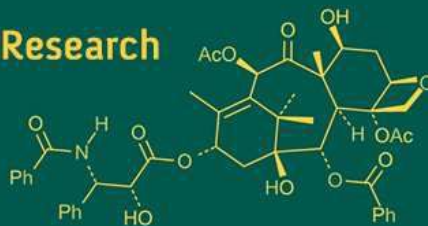
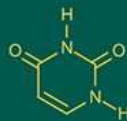


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Studies on the tolerance mechanism in selected rice accession against yellow stem borer, *Scirpophaga incertulas* (Walker)

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Abstract

Investigation on the tolerance reaction of selected rice accessions against yellow stem borer (YSB) indicated that IET 23715 showed moderately resistant with rating scale of 3 followed by both IET 23694 and IET 23272 showed moderately susceptible with rating scale of 5, while IET 23673 and IET 23681 showed susceptible category with rating scale of 7 as against TN 1 registered the rating scale of 9. The yield attributing characters viz., per cent reduction in grain yield/hill, no. of grains/ panicle, 1000 grain weight and per cent increase in chaffy grains in infested plants over healthy plants of the respective test accessions were recorded. Among the accessions, per cent yield reduction was lowest in IET 23694 followed by IET 23715, IET 23272, IET 23681 and IET 23673, whereas percent reduction in panicle length, grains/panicle, 1000 grain and increase in chaffy grains were lowest in IET 23715 followed by IET 23694 and IET 23272. However, IET 23673 recorded the highest percent reduction in panicle length, grains/panicle, 1000 grain and increase in chaffy grains

Keywords: Rice accessions, tolerance reaction, YSB and yield attributing characters

Introduction

Insect pests are considered to be major limiting factors in achieving the targeted yield in rice and their attack cause annual loss of about 20 per cent. Among these insects, YSB is the most important and destructive pest of rice throughout the tropical South and South East Asia including India and attacks both in the *Kharif* and *Rabi* seasons. Yield losses to the tune of 25-30% have been reported due to its attack both at vegetative and reproductive stages in different parts of India Pasalu *et al.* (2002) ^[1]. It is the most abundant stem borer in tropical low land (Catling and Islam 1995) ^[2] due to its close association, profound preference and adaptability to aquatic environment. Although various efforts are being made to manage this pest, but the use of resistant varieties is the most appropriate tool to manage this pest because it is basically free to farmers and judicially fit in IPM schedules. But the progress in developing stable resistant varieties against this pest is very limited because of non-availability of good donors and polygenic nature of resistance (Panigrahi and Rajamani, 2008) ^[3]. Therefore, emphasis is now given on identifying YSB tolerant varieties which can effectively be incorporated in to the integrated management schedule and increase in yield of this ideal eco-system. Also tolerant varieties does not exert selection pressure on insect population for development of new bio-types, favours natural enemy population build up and minimize the frequency of insecticide application. In the light of this, the present study was undertaken to measure the tolerance level of selected rice accessions against YSB.

Materials and Methods

The experiment was conducted during 2015 at Insectary, Department of Agricultural Entomology, Agricultural College and Research Institute, Madurai with selected rice accessions obtained by screening of twenty two rice accessions under green house and sixteen accessions under field conditions.

Among twenty two accessions screened for YSB resistance, four accessions viz., IET 23272, IET 23673, IET 23694 and IET 23715 exhibited good tolerance mechanism through high tillering ability. Tolerance mechanisms for four accessions along with TN 1 were studied under screen house condition. The experiment was replicated three times with five

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hills/replications. Twenty days after planting, the plants were infested with freshly hatched stem borer larvae. Dead heart observations in all the accessions were made on 15 and 30 days after release from selected accessions by adopting the following formula. Per cent dead heart = No. of dead hearts observed / Total no. of tillers observed $\times 100$ (Heinrichs *et al.*, 1985) ^[4].

