

SEASONAL INCIDENCE OF RICE YELLOW STEM BORER, *Scirpophaga incertulas* (WALKER) IN RELATION TO CROP GROWTH STAGES UNDER SOUTH GUJARAT CONDITION

CHAVAN, S. M.,*; PATEL, K. G. AND ARVE, S. S.

DEPARTMENT OF ENTOMOLOGY,
N.M. COLLEGE OF AGRICULTURE
NAVSARI AGRICULTURAL UNIVERSITY, NAVSARI, GUJARAT, INDIA

*Email: sachininto@gmail.com

ABSTRACT

The investigations on rice yellow stem borer, Scirpophaga incertulas (Walker) infestation in relation to crop growth stages and weather parameters was carried out at NARP Farm, Navsari Agricultural University, Navsari (Gujarat) during kharif 2011 and 2012. The maximum infestation (15.47% DH) was observed in first week of September (36th std. week and 45 DAT), whereas minimum infestation (0.64%) was noticed in second week of October (41th std. week and 84 DAT). The maximum, 19.23 per cent white earhead (WEH) damage was recorded during third week of October (90 DAT). The trend of infestation in relation to crop growth stage increased from seedling stage and reached to peak at tillering to booting stage (15.17%). The maximum egg masses were found in fourth week of September (1.55/m²) till third week of October (1.80/m²). The maximum egg masses was noticed in reproductive stage (1.09/m²) followed by ripening (1.03/m²) and vegetative (0.63/m²) stages. Maximum adult female population was observed in ripening stage (1.54/m²) followed by reproductive (1.43/m²) and vegetative (0.63/m²) stages.

KEY WORDS: Rice yellow stem borer, *Scirpophaga incertulas* (Wlk.),

INTRODUCTION

Rice (*Oryza sativa* Linnaeus) is one of the most important cereal crops and staple food of more than sixty five per cent of the world's population and known as a 'King of Cereals'. Over 1400 insect species attack standing and stored rice in the world (Grist and Lever, 1969), while Kalode and Pasalu (1986) reported that over 100 species of insect pests attack rice crop at various stages of its growth. Out of which, 20 are of major economic significance (Pathak and Dhaliwal, 1981). Rice stem borers constitute a key group of insect pests varying in species and numbers due to widespread adaptation. Among the borers, yellow stem borer, *Scirpophaga*

incertulas (Walker) has been reported as the most dominant and widely destructive stem borer species.

In Gujarat, rice is grown in 7.22 lakh hectares, with total production and productivity of 12.26 lakh tonnes and 1697 kg/ha, respectively (Anonymous, 2010). The rice occupy about 5 per cent of the gross cropped area of the state and accounted for around 14 per cent of the total food grain production (Mehta, 2010). For developing any pest management programme for specific agro-ecosystem information on abundance and distribution of pest in relation to crop growth stage is a basic requirement (Patel and Shekh, 2006). The study of agricultural meteorology in

relation to insects (Entomoclimatology) will be very useful to farmers in all areas where major insect pests are appearing year after year and causing serious damage to crops. In the light of the severity of damage by yellow stem borer on rice grown in South Gujarat and the influence of crop growth stages on their growth, multiplication and distribution, investigations were taken up at the Navsari Agricultural University, Navsari, Gujarat to study the seasonal influence of crop growth stages on incidence of YSB.

MATERIALS AND METHODS

Field experiments were conducted at NARP Farm, Navsari Agricultural University, Navsari during *Kharif* season of 2011 and 2012. The rice variety, GR 11 was grown over an area of 1000m². Twenty five days old GR 11 seedlings were transplanted with a spacing of 20 x15 cm. Insecticide was not applied during any of the seasons. All the other recommended cultivation practices were followed during the period of investigation. The observations on *S. incertulas* infestation were recorded at weekly interval immediately after transplanting to the harvest stage. The borer incidence was assessed by counting number of dead hearts in the initial stage of tiller damage and later during flowering stage in the form of white ear heads, from ten randomly selected spots each consisting of five hills. Either dead hearts or white ear heads were removed from the infested tillers so that only fresh infestation of the pest can be realized at each observation. In the early morning, yellowish female adults of *S. incertulas* were settled at the tip of leaves which was the typical behavioral characteristics of female adult. So, the observations on population of female adult settled at the tip of leaves and their egg mass laid were recorded early in the morning from ten spots each consisting of a square meter area at weekly interval commenced from transplanting.

