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PLANT PROTECTION

EVALUATION OF RICE (*ORYZA SATIVA* L.) GERMPLASM RESISTANCE AGAINST *SCIRPOPHAGA INCERTULAS* AND *SCIRPOPHAGA INNOTATA* STEM BORERS

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ABSTRACT

Rice germplasm containing 9 coarse rice and 31 fine rice genotypes was evaluated at Rice Research Station, Bahawalnagar, Pakistan to see their resistance against stem borers for two successive years (2013 and 2014). Thirty day-old nursery of this germplasm was transplanted in well puddled soil. The plot was sown by keeping plant to plant and row to row distance of 20 cm. The experiment was designed in a RCBD with three replications. During 2013, rice germplasm KSK-456 and PK 9586-8-2 showed most resistant response with minimum stem borers attack (4.10 and 4.08% whiteheads) and higher grain yield (0.753 and 0.480 gm^{-2}). During 2014 same genotypes performed better having 4.84 and 4.32 percent whiteheads and grain yield of 0.747 and 0.470 gm^{-2}, respectively.

KEYWORDS: *Oryza sativa;* rice; genotypes; *Scirpophaga incertulas; Scirpophaga innotata;* stem borers; resistance; incidence; Pakistan.

INTRODUCTION

Rice (*Oryza sativa* L.) is the second most important cereal crop after wheat which plays significant role in Pakistan economy. It contributes more than two million tons of national food requirements. Rice industry is an important source of employment and income for rural people. This crop occupies an area of 7005 thousand hectares with an average yield of 2423 kg ha^{-1} in Pakistan (Anon, 2014-15). Rice contains about 90 percent carbohydrate, eight percent protein and two percent fat. It is the most important staple food in areas with high population and low nutritional levels (Kinoshitai and Mori, 2001). Sindh and Punjab are the main rice growing provinces in Pakistan. Kallar areas include Gujranwala, Hafizabad, Sheikhupura, and Sialkot (PARC, 2006). Major yield limiting factor of paddy is the attack of insect pests that cause 20-30% losses every year (Salim *et al.,* 2001). Three hundred species of insect pests are attacking the rice crop at various stages. Of these only 23 species cause significant damage (Pasalv and Katti 2006). The stem borers are usually considered as the serious pests of worldwide rice areas and responsible for major losses. In case of insect attack at vegetative stage, dead heart is produced while its attack at the time of ear development produces whitehead (Reeman *et al.,* 2007). White and yellow stem borers are the major pests in all rice producing areas of the world. Globally *Scirpophaga innotata* causes yield losses of 10 million tons (Huesing and English. 2004). Rice crop show symptoms of deadhearts and whiteheads, when rice stem borers attacked at early age and panicle initiation stage, respectively (Rehman, *et al.,* 2002). *Scirpophaga incertulas and S. innotata* are major rice pests in South and South-East Asia resulting in great crop losses (Bashir *et al.,* 2004). Growing resistant genotypes is the best solution to avoid the pest (Ahmad *et al.,* 2011). The incorporation of resistant crop varieties against pest is the easiest, useful, well-matched, cheap and practicable method to control pest (Sehgal *et al.,* 2001).

The main theme of this study was to evaluate the rice germplasm that is resistant against *Scirpophaga incertulas and S. innotata* and could be used for further breeding programmes.

MATERIALS AND METHODS

This research study was conducted at the experimental farm of Rice Research Station Bahawalnagar, Pakistan during two consecutive years (2013 and 2014). Rice germplasm of 40 different genotypes (9 coarse rice and 31 fine rice) was selected for assessing their resistance or susceptibility combined with seed yield against rice stem borers. Seeds of these genotypes were grown in nursery. Thirty day-old nursery of this germplasm was transplanted in well puddled soil. The plot was sown by keeping plant to plant and row to row distance of 20 cm. The experiment was designed in a RCBD with three

replications. Soil of plots was kept moist with standing water at the time of transplanting and subsequent growth stages. All standard agronomic practices were followed for raising the crop and no control method was applied for insect pests. To control weeds, first weeding was done at 15 days after transplanting followed by second and third weeding at 15 days interval. A basal dose of nitrogen and phosphorus @ 30 kg and urea @ 50 kg ha^{-1} as triple super phosphate, respectively were uniformly incorporated in the soil at the time of sowing, Then 30 kg N as urea was added at tillering stage. Stem borers damage was recorded as deadhearts percentage at vegetative growth and whiteheads percentage at maturity stage by counting number of deadhearts and whiteheads per square meter area of rice plants in each replication. In seledted area, total number of plants and total number of tillers were recorded and then number of deadhearts $hill^{-1}$ was counted to calculate their percentages. At later stage, data for borers' infestation were taken from one meter square hill selected randomly and determined on whiteheads basis. Then percent infestation as whitehead was calculated. After harvesting, paddy yield data were taken (gm^{-2}) and subjected to proper statistical analysis for testing the significance of results.

