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RESEARCH PAPER

Assessment of brown spot, neck /panicle blast and stem borer in scented rice under organic field conditions

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Abstract : Rice (*Oryza sativa* L.), a semi-aquatic annual grass native to tropical Asia, is the world's single most important food crop and a primary food source for more than one third of world's population. India possesses an immense wealth of basmati and non basmati aromatic rice varieties and land races exhibiting a wide variability in their grain quality and cooking characteristics. Scented rices grow best and produce finest quality grains under cool, humid conditions, which are common in Himalayan Tarai of U.P. and Uttarakhand and foot hills of Vindhya Hills. Among all scented rices aroma is considered as most important quality parameter of high quality rice. The major aromatic compound responsible for aroma is considered is 2-acetyl-1- pyrroline, which is degraded by excessive nitrogenous fertilizers. To avoid degradation of 2-acetyl-1- pyrroline and ultimately aroma organic field conditions are preferred. In present study forty five varieties/lines of Basmati and non Basmati aromatic rices were assessed for brown spot, neck/panicle blast and stem borer. In present study for neck/panicle blast 25 varieties/ lines were resistant, 13 were moderately resistant while 05 were moderately susceptible and only 02 were susceptible. In case of brown spot these numbers were 20, 17, 05 and 03, respectively. In assessment of stem borer maximum (18) varieties/lines were moderately resistant, 12 were moderately susceptible, 10 were resistant and only 05 were found susceptible. Some non Basmati scented rice varieties/lines like Tilak Chandan 3048, Kalanamak 3121, Pokkali U etc, shown resistance against more than one disease/pest. Based on this study it was revealed that besides Basmati rice other non Basmati aromatic rice varieties should also be promoted by scientists and adopted by more and more farmers so the loss by major diseases and pests can be minimized and consumers can get better aromatic rice at lower cost and simultaneously we can maintain our traditional non basmati aromatic rice germ plasm.

Key Words : Scented rice, Brown spot, Neck/Panicle blast, Stem borer, Aroma

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INTRODUCTION

More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the calories are consumed by 3 billion Asians (Khush, 1997). India is one of the world's largest producers of white rice, accounting for 20 per cent of all world rice production. India stands first in area, second in production, followed and preceded by China on these two aspects. The other major rice growing countries are Indonesia, Vietnam, Bangladesh, Thailand, Myanmar and Philippines among Asian countries. Now these days rice is excessively produced in whole of the world. Rice grain quality is a major factor from consumer as well as marketing point of view which may be affected by infection of various disease and pests at different growth stages of plant. Scented rice, which has stronger aroma and kernel elongation than ordinary rice, has more in demand in different countries of the world. Scented rices grow best and produce finest quality grains under cool, humid conditions, which are common in Himalayan Tarai of U.P and Uttarakhand and foot hills of Vindhya hills. Hence, Himalayan Tarai of Uttar Pradesh (U.P) and Uttarakhand is probably the place of origin of aromatic rices (Khush, 2000). All types of traditional scented rices *viz.*, small and medium grained non Basmati and long grained Basmati

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rices, were once very widely cultivated in these two states. Within these two states different aromatic rices have adopted to specific localities and conditions where their quality traits are expressed best. For example the finest quality Dehradun Basmati is produced in Seola-Majra Belt of Dehradun District of Uttarakhand; Kalanamak is primarily grown by farmers of Siddarthnagar and Basti Districts of U.P.

