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Short Note

Screening of Rice Genotypes for Resistance to Yellow Stem Borer, *Scirpophaga incertulas* (Walker)

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Seventy four rice cultures developed in TNAU rice research centres were screened for resistance to yellow stem borer under field condition during Rabi, 2011 - 2012. The genotype CB 08504 had the lowest dead heart incidence (1.48%) with the resistan ce rating of 1 (resistant). It was followed by TM 08610 (4.65%) and CB 06651 (5.10%). Grain yields recorded under protected condition for CB 08504, TM 08610 and CB 06651 were 6389, 6325 and 6244 kg/ha respectively. With regard to white ear incidence, AD 08142 had the lowest incidence of 1.25 per cent and significantly differed from all other cultures, followed by ADT (R) 46 and TNRH 206 which recorded 5.40 and 5.62 per cent white ear respectively. Under protected condition AD 08142, ADT (R) 46 and TNRH 206 recorded the grain yields of 6875, 5205 and 8275 kg/ha, respectively. At both vegetative and reproductive crop phases, AD 08142 and ADT (R) 46 recorded the scale of 1 (resistant). AD 08142, CB 08504, TM 08610, CB 06651 and TNRH 206 (hybrid) can be promoted as they have yellow stem borer resistance in addition to good yield.

Key words: Yellow stem borer, rice genotypes, resistance, dead heart, white ear, grain yield

Rice stem borer complex is considered to be the most serious constraint in Rabi crop of Periyar Vaigai Project area of Tamil Nadu. Of the several species recorded, the yellow stem borer is the dominant one followed by pink stem borer, dark headed borer and white stem borer. Exploiting chemicals and biological control agents along with varietal resistance into a unified IPM system will play an important role in the management of rice yellow stem borer. Varietal resistance plays an important role and till now no rice variety is completely resistant to stem borer attack. However, there are sufficient differences among varieties to make varietal resistance an important factor in insect pest management. Stem borer resistance is governed by horizontal resistance and is polygenic in nature. Literally, continuous attempts have been made to incorporate moderate levels of resistance from several donor parents into improved varieties. In line with this, the present study aimed to screen the rice genotypes developed at TNAU Rice research centres against yellow stem borer, *Scirpophaga incertulas* (Walker), Pyralidae, Lepidoptera.

Materials and Methods

Seventy four rice cultures developed in TNAU rice research centres were screened for resistance to yellow stem borer under field condition during Rabi, 2011 - 2012 at the Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai. The test genotypes were planted in two rows of 2m long. The susceptible check TN 1 was planted for every 20 rows of test genotypes. Two replications were maintained. The crop was raised following standard agronomic practices of irrigation and fertilizers. The efficiency of field screening was enhanced considerably by adjusting the planting time of the rice genotypes, such that peak stem borer incidence coincided with the susceptible stage of plant. Likewise, to ensure high level of infestation the egg mass were collected from rest of the rice fields and confined in Petridish containing moist filter paper. Three -day-old larvae were released in top most auricle of the plant using fine camel hair brush. The test genotypes were observed at 20 days after the larval release for dead heart occurrence. In addition, white ear incidence was also recorded ten days before harvest. The infestation was expressed as per cent dead hearts and white ears calculated as per the formula suggested by Shafiq *et al.* (2000). The test genotypes were rated for resistance based on the Standard Evaluation System developed for screening for resistance to yellow stem borer (IRRI, 1988) and the rating system as shown below was adopted.

Standard Evaluation System for yellow stem borer

S.No.	Scale	Dead heart(%)	White ear(%)	Resistance rating
1.	0	No damage	No damage	Highly resistant
2.	1	1-10	1-5	Resistant
3.	3	11-20	6-10	Moderately resistant
4.	5	21-30	11-15	Moderately susceptible
5.	7	31-60	16-25	Susceptible
6.	9	61 and above	26 and above	Highly susceptible

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The susceptible check averaged more than 20 per cent dead heart and 10 per cent white ear for the screening to be considered valid. To record the grain yield, all the genotypes were raised separately under field condition in 5x4 m plot and two rounds of insecticide spray was given at 15 and 45 days after transplanting to protect the crop from natural insect incidence.

The final data were analyzed with analysis of variance (ANOVA) and means were separated by Duncan's Multiple Range Test.

Results and Discussion

The analysis of variance showed significant differences of dead heart and white ear incidence among the genotypes screened and the results are furnished in Table 1.

