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Oviposition Preference of *Scirpophaga incertulas* (Walker) on Different Varieties of Rice Under Caged Condition

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Preference of Yellow Stem Borer (YSB) female for egg deposition on 21 aus and 11 aman rice varieties were observed under caged conditions during 1992, 1993 and 1994. Significant differences in the number of egg mass deposition on different rice varieties were found excepting on aus, 1992 and aman, 1994. The dorsal side of leaf was preferred to ventral side for egg deposition irrespective of the rice variety. Again, the middle portion of leaf was preferred for egg laying to basal and apical portions in all the varieties. Length and width of egg masses deposited on different rice varieties did not differ significantly except the length of the egg mass in aus season. The number of egg masses deposited by the female YSB was positively correlated with leaf blade colour but negatively correlated with plant height, 2nd leaf length and width, number of leaves, number of tillers and leaf hair in both aus and aman rice. So, the leaf blade colour induces egg deposition, while other plant characters reduce it.

Key words: Rice varieties, Plant characters, YSB, Oviposition preference, Egg mass.

Introduction

As early as 1965, Beck suggested that the recognition and orientation of host plant followed by the selection of specific site and finally the deposition of eggs are governed by a number of factors both physical and chemical. Such variation in different varieties may lead to their differential susceptibility to a particular insect. Lukefahr *et al* (1965) reported that the borers preferred glabrous surface of the leaf to the hairy ones. Later, Pathak (1977) found strong preference for oviposition by the female rice stem borer, *Chilo suppressalis* for certain varieties. However, even under heavy infestation, many varieties had only a few egg masses. The percentage of dead-hearts on most varieties was positively correlated with the ovipositional preference of the female moths. A few varieties receiving comparatively large number of egg masses suffered less damage than the other varieties. Padhi and Chatterji (1984) reported that the susceptible Jaya variety received the highest number of egg masses. Also, the egg masses covered more area in this variety. As regards the site of egg deposition, the dorsal side of the rice leaf was more preferred for egg laying than the ventral side and leaf sheath under caged condition, irrespective of variety used. Further, the middle portion of rice leaf was more preferred for egg laying than the basal and apical portions in all these varieties. Yellow stem borer female preferred the early tillering stage for egg laying than the flowering and maximum tillering stages of the rice plant. This necessitated studying the oviposition by *Scirpophaga incertulas* (Walker) on different rice varieties to locate the preferential site on leaf, and to identify the preferred stage of rice plant.

Materials and Methods

The experiments were conducted at the field research laboratory, Department of Entomology, Bangladesh Agricultural University, Mymensingh during 1992, 1993 and 1994. Twenty one rice varieties in aus (TKM6, TN1, IR8, IR29, BR1, BR2, BR3, BR6, BR7, BR8, BR9, BR12, BR14, BR15, BR16, BR20, BR21, Dular, Gomvir, Hashikalmi and Purbachi) and eleven rice varieties (TKM6, TN1, BR4, BR10, BR11, BR22, BR23, Kalizira, Nizersail, Purbachi and Tulsimala) in aman season were studied for oviposition preference. In each season the above mentioned rice varieties were planted in one iron tray (92cm X 80cm X 15cm) having 10 plants/variety and these served as one replication. There were three such replications. A RCBD was followed. Forty (aus) and fifty (aman) days after transplanting, the iron trays were caged and 100 *S. incertulas* female moths per replication were released in the morning/evening. Observations on oviposition were recorded 72 hr after the release and these observations included different parameters viz., (i) number of egg masses, (ii) length and width of egg masses, (iii) site of egg masses and (iv) location of egg masses on rice leaves in each variety. Statistical analysis was carried out using F-test, DMRT, Correlation Coefficient and Full Model Regression Analysis. For correlation coefficient analysis the code guide of IRRI (1980) for leaf blade colour was used.

