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Seasonal incidence of white stem borer, *Scirpophaga fusciflua* Hampson on paddy in Himachal Pradesh

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ABSTRACT

Field experiments were conducted to study the seasonal incidence of white stem borer on paddy during Kharif season 2015-2017. The data revealed that larval population and per cent plant infestation were noted from 30 th standard meteorological week (SMW) and remained up to 42th SMW. The peak larval population infestation was observed at 39th SMW. The maximum cumulative dead hearts (DH) and white ears (WE) were observed at 35th and 39th SMW, respectively. Maximum temperature was found to be positively correlated with larval population as well as per cent plant infestation. However, rainfall and relative humidity were observed to be negatively correlated. To plan the different suitable control measures for the pest, knowledge of population dynamics is very much essential. It is also useful in development of forecasting model for pest.

Key words: *White stem borer, Lepidoptera, paddy, kharif, infestation*

Insect-pests are the major constraints in enhancing the rice productivity, besides diseases and weeds (Behura et al., 2011). Amongst them, rice stem borers are a key group of insect-pests damaging rice crop. Five species of stem borer namely, *Scirpophaga fusciflua, Scirpophaga incertulas, Chilo polychrysus, Chilo suppressalis* and *Sesamia inferens* have been reported from different parts of India (Pasalu et al., 2005). The most common insect-pests of paddy prevalent in Himachal Pradesh are *Scirpophaga fusciflua* (Hampson), *Cnaphalocrocis medinalis* (Guenee), *Nymphula depunctalis* (Guenee), *Dicladispa armigera* (Olivier), *Hydrillia philippina* (Ferino) and *Heteronychus lioderes* (Redtenbacher) etc. (Srivastava et al., 2009).

White stem borer, *S. fusciflua* is the predominant borer species in Himachal Pradesh and occupies nearly all the rice growing areas of the state. It causes damage to rice crop right from tillering to heading stage. At tillering stage, larvae feed inner content of stem from the base to the apical part of plants causing drying of central shoot known as 'dead heart'. The affected tillers do not bear panicles. White ears occur when the stem borer attack at reproductive stage (Chatterjee and Mondal, 2014). Keeping in mind the above facts a field experiments were undertaken to study the seasonal incidence of white stem borer in terms of larval population and plant infestation.

The study of its seasonal incidence was undertaken at nearby farmer's field of Kangra district (Kohala and Jia), besides the experimental field trial at RWRC, Malan during *Kharif* season 2015-2017. The crop was surveyed regularly for pest incidence starting from tillering to maturity stage. For recording the observations, three plots of 250 m^2 (approximately) each were selected at each locality. The methodology used to determine the seasonal incidence of white stem borer by different methods *viz.,* larval population count and plant infestation estimation is given as under:

Larval population count method

To assess the larval population in the paddy fields during the crop season, random sampling of 10 hills was made from each block to observe the number of larvae and

weekly mean was calculated. Individual tillers were dissected for the presence of larvae and pupae.

Plant infestation

The per cent plant infestation was calculated by counting number of dead hearts or white ears on 10 randomly selected hills/plot by using the formula:

$$\text{Infestation (\%)} = \frac{\text{Total number of dead heart or white ears}}{\text{Total number of tillers or panicles}} \times 100$$

The data collected on larval population and per cent plant infestation of different three locations *viz.,* Kohala, Malan and Jia were computed as mean number larval population and per cent plant infestation per week in respective years.

Statistical analysis

Seasonal incidence of white stem borer, (larval population and per cent plant infestation) weekly mean data of different locations was correlated with various abiotic factors *viz.,* maximum and minimum temperature (ºC), relative humidity (%) and total rainfall (mm). For this study, the weekly meteorological data were obtained from the meteorological observatory of Rice and Wheat Research Centre, Malan (HP).

Season I 2015

The mean larvae population during the year 2015 showed that the first damage by the larvae was recorded during 31th SMW (0.38). Mean larvae population thereafter increased with peaks of 5.55 and 5.38 observed at 37th and 39th SMW, respectively. The maximum proportion of larvae was extracted during the month of September which was 18.12 per cent against the total of 30.63 larvae collected during the whole season (Table 1). The data pertaining to mean plant infestation indicated that maximum peaks of infestation were observed at 39th and 40th SMW with respective values of 14.12 and 14.03 per cent during the year 2015 (Table 2). A total of 120.16 plant infestation were recorded during the season with maximum proportion (10.81) observed during the month of September followed by August and October, where the respective proportions were 6.78 and 5.65 per cent, respectively. Correlation studies on larval population showed negative correlation with rainfall and RH (r = -0.436 and -0.203, respectively) while maximum and minimum temperature showed positive correlation with larval population up to the tune of 0.228 and 0.212 (Table 3). Per cent plant infestation also showed positive correlation with maximum and minimum temperature (r = 0.192 and 0.217, respectively).

Table 1. Larval population of *S. fusciflua* on paddy during 2015-2017.

