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Measure of Tolerance Level of Semi-Deep Water Cultivated Accessions Resistant/Moderately Resistant to Yellow Stem Borer *Scirpophaga incertulas* (WIk.) at Reproductive Stage

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Abstract

The Evaluation results of 75 semi-deep water cultivated accessions under field and controlled condition at reproductive stage revealed that 12 accessions viz. Nalini, Matangini, Panidhan, Kalashree, Amulya, Kalamahipal, Andharchaki, RP-2344-OR-47-2, RP-2344-OR-47-3, AYT-SDW-CR-1022-27, Champeisiali and Moogey showed resistant, and three accessions viz. Mayurkantha, CR-1028-14-4 and Seema Showed moderately resistant reaction. The lowest incidence of white head (WH), damaged stem (DS) and total infestation (TIn) and highest tolerance ratio (TR), grain and straw yield in Matangini, Nalini, Kalashree, Panidhan, Amulya, Kalamahipal, RP-2344-OR-47-3, CR-1030, Jogen showed promise under semi-deep water condition.

Key words : Yellow stem borer (YSB), Tolerance, Accessions, Damaged stem (DS), Reproductive stage.

Yellow stem borer, *Scirpophaga incertulas* (Wlk.) is the most important insert pest in rice which attacks the crop both at the vegetative and reproductive stages causing an yield loss of about 25—30% (1). It is more severe in low land, semi-deep and deep water rice ecosystems due to its semi-aquatic habit and increase in 1% yield loss in deep water rice is attributed to each 2% damage stem at harvesting stage (2). Use of resistant moderately resistance rice accessions is the only feasible and eco-friendly alternative available in semi-deep water eco-system for management of this insect because this approach is economical, durable and non-hazardous to humans and beneficial organisms (3). Hundreds of semi-deep water rice accessions are cultivated in India including Orissa. These diverse accessions need to be tested thoroughly to this most dominant and destructive insect for determination of a feasible IPM schedule in this ecosystem. Experiments were conducted at field and controlled condition at nearby farmers field and CRRI, Cuttack during 1998 through 2004 to evaluate 75 semi-deep water rice accessions and measure of tolerance level of 18 accessions resistant/moderately resistant to yellow stem borer at reproductive stage.

Methods

Seventy five semi-deep water cultivated accessions were screened under field condition during the wet season of 1998 and 2000 in farmers field considering water depth at Balitutha (near Kujang) at reproductive stages. Each accession was planted in 5 rows with 20 hills in each row with inter and intra-row spacing of 20 × 25 cm. Recommended agronomic practices were followed and the crop was kept pesticide free throughout the season. Each row was fixed with one laboratory collected (6-day old) egg mass (with the help of an adhesive tape) at booting stage to assess their reaction at reproductive stage. For recording the extent of yellow stem borer infestation in each accession, 50 hills were sampled randomly at the grain ripening stage for enumeration of dead hearts and white ear heads.

Seventy five semi-deep water rice cultivated accessions with appropriate check were evaluated under field condition in 1998 and 2000 were categorized as highly susceptible, susceptible, moderately susceptible, moderately resistant and resistant based on their reaction to yellow stem borer infestation. Out of these the 49 semi-deep water rice cultivated acces-

Table 1. Reaction of some semi-deep water rice accessions to yellow stem borer under natural infestation in 1998 and 2000 and under artificial infestation in 2002 at reproductive stage. R—Resistant, MR—Moderately Resistant, MS—Moderately Susceptible, S—Susceptible, HS—Highly Susceptible.