Diseases are considered major constraints in rice production. Rice diseases are mainly caused by fungi, bacteria or virus. Stunting is one of the symptoms, others are; colour change, wilting or abnormal of certain organs. These symptoms can be found in all organs of plant. Blast, caused by *Magnaporthe grisea,* attacks all aboveground parts of the rice plant. In leaf blast chlorophyll disappears in the parts attacked, which mean that photosynthesis and yield are reduced. Leaf blast usually increases early in the season, and then declines later in the season as leaves become less susceptible. Neck blast occurs when the pathogen infects the neck of the panicle. The infected neck is girdled by a grayish brown lesion and the panicle falls over if the infection is severe. If neck blast occurs before the milk stage, the entire panicle may die prematurely, leaving it white and completely unfilled. Later infections may cause incomplete grain filling and poor milling quality. For blast it is considered as it is favoured by too high a dose of nitrogen and high humidity. Rice brown spot is an aggressive plant disease caused by *Bipolaris oryzae* Shoem (*Helminthosporium oryzae*). It occurs in rice production areas all over the world and is one of the most common diseases in Asia. At the early stage, symptoms of brown spot mainly appear on the leaves. Leaf lesions reduce nutrient absorption and photosynthetic area, which result in the decrease of tillering nodes. Brown spot has been historically largely ignored as one of the most common and most damaging rice diseases. The great Bengal famine, which contributed to the famine of South Asia in 1942 (Padmanabhan 1973), is testimony to this. Brown spot has been, is, and probably will remain a major disease of rice. The striped rice stem borer *(Chilo suppressalis)* is a very important pest of rice in the Middle East and Asia. The larvae tunnel into the growing stems killing it or severely reducing grain production. Rice stem borers infest plants from the seedling stage to maturity. Symptoms of stem borer damage are dead hearts and white heads. Whiteheads are discolored panicles with empty or partially filled grains. These visible symptoms on affected plants vary with the growth stage at which plant infestation began. The pest causes serious damage to rice crops in many areas of the world.

Neck blast damage on scented rices particularly Basmati varieties is getting increasingly severe. Which ultimately decreases yield and some times deteriorate grain quality also. Based on the survey of 11 major rice growing countries Juliano and Duff (1991) concluded that grain quality is second only to yield as the major breeding objective. Among all scented rices aroma is considered as most important quality parameter of high quality rice. The major aromatic compound responsible for aroma is considered is 2-acetyl-1- pyrroline (Buttery *et al.,* 1983, 1986), which is degraded by excessive nitrogenous fertilizers. To avoid degradation of 2-acetyl-1- pyrroline and ultimately aroma organic field conditions are preferred. Basmati rice costs 2-3 times more to pocket of consumers than non Basmati rice. It is not possible for each and every person to expend more money for procurement of Basmati rice for their kitchen. On other hand it is not possible to farmers / traders to provide Basmati for each person as production of most of Basmati rice in India is limited to specific area *i.e.* the Himalayan Tarai region. Hence, there is need to explore potential of other non Basmati aromatic rices e.g. Tilak Chandan, Kalanamak, Hansraj as substitute of Basmati rice, as these rice varieties/ lines can be cultivated in different parts of country and may show resistance to disease and pests with comparison to Basmati. Keeping in mind these facts present study was done to assess brown spot, neck /panicle blast and stem borer in scented rice under organic field conditions. The varieties/ lines in this study showing resistance to these diseases may further be used as donor for scented rice improvement programmes.

MATERIALS AND METHODS

Total 45 varieties/ lines comprising of Basmati, Hansraj, Kalanamak and Tilak Chandan were taken for present study under organic farming system. All the varieties/ lines were grown at Seed Production C3enter (SPC), Pantnagar under G.B.Pant University of Ag. and Tech, Pantnagar, Uttarakhand, India using Randomized Block Design (R.B.D). From nursery seedlings of each variety/line were transplanted in a 20 m^2 (5m x 4 m) plot. During transplanting plant-to-plant distance was 15 cm and row-to-row distance was 20 cm. Standard agronomic practices were followed through out the study. Susceptibility of different varieties/lines of rice to diseases and pests was recorded under natural infection conditions.

