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Using of *Chrysoperla carnea* (Stephens) Larvae as a Biological Control Agent against *Phyllocnistis citrella* Stainton.

El-Masselati, H. S. I.[1] ; A. A. Hafez[2]; F. F. Shalaby[2]and E. E. Nowar[2]
[1] Higher Inst. of Sci. and Tech., Al-Zhraa, Libya.
[2] Plant Protection Dept., Fac. Agric. Moshtohor, Benha Univ., Egypt.
Correspondent author e-mail:Elhossenynowar@fagr.bu.edu.eg

ABSTRACT

Experiments were carried out in the orchards farm of the Fac. of Agriculture at Moshtohor, Benha University, Egypt on navel orange (*Citrus sinesnes*)seedlings grafted on *Citrus volckameriana*tostudy the effect of releasing 2nd instar larvae ofthe aphid lion (*Chrysoperla carnea*) on citrus leaf miner (*Phyllocnistis citrella*) infestation rate in nursery of citrus plants.The efficiency of *Ch. carnea* as a bio-agent against the citrus leaf-miner was estimated.A net wooden cage was divided into 12 cages that measured 75×75×250 cm. each, and covered tightly with screenedfine nylon from all sides. Three treatments were examined compared with control (Tr.1: one & Tr.2: two and Tr.3: four 2ndinstar larvae of *Ch. carnea*/ seedling). Obtained data clarified that releasing *Ch. carnea* on citrus seedlings caused considerable reduction in both the whole mean number of infested leaves and whole mean percentage of infestation by *P. citrella*. Treatment 2 was the best in reducing the seasonal mean infestation rate by *P. citrella* in citrus nursery by 43.70%while, the treatment 3 gave the best results in decreasing the numbers of *P. citrella* mines, larvae, pupae and infested leaves by 50.86, 78.37, 72.47 and 52.68 %, respectively. The mentioned treatments caused reductions in the whole mean number of mines, larvae and pupae of *P. citrella*to be 7.14, 1.14 and 0.68/seedling, respectively.

Keywords: Biological control, *Chrysoperla carnea*, *Phyllocnistis citrella*

INTRODUCTION

The citrus leaf miner (CLM), *Phyllocnistis citrella* (Lepidoptera:Gracillariidae)is considered as an Asian pest species on citrus plants (Heppner, 1993). Within few years, this pest has moved into citrus growing regions of the world with incredible widespread in many countries (Beattie, 1993). This pest was recorded as outbreak population in the most citrus orchards of Egypt in 1994 (Tawfik *et al*., 1996). The citrus leaf-miner causes wide damage in citrus orchards such as; leaf curling and the presence of serpentine mines that are distinctly seen on the lower leaf surfaces and also on the upper leaf surfaces when heavy infestations occurs. Citrus leaf-miner may cause a great damage to trees and the leaves become severely destroyed. It is therefore necessary to control thisserious pest (Garrido, 1994). Many control measures should be done for the control of this pest. Chemical control is the common method for controlling this pest but the efficacies of different insecticides are expected not to be high because larvae are protected in their mines and pupae in their pupal chambers. In addition, the repeated use of pesticides for control of this pest is very harmful because of its residues in trees and fruits and also its harmful effect on natural enemies and causing distance in the whole ecosystem. Shareef *et al*. (2016) reported that generalist predators in their feeding can reduce pest populations effectively (Wise, 1993 and Romeldi *et al*, 2012). Several predators of *P. citrella* have been reported.Among these *Chrysoperla spp*. are the majorcontributors for*P. citrella* predation (Chen *et al*., 1989).Thepresent study was carried out to control the citrus leaf minerby using nonchemical safe effective methods. Releasing of *Chrysoperla carnea*larvae on*P. citrella*that infested citrus plants was evaluated as a biological control tool.

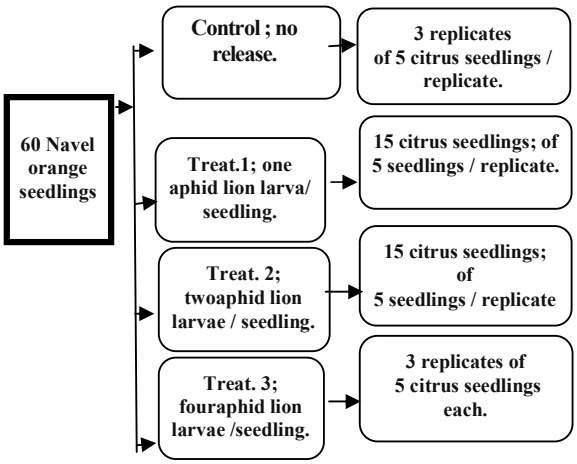
MATERIALS AND METHODS

Experiments were conducted at the citrus orchards of the Fac. of Agriculture, Moshtohor, Benha University, Egypt on seedlings of some citrus varieties. The study dealt with releasing the second instar larvae of *Chrysoperla carnea* for the biological control ofthe citrus leaf miner (CLM)*Phyllocnisilis citrella* Stainton.

