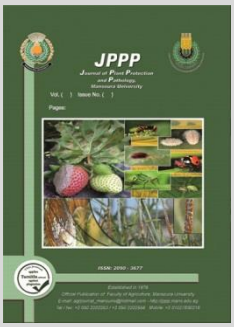
Journal of Plant Protection and Pathology

Journal homepage: www.jppp.mans.edu.eg
Available online at: www.jppp.journals.ekb.eg

Evaluate the Releasing Second Larval Instar of *Coccinella undecimpunctata* L. and *Chrysoperla carnea* (Stephens) as Biological Control Agent against *Icerya purchasi* Maskell (Hemiptera: Monophlebidae)

Sanaa A. M. Ebd El-Mageed*; Samah M. Y. Helmy and H. M. Haris

Plant Prot. Res. Inst., Agric. Res. Center, Dokki, Giza, Egypt.



ABSTRACT

Release of the second larval instar *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae) and *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) predators as biological control agent against the population of *Icerya purchasi* Maskell (Hemiptera: Monophlebidae) under field conditions on Ficus trees at Orman garden at Giza governorate. The obtained result showed that, the average of reduction percentage of nymphs of *I. purchasi* were (69.7%, 77.9% and 81.7%) with the rate 30, 40 and 50 larval /tree of *C. undecimpunctata*, respectively. While reduction percentage of adults of *I. purchasi* were (65.2%, 72.1% and 77.1%) with the same rate of release. The obtained average of reduction percentage of nymphs of *I. purchasi* were (58.6%, 65.5% and 70.5%) with the rate 30, 40 and 50 larval /tree of *C. carnea*, respectively. Also, average of reduction percentage of adults of *I. purchasi* were (36.6%, 43.7% and 52.6%) with the rate 30, 40 and 50 larval /tree, of *C. carnea* respectively.The regression equation indicated that there was a highly positive relationship between the rate of release of *C. undecimpunctata* & *C. carnea* and reduction percentages for nymphs and adults stage of *I. purchasi*. The statistical analysis assured that there was a significant increase in the reduction percentage of nymphs and adults of *I. purchasi* at different rate of release second larval of *C. undecimpunctata* and *C. carnea.*

Keywords: release, *Coccinella undecimpunctata* L., *Chrysoperla carnea* (Stephens), *Icerya purchasi* Maskell.

INTRODUCTION

Icerya purchasi Maskell (Hemiptera: Monophlebidae) causes damage mainly to leaves, stems, and branches of host plants by sucking sap and removing nutrients. It was feeding on 80 plant species and reduced branch production and growth, as well as reducing root growth (Causton 2001; Causton *et al*. 2006). The overuse of pesticides has led to pesticide laden agricultural produce (Donkor *et al.*,2016). Augmentative as well as inoculate releases of various biocontrol agents have been successfully established for insect control in several field crops (Sharma *et al.* 2018).

Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae) is a polyphagous predator, commonly found in agricultural systems. *Coccinella undecimpunctata* L. (Coleoptera: Coccinellidae) is a euryphagous predator. Several studies have been carried out in different parts of the world concerning the predation activity of many predator species such as *C. undecimpunctata* and *C. carnea*.

The release studies and the following are necessary step for IPM program (Stanley and Julien 1998; Gurr and Wratten 2000; and Lynch *et al.* 2001). *I. purchasi* is important as one of the first major successes of biological control. *Rodolia cardinalis* Mulsant (Coleoptera: Coccinellidae) released to control, *I. purchase*, by (Causton *et al.* 2006; Causton 2009 and Calderon Alvarez *et al.* 2012). *C. carnea* predator had ability to control insects like coccidis, mealybug, psyllid, thirps, whiteflies and aphids on various crops (Hemalatha *et al.*, 2014).

Therefore, the aims of the current study were to evaluate the release of second instar larvae of *C. carnea* and *C. undecimpinctata* against *I. purchasi* under field condition.

