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Screening of Basmati rice varieties against *Pyricularia grisea* to find out the sources of resistance

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Abstract
Rice is an important staple food grain crop in the world. Basmati rice is an important export commodity among the food grains. Basmati rice is having the characteristics of extra-long slender grains having soft and fluffy texture upon cooking, delicious taste, superior aroma and distinct flavour. A disease screening nursery of fine Basmati rice varieties was established during the *kharif* 2013-14 and 2014-15 to determine the source of resistance in Basmati rice varieties against *Pyricularia grisea*, cause of rice blast disease at SAVPUA&T Modipuram, Meerut. Screening of available Basmati varieties were carried out under natural field condition, to find out resistance against *P. grisea* by evaluated 20 varieties, out of these varieties none of the variety was immune, five varieties was found to be moderately resistant against *P. grisea*. Five Basmati verities were found moderately susceptible. Eight varieties were susceptible and only two verities were showed susceptible to highly susceptible response. This disease generally causes yield loss of 10-20 per cent in Basmati rice but in severe cases yield loss may reach up to 80 percent.

Keywords: basmati rice blast, *Pyricularia grisea.* screening, resistant, susceptible

Introduction
Rice (*Oryza sativa* L.) is the most important staple food crop and grown in India providing of 43 per cent of calorie requirement for more than 70.0 per cent of the Indian population of the world. According to Globally rice annual production of around 497.9 million tonnes with average productivity of 3.9 tonnes/ha (2016). The annual production of Basmati rice in the country is around 103.36 million tonnes and the average productivity in the country across all the ecosystems is still around 2 tonnes/ha of milled rice. Uttar Pradesh is largest rice growing state covering an area of 6.93 million hectare with total production of 12.91 million tonnes and average productivity 1862 kg/ha [1]. Basmati rice is widely affected by many diseases caused by fungal, bacterial, viral and nematodes attack on Basmati rice crop.
This yield is very low as compared to other developed countries of the world and this low production is attributed to several biotic and a biotic factors. Blast of Basmati rice caused by the Ascomycete fungus, caused by *Pyricularia grisea* Sacc [Telipomorph *Magnoporthe grisea*] [2] is one of the important factors for low productivity of Basmati rice. Blast is one of the most destructive and wide spread diseases [3]. Among them disease caused by fungus *Pyricularia grisea* is a most serious disease as compared to other diseases of Basmati rice. It causes leaf, neck and panicle blast of Basmati rice. This disease generally causes yield loss of 10-20 per cent but in severe cases yield loss may reach up to 80 per cent [4, 5]. The growth of mycelium on the affected parts of the plant under humid conditions and this aids in the spread of the disease to a considerable distance in the field through irrigation water. Therefore, it has become necessary to adopt eco-friendly approaches for better crop health and for yield. Blast is one of the most widespread diseases of Basmati rice caused by *Pyricularia grisea* causes serious yield losses. However it may be vary according to adopted plant protection measures and growing cultivars. The excess use of chemicals resulted in environmental pollution and ill health to biotic community as a whole. Therefore, the biological method of plant disease management seems to be a better alternative to chemical fungicides in managing the blast disease. Furthermore, obvious pollution of the environment and the toxic effects of synthetic chemicals on non-target organisms including humans have prompted investigations on pesticides of plant origin [6].

Materials and Methods
Experimental design
Statistical analysis of the cultivated Basmati rice data was made assuming the experimental

design was a randomized complete block design. Screening of Basmati rice varieties consisting of released varieties was carried out under natural condition as well as under natural condition.

Inoculums preparation

The conidia of *P. grisea* were harvested by touching the conidiophores with a small wire loop containing. At three weeks stage the seedlings were inoculated with aqueous suspension of $1x10^6$ spores/ml of a virulent isolate of *Pyricularia grisea*. The conidial suspension was prepared from pre-inoculated dishes. Ten ml of sterile distilled water was poured on the overgrown cultures. Conidia were then dislodged into a suspension using a metal rod. The suspension was filtered through cheesecloth to remove all mycelium and measured using a hemocytometer. Inoculation was performed during the evening hours at the 6 to 7 leaf stage by spraying 3 ml of the conidial suspension on each rice plant using a fine air sprayer (Atomizer). Under natural condition 20 varieties of Basmati rice grown at department of Plant Pathology of the University were screened in the peak period of disease development during *Kharif* season for two consecutive years *viz*, 2013-14 and 2014-15. Subsequently the varieties showing resistant to moderately resistant reactions were subjected to testing under conditions of artificial inoculation in glasshouse in the next year.