The percentage of dead hearts was converted to a new figure D which corrected for the level of infestation

$$D = \frac{\text{Percent dead hearts in test entry}}{\text{Percent dead hearts in susceptible checks}} \times 100$$

The converted figure was transformed to a 0-9 scale

Grade	Per cent dead heart (D)	Rating
0	No damage	Highly resistance
1	1-20	Resistant
3	21-40	Moderately resistant
5	41-60	Moderately susceptible
7	61-80	Susceptible
9	>81	Highly susceptible

To compare the yield loss due to YSB, the ability of the accessions to recover was assessed by comparing infested plants over the healthy plants. The number of tillers/hill, percentage of productive tillers, plant height, no. of grains/panicle, panicle length, percentage of chaffy grains, 1000 grain weight and yield per plant were recorded from both healthy and infested plants from all the selected accessions. The mean per cent reductions were worked out for all the characters except chaffy grains. For the chaffy grains, per cent increase was worked out by infested plants over healthy plants (Chandra Mohan, 1987) ^[5] during harvesting stage.

Results and Discussions

The evaluation of selected rice accessions against YSB along with biometric variation in YSB infested plants in comparison with healthy plants are presented in table 1 and 2. The results revealed that the mean per cent dead heart ranged from 56.69 to 100 per cent in selected accessions. The accessions viz., IET 23715, IET 23272, IET 23694, IET 23673 and IET 23681 recorded a mean rating of 3, 5, 5, 7 and 7 respectively as against 9 in TN 1. There was significant per cent reduction in grain yield/hill (21.79 - 48.21%), grains/ panicle (9.58 - 26.47%), 1000 grain weight (11.46 - 30.53%) and per cent increase in chaffy grains (18.58 - 45.76%) in infested plants over healthy plants of the respective test accessions.

Plant height and panicle length of selected accessions ranged from 87.5 to 107.8 cm and 17.3 to 24.1 cm, respectively in healthy plants. In infested plants, plant height and panicle length ranged from 85.8 to 103.2 cm and 15.8 to 21.8 cm respectively in selected accessions. Significantly maximum plant height was observed in IET 23681 with 107.8 cm followed by TN1 (90.8 cm), whereas minimum

plant height was observed on IET 23673 (87.5 cm) in healthy plants.

There was a significant variation on yield attributing characters. Among the selected accessions, IET 23694 recorded minimum per cent reduction in grain yield/panicle (21.79%) followed by IET 23715 (22.97%). However IET 23673 recorded maximum per cent reduction in grain yield/hill (33.29%), but grain yield/hill (28.23 g) was maximum in healthy plants when compared to other accessions, whereas in infested plants IET 23673 observed minimum grain yield/hill (18.83%). Similarly, IET 23715 recorded minimum per reduction in no. of grains/panicles (9.58%), 1000 grain weight (11.46%) and per cent increase in chaffy grains (18.58%) followed by IET 23272 which recorded 14.05 per cent reduction in no. of grains/panicle, 15.23 per cent reduction in 1000 grain weight and 25.80 per cent increase in chaffy grains as against in TN 1 with reduction of 26.47 per cent in no. of grains/panicle, 30.53 per cent of 1000 grain weight and 45.76 percent increase in chaffy grains (Table 1).

From the selected accessions, IET 23694 in spite of supporting high larval population and exhibiting more dead heart incidence and also recorded higher percentage of surviving hill with minimum reduction in grain yield/panicle, grains/panicle and per cent increase in chaffy grains compared to the moderately resistant accessions. This was attributed to the stimulation of crop growth leading to production of more tillers which compensated the damage caused by the stem borer. This possibly supported that tolerance ability of the accessions, since the modality of tolerance mechanism operated upon the capacity of plants to repair injury or grow to produce an adequate yield despite supporting an insect population at a level capable of causing more damage to a susceptible host.

Similar findings were reported by Panigrahi and Rajamani (2010) ^[6] reported that early medium varieties like Konark, Kumar, Ananga, Amaravati and Vikash indicated compensatory mechanism when infestation took place at vegetative stage. Ratna showed tolerance both at vegetative and reproductive stages. Panigrahi and Rajamani (2010) ^[7]; Panigrahi (2011) ^[8] were reported that infestation at reproductive stage indicated that the reduction in EBT (Earhead Bearing Tillers) was at a lower range in the resistant varieties and lowest in TKM-6 and in the higher range in the moderately resistant varieties and the highest in ADT-32. Bandang and Litsinger (2005) ^[9] reported that rice plants were able to tolerate infestation by producing more compensatory tillers and suffered more yield losses when damage occurred at the reproductive stage than at the vegetative stage

Earlier worker also reported that rice genotypes showed tolerance reactions to Basmati-15-15, Jajai-25/A, Basmati-15-13 and CR-33 (Sarwar, 2013d) ^[10]. Khan *et al.* (2010) ^[11] reported that IRRI-6 was found tolerant to rice stem borer attack and also showed maximum number of tillers, spike length, grains spike, 1000 grains weight and grain yield/ha.

