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Evaluation of Feeding Potential and Prey Preference of *Chrysoperla zastrowi sillemi* (Esben - Peterson) on different Aphid Species

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ABSTRACT: **The feeding potential and prey preference of *Chrysoperla zastrowi sillemi* among four different aphid species was conducted under laboratory condition at AICRP on Biological Control of Crop Pests, College of Agriculture, Rajendranagar, Hyderabad and the observation showed prey preference in the order of *Aphis craccivora* followed by *Aphis gossypii, Rhopalosiphum maidis* and *Lipaphis erysimi*, exhibiting total aphids consumption throughout the larval period as 445.2± 6.21 of *A. craccivora*; 309.2 ± 8.11 of *A. gossypii;* 197.6 ± 5.99 of *R. maidis* and 130 ± 4.49 of *L. erysimi*. Aphid mean consumption rate of I and II instar larva was 52.4 ± 0.68 and 122.0± 2.21 (*A. craccivora*), 23.0 ± 1.00 80.6 ± 4.24 (*A. gossypii*), 14.4 ± 0.87 62.4 ± 3.4 (*R. maidis*), 8.2 ± 0.66 41.6 ± 2.06 (*L. erysimi*), respectively. The III instar larva exhibited aphid predation rate of 270.8 ± 3.32 (*A. craccivora*), 205.6 ± 2.87 (*A. gossypii*), 120.8 ± 1.72 (*R. maidis*) and 80.2 ± 1.77 (*L. erysimi*) indicating its high predation potential during III instar stage.**

Keywords: *Chrysoperla zastrowi sillemi*, chrysopidae, aphididae, feeding potential, biological control.

INTRODUCTION

Insect predators constitute a major component of Biological control. Among the predacious insects, the green lacewing, *Chrysoperla zastrowi sillemi* (Esben-Peterson) (Neuroptera: Chrysopidae) also called as aphid lions, is an efficient insect predator and polyphagous with a wide range of prey with enhanced searching capacity and voracious feeding habits feeding on leafhoppers, psyllids, aphids, coccids and mites, of which aphids are the most preferred host. Green lacewing is an example of the species that is not predacious in the adult stage but predatory in larval stage. Adults feed on pollen, nectar and aphid honeydew. *C. zastrowi sillemi* predator has the immense potential in inundative release measures in insect management because of their ability to inhabit diverse habitats, shorter life cycle, easy mass multiplication and inherent ability to tolerate pesticides (Amarasekare and Shearer 2013). It is estimated that possibly up to one third of the successful biological insect pest control programmes are attributable to introduction and release of insect predators (Williamson and Smith 1994). Biological control has long been recognized as an important component of Biointensive Integrated Pest Management (BIPM) which is a holistic approach for IPM. Moreover, IPM programme would be most effective if the pesticides used were efficacious against the pest species and relatively safer for beneficial arthropods such as parasitoids and predators. The preservation and maintenance of the natural enemies in the agroecosystem are essential for the establishment of the biological equilibrium and reduction of the production costs as well as to avoid side effects of the chemicals to environment (Gravena & Cunha 1991). Henry *et al.* (2010) compared courtship songs and erected *Chrysoperla zastrowi sillemi* to include both Middle Eastern and the Indian populations. So, in the research paper, the nomenclature of green lacewing is designated as *Chrysoperla zastrowi sillemi* although the name *C. carnea* was used at time of research. It plays a significant role as an efficient bioagent in controlling sucking pest and acquired attention from farmers as well as researchers due to its wide host range, vast geographical distribution, easy to mass multiplied and pesticide tolerant property to some extent. Keeping in view the demerits and limitations encountered in insecticidal application there is an imperative need for the development of biological control as an alternate method of control. Though *Chrysoperla* is proved to be a successful predator of insect pests, not much work has been carried out under the existing conditions of Telangana state especially in case of Bt cotton where the incidence of sucking insect pest complex is a major problem for which farmers are going for repeated use of systemic insecticides. Hence, there is a need for simultaneous use of insecticides as well as bioagents like *Chrysoperla* for insect pest management.

