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Survey Studies on Seasonal Abundance of Parasitoids associated with *Cnaphalocrocis medinalis* Guenee in Zone I and Zone II of Himachal Pradesh, India

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ABSTRACT

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Seasonal abundance studies on parasitoids associated with rice leaf folder, *Cnaphalocrocis medinalis* were carried out during 2015 and 2016 in two agro-ecological zones of Himachal Pradesh i.e. Zone I (Sundernagar and Nurpur) and Zone II (Palampur and Jogindernagar). Five parasitoids namely, *Cotesia cypris* Nixon, *C. ruficrus* Haliday, *Trathala flavoorbitalis* Cameron, *Elasmus* sp., and tachnid fly were recorded to be specific to rice leaf folder larvae. Parasitization of rice leaf folder larvae by *C. cypris* varied from 7.14 to 44.45 per cent which was found to be the higher in all the four locations followed by tachnid fly (4.55-15.38%).

Introduction

Rice (*Oryza sativa* L.) is cultivated extensively in the most diverse ecosystems of tropical and subtropical regions of the world (Karthick *et al.*, 2014). Rice crop has a relatively large number of insect-pests associated with it which attack the rice crop from nursery stage till harvest. Of hundred insect-pests attacking rice nearly 20 species had been reported as major pests (Basit and Bhattacharya 2001). The yield loss due to insect-pests of rice ranges from 25 to 51 per

cent (Panda and Rath, 2003). Among various pests of rice, *Cnaphalocrocis medinalis* has been observed to be major and serious pest due to over use of insecticides, monocropping, introduction of high yielding varieties and adoption of new agronomic practices (Litsinger *et al.*, 1987). The yield losses due to this pest were reported to be about 11.2 per cent in India (Shanmugam *et al.*, 2006).

Several natural enemies (predators, parasitoids and pathogens) under field conditions play a dominant role in maintaining several species

of insect-pests of rice below economic threshold level. A diverse complex of natural enemies has been found associated with rice leaf folder, which includes over 200 different species of parasitoids, predators and pathogens all over Asia and Pacific (Khan *et al.*, 1988). Among parasitoids, *Trichogramma chilonis* (Ishii) and *Apanteles cypris* (Nixon) were most abundant in rice fields. In Gujarat, Korat and Pathak (1996) reported egg parasitoids (*T. chilonis*), larval parasitoid (*Apanteles* sp. and *Goniozus* sp.) and pupal parasitoids (*Tetrastichus howardi* Olliff and *Anatrichus* sp.) associated with rice leaf folder. Hence, these natural biological control agents are responsible for managing the population of rice insect-pests whenever suitable conditions prevail for the survival, development, conservation and multiplication (Bhattacharya *et al.*, 2006).

In Kangra valley of Himachal Pradesh, Kumar *et al.*, (1997) observed seven species of parasitoids and five of predators prevalent in rice ecosystem. The information currently available on natural enemies associated with rice leaf folder from Kangra valley of Himachal Pradesh is still scanty. Keeping in view the above facts, an attempt was made to document the potential parasitoids associated with leaf folder larvae and their parasitism rates from Himachal Pradesh.

Materials and Methods

Survey on the prevalence of parasitoids associated with rice leaf folder larvae was made at fortnightly interval in two agro-ecological zones of Himachal Pradesh *i.e.* Zone I and II. Two locations in each agro-ecological zone and four different localities in each location were selected for recording the abundance of parasitoids associated with rice leaf folder larvae starting from June to November during *kharif* 2015 and 2016. Details of locations and localities surveyed for

recording abundance of parasitoids are given in Table 1.

On an average, 100 folded leaves were collected at 15 days intervals from all the four locations and from these folded leaves, larvae of leaf folder were collected. Larvae were reared individually in collection vials. To maintain the turgidity of leaf bits, moistened cotton wool covered with filter paper was used. The leaf bits were changed every 24 hours till the larvae pupated. The larvae and pupae were observed for the emergence of parasitoids.

