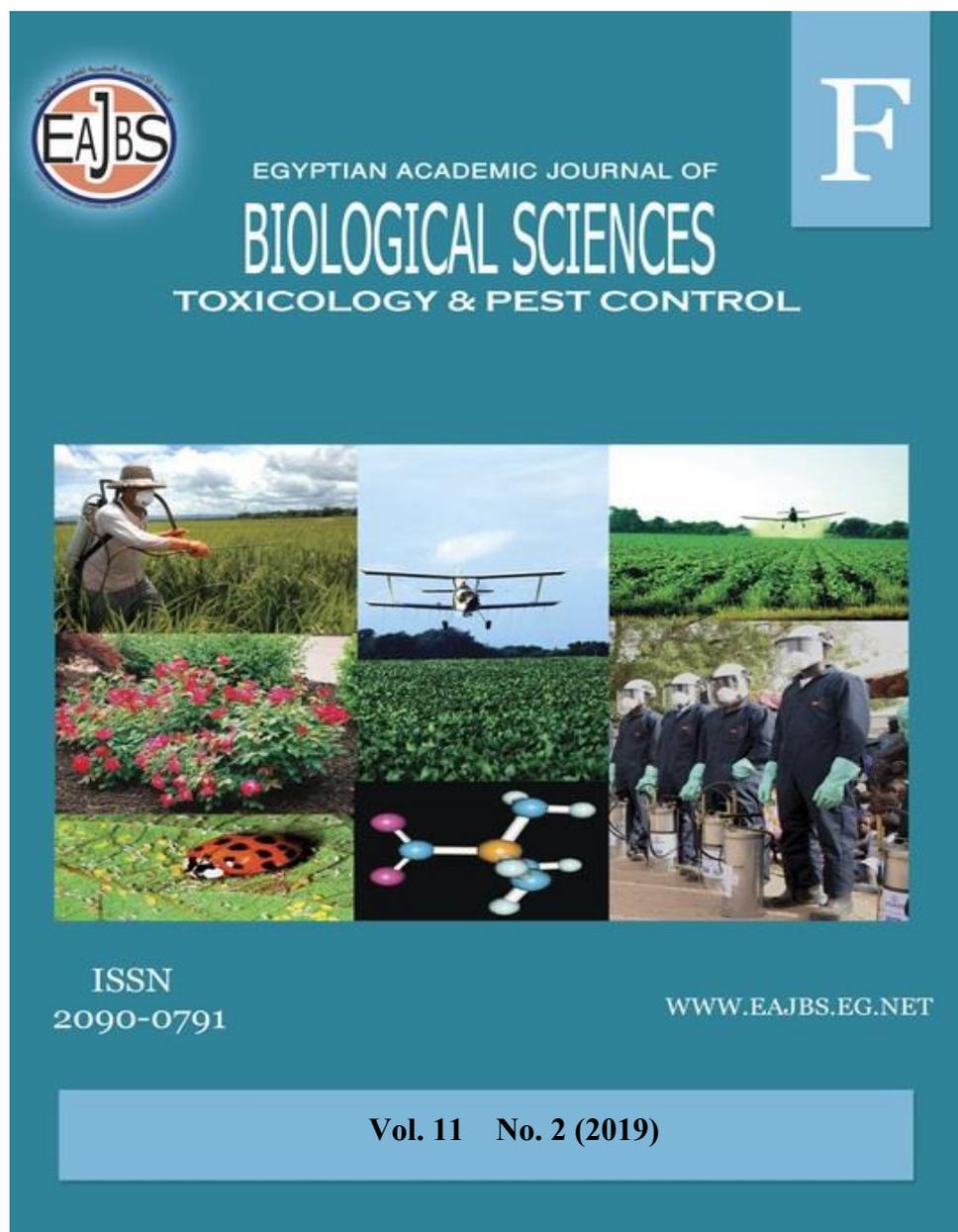


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Biological Control of *Aphis gossypii* Glover on Cucumber Plants by Release *Coccinella septempunctata* L. under Glasshouse Conditions

