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Comparative Studies on Biological Attributes of *Chrysoperla zastrowi sillemi* (Esben-Peterson) Reared on Two Hosts

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Investigations were carried out to study the influence of bhendi spider mites on the biological attributes of *C. z. sillemi* in comparison with *Corcyra cephalonica* and also to study the immature stages of spider mites and *C. cephalonica* egg as prey on the biology of *C. z. sillemi.* The impact of immature stages of spider mites as larval food of *C. z. sillemi* revealed that mite nymphs can be used as an alternate host to culture *C. z. sillemi* as compared to other stages. However *C. cephalonica* eggs were superior to mite nymphs The larval duration of *C. z. sillemi* increased when cultured on adult mites. The larval period was longer on mite nymphs (10.15 days) than on *C. cephalonica* eggs (8.57 days).The larval duration, pupal period, total developmental period, adult longevity, fecundity of *C. z. sillemi* and per cent hatchability of *C. z. sillemi* eggs were more when adults of spider mites were provided to the larval stages of *C. z. sillemi* as compared to *C.cephalonica* eggs as food.

Key words: *C. z. sillemi , C. cephalonica* eggs, *Tetranychus urticae Koch*

Okra or Bhendi, *Abelmoschus esculentus* (L.) Moench (Family: Malvaceae) is one of the important vegetable crops grown throughout the tropical and warm temperate regions of the world. In India, it is grown in both *Kharif* and summer seasons. Global production of 70 per cent of bhendi is produced in India, out of which 60 per cent is exported earning considerable foreign exchange. It is a balanced diet rich in carbohydrate (6.4%), protein (1.9%), fat (0.2%), and minerals (0.7%) (Kanwar and Ameta, 2007). The per capita vegetable consumption in India is only about 140 g, which is far below the minimum dietary requirement of 280 g day^{-1} person^{-1}. Globally, bhendi is cultivated in an area of 7.8 lakh ha with 49.9 lakh MT and 6.39 t ha^{-1} of production and productivity, respectively (www.ikisan.com, 2005). In India, bhendi is cultivated in an area of 3.1 lakh ha with 36.5 lakh MT and 9.59 t ha^{-1} of production and productivity (FAO, 2007). Bhendi is ravaged by many insect pests right from germination to harvest (Jagtab *et al*., 2007). Among the natural enemies, the common green lacewing, *Chrysoperla. zastrowi sillemi* is an important natural predator because of its potential to control a variety of soft bodied insects like aphids, coccids, mealy bugs, thrips, psyllids, whiteflies, and eggs and larvae of many lepidopteran pests and mites occurring on various crops(Rao and Satyanarayana, 1984). Considering the importance of green lacewing in bhendi ecosystem for the management of bhendi spider mites in an ecofriendly manner, the studies were taken up in the Biocontrol laboratory, TNAU, Coimbatore

Materials and Methods

Bhendi plants were raised in clay plots (30cm dia×20 cm ht) filled with soil and farm yard manure mixed at 3:1 ratio. These plants at 30days after sowing were infested with bhendi spider mites collected from field. Care was taken, to avoid the development of other pests, predators or parasitoids on these cultures by covering the plants with mylar film cage. Since the study involves effect of host plants on predator, no insectides were used. In case of spider mites, care was taken to clean silken webs formed by mites to avoid trapping of predators in the silken web. In all the above experiments 8 number of *C. z. sillemi* larvae were used, representing one replicate. The numbers of spider mites killed or partially eaten were counted, using 10X Gowland, hand lens. The experiments were conducted in the laboratory at room temperature of 27±2°C at 60-80 % RH. To study the influence of spider mites from bhendi hosts on the development of *C. z. sillemi*, 250 newly emerged grubs were transferred to plastic basins (40 cm dia.), covered with gada cloth and fed with mites cultured on bhendi. A check was maintained on *C. cephalonica* eggs. Each treatment was replicated eight times. The grubs were observed daily for moulting until pupation and the larval period was worked out. On pupation the cocoons were separated and transferred to plastic containers (20 × 10 cm) with mesh window. They were observed daily for adult emergence and the pupal period was worked out.

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Results and Discussion

The data collected on the biology of *C. z. sillemi* cultured on mites nymphs and *C. cephalonica* eggs are presented in Table 1**.**The larval duration of *C. carnea* increased when cultured on mite adults. The larval period was longer on mites adults (10.15 days) than on *C. cephalonica* eggs (8.57 days). The larval duration, pupal period, total developmental period, adult longevity, fecundity and per cent egg hatchability of *C. z. sillemi* eggs were more when adults of spider mites were provided to the larval stages of *C. z. sillemi* as compared to *C.cephalonica* eggs as food. The total duration of larval period of *C. z. sillemi* was longer when reared on spider mites

Table 1. Developmental parameters of *C. z. sillemi* reared on bhendi spider mite adults and *C.cephalonica* eggs

Developmental parameter of *C. z. sillemi*	On Spider mite Adults (Mean ± SE)	On *C. cephalonica* eggs (Mean ± SE)
Larval period (Days)		
I instar	2.91 ± 0.06	1.69 ± 0.06
II instar	3.52 ± 0.08	2.27 ± 0.08
III instar	3.71 ± 0.10	4.60 ± 0.10
Total larval period (Days)	10.15 ± 0.23	8.57 ± 0.23
Pupal period (Days)	10.16 ± 0.10	7.95 ± 0.10
Developmental period (Days)	22.43 ± 0.31	19.42 ± 0.31
Adult longevity (Days)	30.02 ± 0.78	27.65 ± 0.78
Fecundity (Eggs/female)	188.68 ± 4.57	373.40 ± 4.57
Hatchability (%)	68.95 ± 1.86	71.30 ± 1.86