MATERIALS AND METHODS

Biological control of *Icerya purchasi* Maskell by releasing of the second larval instar of *Coccinella undecimpunctata* L. and *Chrysoperla carnea* (Stephens)

The experiment was conducted at Orman garden, Giza Governorate on Jun 2020 on Ficus tree. Trees about ten years old, 2-2.5 meter high not exposed to insecticides for two years prior to this experiment were chosen. Five trees infested with *I. purchasi* (2 branches 10 cm) were treated by releasing the predator *C. carnea* and *C. undecimpuncata* it used by 30,40 and 50 individuals of the second larval instar of the predator. Releasing was carried out on the 2nd of April, 2020 when the temperature and humidity were 20- 30°C and 56%, respectively.

Percentage of reduction of *I. purchasi* nymph and adult stages in proportional to the pretreatment count and after 15, 30, 45, 60 and 75 days of release were estimated according to Stafford and Summers (1963) equation.

$$\text{Reduction \%} = \frac{\text{Pre-treatment count} - \text{post-treatment count}}{\text{Pretreatment count}} \times 100$$

This tree with heavily infected with *I. purchasi*. The second larval instar of *C. undecimpuncata* and *C. carnea* were obtained from mass rearing unit of Plant Protection Research Institute.

* **Corresponding author.**
E-mail address: sanaa2012521@gmail.com
DOI: 10.21608/jppp.2021.154389

RESULTS AND DISCUSSION

Release of the second larval instar *Coccinella undecimpunctata* L. predator as a biological control agent on population of *I. purchasi* under field conditions on Ficus trees at Orman garden at Giza governorate. Data illustrated in Table (1) showed that the releasing rate 30 larval / tree of *C. undecimpunctata* on nymphs stage of *I. purchasi* recorded reduction percentage (60.2%) 15th days after release then increased to reached (89.1%) at 75days. While treatment 40 larval / tree recorded reduction percentage (67.3%) 15th days after release then increased to reached (94.2%) at 75days. The highest reduction percentage of *C. undecimpunctata* on nymphs stage of *I. purchasi* was (98.2%) at 75 days after release 50 larval/tree. The obtained average of reduction percentage of nymphs of *I. purchasi* were (69.7%, 77.9% and 81.7%) with the rate 30, 40 and 50 larval /tree of *C. undecimpunctata*, respectively. The reduction percentage of nymphs of *I. purchasi* increased by increase of the rate of *C. undecimpunctata* and the duration after release.

Table 1. The reduction percentage of *Icerya purchasi* Maskell after release of the second larval instar *Coccinella undecimpunctata* L. under field conditions on Ficus trees at Orman garden at Giza governorate.

Days after release	Reduction percentage of *Icerya purchasi* Maskell					
	Nymph			Adult		
	30	40	50	30	40	50
15 day	60.2	67.3	75.9	50.6	57.7	61.3
30 day	72.5	85.0	82.7	62.9	75.4	79.1
45 day	80.2	88.7	89.7	74.6	79.1	82.1
60 day	86.3	92.4	93.9	82.7	87.8	93.3
75 day	89.1	94.2	98.2	90.5	92.6	96.6
average	69.7	77.9	81.7	65.2	72.1	77.1

Data illustrated in Table (1), cleared that the rate 30 larval / tree of *C. undecimpunctata* on adults stage of *I. purchasi* recorded reduction percentage (50.6%) 15th days after release then increased to reached (90.5%) at 75days. While treatment 40 larval / tree recorded reduction percentage (57.7%) 15th days after release then increased to reached (92.6%) at 75days. The highest reduction percentage of *C. undecimpunctata* on adults stage of *I. purchasi* was (96.6%) at 75 days after release 50 larval/tree. The obtained average of reduction percentage of adults of *I. purchasi* were (65.2%, 72.1% and 77.1%) with the rate 30, 40 and 50 larval /tree of *C. undecimpunctata* respectively. The reduction percentage of adults of *I. purchasi* increased by increase of the rate of *C. undecimpunctata* and the duration after release.

