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Efficacy of the Predator *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) on Cucurbitaceae Pests Complex at Shendi Area, Sudan

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***Abstract* – Cucurbits are subjected to insect pests that cause economic damage which increases upon infestation with more than one type of these pests. These pests are always subjected to application of chemical pesticides with consequent negative impacts on human health and environment, which necessitated usage of alternative control methods that are eco-friendly, economically viable and sustainable such as botanical pesticides and Integrated Pest Management (IPM), as biological control as alternative methods. The present study demonstrated the efficacy of Chrsoperla carnea to control cucurbit insect pests. It is generalist predator with voracious feeder larvae and adults feeding on pollen and nectar from flowering plants. Field application of was done at the Experimental Farm of Shendi University. Three genotypes of snake cucumber, pumpkin and watermelon were cultivated during Winter (Oct. 2022 - Jan. 2023) and Summer (Feb. - May. 2023), laid out in a Randomized Complete Block Design (RCBD) with three replicates, and insect pests were periodically collected. Temperatures and relative humidity were monitored during each sampling and monthly and seasonal variation in infestation and dominance of these pests in the three cucurbits together and or individually were examined. The overall efficacy of C. carnea instar larvae field release illustrated that releasing the three larval instars of C. carnea on the three cucurbits induced greater reductions in insect pest's infestation during Winter season of growth compared to the Summer. The study recommended further studies on the predatory lion aphid and the preparation of a product???? of C. carnea applicable in the field.**

***Keywords* – Cucurbits, Insect Pests, Predator, Chrysoperlacarnea, Reduction.**

I. Introduction

Sudan depends on agriculture for economic growth and subsistence. The country produces crops, vegetables, fruits, in addition to natural forest and range land products (OECD/FAO, 2023). Cucurbits are among the crops produced in Sudan with potential economic importance as food, medicinal and pharmaceutical products. Subina (2019) showed that although cucurbits demand is increasing but possible losses result from unsustainable use and pest infestations. Cucurbits insect pests include beetles such as blister beetles (Meloidae), two-spotted beetles (*Adalia bipunctata*), twelve-spotted melon beetles(*Chnootribaelaterii*), cucurbit stink bug (*Coridius janus*), squash bug (*Anasa tristis*), onion thrips (*Thrips tabaci*), ginger ant (*Solenopsis geminate*), aphids (*Aphis gossypii*), fl fruit flies (*Dacus ciliatus*) and white flies (*Bemisia tabaci*) (Yasser, 2017 and Subina, 2019). Cucurbits insect pests attack lead to yield mass losses by traditionally; farmers usually use more than one pesticide in alternating manner (E.D, 2013). Ahmed *et al*., (2014) added that chemicals were also used to control insect pests. Indiscriminate use of chemical pesticides resulted in development of resistance to insecticides; residue on food, air, water and soil, pest resurgence, killing of natural enemies, harmful effect on non-target organisms including pollinators and disruption of ecosystem, hereby increasing the cost of production and hazard on human beings and animals, this together with the rising costs of chemical application (Neupane, 2010 and Sharma *et al*., 2012). These negative impacts of chemical pesticides on human health and environment, have led to realize the need for alternative method, which is environmentally friendly, economically viable and sustainable for insect pest management. It can be reduced or minimized through the development, dissemination and promotion of alternative method such as botanical pesticides (Akter, 2015); biological pest control and integrated pest management (IPM) approach (Neupane, 2010). It is important to reduce the pesticides application on plants by using or conserving the biologically derived predator in the field such as green lacewing, *Chrysoperla carnea* (Stephens) (Sarwar, 2014).

