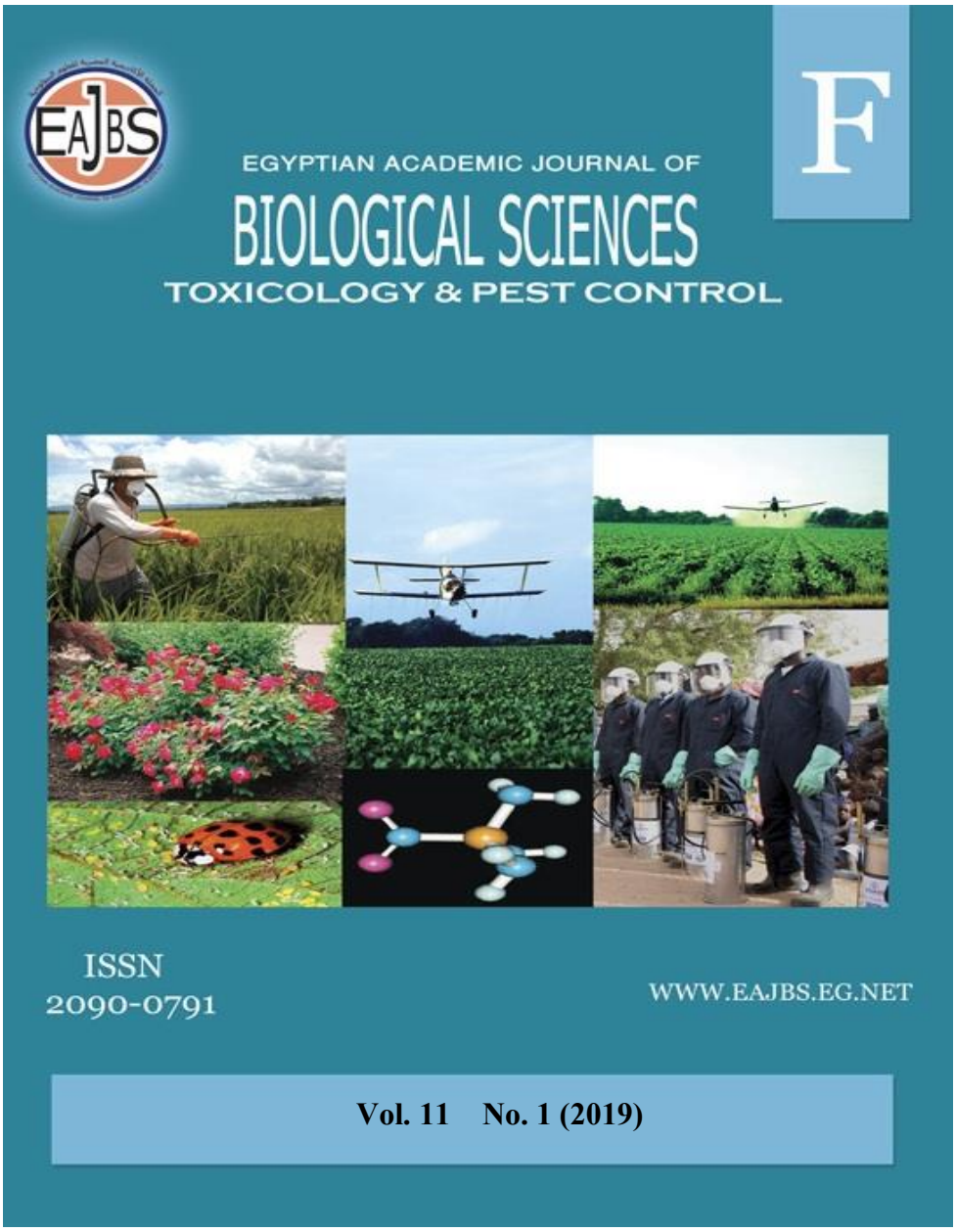

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www.eajbs.eg.net

Egypt. Acad. J. Biolog. Sci., 11(1): 39– 49 (2019)