The regression equation at 30 larval /tree of *C. undecimpunctata* was y = 7.16x + 56.19 and the value of R^2 = 0.94. The second rate of release 40 larval/tree the regression equation y = 6.13x + 67.13 the value of R^2 =0.80. The third rate of release 50 larval/tree the regression equation y = 5.58x + 71.33 the value of R^2 =0.98.This equation indicated that there was a highly positive relationship between the rate of release of *C. undecimpunctata* and reduction percentages for nymph stage of *I. purchasi* (figure 1A)

The regression equation at 30 larval /tree of *C. undecimpunctata* was y = 7.16x + 56.19 and the value of R^2 = 0.94. The second rate of release 40 larval/tree the regression equation y = 6.13x + 67.13 the value of R^2 =0.80. The third rate of release 50 larval/tree the regression equation y = 5.58x + 71.33 the value of R^2 =0.98.This equation indicated that there was a highly positive relationship between the rate of release of *C. undecimpunctata* and reduction percentages for adult stage of *I. purchasi* (Figure 1B)

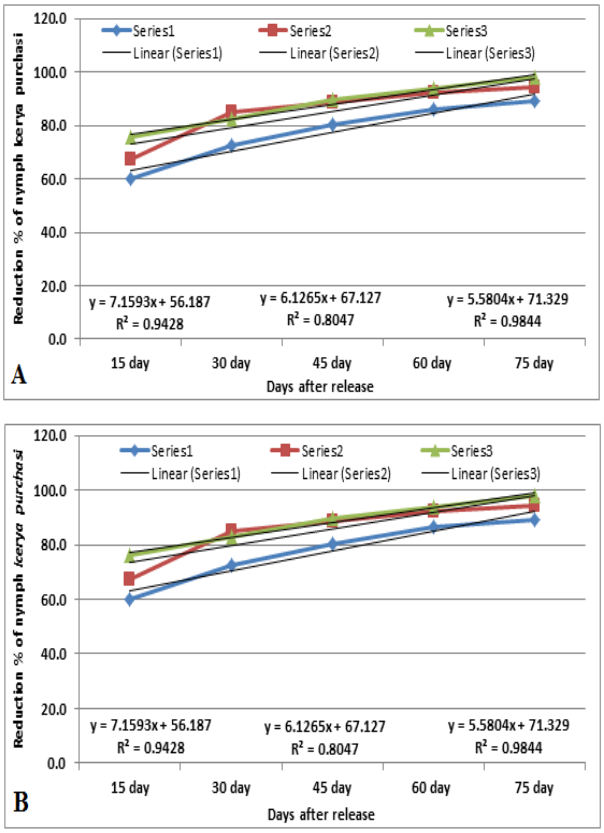


Figure 1. Simple linear regression between rate release of *Coccinella undecimpunctata* L. and the reduction % nymph (A) and adult (B) of *Icerya purchas*

Release of the second larval instar *C. carnea* predator as a biological control agent on population of *I. purchasi*. Data presented in Table (2), revealed that the rate 30 larval / tree of *C. carnea* on nymph stage of *I. purchasi* recorded reduction percentage (42.7, 55.0, 66.7, 74.8 and 82.6%) at 15, 30, 45, 60 and 75 days after release, respectively. While treatment 40 larval / tree recorded reduction percentage (49.8, 67.5, 71.2, 79.9 and 84.7%) at 15, 30, 45, 60 and 75 days after release, respectively. The highest reduction percentage of *C. carnea* on nymph stage of *I. purchasi* was (88.7%) at 75 days after release 50 larval/tree. The recorded average of reduction percentage of nymph of *I. purchasi* were (58.6%, 65.5% and 70.5%) with the rate 30, 40 and 50 larval /tree of *C. carnea*, respectively. The obtained average of reduction percentage of adult of *I. purchasi* were (36.6%, 43.7% and 52.6%) with the rate 30, 40 and 50 larval /tree, of *C. carnea* respectively. The reduction percentage of nymph of *I. purchasi* increased by increase of the rate of *C. carnea* and the duration after release.

The statistical analysis assured that there was a significant increase in the reduction percentage of nymph

of *I. purchasi* at different rate of release second larval of *C. carnea*.

Table 2. The reduction percentage of *Icerya purchasi* Maskell after release of the second larval instar of *Chrysoperla carnea* (Stephens) and under field conditions on Ficus tree at Orman garden at Giza governorate.

