RESEARCH ARTICLE

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Evaluation of Feeding Potential of *C. scelestes* on Different Developmental Stages of Noxious Pests

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ABSTRACT

Biological control is one of the most potent components of IPM. Chrysopids, popularly known as green lacewings are one of the most active predators of many noxious insect pests in different crops. Feeding potential of C. scelestes on various noxious pests was determined by feeding on different types of aphids, eggs of lepidopeteran insects, neonate larval stages and immature stages of fulgurids, jassids and mealy bugs. The data was collected on parameters such as prey consumed, G.R.I., cocoon wt., and larval period. In the present findings, a broad range of hosts was preferred; however the quantity of prey consumed by different unal instars of C. scelestes during their development differed.
Key words: *Feeding Potential, C. scelestes, Noxious Pest*

INTRODUCTION:

The concept of IPM was first pronounced by Geiger and Clark and subsequently stressed by Food and Agricultural Organization (FAO). Panel experts and other scientists (Hagen, *et al.*, 1971; Rabb, 1971 and van den Bosch, *et al.*, 1976) have strongly suggested the adoption of IPM technology. The biological control is one of the most potent components of IPM. Among different biological strategies, viz; parasites, predators and pathogens, which are known to occur in crop ecosystem, the chrysopids popularly known as green lacewings or golden eyes are one of the most active predators and have considerable economic importance because of their role in natural control of many noxious insect pests in different crops. Quaintance and Brues (1905) reported that the larvae of green lacewings are the predators of boll worm in cotton.

Chrysopids are cosmopolitan in distribution and have been reported from various countries of the world. One thousand three hundred and fifty species of the family are known to occur in different parts of the world except New Zealand (Tjeder, 1966). Mehta, *et al.*, (1986) surveyed the natural enemies associated with chickpea, grown alone and intercropped with mustard, wheat, barley and linseed in Delhi, India and *Chrysoperla* species were found as one of the potential predators. Meizulski, *et al.*, (1987) presented the results of a sweep-net study of insects preying on aphids in fields of winter wheat and spring barley in East Central Polland and reported about 8,850 adults and more than 12,000 larvae of coccinellids, 1,000 adults and nearly 5,000 larvae of chrysopids and about 8,000 syrphid larvae. Among chrysophids, *C. carnea* was most abundant.

Debnath, *et al.*, (1988) for the first time reported eight species of aphidophagous Neuroptera from Uttar Pradesh, India. The species found were *A. boninensis*, *A. obvia*, *C. desyphlebia*, *C. himalayana*, *C. murrnensis*, *Chrysopidia garhwalensis*, *Cunctochrysa jubingensis* and *Italo chrysaaegualis*. Thakur and Pawar (1988) reported for the first time the larvae of *Chrysoperla sp.* feeding on *Erioso malanigerum* in the apple orchards in Kullu valley (H.P.), India. Research on this bio-agent will lay a good foundation for the proper and effective utilization of *C. scelestes* for the management of insect pests of several crops.

The above mentioned facts prompted investigation of the feeding potential of predator *C. scelestes* on different noxious pests as a step towards it use in IPM.

MATERIAL AND METHOD :

Studies on feeding potential of *C. scelestes* were carried out at department of Entomology, Rajasthan College of Agriculture (R.C.A.) Campus, Udaipur. The nucleus culture of *C. scelestes* was obtained from department of Entomology, Rajasthan College of Agriculture (R.C.A.) Campus, Udaipur, and maintained in the laboratory throughout the period of study.

The larvae were reared individually in plastic cubicles of 3 x 2.5 cms. size to avoid cannibalism (Barnes, 1975; Olkowski, *et al.*, 1992). The feeding potential at the larval stages, biology and the reproductive potential of the adults was investigated by feeding the larvae on different types of aphids, eggs of lepidopterous insects, neonate larval stages and immature stages of fulgurids, jassids and mealybugs.The details of insect pests targeted for feeding were as:

(a) Aphids:

Nyzus nerii, Boyr. (aak aphid), *Brevicoryne brassicae*, Linn. (cabbage aphid), *Lipaphis erysimi*, Kalt. (mustard aphid), *Aphis gossypii*, Glov. (cottonaphid), *Rhopalo siphummaidis*, Fitsch. (barely aphid), *Dactynotus carthamii*, HRL. (safflower aphid), *Therioaphis maculata*, Linn. (leucerne aphid), *Hyadaphis corrianderi*, Das. (cumin aphid), and *Aphis craccivora*, Koch. (cowpea aphid).