Egyptian Academic Journal of Biological Sciences
F. Toxicology & Pest control
ISSN: 2090 - 0791
http://eajbsf.journals.ekb.eg/

Biological Control of Duranta Aphid, *Aphis durantae* Theobald by Release *Coccinella septempunctata* L. on Duranta Plants under Glasshouse Conditions

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ARTICLE INFO

Article History
Received:6/1/2019
Accepted:8/2/2019

Keywords:
Biological control, Duranta aphid, *Coccinella septempunctata* L, Glasshouse conditions

ABSTRACT

This study was carried out to evaluate the management of Duranta aphid *Aphis durantae* Theobald (Homoptera: Aphididae) which infesting duranta plants by releasing different levels of the seven- spotted lady beetle, *Coccinella septempunctata* L. (Coleoptera: Coccinellidae).

This study was carried out at two locations (Governorates), The International Garden, Cairo Governorate and El-Orman Garden, Giza Governorate during successive season 2018 under glasshouse conditions.

The seven- spotted lady beetle, *C. septempunctata* was released for one time at early February on duranta plants at the two locations at rates of 30, 60 and 90 eggs/plant. In the first level of release (30 eggs/plant), at Cairo Governorate the reduction percentages in the population of Duranta aphid, *A. durantae* increased gradually whereas it were 24.0, 34.4, 44.6, 57.1 and 66.6% on mid-February, first-March, mid-March, first-April and mid-April, respectively. The same trend was achieved at Giza Governorate. Also, in the second level of release (60 eggs/plant), at Cairo Governorate the reduction percentages in the population of *A. durantae* increased gradually whereas it were 27.1, 40.2, 50.3, 60.0 and 69.7% on mid-February, first-March, mid-March, first-April and mid-April, respectively. The same trend was achieved at Giza Governorate. Lastly, the third level of release (90 eggs/plant), at Cairo Governorate the reduction percentages in the population of *A. durantae* increased gradually whereas it were 31.3, 46.0, 58.7, 68.3 and 74.1% on mid-February, first-March, mid-March, first-April and mid-April, respectively. In addition, the same trend was achieved at Giza Governorate.

INTRODUCTION

Duranta plants consider one of the importance, beautiful and famous hedges and ornamental plants all over the world. It is called "Golden dewdrop". They are commonly cultivated as hedges and ornamental plants. Also, duranta plants are one of the most permanent green leafy plants, characterized by bright green leaves, which reproduce through the peripheral part. Duranta is a genus of flowering plants in the verbena family (Verbenaceae). It contains 17 species of shrubs and small trees that are widespread all over the world. Iram, S. *et al*. (2017) in Pakistan found that duranta is a common ornamental plant of the family Verbenaceae that is often grown as a garden hedge in Pakistan.

On the other hand, duranta plants also cultivated for medicinal purposes in many countries all over the world. Sharma, P. *et al.* (2015) studied the antifungal activity of duranta plants against some phytopathogenic fungi as a result of antifungal activity, it was found that the extract of the leaf which contain also many pharmaceutical drugs.

Duranta aphid, *Aphis durantae* Theobald (Homoptera: Aphididae) is the most important pest of duranta plants and many other crops. The adults and nymphs of aphid attack the duranta plants, tender shoots and buds. The aphids are apterous and reproduce parthenogenetically. Aphid populations may increase very rapidly under natural conditions. Ahmed. S. and El-Deeb, M. (2007) found that duranta aphid, *A. durantae* infested duranta plants all over the year, leaves were the highly infested plant part that received aphids attack.

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 leaf worm (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.*, 1980). 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. 1998). 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 Duranta aphid *A. durantae* which infesting duranta plants by releasing different levels of the seven-spotted lady beetle, *C. septempuncta* and this study was carried out at two locations (Governorates), The International Garden, Cairo Governorate and El-Orman Garden, Giza Governorate during successive season 2018 under glasshouse conditions.

MATERIALS AND METHODS

This study was carried out to evaluate the management of Duranta aphid, *Aphis durantae* Theobald which infesting duranta plants by releasing different levels of the seven-spotted lady beetle, *Coccinella septempunctata* L. This study was carried out at two locations (Governorates), The International Garden, Cairo Governorate and El-Orman Garden, Giza Governorate during successive season 2018 under glasshouse conditions.