C. carnea is an important generalist predator (Sarwar, 2014) is best known as biocontrol agent (Memon *et al*., 2015). The larval stage is more voracious feeder of soft bodied insect such as aphids (*Aphis gossypii*), whiteflies (*Bemisia tabaci*), mealy bug (*Planococcus citri*), thrips (*Thrips tabaci*), mites (Acaridae spp.), leafhoppers (*Circulifertenellus*), jassid (*Amrascabiguttula*), caterpillar (*Malacosomaamericanum*) and insect eggs (Ulhaq *et al*., 2006 and Sarwar and Salman, 2016). The adults are free living and they only feed on honey, pollen and water. The ability of *C. carnea* can be exploited as a biocontrol agent in IPM program (Memon *et al*., 2015). The application of the predator reduces the use of insecticides and save money spent on importing pesticides (Zia *et al*., 2008). After knowing the importance of *C. carnea* in agricultural systems, it is important to develop efficient pest management strategies that are simple, economical, sustainable and bio-friendly based on biological control. The richness of Sudan in natural enemies that associated with different agricultural pests is stated by several workers, which recommend more serious studies in this field (Satti and Mahmoud, 2011 and Satti and Mahgoub, 2018). On this understanding, the present investigation on release of the predator and evaluation of its effect in suppressing the major cucurbits insect pests, these pests are: 12-spotted cucurbit beetle (*Chnootribaelaterii*), whitefly (*Bemisia tabaci*), cucumber aphid (*Aphis gossypii*), onion thrips (*Thrips tabaci*) and cotton leaf thrips (*Caliothrips sudanensis*).

II. Materials and Methods

Study Area

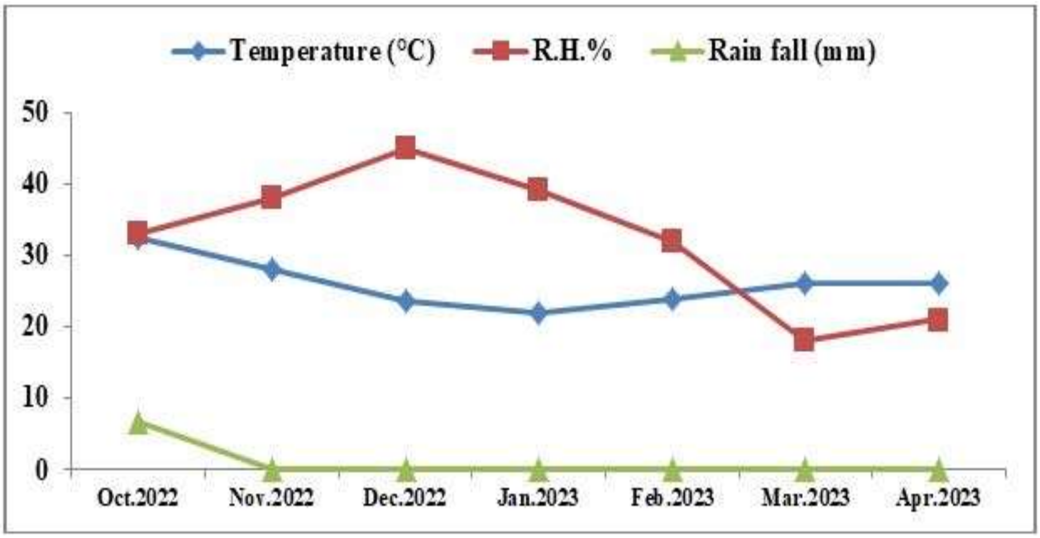

Fig. 1. Mean monthly air temperature (°C), relative humidity (R.H. %) and rain fall (mm), during the study period (Oct. 2022 - May. 2023) at Shendi area (Source Shendi meteorological station, 2023).

Shendi (latitude 16° 40`N: longitude 33° 33`E), lies within the semi-arid zone of the country which is characterized by a hot summer (March to June) and a cold dry Winter (November to February). The average annual temperature is about 29°C, but the maximum temperature may exceed 45°C in Summer season. Autumn season extends from July to October, where the average annual rainfalls are around 100 mm (Fig. 1). Agriculture is practiced in Shendi area where surface irrigation is used to grow different horticultural crops. Natural vegetation (trees, shrubs and weeds) are scattered around these cultivated land. This situation seems to enrich the biodiversity in the area, which ultimately interferes with abundances of agricultural pests and natural enemies.

Field Experiments

Three cucurbit genotypes (snake cucumber, pumpkin and watermelon), were planted in the Experimental Farm of Shendi University during Winter season (October 2022 to January 2023) and Summer season (February to May 2023), laid outin a Randomized complete block design (RCBD) with three replicates following the standard agronomic practices recommended by (ARC). This experiment was conducted under controlled conditions on the farm. Reduction% in insect pest infestation incidence in cucurbits in responses to releasing *C. carnea* larval instars was calculated and compared.