Results and Discussion

Aus season. Observations on the number of egg masses deposited, length and width of egg masses, preferential side for oviposition and location of egg masses on rice leaf in aus season were presented in Table 1. The mean number of egg masses deposited by YSB in three aus season did not show significant differences. There were no significant differences in the number of egg masses deposited on different test rice varieties. However, significant differences were observed in the following years. In 1993, the highest number of egg masses was recorded in BR6, which was not significantly different from that of the other tested varieties except IR29 where no egg mass was recorded. Similarly, egg masses were not observed on TKM6 and Hashikalmi in the year 1994. In the same year, the highest number of egg masses was recorded in BR15, which was statistically identical to that in BR6, BR2, TN1, BR7, BR8, BR9 and BR12. Though the width of egg masses did not vary significantly, the length varied significantly with the varieties. The greatest length of egg masses was recorded in BR6 with the least in BR14.

As regards the preferential side, the dorsal side of rice leaf was preferred more by the YSB to lay eggs than the ventral side with the exception of BR9, BR21, Dular and Gomvir. Among the varieties, BR2 and BR15 received the highest number of egg masses on dorsal side and ventral side respectively. There was no egg deposition on dorsal side in Gomvir variety and ventral side in the varieties BR3, BR12 and BR14. Regarding location of egg masses on the rice leaf, the middle portion was preferred more for egg laying than basal and apical portions. The highest number of egg masses was deposited on basal portion in BR2, BR3, and BR15, on middle portion in BR15 and on apical portion in BR6.

Average plant character values and yellow stem borer egg mass deposited on aus varieties at vegetative stages are presented in Table 2. Correlation and regression coefficient analyses were carried out on the basis of these average plant character values and number of egg masses. Number of egg masses deposited by YSB had an insignificant correlation with leaf blade colour, plant height, 2nd leaf length and width, number of leaves, number of

Table 1

Number, length and width of egg masses, oviposition preference, preferential side for oviposition and location of egg masses of *Scirpophaga incertulas* on rice leaf (BAU Field Research Laboratory, Aus)

Variety	Number of egg mass			Length of egg masses*	Width of egg masses*	Preferential side		Location		
	1992	1993*	1994*			Dorsal*	Ventral*	Basal	Middle	Apical
								1994		
TKM6	1.667	0.667ab	0.000c	--	--	0.000c	0.000b	0.000	0.000c	0.000b
TN1	2.333	0.333ab	1.333abc	3.233bc	2.567	0.222abc	0.222ab	0.333	0.167bc	0.167ab
IR8	0.667	0.333ab	0.667bc	4.900ab	3.100	0.111bc	0.111ab	0.000	0.167bc	0.167ab
IR29	2.000	0.000b	1.000bc	3.400bc	2.433	0.222abc	0.111ab	0.167	0.167bc	0.167ab
BR1	1.333	1.333ab	1.000bc	3.833abc	2.900	0.222abc	0.111ab	0.000	0.167bc	0.333ab
BR2	1.000	1.333ab	2.333ab	5.237a	2.937	0.667a	0.111ab	0.500	0.333bc	0.333ab
BR3	1.333	0.333ab	1.000bc	3.683abc	2.667	0.333abc	0.000b	0.500	0.000c	0.000b
BR6	2.333	2.000a	2.667ab	5.343a	3.000	0.556ab	0.333ab	0.167	0.500abc	0.667a
BR7	2.000	0.333ab	1.667abc	3.387bc	2.820	0.333abc	0.222ab	0.167	0.667ab	0.000b
BR8	1.333	0.667ab	1.333abc	4.750abc	3.000	0.222abc	0.222ab	0.000	0.167bc	0.500ab
BR9	1.000	0.333ab	1.667abc	4.383abc	3.000	0.222abc	0.333ab	0.167	0.667ab	0.000b
BR12	1.333	0.667ab	1.333abc	4.800abc	2.633	0.444abc	0.000b	0.000	0.500abc	0.167ab
BR14	1.000	0.667ab	0.667bc	3.100c	2.733	0.222abc	0.000b	0.000	0.167bc	0.167ab
BR15	1.333	1.000ab	3.333a	4.200abc	2.600	0.556ab	0.556a	0.500	1.000a	0.167ab
BR16	1.333	0.667ab	2.000abc	3.900abc	2.467	0.556ab	0.111ab	0.167	0.500abc	0.333ab
BR20	2.000	0.333ab	2.000abc	3.973abc	2.883	0.333abc	0.333ab	0.167	0.333bc	0.500ab
BR21	1.000	0.667ab	1.000bc	3.167bc	2.367	0.111bc	0.222ab	0.000	0.167bc	0.333ab
Dular	1.000	1.000ab	1.000bc	3.800abc	2.500	0.111bc	0.222ab	0.000	0.333bc	0.167ab
Gomvir	1.667	1.667ab	0.667bc	3.733abc	2.733	0.000c	0.222ab	0.000	0.167bc	0.167ab
Hashikalmi	1.000	1.333ab	0.000c	--	--	0.000c	0.000b	0.000	0.000c	0.000b
Purbachi	2.333	0.667ab	1.000bc	3.667abc	3.000	0.222abc	0.111ab	0.167	0.167bc	0.167ab
Mean	1.476	0.778	1.317	4.026	2.755					
CV(%)	59.13	115.79	94.41	21.73	17.66	25.58	25.58	25.58	25.58	25.58
Side*						0.270	0.169			
Location*								0.143b	0.302a	0.214ab
SE	0.504	0.5199	0.658	0.5053	0.281	0.1464			0.1794	

