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Research Article

SCREENING OF RICE GENOTYPES AGAINST GLUME DISCOLOURATION

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Abstract Glume or grain discolouration is a minor disease but gaining importance in almost all the rice growing areas of the world in recent years. It is a serious problem during south west monsoon in India. The disease has the potential to reduce the yield of rice as much as 75% in severely affected regions due to reduction in grain weight, floret sterility, inhibition of seed germination, reduction of stands, as well as the year-to-year transmission because of the seed borne nature of the pathogen. Host plant resistance is an ecofriendly and economical alternative for the management of the disease. The present study was carried out for the screening of rice genotypes against glume discolouration. A total number of sixty rice genotypes found promising against glume discolouration during previous years in different trials were selected as maintenance. These genotypes were again evaluated during three years against the bacterial blight under artificial inoculation conditions in the field. Out of these rice genotypes, none of the genotype was immune towards the disease. Whereas three genotypes were showed resistant reaction, fourteen genotypes were showed moderately resistant reaction and thirty five genotypes showed moderately susceptible reaction and eight genotypes including susceptible checks GR-11 and TN-1 were showed susceptible reaction. The consistent resistant reactions found in three genotypes viz., IET- 24486, IET- 25654 and IET- 25676 against glume discolouration. These genotypes can be used in breeding programme for developing glume discolouration resistant varieties.
Key word: Glume discolouration, Rice genotypes, Screening

Introduction

Rice (*Oryza sativa* L.) is an important cereal crop of the world and it is a staple food of more than three billion people around the world; most of them live in Asia (ICAR-IRRI, 2009). The crop is cultivated in almost all the states of India in different agro ecological conditions. Rice occupies an area of 43.50 million hectares with the production of 104.41 million tonnes and productivity of 2400 kg per ha in India. Whereas in Gujarat state the rice is cultivated on 0.77 million hectares with the production of 1.70 million tonnes and productivity of 2205 kg per ha (Anonymous, 2017). The productivity of the crop is quite low as it compared with our national productivity. This may be due to several biotic and abiotic stresses. Among the biotic stresses diseases are the major concern. The rice crop is affected by more than 20 diseases caused by fungi, bacteria, viruses and nematodes. Among these diseases glume or grain discoloration caused by several microorganisms, is a minor disease but gaining importance in almost all the rice growing areas of the world in recent years (Bhut *et al*., 2009). Glume discoloration is now spreads almost all the states of India like Andhra Pradesh, Tamil Nadu, Kerala, Orissa, Jharkhand, Bihar, West Bengal, Assam, Eastern Uttar Pradesh, Gujarat, Haryana, Punjab, Uttarakhand and Chhattisgarh. The disease is considered as one of the most degrading factor reported from all rice growing countries in the world and now it has assumed great importance because of change in cropping pattern into intensive system like increased chemical fertilizer application with more rice growing seasons in a year (Sumangala and Patil, 2010). The changes in climatic conditions in India, the disease severity may be minor to major across different ecological zones. Grain discoloration affects the grain morphology (size and shape of the grain) and ultimately significantly lower yield of the crop (Ashfaq *et al*., 2017). The disease has become a serious problem in recent years especially when there is post-flowering rain.

The disease is not only decrease the seed quality but also affect the rice grain quality (Ou, 1985; Khan, 2000 and Phat *et al*., 2005). Rice grain discoloration affects the qualitative and quantitative traits (Sumangata *et al*., 2009; Tariq *et al*., 2012) that ultimately result in yield penalty. Rice yield also affected by many biotic factors i.e. infected brown spot grain disease, insects and other predominant diseases (Hajano *et al*., 2012; Tariq *et al*., 2012). The losses due to brown spot infected grains have been recorded in the range of 16% to 43% (Datnoff *et al*., 1997). The disease has the potential to reduce the yield of rice as much as 75% in severely affected regions due to reduction in grain weight, floret sterility, inhibition of seed germination, reduction of stands, as well as the year-to-year transmission because of the seed borne nature of the pathogen (Trung, *et al*., 1993).