Rearing and Release of C. carnea

According to Sumera *et al*., (2016), a sweeping net was used to collect *C. carnea* specimens for mass rearing under laboratory conditions. Six *C. carnea* adults were sorted into male and female pair groups, where each group was reared in glass chimney sized 10X8 cm diameter, covered with a 4cm diameter perforated lid and provided with a wet cotton piece to allow proper ventilation and keep moisture. As described by (Sohail *et al*., 2018), the paired groups were reared on artificial diet consisting of honey, sucrose and yeast in ratios: 1g: 2g: 1g, respectively, dissolved in 20ml distilled water. This mixture of artificial diet was daily added on food cards sized 2×3cm. Deposited eggs were freed and collected with a razor and a camel hair brush and placed in Petri-dishes. The eggs hatched into larval instars which were successively removed and placed in new Petri-dishes and fed with 50 nymphs of each of the previously reared natural host i.e. *A. gossypii*, *T. tabaci* or *C. sudanensis*. Daily observations were carried out to monitor molting and development of *C. carnea* larval instars, pupae and adults. The recorded biological parameters of *C. carnea* included egg incubation, larval and pupal periods and total life span in days.

A total of 27 individuals of each of *C. carnea*, three larval instars were released into the three selected cucurbits, whereas, control plots were kept free of any larval release. Ten days' intervals were kept between each releasing event throughout two study periods extended from (October 2022 - January 2023) and (February - May 2023), representing winter and summer cucurbits' growing seasons respectively. The efficacy of *C. carnea* as biological control agent was obtained by counting reductions % in insect pests' infestation as anciently formulated by Abbott (1925), below:.

$$\text{Reduction \%} = \frac{\text{Control count} - \text{Treatment count}}{\text{Control count}} \times 100$$

III. Results

Winter Season Release of C. carnea Larvae

Releasing the first instar larva induced significant reduction in mean number of *B. tabaci* and *C. sudanensis* infesting snake cucumber, pumpkin and watermelon as compared to the controls. Contrary, it induced insignificant differences on mean number of *A. gossypii* and *T. tabaci* infesting watermelon and significant one on snake cucumber and pumpkin, ($p \leq 0.05$). Moreover, the rate of infestation reduction in response to first instar release to descending order as follows: watermelon, pumpkin and snake cucumber (Table 1). Releasing the second instar larva induced significant reduction in mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* compared to the controls, ($p \leq 0.05$). The rate of infestation reduction in response to first instar release to descending order as follows: watermelon, snake cucumber and pumpkin, (Table 2). The third larvae of *C. carnea* indicated significant reduction in mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* compared to the controls, ($P \leq 0.05$). The rate of infestation reduction in response to third instar release to descending order as follows: watermelon, pumpkin and snake cucumber (Table 3).

Table 1. Efficiency of 1st instar larva of *C. carnea* winter season release for controlling the three selected cucurbits insect pests under field conditions, during Oct.2022 - Jan.2023.

Insect pests	**Snake Cucumber**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	126	106	20	15.8
A. gossypii	150	132	18	12.0
T. tabaci	149	120	29	19.4
C. sudanensis	162	138	24	14.8
Total reduction%				62.0
Insect pests	**Pumpkin**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	132	116	16	12.1
A. gossypii	156	143	13	8.3
T. tabaci	151	137	14	9.2
C. sudanensis	171	159	12	7.0
Total reduction%				36.6
Insect pests	**Watermelon**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	146	139	7	4.7
A. gossypii	168	161	7	4.1
T. tabaci	161	150	11	6.8
C. sudanensis	186	170	16	8.6
Total reduction%				24.2

Table 2. Efficiency of 2nd instar larva *of C. carnea* winter season release for controlling the three selected cucurbits insect pests under field conditions, during Oct.2022 – Jan.2023.

Insect pests	**Snake Cucumber**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	127	117	10	7.8
A. gossypii	145	123	2	1.3
T. tabaci	135	112	23	17.7
C. sudanensis	154	116	38	24.6
Total reduction%				51.4
Insect pests	**Pumpkin**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	131	113	18	13.7
A. gossypii	154	125	29	18.8
T. tabaci	156	137	19	12.1
C. sudanensis	171	159	12	7.0
Total reduction%				51.3
Insect pests	**Watermelon**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	152	133	19	12.5
A. gossypii	175	141	34	19.4
T. tabaci	166	144	22	13.2
C. sudanensis	173	158	15	8.6
Total reduction%				53.7

Table 3. Efficiency of 3rd instar larva of *C. carnea* winter season release to control the three selected cucurbits insect pests under field conditions, during Oct. 2022 – Jan. 2023.

