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iochemical basis of resistance in rice to yellow stem borer, *irpophaga incertulas* Wlk.

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Abstract: Rice varieties TKM-6 and PTB-18 recorded lower borer incidence, larval survival and sugar content, but higher amount of total phenols, orthodehydroxy phenol and silica indicating their resistance to yellow stem borer (YSB) as compared to Jaya, the susceptible check. Irrespective of varieties, the sugar content of the stem tissue was the highest in maximum tillering stage, so also the borer incidence. However, the amount of phenolic compounds and silica increased significantly with the age of the plant, but the survival of the YSB larvae decreased as crop age advanced.

Key words : Rice, Yellow stem borer, Biochemical, Resistance.

troduction

The yellow stem borer (YSB), *Scirpophaga ncertulas* Wlk. is a serious pest of rice causing onsiderable damage to the plant from seedling maturity, thus accounts for a large share f crop losses. The use of insecticides is also ot an easy way for its control due to its ryptic habits but very expensive, as it requires epeated applications. Hence, other avenues of ontrol measures should be explored out, of which varietal resistance is one such approach. Resistance may be due to physical, chemical or both combined factors. To ascertain some of the biochemical factors responsible for resistance/ susceptibility in rice to YSB, a few rice varieties were taken for study at CRRI, Cuttack.

Materials and Methods

The borer build up on resistant varieties like Ratna, W 1263, ARC 10443, CR 57-MR 1526, RPW 6-13, PTB-18 and TKM-6 with susceptible variety Jaya was studied in 2001-2002 wet seasons by implanting YSB egg masses @ one egg mass/plant at early tillering (30 DAT), maximum tillering (45 DAT) and flowering (60 DAT) stages of crop in field microplots. Observation were made on Deed heart / White ear head (DH/WEH) ten days after implantation.

The percentage survival of the YSB larvae on these varieties was studied at the above three stages of rice plant by cut-stem pieces technique (Prakasa Rao, 1983) feeding them through "no choice" basis in test tubes @ ten neonate larvae/tube having five cut stem pieces of four inches size in the laboratory.

To find out the biochemical factors responsible for the resistance/susceptibility of the rice crop, three varieties (TKM-6, PTB-18 and Jaya) were grown in pots in green house with equal amount of soil and applying equal amount of fertilizers. The stem samples for analysis were collected in the above three stages. For estimation of silica, the molybdenum blue method (Nayar *et al.* 1975) was followed using oven-dried samples. For sugars and phenols, ethanol extract of fresh stem was prepared (Mahadevan *et al.* 1965), from which total and reducing sugars were estimated by Nelson's method (1944), while total phenol was estimated using Folin Ciacalteau's reagent (Bray and Thrope, 1954) and orthodehydroxy phenol was estimated employing Arnow's reagent (Johnson and Schaal, 1952).

Results and Discussion

From the above studies, it was found that TKM-6 was the most resistant amongst them having the lowest (8.51%) borer infestation (Table 1) and percentage of larval survival (31.9%), followed by PTB-18 (Table 2) corroborated the works of various workers like Riaz *et al.* 1993; Gubbaih and Ravana, 1993. But with

regard to the stages of crop growth, maximum tillering stage was found to have the highest infestation, while the early tillering stage harboured the highest larval survival.

It is seen from Table 3 that the susceptible variety Jaya was observed to contain significantly more amount of total and reducing sugars than TKM-6 and PTB-18 (Sahajahan, 1992; Nanda *et al.* 2000). However the latter two varieties were found to have significantly higher amount of total phenol and orthodehydroxy phenol, silica (Table 4) which corroborated the findings of Panda *et al.* (1975), Carbonari and Martir (1998) and Chand and Murlirangan (2000) wh stated that some allelo-chemicals and silica c the host tissue were responsible for the resistanc which interfere in the metabolism of the insec

As regards the crop growth stages, th amount of sugars were seen to be higher i the maximum tillering stage, whereas the amour of total phenols, ortho-dehydroxy phenols an silica were seen to increase in the rice ster tissue irrespective of varieties as the crop ag advanced.