Days after release	Reduction percentage of *Icerya purchasi* Maskell					
	Nymph			Adult		
	30	40	50	30	40	50
15 day	42.7	49.8	53.4	18.7	24.4	33.3
30 day	55.0	67.5	71.2	25.5	30.4	47.4
45 day	66.7	71.2	74.2	36.0	48.2	55.1
60 day	74.8	79.9	85.4	49.7	56.0	61.1
75 day	82.6	84.7	88.7	59.8	63.2	68.6
average	58.6	65.5	70.5	36.6	43.7	52.6

Data arranged in Table (2) assured that, the effect of rate 30 larval / tree of *C. carnea* on adult stage of *I. purchasi* recorded reduction percentage (18.7, 25.5, 36.0, 49.7 and 59.8 %) at 15, 30, 45, 60 and 75 days after release, respectively. While treatment 40 larval / tree recorded reduction percentage (24.4, 30.4, 48.2, 56.0 and 63.2%) at 15, 30, 45, 60 and 75 days after release, respectively. The highest reduction percentage of *C. carnea* on adult stage of *I. purchasi* was (68.6%) at 75 days after release 50 larval/tree. The obtained average of reduction percentage of adult of *I. purchasi* were (36.6%, 43.7% and 52.6%) with the rate 30, 40 and 50 larval /tree, of *C. carnea* respectively. The reduction percentage of adult of *I. purchasi* increased by increase of the rate of *C. carnea* and the duration after release.

The regression equation at 30 larval /tree was y = 10.6x + 6.0 and the value of R^2 = 0.99. The second rate of release 40 larval/tree the regression equation y = 10.3x + 13.467 the value of R^2 =0.97. The third rate of release 50 larval/tree the regression equation y = 8.4x + 27.8 the value of R^2 =0.97.This equation indicated that there was a highly positive relationship between the rate of release of *C. carnea* and reduction percentages for nymph stage of *I. purchasi* (Figure 2A)

The regression equation at 30 larval /tree was y = 9.96x + 34.49 and the value of R^2 = 0.99. The second rate of release 40 larval/tree the regression equation y = 8.22x + 45.93 the value of R^2 =0.93. The third rate of release 50 larval/tree the regression equation y = 8.48x + 49.13 the value of R^2 =0.93.This equation indicated that there was a highly positive relationship between the rate of release of *C. carnea* and reduction percentages for adult stage of *I. purchasi* (Figure 2B).

The obtained results agree with Kumarl and Kovanci (2008) recorded the adults of *C. carnea* appeared from early May to mid-December. Santos *et al.* (2010) recorded that the greatest abundance of coccinellids occurred between June and November.

The reduction percentage of nymph and adult of *I. purchasi* increased by increase of the rate of *C. undecimpunctata* & *C. carnea* the and duration after release this agree with Helmy (2014), reported that2nd larval instar of *C. carnea* caused great reduction (72.94%) in *Saissetia oleae* (Olivier) population within the experimental period (6 weeks). While 2nd larval instar of *C. carnea* caused great reduction (28.7%) in *Hemiberlesia lataniae* (Signoret) population within the experimental period (6 weeks).

Maha (2017) resulted the biological impact of releasing the second larval instar of *C. undecimpunctata* and *C. carnea* at two levels against *Aphis gosspyii* Glover infesting basil plants had non-significant difference where they recorded predaceous % 86.2 and 86.6 at the level of 2 larvae/ basil plant and 75.9 and 78.8% of 1 larva/ basil plant where (LSD = 6.116 & 3.831), respectively.

The statistical analysis assured that there was a significant increase in the reduction percentage of nymph of *I. purchasi* at different rate of release second larval of *C. carnea.* Also, Saleh *e al.* (2020), reported that the predators can be used as biological control agents for *T. urticae* in cotton plantation under field conditions. The regression analysis between P: p ratios of *S. gilvifrons* adults and reduction percentage of the *T. urticae* mites, data showed there were negatively highly relationship of both predators larvae and adult which means that the reduction rate was increased with lower P: p ratios and vice versa.