Insect pests	**Snake Cucumber**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	175	144	31	17.7
A. gossypii	177	151	26	14.6
T. tabaci	169	135	34	20.1
C. sudanensis	184	162	22	11.9
Total reduction%				64.3
Insect pests	**Pumpkin**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	157	131	26	16.5

Insect pests	Snake Cucumber			
	Control	Treatment	Number Reduced	Reduction %
A. gossypii	170	142	28	16.4
T. tabaci	177	155	22	12.4
C. sudanensis	184	164	20	10.8
Total reduction%				56.1
Insect pests	**Watermelon**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	180	160	20	11.1
A. gossypii	179	158	21	11.7
T. tabaci	180	161	19	10.5
C. sudanensis	182	163	19	10.4
Total reduction%				43.7

Summer Season Release of C. carnea Larvae

The 1st instar larva significantly reduced mean number of *B. tabaci*, *T. tabaci* and *C. sudanensis* infesting snake cucumber as compared to the controls, (P≤0.05). It also, significantly minimized *C. sudanensis* but insignificant affected *B. tabaci*, *A. gossypii* and *T. tabaci* in pumpkin, (P≤0.05, table 4). The table also indicated that the decline in insect pest infestations on the three selected cucurbits follow the order snake cucumber, pumpkin and watermelon. The 2nd instar larva significantly reduced mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* infesting snake cucumber, pumpkin and watermelon as compared to the control, except for *C. sudanensis*; insignificant differences in mean number of *B. tabaci*, *A. gossypii* and *T. tabaci* infesting watermelon as compared to the controls, (P≤0.05). Table 5 indicated that decline rate in insect pest infestations to the three selected cucurbits in response to the release of *C. carnea* second release to descending order as follows: pumpkin, snake cucumber and watermelon. Releasing the third instar larvae induced significant reductions in the mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* infesting each of pumpkin, snake cucumber and watermelon as compared to the controls, (P≤0.05). The table also, indicated that the rate of decrease in insect pests infestation to the three selected cucurbits in response to the release of *C. carnea* third instar larva to descending order as follows: pumpkin, snake cucumber and watermelon, (Table 6).

Table 4. Efficiency of the 1st instar larva of *C. carnea* summer season release for controlling insect pests the three selected cucurbits under field conditions, during Feb. - May. 2023.

Insect Pests	Snake Cucumber			
	Control	Treatment	Number reduced	Reduction %
B. tabaci	164	156	8	4.8
A. gossypii	172	154	18	10.4
T. tabaci	190	173	17	8.9
C. sudanensis	180	171	9	5.0

Insect Pests	Snake Cucumber			
	Control	Treatment	Number reduced	Reduction %
Total reduction%				29.1
Insect pests	**Pumpkin**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	188	183	5	2.6
A. gossypii	181	161	20	11.0
T. tabaci	186	166	20	10.7
C. sudanensis	186	164	22	11.8
Total reduction%				36.1
Insect pests	**Watermelon**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	86	72	14	16.2
A. gossypii	79	53	26	32.9
T. tabaci	95	81	14	14.7
C. sudanensis	78	53	25	32.0
Total reduction%				95.8

Table 5. Efficiency of the 2nd larva of *C. carnea* summer season release for controlling insect pests on the three selected cucurbits under field conditions, during Feb. - May. 2023.

Insect Pests	Snake Cucumber			
	Control	Treatment	Number Reduced	Reduction %
B. tabaci	170	146	24	14.1
A. gossypii	178	157	21	11.7
T. tabaci	185	164	21	11.3
C. sudanensis	188	171	17	9.0
Total reduction%				46.1
Insect Pests	**Pumpkin**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	172	161	11	6.3
A. gossypii	163	156	7	4.2
T. tabaci	174	162	12	6.8
C. sudanensis	185	163	22	11.8
Total reduction%				29.1

Insect Pests	Watermelon			
	Control	Treatment	Number Reduced	Reduction %
B. tabaci	89	70	19	21.3
A. gossypii	73	50	23	31.5
T. tabaci	95	71	24	25.2
C. sudanensis	78	52	26	33.3
Total reduction%				111.3

Table 6. Efficiency of the 3rd instar larva of *C. carnea* summer season release for controlling insect pests on the three selected cucurbits under field conditions, during Feb. - May. 2023.