-Mass rearing of the seven-spotted lady beetle, *Coccinella septempunctata* L. and its prey the Cowpea aphid, *Aphis craccivora* (Koch):

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

Aphis 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 fabia 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 use as prey to the lady beetle, *C. septempunctata*.

A. craccivora colonies were cultured under laboratory conditions (23±2ºC and 60±5% R.H.) on broad beans (*Vicia 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 fabia bean plants these plants were inoculated with *C. septempunctata*. The stock culture of ladybird was obtained from infested plants and transferred to the laboratory. Only 10 adults ♂+ 10 adults ♀ 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. In order 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 *duranta* grown in International Garden, Cairo Governorate and El-Orman Garden, Giza 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 duranta 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 a control. The normal release and recommended agricultural practices were applied, also no chemical control against aphid were used during the completely experimental period.

Naturally, the numbers of *C. septempunctata* stages were recorded. Therefore, three levels of *C. septempunctata* eggs; the 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 duranta plants at the two places in 2018 season.

Samples were randomly taken bi-weekly at the two places and counting started from the beginning of February in duranta 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 Duranta aphid, *A. durantae* 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

This study was carried out to evaluate the management of Duranta aphid *Aphis durantae* Theobald (Homoptera: Aphididae) which infesting duranta plants by releasing different levels of the seven-spotted lady beetle, *Coccinella septempunctata* L. (Coleoptera: Coccinellidae).

This study was carried out at two locations (Governorates), The International Garden, Cairo Governorate and El-Orman Garden, Giza Governorate during successive season 2018 under glasshouse conditions.

At International Garden (Cairo Governorate):

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

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

Results in Table (1) and Figure (1) indicated that the number of *A. durantae* in the 1st release plot decreased gradually from 35 on the 1st February to 28, 26, 23, 19 and 16 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 38 individuals/plant, on first-February to 40, 43, 45, 48 and 52 individuals/plant, in the same dates, respectively. The present results showed that the percent reduction of *A. durantae* in 1st release plot increased gradually to reach 24.0, 34.4, 44.6, 57.1 and 66.6% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (1): Population fluctuations and % reduction of *A. durantae* in the 1st plot release at level (30eggs) of *C. septempunctata* at Cairo Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	35	38	-
Mid-February	28	40	24.0
First-March	26	43	34.4
Mid-March	23	45	44.6
First- April	19	48	57.1
Mid-April	16	52	66.6
F (0.05)	**243.25**		
LSD	**1.45**		

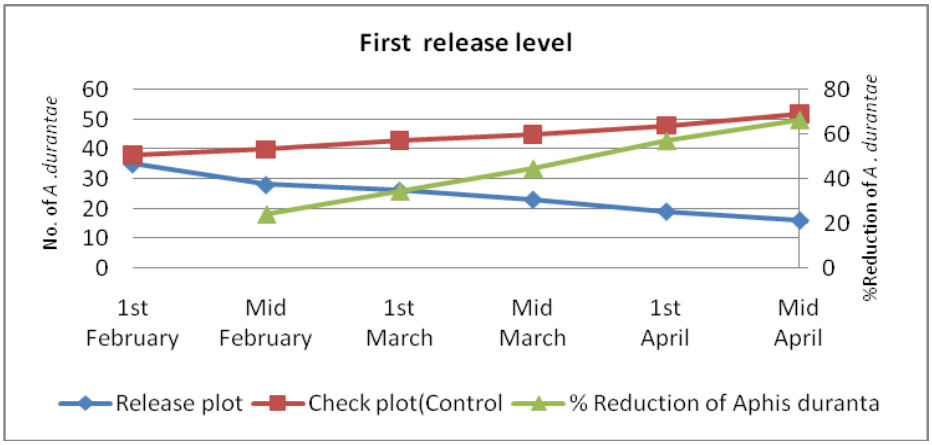

Fig.(1): Population fluctuations and % reduction of *A. durantae* in the 1st plot release at level (30eggs) of *C. septempunctata* at Cairo Governorate.