Within column means followed by same letter(s) did not differ significantly at P<0.05 by DMRT

tillers, leaf hair. Number of egg masses deposited by the female YSB was found positively correlated with leaf blade colour (0.076) but negatively correlated with plant height (-0.118), 2nd leaf length (-0.216), 2nd leaf width (-0.093), number of leaves (-0.203), number of tillers (-0.057) and leaf hair (-0.191) (Table 5). These results indicate that leaf blade colour induces egg deposition, whereas other plant characters reduce egg deposition.

The regression coefficients of number of egg masses deposited and leaf blade colour (-0.044), plant height (-0.018), 2nd leaf length (0.020), 2nd leaf width (-0.150), number of leaves (-0.820), number of tillers (-0.025) and leaf hair (-0.003) were found insignificant at 5% level of probability. Seven above mentioned independent variables in the model together explain only 18% variation in the dependent variable but none of the partial b (regression coefficient) were statistically significant. There were more variables not included in the model, which explained more than 80% of the variability of the dependent variable. The proposed model is:

$$Y = 6.71 - \underset{(0.1428)}{0.0443X_1} - \underset{(0.0169)}{0.0176X_2} + \underset{(0.0700)}{0.0198X_3} - \underset{(0.3158)}{0.1499X_4} - \underset{(0.8151)}{0.0920X_5} - \underset{(0.1506)}{0.0249X_6} - \underset{(0.0041)}{0.0031X_7}.$$

Figures in parentheses below the regression coefficients show the standard errors of the estimated value.

Aman season. There were no significant differences regarding the mean number of egg masses deposited by YSB in two aman seasons. Though the highest number of egg masses was recorded in Tulsimala in 1994, there was no egg deposition in 1993 in the same variety. BR22 received the highest number of egg masses in 1993 (Table 3).

