J. Plant Prot. and Path., Mansoura Univ., Vol.7 (5), 291– 295, 2016

Biological Control of the Chrysanthemum Aphid, *Macrosiphoniella sanborni* (Gillete) by Release *Coccinella septempunctata* l. on Chrysanthemum Plants

Emam, A. S.
Plant Protection Institute, A.R.C., Dokki, Giza, 12618 Egypt

ABSTRACT

The seven-spotted ladybird, *Coccinella septempunctata* L. (Coleoptera : Coccinellidae) was released for one time, at early-February on chrysanthemum plants during the two successive seasons 2013 and 2014, at Giza Governorate at rates of 30, 60 and 90 eggs/plant. On chrysanthemum plants: during the first season (2013), the reduction percentages in the population of *Macrosiphoniella sanborni* (Gillete) increased gradually with elapse of time reaching the maximum. The achieved average reductions in aphid population, were 21.9, 39.3, 46.3, 53.3 and 60.4% on mid-February, first-March, mid-March, first-April and mid-April (2013), respectively in the first level of release (30 eggs/plant). The same trend was achieved in the second season tested (2014). Also, in the second level of release (60 eggs/plant) during the first season (2013), the reduction percentages in the population of *M. sanborni* increased gradually with elapse of time reaching the maximum. The achieved average reductions in aphid population were 39.2, 50.1, 57.3, 61.9 and 71.4% on mid-February, first-March, mid-March, first-April and mid-April, respectively. The same trend was achieved in the second season (2014). The same trend was observed with the third level of release (90 eggs/plant), the reduction percentages in the population of *M. sanborni* increased gradually with elapse of time reaching the maximum. The achieved average reductions in aphid population were 40.7, 62.1, 70.4, 78.3 and 86.8% on mid-February, first-March, mid-March, first-April and mid-April, respectively. In addition, the same trend was achieved in the second season (2014). The present work has shown that the seven-spotted ladybird, *C. septempunctata* L. could used successfully, as a biocontrol agent in an integrated program for controlling *M. sanborni* on chrysanthemum plants.

INTRODUCTION

Macrosiphoniella sanborni (Gillete) (Homoptera: Aphididae), commonly known as chrysanthemum aphid, is an important pest of chrysanthemum and many other crops. The adults and nymphs of aphid attack the chrysanthemum plants and suck cell sap from flowers, tender shoots and buds, ultimately decreasing the market value of chrysanthemum flowers. Aphid infestation badly affects the flowering capacity of plants, resulting in 20-40% losses. The aphids are apterous and reproduce parthenogenetically. Aphid populations may increase very rapidly under natural conditions (Gilkeson and Kelin 2001 & Islam 2007).

The seven-spotted ladybird, *C. septempunctata* (Coleoptera : Coccinellidae) is the commonest ladybird 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, 1948 & 1955 and Bilashini *et al*., 2007). 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 ladybird kills its prey outright and then devours it (Waldbauer, 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, 2009).

The present work aimed to evaluate the management of *Macrosiphoniella sanborni* (Gillete) infesting chrysanthemum plants by releasing different levels of the seven spotted lady beetle, *Coccinella septempunctata* L. (Coleoptera : Coccinellidae).

MATERIALS AND METHODS

1. **Mass rearing of the seven-spotted ladybird, *Coccinella septempunctata* L. and its prey the cowpea aphid, *Aphis craccivora* (Koch):**

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 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 ladybird, *C. septempunctata*.

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

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 ladybird was obtained from infested plants and transferred to 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 *et al*., 2013).

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 *et al*., 2013).

2. Release of *C. septempunctata*:

Releasing study was conducted on *Chrysanthemum* grown in El-Orman Garden, Giza Governorate during the two successive years (2013 and 2014). The selected plants for the present investigation were away from any pesticide contamination. Three plots (3x5m plant each) for chrysanthemum plants were sown during November and the plots were arranged in randomized block with three replicates for each reals level, and another three replicates as control. The normal release and recommended agricultural practices were applied, also no chemical control against aphid were used during the whole experimental period.

Naturally, the numbers of *C. septempunctata* stages were rere, therefore, three levels of *C. septempunctata* eggs; first level consists of 30 eggs (one card), 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 Chrysanthemum in 2013 season and repeated in the same time in 2014 season.

Samples were randomly taken bi-weekly and counting started from the beginning February in Chrysanthemum. Twenty new leaves were examined in the field was made by a hand lens for counting the alive insects and the predator. Both surfaces of the leaf were inspected for the presence of aphid (Mangoud, 2000).