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

Results in Table (2) and Figure (2) indicated that the number of *A. durantae* in the 2nd release plot decreased gradually from 37 on the 1st February to 29, 26, 23, 20 and 16 individuals/plant on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 40 individuals/plant, on first-February to 43, 47, 50, 54 and 57 individuals/plant, in the same dates, respectively. The obtained results showed that the percent reduction of *A. durantae* in 2nd release plot increased gradually to reach 27.1, 40.2, 50.3, 60.0 and 69.7% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (2): Population fluctuations and % reduction of *A. durantae* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Cairo Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	37	40	-
Mid-February	29	43	27.1
First-March	26	47	40.2
Mid-March	23	50	50.3
First-April	20	54	60.0
Mid-April	16	57	69.7
F (0.05)	**289.76**		
LSD	**1.32**		

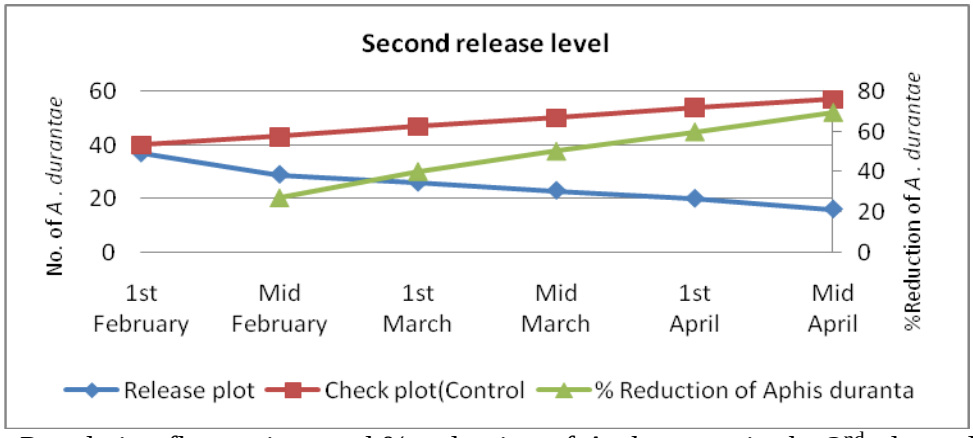

Fig.(2): Population fluctuations and % reduction of *A. durantae* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Cairo Governorate.

3- Third level of release (90 eggs/plant):

Results in Table (3) and Figure (3) indicated that the number of *A. durantae* in the 3rd release plot decreased gradually from 35 on the 1st February to 26, 22, 18, 15 and 13 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 40, 43, 46, 50 and 53 individuals/plant, in the same dates, respectively. The results showed that the percent reduction of *A. durantae* in 3rd release plot increased gradually to reach 31.3, 46.0, 58.7, 68.3 and 74.1% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (3): Population fluctuations and % reduction of *A. durantae* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Cairo Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	35	37	-
Mid-February	26	40	31.3
First-March	22	43	46.0
Mid-March	18	46	58.7
First-April	15	50	68.3
Mid-April	13	53	74.1
F (0.05)	**215.98**		
LSD	**1.21**		

