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NATURAL ENEMIES OF RICE WHITE STEM BORER *SCIRPOPHAGA FUSCIFLUA* (HAMPSON) IN HIMACHAL PRADESH

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ABSTRACT

Fortnightly surveys were made to study natural enemies of white stem borer (WSB) *Scirpophaga fusciflua* (Hampson) in rice. The surveys revealed that the predators of *S. fusciflua* first appeared in the second fortnight of July, with the peak during second fortnight of September during 2016 and 2017; and their relative proportion was- spiders (49.4% and 51.2%), dragonflies (22.2% and 22.6%) and damselflies (28.4% and 26.2%). Four species of parasitoids viz., egg- *Telenomus* sp. and *Tetrastichus* sp., larval- *Stenobracon* sp. and pupal parasitoids- *Xanthopimpla punctata* were observed from egg mass, larvae and pupae collected from Kangra valley of Himachal Pradesh. During 2016 and 2017, the % parasitization was observed to be maximum in the first fortnight of October (53.5 and 62.0%) followed by second fortnight of September (36.4 and 49.1%), respectively.

Key words: *Scirpophaga fusciflua*, rice, predators, parasitoids, Himachal Pradesh, Khangra valley, parasitisation, egg, larval, pupal parasitoids, predators, spiders, odonates

Rice is attacked by a complex set of insect pests, and these have their natural enemies. Amongst these, stem borers are important (Dhaliwal and Arora, 1996), In India, 18 stem borer species belonging to family Pyralidae and three species belonging to family Noctuidae are known (Banerjee, 1964; Kapur, 1967). The predominant are the yellow- *Scirpophaga incertulas* (Walker), striped- *Chilo suppressalis* (Walker) and pink- *Sesamia inferens* (Walker) stem borers. Of these the *S. incertulas* is the most dominant in India (Muralidharan and Pasalu, 2006); while *Scirpophaga fusciflua* Hampson is the predominant borer species in Himachal Pradesh and distributed nearly in all the rice growing areas and recently it was identified (Srivastava et al., 2012). Natural enemies play a major role in maintaining such pests below economic threshold levels; however, their parasitism/ predation efficacy vary with place and time depending on several factors. Many parasitoids and predators in rice ecosystem were observed by Kumar et al. (1997) in Kangra valley of Himachal Pradesh (India). However, the information with respect to natural enemies associated with *S. fusciflua* is lacking from Kangra valley, as it has been only recently found. Keeping these in view, the present study on the natural enemies associated with *S. fusciflua* from the north mid hills of Himachal Pradesh.

MATERIALS AND METHODS

Study was carried out at the Chaudhary Sarwan Kumar Himachal Pradesh Agricultural University (CSK HPAU), Rice and Wheat Research Centre, Malan (Himachal Pradesh) during 2016 and 2017, this lies in Kangra valley (32°07.180 N, 76°25.065 E, 961 masl). The fortnightly surveys of rice fields focused on the abundance of predators were made with observations using sweep; for observations on parasitoids, 10 egg masses were randomly collected from the unsprayed plot at fortnightly interval and brought to the laboratory for the emergence of parasitoids and larvae; egg mass was identified following Srivastava et al. (2012). These egg masses were kept separately in glass vials (10x 5 cm dia) provided with sufficient moisture to prevent desiccation of larvae and leaves. Egg masses were observed daily for number of larvae hatched. In the other hand 50 damaged tillers (dead heart/ white ear) were collected at fortnightly intervals from field and larvae were collected. These oobservations on the parasitoids were made under laboratory conditions (26±1,85-90%RH). Based on the parasitoid emerged from eggs, larvae and pupae the % parasitization was calculated. The data were subjected to statistical analysis with data transformed through CPCS- 1 software as per Gomez and Gomez (1984).