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ABSTRACT

This study was carried out to evaluate the management of *Aphis gossypii* Glover (Homoptera: Aphididae) which infesting cucumber plants var. *Cucumis sativus* L. by releasing different levels of the seven spotted lady beetle, *Coccinella septempunctata* L. (Coleoptera: Coccinellidae). This study was carried out at two locations (Governorates), Perkash (Giza Governorate) and Tokh (Qaluobiya Governorate) during successive season 2018 under glasshouse conditions.

At Giza Governorate, in the first level of release (30 eggs/plant), the reduction percentages in the population of *A. gossypii* increased gradually whereas it was 23.2, 35.3, 48.5, 57.4 and 68.2% on mid-February, first-March, mid-March, first-April and mid-April, respectively. Also, in the second level of release (60 eggs/plant). The reduction percentages in the population increased gradually whereas it was 21.9, 38.2, 47.5, 58.3 and 67.7% on the same dates respectively. Lastly, the third level of release (90 eggs/plant) the reduction percentages in the population increased gradually whereas it was 23.5, 36.3, 48.2, 63.5 and 74.4% on the same dates, respectively. The same trend was achieved at Qaluobiya Governorate.

From obtained results. we can recommend using *C. septempunctata* as one of the important methods of biological control of *A. gossypii* on cucumber plants.

INTRODUCTION

Cucumber considers one of the most important vegetable crops in Egypt and all over the world which cultivated in the open field and under greenhouses conditions. Also, its cultivated area increased gradually during the last years, especially in the newly reclaimed areas for purposes of local consumption and exportation to the foreign markets (Hanafy, A. R. 2004).

Cucumber crop infested with large scale of different insects such as *Aphis gossypii* Glover (Homoptera : Aphididae) which consider one of the most damaging insects infesting vegetables crops either in the open field or under greenhouses conditions, (Adriaan, J. *et al.* 2014) who reported that the aphid *A. gossypii* seen as highly population on cucumber crop both in the open field and under glasshouse conditions. Deborah, J. *et*

al. (2004) who reported that *A. gossypii* transmit Cucumber Mosaic Virus (CMV) which causes a serious disease of narrow-leafed lupin, and he reported also that the aphid *A. gossypii* consider a harmful pest on most vegetable crops, and causes direct damage, reducing plant vigor, and indirect damage by honeydew secretion and transmission of several viruses.

The seven spotted lady beetle, *Coccinella septempunctata* L. (Coleoptera : Coccinellidae) is the commonest lady beetle known in Egypt, it is an important predator of many aphid species; eggs and small nymphs of mealybugs, jassids, eggs and larvae of cotton leafworm (Ibrahim, M. 1948 & 1955 and Bilashini, Y. *et al.* 2017). The adults and small stages are often encountered in large numbers on the plants infested with aphids. They feed on these harmful insects and often play a great role in suppressing them under control. Both the adult and larval stages feed on insects harmful to plants, such as aphids and scale insects (Anonymous, 1997). Adults can be killing up to 100 aphids per day (Arnett, *et al.* 2015). The seven spotted lady beetle, *C. septempunctata* lives in a wide variety of habitats, any place where there are plants and aphids may attract these species (Fleming, R. 2000). The lady beetle kills its prey outright and then devours it (Waldbauer, G. 2007). Under field conditions, numerous coccinellids consume nectar, honeydew, pollen, fruit, vegetation, and fungus. These non-prey foods are used by coccinellids to increase survival when prey is scarce, reduce mortality during diapause, fuel migration, and enhance reproductive capacity. Each of these non-prey foods has unique nutritional and defensive characteristics that influence its suitability for lady beetles (Lundgren, J. 2015).