Table 1: Evaluation of selected accessions for YSB tolerance.

Accessions	Days after release					Infested			Healthy			% reduction in grain yield
	15 days	30 days	Mean	D	Rating scale	Tillers/hill	Productive tillers (%)	Yield (g/hill)	Tillers/hill	Productive tillers (%)	Yield (g/hill)	
IET 23272	19.58	26.83	23.20 (28.79) ^c	56.69	5	25.78	64.21	16.25	24.11	78.35	22.16	26.67 (31.09) ^c
IET 23673	26.82	36.41	31.61 (34.21) ^e	77.24	7	29.89	58.71	18.83	30.22	84.54	28.23	33.29 (35.24) ^e
IET 23681	23.56	34.82	29.12 (32.66) ^d	71.33	7	26.67	62.50	16.94	25.56	75.62	23.57	28.12 (32.03) ^d
IET 23694	15.67	21.24	18.45 (25.44) ^b	45.08	5	31.22	70.82	19.74	32.78	86.08	25.24	21.79 (27.83) ^a
IET 23715	12.84	17.37	15.10 (22.87) ^a	36.90	3	28.44	76.58	21.13	28.89	82.34	27.43	22.97 (28.64) ^b
TN 1	35.29	46.56	40.92 (39.77) ^f	100.00	9	21.56	50.32	10.12	20.89	68.12	19.54	48.21 (43.98) ^f
		SEd	0.28								SEd	0.27
		CD(0.05)	0.61								CD (0.05)	0.58

*Means of three replications

Values were arc sine transformed and original values are given

In a column mean followed by same letter are not significantly different at P = 0.05 as per DMRT

Table 2: Effect of stem borer damage on yield attributing characters of selected rice accessions.

Accessions	Plant Height (cm)		Panicle length (cm)		No. of grains/panicle		% reduction	% chaffy grains		% increase	1000 grain weight (g)		% reduction
	Healthy	Infested	Healthy	Infested	Healthy	Infested		Healthy	Infested		Healthy	Infested	
IET 23272	89.5	87.5	17.3	15.8	121	104	14.05 (22.01) ^c	23.3	31.4	25.80 (30.53) ^c	19.37	16.42	15.23 (22.97) ^c
IET 23694	90.1	89.7	21.6	20.1	213	186	12.68 (20.86) ^b	19.4	24.7	22.27 (28.16) ^b	18.86	16.34	13.36 (21.44) ^b
IET 23715	89.4	88.3	23.4	22.6	168	152	9.58 (18.03) ^a	20.6	25.3	18.58 (25.53) ^a	16.31	14.44	11.46 (19.78) ^a
IET 23681	107.8	103.2	18.5	16.3	153	126	17.64 (24.83) ^d	25.3	34.6	26.88 (31.23) ^c	20.22	16.91	16.37 (23.87) ^d
IET 23673	87.5	85.8	22.8	20.4	187	152	18.72 (25.64) ^e	24.1	33.8	28.70 (32.39) ^d	21.16	17.08	19.28 (26.05) ^e
TN 1	90.8	86.6	24.1	21.8	102	75	26.47 (30.96) ^f	22.4	41.3	45.76 (42.57) ^e	17.65	12.26	30.53 (33.54) ^f
					SEd		0.33	SEd		0.27	SEd		0.32
					CD(0.05)		0.73	CD(0.05)		0.59	CD(0.05)		0.70

*Means of three replications

Values were arc sine transformed and original values are given

In a column mean followed by same letter are not significantly different at P = 0.05 as per DMRT.

Conclusion

After completion of this present investigation it is concluded that IET 23715 showed moderately resistant, IET 23694 and IET 23272 showed moderately susceptible, whereas IET 23673 and IET 23681 showed susceptible as against TN 1. Among the accessions, per cent yield reduction was lowest in IET 23694 followed by IET 23715, IET 23272, IET 23681 and IET 23673 in contrary to IET 23673.

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