Table 1. Percentage of borer infestation in selected rice varieties

Variety	S_1(DH)	S_2(DH)	S_3(WEH)	Mean
Ratna	8.48	14.30	17.43	13.40
W 1263	9.50	16.55	18.10	14.72
RPW 6-13	9.15	12.33	10.48	10.65
ARC 10443	6.63	17.70	15.83	13.38
CR 57-MR 1526	8.43	12.30	9.75	10.16
PTB-18	7.55	11.43	9.05	9.34
TKM-6	6.85	10.43	8.25	8.51
Jaya	18.68	33.10	26.45	26.08
Mean	9.41	16.02	14.42	
CD at	5%	1%		
Varieties (V)	1.63	2.17		
Stages (S)	1.02	1.33		
Interaction (VxS)	2.93	3.76		

S_1 = Early tillering stage, S_2 = Maximum tillering stage, S_3 = Flowering stage

Table 2. Percentage YSB larval survival on stem tissue

Variety	S_1	S_2	S_3	Mean
Ratna	33.05	36.22	36.16	35.14
W 1263	34.72	37.66	36.22	36.20
RPW 6-13	40.61	34.50	29.89	35.00
ARC 10443	31.55	37.66	33.05	34.09
CR 57-MR 1526	37.66	33.05	28.22	32.98
PTB-18	42.12	34.56	26.56	34.41
TKM-6	37.66	31.39	24.53	31.19
Jaya	78.75	60.64	47.95	62.45
Mean	42.01	38.21	32.82	
CD at	5%	1%		
Varieties (V)	4.76	6.32		
Stages (S)	2.92	3.87		
Interaction (VxS)	8.24	10.95		

Table 3. Sugar content in stem tissue of rice varieties

Variety	Total sugar (mg g^{-1} fresh stem tissue				Reducing sugar (mg g^{-1} fresh stem tissue)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
Jaya	17.35	19.95	14.05	17.12	13.80	15.35	10.25	13.13
TKM-6	13.00	15.35	11.75	13.37	10.70	13.95	9.75	11.47
PTB-18	13.70	16.30	12.80	14.27	11.35	14.20	9.75	11.77
Mean	14.68	17.20	12.87		11.95	14.50	9.92	
C.D. at		5%	1%			5%	1%	
Varieties (V)		0.164	0.225			0.169	0.231	
Stages (S)		0.164	0.225			0.169	0.231	
Interaction (V x S)		0.280	0.390			0.293	0.401	

Table 4. Phenolic compounds and silica content in stem of rice varieties

Variety	Total phenols (mg g^{-1})				OD phenols (mg g^{-1})				Silica (%)			
	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean	S_1	S_2	S_3	Mean
Jaya	0.24	0.49	1.19	0.64	0.03	0.10	0.22	0.11	3.05	4.95	6.05	4.68
TKM-6	0.81	1.40	2.11	1.44	0.11	0.19	0.31	0.21	3.95	5.80	7.60	5.78
PTB-8	0.75	1.26	2.03	1.35	0.10	0.18	0.21	0.19	3.85	5.85	7.20	5.63
Mean	0.60	1.05	1.77		0.08	0.15	0.27		3.62	5.53	0.95	
C.D. at			5%	1%			5%	1%			5%	1%
Varieties (V)			0.016	0.021			0.014	0.019			0.157	0.215
Stages (S)			0.016	0.021			0.014	0.019			0.157	0.215
Interaction (V x S)			0.027	0.037							0.271	0.372

From these studies it was derived that the borer larvae found sufficient sugar to survive, so the infestation level was seen to increase till maximum tillering stage irrespective of varieties. The susceptible variety Jaya with its higher sugar content showed three times more incidence as well as almost double the larval survival percentage in comparison to the resistant TKM-6 and PTB-18. Secondly, the percentage of larval survival was seen to decrease corresponding to the increase in phenolic compounds and silica content in the stem tissue with the advancement of the crop age.

The study also revealed that sugars helped the YSB larvae to survive and cause more infestation in the maximum tillering stage corroborated the finding of Bottger (1951), who reported that high infestation and high larval survival of European comborer was associated with high sugar content, which was reflected in rice variety Jaya. On the other hand, varieties with higher amount of phenolic compounds and silica make the plant resistant as these compounds cause barrier to the borer larvae to utilize the plant nutrients (Kind, 1954). So the degree of resistance in TKM-6 and PTB-18 to *S.incertulas* was influenced by the presence of high silica content (Shim, 1965; Djamin and Pathak, 1967; Chand and Murlirangan, 2000) and high phenolic compounds (Carbonari and Martins, 1998). Similar phenomenon had also been reported in other crops like tomato (Sivaprakasam, 1996), brinjal (Kumar, 1997: Doshi *et al.* 1999) and sorghum (Kalappanavar and Hiremath, 2000).

So it is suggested that rice genotypes having high phenolic compounds and silica with

lower sugar content could be utilized in the breeding programme for developing YSB resistant varieties.

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