Brown spot:

Over all disease intensity in a plot was recorded as per cent plant area infected by visual observation for each germplasm. Per cent flag leaf area infected was also recorded for 10 randomly selected flag leaves per germplasm. Disease index (DI) was calculated by

$$DI = \frac{\text{Plot rating (\%) x Av. flag leaf rating (\%)}}{100}$$

Different varieties/lines were assessed for brown spot by disease index (%) scale as following: Resistant (R) < 5 DI (%), moderately resistant (MR): 5 to 10 DI (%), moderately susceptible (MS): 10 to 15 DI (%) and susceptible (S): > 15 DI

(%)

Neck/Panicle blast: Incidence (proportion of panicles infected) and severity of panicle blast were assessed by following the standard procedure described by IRRI (1998-2000). Ten hills were selected diagonally per plot (per germplasm) for the assessment. Panicle blast incidence was assessed as:

(S % infected panicles from hill 1 to 10) ÷ (10)

where, per cent infected panicles for each hill is calculated as:

[(number of infected panicles per hill) ¸ (total number of panicles per hill)] * 100

Observation on severity were recorded on 5 infected panicles for each sample hill. In case 5 infected panicles are not available data was recorded only on available infected panicles. Severity was recorded using 0 to 9 scale: 0 = No visible lesion; 1 = < 5 per cent of pedicels/ secondary branches of a panicle affected; 3 = 5 to 25 per cent of pedicels/ secondary branches of a panicle affected; 5 = 26 to 50 per cent of pedicels/ secondary branches of a panicle affected; 7 = 51 to 75 per cent of pedicels/ secondary branches of a panicle affected; 9 = > 75 per cent of pedicels/ secondary branches of a panicle affected.

Disease severity on plot basis was calculated as:

(S of disease severity from hill 1 to 10) ÷ (10)

where, mean disease severity for each hill is calculated as:

(Σ of disease severity from panicle 1 to n) ¸ [(9) * (n)]

where, n is number of infected panicles assessed per hill and 9 is maximum disease grade.

Disease index was calculated as: (Per cent incidence)* (severity). Conclusion about disease was as following: Resistant (R): =5 disease index (DI), moderately resistant (MR): >5 to 10 DI, moderately susceptible (MS) : >10 to 20 DI, susceptible (S): > 20 DI.

Stem borer (White head):

Rating of, stem borer was recorded on randomly selected 10 hills per plot on diagonal axis. Total number of tillers/hill and number of infected tillers/hill were recorded for these pests and incidence (*i.e.* % tillers infected). Rating scales used were as follows: Resistant (R): =5 disease incidence (%), moderately resistant (MR): >5 to 10 disease incidence (%), moderately susceptible (MS): >10 to 15 disease incidence (%), susceptible (S): > 15 disease incidence (%).

RESULTS AND DISCUSSION

The mean values of susceptibility of scented rice varieties/lines against different diseases and pests under natural infection in present study are summarized in Table 1. Rice blast is caused by *Magnaporthe grisea.* All aboveground parts of the rice plant are attacked by the fungus (Fig. 1). Blast reduces yield and leads to incomplete grain filling and poor milling quality also. In present study 2 varieties/lines *i.e.* Basmati 134 and Hansraj 3074 U were susceptible for neck/ panicle blast while 5 varieties/lines *i.e.* Basmati 370, Dehradun Basmati 3020, Basmati 3065 AR 1409 U, Basmati Mohan 381 and Hansraj 3077) were moderately susceptible. Out of 45 varieties/lines 13 were moderately resistatant (Tilak Chandan 3048, Pokkali U, Basmati 217, Basmati Uzearpka, Basmati 127, Basmati 6129, Basmati Nepal, Basmati 1-1 A, Basmati 433, Basmati 5875, Basmati 622, type 3 and Basmati 3086)and remaining 25 showed resistance against neck/panicle blast.In leaf blast chlorophyll disappears in the parts attacked which leads to less photosynthesis and reduced yield. Neck blast occurs when the pathogen infects the neck of the panicle. The infected neck is girdled by a grayish brown lesion and the panicle falls over if the infection is severe. If neck blast occurs before the milk stage, the entire panicle may die prematurely, leaving it white and completely unfilled. Later infections may cause incomplete grain filling and poor milling quality. For blast it is considered as it is favoured by too high a dose of nitrogen and high humidity. Population study of *Magnaporthae grisea* by proper isolation, maintenance of pathogen culture and use of molecular markers may help proper management of blast disease (Singh, 2009, Singh, 2010, Singh and Kumar 2010) for long duration