Resistance expressed at vegetative phase

The dead heart occurrence in test genotypes ranged from 1.48 to 30.23 per cent. Out of the seventy four genotypes screened, 27 genotypes had dead heart incidence below ETL. The genotype CB 08504 had the lowest dead heart incidence (1.48%) with the resistance rating of 1 (resistant). The next best genotypes with low dead heart incidence was TM 08610 (4.65%) and CB 06651 (5.10%). Grain yield recorded under protected condition for CB 08504, TM 08610 and CB 06651 was 6389, 6325 and 6244 kg/ha respectively.

Khan (2005) studied the reaction of Basmathi varieties to yellow rice borer, which revealed that Basmati Super was resistant with minimum of 2.05 per cent dead hearts and variety Basmati 370 had maximum 4.01 per cent dead hearts under natural conditions. The varieties under natural conditions were ranked as Basmati Super > Basmati 2000 > Basmati 385 > Basmati Pak > Basmati 370 ().

Resistance expressed at reproductive phase

With regard to white ear incidence, the genotype AD 08142 had the lowest incidence of 1.25 per cent and significantly differed from all other cultures. The next best genotypes were ADT (R) 46 and TNRH 206 which recorded 5.40 and 5.62 per cent white ear respectively (Table 1). Under protected condition the genotype AD 08142, ADT (R) 46 and TNRH 206 recorded the grain yield of 6875, 5205 and 8275 kg/ ha, respectively.

Resistance expressed both at vegetative and reproductive phase

On viewing the resistance expressed at vegetative and reproductive phase, two genotypes viz., AD 08142 and ADT (R) 46 recorded the scale of 1 (resistant) at both dead heart and white ear for the yellow stem borer damage (Table 1). Whereas 16 genotypes viz. ACK 09103, ACM 08021, AD (Bio) 09505, AD 08010, CB 06651, CB 08504, AD 08130, CB 09142, TP 08043, TM 08610, TM 07275, TNRH 258, CB 05219, AD 07264, TR 05043 and TNRH 237 recorded the scale of 1 for dead heart and scale 3 for white ear (moderately resistant) for the yellow stem borer damage (Table 1). The released varieties CR 1009, BPT 5204, TRY 3 and CORH 3 were on par with them.

Khan et al. (2010) observed maximum dead hearts (58.35%) and white earheads (13.67%) in Basmati Super whereas minimum dead hearts (13.63%) and white earheads (2.35%) in IRRI-6 followed by DR-83 and KSK-282 with 20.06 per cent and 25.74 per cent dead hearts and 9.45 per cent and 4.97 per cent white earheads, respectively. IRRI-6 was found not only tolerant to rice stem borer attack but also showed maximum number of tillers (49.60), spike length (32.61cm), grains spike-1 (132.8), thousand grains weight (35.67g) and yield hectare-1 (6.53 tons). However, it showed less plant height (97.22 cm) compared to other tested varieties. Over all, results showed that fine varieties (Basmati) were highly susceptible to the yellow stem borer compared to the coarse varieties tested.

Khan et al. (2003) screened eight rice varieties JP-5, Swat-1, Swat-2, Dilrosh-97, Basmati-385, KS-282, Gomal-6 and Gomal-7 for their resistance against rice stem borer. None of the tested varieties was free from the attack of rice stem borer. However, variety KS-282 was found resistant as compared to other tested cultivars.

Resistant donors to yellow stem borer

Among 118 released varieties from India, 12 were resistant to yellow stem borer (Subudhi et al., 2007). Sudha was identified as a common donor of resistance to stem borer.

Further screening has identified IR75288-38-3-1 as an important donor for stem borer resistance, with more than 86 per cent larval mortality both on detached leaf and with field screening (Li et al., 2010).

Reaction of aromatic/ non-aromatic rice varieties to stem borer

Abdul Rehman Dhuyo (2009) studied the genetic variability of rice varieties to stem borer. Scented rice entries viz., Lateefy, DR-65, Basmati 385, Basmati 370, Shaheen Basmati, DR-66, DR-61, DR-67, IR67017-13-3-3, PARC-228, Ambreen were noted more susceptible than the coarse rice entries for yellow rice stem borer. The aromatic rice entry Lateefy recorded moderate resistance to S. incertulas under field and green house conditions than the other aromatic entries. The medium maturing coarse rice entries viz., Tox 3241-21-3, LTPR-4-32-1-1-1, ITR-344, LT9852-5-2-1-1, CT22048-3, KAJAT-2, IR86949-1, TCX3162-11-1-2-1, IR65077-33-1-3-3, IR68068-99-1-33, DR-58, IR-6 were comparatively more damaged by yellow rice stem borer as compared to the early maturing rice entries DR-83XDR-92, DR-83XDR-46, DR-

Table 1. Reaction of the rice genotypes to yellow stem borer under field condition.