The glume or grain discoloration is a complex disease and caused by number of fungi like *Botrytis*, *Helminthosporium*, *Alterneria*, *Pyricularia*, *Sarocladium*, *Curvularia*, *Cercospora*, *Fusarium* etc. and bacteria as *Pseudomonas*, *Xanthomonas* etc. Mustafa and Mohsan (2017) reported six fungal species *Alternaria alternata*, *Dreschelera oryzae*, *Curvularia oryzae*, *Fusarium moniliforme*, *Cercospora oryzae* and *Helminthosporium oryzae* found associated with discoloured panicles of different varieties of rice in the field. Phon *et al*. (2001) surveyed the effect of discolored grains to grain quality of rice and found that fungal isolate *Curvularia sp*. (13.4%) was most dominating one recovered from the discolored grains. Utobo *et al*. (2011) studied the seed borne fungi associated with a hybrid and three local checks of rice and recovered nine different genera of fungi.

The common symptoms of glume discoloration can be observed as darkening glumes of spikelets, brown or black colour in rotten glumes by one or more pathogens. The disease is appears as dark brown to semi dark brown lesions caused due to infestation of *Curvularia spp*. (Jin, 1989). *Fusarium moniliforme* (Gibberella fujikuroi) found responsible for pink discoloration and *Sarocladium oryzae* responsible for light brown discoloration were found in the seed coat, endosperm and embryo of discolored seed (Sachan and Agrawal, 1995).

Unseasonal rainfall due to climate change during the grain maturity period in rice crop creates a congenial weather for the development of glume discolouration complex. Sometimes use of injudicious fertilizers adds to the chances of disease appearance. Fungicides used at maturity period for the management of glume discolouration may cause residual effect on rice grains which is hazardous to human health. In spite of this pathogens may develop resistance to the fungicides. Host Plant resistance is an important component of an integrated disease management programme. To minimize the risk of glume discoloration evolving resistant cultivars is a best non chemical method for the integrated management. The use of resistant varieties is an economical alternative which also provides a satisfactory eco-friendly control of the disease. Therefore it is necessary to find out the resistant source for responsible pathogens. Eleven lines of donor screening nursery trial were possessing resistance against glume discoloration (ICAR-IIRR, 2017). Whereas six entries under national screening nursery trials were found promising against glume discolouration (ICAR-IIRR, 2018). The screening programme comprising of advance generation breeding material and entries of small scale varietal trial, large scale varietal trial, aromatic and state varietal trials were undertaken to find out the resistant source against multiple diseases under natural/ artificial and unprotected field conditions. The genotypes found promising against glume discolouration during the initial trials were categorized as plant pathology maintenance. To keep in view about the seriousness of the disease these 60 genotypes of plant pathology maintenance were again evaluated against glume discolouration to find out the source of stable resistance.

Materials and Methods

The screening trial was carried out with 60 rice genotypes including 2 susceptible checks (1 NC + 1 LC) showed resistance against glume or grain discolouration during previous years trials. These selected genotypes were again evaluated for three years (*Kharif* 2015 to 2017) against glume discolouration to find out the source of stable resistance at Main Rice Research Station, Anand Agricultural University, Nawagam, Kheda (Latitude: 22.79685`N, Longitude: 72.57486`E, Elevation: 37 m above mean sea level), Gujarat, India.

List of evaluated genotypes: IET-24438, IET-24486, IET-25390, IET-25394, IET-25400, IET-25196, IET-25421, IET-25114, IET-25126, IET-25584, IET-25611, IET-25618, CR Dhan-201, IET-25637, IET-24721, IET-25654, IET-25655, IET-24395, IET-24709, IET-25324, IET-25332, IET-24735, IET-24331, IET-24744, Chittimuthyalu, IET-25520, IET-25523, IET-24424, IET-25089, CSR-36, US-312, Taraori Basmati, Sabita, IET-24122, IR-64, IET-24797, IET-24040, IET-24727, IET-24737, IET-25669, IET-25673, IET-25676, Ranjit, Bahadur, Imp. Samba Mahsuri, IET-24901, IET-24904, IET-24935, TNRH-282, PJTSAU-BR-14, PJTSAU-BR-16, PJTSAU-BR-126, PJTSAU-BR-155-1, PJTSAU-BR-155-2, DRR-BL-155-2, VL-31802, IET-25671, IET-25674, TN-1(NC), GR-11(LC).