This study was carried out to evaluate the management of *A. gossypii* which infesting cucumber plants var. *Cucumis sativus* L. by releasing different levels of the seven spotted lady beetle, *C. septempunctata*. This study was carried out at two locations (Governorates), Perkash (Giza Governorate) and Tokh (Qaluobiya Governorate) during successive season 2018 under glasshouse conditions.

MATERIALS AND METHODS

Mass Rearing of the Seven Spotted Lady Beetle, *Coccinella septempunctata* and Its Prey the Cowpea Aphid, *Aphis craccivora*:

1. Mass Rearing of *A. craccivora* as A Prey:

A. craccivora is considered the most preferable prey for mass production of *C. septempunctata*. Strong culture of this aphid should be available during the rearing time to maintain the predator rearing process.

The broad bean, *Vicia faba* seeds were planted in plastic trays (25X 40X15 cm) or foam trays (60X25X20 cm with 109 wholes) contained peat muss. The seeds were planted at 1-2 cm deep and followed with irrigation and fertilizers as required. When the first leaflet appeared after about one week from cultivation. Bean leaves were infested with *A. craccivora* which distributed over the new foliage of cultivated trays. Culturing of faba bean plants and artificial aphid infestation was a continuous process carried out at weekly intervals.

The infested trays were followed until the population of *A. craccivora* increased and become suitable for using as prey to the lady beetle, *C. septempunctata*. *A. craccivora* colonies were cultured under laboratory conditions ($23\pm 2^{\circ}\text{C}$ and $60\pm 5\%$ R.H.) on broad beans (*V. faba*). Such leaves of beans were infested by different stages of aphids and kept under a glass chimney which its upper opening was covered with white muslin. The potted plants were irrigated and fertilized whenever necessary and kept in wooden cages (100X135X135 cm) with nylon gauze sides using the method described by

(Mangoud, A. 2003 and Mahyoub, J. *et al.*, 2013). *A. craccivora* and *C. septempunctata* instars were originally collected from an agricultural field.

2. Mass Rearing of *C. septempunctata*:

When the population of *A. craccivora* increased and reached to suitable density individuals (approximately 100 individuals/plant,) on faba bean plants these plants were inoculated with *C. septempunctata*. The stock culture of a ladybird was obtained from infested plants and transferred to the laboratory. Only 10 adult ♂+ 10 adult ♀ of ladybird (to prevent larval cannibalism) were transferred to rearing cages (30 cm diameter X 25 cm high) and kept in wooden cages (100X135X135 cm) with nylon gauze sides. To maintain the predator culture, a suitable number of the prey was daily offered to the predator (Mahyoub, J. *et al.*, 2013).

3. Egg Picking:

The method for egg-laying [black polyethylene strips fixed inside a plastic cylindrical (10 cm length X 2 cm diameter) for laying eggs and put in the rearing pots]. After laid egg-masses, they were removed from plastic cylinders to separate the egg-masses from the cylindrical plastic and to be ready to stick on the carton paper card for releasing. The plastic cylinder was checked twice/day for egg-masses because of the cannibalistic habits of the adults, especially when there was a shortage of host food. To provide the developing larva with sufficient food throughout their developmental period, it was necessary to increase the amount of food with the advancement of their development (Mahyoub, J. *et al.* 2013).

Release of *C. septempunctata*:

Releasing study was conducted on cucumber plants grown in the two locations, Perkasah (Giza Governorate) and Tokh (Qaluobiya Governorate) during successive season 2018 under glasshouse conditions. The selected plants for the present investigation were away from any pesticide contamination. Both in the two places, glasshouse divided into three plots (3x5m for each) for cucumber plants which were sown during January month. Each plot for each release level and each plot also divided into three replicates for that release level and another three replicates as control. The normal release and recommended agricultural practices were applied, also no chemical control against aphid was used during the whole experimental period.

Naturally, the numbers of *C. septempunctata* stages were recorded. Therefore, three levels of *C. septempunctata* eggs; first level consists of 30 eggs (one card), the second level consists of 60 eggs (two cards) and the third one consists of 90 eggs (three cards) were released to encouragement the normal predator population to reduce the aphid. *C. septempunctata* were released (one time) by the beginning of February on cucumber plants at the two places in the 2018 season.

