THE EFFICIENCY OF THE VEDALIA BEETLE, *RODALIA CARDINALIS* (MULSANT) IN SUPPRESSING THE POPULATION OF THE SEYCHELLARUM MEALYBUG, *ICERYA SEYCHELLARUM* (WESTWOOD) ON WASHINGETONIA PALMS

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Abstract

Larvae and adult of seychellarum mealybug, *Icerya seychellarum* (Westwood) (Homoptera : Margarodidae) became very important insect pest attacking different species of ornamental plants such as Washingetonia palms, *Washingtonia filifera*. The vedalia beetle, *Rodalia cardinalis* (Mulsant) (Coleoptera: Coccinellidae) play a good role in reducing the population density of Seychellarum mealybug. *R. cardinalis* was released (one time), at early June 2003 and repeated in 2004, at Giza Governorate at a rate of 20, 30 and 40 individuals/tree during the first season (2003), the percent reduction of *I. seychellarum* increased gradually with elapse of time reaching the maximum in early September. The achieved reduction in Seychellarum population averaged 73, 87 and 97%, respectively. The same trend of percent reduction of *I. seychellarum* was achieved in the second season (2004). The following percent reduction, 74, 85 and 98% was induced at release rate of 20, 30 and 40 individuals of Vedalia beetle, respectively.

From the above mentioned results, the vedalia beetle, *Rodalia cardinalis* (Mulsant) could be used successfully as an active component in the integrated program for controlling the seychellarum mealybug, *Icerya seychellarum* (Westwood) on the ornamental plants for minimizing the risk use of insecticides on the public health and the environment.

INTRODUCTION

The seychellarum mealybug, *Icerya seychellarum* (Westwood) (Homoptera : Margarodidae) infests many ornamental plants such as Washingetonia palms in Egypt. The female lays between 600-800 eggs/female in an ovisac made of wax secreted from the lower side of abdomen. The different developmental stages are usually found in clusters on leaves. The insect female scale feeds on the sap sucked from the host plant tissues. High infestation results in a great loss of sap, thus leading to defoliation, dryness and reduction of the palm vitality. In addition, the mealybugs secrete honeydew, which offers a suitable medium for the growth of fungus (Dreistadt *et al.*, 1994), which attracts many other insects such as ants.

The vedalia beetle, *Rodalia cardinalis* (Mulsant) (Coleoptera : Coccinellidae) is an important predator of true mealybug species (Homoptera : Margarodidae) (Kamal 1951) e.g. Egyptian fluted mealybug, *Icerya aegyptiaca* (Douglas), the Seychellarum mealybug, *Icerya seychellarum* (Westwood) and the cottony cushion mealybug, *Icerya purchasi* Maskell (Annecke and Moran 1982). This predator was introduced to Egypt from Los Angeles during (1890-1892) and again in 1922, to compact the cottony-cushion mealybug, *Icerya purchasi* Mask. (Kamal, 1951), the introduction was successful and the beneficial beetle became established and now is common all over the country.

Female predators lay their eggs underneath the mealybugs or attach them to their ovisac, their young larvae move into the egg mass of the Seychellarum mealybug and feed on the eggs (Caltagirone and Doutt, 1989). *R. cardinalis* has used as biological control agent on different stages of true mealybugs for more than 100 years and been introduced into many countries and has not shown interest in eating other species (Baker, 1994).

The main purpose of this study is to: evaluate the role of the vedalia beetle, *R. cardinalis* in suppressing the population density of *I. seychellarum* using release technique on Washingetonia palms at Giza Governorate during two successive years (2003-2004).

MATERIALS AND METHODS

Mass rearing of *I. seychellarum* and its predator, *R. cardinalis*:

I. seychellarum was reared under green house conditions at 25 ±2ºC and 60 ± 5% RH, on small ficus plants (*F. nitida*). Ficus plants were grown in pots (30 cm diameter X 25 cm high). Every plant was kept under a glass chimney and its upper opening was covered with white muslin. The potted plants were irrigated and fertilized whenever necessary. An aspirator was used to collect mealybug crawlers from the infested *F. nitida* trees. The crawlers of *I. seychellarum* were then carefully transferred to larger ficus plants which were grown in bigger pots and kept in wooden cages (100x135x135 cm) with nylon gauze sides using the method described by Mangoud (2003).