RESULTS AND DISCUSSION

Kharif, 2013

In kharif season 2013, under normal field conditions no tiller percent damage was observed during reproductive stage. Among 40 genotypes, minimum, stem borer attack was observed in two genotypes. KSK 456 and PK 9586-8-2 with rating scale '1' (1-5% whiteheads) which fell under resistant category (Table 1). Twenty two genotypes i.e. KSK463, KSK457, KSK452, KSK464, KSK459, KSK466, KSK469, PK7688, PK8649, PK8749-2-4-5-1, PK8662-12-2-1, PK 3810-30-1, PK8536-15-1, PK8647-11-1-1, PK7899-9-2-1-1-1, PK8677-18-1-7-14, PK-177, PK178-2, PK 6292, PK3317-12, PK3327-2, and SR12 showed moderately resistant response with rating scale '3' (6-10% WH) (Table.1). Fourteen genotypes i.e. KSK468, PK8660-13-3-1, PK8685-1-1-1-1, PK8649-2-4-5-1, PK 8535-15-2, PK 8662-2-15-4, PK8662-12-2, PK8644-1-3-1, PK7837-11-1-1-3-1, PK10052-1, PK9843-15-1, PK7899-9-2-1-1-1, PK9653-9-3 and PK3303-7-2 showed moderately susceptible response with rating scale'5'(11-15% WH) (Table.1). Two genotypes i.e. PK13-79-9-1-1 and PK3732-15-1 were susceptible with '7' scale (16-26%WH). In field conditions increased seed yield (0.753 and 0.480 gm^{-2}) was produced by genotypes KSK 456 and PK 9586-8-2 respectively.

Table 1. Evaluation of rice germplasm for stem borers and grain yield (2013).

Germplasm	White heads (%)	Rating scale	Level of resistance/ susceptibility	Yield (gm^{-2})
KSK-463	8.0	3	MR	0.722
KSK-457	6.17	3	MR	0.627
KSK-452	6.45	3	MR	0.720
KSK-456	4.10	1	R	0.753
KSK-464	6.25	3	MR	0.703
KSK-459	7.31	3	MR	0.676
KSK-466	8.4	3	MR	0.622
KSK-468	14.8	1	MS	0.618
KSK-469	8.5	3	MR	0.662
PK-7688	8.9	3	MR	0.422
PK-8649	9.2	3	MR	0.451
PK-8660-13-3-1	11.11	5	MS	0.432
PK-8685-1-1-1-1	10.78	5	MS	0.413
PK-8749-2-4-5-1	8.79	3	MR	0.384
PK-8662-12-2-1	9.37	3	MR	0.403
PK-8649-5-1-1-2	10.52	5	MS	0.382
PK-3810-30-1	8.24	3	MR	0.415
PK-8535-15-2	10.78	5	MS	0.374
PK-8662-2-15-4	11.42	5	MS	0.378
PK-8662-12-2	11.81	5	MS	0.363
PK-8644-1-3-1	14.0	5	MS	0.376
PK-8536-15-1	9.89	3	MR	0.418
PK-7837-11-1-1-3-1	13.0	5	MS	0.370
PK-8647-11-1-1	6.4	3	MR	0.420
PK-7899-9-2-1-1-1	7.3	3	MR	0.428
PK-10052-1	11.4	5	MS	0.376
PK-9843-15-1	14.0	5	MS	0.372
PK-7899-9-2-1-1-1	11.0	5	MS	0.342
PK-9653-9-3	13.4	5	MS	0.368
PK-9586-8-2	4.08	1	R	0.480
PK-8677-18-1-7-14	6.66	3	MR	0.428
PK-177	7.36	3	MR	0.424
PK-178-2	7.6	3	MR	0.445
PK-6292	7.14	3	MR	0.440
PK13-79-9-1-1	20.51	7	S	0.330
PK-3317-12	6.25	3	MR	0.432
PK-3327-2	6.48	3	MR	0.415
PK3732-15-1	22.5	7	S	0.303
PK-3303-7-2	12.38	5	MS	0.355
SR-12	6.93	3	MR	0.380