(b) Immature Stages of:

Pyrilla perpusilla, wlk. (sugarcane leaf hopper), *Saccharicoccus sacchari*, cki. (mealy bug), *Amrasca biguttulabiguttula*, Ishida. (cottonjassid), *Thrips tabaci*, Lind. (onion thrips), and *Bemisia tabaci*, Genn. (white fly).

(c) Neonate Larvae of:

Corcyra cephalonia, Staint. (rice grain moth), *Helicoverpa armigera*, Hüb. (gram pod borer), *Spodoptera litura*, Fitsch. (tobacco caterpillar), and *Chilo partellus*, Sin. (sorghum stem borer).

(d) Eggs of:

Corcyra cephalonia, Staint. (rice grain moth), *Helicoverpa armigera*, Hüb. (gram pod borer), *Spodoptera litura*, Fitsch. (tobacco caterpillar), *Chilo partellus*, Sin. (sorghum stem borer), and *Pyrilla perpusilla*, wlk. (sugarcane leaf hopper).

RESULT AND DISSCUSION:

The data indicated maximum predation on mustard aphid, followed by cowpea and leucerne, and were statistically at par approximately. Safflower aphid was the least preferred food similarly, maximum growth rate of *C. sceiestes* was on cowpea aphid and least on safflower aphid. The relative growth rate picture indicated 2.4, 2.3, 1.9, 1.7, 1.79, 1.72, 1.70 and 1.55 times greater in cowpea, mustard, leucerne, cabbage, barley, aak, cumin and cotton aphids, when compared with growth rate index of safflower taken as 1.

When freshly laid eggs of *C. cephalonica*, *H. armigera*, *Shitura*, *C. partellus* and *P. perpusilla* were offered for predation to different larval instars, the total consumption by the predator was maximum in case of *C. cephalonica* and remained statistically superior to rest of the treatments. The least preference was shown by the predator for *S. litura* eggs. While comparing the growth index, maximum growth rate index was observed in *C. cephalonica* eggs fed larvae and least in the case of *S. litura* eggs fed larvae. All the three larval instars of *C. scelestes* consumed neonate larvae of different lepidopterous insect pests. The pool data indicated that *C. cephalonica* larvae were the most preferred host for predation and the least preferred host was *S. litura* larvae. The growth rate index was maximum of *C. cephalonica* (75.85) followed by *H. armigera* (70.17) and *C. partellus* (56.15). The predator larvae fed on neonates of *S. litura* could not spin cocoons and died at the last larval instar. Feeding potential of *C. scelestes* on the immature stages of sugarcane jassid, cotton jassid, mealy bug of sugarcane, white fly of tobacco and onion thrips revealed that whitefly was the most preferred host which was at par with onion thrips and statistically superior than rest of the three treatments. Among the three other treatments, the least preferred host was sugarcane leaf hopper, which was significantly superior to rest of the treatments. However, the growth rate index was maximum in sugarcane leaf hopper fed predators (77.58) and least in onion thrips fed predators (49.32).

Table 1: Feeding potential of *C. scelestes* on different aphids & G.R.I.

S.No	Aphid Species (Common Name)	Average number of prey consumed by different larval instars			Average number of prey consumed during larval stages	Average larval period (in days)	Weight of cocoon (in mg)	Growth rate index	Relative picture of growth rate index
		I	II	III					
1.	*Aphis craccivora, Koch.* (Cowpea aphid)	21.2	62.2	264.2	347.60	9.20	10.30	111.95	2.424
2.	*Lipaphiserysimi, Kalt.* (Mustard aphid)	23.4	60.8	263.6	349.80	9.60	10.20	106.25	2.300
3.	*Therioaphismaculata, Linn.* (Leuceme aphid)	21.8	58.8	261.0	341.60	10.60	9.50	89.62	1.940
4.	*Brevicorynebrassicae, Linn.* (Cabbage aphid)	17.2	50.4	241.4	309.00	11.20	9.30	83.03	1.797
5.	*Rhopalosiphummaidis,* Fitsch. (Barely aphid)	18.6	54.0	240.8	313.40	11.00	9.10	82.72	1.791
6.	*Nyzusnerii,* Boyr (Aak aphid)	16.6	49.4	227.6	293.60	11.00	8.75	79.54	1.722
7.	*Hyadaphiscorrianderi,*Das. (cumin aphid)	18.4	48.8	206.8	274.00	10.80	8.50	78.70	1.704
8.	*Aphis gossypii*, Glov. (cotton aphid)	16.2	46.4	214.6	277.20	11.40	8.20	71.92	1.557
9.	*Dactynotuscarthamii,*HRL. (safflower aphid	14.2	47.6	169.4	231.20	14.40	6.65	46.18	1.000

