Symptomatological significance and characterization of susceptibility / resistance group among low land rice cultivars towards stem rot of rice in Manipur valley

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ABSTRACT: Stem rot of rice caused by Sclerotium oryzae. Catt., has rapidly spread throughout the Manipur valley during the past 9 years ( 1997-2005). It has infected all cultivated low land rice cultivars either of local or exotic origin to Manipur. None of the 33 cultivars studied in current roving and fixed location surveys during 2004-2005 Kharif, were resistant or highly resistant against the disease. The degree of susceptibility among cultivars differed with marked symptomatological difference in size, number and position of lesions on the infected stems above the field water level. Highly susceptible cultivars exhibited more number of lesions (3.0-8.5), larger coalesced lesion size (72.6 sq.mm - 406.2 sq.mm) at crop maturity and extended to higher positions on the stems up to 6.6 inches above the soil, in fields with 2" water level during cropping period. The size, number and positions of the lesions decreased with increasing resistance of the individual cultivars.

Key words: Rice, stem rot lesion, resistance, susceptibility, symptom, Sclerotium oryzae

Wetland rice cultivated exclusively under rain fed condition during Kharif is the principal crop in Manipur, occupying nearly 80% of the total cropped area in the state (Anonymous, 2003). The exclusive and constant monoculture of rice with no alternate crop rotation practices, coupled with the unavailability of resistant rice cultivars to the disease has aggravated the incidences and severity of stem rot of rice in the state. The disease is now endemic in Manipur (Konthoujam, 1998). Ali and Singh (1994) have also claimed that the disease has infected all rice cultivars in Haryana. Mishra and Mohammad (1964) also shared their view that most of the Indian varieties are susceptible to the disease. Few workers have classified degree of resistances of rice cultivars, on the length of the lesions (Ali and Singh, 1992; 1994).

However, Singh and Doodan (1997) found overlapping representation of some of the cultivars under 1 or more reaction groups of susceptibility / resistance on such categorization. They formulated and categorized the type of reaction exhibited by the different cultivars on the coefficient of infection percent, which takes both the disease incidence and severity into account in determining the type of susceptibility of rice cultivars to the disease.

The present study highlights the reaction of rice cultivars against stem rot infection on the light of the coefficient of infection percent and their symptomatological parameters that significantly provides a comprehensive visual rating of the degree of resistance /susceptible of individual cultivars.

MATERIALS AND METHODS

Extensive roving survey in the farmers fields and fixed location survey at the Agriculture Department and Central Agriculture University experimental fields, were conducted during 2004 and 2005 Kharif rain fed rice. The plants were visually examined for characteristic stem rot lesions during maturity and harvesting stages of the crop following Ou(1985) and Standard Evaluation System.
(SES) of Rice formulated by IRRI (Anonymous, 1980). Fifty diseased plant samples of each cultivar were randomly drawn by moving diagonally in a zigzag position across the field, from 5 sampling blocks, each measuring 1 Acre at different locations. Total number of 250 samples of each cultivar was thus collected from the different sampling blocks. Plants of the same cultivars collected from different locations were pooled together and mixed thoroughly, out of which 100 stem rot infected tillers were selected randomly and observed for the size, number and position of stem rot lesions on the infected stems from the zone of the roots.

The size of the lesions which are generally circular /oblong or irregular outline is measured in terms of area of a circle, calculated by using the formula below.

\[
\text{Area of a circle} = \pi r^2
\]

Where, \( r = \frac{M + m}{2} \)

\( M = \) radius at the broadest point of the lesion
\( m = \) radius at the narrowest point of the lesion

Type of reaction exhibited by the individual cultivars were scored and designated by calculating the coefficient of infection percent (CI%) following Singh and Doodan (1997).

**RESULTS AND DISCUSSION**

The worldwide occurrence of stem rot of rice and its potential threat to world rice cultivation and production has well been documented. Paracer and Luthra (1944) and Singh & Pavgi (1966) reported 70% yield loss due to stem rot of rice in India. Kumar *et al.* (2003) claimed that stem rot is a great limiting factor in rice cultivation in Haryana. However, the disease is yet to be familiarized among local farmers. Inexperienced farmers and casual observers may often confuse the disease with sheath blight (R. solani) or sheath spot (R. oryzae). Such inappropriate identification and distraction has diverted proper attention and appropriate plant protection measures against the disease. The disease is best characterized by irregular black lesions on the stem near the field water line at crop maturity along with dark greyish mycelium and black sclerotia inside the stems of infected plants (Ou, 1985).