3. Statistical analysis:

The percent reduction of aphid after *C. septempunctata* released was calculated according to Henderson and Tilton equation (1955).

The data was 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

The seven-spotted ladybird, C. *septempunctata* lives in a wide variety of habitats. Any place where there are plants and aphids may attract these species (Fleming, 2000).

I. Release of *C. septempunctata*:

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 during 2013 and 2014 on Chrysanthemum plants.

First year (2013):

First level of release (30 eggs/plant):

In first tested level of release (30 eggs/plant), the pre-count of *M. sanborni* was 99 individuals/plant in releasing area, while it was 93 individuals/plant in check (control).

The results in Fig. (1) indicated that the number of *M. sanborni* in the 1st release plot decreased gradually from 93 on the 1st February to 77, 61, 56, 50 and 45 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to check plot (aphid populations changed from 99 individuals/plot, on first-February to 105, 107, 111, 114 and 121 individuals/plot, in the same dates, respectively). The present results showed that the percent reduction of *M. sanborni* in 1st release plot increased gradually to reach 21.9, 39.3, 46.3, 53.3 and 60.4% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Second level of release (60 eggs/plant):

In second level of release (60 eggs/plant), the pre-count of *M. sanborni* was 111 individuals/plant in releasing area, while it was 105 individuals/ plant in check (control).

The results in Fig. (2) indicated that the number of *M. sanborni* in the 2nd release plot decreased gradually from 111 on the 1st February to 72, 66, 60, 56 and 43 individuals/plant on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to check plot (aphid populations changed from 105 individuals/plant, on first-February to 112, 125, 133, 139 and 142 individuals/plant, in the same dates, respectively). The obtained results showed that the percent reduction of *M. sanborni* in 2nd release plot increased gradually to reach 39.2, 50.1, 57.3, 61.9 and 71.4% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

In third level of release (90 eggs/plant):

In third level of release, the pre-count of *M. sanborni* was 114 individuals/plant in releasing area, while it was 116 individuals/plant in check (control).

The obtained results in Fig. (3) indicated that the number of *M. sanborni* in the 3rd release plot decreased gradually from 114 on the 1st February to 71, 51, 43, 33 and 21 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as

compared to check plot (aphid populations changed from 116 individuals/plant, on first-February to 122, 137, 148, 155 and 162 individuals/plant, in the same dates, respectively). The results showed that the percent reduction of *M. sanborni* in 3rd release plot increased gradually to reach 40.7, 62.1, 70.4, 78.3 and 86.8% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

These results are in agreement with those obtained by Mangoud, (2009) the seven-spotted ladybird, *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.

Second year (2014):

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 *Chrysanthemum* during 2014. Figs (4,5,6)

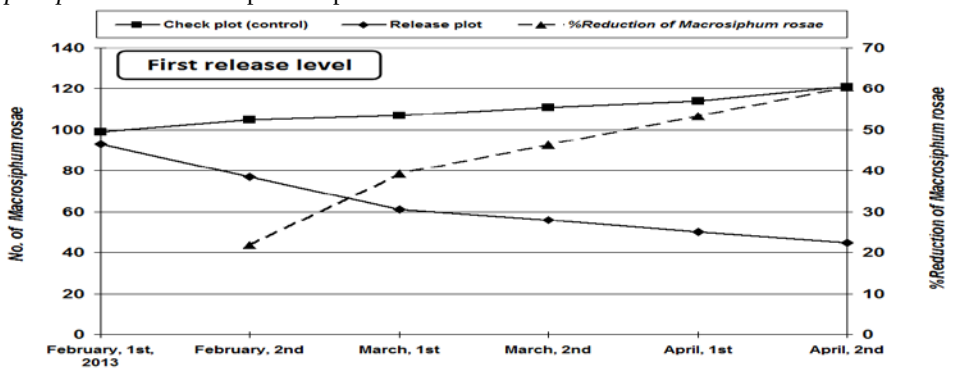

Fig. (1): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 1st plot release at level (30 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2013 season.