Screening of 20 Basmati varieties (showing resistant to moderately resistant reaction) was done under artificial inoculation condition during *kharif* season of the year, 2014-15. The surface sterilized seed of these varieties were shown in autoclaved soil in 30 cm diameter earthen pots. Five seed per pot of each variety were shown and watered periodically. One month old plants raised in pots were then inoculated with spore- cum- mycelia suspension of the fungus. The inoculum was prepared by mixing the mycelia and spores of the fungus in warring blender following the procedure. [7] Sterilized water was added to dilute the mixture so that it could pass through the fine spray nozzle of the atomizer. The inoculation of the plants was done in evening times and inoculated plants were covered with polythene bags for 24hrs to avoid unwanted infection and to provide favorable condition. Inoculated plants were then allowed to grow for three weeks after which the observations on percentage disease intensity were recorded. For categorizing Basmati varieties 0-9 disease scale, given by [8] was followed, Basmati rice varieties showing resistance against leaf blast disease caused by *P. grisea* under naturals conditions and found none was immune or resistant- 05 Moderately resistant, 08 Moderately susceptible, 05 susceptible, and rest found 02 highly susceptible varieties were further tested in the year *kharif*-2015.

Table 1: Disease scale, given by IRRI

Disease rating scale	Reaction	Description
0	Immune	No. Infection
1	Resistant	Vertical spread of the lesions up to 20% of plant height.
3	Moderately resistant	Vertical spread of the lesions up to 21-30% of plant height.
5	Moderately susceptible	Vertical spread of the lesions up to 31-45% of plant height.
7	Susceptible	Vertical spread of the lesions up to 46-65% of plant height.
9	Highly susceptible	Vertical spread of the lesions up to 66-100% of plant height.

The seeds of twenty varieties of Basmati rice were collected from Basmati Export Development Foundation (BEDF) Modipuram, Meerut joint to the APEDA. Tested resistance against blast disease caused by *P. grisea* under natural's field conditions during *kharif*-2014-15. All recommended agronomical and cultural practices were followed for raising a good crop. Under field conditions crop was regularly watched for appearance of disease after transplanting. Final observation on the affected plants were recorded and graded as per 0-9 SES scale (Table 1), mention by IRRI-1996. The procured isolates *P. grisea* divers with regard to morphology culture pathogen were reported [9].

Table 2: Detailed information of the Basmati rice varieties

Sl. No.	Name of varieties	Origen	Agronomical characteristic feature
01	Pusa Basmati-1	IARI, New Delhi, India	Super fine, semi dwarf, export quality
02	Pusa Basmati-6	IARI, New Delhi, India	Super fine, semi dwarf, export quality
03	Pusa Basmati-1121	IARI, New Delhi, India	Super fine, semi dwarf, export quality
04	Pusa Basmati-1509	IARI, New Delhi, India	Semi dwarf,. short duration, export quality
05	Vallabh Basmati-21	SVBPUA &T, India	Super fine, semi dwarf, export quality
06	Vallabh Basmati-22	SVBPUA &T, India	Super fine, semi dwarf, export quality
07	Vallabh Basmati-23	SVBPUA &T, India	Super fine, semi dwarf, export quality
08	Haryana Basmati-2	HAU, Kaul,, India	Super fine, semi dwarf, export quality
09	Type-3	Nagina, U P, India	Basmati, tall, long duration, export quality
10	Unnath Pusa Basmati-1	IARI, New Delhi, India	Super fine, semi dwarf, export quality
11	Basmati-386	PAU, Punjab, India	Super fine, semi dwarf, export quality
12	Tarori Basmati	HAU, Kaul, India	Basmati, tall, long duration, export quality
13	Basmati-564	SKUAST- Jammu, India	Super fine, semi dwarf, export quality
14	Punjam Basmati-3	PAU, Punjab, India	Super fine, semi dwarf, export quality
15	Ranveer Basmati	J.& K., India	Basmati, tall, short duration, export quality
16	Super Basmati	PAU, Punjab, India	Tall, long duration, lodging susceptible
17	Basmati CSR-30	CSSRI, Karnal, India	Super fine, semi dwarf, export quality
18	Basmati-370	Karnataka	Semi dwarf,. short duration, export quality
19	Vallabh Basmati-24	SVBPUA &T, India	Super fine, semi dwarf, export quality
20	Pusa Basmati -2511	Punjab	Super fine, semi dwarf, export quality