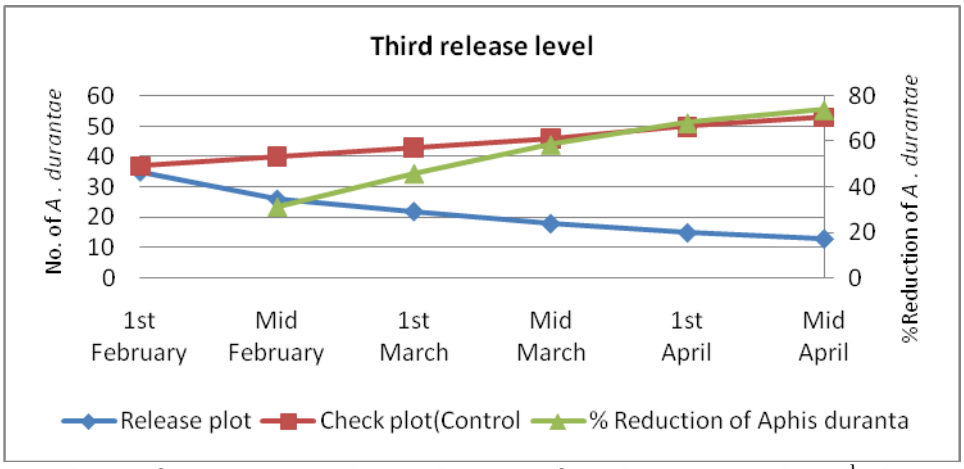

Fig.(3): Population fluctuations and % reduction of *A. durantae* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Cairo Governorate.

El-Orman Garden (Giza Governorate):

Also, three levels of *C. septempunctata* eggs; first level (30 eggs on one card), second level (60 eggs on two cards) and the third level (90 eggs on three cards) were released (one time), by the beginning of February on duranta plants during 2018.

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

Results in Table (4) and Fig. (4) indicated that the number of *A. durantae* in the 1st release plot decreased gradually from 45 on the 1st February to 37, 32, 30, 26 and 22 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 47 individuals/plant, on first-February to 50, 53, 57, 60 and 65 individuals/plant, in the same dates, respectively. In addition, the results showed that the percent reduction of *A. durantae* in 1st release plot increased gradually to reach 22.8, 36.9, 45.1, 54.8 and 64.7% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (4): Population fluctuations and % reduction of *A. durantae* in the 1st plot release at level (30eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	45	47	-
Mid-February	37	50	22.8
First-March	32	53	36.9
Mid-March	30	57	45.1
First-April	26	60	54.8
Mid-April	22	65	64.7
F (0.05)	**272.34**		
LSD	**1.23**		

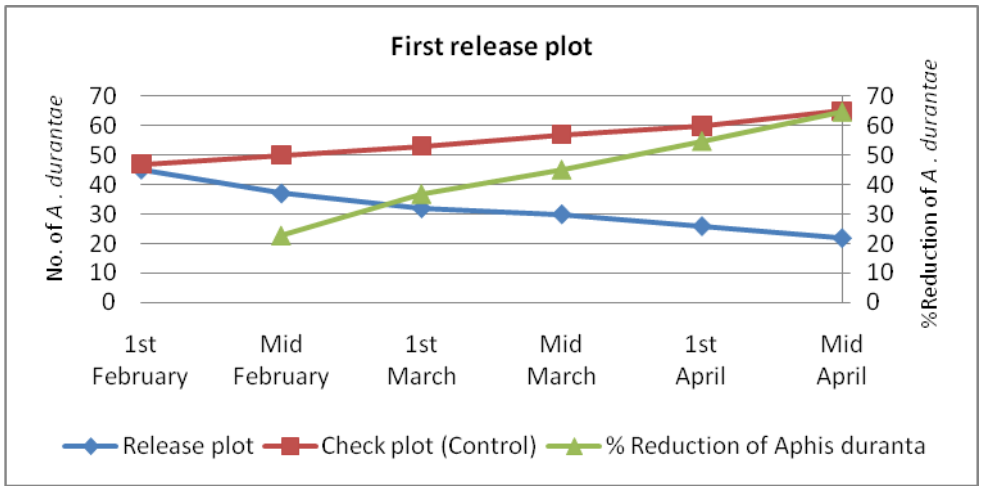

Fig.(4): Population fluctuations and % reduction of *A. durantae* in the 1st plot release at level (30eggs) of *C. septempunctata* at Giza Governorate.