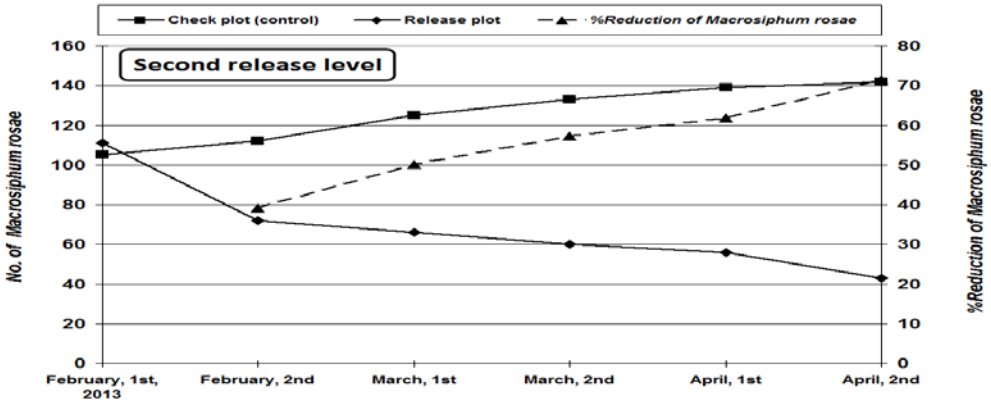

Fig. (2): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 2nd plot release at level (60 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2013 season.

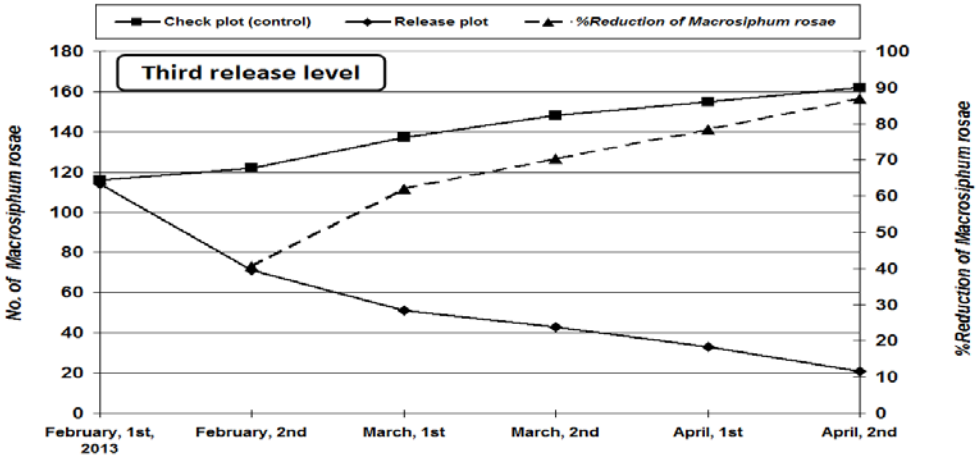

Fig. (3): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 3rd plot release at level (90 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2013 season.

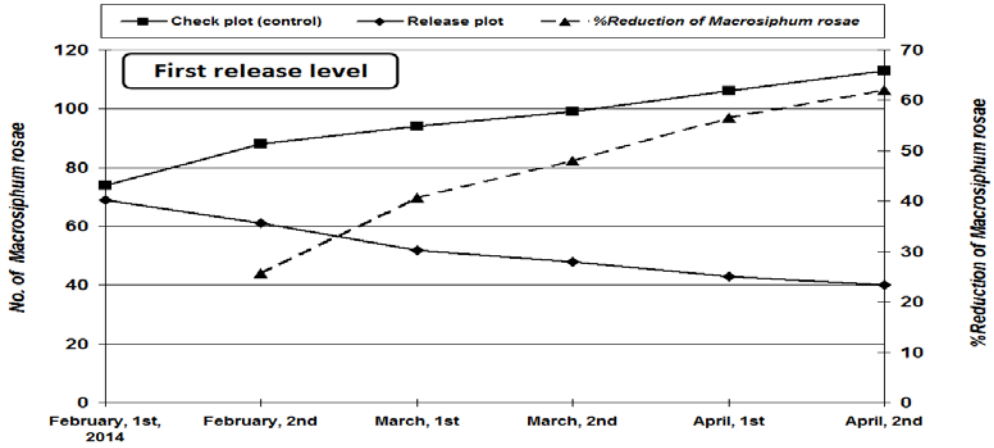

Fig. (4): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 1st plot release at level (30 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2014 season.