Rice brown spot (Fig. 2) is an aggressive plant disease caused by *Bipolaris oryzae* Shoem (*Helminthosporium oryzae*). It occurs in rice production areas all over the world and is one of the most common diseases in Asia. In our study 03 varieties/lines *i.e.* Basmati 3065 AR 1409, Basmati Sufaid 100 and Basmati 376 were susceptible for brown spot while 5 varieties/lines *i.e.* Taraori Basmati, Basmati 124-10, Basmati 433, Basmati 134 and Basmati Sathi) were moderately susceptible. Out of 45 varieties/lines 17 were moderately resistatant (Kalanamak 3121, Basmati 3317-I, Basmati 370, Basmati 3085, Dehradun Basmati 3020, Basmati 3032 AR 575 U, Basmati 136, Basmati 127, Basmati 6129, Basmati 217, Basmati Nepal, Basmati C-622, Basmati 375 A, Hansraj 3078, Hansraj 3077, Hansraj 3074, Hansraj 3072-2 U) and remaining 20 showed resistance against brown spot. Rice brown spot causes severe damage under the conditions of cool summer and nitrogen deficiency. High humidity (>92.5%), leaf wetness and temperature (24 to 30° C) are favourable conditions for disease development (Picco and Rodolfi, 2002). Wind and rainfall can spread the spores to other organs of the same individual and other plants. Losses can be severe if weather and field conditions are favourable for disease spreading. Rice brown spot can be found during the whole growing season. At the early stage, symptoms of brown spot mainly appear on the leaves. Leaf lesions reduce nutrient absorption and photosynthetic area, which result in the decrease of tillering nodes. Brown spot has been historically largely ignored as one of the most common and most damaging rice diseases.

Table 1: Mean values of susceptibility of scented rice varieties/lines against different diseases and pests under natural infection

Variety/ Line	Brown spot	Stem borer	Neck / panicle blast	Variety/ Line	Brown spot	Stem borer	Neck / panicle blast	Variety/ Line	Brown spot	Stem borer	Neck / panicle blast
Tilakchandan 3048	R	R	MR	Basmati Uzearpka	R	MS	MR	Basmati Sufaid 100	S	MS	R
Kalanamak 3121	MR	R	R	Basmati 124-10	MS	MS	R	Basmati – C-622	MR	S	MR
Pokkali (U)	R	R	MR	Basmati 127	MR	MR	MR	Basmati 376	S	MS	R
Basmati 3317-1	MR	MR	R	Basmati 3065AR 771(U)	R	MR	R	Basmati Sathi	MS	MS	R
Basmati 370	MR	S	MS	Basmati 6129	MR	MR	MR	Basmati 375A	MR	R	R
Basmati 3034	R	MR	R	Basmati Nepal	MR	MR	MR	Type 3	R	MR	MR
Basmati 3085	MR	R	R	Basmati 1-1A	R	MS	MR	Hansraj 3078	MR	MR	R
Dehradun Basmati 3020	MR	MS	MS	Basmati 433	MS	MR	MR	Hansraj 3072-2	R	MR	R
Taraori Basmati	MS	MR	R	Basmati 134	MS	S	S	Hansraj 3072-1	R	MR	R
Basmati 3032AR 575(U)	MR	R	R	Basmati Mohan 381	R	S	MS	Hansraj 3067	R	MR	R
Basmati 3065AR 1409(U)	S	R	MS	Basmati 43A	R	R	R	Hansraj 3086	R	R	MR
Dehradun Basmati 3020(U)	R	MR	R	Basmati 106	R	MS	R	Hansraj 3077	MR	MR	MS
Basmati 217	MR	MR	MR	Basmati 122	R	S	R	Hansraj 3074	MR	MS	R
Basmati 107	R	MR	R	Basmati 5836	R	MS	R	Hansraj 3072-2 (U)	MR	MR	R
Basmati 136	MR	R	R	Basmati 5875	R	MS	MR	Hansraj 3074(U)	R	MS	S