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

Results in Table (5) and Figure (5) indicated that the number of *A. durantae* in the 2nd release plot decreased gradually from 47 on the 1st February to 35, 30, 25, 20 and 17 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to control which aphid populations changed from 49 individuals/plant, on first-February to 52, 54, 59, 62 and 67 individuals/plant, in the same dates, respectively. In addition, the results showed that the percent reduction of *A. durantae* in 2nd release plot increased gradually to reach 29.8, 42.1, 55.8, 66.4 and 73.5% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (5): Population fluctuations and % reduction of *A. durantae* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	47	49	-
Mid-February	35	52	29.8
First-March	30	54	42.1
Mid-March	25	59	55.8
First-April	20	62	66.4
Mid-April	17	67	73.5
F (0.05)	**215.21**		
LSD	**1.71**		

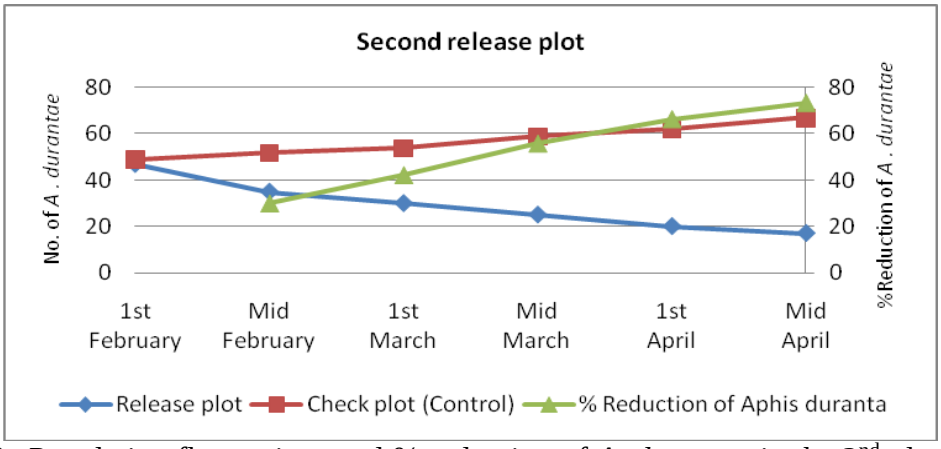

Fig.(5): Population fluctuations and % reduction of *A. durantae* in the 2nd plot release at level (60eggs) of *C. septempunctata* at Giza Governorate.

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

Results in Table (6) and Figure (6) indicated that the number of *A. durantae* in the 3rd release plot decreased gradually from 43 on the 1st February to 31, 27, 20, 17 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 40 individuals/plant, on first- February to 43, 47, 50, 54 and 60 individuals/plant, in the same dates, respectively. In addition, the results showed that the percent reduction of *A. durantae* in 3rd release plot increased gradually to reach 32.9, 46.6, 62.8, 70.7 and 76.7% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Table (6): Population fluctuations and % reduction of *A. durantae* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Giza Governorate.

Date	Release plot	Chick plot (Control)	% Reduction
First-February	43	40	-
Mid-February	31	43	32.9
First -March	27	47	46.6
Mid-March	20	50	62.8
First-April	17	54	70.7
Mid-April	15	60	76.7
F (0.05)	**245.76**		
LSD	**1.35**		

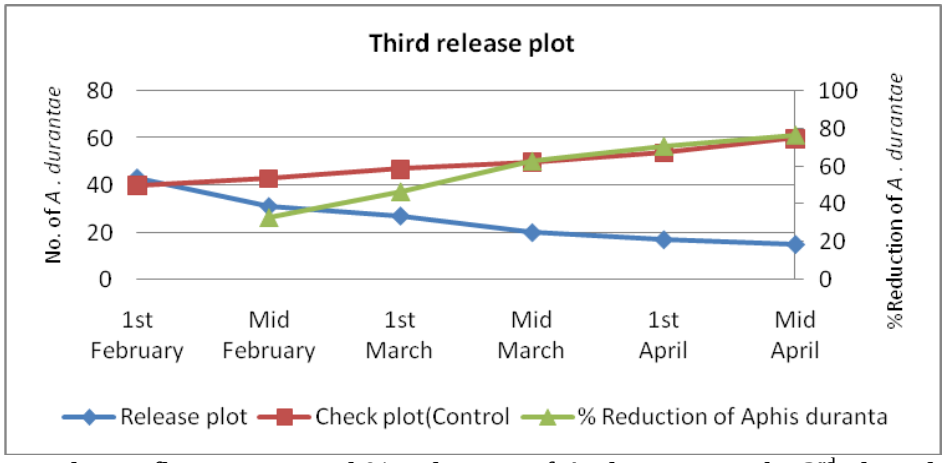

Fig.(6): Population fluctuations and % reduction of *A. durantae* in the 3rd plot release at level (90eggs) of *C. septempunctata* at Giza Governorate.