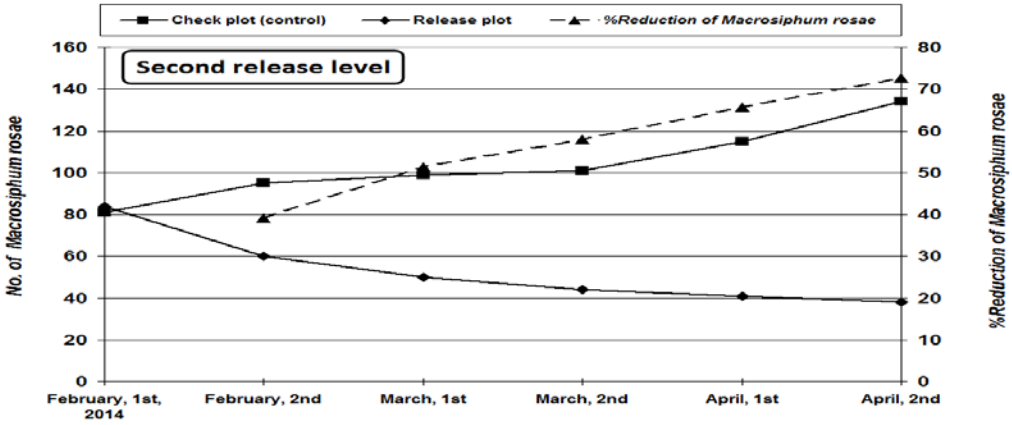

Fig. (5): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 2nd plot release at level (60 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2014 season.

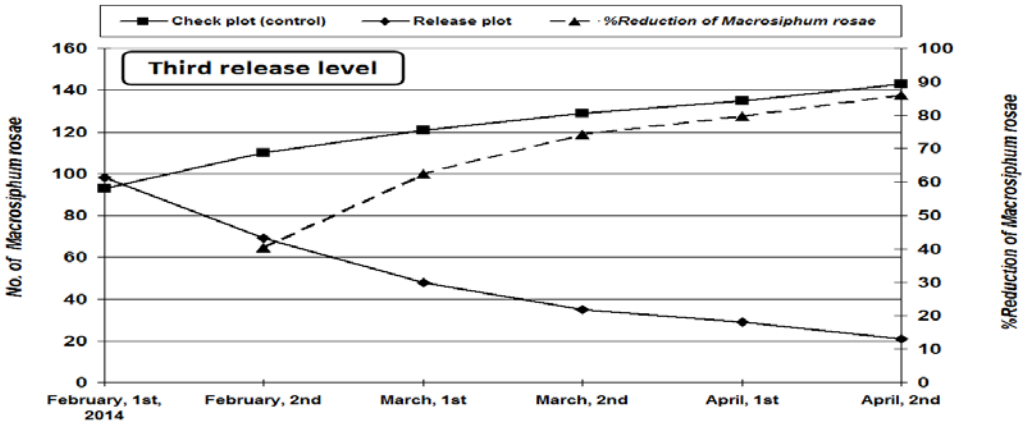

Fig. (6): Fluctuation in the population numbers of *Macrosiphoniella sanborni* (Gillete) in the 3rd plot release at level (90 eggs) of the seven-spotted ladybird, *Coccinella septempunctata* L. and the corresponding % reduction of the aphid density on chrysanthemum plants during 2014 season.

First level of release (30 eggs/plant):

In first level of release (30 eggs/plant), the pre-count of *M. sanborni* was 69 individuals/plant in releasing area, while it was 74 individuals/plant, in check (control).

The obtaind results in Fig. (4) indicated that the number of *M. sanborni* in the 1st release plot decreased gradually from 69 on the 1st February to 61, 52, 48, 43 and 40 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to check plot (aphid populations changed from 74 individuals/plant, on first-February to 88, 94, 99, 106 and 113 individuals/plant, in the same dates, respectively). In addition, the results showed that the

percent reduction of *M. sanborni* in 1st release plot increased gradually to reach 25.7, 40.7, 48.0, 56.5 and 62.0% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Second level of release (60 eggs/plant):

In second level of release (60 eggs/plant), the pre-count in the releasing area with *M. sanborni* 84 individuals/plant, while it was also 81 individuals/plant in control (check).

The presented results in Fig. (5) cleared that the number of *M. sanborni* in the 2nd release plot decreased gradually from 84 on the 1st February to 60, 50, 44, 41 and 38 individuals/plant on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to check plot (aphid populations changed from 81 individuals/plant, on first-February to 95, 99, 101, 115 and 134 individuals/plant, in the same dates, respectively). In addition, the results showed that the percent reduction of *M. sanborni* in 2nd release plot increased gradually to reach 39.1, 51.3, 58.0, 65.6 and 72.7% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

In third level of release (90 eggs/plant):

In the third level of release, the pre-count in the releasing area with *M. sanborni* 98 individuals/plant, while it was also 93 individuals/plant in control (check).