Table 2: Feeding potential of *C. scelesteson* eggs of different pests and the G.R.I.

S.No.	Eggs of prey species.	Average number of eggs consumed by different larval instars			Average number of prey consumed during larval stages	Average larval period (in days)	Weight of cocoon (in mg)	Growth rate index	Relative picture of growth rate index
		I	II	III					
1.	*Corcyra cephalonia*, Staint. (rice grain moth)	24.6	100.8	505.2	630.60	7.40	10.40	140.54	2.294
2.	*Helicoverpaarmigera,* Hüb. (gram pod borer)	20.0	86.4	386.2	492.60	9.20	8.50	92.39	1.508
3.	*Pyrillaperpusilla,*wlk. (sugarcane leaf hopper)	23.0	85.6	369.0	477.60	11.40	8.50	74.56	1.217
4.	*Chilopartellus,*Sin. (sorghum stem borer)	23.6	83.4	357.0	464.00	11.20	7.75	69.19	1.129
5.	*Spodopteralitura,*Fitsch. (tobaccocaterpillar)	22.6	83.6	278.4	384.60	12.00	7.35	61.25	1.000
S Em ±		0.79	3.67	7.30	8.89	0.65	0.127		
C D at 5%		2.37	11.27	21.90	26.65	1.95	0.417		