1. Effect of releasing the aphid lion larvae on citrus leaf miner infestation rate in the citrus nursery as a biological control method.

60 Navel orange (*C. sinesnes*) seedlings grafted on *Citrus volckameriana* were used for studying the effect of releasing 2nd instar larvae ofthe aphid lion (*Chrysoperla carnea*) on citrus leaf miner infestation in citrus plantsnursery. These citrus seedlings were put in net wooden cage divided into 12 cages with dimensions 75×75×250 cm. each.Each cage was tightly covered with finely screened nylon from all directions. In each cage, 5 citrus seedlings were placed as a replicate. 2nd instar larvae of *Chrysoperla carnea*were obtained from the aphid lion production unit at the Fac. of Agric., Cairo Univ. and released on the examined citrus seedlings at three different rates under randomized complete blockdesign (RCBD) with three replications /treatment (Shareef*et al*, 2016). The number of infested and healthy leaves, mines, larvae and pupae of *P. citrella* were counted before releasing 2nd instar larvae of *Ch. carnea* and weekly counted after that during successive 11 weeks.

Seedlings were divided into 4 groups as shown in the following diagram according to that described by Smith and Hoy (1995)and Mafi1 and Ohbayashi(2010):



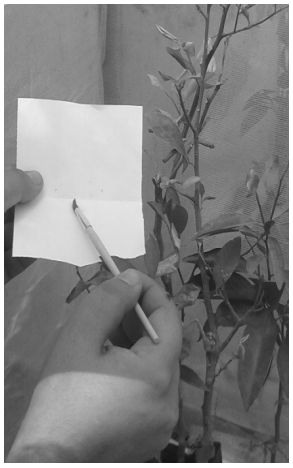
The number of infested and healthy leaves, mines, larvae and pupae of *P. citrella* were counted to calculate the infestation rate with citrus leaf miner.The infestation percentage was calculated according to the following formula:

$$\text{Infestation rate (\%)} = \frac{\text{No. of infested leaves / sample}}{\text{Total No. of leaves / sample}} \times 100$$

Experimental Design and Analysis:

All the data of experiments were analyzed in a randomized complete block design (RCBD) due to those obtained on the ANOVA tables by MSTAT-C version 1.41 according to Snedecor& Cochran (1980). Also, significance between means was determinedby Duncan's multiple range tests at 0.05 probability level according to Steel & Torrie (1980).

Unit of experimental cage . 5 citrus plants represented one replicate.



Releasing 2nd instar larvae of (Chrysoperla carnea) on nursery

RESULTS AND DISCUSSION

1- Effect of releasing *Chrysoperla carnea*larvae on citrus leaf-miner infestation in citrus nursery plants during 2016.

Data presented in Table (1) indicate that the percentage of infestation by citrus leaf-miner,*P. citrella*decreased by releasing the aphid lion 2nd instar larvae. Data in this table proved that releasing two 2nd:instar *Ch. carnea* larvae per citrus seedling gave the highest reduction in the infestation rate with citrus leaf-miner by -43.70% followed by releasing four 2nd:instar larvae (-33.73%), while there was an increase in the infestation rate in the control treatment by +14.30%. These data were in harmony with Shareef *et al* (2016)who reported that using *Ch.carnea*reduced the population infestation of citrus leaf miner by 14%.In similar studies, Ahmed *et al*, (2013)observed slight reductions in citrus leaf miner infestation rates with time in *Ch.carnea* treatment, but the pest's population had non-significant differences in terms of increasingthe releasing rate and number of days after treatment.Parasitoid alone and in combination with others was found less effective in comparison with *Ch.carnea* on *P. citrella* populations (Amalin *et al*, 2002).

2- Effect of releasing *Chrysoperla carnea* larvae on reduction percentage of mines, larvae and pupaeof the citrus leaf miner on citrus plants in nursery during 2016.

As shown in Table (2) the highest reduction in mines caused by *P. citrella*(-50.86%), was recorded in the treatment 3, in which four 2nd larvae of *Ch. carnea* were released on each citrus seedling, while the lowest reduction rate in mines number (-37.70) was in treatment 1 (one *Ch. carnea*2nd instar larvae / seedling).On contrary, in control treatment there were no difference in larval counts from the beginning to the end of the experiment in the citrus leaf-miner mines rates.

