly suppressed *Myzus persicae* Sulzer (Hemiptera: Aphididae) consumption rates when colorado potato beetle eggs were also present (in laboratory). Also, Fitzgerald and Jay (2010) demonstrated that the potential of *C. carnea* to significantly reduce numbers of strawberry aphid, *Chaetosiphon fragaefolii* (Cockerell) (Hemiptera: Aphididae), western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae) and capsid *Lygus rugulipennis* Poppius (Heteroptera: Miridae) when each pest was presented alone. Huang and Enkegaard (2010) found that in the presence of the aphids, the predation on eggs or larvae of *Pieris brassicae* L. (Lepidoptera: Pieridae) was either completely abandoned or reduced by about 70%, respectively, by second instar lacewings and either reduced by about 80% or maintained, respectively, by third instar lacewings. Rouhani and Samih (2012) showed that the efficiency of *C. carnea* to biological control of the two aphid species, *Aphis punicae* Passerini (Hemiptera: Aphididae) and *Agonoscena pistaciae* Burckhardt and Lauterer (Hemiptera: Psylloidea), is more than the leafhopper, *E. decipiens*. Jaworski *et al.* (2013) reported that the predation activity of *Macrolophus pygmaeus* Rambur (Heteroptera: Miridae) on *B. tabaci* was affected by the presence of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) eggs or larvae in the prey complex with an opposite effect when comparing adult and juvenile predators. Cuthbert *et al.* (2018) suggested that prey switching, and prey preferences may affect on the success of invaders pest's population, alongside the capacity for biotic resistance by recipient communities. On the other hand, Medal *et al.* (1997) indicated that predation of *Spissistilus festinus* (Say) (Hemiptera: Membracidae) nymphs by *Geocoris punctipes* (Say) (Hemiptera: Lygaeidae) and *Nabis roseipennis* Reuter (Heteroptera: Nabidae) did not differ significantly in the presence of *Pseudoplusia includens* (Walker) larvae and/or *Heliothis zea* (Boddie) (Lepidoptera: Noctuidae) larvae as alternative prey. Also, Lucas *et al.* (2004) mentioned that the total *Aphis pomi* DeGeer (Hemiptera: Aphididae) and *Choristoneura rosaceana* (Harris)

(Lepidoptera: Tortricidae) consumed by *C. septempunctata* and *Harmonia axyridis* Pallas (Coleoptera: Coccinellidae) were significantly higher when both prey were present than in single-prey treatments.

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