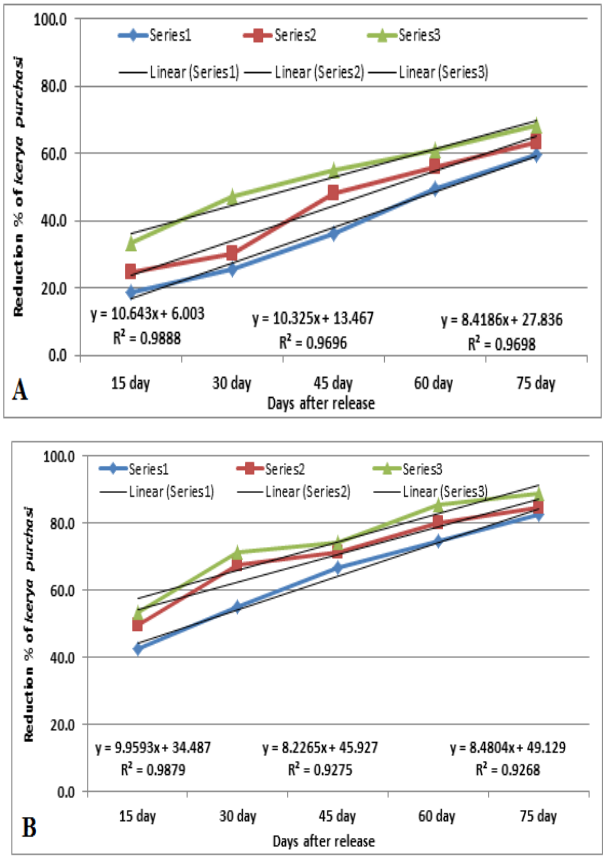


Figure 2. Simple linear regression between rate release of *C. carnea* and the reduction % nymph (A) and adult (B) of *Icerya purchasi*

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تقييم فاعلية إطلاق يرقات العمر الثاني لكلا من أبو العيد ذو إحدى عشر نقطة *Coccinella undecimpunctata* L. وأسد المن الأخضر *Chrysoperla carnea* (Stephens) كعامل تحكم بيولوجى ضد البق الدقيقى الأسترالي *Icerya purchasi* Maskell (Hemiptera: Monophlebidae)

سناء عبدالبديع محمد عبدالمجيد و سماح محمد ياسين حلمي و حسام محمد حارس

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقى – جيزة – مصر

إطلاق الطور اليرقى الثاني لكلا من *Coccinella undecimpunctata* L. و *Chrysoperla carnea* (Stephens) كعامل مكافحة بيولوجية على البق الدقيقى الأسترالي *Icerya purchasi* Maskell تحت الظروف الحقلية على أشجار الفيكس في حديقة الأورمان بمحافظة الجيزة وكان متوسط نسبة الخفض التي تم الحصول عليها من حوريات البق الدقيقى الأسترالي (٦٩,٧٪ ، ٧٧,٩٪ و ٨١,٧٪) بمعدل ٣٠ ، ٤٠ و ٥٠ يرقة / شجرة من *C. undecimpunctata* على التوالي. بينما كانت نسبة الخفض عند الاناث البالغة (٦٥,٢٪ ، ٧٢,١٪ و ٧٧,١٪) بنفس معدل الإطلاق. كان متوسط نسبة الخفض التي تم الحصول عليها من الحوريات (٥٨,٦٪ ، ٦٥,٥٪ و ٧٠,٥٪) بمعدل ٣٠ ، ٤٠ و ٥٠ يرقة / شجرة من *C. carnea* على التوالي. كما بلغ متوسط نسبة النقص لدى الاناث البالغة (٣٦,٦٪ ، ٤٣,٧٪ و ٥٢,٦٪) بمعدل ٣٠ ، ٤٠ و ٥٠ يرقة / شجرة فى حالة إطلاق أسد المن الأخضر *C. carnea* على التوالي. أشارت معادلة الانحدار إلى وجود علاقة موجبة بين معدل إطلاق *C. undecimpunctata* و *C. carnea* ونسبة الخفض للحوريات و الاناث البالغة من البق الدقيقى الأسترالي. أكد التحليل الإحصائي أنه كانت هناك زيادة معنوية في نسبة اختزال الحوريات والاناث البالغة من البق الدقيقى الأسترالي.