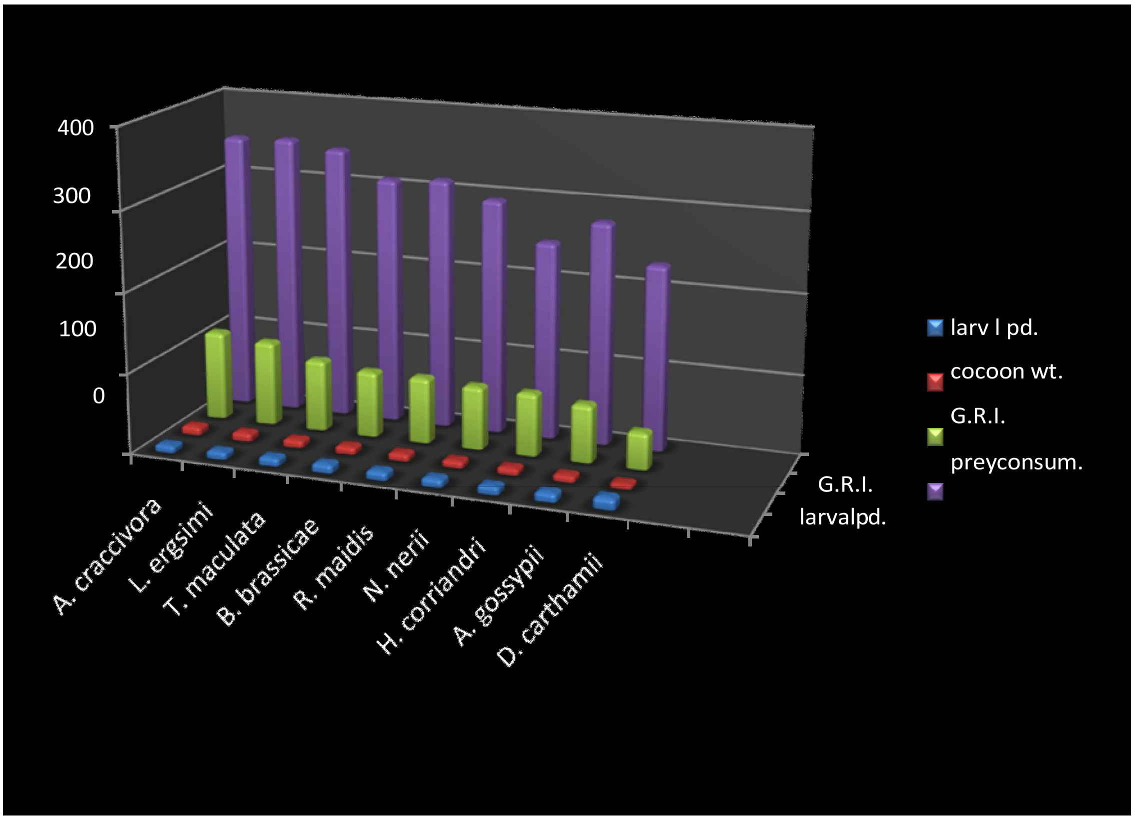

Fig. 1: Feeding potential of C. scelesteson different aphids & G.R.I.

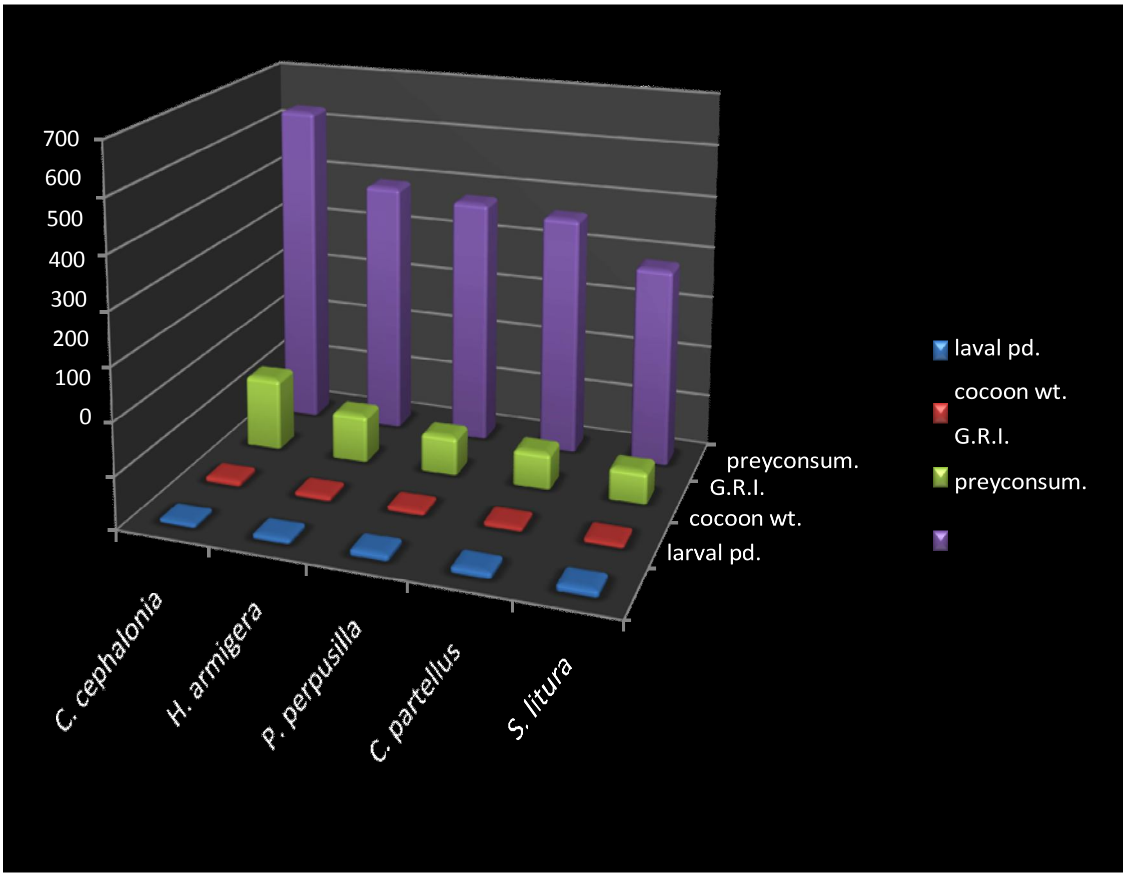

Fig. 2: Feeding potential of *C. scelestes* on eggs of different aphids & G.R.I.

Table 3: Feeding potential of *C. scelestes* on nymphs of different pests and the G.R.I.

