UNIVERSITY OF SINDH JOURNAL OF ANIMAL SCIENCES
Vol. 1, Issue 1, pp: (33-37), November, 2017
Email: editor.usjas@usindh.edu.pk
http://sujo.usindh.edu.pk/index.php/USJAS
ISSN: 2521-8328

(USJAS)

Impact of Natural Diets on the Development and Morphometrics of *Chrysoperla carnea* (Stephens) under Laboratory Conditions

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ARTICLE INFORMATION

Article History:
Received: 12th August, 2017
Accepted: 1st November 2017
Published online: 16th November, 2017

Authors Contribution:
FHM planned the study, AAS wrote the results, AB supervised the experiment & compiled data with help to statistical analysis, IAK noted the duration of developmental stages, and SMJ look after the whole research experiment maintained under laboratory condition.

Key words:
Chrysoperlacarnea,
Natural diets,
Development,
Morphometric,
Laboratory condition.

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ABSTRACT

The study was conducted under laboratory conditions, in Bio-control Research Laboratory, Department of Entomology, Faculty of Crop Protection, Sindh Agriculture University Tandojam during 2015-2016 to determine better artificial diets for mass rearing of *C. carnea.* The four natural diets Mustard, Akk, Cabbage aphid and *Sitroga cercellela* eggs were used. The results indicated that the maximum larval developmental period was recorded 5.5±0.6 of 1st instar larvae of *C. carnea* on akk aphid, whereas the shortest development was 2.25±0.3 days in 2nd instar on *S. cerellela* and mustard aphid, while the results further revealed that the highest development period of 3rd instar larvae observed 4.25±1.3 on akk aphid. The maximum pupal developmental time was recorded (7.0±1.1) on *S. cerellela* eggs followed by cabbage aphid (6.25±1.3), akk aphid (5.75±1.3), and mustard aphid (5.00±1.0) On the other hand the morphometric measurement of *C. carnea* highest length and breadth was at 1st instar 4.38±0.13 L/B 2.25±0.25mm 2nd instar 5.13±0.31 2.13±0.13mm and 3rd instar 6.88±0.31 2.88±0.13mm on *S.cerellela* eggs. The analysis of variance indicated that there was highly significant difference between the natural diets, and their larval, pupal, developmental, and morphometric stages on different aphid species.

1. INTRODUCTION

Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae), is a Common green lacewing, generallly predators, and very efficient and useful in biological control agent. The chrysopidae lacewings are very useful insects of agricultural ecosystems [1]. An entomologist knows that target of biological control programs and its family included more than 90 type and 1800 well-famous species and their predating performance always paying attention and reported thatin Iran 46 species are member of Chrysopidae families and 193 lacewings species are described [2]. The potential of feeding behaviour of first-instar larva of *C. carnea*on unusual prey species in the order of *Aphis craccivora*, *Drosophila melanogaster*, *Corcyra cephalonica.*

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Reliant on these studies, *D. melanogaster* appeared to be capable for mass production of the predator in the laboratory for mass rearing, no native aphids or other natural hosts could be available throughout the year; in this context experiments were conducted to standardize an artificial diet instead of eggs of Angoumois grain moth, to generate their some numbers at a low cost [3].The number of methods has been used for rearing lacewing with a cannibalistic tendency. Term paper sheets covered with *Phthorimaea oprulella* (Zeller) eggs as a kill sprinkled on top in wooden tray sheltered with muslin for rearing *C.carnea* larvae to keep away from cannibalism. To divide larvae of *Chrysoperla* honey examine shape was used as rearing containers and *Sitrtroga cerealella* eggs were provide as food to the larvae independently. They are successful predators of jassid, whiteflies, thrips, aphids and mites they also nourish on the eggs and tiny larvae of the cotton bollworms [4]. The *Chrysoperla carnea* and *Malladadesjardinsi* are well widely described in