Kharif, 2014

During kharif 2014, at reproductive stage, two genotypes viz., KSK-456 and PK 9586-8-2 proved as resistant with rating scale'1' (Table.2). Twenty one genotypes i.e. KSK463, KSK452, KSK464, KSK459, KSK466, KSK469, PK7688, PK8649, PK8749-2-4-5-1, PK8662-12-2-1, PK 3810-30-1, PK8644-1-3-1, PK8647-11-1-1, PK7899-9-2-1-1-1, PK8677-18-1-7-14, PK-177, PK178-2, PK 6292, PK3317-12, PK3327-2, and SR12 showed moderately resistant response with rating scale'3' (6-10%WH). Fifteen genotypes i.e. KSK 457,KSK468, PK8660-13-3-1, PK8685-1-1-1-1, PK8649-2-4-5-1, PK 8535-15-2, PK 8662-2-

15-4, PK8662-12-2, PK8644-1-3-1, PK7837-11-1-1-3-1, PK10052-1, PK9843-15-1, PK7899-9-2-1-1-1, PK9653-9-3 and PK3303-7-2 showed moderately susceptible response with rating scale '5' (11-15% WH). Two genotypes i.e. PK13-79-9-1-1 and PK3732-15-1 were highly susceptible with '9' scale (26% and above WH). In field conditions increased seed yield (0.747 and 0.470 gm^{-2}) was expressed by genotypes KSK 456 and PK 9586-8-2, respectively.

Table 2. Evaluation of rice germplasm for stem borers and grain yield (2014).

Germplasm	White heads (%)	Rating scale	Level of resist-ance/ suscep-tibility	Yield (gm^{-2})
KSK-463	9.33	3	MR	0.709
KSK-457	12.5	5	MS	0.627
KSK-452	6.06	3	MR	0.728
KSK-456	4.84	1	R	0.747
KSK-464	7.05	3	MR	0.705
KSK-459	7.5	3	MR	0.670
KSK-466	9.75	3	MR	0.651
KSK-468	11.11	1	MS	0.612
KSK-469	9.0	3	MR	0.670
PK-7688	9.41	3	MR	0.413
PK-8649	9.47	3	MR	0.434
PK-8660-13-3-1	15.0	5	MS	0.418
PK-8685-1-1-1-1	12.97	5	MS	0.401
PK-8749-2-4-5-1	8.88	3	MR	0.420
PK-8662-12-2-1	9.52	3	MR	0.411
PK-8649-5-1-1-2	14.28	5	MS	0.397
PK-3810-30-1	9.09	3	MR	0.418
PK-8535-15-2	13.51	5	MS	0.416
PK-8662-2-15-4	14.28	5	MS	0.391
PK-8662-12-2	13.63	5	MS	0.386
PK-8644-1-3-1	13.95	5	MS	0.399
PK-8536-15-1	10.0	3	MR	0.424
PK-7837-11-1-1-3-1	14.73	5	MS	0.405
PK-8647-11-1-1	7.77	3	MR	0.411
PK-7899-9-2-1-1-1	9.47	3	MR	0.415
PK-10052-1	13.33	5	MS	0.382
PK-9843-15-1	13.95	5	MS	0.378
PK-7899-9-2-1-1-1	13.75	5	MS	0.363
PK-9653-9-3	13.02	5	MS	0.374
PK-9586-8-2	4.32	1	R	0.470
PK-8677-18-1-7-14	9.75	3	MR	0.393
PK-177	8.78	3	MR	0.405
PK-178-2	9.23	3	MR	0.397
PK-6292	9.80	3	MR	0.390
PK13-79-9-1-1	28.57	5	HS	0.240
PK-3317-12	7.17	3	MR	0.393
PK-3327-2	7.56	3	MR	0.390
PK3732-15-1	27.02	5	HS	0.220
PK-3303-7-2	14.63	5	MS	0.343
SR-12	9.72	3	MR	0.391

CONCLUSION

The germplasm KSK-457 and PK 9586-8-2 showed resistance against stem borers in both the years. So these two genotypes can be used as commercial varieties or can be incorporated in propagation programme as a source of stem borer resistance. Resistance phenomenon is the most economical way to decrease pest attack or minimize pest level.

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CONTRIBUTION OF AUTHORS

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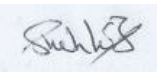
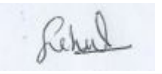
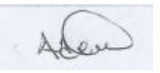
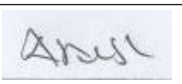
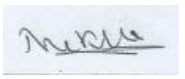
1.	Shahbaz Mustafa	Conceived the idea, conducted lab and filed trial and wrote up manuscript	
2.	Sohail Rashid	Conducted field work, collected and compiled data	
3.	Adeel Mukhtar	Helped in data analysis	
4.	Akash Zafar	Helped in write up of article	
5.	Muhammad Makky Javed	Supervised all research plan	
6.	Muhammad Akhtar	Reviewed the manuscript