Rice yellow stem borer damage assessment (Heinrichs et al., 1985)

$$\% \text{ Dead heart (DH)} = \frac{\text{No.of dead hearts}}{\text{No.of total tillers}} \times 100$$

$$\% \text{ White earhead(WEH)} = \frac{\text{No.of dead hearts}}{\text{No.of productive tillers}} \times 100$$

RESULT AND DISCUSSION

Infestation of *S. incertulas* in terms of dead heart and white earhead

The incidence of yellow stem borer in terms of per cent dead heart (DH) and white earhead (WEH) infestation was found at all the crop growth stages during both the years (*kharif* 2011 and *kharif* 2012). During 2011, infestation started appearing just after establishment of transplanted paddy seedlings i.e. from third week of July [30th std. week and 7 days after transplanting (DAT)] and continued up to the second week of October (41st std. week and 75 DAT). The maximum infestation (16.21% DH) was found in first week of September (36th std. week and 45 DAT). The per cent infestation started declining thereafter continuously up to the harvest of the crop. The minimum per cent infestation (0.71% DH) was recorded in second week of October (41th std. week and 84 DAT). The WEH infestation to the tune of 20.14 per cent was noticed 10 days before harvest (at 90 DAT) (Table 1).

During 2012, the similar trend of infestation but in lower form was observed as in 2011. Infestation was commenced from third week of July (30th std. week and 7 DAT) and continued up to the second week of October (41th std. week and 84 DAT). Moreover, infestation was noticed increasing trend to the advancement of crop growth till heading stage. The maximum infestation (15.17 % DH) was found in second week of September (37th std. week and 50 DAT). The per cent infestation

was started declining thereafter continuously up to the harvest of the crop. The minimum per cent infestation (0.56 per cent) was recorded in second week of October (41st std. week and 84 DAT). The WEH infestation to the tune of 18.31 per cent was recorded 10 days before harvest (42nd std. week) (Table 1). In pooled results, maximum infestation (15.47 % DH) was observed in first week of September (36th std. week and 45 DAT), whereas minimum infestation (0.64 %) was noticed in second week of October (41st std. week and 84 DAT). At harvest, 19.23 per cent WEH damage was recorded (91 DAT).

Infestation of *S. incertulas* (DH and WEH) in relation to crop growth stages

In rice, mainly three broad growth stages have been observed viz. vegetative (germination to panicle initiation), reproductive (panicle initiation to flowering) and ripening (grain filling to mature grain). The results revealed that infestation commenced from seedling stage and continued up to milk grain stage (Table 1). The trend of infestation increased from seedling stage and reached to peak at tillering to booting stage (i.e. 30 to 60 DAT) during both the years (16.21% and 15.17% during 2011 and 2012, respectively). The infestation of DH was decreasing onwards from heading or panicle exertion to flowering (4.27, 4.02 and 4.15% DH) and continued up to milk grain stage (0.71, 0.56 and 0.64 % DH).

The late crop growth is the ripening stage which was further categorized into milk grain, dough grain and mature grain stages. As soon as the DH infestation started to declining, the infestation of WEH was initiated. During both the years, initiation of WEH damage commenced from flowering i.e. 75 DAT (2.41%, 2.08% and 2.25% during 2011, 2012 and pooled of both years, respectively) and reached peak during early dough grain stage. At this stage, the infestation of WEH was 20.14%, 18.31% and 19.23 %. Finally at mature grain stage, lowest per cent WEH's i.e., 6.42%, 4.15% and 5.29 % were observed (Table 1).