S.No.	Eggs of prey species of different nymphs	Average number of prey consumed by different larval instars			Average number of prey consumed during larval stages	Average larval period (in days)	Weight of cocoon (in mg)	Growth rate index	Relative picture of growth rate index
		I	II	III					
1.	*Pyrillaperpusilla,* wlk. (sugarcane leaf hopper)	11.4	38.2	108.4	158.00	11.6	9.0	77.58	1.572
2.	*Amrascabiguttula, Ishida.* (cotton jassid)	21.8	65.0	351.8	338.60	12.2	9.0	73.77	1.495
3.	*Saccharicoccussacchari, cki.* (mealy bug)	33.6	47.6	233.8	315.00	13.2	7.4	56.06	1.136
4.	*Bemisia tabaci, Genn.* (white fly)	31.4	129.5	290.5	451.40	13.4	7.1	52.98	1.074
5.	*Thrips tabaci,* Lind. (onion thrips)	28.2	88.5	322.5	439.20	14.8	7.3	49.32	1.000
S Em ±		1.24	2.35	5.41	6.36	0.57	0.110		
C D at 5%		3.72	7.34	16.90	19.06	1.71	0.349		

Table 4: Feeding potential of *C. scelesteson* Neonate larvae of different pests and the G.R.I.

S.No.	Larvae of prey species.	Average number of larvae consumed by different larval instars			Average number of prey consumed during larval stages	Average larval period (in days)	Weight of cocoon (in mg)	Growth rate index	Relative picture of growth rate index
		I	II	III					
1.	*Corcyra cephalonia, Staint. (rice grain moth)*	22.2	94.2	324.2	440.60	10.4	7.9	75.48	1.344
2.	*Helicoverpaarmigera, Hüb. (gram pod borer)*	18.2	72.6	309.4	400.20	11.4	8.0	70.18	1.249
3.	*Chilopartellus, Sin. (sorghum stem borer)*	20.6	75.2	288.6	384.40	13.0	7.3	56.15	1.000
4.	*Spodopteralitura, Fitsch. (tobacco caterpillar)*	16.2	55.2	191.0	262.40	13.2	-		
S Em ±		0.97	2.68	7.98	15.08	0.35	0.207		
C D at 5%		2.98	8.25	24.57	46.44	1.08	0.653		

All chrysopid larvae naturally feed on small, soft bodied arthropods. They are characterstically highly voracious and often have a broad prey range (Parisar, 1919). But this large host diversity should not obscure the true prey habit of various chrysopids. If prey is easily available, it is likely to be eaten and is preferred and provides effective predator growth, high survival of adult and unimpaired fecundity. Earlier studies made on feeding potential of *Chrysoperla sp.* larvae feeding on eggs (Sengonca and Coeppicus, 1985; Patel, 1985; Butler and Henneberry, 1988: Kaya and Oncuer, 1988; Obryki *et al.*, 1989; Balsubramani and Swamiappan, 1994; Greenberg *et al.*, 1994 & Legaspi. 1994 on neonate larvae (Krishnamoorthy and Mani, 1982 & Krishnamoorthy, 1988), on nymphs and adults of aphids (Lefroy, 1909; Wildermuth, 1916; Bhagat and Masoodi, 1986; Thakur *et al.*, 1988; Patnaik and Bhagat, 1989: Rana *et al*, 1992; Yuksel and Gocmen, 1992: Balsubramani and Swamiappan, 1994 & Singh and Singh, 1994), suggested that Chrysoperla is a voracious feeder with host diversity.