Table 1. Predators and parasites associated with *S. fusciflua* (kharif 2016, 2017)

Year	Predator groups	Adults caught/ 125 sweeps								LSD (P=0.05)	$F_{2,23}$	Relative proportion (%)
		July-I	July-II	Aug-I	Aug-II	Sept-I	Sept-II	Oct-I	Oct-II			
2016	Spiders	0.0 (0.707)^{f}	0.0 (0.707)^{f}	2.0 (1.559)^{e}	6.0 (2.544)^{c}	10.0 (3.230)^{b}	17.0 (4.179)^{a}	4.0 (2.112)^{d}	1.0 (1.225)^{e}	(0.389)	0.144	49.4
	Damselflies	0.0 (0.707)^{c}	2.0 (1.559)^{b}	4.0 (2.091)^{ab}	6.0 (2.529)^{a}	4.0 (2.112)^{ab}	5.0 (2.318)^{a}	2.0 (1.559)^{b}	0.0 (0.707)^{c}	(0.594)	0.020	28.4
	Dragonflies	0.0 (0.707)^{c}	1.0 (1.225)^{bc}	3.0 (1.814)^{ab}	5.0 (2.327)^{a}	5.0 (2.339)^{a}	3.0 (1.814)^{ab}	1.0 (1.171)^{c}	0.0 (0.707)^{c}	(0.616)	1.075	22.2
	Total	0.0 (0.707)^{f}	3.0 (1.171)^{def}	9.0 (1.858)^{bcd}	17.0 (2.481)^{abc}	19.0 (2.569)^{ab}	25.0 (2.800)^{a}	7.0 (1.642)^{cde}	1.0 (0.880)^{ef}	(0.912)	1.917	100.0
2017	Spiders	0.0 (0.707)^{f}	1.0 (1.171)^{ef}	3.0 (1.858)^{cd}	5.0 (2.339)^{bc}	11.0 (3.389)^{a}	15.0 (3.932)^{a}	6.0 (2.544)^{b}	2.0 (1.470)^{de}	(0.612)	0.754	51.2
	Damselflies	0.0 (0.707)^{d}	2.0 (1.559)^{c}	3.0 (1.858)^{bc}	7.0 (2.727)^{a}	4.0 (2.084)^{b}	4.0 (2.112)^{b}	2.0 (1.559)^{c}	0.0 (0.707)^{d}	(0.510)	0.893	26.2
	Dragonflies	0.0 (0.707)^{e}	1.0 (1.171)^{de}	2.0 (1.559)^{cd}	5.0 (2.339)^{ab}	6.0 (2.535)^{a}	3.0 (1.858)^{bc}	2.0 (1.470)^{cd}	0.0 (0.707)^{e}	(0.641)	0.731	22.6
	Total	0.0 (0.707)^{e}	4.0 (1.344)^{cde}	8.0 (1.774)^{bcd}	17.0 (2.476)^{ab}	21.0 (2.687)^{a}	22.0 (2.643)^{a}	10.0 (1.904)^{abc}	2.0 (0.998)^{de}	(0.802)	4.327	100.0