Insect Pests	Snake Cucumber			
	Control	Treatment	Number reduced	Reduction %
B. tabaci	179	151	28	15.6
A. gossypii	181	156	25	13.8
T. tabaci	175	138	37	21.1
C. sudanensis	187	166	21	11.2
Total reduction%				61.7
Insect Pests	**Pumpkin**			
	Control	**Treatment**	**Number reduced**	**Reduction %**
B. tabaci	166	135	31	18.6
A. gossypii	178	146	32	17.9
T. tabaci	182	164	18	9.8
C. sudanensis	187	165	22	11.7
Total reduction%				58.0
Insect Pests	**Watermelon**			
	Control	**Treatment**	**Number Reduced**	**Reduction %**
B. tabaci	176	160	16	9.0
A. gossypii	106	62	44	41.5
T. tabaci	129	80	49	37.9
C. sudanensis	102	35	67	65.6
Total reduction%				154

Overall Seasonal Efficacy of C. carnea Larvae in Controlling Cucurbit Insect Pests

The overall seasonal efficacy of *C. carnea* instar larvae field release to controlling cucurbits insect pests was depicted at the Experimental Farm of Shendi University. Results indicated that releasing the three larval instars of *C. carnea* on snake cucumber, pumpkin and watermelon induced greater reductions in *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* during winter season of growth compared to the summer one (Table 7).

Table 7. Comparison overall seasonal efficacy of *C. carnea* instars larvae release for controlling cucurbit insect pests, during Oct.2022 - May. 2023.

Stages	Winter Season		
	Snake Cucumber	**Pumpkin**	**Watermelon**
First instar	62.0	36.6	06.6
Second instar	51.4	51.3	53.7
Third instar	64.3	56.1	43.7
Stages	**Summer Season**		
	Snake Cucumber	**Pumpkin**	**Watermelon**
First instar	29.1	36.1	95.8
Second instar	46.1	29.1	111.3
Third instar	61.7	58.0	154

IV. Discussion

Winter Season Release of C. carnea Larvae for Controlling Cucurbit Insect Pests

Significant reduction in mean number of *B. tabaci* and *C. sudanensis*on three cucurbits compared to the controls. The results are significant decrease in mean number of *A. gossypii* and *T. tabaci* on snake cucumber and pumpkin, but insignificant in *A. gossypii* and *T. tabaci*on watermelon. The infestation of these insect pests followed the descending order as follows: watermelon, pumpkin and snake cucumber. These results were in conformity with Luna-Espino *et al*., (2020), who claimed that *C. carnea* first instar larvae significantly reduced *A. gossypii* infestation regardless of the plant stage. Soomro *et al*., (2020), who tested *C. carnea* against *B. tabaci* infestations, indicated a significant potential of predation against sucking insect pests especially *B. tabaci* by reducing the insect population significantly. The order of insect pests' infestation to the three cucurbits could be ascribed to their food preference which was also noticed by Mohammed, (2018), who studied food preference of cucurbits insect pests in Sudan. His results indicated that the type of food had significant effects on insect larval, pupal period, and life cycle. He added that insect pests preferred snake cucumber and watermelon mostly preferred for egg laying and thus harbor more insect pest population to be prayed by *C. carnea* larvae.

Chrysoperlacarnea second instar larva significantly reduced the mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* compared to the control and the incidence reduction rate in descending order was as follows: watermelon, snake cucumber and pumpkin. Saleh *et al*., (2017), reported significant reduction in aphid population infesting cucurbits in response of *C. carnea* second stage larva in Egypt. They attributed their results to the vigorous feeding behavior of this larva to develop to the third stage. Alghamdi *et al*., (2018), indicated that the larval stages of *C. carnea* has significantly reduced the mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and other soft bodied insects under field conditions. The order of infestation in the three cucurbits could be due to botanical need of insect pest to develop and complete their life cycles. Kumar *et al*., (2024), studied the cucurbits in India. They showed that the major insect pest has especial botanical needs to complete their life cycle such as *A. gossypii* infesting pumpkin that, lay eggs underside the leaves that hatch into tiny larvae that pupate by forming cocoons on surfaces of these leaves or stems, which then feed voraciously on the pumpkin leaves, growing rapidly through several molts to maturity.

