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The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 1016-1019

www.thepharmajournal.com
Received: 18-05-2023
Accepted: 17-06-2023

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Studies on intraguild egg predation of *Micraspis* sp. by *Menochilus sexmaculatus* and *vice-versa* at Raipur, Chhattisgarh

Chunni Kumari, Nivedita Shah, Jayalaxmi Ganguli, SS Shaw and YK Yadu

Abstract
Studies on the intraguild egg predation of *Micraspis* sp. and *Menochilus sexmaculatus* were undertaken in the Bio-control Laboratory, Department of Entomology, IGKV, Raipur, Chhattisgarh during the year 2019-20 and 2020-21. During the study, it has been found that *M. sexmaculatus* predated more on eggs of *Micraspis* sp., such as 25 eggs of *Micraspis* sp. were predated by 4th and 3rd instar larvae followed by the female beetle of *M. sexmaculatus* with 23.90 eggs. Minimum predation 0.3 eggs were observed by the 1st instar larvae of *M. sexmaculatus.* However, maximum predation, i.e. (4.3) of eggs of *M. sexmaculatus* was observed by the 4th instar larvae of *Micraspis* sp. followed by the female beetle and 3rd instar larvae i.e. (3.8) eggs of *Micraspis* sp. and minimum predation (0.10) was observed by the 2nd instar larvae and no predation was observed by the 1st instar larvae of *Micraspis* sp. Hence, Intraguild egg predation by *M. sexmaculatus* was more than that of *Micraspis* sp.

Keywords: Intraguild, predation, *Micraspis* sp., *Menochilus sexmaculatus*

Introduction
Ladybird beetles belonging to family Coccinellidae of the largest order Coleoptera are one of the economically important insects. They have immense potential to be used as biocontrol agents of several phytophagous pests, *viz*. aphids, scale insects, stages of other heterospecific ladybirds. Ladybirds can be effective biocontrol agents of numerous native and exotic pests in normal conditions (Symondson *et al.*, 2002) [7]. However, Intraguild predation (IGP) could negatively interfere and may slow down the outcome of biocontrol (Snyder and Wise, 1999) [6]. The intraguild predation (IGP) has been defined as “the killing and eating of species that use similar resources and thus are potential competitors” and it occurs in many insect communities when beneficial species share a pest species as their common prey (Polis and Holt 1992) [4]. It is a blending of predation and competition that plays a vital role in influencing some community structures. The determination of IGP seems counter intuitive as circumstances in which one consumer constantly eats both the prey base and intermediate consumers are evolutionarily unstable which results in elimination of weaker competitor. IGP results in the dominant species monopolizing the resources and a decrease in the abundance of competitors. Therefore, the present studies were undertaken to know the dominance of coccinellid beetles and laboratory experiments were performed to quantify the incidence of intraguild predation of eggs by two co-occurring ladybird species. These experiments revealed that all predatory stages preyed upon hetero specific eggs, but differently.
Therefore, the present studies were undertaken to know the dominance of coccinellid beetles and laboratory experiments were performed to quantify the incidence of intraguild predation of eggs by two co-occurring ladybird species. These experiments revealed that all predatory stages preyed upon hetero specific eggs, but differently.

Material and Methods
Adults of *M. sexmaculatus* and *Micraspis* sp. were collected from the cowpea field of the Horticultural Research Farm, IGKV, Raipur and reared in the Bio-Control Laboratory and paired in plastic petri dishes (9.0 cm diameter × 2.0 cm height) under constant conditions (27±2 ºC; 65±5% RH; 14L: 10D) in B.O.D. Incubator. The number of eggs laid by *M. sexmaculatus* were counted and 24 hours starved adult male and female beetles of *Micraspis* sp. were transferred to the petri-dishes containing 25 eggs of *M. sexmaculatus*, separately.

Observations were recorded by counting the number of eggs fed by the adult beetle of *Micraspis* sp. after every 24 hours.
Similar experiments were conducted to study the egg predation by 1st, 2nd, 3rd and 4th instar grub stages of *Micraspis* sp. and all the stages of *M. sexmaculatus* This experiment was replicated three times. Data were recorded by counting the number of eggs fed by the adult beetles and larvae of *M. sexmaculatus* and *Micraspis* sp. respectively.

