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Diversity of noctuid parasitoids in vegetable ecosystems of Karnataka

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Abstract
The parasitiods emerged out of biological stages of noctuid caterpillars such as larvae and pupae were collected and documented with the host. A total of 14 species of parasitoids belonging to 12 genera were documented under two orders *viz.,* Diptera and Hymenoptera with eight families. Among these the family Braconidae is predominate under Hymenoptera whereas, Diptera is represented by a single family. The genus *Glyptapanteles* is more dominant with three species compare to other genera. One species was recorded as new to the science *i.e. Parapanteles* sp. (Braconidae) which was collected from *S. litura*.

Keywords: Caterpillars, Diversity, Noctuidae, Parasitoids, Vegetables

Introduction
The caterpillars belonging to family Noctuidae of order Lepidoptera are of great economic importance. Larvae of these noctuid moths are polyphagous and feed on different kind of vegetables, grasses, cereals, weeds, flowers and fruit crops. Many of these caterpillars cause serious damage to vegetable crops and affect the yield drastically. Some of the noctuid caterpillars such as *Helicoverpa armigera* (Hub.), *Spodoptera litura* (F.), *Spodoptera exigua* (Hub.), *Xanthodes transversa* (Fab.), *Anadevidia peponis* (Fab.), *Earias insulana* (Boisduval), *Earias vittella* (F.) are reported as the pest of vegetables in India (Nair, 1970, Sharma, 2011, Muddasar *et al.,* 2017) [3, 5, 21]. Several parasitoids have been reported to parasitize on noctuid caterpillars such as *S. litura* on different host plants in different parts of India.

Materials and methods
The present study was conducted during 2015-16 through survey in different parts of Karnataka. During the survey larvae of noctuid caterpillars were collected and reared in the laboratory till pupation and adult emergence. The parasitiods emerged out of biological stages such as larvae and pupae were collected and preserved separately in 70 per cent alcohol in 15 ml glass vials, each vial is labelled and were got identified by sending to Dr. Santhosh. S, Assistant Professor, T. C. Narendran Trust for Animal Taxonomy, Kozikod, Kerala.

Diversity of parasitoids was calculated by using Shannon wiener index formula

$$H^{1} = -\sum_{i=1}^{s} pi \ln Pi$$

Average temperature, rainfall and Elevation recorded during the study
Temperature (ºC): Max- 30 ºC Min-19 ºC
Relative Humidity (%): Max- 85.00% Min-67.00%
Rainfall (mm): 2.10 mm
Elevation- 770 m

Result and Discussion
The parasitiods emerged out of biological stages such larvae and pupae were collected and documented with the host insect. A total of 14 species of parasitoids were documented, belonging to eight families from five different species of noctuid caterpillars from vegetable ecosystem during 2015-16. Totally parasitoid species belonging to six families of Hymenoptera and one family of Diptera were recorded during study. Highest number of parasitoids were recorded from *S. litura,* (4 species), followed by *A. peponis* (3), *H. armigera* (3), *X. transversa* (2), and *E. vittella* (2). Out of these one species, *Parapanteles sp.* on *S. litura*

was reported as new to science (species description awaited). The family Braconidae of Hymenoptera was found dominant parasitoid group (7 species) followed by Ichneumonidae (2 species).

In the present study the larvae of *Spodoptera litura* were found parasitized by four different species of parasitoids. Among them, one was larval-pupal parasitoid belonged to family Ichneumonidae collected from potato ecosystem. Overall three larval parasitoids belonging to family Braconidae and Eurytomidae were recorded. Rao and Sathyanarayana, (1984) [4] reported four species of parasitoids from *S. litura* on tobacco *viz., Charops obtusa* Morle, (Ichneumonidae), *Apanteles africanus* Cameron, *Apanteles ruficrus* Halliday and *Apanteles marginiventris* Cresson (Braconidae). Whereas, *Parapanteles* sp. were reported as new to science and awaited for description. These species were found to parasitize the early instar larvae of *S. litura* in chilli ecosystem.

The larvae of *Helicoverpa armigera* found parasitized by two hymenopteran (Chalcididae and Ichneumonidae) and one dipteran (Tachinidae) parasitoid, all the three species were larval parasitoids. Ganeshan *et al.,* (1997) [1] reported four different species of parasitoids from *H. armigera* viz., *Trathala* sp. *Dolichogenidea* sp. *Brachymeria* sp. *Campoletis chlorideae*.