Damage (%)	Field condition 1998	2000	Controlled condition 2002	Reaction
1—10	Panidhan, Nalini, Matangini, Kalamahipal, Amulya, RP-2344-OR-47-2, Champeisiali, Hendakadal, Kalashree. RP-2344-OR-47-3, Andharchaki, Jogen, CR-1030, AYT-SDW-CR-1022-27, SDW-CN-580-869-43-3	Panidhan, Nalilni, Matangini, Kalamahipal, Amulya, RP-2344-OR-47-2, Champeisiali, Hendakadal, Kalashree, RP-2344-OR-47-3, Andharchaki, Jogen, CR-1030, AYT-SDW-CR-1022-27, SDW-CN-580-869-43-3, SER-3015-6-6-28-6, AYT-SDW-CN-573-661-43	Panidhan, Nalilni, Matangini, Kalamahipal, Amulya, RP-2344-OR-47-2, Champeisiali, Hendakadal, Kalashree, RP-2344-OR-47-3, Andharchaki, CR - 1030, SDW-CN-580-869-43 - 3, AYT-SDW-CR-1022 - 27, Jogen, Moogey	R
11—20	Chaitanya, Jallahari, Matia, Madankhatia, NDGR-21, NDR-954142, NDR-4107, Mayurkantha, PLA-8572, RP-2344-OR-47-9, Moogey, Sapadidhan, AYT-SDW-CR-340-22-17, CR-1028-14-4, Achwabayahonda, Bayahonda, Sudha, Jitendra, Champa	Chaitanya, Jallahari, Moogey, Matia, Madankhatia, NDGR-21, Mayurkantha, Sapadidhan, CR-1028-14-4, Achwabayahonda, Mandira, Bayahonda, Sudha, Jitendra, Champa, Kaudimaji, Mahananda, NDGR-392, Kalapakhira	Jallahari, Matia, Madankhatia, NDGR-21, Mayurkantha, Sapadidhan, CR-1028-14-4, Achwabayahonda, Bayahonda, Sudha, Jitendra, Champa, Kaudimaji, Seema	MR
21—30	Sriranga, Suresh, Bhogali, Vaidehi, Saraswati, Barahavarodhi, Mahananda, NDGR-392, Kalapakhira, Kaudimaji, Akashmalli, AYT-SDW-CN-573-661-43, Neeraja, Bahadur, Mandira, NDR-954655	NDR-GS-4561, Neeraja, Bahadur, RP-3797-1799, NDR-954462, OR-1357-RGA-DR-9, OR-1360-RGA-DR-3, OR-1354-RGA-13-129-14, AYT-SDW-CR-340-22-17, Pranav, Vaidehi, Barahavarodhi, Chandan, Suresh	Neeraj, Bahadur, Chaitanya, Bhagirathi, Mahananda, Sarala, Biraj, Tulasi, Sabita	MS
31—60	Pranav, Pateni, Sarala, Janaki, Sabita, PLA-189, Tulsi, NDR-GS-4561, Sudhir, CN-1035-61, RP-2345-OR-48-1, OR - 1360-RGA-DR-3, OR-1534-RGA-3-129-14, OR-1357-RGA-DR-6, OR-1357-RGA-DR-9	PLA-189, PLA-8572, NDR-4107, NDR-954655, RP-4344-OR-4709, NDR-9541-42, OR-1357-RGA-DR-6, Bhogali, Sreeranga, Saraswati, Akashmalli, Sabita, Tulsi, Sudhir, Purnendu, Pateni, Bhagirathi, RP-3797-1799	Bhogali, Akasamali, Suresh, Pateni	S
61 & above	Golak, Chandan, Bhagirathi, Biraj, Sunil, NDR-954462, SER-3015-6-6-28-6, Jalaprava, RP-3797-1799	CN-1035-61, Golek, Durga, Janaki, Sarala, Jalaprava, Biraj, Sunil	Sreeranga, Saraswati, Golek, Pranav, Sunil, Janaki	HS
	Susceptible check- Panikoili	Susceptible check- Panikoili	Susceptible check- Panikoili	

sions which were showed resistant and moderately resistant reactions at reproductive stage and also wherever possible the popular cultivated accessions were selected and screened under controlled condition at CRRI, Cuttack in the wet season of 2002. The accessions were grown in sub-plots (measuring 2 m × 1.5 m) with a spacing of 30 × 20 cm and inter-varietal spacing of 60 cm. There were 50 hills in five rows in each sub-plot. Recommended agronomic practices were followed and water depth of 30—50 cm was maintained based on the requirement throughout the cropping season. Each tiller of the test entry along with the susceptible check was infested with freshly hatched YSB larvae at booting stage separately for observation of the infestation of the insect at reproductive stages. The micro-ponds were covered with

well-perforated nylon mesh throughout the cropping season to prevent further infestation from other sources.