Statistical analysis showed that highly significant differences between the three releasing levels (30, 60 and 90 eggs/plant) of *C. septempunctata* predator in reduction of *A. durantae* at both the two locations compared to control, whereas (F 0.05) value and (LSD) were (243.25, 1.45), (289.76, 1.32) and (215.98, 1.21), respectively for the three releasing levels (30, 60 and 90 eggs/plant) of *C. septempunctata* predator at Cairo Governorate. Also, at Giza Governorate statistical analysis show highly significant differences between the three releasing levels (30, 60 and 90 eggs/plant) of *C. septempunctata* predator in reduction of *A. durantae* compared to control whereas (F 0.05) value and (LSD) were (272.34, 1.23), (215.21, 1.71) and (245.76, 1.35), respectively for the three releasing levels (30, 60 and 90 eggs/plant) of *C. septempunctata* predator at Giza Governorate.

These results are in agreement with those obtained by Mangoud, A. (2009) 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* (Hausmann) (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, *Aphis gossypii* (Hausmann) (Homoptera : Aphididae) attacking apple trees.

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 yellow River valley in China.

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ARABIC SUMMARY

المكافحة الحيوية لحشرة من الدورانتا *Aphis durantae* Theobald علي نباتات الدورانتا بإطلاق خنفساء أبو العيد ذو السبع نقاط *Coccinella septempunctata* L. تحت ظروف الصوب الزجاجية

أشرف صلاح إمام ، سامية عبد الفتاح يسن و فرحة حسنى حسن فرج الله
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي – الجيزة – مصر

أجري هذا البحث لتقييم مستويات مختلفة من إطلاق أبو العيد ذو السبع نقاط *Coccinella septempunctata* L. (30 ، 60، 90 بيضة/ نبات) في خفض تعداد حشرة من الدورانتا *Aphis durantae* Theobald علي نباتات الدورانتا بمحافظتى القاهرة و الجيزة خلال موسم 2018 تحت ظروف الصوب الزجاجية. حيث أدى إطلاق مفترس أبو العيد ذو السبع نقاط بمستوي 30 بيضة/ نبات فى الحديقة الدولية (محافظة القاهرة) إلي خفض نسبة الإصابة بمن الدورانتا بنسبة تدرجت من 24.0، 34.4، 44.6، 57.1، 66.6% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل علي التوالي، وعلي نفس المنوال تدرجت الفاعلية فى حديقة الأورمان (محافظة الجيزة) حتي وصلت أقصاها في منتصف أبريل. بينما أدي إطلاق هذا المفترس بمستوي 60 بيضة /نبات إلي خفض نسبة الإصابة بمن الدورانتا بنسبة تدرجت من 27.1، 40.2، 50.3، 60.0، 69.7% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل على الترتيب وذلك بالحديقة الدولية (محافظة القاهرة) وعلي نفس المنوال تدرجت الفاعلية فى حديقة الأورمان (محافظة الجيزة) حتي وصلت أقصاها في منتصف أبريل. كما أدي إطلاق هذا المفترس بمستوي 90 بيضة / نبات الي خفض نسبة الإصابة بمن الدورانتا بنسبة تدرجت من31.3 ، 46.0 ،58.7، 68.3، 74.1% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل علي التوالي بمحافظة القاهرة ، وعلي نفس المنوال تدرجت الفاعلية في حديقة الأورمان (محافظة الجيزة) حتي وصلت أقصاها في منتصف أبريل. ومن النتائج السابقة يمكن التوصية بإستخدام المفترس الحشري أبو العيد ذو السبع نقط *C. septempunctata* بنجاح كأحد عناصر المكافحة البيولوجية الفعاله في برامج المكافحة المتكاملة لحشرة من الدورانتا *A. durantae* علي نباتات الدورانتا.