Two species of *Glyptapanteles* (Braconidae) were collected from the larvae of *Xanthodes transversa* from the bhendi ecosystem and both the species were larval parasitoids.

The larvae of Snake gourd semilooper, *Anadevidia peponis* were found parasitized by three different species of parasitoids, belonging to Braconidae, Bethylidae and Eulophidae and all were larval parasitoids.

The larvae of Bhendi shoot and fruit borer, *Earias Vittella* found parasitized by two species of parasitoids belonging to two different families such as Braconidae and Pteromalidae. Both the species were larval parasitoids. Sharma and Yadav (1996) [6] reported two species of parasitoids *viz., Bracon* sp and *Pteromalid* sp from bhendi shoot and fruit borer (*Earias* sp).

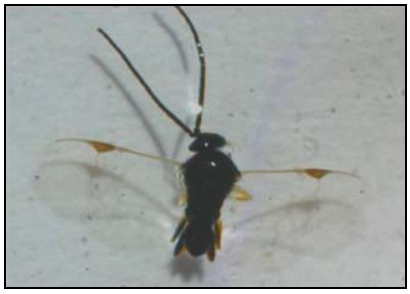
Table 1: Shannon wiener index (H ^{l}) values across different crop ecosystems and host insects during 2015-16.

S. No	Different crop ecosystems	Shannon wiener index (H ^{l})	Pielou's evenness	Host insect	Shannon wiener index (H ^{l})	Pielou's evenness
1	Okra	1.37	0.85	*Anadevidia peponis*	0.84	0.76
2	Sponge gourd	0.33	0.48	*Earias vittella*	0.58	0.84
3	Chilli	0.61	0.88	*Xanthodes transversa*	0.66	0.95
4	Snake gourd	-	-	*Spodoptera litura*	1.14	0.82
5	Pigeon pea	0.68	0.98	*Helicoverpa armigera*	0.96	0.87
6	Tomato	0.41	0.59			
7	Potato	-	-			

The diversity of noctuid parasitoids across different crop ecosystems reveals that, highest species of parasitoids were observed under okra ecosystem (1.37) with evenness (0.85). Whereas, diversity of parasitoids with respect to host insects reveal that *S. litura* being polyphagous it is highly parasitizes with more species of caterpillars followed by *H. armigera* (Table. 1).

Table 2: List of parasitoids recorded from the noctuid caterpillars infesting vegetable crops in Karnataka.

S. No	Parasitoid	Family	Host	Host stage	Locality
1	*Apanteles* sp.	Braconidae	*Anadevidia peponis*	Larva	Bagalkot
2	*Bracon* sp.1	Braconidae	*Earias vittella*	Larva	Bagalkot
3	*Glyptapanteles* sp.	Braconidae	*Xanthodes transversa*	Larva	Bagalkot
4	*Glyptapanteles* sp. 1	Braconidae	*Xanthodes transversa*	Larva	Belgaum
5	*Glyptapanteles* sp. 2	Braconidae	*Spodoptera litura*	Larva	Bagalkot
6	*Parapanteles* sp	Braconidae	*Spodoptera litura*	Larva	Bagalkot
7	*Goniozus lygropiae*	Bethylidae	*Anadevidia peponis*	Larva	Bagalkot
8	*Brachymeria* sp.	Chalcididae	*Helicoverpa armigera*	Larva	Bagalkot
9	*Eurytomid* sp.	Eurytomidae	*Spodoptera litura*	Larva	Bagalkot
10	*Pediobius* sp.	Eulophidae	*Anadevidia peponis*	Larva	Bagalkot
11	*Neofacydes* sp.1	Ichneumonidae	*Spodoptera litura*	larva- pupa	Mudigere
12	*Nepiera* sp.1	Ichneumonidae	*Helicoverpa armigera*	Larva	Bagalkot
13	*Pteromalid* sp.	Pteromalidae	*Earias vittella*	Larva	Bagalkot
14	*Tachinid* sp.	Tachinidae	*Helicoverpa armigera*	Larva	Bagalkot



Parapanteles sp.

Bracon sp.

Glyptapanteles sp.2

Glyptapanteles sp.1

Glyptapanteles sp.

Pediobius sp.

Apanteles sp.

Brachymeria sp.

Fig 1: Parasitoids of family Braconidae and Chalcididae

Nepiera sp.1

Neofacydes sp.1

Pteromalid sp.

Goniozus lygropiae

Tachinid sp. *Eurytomid* sp.

Fig 2: Parasitoids of family Ichneumonidae and others

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