Resist resistant (R), Moderately resistant (MR), Moderately susceptible (MS), Susceptible (S)

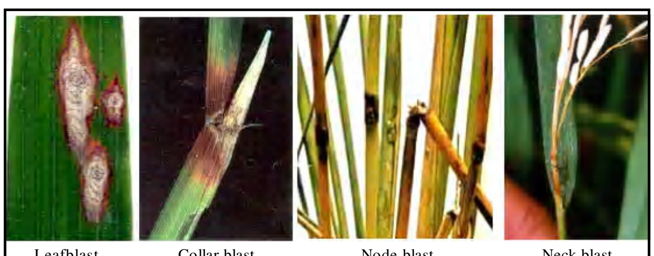

Fig. 1 : Different forms of rice blast

The great Bengal famine, which contributed to the famine of South Asia in 1942 (Padmanabhan, 1973), is testimony to this. Brown spot has been, is, and probably will remain a major disease of rice. Liu *et al.* (2007) has also studied rice brown spot severity using step wise regression for its proper control.


Fig. 2 : Brown spot of rice

The rice stem borer (Fig. 3) is a very important pest of rice in Asia and is caused by *Chilo suppressalis*. The larvae tunnel into the growing stems killing it or severely reducing grain production. Rice stem borers infest plants from the seedling stage to maturity. In present study 5 varieties/lines *i.e.* Basmati 370, Basmati 134, Basmati Mohan 381, Basmati 122 and Basmati C-622 were susceptible for stem borer while 12 varieties/lines *i.e.* Basamti uzerpka, Basmati 124-10, Basmati 1-1 A, Basmati 106, Basmati 5836, Basmati 5875, Basmati Sufaid 100, Basmati 376, Basmati Sathi, Basmati 3074,Hansraj 3074 U and Dehradun Basmati 3020) were moderately susceptible. Out of 45 varieties/lines 10 were resistatant (Tilak Chandan 3048, Kalanamak 3121, Basmati 3085, Pokkali U, Basmati 3032 AR 575 U, Basmati 3065 AR 1409 U, Basmati 136, Basmati 43 A, Basmati 375 A and Hansraj 3086) and remaining 18 showed moderate resistance against rice stem borer. Symptoms of stem borer damage are dead hearts and white heads. Whiteheads are discolored panicles with empty or partially filled grains. These visible symptoms on affected plants vary with the growth stage at which plant infestation began. The larvae can inflict 3 other forms of

Fig. 3 : Rice stem borer

damage - transparent or yellowing leaf sheaths, presence of entrance or exit holes on the stem, and disintegrated tissues or broken stems. Stem borer larvae may feed within the stem without severing the growing plant parts at the base. This can result in reduced plant vigour, and many unfilled grains. The pest causes serious damage to rice crops in many areas of the world, but fortunately its behaviour and life cycle make it particularly suitable for control by mating disruption. Ramesh *et al.* (2005) has reported that organic crops have been shown to more tolerant as well as resistant to insect attacks and organic rice is reported to have thicker cell wall and lower levels of free amino acids than conventional rice. Chau and Heong (2005) in their study also reported that organic fertilizers minimized the out break of insect pests and diseases such as brown plant hopper, stem borer, leaf folder, blast and sheath blight.

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