S. No.	Culture	Dead heart %	Scale	White ear %	Scale	Grain yield (kg/ha)
Short duration genotypes (100-110 days)						
1	TM 07335	9.18a-h	1	15.90d-j	5	5167
2	ACK 09103	9.89a-i	1	8.62a-i	3	5278
3	ACM 08021	10.78a-j	1	7.04a-f	3	6667
4	AD 07105	15.63b-j	3	9.88a-i	3	5333
5	AD(Bio) 09505	6.05a-d	1	9.94a-i	3	7056
6	AS 10046	12.61a-h	3	8.33a-i	3	6365
7	AD 08010	6.47a-e	1	6.58a-e	3	6778
8	CB 08504	1.48a	1	10.19a-i	3	6389
9	ADT(R) 45	11.09a-i	3	7.94a-h	3	5500
10	ASD 16	21.81j-l	5	13.38b-j	5	5139
Medium duration genotypes (110-125 days)						
11	CB 07537	11.74a-j	3	11.63b-i	5	5275
12	TM 08560	11.02a-j	3	17.64i-j	7	5275
13	AD 08130	8.91a-g	1	10.49a-i	3	6275
14	ACK 09009	17.64e-k	3	13.32b-j	5	6275
15	TM 07278	14.23b-j	3	12.46b-j	5	7675
16	ACM 07001	12.20b-j	3	7.79a-j	3	7675
17	ADT 42	9.52a-i	1	11.82b-i	5	5800
18	ADT 39	13.20b-j	3	7.18a-f	3	5900
Long duration genotypes (125-140 days)						
19	CB 09153	15.50b-j	3	6.32a-e	3	6475
20	CB 09142	10.86a-j	1	6.23a-c	3	6575
21	AD 08141	16.50d-j	3	6.27a-d	3	6625
22	AD 08142	10.67a-j	1	1.25a	1	6875
23	ADT (R) 46	7.93a-f	1	5.40a-b	1	5205
24	CO(R) 50	20.72i-l	3	11.69b-i	5	5455
Long duration genotypes (Above 140 days)						
25	TP 08043	10.64a-j	1	9.75a-i	3	6095
26	AD 08087	17.78e-k	3	8.32a-i	3	5592
27	SWARNA	16.35c-k	3	10.37a-i	3	5231
28	CR 1009	6.02a-d	1	8.04a-i	3	5802
Quality Rice - Early (105-120 days)						
29	CB 08517	9.84a-i	1	14.35b-j	5	5619
30	CB 08513	14.45b-j	3	10.73a-i	3	5333
31	AD 07073	17.14d-k	3	14.33b-j	5	6639
32	AD 07320	19.14f-l	3	12.50b-j	5	6722
33	ACK 09002	13.40b-j	3	8.38a-i	3	5000
34	AS 10024	16.05c-k	3	17.63i-j	7	6389
35	TM 07030	9.38a-h	1	34.20k	9	6167
36	CB 08514	13.10b-j	3	15.37c-j	5	6139
37	ADT 43	12.71a-j	3	8.12a-i	3	5278
Quality Rice -Medium (130-140 days)						
38	CB 09123	10.43a-i	1	15.35c-j	5	6825
39	CB 09138	15.24c-j	3	11.19b-i	5	7725
40	AD 08132	14.95b-j	3	6.33a-e	3	6825
41	TM 08610	4.65ab	1	8.18a-i	3	6325
42	AD 04072	9.24a-h	1	12.62b-j	5	7225
43	AD 07302	11.74a-i	3	6.91a-f	3	6875
44	ACM 08028	15.95b-k	3	16.32f-j	5	7750
45	CB 06124	7.21a-e	1	11.85b-i	5	6775
46	CO (R) 49	13.57b-j	3	11.65b-i	5	6405
Adaptive Research Trial - Early (100-110 days)						
47	CB 06535	20.11g-l	3	10.00a-i	3	6095
48	TP 08010	15.51b-k	3	10.68a-i	3	6122
49	AD 04001	14.78b-j	3	8.26a-i	3	6350
50	ACM 01010	8.87a-g	1	14.52b-j	5	6875
51	ADT (R) 45	12.13a-j	3	9.11a-i	3	7105
Adaptive Research Trial - Medium (110-125 days)						
52	AD 03005	12.47a-j	3	8.93a-i	3	5990
53	CB 06651	5.10a-c	1	7.34a-f	3	6244
54	TM 07275	9.37a-h	1	7.31a-f	3	6125
55	CB 05219	9.69a-h	1	9.93a-i	3	6040
56	AD 07264	8.37a-f	1	6.41a-b	3	5943
57	BPT 5204	9.79a-i	1	6.22a	3	7125
Genotype for Saline/Alkaline						
58	TRY 1	13.78b-j	3	10.29a-i	3	3739
59	TRY® 2	13.27b-j	3	9.98a-i	3	4862
60	TRY 3	9.78a-i	1	8.28a-i	3	4421
61	TR 05041	15.51b-j	3	9.44a-i	3	4747
62	TR 05043	7.02a-e	1	7.58a-f	3	3765
63	ACK 09002	9.07a-g	1	12.14b-j	5	3745
64	ACK 09013	9.89a-i	1	12.40b-j	5	3016
Hybrid Rice Medium (125-140 days)						
65	TNRH 244	9.51a-i	1	17.42g-j	7	8692
66	TNRH 237	7.98a-f	1	8.13a-i	3	7075
67	TNRH 27	10.20a-i	1	14.46b-j	5	8475
68	TNRH 206	16.59d-k	3	5.62a-b	1	8275
69	TNRH 222	18.76f-k	3	12.20b-j	5	7175
Hybrid Rice Early (100-120 days)						
70	TNRH 258	10.04a-i	1	8.46a-i	3	6917
71	TNRH 259	30.23l	5	15.97e-j	5	7375
72	TNRH 193	13.04b-j	3	11.49b-i	5	7542
73	TNRH 243	10.43a-i	1	17.52h-j	7	6958
74	CORH 3	9.75a-i	1	7.78a-g	3	6917
75	TN 1 (S check)	27.23kl	5	21.52j	7	4542