Population of *S. incertulas* in terms of number of egg masses per square meter

During 2011, observations on egg masses were commenced from third week of July (30th std. week and 7 DAT) and continued up to harvesting stage (44th std. week and 105 DAT). The maximum numbers of egg masses were found during fourth week of September (1.2/m²) to third week of October (1.6/m²) which coincided with 39th (70 DAT) to 42nd std. week (90 DAT). During the subsequent year, similar trend of infestation was observed as in first year. The maximum numbers of egg masses were found during first week of October (1.3/m²) to third week of October (1.4/m²) which were coincided with 40th (75 DAT) to 42nd std. week (90 DAT). In pooled result, egg masses were started appearing from third week of July (30th std. week and 7 days after transplanting) and continued up to harvesting stage (44th standard week and 105 DAT). The maximum numbers of egg masses was found in fourth week of September (1.55/m²) till third week of October (1.80/m²) (Table 2).

YSB egg masses per square meter in relation to crop growth stages

During both the years egg masses started appearing from seedling to mature grain stages throughout the cropping season (Table 2). The pooled results indicated maximum number of egg masses laid in reproductive stage (1.09) followed by ripening (1.03) and vegetative stage (0.63).

Population of YSB in terms of female adults per square meter

Results revealed that, during both the years female adults were observed throughout the cropping season (Table 2). The population of adult in the field commenced from third week of July (30th std. week and 7 DAT) and continued up to harvesting stage (44th std. week and 105 DAT). The maximum numbers of adults were observed in second week of October i.e. at 41st std. week (84 DAT) during

both the years (2.0 and 1.4 adult/m² in 2011 and 2012, respectively).

Population *S. incertulas* (female adult per square meter) in relation to crop growth stages

From the pooled results, maximum number of adult female population was observed in ripening stage (1.54) followed by reproductive (1.43) and vegetative (0.63) stages (Table 2). In past, Hugar *et al.* (2009) from Bangalore revealed that borer infestation attained its peak activity when the crop was 60 days old. Chakraborty and Deb (2010) indicated maximum collection of YSB moths at ripening stage (67.4%) followed by reproductive (22.4%) and vegetative (10.2%) stages. The present findings are more or less in line with Chakraborty and Deb (2010) and thus confirm the present investigation (Table 2).

Correlation of stem borer damage with egg masses and female adult population

Result revealed that negative correlation was observed between DH damage and female adult population ($r = -0.1829$, -0.1799 and -0.1848 in 2011, 2012 and pooled analysis, respectively), whereas positive correlation between WEH damage and female adult population ($r = 0.4159$ and 0.4730 in 2011 and pooled analysis, respectively) was observed. However, WEH damage exhibited significant positive correlation with female adult population in 2012. Number of egg masses/m² had positively correlation with DH and WEH damage ($r = 0.0013$ and 0.1375) (Table 3).

CONCLUSION

From the present investigation on seasonal influence of rice yellow stem borer, *Scirpophaga incertulas* (Walker) infestation in relation to crop growth stages under south Gujarat it revealed that maximum DH infestation (15.47% DH) was observed in first week of September [36th standard week and 45 (DAT)], whereas minimum infestation (0.64%) was noticed in second week of October (41st standard week and 84 DAT). The

maximum, 19.23 per cent white earhead (WEH) damage was recorded during third week of October (90 DAT). The trend of infestation in relation to crop growth stage increased from seedling stage and reached to peak at tillering to booting stage (15.17%). At ripening stage, the DH infestation started declining, whereas infestation of WEH was initiated. The initiation of WEH damage commenced from flowering (2.25 %) and reached peak during early dough grain stage (19.23%). Finally, at mature grain stage, lowest per cent WEH (5.29 %) was observed. The maximum egg masses were found in fourth week of September (1.55/m²) till third week of October (1.80/m²). The egg masses in relation to crop growth stages revealed maximum egg masses in reproductive stage (1.09/m²) followed by ripening (1.03/m²) and vegetative (0.63/m²) stages. The population of adult in the field commenced from third week of July (30th standard week or 7 DAT). Moreover, maximum adult female population was observed in ripening stage (1.54/m²) followed by reproductive (1.43/m²) and vegetative (0.63/m²) stages.

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Table 1: Population dynamics of yellow stem borer infestation (dead heart and white earhead) in relation to different crop growth stages during *Kharif* 2011 and 2012.