Samples were randomly taken bi-weekly at the two places and counting started from the beginning of February in cucumber plants. Twenty new plants were examined from each plot (five leaves for each plant), were made by a hand lens for counting the alive insects and the predator and took the mean numbers. Both surfaces of the leaf were inspected for the presence of aphid (Mangoud, A. 2000).

Statistical Analysis:

The percent reduction of *A. gossypii* after *C. septempunctata* released was calculated according to Henderson and Tilton equation (1955). The data were subjected to analysis of variance (ANOVA) and the means were compared by L.S.D. test at 0.05 level, using SAS program (SAS Institute, 1988).

RESULTS AND DISCUSSION

At Giza Governorate:

Three levels of *Coccinella septempunctata* L. eggs; first level (30 eggs on one card), the second level (60 eggs on two cards) and the third level (90 eggs on three cards) were released (one time) on the beginning of February on cucumber plants during 2018 season.

1. First Level of Release (30 eggs/plant):

Results in Table (1) and Fig. (1) indicated that the number of *Aphis gossypii* in the 1st release plot decreased gradually from 45 on the 1st February to 36, 34, 29, 26 and 20 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 48 individuals/plant, on first-February to 50, 56, 60, 65 and 67 individuals/plant, at the same dates, respectively. The present results showed that the percent reduction of *A. gossypii* in 1st release plot increased gradually to reach 23.2, 35.3, 48.5, 57.4 and 68.2% at the same dates respectively.

Table (1): Population fluctuations of *A. gossypii* in the 1st plot release at level (30eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	%Reduction
First February	45	48	-
Mid February	36	50	23.2
First March	34	56	35.3
Mid March	29	60	48.5
First April	26	65	57.4
Mid April	20	67	68.2
F (0.05)	245.65		
LSD	1.25		

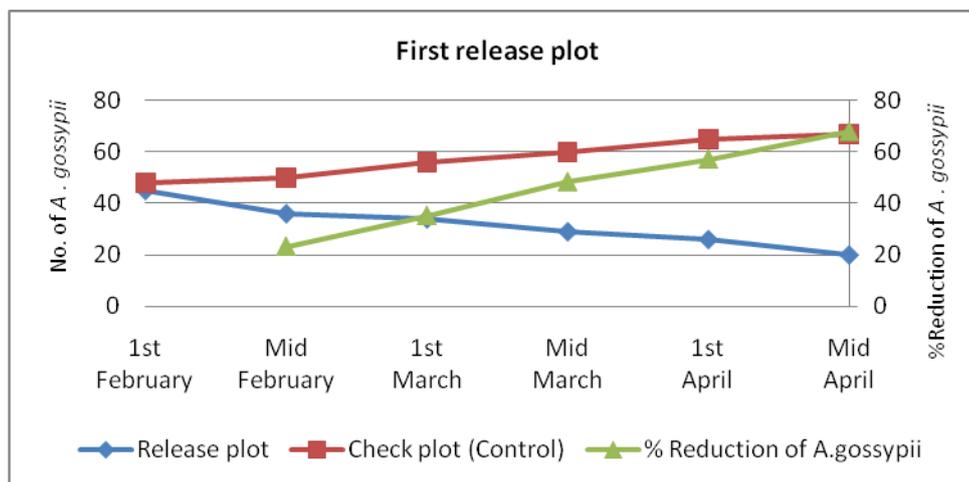


Fig. (1): Population fluctuations of *A. gossypii* in the 1st plot release at level (30eggs) of *C. septempunctata* at Giza Governorate.