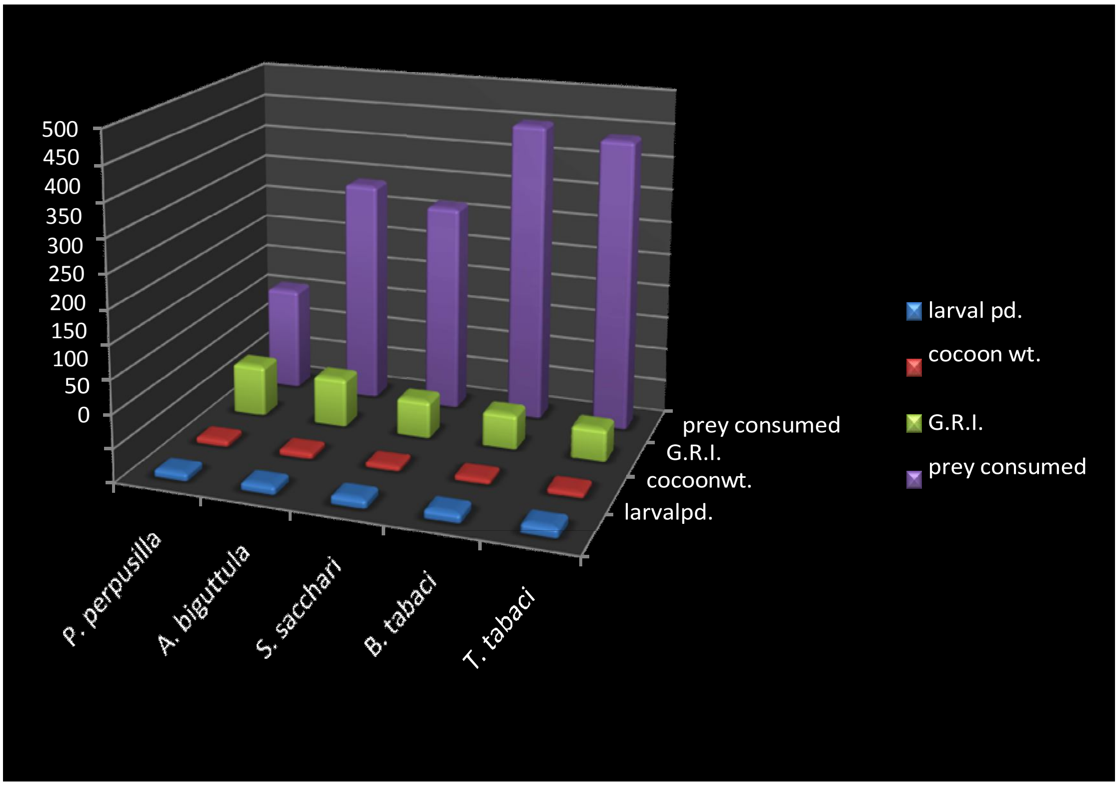

Fig. 3: Feeding potential of *C. scelestes* on nymphs different pests & G.R.I.