R. cardinalis was also mass reared in the green house at 25±2ºC and 60±5% RH. The stock of *R. cardinalis* was obtained from the infested ornamental plants. Adults and larval stages of *R. cardinalis* were transferred to infested ficus plants grown in pots (30 cm diameter X 25 cm high) and kept in wooden cages (100x135x135 cm) with nylon gauze sides for rearing the predator. Adults and larvae of *R. cardinalis* were collected by aspirator and put in plastic cage (10 cm length x 8 cm width x 2 cm

height) with some pieces of paper and pieces of cotton wool containing sucrose solution for feeding and transferred to the field for release using the method described by Mangoud (2003).

Release *R. cardinalis*:

Different rates of *R. cardinalis* (10 adults and 10 larvae), (15 adults and 15 larvae) and (20 adults and 20 larvae) were released in El-Saaf, Giza Governorate, Egypt. In this area no pesticides were applied during the period of study. Release of *R. cardinalis* experiment was carried out on a group of Washingetonia palms, which were divided into 4 replicates for each rate, each replicate was consisted of 16 trees and another 16 trees were left as control. Different rate s of *R. cardinalis* released directly (one time) during early June 2003 and repeated in the same period in the second year, 2004 in the centre of the palm using the method described by Mangoud (2003). The period from the beginning of release to taking samples was 15 days. Randomly samples leaves (60 leaves/sample) were taken biweekly, leaves samples were cut and kept in paper bags and transferred to the laboratory for examination. The alive nymphs, adult females (ovipositing and non-ovipositing females), and all stages of *R. cardinalis* were counted by using the aid of stereomicroscope.

Statistical Analysis:

The percent reduction of infestation was statistically calculated according to the equation of Henderson and Tilton (1955).

RESULTS AND DISCUSSION

Release of *R. cardinalis*:

First year (2003):

The pre count numbers of *I. seychellarum* were 85, 83 and 81 individuals/leaf in the three releases plots, respectively, while reached 89 individuals/leaf in the (check plot). Three level of *R. cardinalis*, the first level (10 adults and 10 larvae), the second level (15 adults and 15 larvae) and the third level (20 adults and 20 larvae) were released (one time), by the beginning of June 2003.

In the fist plot (1st level):

The results in Fig. (1) indicateds that the number of *I. seychellarum* in the 1st release plot decreased gradually 78, 71, 66, 58, 51,44 and 38 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 101, 124, 138, 147, 155, and 168 in the check plot, in the same periods, respectively. Also, the results showed that the percent reduction of *I. seychellarum* in the 1st release plot increased gradually from 19, 40, 50, 59, 66 and 73% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

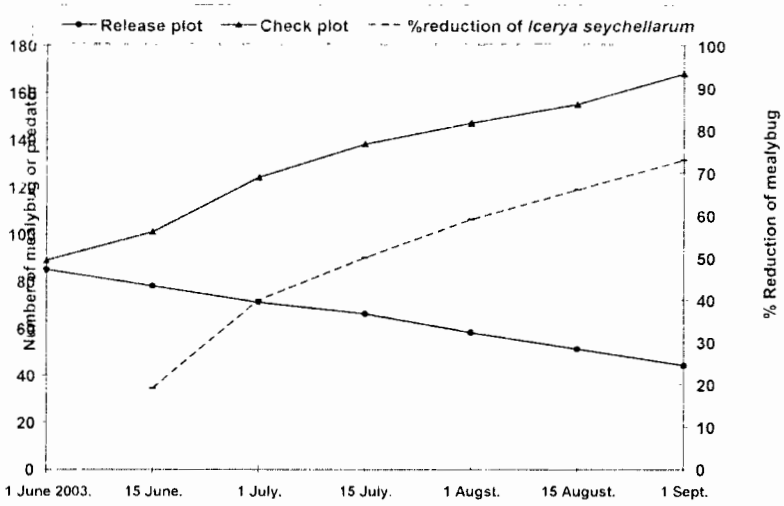

Fig. 1. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 1st plot release at level of (10 adults and 10 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2003.