MATERIAL AND METHODS

Laboratory experiments were conducted at All India Coordinated Research Project (AICRP) on Biological control of Crop pests, Rajendranagar, Hyderabad, Telangana during 2016. Cowpea, maize, cotton and mustard seeds were sown in 20 earthen pots each and watered daily. Sufficient care was taken to raise healthy plants without any insecticidal application to develop good aphid culture. These aphids served as a source of aphid used for conducting experiment. Different four aphid species like *A. craccivora*, *A. gossypii*, *R. maidis* and *L. erysimi* were collected from cowpea, cotton, maize and mustard plants. All aphid species were taken from respective plants subsequent to counting the quantity of aphids on leaves. Individual predator larva was bound to a glass vial (5 × 3 cm) which was given 100 aphids as food on everyday schedule till the finishing of larval period. Prey consumption on daily basis was recorded by counting the quantity of leftover aphids. Absolute number of aphids consumed by individual instar all through the existence period and the quantity of prey eaten on the earlier day were recorded. Information gathered on the perceptions during the analysis was examined by utilizing required statistical methods.

RESULTS AND DISCUSSION

Results pertaining to predation potential of different stages of *Chrysoperla* larva on different species of aphids *viz.*, *A. craccivora* (Cowpea aphid), *A. gossypii* (Cotton aphid), *R. maidis* (Maize aphid) and *L. erysimi* (Mustard aphids) is shown by Table 1 and Fig. 1, revealing that among the four species of aphids, *A. craccivora* was highly preferred by larva of *Chrysoperla* at all the three stages, whereas *L. erysimi* was least preferred. This was shown by mean utilization of aphids all through the larval period recorded as 445.2 ± 6.21 of *A. craccivora*; 309.2 ± 8.11 of *A. gossypii*; 197.6 ± 5.99 of *R. maidis* and 130 ± 4.49 of *L. erysimi* showing its high predation for *A. craccivora* supported by Vivek *et al*. (2013) showing the same order. Kumar *et al*., (2019) recorded that average number of preys consumed during first, second and third instar larva was 30.67, 53.00 and 123, total consumption was 206.66 on *Aphis craccivora*. Whereas Naruka *et al*. (2017) reported that the total prey consumption was 204.76 on *A. craccivora* where first, second and third instar larva consuming 36.37, 75.50 and 89.59 preys respectively. Single *Chrysoperla* larva could consume about 600-950 nymphs and grownup adult of *M. persicae*, whitefly pupae (Sewak *et al.*, 2011). *Chrysoperla* larva prefer more *A. gossypii* to *L. erysimi* revealed by Liu and Chen (2001) which is in concurrence with the finding of Chakraborty and Korat (2010). Hence, it could be utilized much conveniently in crop plant ecosystem especially cotton than others as it preys not only on aphids but also other sucking insect pests along with eggs and neonate larvae of bollworm. Mean aphid predation rate of I and II instar larva of *Chrysoperla* on different aphid species was found as 52.4 ± 0.68 and 122.0 ± 2.21 (*A. craccivora*), 23.0 ± 1.00 and 80.6 ± 4.24 (*A. gossypii*), 14.4 ± 0.87 and 62.4 ± 3.4 (*R. maidis*), 8.2 ± 0.66 and 41.6 ± 2.06 (*L. erysimi*) respectively. Similarly, III instar larva exhibited a mean utilization rate of 270.8 ± 3.32, 205.6 ± 2.87, 120.8 ± 1.72 and 80.2 ± 1.77 for *A. craccivora*, *A. gossypii*, *R. maidis* and *L. erysimi* indicating its high consumption potential during III instar stage. Balasubramani and Swamiappan (1994) reported the high feeding capability of third instar larva consuming around 419.8 nymphs of *A. gossypii* of which 60-80 per cent were eaten up by third instar itself. Similar observations were reported by Krishnamoorthy & Mani (1982); Megahed *et al.* (1984); Saminathan *et al.* (2003); Jagadish & Jayaramaiah (2004). It was confirmed from investigation that as larva grown up into adults, its prey utilization rate likewise expanded regardless of prey consumed. Accordingly, Solangi *et al*. (2013) observed that the 3rd instar larvae voraciously fed on 3rd instar nymphs of all sucking pests. Batool *et al*. (2014) also observed that the daily predation rate of *C. carnea* increased slowly during the first two instars and reached to its peak in the third larval instar.