Mean of two replications.; In the column, means followed by same letters are not significantly different (P=0.05) by DMRT.

82XS.Kangani, ZHONG-XIANGI, IR72885-1-4-1-4-3-6, JIANGZHOU-XIANGNUD, DR-64 and DR-83.

Sarwar (2012) reported that non-aromatic IR 8 and Sharshar had 3.21 per cent, 2.47 per cent dead hearts, 6.05 and 4.24 per cent whiteheads and higher production of 2313 and 2807 g per 4.5 m2, respectively. While, aromatic Basmati-370 and Mehak with 5.44 per cent, 4.75 per cent dead hearts, 8.94 and 7.45 per cent whiteheads and production of 1500 and 1823 g per 4.5 m2, respectively, had higher borer infestation.

Mechanism of resistance to stem borer

The mechanism of rice varietal resistance to the yellow stem borer in terms of vascular bundles arrangement, layers of sclerenchyma tissue, water content and silica content are to be explored for the promising genotypes in future. Chandler (1968) reported that stem borer resistance is derived from several characteristics of the rice plant. Rice varieties with vascular bundles arranged closer than the width of the larval head offered resistance to larval boring. Varieties with thick layers of sclerenchyma tissue were usually less heavily infested than those with thin layers. Similarly internal factors such as silica content and other chemical characteristic may be involved. Panda *et al.* (1977) observed a negative influence of high silica contents of a resistant rice variety on the utilization of starch by the rice- borer. Pathak *et al.* (1971) detected worn mandibles of the larvae feeding on a variety with high silica contents and making the larvae inefficient feeder.

The cultivation of rice variety IR 198007-21-2-2 having low water and high silica contents should be encouraged in the field, to get a borer-free crop and

to check further proliferation of the pest in the rice growing tracts (Marwat and Baloch, 1985). Eventually, rice varieties are to be developed with low water-uptake characteristics, high silica contents and desirable pool of agronomic characters for the benefit of the farming community.

The genotypes AD 08142, CB 08504, TM 08610, CB 06651 and TNRH 206 (hybrid) can be promoted as they have yellow stem borer resistance in addition to good yield.

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