In the second plot (2nd level):

The results in Fig. (2) indicated that the number of *I. seychellarum* in the 2nd release plot decreased gradually 72, 62, 66, 48, 41 and 21 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 101, 124, 138, 147, 155, and 168 in the check plot, in the same periods, respectively. Also, the results showed that the percent reduction of *I. seychellarum* in the 2nd release plot increased gradually from 24, 38, 49, 65, 72 and 87% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

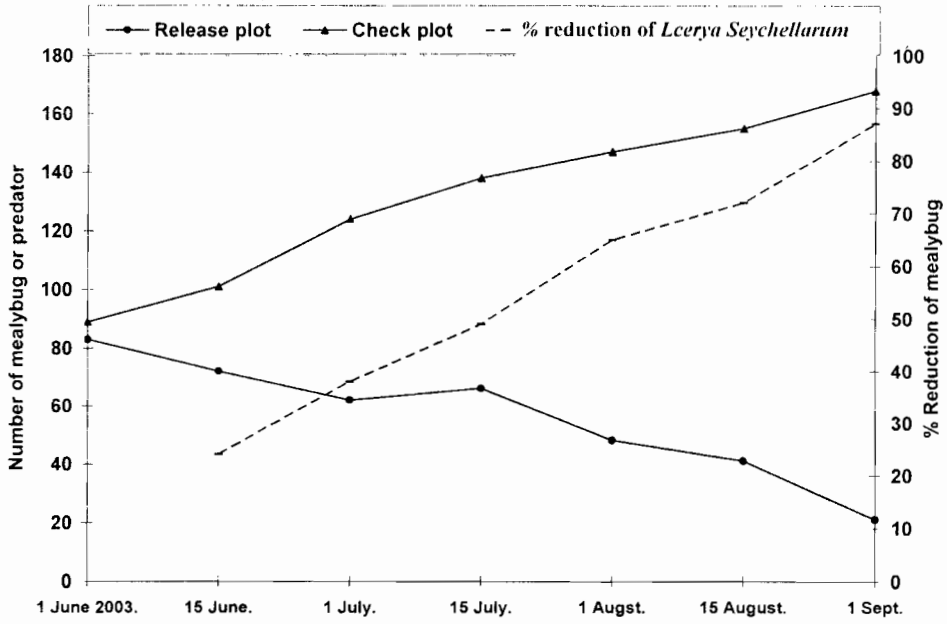

Fig. 2. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 2nd release plot at level of (15 adults and 15 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2003.

In the third plot (3rd level):

The results in Fig. (3) indicated that the number of *I. seychellarum* in the 3rd release plot decreased gradually 61, 58, 42, 32, 28 and 5 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 101, 124, 138, 147, 155 and 168 in the check plot, in the same periods, respectively. Also, the results showed that the percent reduction of *I. seychellarum* in 2nd release plot increased gradually from 34, 49, 67, 76, 80 and 97% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

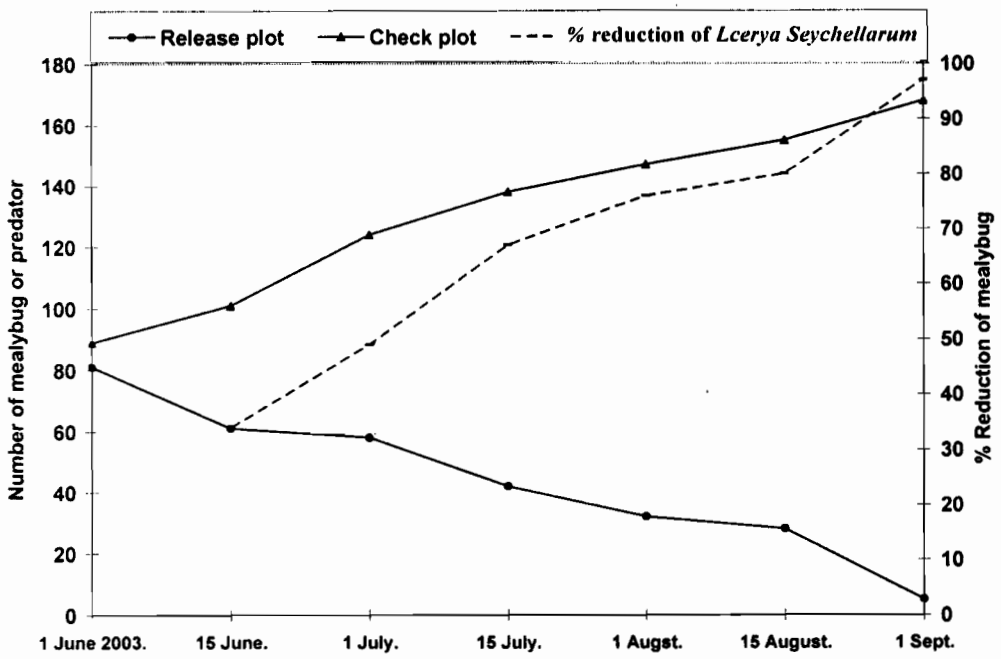

Fig. 3. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 3rd release plot at level of (20 adults and 20 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2003.