2. Second Level of Release (60 eggs/plant):

Results in Table (2) and Fig. (2) indicated that the number of *A. gossypii* in the 2nd release plot decreased gradually from 42 on the 1st February to 35, 30, 27, 23 and 19 individuals/plant on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 45 individuals/plant, on first-February to 48, 52, 55, 59 and 63 individuals/plant, at the same dates, respectively. The obtained results showed that the percent reduction of *A. gossypii* in 2nd release plot increased gradually to reach 21.9, 38.2, 47.5, 58.3 and 67.7% at the same dates respectively.

Table (2): Population fluctuations of *A. gossypii* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First February	42	45	-
Mid February	35	48	21.9
First March	30	52	38.2
Mid March	27	55	47.5
First April	23	59	58.3
Mid April	19	63	67.7
F (0.05)	285.35		
LSD	1.22		

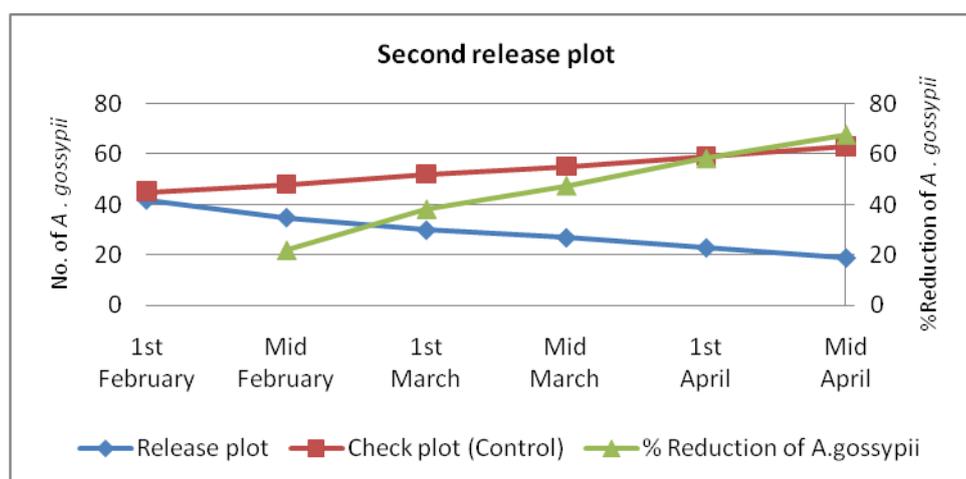


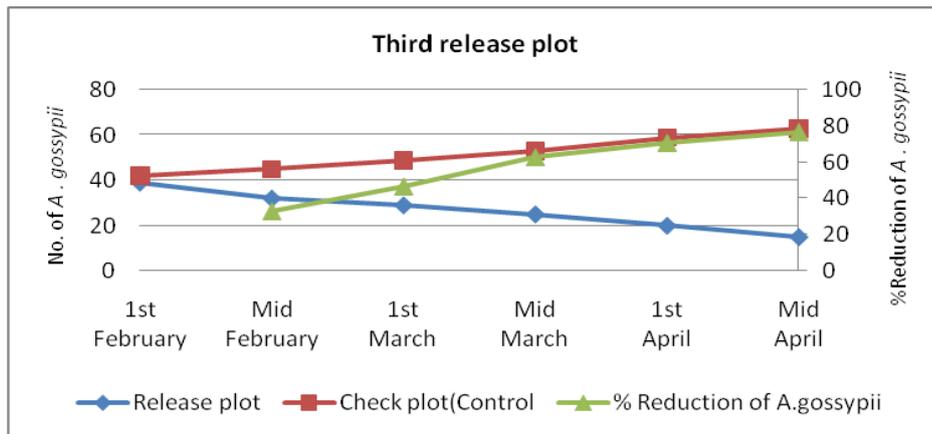
Fig. (2): Population fluctuations of *A. gossypii* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Giza Governorate.