Significant reduction in mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* compared to the controls was noticed upon releasing *C. carnea* third larval instar and the incidence reduction rate in descending order was as follows: watermelon, pumpkin and snake cucumber. This reduction could be due the voracious feeding rate of these larvae to attain maturity. Saleh *et al*., (2017), had undertaken a survey on certain piercing-sucking pests and their natural enemies infesting cucumber plants such as *A. gossypii* upon release of *C. carnea* larvae for controlling them. Their results indicated significant reduction of insect pest upon releasing *C. carnea*third larval instars. Alghamdi *et al*., (2018), used *C. carnea* larval instars in controlling whitefly, aphid and thrips infesting some cucurbits in Saudi Arabia. They came to conclude that these larval instars significantly reduced insect pests number depending on the number and stage of the released larvae. Rana *et al*., (2017), demonstrated that the third instar larvae of *C. carnea* are more voracious as compared to 1st and 2nd instars.

Summer Season Release of C. carnea Larvae to Control Cucurbit Insect Pests

Summer release of *C. carnea* first larval instar significantly decreased the mean number of *C. sudanensis* infested pumpkin and snake cucumber while insignificantly affected *A. gossypii* on snake cucumber, or *B. tabaci*, *A. gossypii* and *T. tabaci* in pumpkin. Similar observations were given by Sarwar, (2014), who used the 1st, 2nd and ^{3rd} instars of *C. carnea* larvae against insect pests under field conditions. His results indicated that these predators, irrespective of their developmental stage, reacted very positively to their preys' reduction except in untreated control. He noticed that applications of 1st, followed by 2nd and ^{3rd} instars larvae were most effective in reducing insect pest population compared to the control. Summer release of *C. carnea* 2nd instar larvae induced significant reductions in mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* infesting snake cucumber, pumpkin and watermelon as compared to the controls. El-Ghanam, (2017), conducted field experiments to study the biological impact of releasing the second larval instar of *Coccinella undecimpunctata* and *C. carnea* in controlling *A. gossypii* infesting basil plants. Her results indicated significant reductions in insect pest mean number in response of larval release. The efficiency of *C. carnea* 3rd instar larvae in reducing insect pest numbers on three selected cucurbits indicated significant reductions in the mean number of *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* infesting each of pumpkin, snake cucumber and watermelon as compared to the controls. Saleh *et al*., (2024), investigated potential impact of the 3rd instar larvae of *C. carnea* on insect pests under field conditions. These results revealed significant reduction effect compared to the control.

Overall Seasonal Efficacy of C. carnea Larvae to Control Cucurbit Insect Pests

The overall efficacy of *C. carnea* instar larvae field release in controlling cucurbits insect pests was depicted at the experimental farm of Shendi University. Results indicated that releasing the three larval instars of *C. carnea* on snake cucumber, pumpkin and watermelon induced greater reductions in *B. tabaci*, *A. gossypii*, *T. tabaci* and *C. sudanensis* during winter season of growth compared to the summer one. These results could be due to habitat ecological properties such as climatic factors which favor *C. carnea* proliferation and biological control. Paredes*et al*., (2024), conducted a comprehensive study on *C. carnea* across diverse habitats in

Portuguese. The findings revealed *C. carnea*displayed a widespread presence in all habitats, depending on the presence of its preferred prey. It showed significant gradual decrease throughout the summer season. They attributed their findings to habitat ecological diversification which contributed to increasing and diversifying of prey populations and thus increasing abundance of *C. carnea* and consequent enhanced efficacy in insect pest control.

V. Conclusion

The use of the larval stages of the predator, especially the 3rd instar, has resulted in a reduction in the numbers of insect pests attacking cucurbit plants.

VI. Recommendations

- Encourage more research on the use of *C. carnea* as a biological control agent against cucurbit insect pests to prepare a biological control package using its different developmental stages.
- Empower agricultural extension on the role of *C. carnea* larvae as cucurbit insect pests control thus minimizing the use of insecticides through adoption of IPM program.

Plate 1. Adults of *Chrysoperla carnea* (Stephens.).

Plate (2). Egg of *Chrysoperla carnea* (Stephens.).

Plate 3. Larva of *Chrysoperla carnea* (Stephens.).

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