These results are in agreement with those obtained by Uygun and Sekeroglu (1984) found that local infestation by *Icerya purchasi* was rapidly controlled by *Rodolia cardinalis*. Also, Mangoud & Abd El-Gawad, 2003, mentioned that the *R. cardinalis* is an active predator for controlling *Icerya seychellarum* infesting apple trees. *Rodalia cardinalis* has a rapidly life history and can complete four generations in a period that takes *I. seychellarum* to complete only one generation. *R. cardinalis* in an orchard can control *I. seychellarum* in three months.

The second year (2004):

The pre releasing number of *I. seychellarum* was 75, 72 and 74 individuals/leaf, in the three releases plots, respectively, while reached 79 individuals/leaf in the check plot. Three level of *R. cardinalis*, first level (10 adults and

10 level), second level (15 adults and 15 level) and third rate (20 adults and 20 larvae) of *R. cardinalis* were released (one time), by the beginning of June 2004.

In the fist plot (1st level):

The results in Fig. (4) indicated that the number of *I. seychellarum* in the 1st release plot decreased gradually to became 67, 63, 54, 49, 41 and 38 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 101, 124, 138, 147, 155, and 168 in check plot, in the same periods, respectively.

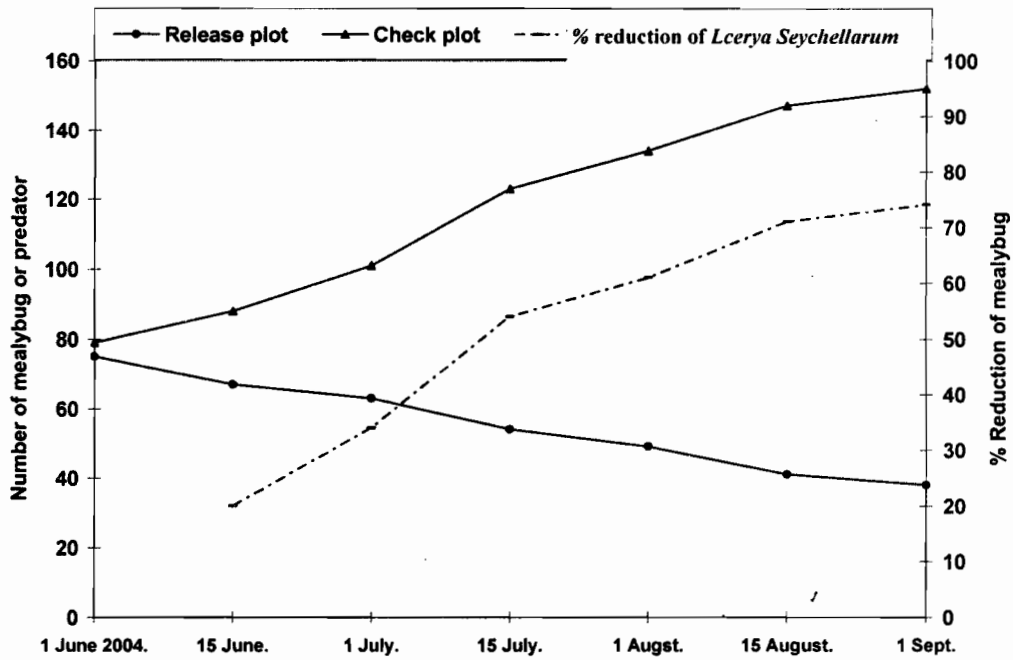

Fig. 4. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 1st plot release at level of (10 adults and 10 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2004.