The per cent parasitization was calculated as below:

$$\% \text{ parasitization} = \frac{\text{Number of parasitized larvae}}{\text{Total number of leaf folder larvae}} \times 100$$

Results and Discussion

Seasonal abundance of parasitoids associated with *Cnaphalocrocis medinalis*

Rearing of field collected larvae of rice leaf folder resulted in emergence of larval parasitoids and the data on per cent parasitization by parasitoids is being presented in Table 2 to 7.

Sundernagar

The data recorded on number of parasitized larvae from total number of leaf folder larvae during 2015 presented in Table 2 revealed that five species of parasitoids namely, *Cotesia cypris*, *C. ruficrus*, *Elasmus* sp., *Trathala flavorbitalis* and tachnid fly were found to be associated with leaf folder (Fig. 1). The parasitization initiated from first fortnight of August and remained until second fortnight of

October. Total number of leaf folder larvae from 100 damaged leaves varied from 2.00 to 22.00 and the number of parasitized larvae ranged between 1.00 to 10.00. During second fortnight of September, the per cent parasitization (31.25%) was maximum by *C. cypris* followed by tachnid fly, *C. ruficrus*, *Elasmus* sp., and *T. flavoorbitalis* with 12.50, 6.25, 6.25 and 6.25 per cent parasitization, respectively, and the total parasitization was 62.50 per cent.

During 2016, the total number of larvae from damaged leaves varied from 1.00 to 18.00 (Table 3). The parasitization was first observed in second fortnight of August with 20 per cent parasitization and it kept on increasing and reached peak during second fortnight of September (60.00%). The per cent parasitization was maximum by *C. cypris* (26.66%) followed by tachnid fly (13.33%), *C. ruficrus* (6.67%), *Elasmus* sp. (6.67%) and *T. flavoorbitalis* (6.67%) during second fortnight of September.

Nurpur

Data contained in Table 4 revealed that *C. cypris* was the only larval parasitoid associated with leaf folder larvae at Nurpur location which resulted in parasitization varying from 10.00 to 14.29 and 8.33 to 20.00 per cent during 2015 and 2016, respectively.

It was observed that parasitization by *C. cypris* initiated in first fortnight of September and reached the peak of 14.25 and 20.00 during 2015 and 2016, respectively in first fortnight of October.

Jogindernagar

Observations recorded on parasitization by *C. cypris* at Jogindernagar presented in Table 5 revealed that the activity of parasitoids initiated in first fortnight of September with

7.14 per cent parasitization during 2015 and reached the peak of 20.00 per cent in the first fortnight of October. During 2016, parasitization initiated in second fortnight of August (12.50%) and was maximum (22.22%) in first fortnight of October when the larval population and parasitized larvae were 9.00 and 2.00, respectively.

Palampur

Data presented in Table 6 and 7 revealed that at Palampur, five parasitoids were found associated with leaf folder larvae. Among them, *C. cypris* was found to be the most dominating followed by tachnid fly, *C. ruficrus*, *Elasmus* sp. and *T. flavoorbitalis* during both the study years (Fig. 1). A perusal of data presented in Table 6 revealed that during 2015 activity of leaf folder larvae started during second fortnight of August with 14.29 per cent parasitization and remained associated till the final harvest of the crop. The parasitization reached the peak (64.29%) in the first fortnight of October. It was also observed that when number of parasitized larvae were maximum, parasitoids, namely, *C. cypris*, *C. ruficrus*, *Elasmus* sp., *T. flavoorbitalis* and tachnid fly contributed to 22.58, 9.68, 3.23, 6.45 and 12.90 per cent parasitization, respectively, with total parasitization of 54.84 in second fortnight of October.

During 2016, total number of leaf folder larvae from 100 damaged leaves varied from 1.00 to 26.00 while number of parasitized larvae varied from 1.00 to 15.00 and the total parasitization varied from 27.27 to 66.67 per cent. The parasitization initiated in first fortnight of September and reached the peak of 66.67 per cent in first fortnight of October and per cent parasitization by *C. cypris*, *C. ruficrus* and tachnid fly was observed to be 44.45, 11.11 and 11.11 per cent, respectively (Table 7).