The results in Fig. (6) indicated that the number of *M. sanborni* in the 3rd release plot decreased gradually from 98 on the 1st February to 69, 48, 35, 29 and 21 individuals/plant, on mid-February, first-March, mid-March, first-April and mid-April, respectively as compared to check plot (aphid populations changed from 93 individuals/plant, on first-February to 110, 121, 129, 135 and 143 individuals/plant, in the same dates, respectively). In addition, the results showed that the percent reduction of *M. sanborni* in 3rd release plot increased gradually to reach 40.5, 62.4, 74.3, 79.6 and 86.1% on mid-February, first-March, mid-March, first-April and mid-April, respectively.

Statistical analysis showed that highly significant differences between the three releasing levels (30, 60 and 90 eggs/replicate) of *C. septempunctata* predator in reduction *M. sanborni* (F= 124.27, P<0.05 and LSD was 1.98, respectively during 2013 year). Also, during 2014 year statistical analysis show highly significant differences between the three releasing levels (30, 60 and 90 eggs/replicate) of *C. septempunctata* predator in reduction *M. sanborni* (F= 188.79, P<0.05 and LSD were 1.71) (Table 1).

These results are in agreement with those obtained by Mangoud (2003) who stated that the seven-spotted ladybird, *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.

Table (1): Percent reduction of the chrysanthemum aphid, *Macrosiphoniella sanborni* (Gillete) after releasing the seven-spotted ladybird, *Coccinella septempunctata* L. on chrysanthemum plants during 2013 and 2014 seasons.

Level of release	Reduction% during 2013	Reduction% during 2014
1st	60.4	62.0
2nd	71.4	72.7
3rd	86.8	86.1
F 0.05	124.27***	188.79***
LSD	1.98	1.71

These results are in harmony with those obtained by Hoyt and Madsen (1960) found that the control of aphid species complex is complicated by the continue 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 and Kanwar (1994) in field experiments in India found *C. septempunctata* was an effective predator against *A. craccivora* infesting fenugreek germplasm. El-Aish *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 were 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 *et al*. (1984) found the coccinellids, *C. septempunctata* good controlling *B. brassicae* in cotton fields at yellow Rever valley in China.

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المكافحة الحيوية لحشرة من الكريزانثيم علي نباتات الكريزانثيم بإطلاق خنفساء أبو العيد ذو السبع نقاط

أشرف صلاح امام

معهد بحوث وقاية النباتات - مركز البحوث الزراعية- الدقي – الجيزة – ١٢٦١٨ مصر

أجري هذا البحث لتقييم مستويات مختلفة من إطلاق أبو العيد (٣٠ ، ٦٠، ٩٠ بيضة/نبات) في خفض تعداد حشرة من الكريزانثيم علي نباتات الكريزانثيم بمحافظة الجيزة خلال موسمين متتاليين ٢٠١٣، ٢٠١٤. حيث تم إطلاق مفترس أبو العيد ذو السبع نقاط بمستوي ٣٠ بيضة/نبات أدى الي خفض نسبة الإصابة بمن الكريزانثيم بنسبة تدرجت من ٢١.٩، ٣٩.٣، ٤٦.٣، ٥٣.٣، ٦٠.٤% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل خلال عام ٢٠١٣ علي التوالي، وعلي نفس المنوال تدرجت الفاعلية في الموسم الثاني ٢٠١٤ حتي وصلت أقصاها في منتصف أبريل. بينما أدي إطلاق هذا المفترس بمستوي ٦٠ بيضة /نبات الي خفض نسبة الإصابة بمن الكريزانثيم بنسبة تدرجت من ٣٩.٢، ٥٠.١، ٥٧.٣، ٦١.٩، ٧١.٤% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل خلال عام ٢٠١٣ علي التوالي، وعلي نفس المنوال تدرجت الفاعلية في الموسم الثاني ٢٠١٤ حتي وصلت أقصاها في منتصف أبريل. كما أدي إطلاق هذا المفترس بمستوي ٩٠ بيضة / نبات الي خفض نسبة الإصابة بمن الكريزانثيم بنسبة تدرجت من ٤٠.٧، ٦٢.١، ٧٠.٤، ٧٨.٣، ٨٦.٨% وذلك في منتصف فبراير، وبداية مارس ومنتصف مارس وبداية أبريل ومنتصف أبريل خلال عام ٢٠١٣ علي التوالي، وعلي نفس المنوال تدرجت الفاعلية في الموسم الثاني ٢٠١٤ حتي وصلت أقصاها في منتصف أبريل.ومن النتائج السابقة يمكن استخدام المفترس الحشري أبو العيد ذو السبع نقط بنجاح كأحد عناصر المكافحة البيولوجية الفعاله في برامج المكافحة المتكاملة لمن الكريزانثيم علي نباتات الكريزانثيم.