Parasitization of *S. fusciflua* egg masses, larvae and pupae

Period	Parasitization (%) 2016					Parasitization (%) 2017				
	Egg parasitoid		Larval parasitoid	Pupal parasitoid	Total parasitization (%)	Egg parasitoid		Larval parasitoid	Pupal parasitoid	Total parasitization (%)
	Telenomus sp.	*Tetrastichus* sp.	*Stenobracon* sp.	*Xanthopimpla punctata*		*Telenomus* sp.	*Tetrastichus* sp.	*Stenobracon* sp.	*Xanthopimpla punctata*	
July-I	0.0 (0.707)d	0.0 (0.707)d	0.0 (0.707)b	0.0 (0.707)b	0.0 (0.707)	0.0 (0.707)c	0.0 (0.707)c	0.0 (0.707)b	0.0 (0.707)c	0.0 (0.707)
July-II	0.0 (0.707)d	0.0 (0.707)d	0.0 (0.707)b	0.0 (0.707)b	0.0 (0.707)	0.0 (0.707)c	0.0 (0.707)c	0.0 (0.707)b	0.0 (0.707)c	0.0 (0.707)
Aug-I	0.0 (0.707)d	0.0 (0.707)d	0.0 (0.707)b	0.0 (0.707)b	0.0 (0.707)	0.0 (0.707)c	3.7 (2.047)b	0.0 (0.707)b	0.0 (0.707)c	3.7 (1.043)
Aug-II	3.8 (2.072)c	4.3 (2.196)c	0.0 (0.707)b	0.0 (0.707)b	8.1 (1.420)	9.1 (3.094)a	0.0 (0.707)c	0.0 (0.707)b	0.0 (0.707)c	9.1 (1.305)
Sept-I	11.5 (3.461)b	8.9 (3.060)b	0.0 (0.707)b	0.0 (0.707)b	20.5 (1.986)	7.4 (2.810)b	11.8 (3.503)a	0.0 (0.707)b	0.0 (0.707)c	19.2 (1.933)
Sept-II	13.6 (3.749)a	22.8 (4.830)a	0.0 (0.707)b	0.0 (0.707)b	36.4 (2.499)	0.0 (0.707)c	0.0 (0.707)c	24.1 (4.963)a	25.0 (5.047)b	49.1 (2.856)
Oct-I	0.0 (0.707)d	0.0 (0.707)d	36.8 (6.111)a	16.7 (4.146)a	53.5 (2.917)	0.0 (0.707)c	0.0 (0.707)c	0.0 (0.707)b	62.0 (8.112)a	62.0 (2.507)
LSD (P=0.05)	(0.235)	(0.132)	(0.110)	(0.085)	(NS)	(0.151)	(0.152)	(0.055)	(0.190)	(NS)
F 2,20	0.323	0.667	1.000	1.000	*F* 3,20 0.249	1.006	1.525	1.000	1.557	*F* 3,20 0.531

I: First fortnight; II: Second fortnight; Mean value within columns bearing same letters not significantly different- LSD (p = 0.05); Figures in parentheses square root transformed values

RESULTS AND DISCUSSION

Three predators viz., spiders, dragonflies and damselflies were found associated with *S. fusciflua*. white stem borer (Table 1); during 2016, of all predators, spiders shared 49.4% of total diversity, and in during 2017 it amounted to 51.2%. These predators first appeared in second fortnight of July (3.0 adults/ 125 sweeps) during 2016 and remained active up to second fortnight of October; maximum numbers of predators recorded was during second fortnight of September (25.0 adults/ 125 sweeps), which was statistically at par with first fortnight of September (19 adults/ 125 sweeps) and second fortnight of August (17 adults/ 125 sweeps); the least numbers of predators observed in first fortnight of July and second fortnight of October (LSD = 0.912, $F_{2.23}$ = 1.917, P = 0.05). Whereas, during 2017, predators were found from second fortnight of July (4.0 adults/ 125 sweeps) to second fortnight of October (2.0 adults/ 125 sweeps) with maximum being 22.0 adults/ 125 sweeps during second fortnight of September. These results corroborate those of Deng and Jin (1985), who observed *Conocephalus* sp. as a predator of rice stem borer which preyed on the egg masses. Bhardwaj and Pawar (1987) enlisted this predator on rice insect pests in Madhya Pradesh.

The emergence of parasitoids during 2016 given in Table 1 reveal four species viz., *Telenomus* sp., *Tetrastichus* sp., *Stenobracon* sp. and *Xanthopimpla punctata*. The parasitization initiated from second fortnight of August and remained until first fortnight of October. During first fortnight of October, maximum parasitization was observed with the larval parasitoid (36.8%) followed by pupal parasitoids *X. punctata* (16.7%) and the total parasitization was 53.5%; during 2017, the parasitization was first observed in first fortnight of August with 3.7% reaching a peak in first fortnight of October (62.0%). The parasitization by *X. punctata* (25.0%) was followed by larval parasitoid (24.1%) in second fortnight of September. Present results corroborate with those of Ganeshwari and Kumar (2019) who found three parasitoids *i.e. Telenomus* sp., *Trichogramma* sp. and *Tetrastichus* sp. with parasitization ranged from 23.70 to 58.84%. Chakraborty (2012), Manju et al. (2002), Kishore et al. (2003) reported that egg masses were parasitized by the *Telenomus beneficiens, Trichogramma japonicum* and *Tetrastichus schoenobii*. Lakshmi et al. (2010) revealed that egg parasitoids played an important role in population regulation of stem borer by parasitizing 95% of the egg masses.

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