RESISTANCE RESPONSE OF RICE (*ORYZA SATIVA* L.) GERMPLASM AGAINST RICE LEAF FOLDER (*CNAPHALOCROCIS MEDINALIS* G.) UNDER GREENHOUSE CONDITION IN PAKISTAN

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ABSTRACT:- Rice leaf folder (*Cnaphalocrocis medinalis* G.) is a key insect pest of rice crop and distributed all over the rice growing areas of the world including Pakistan. The infestation of rice leaf folder often appears very suddenly resulting in huge yield losses. Host plant resistance is an important component of IPM. It is easy to use, viable, durable, effective and long term method as compared to any other control measure. It was imperative to exploit the sources of resistance to cope with threat the pest and its environmental friendly control. Present study was carried out in greenhouse of Plant Genetic Resources Institute (PGRI), NARC. Twenty six Pakistani genotypes of rice germplasm including 15 coarse and 10 fine genotypes were screened in pot experiment during 2011 including TNI, used as susceptible check. The damage results revealed that one genotype PK-8893-4-1-3-1 was moderately resistant, seven genotypes were moderately susceptible, eleven genotypes found susceptible and seven genotypes were highly susceptible. The present study will facilitate the breeders in the development of leaf folder resistant varieties in future.

Key Words: Oryza sativa; Leaf folder; Cnaphalocrocis medinalis; Germplasm; Resistance; Pakistan.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple foods of the world and reduces the food security issue of rice growing countries of the world. Around 90% of the world rice is produced and consumed in Asian countries (Ahmad and Rehman, 2014). It is growing in 112 counties ranging from flood plains of Bangladesh to Himalayan foot hills of Nepal and from the forests of Indonesia to desert plains of Australia (Khakwani et al., 2006).

In Pakistan, rice is second major staple food after wheat and second export commodity after cotton. Rice is planted on more or less 2.7 mha and annual production of 6.7 mt. It accounts for 3.1% of value added in agriculture and 0.7 % in GDP (GoP, 2013-14).

In Pakistan two types of rice are grown; one is coarse and second is fine. Coarse rice include IR- 6, KSK-133 etc. are high yielding but they have rough and non-aromatic kernal whereas, fine rice include Basmati 515, Super basmati, Basmati 385 etc.

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are aromatic, thin and long kernal (Arshad et al.,2012).

Despite much advancement in rice research and development, the rice yield in Pakistan is very low as compared to other rice growing countries. One of the major yield limiting factors is the attack of insect pests. Of these, rice leaf folder (LF) *C. medinalis* Gn. has inflicted severe substantial yield losses every year on rice crop of Pakistan (Rehman, 2003; Salim et al., 2003). Yield loss estimation due to leaf folder is 30-80% (Nanda and Bisoi, 1990).

Before 1980, rice leaf folder was a minor and sporadic foliage feeding pest but now it acquired the status of a major insect pest of rice crop throughout the world including Pakistan (Teng et al., 1993). In fact, pest status of rice leaf folder changes with changes in physical environment, cultural practices, imbalance use of fertilizer particularly high usage of nitrogenous fertilizer, multiple cropping pattern, non-judicial uses of insecticides and lack of resistance sources in high yielding varieties (Laskar et al., 2008). Over dependence on insecticides is not sound and sustainable pest control strategy as it results in resistance against insecticides, reduction in biocontrol agents and other insect fauna, outbreak of secondary and sporadic pests and contamination of environment and food product (Heong, 2005). Realizing the importance of varietal resistance in insect control strategies, the present study was initiated. The growing of insect resistant rice varieties is a major tactic in the IPM. Farmers do not have to bear extra cost, easy to use, do not disturb the natural balance, economically viable and environmental friendly. Therefore, it is vital to investigate and find out the resistance sources against rice leaf folder. The present study was conducted to screen the rice germplasm to find out resistance sources against rice leaf folder.

MATERIALS AND METHOD

The experiment was conducted in a green house of Plant Genetic Resources Institute, NARC, Islamabad, during the rice growing season 2011. Twenty six lines/varieties of rice germplasm were acquired from Rice Program, National Agricultural Research Centre, Islamabad.

The procedure for screening of rice germplasm was used according to Heinrichs et al. (1985). For screening, infestation was maintained at least 60% leaf damage to susceptible check. After 21 days of insect infestation, data on the extent of damage was recorded. For each entry, all the leaves were examined and each leaf was rated (0-3) based on the extent of damage as follows.

Grade	Damage grade
0	No damage
1	Upto 1/3 leaf area scraped
2	More than 1/3 to 1/2 of leaf area scraped
3	More than 1/2 of leaf area scraped

Based on the number of leaves with each damage grade, damage rating (R) was computed as follows:

$$A = \frac{\text{(No. leaves with damage grade of 1*100)}}{\text{Total No. of leaves observed}}$$

$$B = \frac{\text{(No. leaves with damage grade of 2*100)}}{\text{Total No. of leaves observed}}$$

$$C = \frac{\text{(No. leaves with damage grade of 3*100)}}{\text{Total No. of leaves observed}}$$

Damage rating (R) = A+B+C÷6

The damage rating (R) was calculated for each entry including susceptible check. Adjusting damage rating (D) was also determined for each entry (Standard Evaluation System for Rice, 1996)

$$D = \frac{\text{R of test entry}}{\text{R of susceptible check}} \times 100$$

Adjusted damage rating (D) was converted into following 0 - 9 scale. Scale was considered 0 if damage rating was 0% and denoted by Highly resistant (HR), 1 scale if damage rating was 1-10%, 3 scale if damage rating was11-30 % , 5 scale if damage rating was 31-35%, 7 scale if damage rating was 51-75% , 9 scale if damage rating was more than 75% (Standard Evaluation System for Rice, 1996).