Statistical analysis
The experimental data was analyzed statistically by doing an analysis of variance (ANOVA) developed by an eminent Scientist namely, Fisher. The value of the data was then converted into square root transformed values. The Critical difference (CD) values at 5% has been determined by using the following expression:

CD at 5% = SE of difference x $t_{0.05}$ for error degrees of freedom

Results
The results have been duly analyzed under the following sub heads:

Eggs predation of *Micraspis* sp. by various growth stages of *Menochilus sexmaculatus*
Significant differences were observed on the egg predation of *Micraspis* sp. by various growth stages of *Menochilus sexmaculatus*. Among all the stages, 4th and 3rd instar larvae were found to be highly voracious towards the heterospecific egg predation. Maximum egg predation *i.e.* (25.00) of *Micraspis* sp.was observed by the 4th and 3rd instar larvae of *M. sexmaculatus* followed by female beetle (23.90), and male beetle (17.20), 2rd instar larvae (13.30) but the 4th instar, 3rd instar larvae and female beetle were on par with each other and minimum predation (0.3) was observed by the 1st instar larvae of *M. sexmaculatus.*

Predation of eggs of *M. sexmaculatus* by different growth stages of *Micraspis sp*
Predation of eggs of *M. sexmaculatus* by different growth stages of *Micraspis* sp. was found to be significantly different with each other. Among all the stages, maximum predation, *i.e.* (4.30) of eggs of *M. sexmaculatus* was observed by the 4th instar larvae of *Micraspis* sp. followed by the female beetle and 3rd instar larvae *i.e.* (3.80) by *Micraspis* sp. but the egg predation by 4th instar, 3rd instar and female beetle were found to be on par with each other and minimum predation (0.10) was observed by the 2nd instar larvae and no predation was observed by the 1st instar larvae of *Micraspis* sp. (Table 1 and Fig.1)

Table 1: Eggs predation of *Micraspis* sp. by different growth stages of *M. sexmaculatus* and egg predation of *M. sexmaculatus* by different growth stages of *Micraspis* sp

Sl. No.	Different stages of *M. sexmaculatus*	No. of eggs (*Micraspis* sp.) given	No. of eggs (*Micraspis* sp.) fed	Different stages of (*Micraspis* sp.)	No of eggs (*M. sexmaculatus*) given	No. of eggs (*M. sexmaculatus*) fed
1	Female	25	23.88 (4.988)	Female	25	3.80 (2.178)
2	Male	25	17.22 (4.266)	Male	25	1.30 (1.517)
3	1st Instar	25	0.33 (1.138)	1st Instar	25	0.00 (1.000)
4	2nd Instar	25	13.33 (3.783)	2nd Instar	25	0.10 (1.047)
5	3rd Instar	25	25.00 (5.099)	3rd Instar	25	3.80 (2.16)
6	4th Instar	25	25.00 (5.099)	4th Instar	25	4.30 (2.30)
	C.D. @5%		0.283			0.466
	SE(m)±		0.091			0.151