3. In the Third Level of Release (90 eggs/plant):

Results in Table (3) and Fig. (3) indicated that the number of *A. gossypii* in the 3rd release plot decreased gradually from 39 on the 1st February to 32, 29, 25, 20 and 15 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 42 individuals/plant, on first-February to 45, 49, 53, 59 and 63 individuals/plant, at the same dates, respectively. The results showed that the percent reduction of *A. gossypii* in 3rd release plot increased gradually to reach 23.5, 36.3, 48.2, 63.5 and 74.4% at the same dates respectively.

Table (3): Population fluctuations of *A. gossypii* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First February	39	42	-
Mid February	32	45	23.5
First March	29	49	36.3
Mid March	25	53	48.2
First April	20	59	63.5
Mid April	15	63	74.4
F (0.05)	225.33		
LSD	1.25		

**Fig.(3):** Population fluctuations of *A. gossypii* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Giza Governorate.**At Qaluobiya Governorate:****1. First Level Of Release (30 eggs/plant):**

Results in Table (4) and Fig. (4) indicated that the number of *A. gossypii* in the 1st release plot decreased gradually from 38 on the 1st February to 31, 28, 24, 20 and 15 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 42 individuals/plant, on first-February to 47, 50, 53, 58 and 65 individuals/plant, at the same dates, respectively. In addition, the results showed that the percent reduction of *A. gossypii* in 1st release plot increased gradually to reach 27.1, 38.2, 49.9, 61.9 and 74.5% at the same dates respectively.

Table (4): Population fluctuations of *A. gossypii* in the 1st plot release at level (30eggs) of *C. septempunctata* at Qaluobiya Governorate

Date	Release plot	Chick plot (Control)	% Reduction
First February	38	42	-
Mid February	31	47	27.1
First March	28	50	38.2
Mid March	24	53	49.9
First April	20	58	61.9
Mid April	15	65	74.5
F (0.05)	235.76		
LSD	1.37		

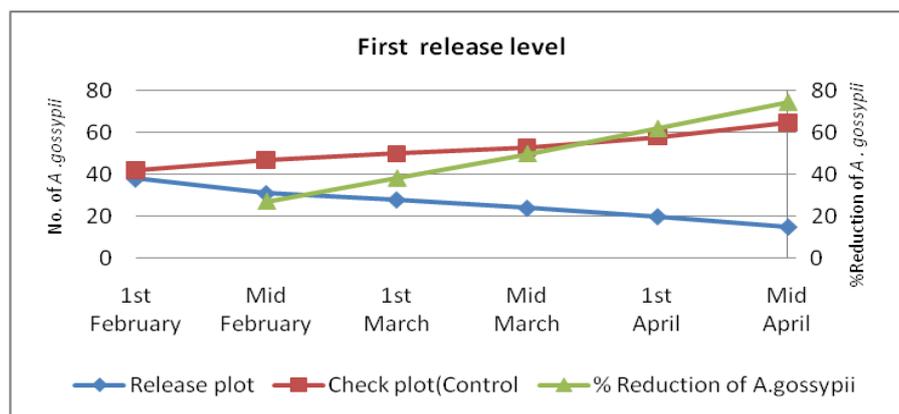


Fig.(4): Population fluctuations of *A. gossypii* in the 1st plot release at level (30eggs) of *C. septempunctata* at Qaluobiya Governorate.

2. Second Level of Release (60 eggs/plant):

Results in Table (5) and Fig. (5) indicated that the number of *A. gossypii* in the 2nd release plot decreased gradually from 35 on the 1st February to 31, 25, 21, 18 and 15 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 39 individuals/plant, on first-February to 45, 50, 58, 62 and 67 individuals/plant, at the same dates, respectively. In addition, the results showed that the percent reduction of *A. gossypii* in 2nd release plot increased gradually to reach 23.3, 44.3, 59.7, 67.7 and 75.1% at the same dates respectively.