Table 1: Predation potential of *Chrysoperla zastrowi sillemi* on different species of aphids.

Prey Species	Mean Predation Rate (Number / Instar) *			
	I instar	II instar	III instar	Total
Aphis craccivora	52.4 ± 0.68	122 ± 2.21	270.8 ± 3.32	445.2 ± 6.21
Aphis gossypii	23.0 ± 1.00	80.6 ± 4.24	205.6 ± 2.87	309.2 ± 8.11
Rhopalosiphum maidis	14.4 ± 0.87	62.4 ± 3.40	120.8 ± 1.72	197.6 ± 5.99
Lipaphis erysimi	8.2 ± 0.66	41.6 ± 2.06	80.2 ± 1.77	130.0 ± 4.49
C.D (0.05)	2.47	9.40	7.62	_
S.E. m ±	0.82	3.11	2.52	_

*: Mean of five replications.

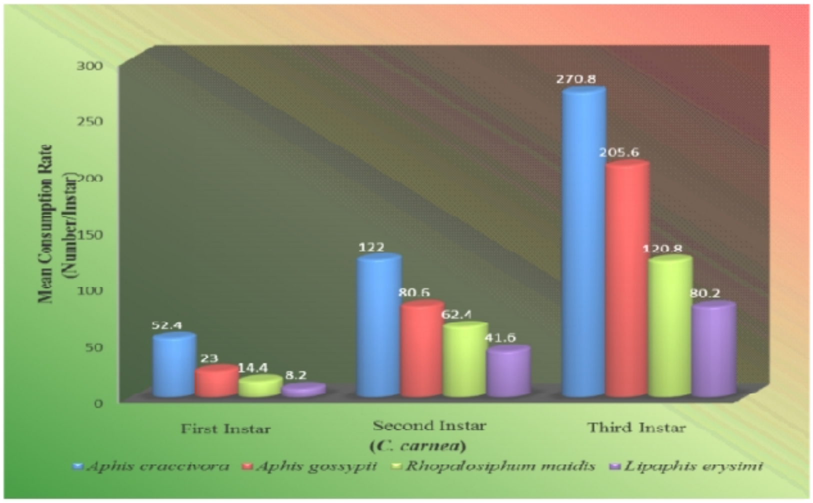

Fig. 1. Predation potential of *Chrysoperla larva* on different species of aphid.

Data pertaining to daily consumption rate of *Chrysoperla* on different species of aphid revealed the significant increased of feeding from 7th day onwards indicating III instar as major predatory stage (Table 2 and Fig. 2). The result is in agreement with Vivek *et al.* (2013) exhibiting *C. carnea* predation potential upto 68.8-80.2% of total prey consumed. Satpathy *et al.* (2001) also observed higher food consumption rate with increasing prey density. Among four aphid species, *Chrysoperla* larvae feeding on *A. craccivora* and *R. maidis* have gone to pupation on 10th day whereas those larvae feeding on *A. gossypii* and *L. erysimi* have gone pupation on 9th day leading to forced pupation with consumption of unpreferred food.

Therefore, the present study revealed the preference order of *Chrysoperla* larvae among aphid species as *Aphis craccivora* followed by *A. gossypii*, *R. maidis* and mustard aphid as least preferred prey. Such a comprehension will have broad applied esteem as far as using the biocontrol agents against various insect pests. The results clearly indicated that *Chrysoperla zastrowi sillemi* could be a promising bioagent against different aphid species. According to Nair *et al*. (2020) one of the major concerns on success of biocontrol agents against crop pests is their performance in the field and the biocontrol agents are to be used innundatively, *i.e.*, repeated applications. However, there is always an optimal rate and timing of biological intervention to have more impact on pest control than the release rate. The release timing affects the host: natural enemy synchrony and decide the successful establishment of a biocontrol agent in the field (Liu and Stansly 2005).