Mean of 8 replications

as prey as compared to *C. cephalonica* eggs. Among the immature stages of the prey *viz.,* larva, protonymph and deutonymph, deutonymph was the most preferred prey followed by protonymph and larva. The total developmental period was 21.76 to 23.10 days on immature stages of spider mites where as it was 20.00 days on *C.cephalonica* eggs. The per cent adult emergence and adult longevity were also influenced by the nature of prey given to *C. z. sillemi* larvae .The per cent adult emergence and adult longevity was more when *C.cephalonica* eggs were provided (Table 2). The Pre-oviposition period, oviposition period, oviposition/day/female, fecundity, per cent hatchability of eggs and post

Table 2. Developmental parameters of *C. z. sillemi* reared on immature stages of spider mites

Developmental parameter of *C. z. sillemi*	Host			
	Spider mite			*C. cephalonica* egg
	Larva	Protonymph	Deutonymph	
Larval period (Days)				
I instar	3.12$_{d}$	2.90$_{c}$	2.72$_{b}$	1.74$_{a}$
II instar	3.71$_{c}$	3.41$_{b}$	3.37$_{b}$	2.34$_{a}$
III instar	3.87$_{c}$	3.67$_{b}$	3.60$_{b}$	4.74$_{a}$
Total larval period (Days)	10.70$_{c}$	9.98$_{b}$	9.84$_{b}$	8.82$_{a}$
Pupal period (Days)	9.44$_{c}$	9.18$_{c}$	8.88$_{b}$	8.19$_{a}$
Developmental period (Days)	23.10$_{c}$	22.47$_{b}$	21.76$_{b}$	20.00$_{a}$
Adult emergence (%)	64.77$_{bc}$	65.25$_{b}$	63.26$_{c}$	61.66$_{a}$
Adult longevity (Days)	64.77$_{bc}$	65.25$_{b}$	63.23$_{c}$	60.59$_{a}$

Mean of 8 replications

In a row, means followed by same letter are not significantly different by DMRT (P=0.05)

oviposition period *C. z. sillemi* which was reared on spider mite nymphs during the larval instars was compared with that of reared on *C.cephalonica* eggs. In general, *C.cephalonica* eggs were more preferred than the spider mite nymphs (Table 3). The oviposition by the adult *C. z. sillemi* and fecundity are more on *C.cephalonica* than on spider mite nymphs which differed significantly.

C. z. sillemi has been widely acclaimed as efficient biocontrol agents because of its ubiquitous nature, polyphagous habits, and tolerance to selected chemical pesticides, microbial agents and amenability to mass rearing. Natural organic farming emphasises avoidance of fertilizer and pesticides. Integrated pest management (IPM) combined with organic practices will be a better alternative in plant protection. Among the components of IPM, biological control occupies an important position due to environmental safety and global demand for pesticide residue free food. The percentage of hatchability of eggs ranged between 60.28 and 72.00 per cent when *C.carnea* was cultured on different instars of leafhopper. Gautam (1994) reported a mean hatchability of more than 80 percent in Coimbatore, Bangalore and Delhi stock of *C. carnea* when reared on *A. craccivora* and eggs of *C. cephalonica* and *E. vitella*.

Studies carried out to assess the impact of immature stages of spider mites as larval food of *C. z. sillemi* revealed that mite nymphs can be used as an alternate host to culture *C. z. sillemi* as compared to other stages. However *C. cephalonica* eggs were superior to mite nymphs. Fecundity of *C. z. sillemi* was higher in the *C.cephalonica* compared to immature stages of mites. Spider mites usually construct are found to exhibits silken webs among the colonies This may be a hinderance for the activity of *C. z. sillemi*. Similar finding was observed by Obrycki *et al*. (1989) where the silk produced by the neonates of *Ostrinia nubilalis* acted as a physical entanglement of *C.carnea.*

Table 3. Developmental characteristic of C. *z. sillemi* reared on immature stages of spider mites and *C.c* eggs

Developmental characteristic	I instar		II instar		III instar	
of *C. z. sillemi*	Mite nymph	*C.cephalonica* (Egg)	Mites nymph	*C.cephalonica* (Egg)	Mites nymph	*C.cephalonica* (Egg)
Pre-oviposition period (Days)	5.97_{d}	6.50_{b}	4.93_{d}	5.72_{ab}	5.20_{c}	5.83_{a}
Oviposition period (Days)	24.50_{b}	36.95_{a}	22.29_{b}	32.19_{a}	20.38_{c}	31.58_{a}
Oviposition/day/ female	17.85_{b}	25.80_{a}	14.90_{b}	21.20_{a}	13.77_{c}	21.58_{a}
Fecundity (Eggs/female)	194.39_{b}	386.39_{a}	176.56_{b}	369.76_{a}	179.84_{b}	396.39_{a}
Hatchability (%)	68.96_{a}	70.33_{a}	64.12_{b}	74.30_{a}	64.25_{b}	70.29_{a}
Post-oviposition period (Days)	6.52_{c}	9.12_{a}	6.16_{cd}	8.72_{a}	5.85_{d}	8.19_{b}

Mean of 8 replications

In a row, means followed by same letter are not significantly different by DMRT (P=0.05)

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