Table (5): Population fluctuations of *A. gossypii* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Qaluobiya Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First February	35	39	-
Mid February	31	45	23.3
First March	25	50	44.3
Mid March	21	58	59.7
First April	18	62	67.7
Mid April	15	67	75.1
F (0.05)	225.34		
LSD	1.67		

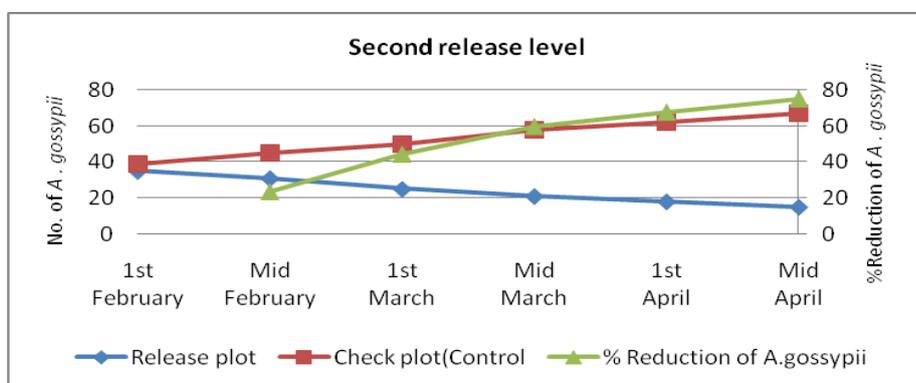


Fig.(5): Population fluctuations of *A. gossypii* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Qaluobiya Governorate

3. In Third Level of Release (90 eggs/plant):

Results in Table (6) and Fig. (6) indicated that the number of *A. gossypii* in the 3rd release plot decreased gradually from 33 on the 1st February to 28, 22, 18, 15 and 12 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 37 individuals/plant, on first-February to 43, 48, 54, 60 and 65 individuals/plant, at the same dates, respectively. In addition, the results showed that the percent reduction of *A. gossypii* in 3rd release plot increased gradually to reach 27.0, 48.6, 62.7, 72.0 and 79.3% at the same dates, respectively.

Table (6): Population fluctuations of *A. gossypii* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Qaluobiya Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First February	33	37	-
Mid February	28	43	27.0
First March	22	48	48.6
Mid March	18	54	62.7
First April	15	60	72.0
Mid April	12	65	79.3
F (0.05)	215.73		
LSD	1.25		

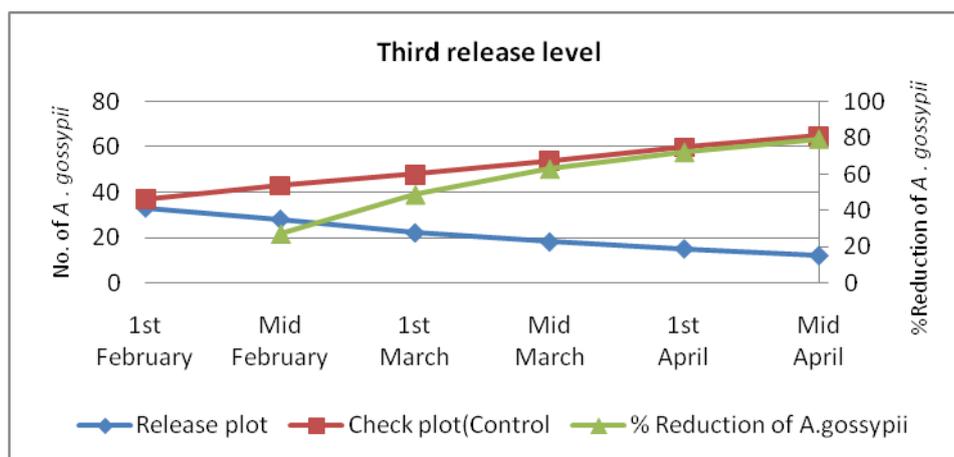


Fig.(6): Population fluctuations of *A.gossypii* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Qaluobiya Governorate.

Statistical analysis showed that highly significant differences between the three releasing levels (30, 60 and 90 eggs/plant) of *C. septempunctata* predator in a reduction of *A. gossypii* at both the two locations compared to control.