Month	Week	Std. Week	DAT	Crop Growth Stage	<i>Kharif</i> 2011		<i>Kharif</i> 2012		Pooled	
					% Dead Heart	% White Earhead	% Dead Heart	% White Earhead	% Dead Heart	% White Earhead
July	3 rd	30	7	Seedling	2.34	-	1.94	-	2.14	-
	4 th	31	14	Seedling	3.85	-	2.29	-	3.07	-
August	1 st	32	21	Tillering	7.58	-	6.53	-	7.06	-
	2 nd	33	28	Tillering	9.64	-	8.07	-	8.86	-
	3 rd	34	35	Stem elongation	13.28	-	10.16	-	11.72	-
	4 th	35	42	Stem elongation	14.95	-	13.87	-	14.41	-
Sept	1 st	36	49	Booting	16.21	-	14.73	-	15.47	-
	2 nd	37	56	Heading	12.04	-	15.17	-	13.61	-
	3 rd	38	63	Heading to panicle exertion	9.81	-	10.13	-	9.97	-
	4 th	39	70	Flowering	4.27	-	4.02	-	4.15	-
Oct	1 st	40	77	Flowering	2.09	2.41	2.04	2.08	2.07	2.25
	2 nd	41	84	Milk grain stage	0.71	4.56	0.56	3.98	0.64	4.27
	3 rd	42	91	Dough grain stage	0	20.14	0	18.31	0.00	19.23
	4 th	43	98	Dough grain stage	0	14.75	0	11.34	0.00	13.05
Nov	1 st	44	105	Mature grain stage	0	6.42	0	4.15	0.00	5.29

DAT- Days After Transplanting, Std. Week- Standard week

Table 2: Population dynamics of yellow stem borer (based on egg mass and female adult /m²) in relation to different crop growth stages during *Kharif* 2011 and 2012.

Month	Week	Std. Week	DAT	Crop Growth Stage	<i>Kharif</i> 2011		<i>Kharif</i> 2012		Pooled			
					Egg Mass/m ²	Adult/m ²	Egg Mass/m ²	Adult/m ²	Egg Mass/m ²	Average	Adult/m ²	Average
July	3 rd	30	7	Seedling	0.2	0.3	0.2	0.1	0.20	0.63 (during vegetative stage)	0.20	0.63 (during vegetative stage)
	4 th	31	14	Seedling	0.5	0.4	0.4	0.2	0.45		0.30	
August	1 st	32	21	Tillering	0.6	0.8	0.4	0.5	0.50		0.65	
	2 nd	33	28	Tillering	0.9	0.8	0.8	0.8	0.85		0.80	
	3 rd	34	35	Stem elongation	1.0	0.9	0.8	0.7	0.90		0.80	
	4 th	35	42	Stem elongation	0.9	1.1	0.9	0.9	0.90		1.00	
Sept	1 st	36	49	Booting	1.1	1.3	0.9	1.1	1.00	1.09 (during reproductive stage)	1.20	1.43 (during reproductive stage)
	2 nd	37	56	Heading	0.9	1.4	0.9	1.2	0.90		1.30	
	3 rd	38	63	Heading	1.0	1.6	1.1	1.2	1.05		1.40	
	4 th	39	70	Flowering	1.2	1.6	1.0	1.5	1.10		1.55	
Oct	1 st	40	77	Flowering	1.5	1.7	1.3	1.7	1.40		1.70	
	2 nd	41	84	Milk grain	1.5	2.0	1.4	1.9	1.45	1.03 (during ripening stage)	1.95	1.54 (during ripening stage)
	3 rd	42	91	Dough grain	1.6	1.9	1.4	1.7	1.50		1.80	
	4 th	43	98	Dough grain	0.8	1.2	0.6	1.5	0.70		1.35	
Nov	1 st	44	105	Mature grain	0.6	1.2	0.3	0.9	0.45		1.05	

DAT- Days After Transplanting, Std. Week- Standard week

Table 3: Correlation of stem borer damage with egg masses and female adult population

Yellow Stem Borer	Correlation Coefficient ('r')					
	Dead Heart Damage (Y₁)			White Earhead Damage (Y₂)		
	2011	2012	Pooled	2011	2012	Pooled
Egg Mass/m²(X₁)	-0.0658	0.0816	0.0013	0.3620	0.3134	0.3375
Female Adult/m²(X₂)	-0.1829	-0.1799	-0.1848	0.4159	0.5099*	0.4730

** Significant at 5 % level*