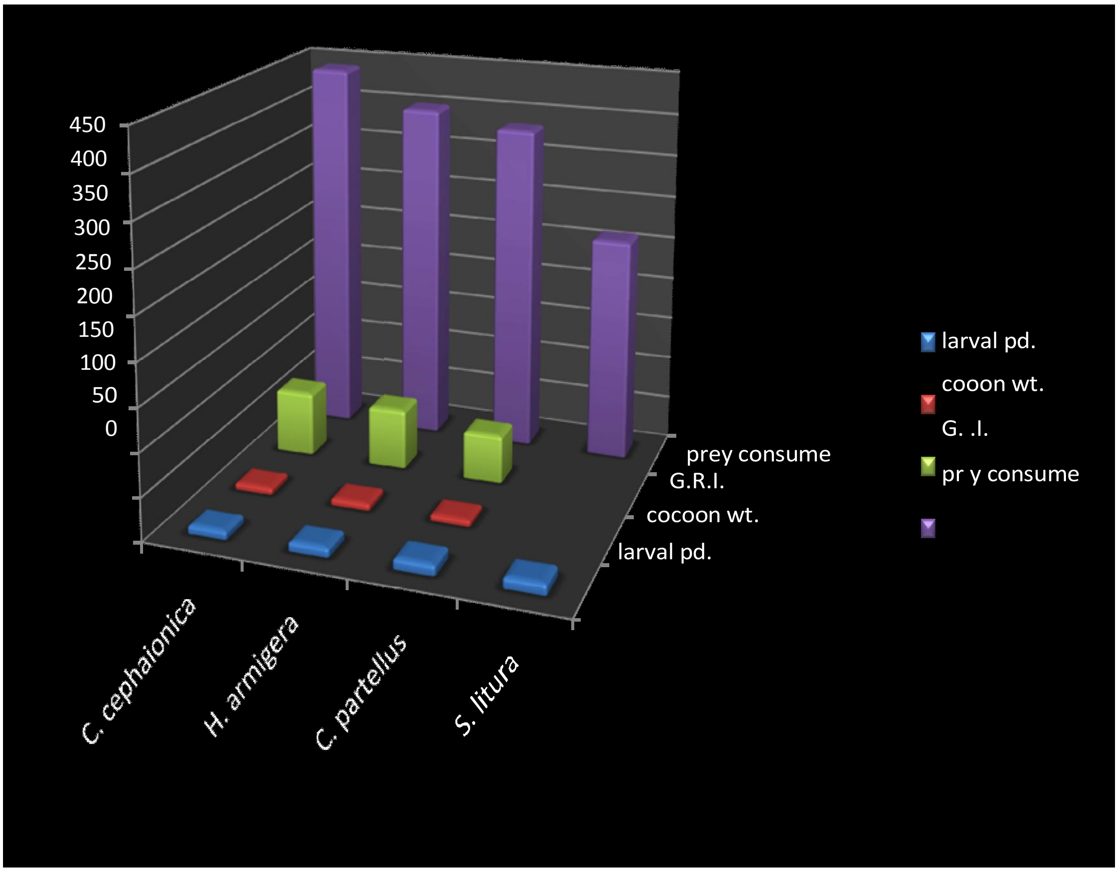

Fig. 4: Feeding potential of *C. scelestes* on neonates different pests & G.R.I.

In the present findings also a broad range of hosts was preferred, however the quantity of prey consumed by different unal instars of *C. scelestes* during their development differed from the observations of other workers to a great extent Among the aphid feed, maximum consumption (349.80) was recorded on mustard aphid and least on safflower aphid (231.20). Earlier workers have suggested that this change in food consumption has been attributed to variation in temperature (Sundby 1966; Scopes 1969 and Zaki 1987), feeding stimulating kairomones (Nordlund *et al*., 1977) and overcrowding of the host (Canard 1984). It is therefore clear that the methodology for quantifying food consumption generally needs more critical appraisal, only then, a proper comparison can be made. The data indicated that safflower aphid was the least preferred host. Moreover, its predation also affected the development and other vital functions of the predator. Similarly, there are other examples where preys were normally accepted and eaten by the chrysopid and its development was hindered to a great extent. The cushion scale *Icerya sp.* are regarded as unsuitable prey for *C.carnea* in Egypt (Awadallah, *et al*, 1976), though *leena purchasi* is well tolerated by *Anisochrysa boninensis* in Japan, yet it is not a proper host (Kuwayama, 1962). It was also observed that *Chrysoperla* larvae fed on *S. litura* neonates could moult to the final larval stage but failed to spin cocoons .Similar observations were made by Canard (1973) when *Chrysoperla* was fed on *Micro siphumrosae* and *C. rufilabrison*. *Drossophila melanogaster* adult and *Telranychus gloveri*, *S. litura* neonates induced differential retardation or suppression in the pupal development and it gets support from the findings of Hydorn and Whiteomb (1979). The present study revealed that *C. scelestes* larvae are highly adaptive to the various ranges of prey species offered to them.

Among the diets of eggs of different hosts, the predator larvae consumed maximum number of the rice grain moth eggs (630.60). Which was quite close to the number (487.50) recorded by Anonymous (1994). This diet produced larvae with a minimum larval duration of 7.40 days which could spin healthy cocoons of 10.4 mg and showed maximum growth rate index (140.54). Eggs of *H.armigera* were next in choice by the predator which consumed 492.6 of them during its larval duration. However, 66.54 eggs were consumed by *C. scelestes* according to Krishnamoorthy and Mani (1982). Tobacco caterpillar eggs were the least preferred food which gave a prolonged larval duration of 12 days. From this data it may be concluded that *C. cephalonica* eggs clearly emerged to be the best diet for the predator. Again, *C. scelestes* when fed on neonate larvae of various hosts, consumed 440.6 neonates of the rice grain moth and 400.2 of *H. armigera,* which were close to the data (410 larvae) reported by Krishnamoorthy and Mani (1982).

Like eggs, the larvae of tobacco caterpillar were also not relished by the predator and the larvae so fed, died at the last larval instar. In all the diets offered, the rate of predation increased with the successive larval instars, reaching a peak in the third instar. This increase in the predation potential was consistent irrespective of the types of food consumed. These findings get support from the observations of earlier workers (Burke and Martin, 1956; Afzal and Khan, 1978; Bretell, 1979; Rana *et al*., 1992; Anonymous, 1994; Balsubramani and Swamiappan, 1994 & Klington *et al*., 1996).

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