Also, the results showed that the percent reduction of *I. seychellarum* in the 1st release plot increased gradually from 20, 34, 54, 61, 71 and 74% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

In the second plot (2nd level):

The results in Fig. (5) indicated that the number of *I. seychellarum* in the 2nd release plot decreased gradually to 67, 55, 42, 34, 29 and 21 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 101, 124, 138, 147, 155, and 168 in check plot, in the same periods, respectively. Also, the results showed that the percent reduction of *I. seychellarum* in the 2nd release plot increased gradually from 25, 40, 63, 72, 78, 85% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

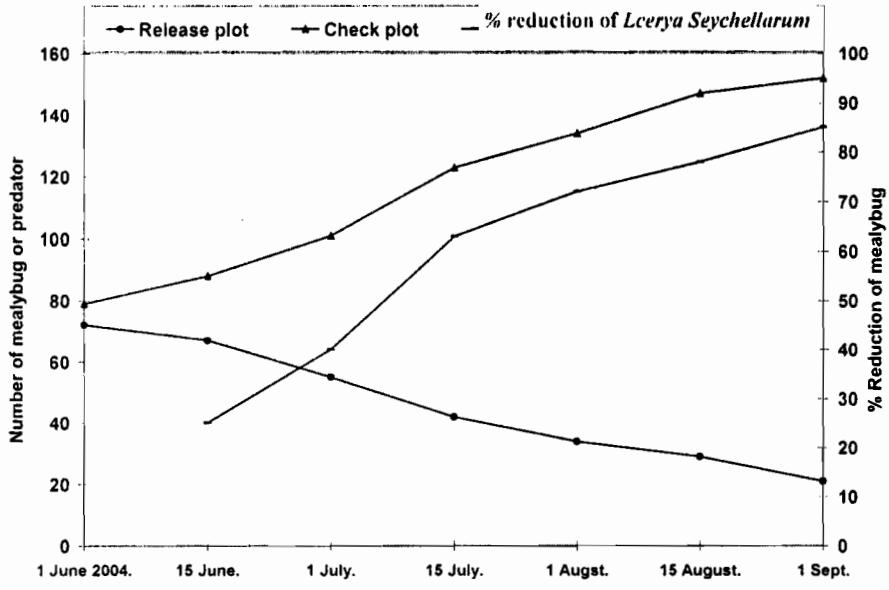

Fig. 5. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 2nd release plot at level of (15 adults and 15 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2004.

In the third plot (3rd level):

The results in Fig. (6) showed that the number of *I. seychellarum* in the 3rd release plot decreased gradually 51, 46, 33, 24, 17 and 3 in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively as compared to 88, 101, 123, 134, 147 and 152 in the check plot, in the same periods, respectively. Also, the results show that the percent reduction of *I. seychellarum* in the release plot increased gradually, from 38, 51, 71, 81, 88 and 98% in 15th June, 1st, 15th July, 1st, 15th August and 1st September, respectively.

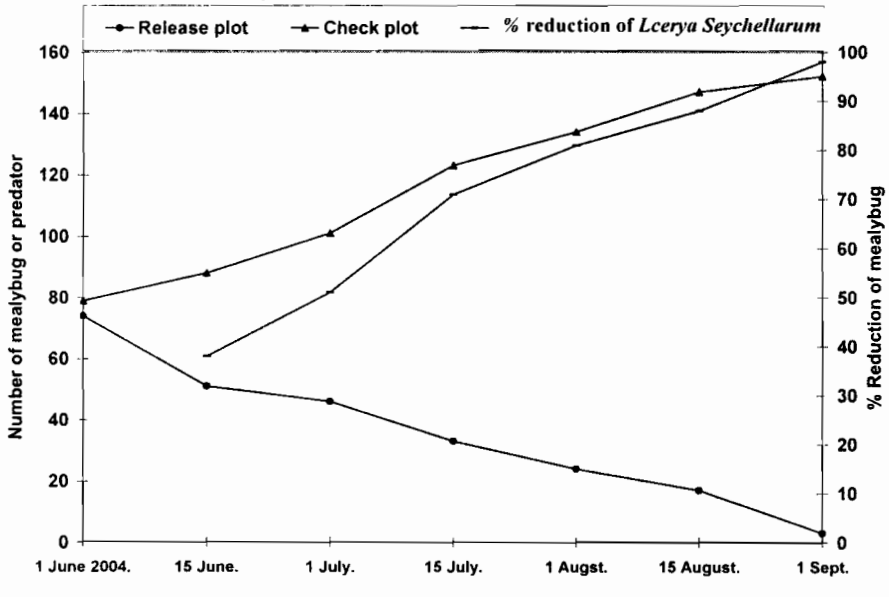

Fig. 6. Fluctuation in the population numbers of the seychellarum mealybug, *Icerya seychellarum* in the 3rd release plot at level of (20 adults and 20 larvae) in the check plot and the corresponding %reduction of the mealybug on Washingetonia palms during 2004.