For recording the extent of YSB infestation, in each accession, two ropes were put diagonally at the grain ripening stage for enumeration of white ear heads (WEH) and percent WH was calculated using following formula

$$\text{White ear head \%} = \frac{\text{No. of white heads}}{\text{Total no. of tillers with panicles (Healthy panicles + white ear heads)}} \times 100$$

For measurement of tolerance level of semi-deep/ deep water cultivated accessions, a randomized and raplicated (five) experiment was conducted under controlled condition at CRRI, Cuttack in the wet seasons of 2003 and 2004 with a set of 18 semi-deep water cultivated accessions at reproductive stage separately with a spacing of 30 × 20 cm and intervarietal spacing of 60 cm. Each sub-plot measured 3 m^2 (2 m × 1.5 m) and there were 50 hills in five rows in each plot. Recommended agronomic practices were followed and water depth of 30—50 cm was maintained based on the requirement throughout the cropping season under controlled condition. Each tiller of the test entry along with the susceptible check was infested with two freshly hatched YSB larvae at booting stage for measurement of tolerance level at reproductive stage. The micro-ponds were covered with well-perforated nylon mesh throughout the cropping season to prevent further infestation from other sources.

For recording the extent of YSB infestation, in each accession, two ropes were put diagonally at the grain ripening stage for enumeration of white ear heads (WEH). Tillers of 10 randomly selected hills from each accession were selected and dissected both at grain ripening stages (2 days before harvest) to study the extent of stem damage, hereafter referred to as damaged stems (DS). Damaged stems without DH or WEH symptoms externally were also estimated by dissecting 100 stems selected at random. Total infestation (TIn) at vegetative and reproductive/heading stages was calculated by the formula

$$TI_n = \text{Damaged stems (DS)} + \text{WEH}$$

Like wise, tolerance ratio at vegetative and reproductive stages was calculated by the formula

$$TR = TI_n : \text{WEH}$$

Grain and straw yield at reproductive stage were also recorded in each of the test entry including susceptible check.

Results and Discussion

The evaluation results of semi-deep water cultivated accessions under field and controlled condition revealed that 12 accessions viz. Nalini, Matangini, Panidhan, Kalashree, Amulya, Kalamahipal, Andharchaki, RP-2344-OR-47-2, RP-2344-OR-47-3, AYT-SDW-CR-1022-27, Champeisiali and Moogey showed resistant and Mayurkantha, CR-1028-14-4, Seema showed moderately resistant reaction at reproductive stages in 1998 and 2000 under field condition and 2002 under controlled condition (Table 1). CR-1030 and Jogen showed moderately resistant reaction at reproductive stage in 1998 and 2000. On the contrary, Hendakadal showed resistant and moderately resistant reaction at reproductive stage in 1998 and 2000 respectively (Table 1). Also the accessions like Madankhatia, Matia, NDGR-21, Bayahonda, Achwabayahonda, Jitendra, Champa, Mahananda, Neeraja and Sudha showed moderately resistant reaction at reproductive stage in 1998 and 2000 under field condition and 2002 under controlled condition. The evaluation results of some of the cultivated semi-deep water accessions made in the present investigation showing resistant/moderately resistant reaction are in conformity with the earlier evaluations made by previous workers for Bayahonda, Sapadidhan, Achwabayahonda, Hendakadal, Moogey, Kalamahipal (4), for Champa, Matia, Madankhatia and Mayurkantha (5), for Sudha and Jitendra (6) and for Panidhan, Champeisiali and Kalamahipal (7). The accessions like Jallahari, Mahananda, Neeraj showed moderately resistant reaction at reproductive stage presumably due to the use of resistant donors like IR-36 for Mahananda, Pankaj, Mahsuri and TKM-6 for Jallahari and Pankaj for Neeraja. In the present investigation, the percent WH, DS and TIn at reproductive stage varied between (3.5—16.5), (13.6—27.2) and

Table 2. Measure of tolerance level of semi-deep water rice released accessions and landraces at reproductive stage under controlled condition. WEH : White ear head, DS : Damaged stem, TIn : Total infestation, TR : Tolerance ratio. Figures in parentheses are the arcsin values.