Europe, USR, North Americaa, and Central Africa. And some prey of green lacewings, *Chrysoperla*spp. (Chrysopidae) are international predators that come to mind to control in a wide number range of agricultural pests. The larvae of *Chrysoperla* is a very active, and native predator of biological control agent of a range of phytophagous arthropods like as aphids, caterpillars, leafhoppers, thrips and eggs [5].The highest biological agent of *C. carnea* was observed when adult fed on a diet based on honey, yeast and pollen there were significant difference between rate of oviposition, larvae longevity, fertility and sex ratio on different diets (female: male when larvae fed on age of nymph *Shizaphisgraminum, Bemisiatabaci* and artificial diet. Considering above parameters, artificial diet can be a best choice for mass rearing *C. carnea*[6].The Biological control programe is a permanent, secure, and economically and environmental important. The action of parasites has been described and parasitoids prey and pathogenic which are the key pest populations at a lowest typical more economic damage level". Most of the natural bio agents are host-specific to a small number of strongly as compared to *C. carnea*. Thus the non-target species are no affected. Capable natural enemies frequently carry on having a supress have an effect on insect pests [7].A larva of *C. carnea* is a predator of uncovered eggs, small larvae of biological agents and lepidopterist pests. It nourish on time-consuming affecting, very elastic bodied arthropods like as aphids, whitefly, scales, mealy bugs and mites [8]. The rearing technique is provider *C. carnea* culture and large numbers of eggs and larvae which considered necessary for inundative release in sort to start a natural programme with *C. carnea*.

2. MATERIAL AND METHODS

2.1 *Place of work*

The experiment was conducted onimpact of natural diets on the development and morphometric of *Chrysoperlacarnea* (stephens) under laboratory conditions, during 2015-2016, Department of Entomology, Faculty of Crop Protection, Sindh Agriculture university, Tandojam. The stock culture of *Chrysoperlacarnea* and *Sitotrogacerellela* were obtained from N.I.A laboratory.

2.2 *Experimental design*

The aphid species (Giant milk weed, Mustard and Cabbage) were collected from respective crops. The prey species were provided to the predator larvae to determine the development period and morphometrics of different larval instars of *C. carnea* under laboratory conditions. The temperature maintained between 26±2^{O}C and Relative humidity 60±5%. The experimental design will be Complete Randomized Design (CRD) with four replications.

2.3 *Treatments*

There was four treatments i.e. $T_{1=}$ *Aphis nerii*, $T_{2=}$ *Lipaphis erysimi,* T_3= *Bervicoryne brassicae* and T_4 =*S. cerealella* eggs.

2.4 *Data collection*

First instar larvae of *C. carnea* was shifted in each Petri dishes for experiment. The larvae feed on aphid species and *S. cereallela* eggs.

The observation was taken daily to determine the developmental time and morphometric measurement of each life stage daily with help of magnifying glass scale.

2.5 *Statically Analysis*

The collected data were subjected for statistical analysis and statistical differences existed between data sets (P<0.05), Fisher's Least Significant Differences (LSD) was used to separate the differing means.

3. RESULTS

3.1 Development period of *Chrysoperla carnea* on different natural diet

3.1.1 *Larval period*

The result showed in Table.1 indicated that the maximum development period was observed 4.5±0.6 days in the 1st instar larvae of *C. carnea* fed with *S. cerellela* eggs, whereas minimum development period was recorded as 2.68±0.29, 2.95±0.72, and 3.5±0.58 on mustard, cabbage and akk aphid, respectively. Similarly, the lowest development period was recorded 3.10±0.38, days in 2nd instar larvae on both mustard aphid and akk aphid, followed by 4.8±0.89 and 5.89±0.25 on cabbage and *S. cerellela* eggs, respectively. The results further revealed that the highest development period was observed 6.92±1.05 in 3rd instar on *S. cerellela* eggs whereas lowest development period was 4.89±0.39 on both musrard aphid and akk aphid 5.31±1.20, respectively. In the light of above results the minimum development period was occurred on *S. cerellela* eggs whereas maximum development time was observed on mustard, cabbage and akk aphids. The analysis of variance indicated that there was highly significant difference between the larval development on different aphid species (P<0.05).