Results and Discussion

Screening for resistance to *P grisea*

Twenty Basmati rice varieties were screened against blast disease during *kharif*-2014-15. None was found either immune or resistant. The genotypes were further tested in the *kharif*-2015 to find out the immune or resistant reaction. The screening of Basmati rice against rice blast disease revealed that, none of the variety was immune, only five varieties were found to be moderately resistant against blast (Table 3). Five Basmati varieties found moderately susceptible. Eight varieties were susceptible and only two verities were showed susceptible to highly susceptible response. Studies on screening of available Basmati varieties were carried out under natural condition, to find out the source of resistance against *P grisea* by evaluating 20 varieties, out of these varieties none of the variety was immune and five varieties were found to be moderately resistant against blast. Five Basmati verities were found moderately susceptible. Eight varieties were susceptible and only two verities showed highly susceptible response.

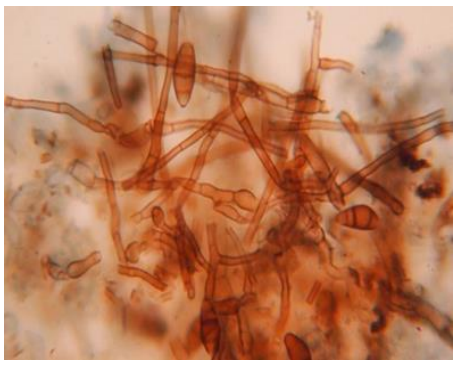
Very few reports are available on the screening of rice germplam against the blast disease. Screened 23 genotypes during 1990 and 1991 and reported that 19 genotypes were highly resistance [10] and 3 were resistant to leaf and neck blast caused by *Pyricularia grisea*. [11] The screening of Basmati rice varieties against the blast disease was also carried out in other rice growing countries. Screening trials at Bangladesh reported that among twenty eight restored line and four standard checks, three were highly resistant, 12 resistant, 16 moderately susceptible. [12] Out of one hundred genotypes tested under natural conditions, none was found to be immune and resistant. However, 41 genotypes were found moderately resistant, 35 genotypes moderately susceptible, while 13 genotypes susceptible and rest genotypes 11 highly susceptible. Similarly found that short and medium grain type Japonica rice showed highest degree of resistance [13]. The forty-four test entries of parental lines of rice with one susceptible and one resistant check were screened against sheath blight. Twenty one rice genotypes that were screened to identify the rice blast disease reaction [14]. Same verities had been released as resistant but due course effective they found select against different isolates was reported [15].

Table 3: Response of Basmati rice varieties against *P. grisea* during *khrif*-2014-15

Resistant	Moderately resistant	Moderately Susceptible	Susceptible	Highly susceptible
	Pusa Basmati-6 Pusa Basmati-1121 Pusa Basmati-1509 Type -3 UnnathPusa Basmati-1	Punjab Basmati-3 Basmati-564 Super Basmati Basmati-386 Vallabh Basmati-22 Pusa Basmati-1 Vallabh Basmati-21 Pusa Basmati-2511	Vallabh Basmati-23 Tarori Basmati Ranveer Basmati Vallabh Basmati-24 Basmati-370	Haryana Basmati-2 Basmati CSR-30

Symptoms of blast

Pure culture of *P. grisea*



Conidia and mycelia of P grisea

Grains of Basmati- 1121

Conclusion

According of disease scoring scale against the blast disease twenty varieties' of Basmati rice was tested under natural field conditions, has been divided into six groups. Twenty Basmati rice varieties were screened against blast disease during *kharif*-2014-15. None was found either immune or resistant the genotypes further tested in the *kharif*-2015 to find out the immune or resistant reaction. The screening of Basmati rice against rice blast disease revealed that, none of the variety was immune, only five varieties were found moderately resistant against blast. Five Basmati varieties were found moderately susceptible. Eight varieties were susceptible and only two verities were showed susceptible to highly susceptible response. These moderately resistance genotypes can be used for minimize the disease. This method proved useful on a limited scale for screening genotypes that evaluated under field conditions.

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