	Name of the accessions	WEH	DS	TIn	TR	Grain yield (kg/ha)	Straw yield (kg/ha)
1	Panidhan	5.4 (13.44)	17.5 (24.73)	22.9 (28.59)	4.24	3374	7532
2	Moogey	8.9 (17.36)	19.0 (25.84)	27.9 (31.88)	3.13	2212	7166
3	Jogen	9.2 (17.66)	20.4 (26.85)	29.6 (32.96)	3.22	2313	5324
4	Nalini	4.6 (12.38)	15.4 (23.11)	20.0 (26.57)	4.35	3593	7845
5	Matangini	3.5 (10.78)	13.6 (21.64)	17.1 (24.43)	4.89	4237	8687
6	Mayurkantha	14.6 (22.46)	25.6 (30.40)	40.2 (39.35)	2.75	1733	5454
7	Kalamahipal	6.1 (14.30)	18.8 (25.70)	24.9 (29.93)	4.08	3140	6772
8	Handakadal	10.8 (19.19)	21.8 (27.83)	32.6 (34.82)	3.02	2112	6940
9	Champeisali	6.9 (15.23)	21.9 (27.90)	28.8 (32.46)	4.17	3236	7136
10	Kalashree	5.1 (13.05)	16.9 (24.27)	22.0 (27.97)	4.31	3478	7226
11	CR-1030	8.8 (17.26)	17.6 (24.80)	26.4 (30.92)	3.0	2080	6416
12	RP-2344-OR-47.2	9.8 (18.24)	20.1 (26.64)	29.9 (33.15)	3.05	2158	6590
13	RP-2344-OR-47-3	3.7 (11.09)	13.9 (21.89)	17.6 (24.80)	4.76	4025	8427
14	Amulya	5.3 (13.31)	15.5 (23.18)	20.8 (27.13)	3.92	3024	7168
15	SDW-CN-580-869-43-3	15.0 (22.79)	27.2 (31.44)	42.2 (40.51)	2.81	1876	5987
16	AYT-SDW-CR-1022-27	8.2 (16.64)	15.7 (23.34)	23.9 (29.27)	2.91	1965	5828
17	CR-1028-14-4	16.5 (23.97)	24.5 (29.67)	41.0 (39.82)	2.48	1682	4915
18	Andharchaki	6.5 (14.77)	17.2 (24.50)	23.7 (29.13)	3.65	2872	5953
	Panikoili (Susceptible check)	39.2 (38.76)	40.3 (39.41)	79.5 (63.08)	2.03	1248	3941
	SEM ±	0.94	0.69	0.74		180.7	312.8
	LSD at 5%	1.92	0.84	0.98		287.2	312.2

(17.1—42.2%) respectively in different test accessions. (Table 2) Senapati et al. (7) reported that these figures between (5.4—38.3), (20—41.6) and (25.4—75.6%) in different test accessions under field condition. The difference in these findings were due to the varietal difference and presence of all the stem borer species at reproductive stage under field condition. The observations made in the present investigation in relation to the extent of infestation were in conformity with the observations of Tiwary et al. (8) and Senapati and Samalo (4). The TR, grain and straw yield varied between 2.48—4.89. 1,682—4,237 and 5,324—8,687 kg/ha in different test accessions. The corresponding WH, DS, TIn, TR, grain and straw yield in the susceptible check Panikoili were 39.2, 40.3, 79.5, 2.03, 1,248 and 3,914 kg/ha. Differential reactions of

semi-deep and deep water rice varieties to YSB attack were also reported from Bangladesh and Thailand (9—11) and India (12). Considering the extent of infestation (WH, DS and TIn) tolerance ratio (TR), grain and straw yield into account Matangini, Kalashree, Nalini, Panidhan, Amulya, Kalamahipal, RP-2344-OR-47-3, CR-1030 and Jogen were found to be more tolerant and hence promising at reproductive stage under semi-deep water condition, than the other test accessions.

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