Month	SMW	Larvae (no/DH/WE)				Proportion of larvae/month (%)			
		2015	2016	2017	Pooled	2015	2016	2017	Pooled
JULY	27	0.00	0.00	0.00	0.00				
	28	0.00	0.00	0.00	0.00				
	29	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	30	0.00	0.00	0.20	0.07				
AUG	31	0.38	0.27	0.45	0.37				
	32	0.79	1.02	0.90	0.90				
	33	0.57	1.65	1.84	1.35	3.10	4.54	4.65	3.83
	34	1.67	2.32	2.45	2.15				
	35	2.23	3.30	3.15	2.89				
SEPT	36	3.47	4.18	3.85	3.83				
	37	5.55	4.13	5.75	5.14	18.12	16.15	15.80	14.54
	38	4.5	5.87	6.25	5.54				
	39	5.38	6.45	6.19	6.01				
OCT	40	3.85	4.83	5.30	4.66				
	41	1.59	1.80	2.55	1.98				
	42	0.27	0.50	0.65	0.47	0.90	1.37	1.64	1.34
	43	0.00	0.00	0.00	0.00				
	44	0.00	0.00	0.00	0.00				
Total =		30.63	36.32	39.54	35.37				

Table 2. Infestation caused by *S. fusciflua* on paddy during 2015-2017.

Month	SMW	(%) plant infestation DH/WE				Proportion of plant infestation/month (%)			
		2015	2016	2017	Pooled	2015	2016	2017	Pooled
JULY	27	0.00	0.00	0.00	0.00				
	28	0.00	0.00	0.00	0.00				
	29	0.00	0.00	0.00	0.00	0.00	1.14	1.94	1.04
	30	0.00	1.38	2.45	1.28				
AUG	31	4.22	2.16	3.04	3.14				
	32	6.28	5.74	5.48	5.83				
	33	8.15	6.73	6.66	7.18	6.78	5.56	5.33	5.84
	34	9.16	8.01	8.35	8.51				
	35	10.99	12.59	9.82	11.13				
SEPT	36	10.69	10.91	11.45	11.02				
	37	13.00	12.73	13.58	13.10	10.81	12.08	12.82	10.65
	38	13.75	14.57	16.04	14.79				
	39	14.12	16.67	17.99	16.26				
OCT	40	14.03	16.10	14.93	15.02				
	41	9.02	12.01	10.52	10.52				
	42	6.79	4.09	4.77	5.22	5.65	3.39	3.81	4.24
	43	0.00	0.00	0.00	0.00				
	44	0.00	0.00	0.00	0.00				
Total =		120.16	120.60	125.05	122.99				

Season II 2016

The data pertaining to mean value of larvae population during the year 2016 revealed that the first larvae incidence was recorded during 31th SMW (0.27). Mean larvae population thereafter increased with peaks of 6.45 and 5.87 observed at 39th and 38th SMW, respectively (Table 1). A total of 36.32 larvae was recorded with maximum proportion (16.15 %) extracted during the month of September and the proportion declined in the following months (4.54 August) and (1.37 October). The perusal of data based on mean plant infestation revealed that the maximum infestation of 16.67 and 16.10 per cent was recorded during 39th and 40th SMW (Table 2). The peak proportion of the plant infestation was 12.08 per cent observed during September and followed by August (5.56 per cent) and October (3.39 per cent). On the other hand, larval population had negative correlation with minimum temperature, rainfall, and RH up to the tune of -0.363, -0.439 and -0.095, respectively (Table 3). However, positive relationship was recorded with maximum temperature (r = 0.029). The relationship of per cent plant infestation also showed negative correlation with minimum temperature, rainfall and RH up to the tune of -0.459, -0.453 and -0.082, respectively. Non-significantly positive correlation was obtained with maximum temperature (r = 0.014).

Season III 2017

The data pertaining to mean of larvae population during the year 2017 revealed that a total of 39.54 larvae was recorded with maximum proportion (15.80%) extracted in the month of September (Table 1). The overall mean incidence revealed that the mean maximum plant infestation 17.99 per cent was observed during 39th SMW (Table 2). The peak proportion of plant infestation was 12.82 per cent, observed during September and followed by August (5.33 per cent) and October (3.81 per cent). Whereas, correlation studies on larval

Table 3. Correlation (r) between various abiotic factors and seasonal incidence of *S. fusciflua* on paddy.

Factor	Correlation (r)		
	Year	Larval population	(%) plant infestation
Max. temperature (°C)	2015	0.228	0.192
	2016	0.029	0.014
	2017	0.315	0.362
Min. temperature (°C)	2015	0.212	0.217
	2016	-0.363	-0.459
	2017	-0.004	0.016
Rainfall (mm)	2015	-0.436	-0.402
	2016	-0.439	-0.453
	2017	-0.486	-0.455
RH	2015	-0.203	-0.347
	2016	-0.095	-0.082
	2017	0.216	-0.160

population showed negative correlation with minimum temperature, rainfall and RH (r = -0.004, -0.486 and -0.216, respectively) (Table 3). However, maximum temperature was found to be positively correlated (r = 0.315). Per cent plant infestation also showed positive correlation with (maximum and mini) temperature (r = -0.362 and 0.016), though it was negative but non-significant with rainfall and RH (r = -0.455 and -0.160, respectively).

The present findings are corroborated by the findings of Wagan et al. (1999) who observed that the maximum larval infestation of borer was recorded during August and October in terms of dead heart and white ear head, respectively. Additionally, Adiroubane and Raja (2010), Chavan et al. (2013), Rana et al. (2017) recorded the higher incidence of borer during August-September. Hugar et al. (2016) revealed that borer infestation attained its peak activity when the crop was 60 days old. These observations are in close conformity with Bhatnagar and Saxena (1999) at Jagdalpur observed a significant negative correlation with minimum temperature, evening relative humidity and rainfall. Zainab et al. (2017) reported that dead hearts and white ears incidence were negatively correlated with mean temperature, positively correlated with relative humidity and showed significant positive correlation with rainfall. Such differences could be due to the differences in agro-climatic conditions under which seasonal incidence of white stem borer was studied.

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