Data also indicated that releasing four 2nd instar larvae of *Ch. carnea*on each citrus seedling gave the highest reduction rate in citrus leaf-miner larvae by -78.37%. On contrary, the lowest decreasing rate was obtained in control treatment by rate -18.33%.

As for the pupal counts, data in Table (2) revealedthat the treatment 3 (four 2nd instar larvae of *Ch. carnea*per each citrus seedling) gave the highest reduction in leaf-miner pupal stage counts(-72.47%), while the lowest decreasing rate was obtained in control treatment by mean rate -20%.

The present findings are supported by those ofUrbaneja*et al*. (2004)who reported that *Ch.carnea* could complete its development feeding on *P. citrella* only during the laboratory rearing.The same authors indicated that predation upon *P. citrella* had been satisfactorily correlated to flushing in Eastern Spain.

Table 1. Effect of releasing *Chrysoperla carnea* larvae at different rates on citrus leaf miner infestation rates on citrus nursery plants during 2016.

Parameter	Treatment	Pretre-atment	Investigation period (successive weeks) 1	2	3	4	5	6	7	8	9	10	11	Mean
% infestation	Control	36.79	44.88	42.17	40.83	42.62	32.09	40.50	37.94	46.26	46.80	44.47	43.98	42.05
		100%	+21.99	+14.62	+10.98	+15.85	-12.78	+10.08	+3.13	+25.74	+27.21	+20.88	+19.54	+14.30
	T1	49.17	49.26	29.59	36.09	40.04	42.17	42.24	43.17	43.39	45.94	48.50	50.73	42.83
		100%	+0.18	-39.82	-26.6	-18.57	-14.24	-14.09	-12.20	-11.76	-6.57	-1.36	+3.17	-12.90
	T2	53.04	39.29	28.38	26.39	20.36	25.64	31.49	30.97	28.79	27.3	34.01	35.79	29.86
		100%	-25.92	-46.49	-50.25	-61.61	-51.66	-40.63	-41.61	-45.72	-48.53	-35.88	-32.52	-43.70
	T3	62.49	44.58	34.21	38.83	35.67	33.18	43.85	38.31	42.65	45.46	49.77	48.96	41.41
		100%	-28.66	-45.26	-37.86	-42.92	-46.90	-29.38	-38..69	-31.75	-27.25	-20.36	-21.65	-33.73

T1: one *Ch. carnea* larva / seedling
T2: two *Ch. carnea* larvae / seedling
T3: four *Ch. carnea* larvae / seedling

Table 2. Effect of releasing Chrysoperla carnea larvae on reduction percentage of mines, larval and pupal rates of citrus leaf miner on citrus nursery plants during 2016.