3.1.2 *Pupal stage*

The result further depicted in table 1 that the maximum developmental time was recorded 7.75±1.24a in pupa on *S. cerellela* eggs followed by 7.0±1.1a cabbage and 6.25±1.3, on akk, aphid, while minimum 6.16±1.05, days on mustard aphids. The analysis of variance indicated that there was highly significant difference in the pupal development on different host species (P<0.05).

Table 1. Mean Development Time (Days) of *Chrysoperla carnea* on different natural diets

Life stages	Mustard Aphid (T_1)	Akk Aphid (T_4)	Cabbage Aphid (T_2)	*S.cerella* eggs (T_3)
1st instar	2.68±0.29c	2.95±0.72bc	3.5±0.58b	4.5±0.6a
2nd instar	3.10±0.38c	3.98±0.78c	4.8±0.89b	5.89±0.25a
3rd instar	4.89±0.39c	5.31±1.20b	5.41±0.28b	6.92±1.05a
Pupa	6.16±1.05b	6.25±1.3b	7.0±1.1a	7.75±1.24a

3.2 Morphometrics of *Chrysoperla carnea* on different host species.

3.2.1 *Larval stage*

The results presented in Table 2 showed that the highest length and breadth was measured 3.02±0.43 and 1.05±0.24mm in the 1st instar larvae of *Chrysoperla carnea* on mustard aphid followed by 2.78±0.32; 0.92±0.13 and 2.41±0.13; 0.89±0.05b and 0.72±0.02mm reared on cabbage, akk aphids, and *S. cereallela* eggs, respectively. Similarly, the maximum length and breadth of 2nd instar larvae was recorded 4.45±0.52 and 1.62.±0.29mm on mustard aphids whereas minimum was 2.98.±0.08 and 2.25±0.25; 4.75±0.25 and 2.25±0.25; 4.88±0.52 and 1.50±0.29mm on akk, cabbage and *S. cereallela* eggs, respectively. The results further revealed that the highest length and breadth of 3rd instar larvae was measured 5.89±0.24 and2.12±0.13mm on mustard aphid followed by 5.35±0.20; 1.98±0.13mm and 5.01±0.38; 1.79±0.21 and 4.86±0.31; 1.49±0.13 on akk, cabbage and *S. cereallela* eggs, respectively. The analysis of variance indicated that there was highly significant difference between the larval morphometrics on different host species (P<0.05).

3.2.2 *Adult Male and female*

Similarly, the maximum length and breadth of female adult of *Chrysoperla carnea* was recorded 6.78±0.78 and 1.62±0.41mm on mustard aphid whereas minimum was 5.48±0.11; 1.10±0.06 on *S. cereallela* eggs, followed by 6.01±0.71; 1.31±0.41 and 6.21±0.71; 1.43±0.61 on cabbage, akk aphids, respectively. The analysis of variance indicated that there was highly significant difference between the adult female stages on different aphid species (P<0.05).The results further revealed that the highest length and breadth of adult male stage of *Chrysoperla carnea* was measured 6.05±0.50 and 1.41±0.28mm on mustard aphids followed by 5.92±0.36; 1.18±0.23 and 5.86±0.43; 1.05±0.29 and 0.89±0.04mm on akk aphid, cabbage aphid and *S. cerellela* eggs, respectively. The analysis of variance indicated that there was highly significant difference between the male adult stage on different host species.