Table.1 Details of localities surveyed for recording abundance of parasitoids associated with *Cnaphalocrocis medinalis* larvae in H.P

Agro-ecological Zone	Location	Altitude (m asl)	Average rainfall (mm)	Latitude °N	Longitude °E	Localities
Zone I Sub-mountainous and low hills sub-tropical	Sundernagar	656	1291	31.54	76.91	Jaral, Bharjwanu, Sai and Dhanotu
	Nurpur	643	1500	31.60	76.30	Rinna, Jonta, Rehan and Bharmar
Zone II Mid hills sub-humid	Jogindernagar	1220	1851	31.98	76.77	Bir, Ahju, Sukhbagh and Dhelu
	Palampur	1290	2300	32.10	76.52	Malan, Majhetli, Pharer and Menjha

Table.2 Parasitization of *Cnaphalocrocis medinalis* larvae at Sundernagar during 2015

Period	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)					Total parasitization (%)
			<i>C. cypris</i>	<i>C. ruficrus</i>	<i>Elasmus</i> sp.	<i>T. flavoorbitalis</i>	Tachnid Fly	
July-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July-II	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-I	6.00	1.00	16.67	0.00	0.00	0.00	0.00	16.67
Aug-II	9.00	2.00	11.11	11.11	0.00	0.00	0.00	22.22
Sept-I	22.00	7.00	13.64	4.55	4.55	4.55	4.55	31.84
Sept-II	16.00	10.00	31.25	6.25	6.25	6.25	12.50	62.50
Oct-I	10.00	4.00	20.00	0.00	0.00	10.00	10.00	40.00
Oct-II	7.00	1.00	14.29	0.00	0.00	0.00	0.00	14.29
Nov-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Table.3 Parasitization of *Cnaphalocrocis medinalis* larvae at Sundernagar during 2016

Period	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)					Total parasitization (%)
			<i>C. cypris</i>	<i>C. ruficrus</i>	<i>Elasmus</i> sp.	<i>T. flavoorbitalis</i>	Tachnid Fly	
June-II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
July-I	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul-II	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-I	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-II	5.00	1.00	20.00	0.00	0.00	0.00	0.00	20.00
Sept-I	18.00	5.00	11.11	0.00	5.55	5.55	5.55	27.76
Sept-II	15.00	9.00	26.66	6.67	6.67	6.67	13.33	60.00
Oct-I	4.00	1.00	25.00	0.00	0.00	0.00	0.00	25.00
Oct-II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Table.4 Parasitization of *Cnaphalocrocis medinalis* larvae by *Cotesia cypris* at Nurpur during 2015 and 2016

Period	2015			2016		
	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)
July-II	0.00	0.00	0.00	0.00	0.00	0.00
Aug-I	2.00	0.00	0.00	0.00	0.00	0.00
Aug-II	3.00	0.00	0.00	2.00	0.00	0.00
Sept-I	10.00	1.00	10.00	8.00	1.00	12.50
Sept-II	17.00	2.00	11.76	12.00	1.00	8.33
Oct-I	7.00	1.00	14.29	5.00	1.00	20.00
Oct-II	3.00	0.00	0.00	0.00	0.00	0.00
Nov-I	0.00	0.00	0.00	0.00	0.00	0.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Table.5 Parasitization of *Cnaphalocrocis medinalis* larvae by *C. cypris* at Jogindernagar during 2015 and 2016

Period	2015			2016		
	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)
July-II	0.00	0.00	0.00	0.00	0.00	0.00
Aug-I	0.00	0.00	0.00	2.00	0.00	0.00
Aug-II	4.00	0.00	0.00	8.00	1.00	12.50
Sept-I	14.00	1.00	7.14	11.00	2.00	18.18
Sept-II	22.00	3.00	13.64	19.00	4.00	21.05
Oct-I	10.00	2.00	20.00	9.00	2.00	22.22
Oct-II	2.00	0.00	0.00	0.00	0.00	0.00
Nov-I	0.00	0.00	0.00	0.00	0.00	0.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Table.6 Parasitization of *Cnaphalocrocis medinalis* larvae at Palampur during 2015