Parameter	Treatment	Pretre-atment	Reduction rates during investigation period (successive weeks) 1	2	3	4	5	6	7	8	9	10	11	Mean
Mines	Control	10.13	8.73	8.27	8.53	9.60	10.27	10.07	12.13	14.20	9.73	10.47	9.40	10.13
		100%	-13.82	-18.23	-15.79	-5.23	+1.38	-0.59	+19.74	+40.18	-3.95	+3.36	-7.21	0%
	T1	12.20	6.60	9.33	6.13	7.73	7.73	6.60	7.87	7.07	8.87	7.47	8.20	7.6
		100%	-45.90	-23.52	-49.75	-36.64	-36.46	-45.90	-35.49	-42.05	-27.30	-38.77	-32.79	-37.70
	T2	11.33	7.07	6.53	6.53	6.00	6.07	7.00	6.73	7.80	7.40	7.00	7.13	6.84
		100%	-37.60	-42.37	-42.37	-47.04	-46.43	-38.22	-40.60	-31.16	-34.69	-38.22	-37.07	-39.63
	T3	14.53	6.07	6.93	6.87	7.07	5.87	7.73	7.00	8.13	7.47	7.80	7.60	7.14
		100%	-58.22	-52.31	-52.72	-51.34	-59.60	-46.8	-51.82	-44.05	-48.60	-46.32	-47.70	-50.86
Larvae	Control	1.8	2.07	3.4	2.4	1	1.07	1	0.87	0.73	1	1.2	1.4	1.47
		100%	+15	+88.89	+33.33	+44.44	-40.56	-44.44	-51.67	-59.44	-44.44	-33.33	-22.22	-18.33
	T1	2.13	2.6	3.07	2.8	0.6	0.6	0	0.41	0.73	0.33	0.13	1.13	1.13
		100%	+22.07	+44.13	+31.46	-71.83	-71.83	-100	-80.75	-65.73	-84.51	-93.90	-46.95	-46.95
	T2	2.93	3.2	3.33	2.67	0.6	0.87	0	0.6	1.13	0.67	0.67	0.73	1.13
		100%	+9.22	+13.65	-8.87	-79.52	-70.30	-100	-79.52	-61.43	-77.13	-77.13	-75.09	-61.43
	T3	5.27	2.93	2.67	2.6	0.73	0.4	0	0.4	0.8	0.4	0.8	0.8	1.14
		100%	-44.40	-49.34	-50.66	-86.15	-92.41	-100	-92.41	-84.82	-92.41	-84.82	-84.82	-78.37
Pupae	Control	1.4	1.33	2	1.33	0.4	0.53	1.1	1.13	1.4	0.9	1.03	1.22	1.12
		100%	-5	+42.86	-5	-71.43	-62.14	-21.43	-19.29	0	-35.71	-26.43	-12.86	-20
	T1	1.8	1.53	2	1.67	0.27	0.27	0	0	0.47	0.2	0.13	0.07	0.6
		100%	-15	+11.11	-7.22	-85	-85	-100	-100	-73.89	-88.89	-92.78	-96.11	-66.67
	T2	2.13	1.93	2.07	1.33	0.2	0.4	0	0.47	0.73	0.47	0.47	0.47	0.78
		100%	-9.39	-2.82	-37.56	-90.61	-81.22	-100	-77.93	-65.73	-77.93	-77.93	-77.93	-63.38
	T3	2.47	1.67	1.53	1.47	0.27	0.13	0	0.27	0.53	0.27	0.67	0.67	0.68
		100%	-32.39	-38.06	-40.49	-89.07	-94.74	-100	-89.07	-78.54	-89.07	-72.87	-72.87	-72.47

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استخدام يرقات أسد المن كعامل من عوامل المكافحة البيولوجية لصانعة أنفاق أوراق الموالح.

حسين سالم إبراهيم المسلاتي١ ،عادل عبد الحميد حافظ٢ ، فوزي فائق شلبي٢و الحسيني السيد نوار٢

[١] المعهد العالى للعلوم التقنية، الزهراء، ليبيا.

[٢]قسم وقاية النبات، كلية الزراعة بمشتهر، جامعة بنها، مصر.

أجريت التجارب في مزرعة البساتين بكلية الزراعة بمشتهر، جامعة بنها، مصر على شتلات البرتقال أبو سرة والمطعمة على أصل فولكا ماريانا لدراسة تأثير إطلاق العمر الثاني ليرقات أسد المن (*Chrysoperla carnea*)على نسبة الإصابة بصانعة أنفاق أوراق الموالح بنباتات الموالح في المشتل.تم تقييم كفاءة استخدام اسد المن كعامل بيولوجي لمكافحة صانعة أنفاق أوراق الموالح. تم استخدام قفس خشب مسلك مقسم الى ١٢ قفص وكل قفص أبعاده ٧٥ × ٧٥ × ٢٥٠ سم ومغطى بإحكام بقماش نايلون ناعم من كل اتجاه. تم اختبار ٣ معاملات بالإضافة للكنترول (Tr.1 يرقه واحدة - Tr.2 يرقتان و Tr.3أربع يرقات من العمر الثاني ليرقات اسد المن لكل شتلة).أوضحت النتائج ان إطلاقيرقات اسد المن على شتلات الموالح تسببت في انخفاض كبير لكل من المتوسط العام لعدد الأوراق المصابة والمتوسط العام لنسبة الإصابة بصانعة أنفاق أوراق الموالح.كانت المعاملة الثانية Tr.2 هي الأفضل في خفض المتوسط الموسمي لنسبة الإصابة بصانعة أنفاق أوراق الموالح في المشتل بمعدل ٤٣.٧٠% بينما كانت المعاملة الثالثة Tr.3 هي الأفضل في تقليل أعداد الأنفاق واليرقات والعذارى والأوراق المصابة بمعدلات ٥٠.٨٦، ٧٨.٣٧ ،٧٢.٤٧ و٥٢.٦٨% بالترتيب. تسببت المعاملة المذكورة في خفض المتوسط العام لعدد الأنفاق واليرقات والعذارى لصانعة أنفاق أوراق الموالح لتكون ٧.١٤، ١.١٤ و٠.٦٨ لكل شتله بالترتيب.