Table 2. Morphometric measurement of different life stages *Chrysoperla carnea* on different natural diets

Life stages	Mustard Aphid (T_1)		Akk Aphid (T_4)		Cabbage Aphid (T_2)		*S.cerella* Eggs (T_4)	
	Length	**Breadth**	**Length**	**Breadth**	**Length**	**Breadth**	**Length**	**Breadth**
1st Instar	3.02±0.43a	1.05±0.24a	2.78±0.32ab	0.92±0.13ab	2.41±0.13b	0.89±0.05b	2.04±0.11b	0.72±0.02b
2nd instar	4.45±0.52a	1.62.±0.29a	3.79±0.25ab	1.24±0.25ab	3.39±0.31b	1.05±0.09b	2.98.±0.08b	0.98±0.05b
3rd instar	5.89±0.24a	2.12±0.13a	5.35±0.20a	1.98±0.13ab	5.01±0.38a	1.79±0.21b	4.86±0.31b	1.49±0.13b
Female	6.78±0.78a	1.62±0.41a	6.21±0.71a	1.43±0.61a	6.01±0.71a	1.31±0.41a	5.48±0.11b	1.10±0.06a
Male	6.05±0.50a	1.41±0.28a	5.92±0.36a	1.18±0.23a	5.86±0.43a	1.05±0.29a	5.21±0,09a	0.89±0.04a

4. DISCUSSION

The findings of present result indicated that the maximum development period was observed 4.5±0.6 days in the 1st instar larvae of *C. carnea* fed with *S. cerellela* eggs, whereas minimum development period was recorded as 2.68±0.29, 2.95±0.72, and 3.5±0.58 on mustard, cabbage and akk aphid, respectively. The maximum developmental time was recorded 7.75±1.24a in pupa on *S. cerellela* eggs followed by 7.0±1.1a cabbage and 6.25±1.3, on akk, aphid, while minimum 6.16±1.05, days on mustard aphids. . The results further revealed that the highest length and breadth of 3rd instar larvae was measured 5.89±0.24 and2.12±0.13mm on mustard aphid followed by 5.35±0.20; 1.98±0.13mm and 5.01±0.38; 1.79±0.21 and 4.86±0.31; 1.49±0.13 on akk, cabbage and *S. cereallela* eggs, respectively. Similarly, the maximum length and breadth of female adult of *Chrysoperla carnea* was recorded 6.78±0.78 and 1.62±0.41mm on mustard aphid whereas minimum was 5.48±0.11; 1.10±0.06 on *S. cereallela* eggs. The findings of present result have the conformity with report of [9] reported the study on predator lacewing species *Chrysoperla comanche* (Banks) and *Chrysopa nigricornis* Burmeister, ovipositional favorite larval to adult late presentation of 2 generalist. These both predators are most plentiful in pecan trees *Carya illinoensis* (Wagenh) K. Kock) in southern Arizon specialist aphids *Monellia caryella* (Fitch) and *Melanocallis caryaefoliae* (Davis) are obtained. The experiment with seedlings of infested one of the 2 native aphid species some time without aphid's Ovi-positional preference was experienced in a three-way choice. And the Female adults of both species of green lacewing predator showed an important ovipositing liking on plants bearing aphids, but simply *C. Comanche* well-known among the two aphid species. The both aphid species are suitable for larval development but development period were not affected by the specie of aphid treatment. *C. nigricornis* pupae were significantly heavier as compared to larvae of *M. caryaefoliae*, but no difference was found in *C. Comanche* between pupal weights. The oviposition time was significantly longer which feed a combination of the two aphid species of *C. nigricornis* females that compared with each aphid species larval development. On the other hand, eggs laid by either species aphid diet did not affect the amount of during the first five days of oviposition.

5. CONCLUSION

The maximum larval developmental period of *C. carnea* was recorded on akk aphid followed by *S. cereallela* eggs, cabbage aphid and mustard aphid. The pupal developmental period of *C. carnea* was significantly different when larvae fed with natural prey species. The highest length and breadth was measured in the larval instars on mustard aphid followed by cabbage aphid, *S. cereallela* eggs and akk aphid. Similarly, the maximum length and breadth of adults of *C. carnea* was measured on mustard aphid followed by cabbage aphid, *S. cereallela* eggs and akk aphid.

6. CONFLICTS OF INTERESTS

The authors declare that there are no conflicts of interests regarding the publication of this article.

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