These results are coinciding with those obtained by (Mangoud & Abd El-Gawad, 2003), who found that *R. cardinalis* is an effective predator for controlling *Icerya seychellarum* infesting apple trees. *Rodalia cardinalis* has a very fast life history and can complete four generations in a period that takes *I. seychellarum* to complete only one generation. *R. cardinalis* in an orchard can control *I. seychellarum* in three months.

These results also are in agreement with the findings of Khalaf (1987), who found that the coccinellid, *Vedalia cardinalis* (*Rodolia cardinalis*) proved a very efficient predator of the margarodid, *Icerya purchasi*, which was collected from 12 food plants (mainly Citrus spp. and pomegranate), it produced 4 generations a year in the Khabre and Shiraz regions of Iran. The life cycle lasted from 70 to 140 days. The efficiency of the coccinellid for biological control resulted from the ability of both adults and larvae to attack all growth stages of the pest.

Mangoud & Abd El-Gawad, (2003b) found that releasing of *R. cardinalis* one time, at the beginning of September 2002, reduced *Icerya aegyptiaca* and the predator increased gradually to reach 91.1% in 15th December. Also, Muniappan (1993) mentioned that, the population of *Icerya purchasi* could be reduced by the introducing parasitoids, *Cryptochetum iceryae* in Israel and *I. aegyptiaca* by releasing the predator *Rodolia* sp. in the Pacific Islands.

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تقييم كفاءة إطلاق مفترس الفيداليا في خفض تعداد بق السيشيلارم الدقيقي علي نخيل الواشنجطونيا

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أصبح بق السيشيلارم الدقيقي (أيسيريا سيشيلارم) من أكثر الآفات إصابة لنباتات الزينة وخاصة نخيل الواشنطجونيا في مصر. يرتبط بهذا النوع من البق الدقيقي مفترس قوي وهو مفترس الروداليا. وقد أجري هذا البحث لتقييم جرعات إطلاق مختلفة (١٠ يرقات + ١٠الحشرات الكاملة) و (١٥ يرقة + ١٥ الحشرات الكاملة) (٢٠ يرقة + ٢٠ الحشرات الكاملة) في خفض تعداد بق السيشلارم الدقيقي علي أشجار الواشنجطونيا بمحافظة الجيزة خلال موسمين متتاليين ٢٠٠٣، ٢٠٠٤.

فقد أدي إطلاق هذا المفترس بجرعة ٢٠ فرد (١٠ يرقات + ١٠الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي ٧٣% وذلك في بداية سبتمبر خلال عام ٢٠٠٣. بينما أدي إطلاق هذا المفترس بجرعة ٣٠ فرد (١٥ يرقات + ١٥ من الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي٨٧% وذلك في بداية سبتمبر خلال عام ٢٠٠٣. وأخيرا فقد أدي إطلاق المفترس بجرعة ٤٠ فرد (٢٠ يرقات + ٢٠ من الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي ٩٧% وذلك في بداية سبتمبر خلال عام ٢٠٠٣.

فقد أدي إطلاق هذا المفترس بجرعة ٢٠ فرد (١٠ يرقات + ١٠الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي ٧٤% وذلك في بداية سبتمبر خلال عام ٢٠٠٤. بينما أدي إطلاق هذا المفترس بجرعة ٣٠ فرد (١٥ يرقات + ١٥ من الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي٨٥% وذلك في بداية سبتمبر خلال عام ٢٠٠٤. وأخيرا فقد أدي إطلاق المفترس بجرعة ٤٠ فرد (٢٠ يرقات + ٢٠ من الحشرات الكاملة) الي خفض في نسبة الإصابة ببق السيشيلارم الدقيقي بنسبة وصلت أقصاها الي ٩٨% وذلك في بداية سبتمبر خلال عام ٢٠٠٤.

ومن النتائج السابقة يمكن استخدام مفترس الفيداليا بنجاح كعنصر فعال في برامج المكافحة المتكاملة للبق الدقيقي "البق الدقيقي الحقيقي" خاصة بق السيشيلارم الدقيقي علي أشجار نخيل الواشنجطونيا.