Figure in parentheses indicate square root transformed values

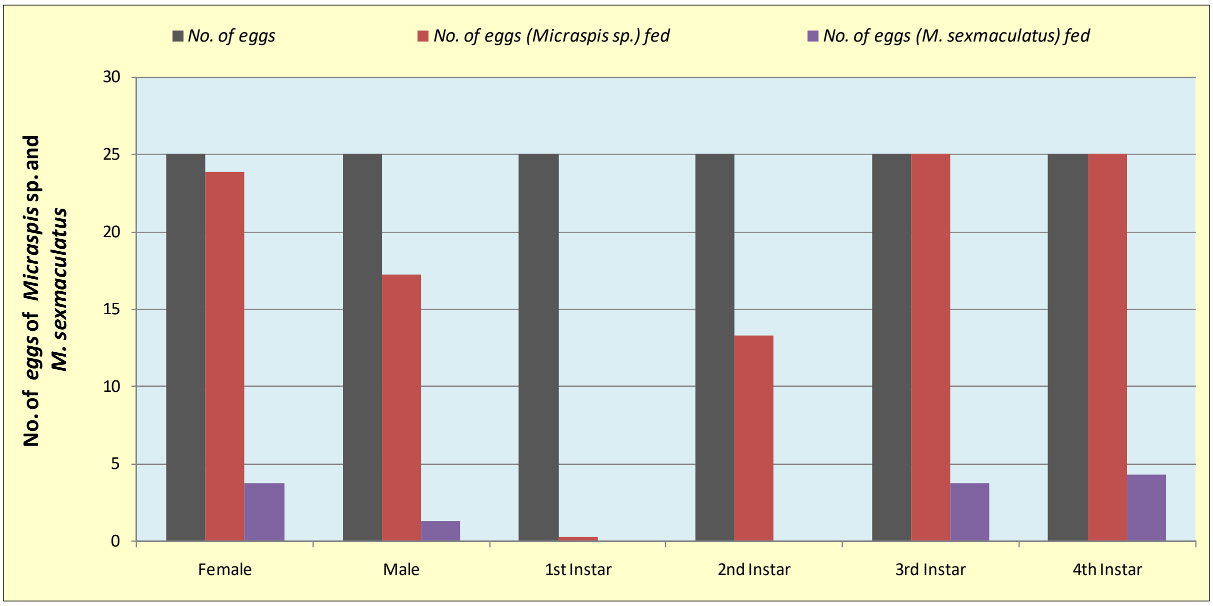

Fig 1: Eggs predation of *Micraspis* sp. by different growth stages of *M. sexmaculatus* and egg predation of *M. sexmaculatus* by different growth stages of *Micraspis* sp

Discussion

Thus, from the present studies on intra-guild predation of *Micraspis* sp. by different growth stages of *M. sexmaculatus* and *vice versa*, the results revealed that all larval instars along with adult male and female behaved differently in terms of heterospecific egg predation. Ladybird beetle's eggs were most likely to be protected from predation by defensive alkaloids, pyrazines and quinolenes. The alkaloids are synthesized by ladybirds and were reported to be found in all developmental stages (Agarwala and Yasuda 2001) [1]. Hence, *M. sexmaculatus* could act as intraguild predator in the absence of natural prey, *i.e.*, aphids, and could easily attack heterospecific eggs, which could be the reason for its successful establishment and cosmopolitan distribution.

The present study is partially in agreement with the findings of Pervez and Kumar, (2017) [5] who observed that the 1st instars and adult females of *M. sexmaculatus* significantly consumed a greater number of *Propylea dissecta* eggs and *vice versa*. Both first instar and adult female of *P. dissecta* showed reluctance in consuming hetero-specific eggs, which was not the case with the similar predatory stages of *M. sexmaculatus*.

Similar findings were also observed by the Maurice and Ramteke (2012) [3] in which they observed that the 4th instar larvae were the strongest predator as they have high feeding efficiency, and they are under the peer pressure to enter the pupation which is also in with the present findings.

The results were corroborated with the findings of Maurice and kumar (2012) [2] who observed that the fourth instar of *C. transversalis* favours to contact as well as devour conspecific eggs as compared to that of heterospecific eggs.

Hunger and food scarcity are mainly the reason and hence these factors were largely accountable for intraguild predation. The larva used to switch to an alternative food when they felt deficiency of indispensable food, which could be anything even a heterospecific larva. Consequently, there are potential costs allied with IGP. It is well acknowledged that the fourth instar is under peer pressure of pupation so that adult emergence may occur subsequently, so its voracity is higher. The less insatiable nature of fourth instar of *C. transversalis* was really difficult to explain evolutionarily and hence it needs more concern. The egg predation in Coccinellidae was usually associated with immature stages.

Fig 1: Eggs of *M. sexmaculatus* predated by *Micraspis* sp.

Fig 2: Eggs of *M. sexmaculatus* predated by *Micraspis* sp. grub.

Fig 3: Eggs of *Micraspis* sp. fed by grub of *M. sexmaculatus*

Fig 4: Eggs of *Micraspis* sp. fed by *M. sexmaculatus*

Conclusion

It can be concluded from the present studies that egg predation was more by the 4th and 3rd instar larvae of *M. sexmaculatus* and more egg predation was observed by the 4th instar larvae of *Micraspis* sp. and minimum egg predation was observed by the 1st instar larvae of both species. Hence, Intraguild egg predation by *M. sexmaculatus* was more than that of *Micraspis* sp.

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