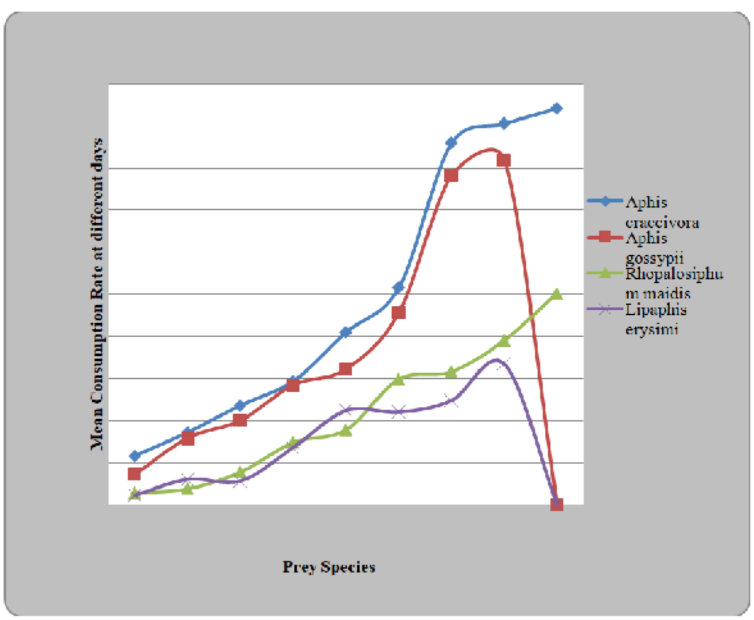

Fig. 2. Daily consumption rate of *Chrysoperla* on different species of aphids.

Table 2: Daily consumption of *Chrysoperla zastrowi sillemi* on different species of aphid.

Prey Species	Mean Predation/Consumption Rate at different days *								
	1	2	3	4	5	6	7	8	9
Aphis craccivora	11.6±0.75	17.2±0.86	23.6±0.51	29.4±0.87	41.0±0.71	51.6±0.93	86±1.64	90.6±1.5	94.2±1.32
Aphis gossypii	7.2±0.58	15.8±1.16	20±1.7	28.4±1.44	32.2±2.2	45.6±3.59	78.2±1.6	81.8±2.27	—
Rhopalosiphum maidis	2.8±0.2	3.8±0.37	7.8±0.66	14.8±1.2	17.8±1.2	29.8±1.59	31.6±1.1	39±1.3	50.2±1.66
Lipaphis erysimi	2.2±0.2	6±0.55	5.6±0.75	13.6±1.12	22.4±0.51	22±0.71	24.8±0.8	33.4±0.68	—
C.D (0.05)	1.497	2.400	3.084	3.552	4.012	6.190	4.179	4.675	3.200
S.E. m ±	0.50	0.79	1.02	1.18	1.33	2.05	1.38	1.54	1.06

*: Mean of five replications

CONCLUSION

Study of prey preference of *C. zastrowi sillemi* among four different aphid species exhibited an order of preference *i.e., Aphis craccivora*>*Aphis gossypii* >*Rhopalosiphum maidis* > *Lipaphis erysimi*. Such an understanding will have far reaching applied value in terms of utilizing the biocontrol agent against insect pests. The results clearly indicated that *C. zastrowi sillemi* could be a better biological control agent against different aphid species, among them it could effectively control *A. craccivora* than *L. erysimi* where tritrophic interaction played much role.

FUTURE SCOPE

— Abundance, colonization and commercialization of *Chrysoperla* under field condition have to be studied.
— Prey preference and feeding potential of *Chrysoperla* on different pests in different crop agro-ecosystems including tritrophic interaction between crop species – prey insect – *Chrysoperla* have to be made.

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Conflict of interest. None.

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