Table 2

Average plant character values and yellow stem borer (YSB) egg masses deposited on Aus rice variety at vegetative stage

Variety	Leaf blade colour	Plant height	2nd leaf length	2nd leaf width	Number of leaves	Number of tillers	Leaf hair	Number of egg mass
TKM6	PG (1)	95.30	40.94	7.08	4.12	11.08	91.84	0.778
TN1	DG(3)	76.62	36.54	8.49	3.94	8.12	11.41	1.333
IR8	DG(3)	68.89	39.61	8.67	4.31	8.35	39.41	0.556
IR29	G(2)	69.99	32.38	8.21	4.05	8.92	20.21	1.000
BR1	DG(3)	65.71	33.13	7.60	3.69	10.12	68.52	1.222
BR2	G(2)	73.32	39.04	8.13	4.12	9.88	2.00	1.555
BR3	G(2)	63.11	35.76	7.93	4.42	9.83	30.42	0.889
BR6	DG(3)	77.22	35.24	8.26	3.83	7.26	19.03	2.333
BR7	G(2)	79.27	38.43	8.01	3.96	8.89	4.28	1.333
BR8	G(2)	64.22	36.58	8.06	4.29	8.36	17.90	1.111
BR9	G(2)	92.11	38.47	9.23	3.91	8.03	39.54	1.000
BR12	G(2)	68.27	36.75	7.51	4.04	9.71	67.01	1.111
BR14	G(2)	76.81	38.68	8.73	3.89	8.15	4.64	0.778
BR15	G(2)	75.12	38.14	7.90	3.91	8.87	25.26	1.889
BR16	G(2)	73.59	34.93	8.10	3.92	8.64	87.76	1.333
BR20	G(2)	87.98	37.00	7.88	3.93	10.37	8.57	1.444
BR21	G(2)	92.90	39.04	8.76	3.89	6.71	39.72	0.889
Dular	PM(5)	90.75	37.44	8.05	3.63	7.40	18.92	1.000
Gomvir	PG(1)	96.27	36.46	7.94	3.58	7.65	11.78	1.334
Hashikalmi	G(2)	94.60	35.03	7.89	3.51	7.76	1.55	0.778
Purbachi	DG(3)	73.19	36.67	8.60	3.89	8.20	35.04	1.333
Year								
1991		85.39	--	--	4.20	9.05	30.71	--
1992		75.73	33.24	8.36	3.99	9.68	--	1.476
1993		--	--	--	--	--	--	0.778
1994		75.34	40.68	7.92	3.65	7.31	--	1.317

Note: DG, Dark green; G, Green; PG, Pale green; PM, Pale margin. Figures within parentheses are code guide for rice, *Oryzae sativa* L. (IRRI, 1980).

Table 3

Number, length and width of egg masses, oviposition preference, preferential side for oviposition and location of egg masses of *Scirpophaga incertulas* on rice leaf (BAU Field Research Laboratory, Aman)

Variety	Number of egg mass		Length of egg masses	Width of egg masses	Preferential side		Location		
	1993*	1994			Dorsal	*Ventral	Basal	Middle	Apical
						1994			
TKM6	1.000bc	1.667	5.233	3.367	0.444b	0.111	0.167	0.167b	0.500
TN1	1.000bc	2.000	4.083	2.783	0.444b	0.222	0.167	0.500ab	0.333
BR4	1.667ab	2.000	4.033	2.933	0.667b	0.000	0.000	0.667ab	0.333
BR10	1.333abc	1.333	3.867	2.800	0.222b	0.222	0.500	0.167b	0.000
BR11	1.000bc	1.333	4.950	3.333	0.333b	0.111	0.333	0.333b	0.000
BR22	2.667a	1.000	4.233	3.200	0.333b	0.000	0.167	0.333b	0.000
BR23	0.333bc	1.000	2.967	2.033	0.333b	0.000	0.167	0.333b	0.000
Kalizira	0.333bc	1.000	4.600	3.100	0.333b	0.000	0.000	0.500ab	0.000
Nizersail	0.667bc	1.000	4.900	3.467	0.222b	0.111	0.000	0.333b	0.167
Pajam	1.000bc	1.667	4.600	3.177	0.556b	0.000	0.000	0.667ab	0.167
Tulsimala	0.000c	4.000	4.317	2.857	1.333a	0.000	0.000	1.333a	0.167
Mean	1.000	1.636	4.344	3.005	-	-		-	-
CV(%)	81.46	132.0	22.07	20.51	247.48	247.48	247.48	247.48	247.48
Side*		6		-	0.475a	0.071b			
Location**							0.136b	0.485a	0.197b
SE	0.0894	0.159	-	-	0.2251			0..2757	-

Within column means followed by same letter (s) did not differ significantly at ** P<0.01 and P<0.05 respectively by DMRT.