Period	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)					Total parasitization (%)
			<i>C. cypris</i>	<i>C. ruficrus</i>	<i>Elasmus sp.</i>	<i>T. flavoorbitalis</i>	Tachnid Fly	
Aug-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-II	7.00	1.00	14.29	0.00	0.00	0.00	0.00	14.29
Sep-I	11.00	4.00	9.09	9.09	0.00	9.09	9.09	36.36
Sep-II	31.00	17.00	22.58	9.68	3.23	6.45	12.90	54.84
Oct-I	14.00	9.00	42.87	0.00	0.00	7.14	14.28	64.29
Oct-II	6.00	3.00	33.33	0.00	16.67	0.00	0.00	50.00
Nov-I	5.00	1.00	20.00	0.00	0.00	0.00	0.00	20.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Table.7 Parasitization of *Cnaphalocrocis medinalis* larvae at Palampur during 2016

Period	Total number of larvae per 100 DL	Total parasitized larvae	Parasitization (%)					Total parasitization (%)
			<i>C. cypris</i>	<i>C. ruficrus</i>	<i>Elasmus sp.</i>	<i>T. flavoorbitalis</i>	Tachnid Fly	
Jul-II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-I	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug-II	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep-I	11.00	3.00	9.09	0.00	9.09	9.09	0.00	27.27
Sep-II	26.00	15.00	26.92	7.69	3.85	3.85	15.38	57.69
Oct-I	9.00	6.00	44.45	11.11	0.00	0.00	11.11	66.67
Oct-II	3.00	1.00	33.33	0.00	0.00	0.00	0.00	33.33
Nov-I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DL: Damaged leaves I: First fortnight II: Second fortnight

Fig.1 Parasitoids associated with *Cnaphalocrocis medinalis* (a) Larvae of *Elasmus* sp. (b) Adult *Elasmus* sp. (c) Larva of *Cotesia cypris* (d) Cocoon of *C. cypris* (e) Adult *C. cypris* (f) Pupa of *Trathala flavoorbitalis* (g) Adult *T. flavoorbitalis* (h) Adult *C. ruficrus* (i) Pupa of Tachnid fly (j) Adult Tachnid fly

(a)

(b)

(c)

(d)

(e)

(f)

(g)

(h)

(i)

(j)

Different workers also recorded *C. cypris* as one of the most dominating larval parasitoid of the rice leaf folder from different parts of country (Natarajam *et al.*, 1980; Mishra & Mandal 2003; Rani *et al.*, 2007). The seasonal percentage of larval parasitism ranged from 14 to 56 per cent (Kraker *et al.*, 1999). However, the present investigation draws support from their results wherein parasitization by *C. cypris* ranged from 7.14 to 44.45 per cent.

All the five parasitoids namely, *C. cypris*, *C. ruficrus*, *Elasmus* sp., *T. flavoorbitalis* and tachnid fly recorded in present studies have been reported as important parasitoids of rice

leaf folder by various workers (Arida and Shepard 1990; Rani *et al.*, 2007; Dhanapatidevi & Varatharajan 2013; Pathak *et al.*, 2011).

Five parasitoids namely, *Cotesia cypris* Nixon, *C. ruficrus* Haliday, *Trathala flavoorbitalis* Cameron, *Elasmus* sp., and tachnid fly were specific to *C. medinalis* larvae and these need to be conserved by use of selective pesticides. *Cotesia cypris* was dominant in all the locations resulting in higher parasitization of *C. medinalis* larvae compared to all other parasitoids. As it is evident that biological control is an important

component of IPM so the potential of *C. cypris* can be harnessed for the management of this pest.

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