RESULTS AND DISCUSSION

Resistant varieties play pivotal role in the management of insect pest of any crop as compared to any other control measures. Therefore, 26 rice germplasm including (coarse and fine) were screened against rice leaf folder. Results of the present study showed that one fine rice line was moderately resistant (MR), 7 were moderately susceptible (MS), 11 were susceptible (S) and 7 were highly susceptible (HS). The results also showed the infestation by the rice leaf folder ranged from 27.70% to 98.68%, (Table 1). Moderately resistant fine germplasm PK-8893-4-1-3-1 showed the leaf folder infestation of 27.70%.

Among the highly susceptible lines, maximum leaf infestation (98.68 %) was found on rice line, NIA-625 (Table 1).The concept of host plant resistant is quite old, therefore, the development and use of resistant varieties against insects and to identify pest resistance sources, it is very important to have such type of genetically diverse crop materials. Therefore, the current study was undertaken to identify the leaf folder resistance sources. The results revealed that only one rice line PK-8893-4-1-3-1 was resistant to leaf folder. The remaining tested rice lines/varieties were either moderately susceptible, susceptible or highly susceptible. The results revealed that Basmati 515, IR-6, KSK-133, GBR-1 were susceptible whereas Super Basmati was moderately susceptible.

These results are in line with finding of Ahmad and Rehman (2014) for Basmati 515; Shah et al. (2008) for IR-6; Salim (2010) for IR-6, GEB-1, Super Basmati and KSK-133 and Rehman (2003) for IR-6, GEB-1, Super Basmati.

It is concluded that an understanding of the resistance response of rice germplasm will be useful for the development of efficient utilization of the existing resistance sources for the development of resistance variety because cultivation of insect resistant rice cultivar against rice leaf folder is a major component of Integrated Pest Management (IPM) program and highly compatible with other control measures.

Table 1. Reaction of Pakistani rice genotypes against leaf folder

Entry No.	Designation	Leaves with damage grade			Damage rating (R)	Adjusted damage (D)	Scale	Response
		1%	2%	3%				
1	NARC-10-1	13.04	52.17	104.34	28.25	93.94	9	HS
2	NARC-10-2	18.18	54.54	95.45	28.08	93.38	9	HS
3	KSK-133	22.72	18.18	27.27	00.00	37.44	5	MS
4	IR-6	17.32	46.00	50.00	18.88	62.79	7	S
5	NIBGE-RICE-2	23.07	38.46	115.38	29.48	98.03	9	HS
6	NIBGE-RICE-1	13.33		79.99	15.55	51.71	7	MS
7	DK-3	26.66	13.33	19.99	9.98	33.18	5	MS
8	DK-2	33.33	66.66	24.99	20.51	68.20	7	S
9	NARC-10-8	21.00	59.00	15.00	15.81	52.55	7	S
10	NARC-10-6	28.00	56.00	48.00	22.00	73.16	7	MS
11	NIA-102	37.83	29.27	32.43	16.66	55.40	7	MS
12	NIA-625	26.82	17.07	117.07	29.67	98.66	9	HS
13	KSK-449	23.07	15.38	46.15	14.10	46.89	5	MS
14	PK-8480-1-1-1	16.66	46.66	49.99	18.88	62.78	7	S
15	PK-8785-1-1	12.50	45.00	37.50	13.95	46.39	5	MS
16	PK-8893-4-1-3-1	00.00	50.00	00.00	8.33	27.70	3	MR
17	PK-8677-18-1-7-14	25.00	29.16	106.24	26.73	88.89	9	HS
18	PK-8677-18-1-7-17	48.14	51.85	22.22	20.36	67.70	7	S
19	EF-1-20-52-04	21.21	66.66	81.81	28.28	94.04	9	HS
20	EF-1-30-39-04	20.00	40.00	30.00	15.00	49.88	5	MS
21	GBR-1	40.00	30.00	15.00	14.10	46.89	5	MS
22	Super basmati	20.00	20.00	60.00	11.66	38.77	5	MS
23	Basmati 515	29.03	25.80	58.06	18.81	62.55	7	S

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AUTHORSHIP AND CONTRIBUTION DECLARATION

S.No	Author Name	Contribution to the paper
1.	Mr. Ishaq Ahmad	Wrote abstract, Methodology, Results and Discussion, Introduction, References
2.	Dr. Abdul Rehman	Conceived the idea, Technical input at every step, Overall management of the article
3.	Dr. Ehsan–Ul-Haq	Conceived the idea
4.	Dr. Arif Mahmood	Data collection, Data entry in SPSS and Analysis

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