Table 4

Average plant character values and yellow stem borer (YSB) egg masses deposited on Aman rice variety at vegetative stage

Variety	Leaf blade colour	Plant height	2nd leaf length	2nd leaf width	Number of leaves	Number of tillers	Leaf hair	Number of egg mass
TKM6	PG(1)	96.39	33.04	7.86	3.71	9.81	98.17	1.334
TN1	DG(3)	87.63	37.09	10.60	3.90	8.16	5.51	1.500
BR4	DG(3)	76.88	44.10	8.41	3.91	9.51	21.09	1.834
BR10	DG(3)	76.69	34.74	10.73	3.68	9.55	76.25	1.333
BR11	G(2)	68.69	31.89	11.05	4.20	9.37	15.37	1.167
BR22	G(2)	74.21	35.31	10.31	4.04	8.34	111.90	1.834
BR23	G(2)	77.73	39.70	10.10	4.07	9.71	9.43	0.667
Kalizira	G(2)	90.21	43.17	9.20	4.10	9.77	112.60	0.667
Nizersail	PG(1)	87.48	41.12	9.34	3.79	7.80	88.01	0.834
Pajam	G(2)	82.69	38.53	9.95	4.32	10.07	117.30	1.334
Tulsimala	DG(3)	90.54	41.13	8.65	3.79	8.04	0.00	0.000
Mean	-	82.65	38.17	9.65	3.96	9.10	59.60	1.319
Year								
1993		91.00	41.50	10.25	4.18	11.41		1.000
1994		74.29	34.83	9.05	3.72	6.79		1.636

Note: DG, Dark green; G, Green; PG, Pale green.Figures within parentheses are code guide for rice, *Oryzae sativa* L. (IRRI, 1980).

Length and width of egg masses deposited by YSB on different rice varieties did not differ significantly. The greatest length and width of egg masses were recorded in TKM6 and Nizersail, respectively (Table 3).

It is evident from Table 3 that significantly the highest number of egg masses was deposited on dorsal side compared with ventral side of rice leaf. Among the varieties, Tulsimala received significantly the highest number of egg masses on dorsal side. There was no egg deposition on ventral side in the varieties BR4, BR22, BR23, Kalizira, Pajam and Tulsimala.

So far as the location of egg masses on the rice leaf was concerned, significantly the highest number of egg masses was observed on the middle portion of the rice leaf. There were no significant differences in the number of egg masses deposited on basal and apical portions of rice leaves of different rice varieties. The variety Tulsimala received the highest number of egg masses in the middle portion of the rice leaf, which was statistically similar to that of TN1, BR4, BR10, Kalizira and Pajam (Table3).

Average plant character value and yellow stem borer egg masses deposited on aman rice varieties at vegetative stages are presented in Table 4. Correlation and regression coefficient analyses were carried out on the basis of these average plant character values and number of egg masses. Number of egg masses deposited by the female YSB moth had an insignificant correlation with the leaf blade colour, plant height, 2nd leaf length and width, number of leaves, number of tillers and leaf hair. Number of egg masses deposited by the YSB was found positively correlated with leaf blade colour (0.537), but negatively correlated with plant height (-0.073), 2nd leaf length (-0.077), 2nd leaf width (-0.183), number of leaves (-0.241), number of tillers (-0.333) and leaf hair (-0.224) (Table 6). These results indicate that the leaf blade colour induces egg deposition, whereas other plant characters reduce the egg deposition.