These results obtained are in agreement with those obtained by Mangoud, A. (2009) who found that the seven spotted lady beetle, *C. septempunctata* is an important predator of aphids play a good role in reducing the population density of the woolly apple aphid, *Eriosoma lanigerum* (Homoptera : Aphididae) attacking apple trees. Also, these results are in agreement with those obtained by Mangoud, A. (2003) who stated that the seven spotted lady beetle, *C. septempunctata* is an important predator of aphids play a good role in reducing the population density of the green peach aphid, *Myzus persicae* and the cotton aphid, *A. gossypii* (Homoptera : Aphididae) attacking apple trees.

Also, these results are in harmony with those obtained by Hoyt, S. and Madsen, H. (1960) found that the control of aphid species complex is complicated by the continued dispersal of aphids from the roots to the aerial portions of the tree, and a corresponding dispersal in the opposite direction. Release *C. septempunctata* adopted here can cope very well with this behaviour. Brar, K. and Kanwar, J. (1994) in field experiments in India found *C. septempunctata* was an effective predator against *A. craccivora* infesting fenugreek germplasm. El-Aish, H. *et al.* (2004) stated that the role of the predator *C. septempunctata* in biological suppressing of cereal aphids showed that the eggs last 2-3 days and the 1st, 2nd, 3rd and 4th larval instars have lasted 3, 2, 2 and 4 days, respectively, the pupal stage lasted 8 days at the room temperature. The adult predator consumed 46.13 aphids, while the larval consumed 26.9 aphids daily. Fang, C. *et al.* (1984) found the coccinellids, *C. septempunctata* good controlling *B. brassicae* in cotton fields at the yellow River valley in China.

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ARABIC SUMMARY

المكافحة الحيوية لحشرة *Aphis gossypii* علي نباتات الخيار بإطلاق خنفساء أبو العيد ذو السبع نقاط *Coccinella septempunctata* L. تحت ظروف الصوب الزجاجية

مروة عبد المنعم محمد عبد الله¹، أشرف صلاح إمام¹، صبحي عبد الظاهر محمود إسماعيل¹، وعاطف عبد الرحمن علي محمد²

1-معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقي - الجيزة - مصر
2-قسم افات ووقاية النبات - المركز القومي للبحوث - الدقي - الجيزة - مصر

أجري هذا البحث لتقييم مستويات مختلفة من إطلاق أبو العيد ذو السبع نقاط *Coccinella septempunctata* L. علي نباتات الخيار بمحافظة الجيزة والقلوبية خلال موسم 2018 تحت ظروف الصوب الزجاجية. حيث أدى إطلاق مفترس أبو العيد ذو السبع نقاط بمستوي 30 بيضة/ نبات في محافظة الجيزة إلي خفض نسبة الإصابة بمن القطن بنسبة تدرجت من 23.2، 35.3، 48.5، 57.4، 68.2% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل علي التوالي، بينما أدى إطلاق هذا المفترس بمستوي 60 بيضة/ نبات إلي خفض نسبة الإصابة بنسبة تدرجت من 21.9، 38.2، 47.5، 58.3، 67.7% وذلك في نفس التوقيتات علي الترتيب. كما أدى إطلاق هذا المفترس بمستوي 90 بيضة / نبات الي خفض نسبة الإصابة بنسبة تدرجت من 23.5، 36.3، 48.2، 63.5، 74.4% وذلك في نفس التوقيتات علي التوالي، وعلي نفس المنوال تدرجت الفاعلية في محافظة القلوبية.

من النتائج السابقة يمكن التوصية بإستخدام المفترس الحشري أبو العيد ذو السبع نقط *C. septempunctata* بنجاح كأحد عناصر مكافحة البيولوجية الفعالة في برامج مكافحة المتكاملة لحشرة من القطن *A. gossypii* علي نباتات الخيار.