Layout: The field was prepared for sowing by leveling thoroughly. Care has been taken that water should not be stagnant in the field because of rainfall. Nursery was grown on raised beds. All the recommended agronomical practices were adopted for raising the nursery of all genotypes. The experiment was established under transplanting conditions in the spacing of 20x15 cm. The row length of each genotype was 1.5 m along with two replications. The one row of each susceptible variety *i.e.* GR-11 and TN-1 was transplanted after every 5 tested genotypes. In addition to this the experimental plot was surrounded by border rows of highly susceptible variety GR-11. The basal application of NPK at 40:25:00 Kg/ha was applied at the time of transplanting. Whereas 60 kg/ ha nitrogen was applied as top dressing in two splits at 25 days after transplanting and at panicle initiation stage. Ten metric tones of FYM was applied per hectare, while 300 kg/ha castor cake was also applied. Manual weeding was adopted to keep the experimental field free from weeds. Plant protection measures adopted only to prevent insect-pests damage to the crop. The need based irrigation was applied.

Observations recorded: The observations were recorded through screening by adopting standard evaluation system.

SES scale for Glumes Discoloration

Score	Description
0	No incidence
1	Less than 1%
3	1–5%
5	6–25%
7	26–50%
9	51–100%

Results and Discussion

The screening trial to find out the resistance source against glume discolouration was carried out under natural and unprotected field conditions during 3 years. The results presented in table 1 revealed that out of 60 rice genotypes, none of the genotypes was found immune towards glume discolouration. Whereas three genotypes were showed resistant reaction, fourteen genotypes were showed moderately resistant reactions, thirty five genotypes were showed moderately susceptible reaction. While eight genotypes including susceptible checks GR-11 and TN-1 were showed susceptible reactions. It was also observed that discolored grains were showed light to dark brown colour. The consistent resistant reaction was showed by the genotypes *viz*., IET- 24486, IET- 25654 and IET- 25676 against glume discolouration.

RC = Regional Check, NC = National Check

These findings having close concerns with the findings of earlier workers who have reported that eleven lines *viz.*, HWR-1, CB-14186, DRR-LR-202, MSM-TH-154-1, MSM-TH-154-2, V-MSM-141, V-MSM-144, RP-Patho-10-6-1, HWR-34, HWR-35 and Phougak possessing resistance against glume discolouration (ICAR-IIRR, 2017). Whereas some other worker have been reported in the progress report of AICRIP that six line *viz*., IET-27350, IET-27352, IET-27353, IET-27360, IET-27361 and IET-27393 possessing resistance against glume discolouration (ICAR-IIRR, 2018).

The information given in Table 2 indicates the details about the cross/ designation of resistant genotypes *viz*., IET- 24486, IET- 25654 and IET- 25676.

Conclusion

Growing concern about the health issues due to pollution, minimized use of fungicides is being discussed, which for some reason is not practical. Host plant resistance is most promising to combat this disease. Based on above findings it is concluded that the consistent resistant reactions observed in three genotypes *viz*., IET- 24486, IET- 25654 and IET- 25676 against glume discolouration. These genotypes can be used in breeding programme for developing glume discolouration resistant varieties. Further the study and time to time field evaluation of rice genotypes against glume discoloration is entertained.

Table1: Screening of rice germplasm for resistance against glume discolouration during *Kharif*-2015, 2016 and 2017

Disease rating scale	Response	No. of entries	Genotypes
0	Immune	Nil	Nil
1	Resistant	3	IET-24486, IET-25654, IET-25676
3	Moderately resistant	14	IET-24438, IET -25324, IET -25584, IET -25089, CSR -36, IR -64, IET -24735, Ranjit, CR DHAN -201, C. Muthyalu, Taraori Basmati, IET -24737, PJTSAU -BR-126, DRR-BL-155-2
5	Moderately susceptible	35	IET-25637, IET-24721, IET-25655, IET-24395, IET-24709, IET-25332, IET-24331, IET-24744, IET-25114, IET-25126, IET-25196, IET-25394, IET-25400, IET-25671, IET-25520, IET -25523, IET -25611, IET -25618, Sabita, IET -24122, IET -24797, IET-24040, IET -24727, IET -24904, IET -25669, IET -25673, Bahadur, Imp. Samba Mahsuri, IET-24901, PJTSAU -BR-14, PJTSAU -BR-16, US-312, PJTSAU -BR-155-1, PJTSAU-BR-155-2, VL-31802
7	Susceptible	8	IET-24424, IET -25390, IET -25421, IET -24935, IET -25674, TNRH 28 2, TN -1(NC), GR-11(LC)
9	Highly susceptible	Nil	Nil

Table 2: Details of cross/ designations of resistant genotypes

S. N.	Genotypes	Cross/ Designation
1.	IET-24486	PLA1100/BM71
2.	IET-25654	IR72/PSB RC18
3.	IET- 25676	CO43/FR 13A

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