The regression coefficients of number of egg masses deposited and leaf blade colour (0.663), 2nd leaf length (-0.092), 2nd leaf width (-0.558) and number of tillers (-0.398) were significant ($P<0.05$), but plant height (-0.022), number of leaves (0.947) and leaf hair (0.004) were insignificant at 5% level of probability. Seven independent variables in the model together explain 95% variation in the dependable variable. The proposed model is:

$$Y = 10.2976 + 0.6628X_1 - 0.0224X_2 - 0.0922X_3 - 0.5581X_4 + 0.9466X_5$$
$$(0.1068) \quad (0.0099) \quad (0.0193) \quad (0.0978) \quad (0.3904)$$
$$-0.3975X_6 + 0.0035X_7$$
$$(0.8530) \quad (0.0015)$$

Figures in parentheses below the regression coefficients show the standard errors of the estimated value.

Table 5

Correlation coefficient between rice plant characters and number of egg masses deposited by YSB (Aus)

Variables	Plant height	2nd leaf length	2nd leaf width	Number of leaves	Number of tillers	Leaf hair	Number of egg mass
Leaf blade colour	-0.163	-0.159	0.231	-0.208	-0.344	-0.125	0.076
Plant height	-	0.363	0.033	-0.590	-0.282	-0.100	-0.118
2nd leaf length	-	-	0.143	0.272	0.048	0.017	-0.216
2nd leaf width	-	-	-	0.018	-0.654	-0.337	-0.093
Number of leaves	-	-	-	-	0.421	0.165	-0.203
Number of tillers	-	-	-	-	-	0.379	-0.057
Leaf hair	-	-	-	-	-	-	-0.191

Table 6

Correlation coefficient between rice plant characters and number of egg masses deposited by YSB (Aman)

Variables	Plant height	2nd leaf length	2nd leaf width	Number of leaves	Number of tillers	Leaf hair	Number of egg mass
Leaf blade colour	-0.274	0.214	0.241	-0.084	-0.089	-0.552	0.537
Plant height	-	0.261	-0.674	-0.424	-0.140	0.212	-0.073
2nd leaf length	-	-	-0.445	0.032	-0.105	-0.090	-0.077
2nd leaf width	-	-	-	0.397	-0.067	-0.119	-0.183
Number of leaves	-	-	-	-	0.374	0.123	-0.241
Number of tillers	-	-	-	-	-	0.258	-0.333
Leaf hair	-	-	-	-	-	-	-0.274

The present investigations were almost in the same line with those of the previous workers and conform to the findings of several workers. Their findings were as follows: YSB female moths preferred laying more eggs on the dorsal side followed by ventral side and leaf-sheath under caged condition. Middle portion of leaf was more preferred by the female moth than the basal and apical portions and the egg masses covered more area in the susceptible variety (Islam and Catling 1991; Kalode and Israel 1970; Kojima *et al* 1955; Padhi and Chatterji 1984; Prakasa Rao 1972). Borers preferred glabrous surface of the leaf to the hairy ones (Lukefahr *et al* 1965; Pathak 1971; Pathak *et al* 1971). Resistant varieties, in general, were less preferred by the female moths for oviposition than the susceptible varieties (Manwan and Vega 1975; Panda *et al* 1975; Pathak 1967; Pathak *et al* 1971; Prakasa Rao 1983). The results of the present experiments differ from those of Wada (1942), Patanakamjorn and Pathak (1967) and Islam (1991), who reported that plant height, stem diameter, length and width of leaf and tiller density were positively correlated with number of eggs laid. Although the results of the present study are negatively correlated, the value of the correlation is statistically insignificant. However, this variation could be due to the differences of varieties used by different investigators. In the present study, all the varieties except Tulsimala possess macro hairs, which appear to be the dominating factor influencing the egg deposition of yellow stem borer.

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