The data presented in Table 1 revealed that, not a single cultivar was resistant or highly resistant to the disease. Out of 33 low land rice cultivars, either of local or exotic origin to Manipur surveyed during the current studies, majority of the cultivars

<table>
<thead>
<tr>
<th>Reaction score</th>
<th>%Coefficient of Infection</th>
<th>Reaction category</th>
<th>Cultivars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Highly resistant</td>
<td>Nil</td>
</tr>
<tr>
<td>1</td>
<td>Less than 5%</td>
<td>Resistant</td>
<td>Nil</td>
</tr>
<tr>
<td>2</td>
<td>5-10%</td>
<td>Moderately resistant</td>
<td>Chakhao amuba, Ching Chakhao, Huikap</td>
</tr>
<tr>
<td>3</td>
<td>10-20%</td>
<td>Moderately susceptible</td>
<td>Chakhao angangbi, Chakhao anagouba, Chakhao poreiton, Changphai, CAU R2, CAU R4, Punshi, Phouoibi, RCM 11, Saheb Dhan 2, Saheb Dhan 3</td>
</tr>
<tr>
<td>4</td>
<td>20-40%</td>
<td>Susceptible</td>
<td>Akhan phou, Basmati 1, Basmati 370, Basmati Kasturi, CAU -S1, China 988, IR 64, Leima phou, Moirang phou angouba, Moirang phou angangbi, RCM 5, RCM 9, RCM 10, Drum phou, Saheb Dhan 1, Sanayanbi, Champra phou, Tampha phou, Sana phou</td>
</tr>
<tr>
<td>5</td>
<td>Above 40%</td>
<td>Highly susceptible</td>
<td></td>
</tr>
</tbody>
</table>

# Mean of 100 naturally infected tillers of each cultivars from different locations
Table 2. Reaction category and their disease parameters of rice cultivars on rice stem rot infection

<table>
<thead>
<tr>
<th>Reaction category</th>
<th>Score</th>
<th>CI%</th>
<th>Area (Sq.mm)*</th>
<th>Number*</th>
<th>Position (inches)#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly resistant</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Resistant</td>
<td>1</td>
<td>9.3</td>
<td>144.8</td>
<td>2.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Moderately resistant</td>
<td>2</td>
<td>(7.9-12.1)</td>
<td>(71.2-210.7)</td>
<td>(2.0-3.0)</td>
<td>(2.2-4.0)</td>
</tr>
<tr>
<td>Moderately susceptible</td>
<td>3</td>
<td>18.0</td>
<td>171.1</td>
<td>4.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Susceptible</td>
<td>4</td>
<td>27.5</td>
<td>298.9</td>
<td>4.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Highly susceptible</td>
<td>5</td>
<td>36.3</td>
<td>(17.8-35.0)</td>
<td>(70.4-327.5)</td>
<td>(2.0-6.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(21.4-40.1)</td>
<td>(72.6-406.2)</td>
<td>(3.0-8.5)</td>
</tr>
</tbody>
</table>

Correlation (r value) with CI%

*Pooled mean of cultivars under each reaction category (Ref: Table1) of 2 years (2004-2005); +Number of coalesced lesions is taken as one (1) unit; -Not available ; #Above soil level; ( )figure in parenthesis are range value

(16) were susceptible to the disease. While 11, 3, and 3 cultivars were moderately susceptible, highly susceptible and moderately resistant to the disease respectively.

It is seen in Table 2 that CI% has strong correlation with size of the lesions. Increase in the CI% is reciprocated with an increase in the size of the lesions, wherein maximum size was observed in highly susceptible cultivars and minimum in moderately resistant cultivars. Many individual lesions sooner or latter coalesce together to occupy larger lesion area. Since the lesions coalesced sooner or later after formation, it is apparent that the number of single lesions is accountable to the size of the coalesced lesions. The size of lesions varied from 72.6-406.2 sq.mm in highly susceptible cultivars and 70.4-327.5, 62.5-303.9 and 71.2-210.7 sq.mm. in susceptible, moderately susceptible and moderately resistant cultivars respectively. The number of lesions either in their coalesced state or single distinct young ones are lowest ranging form (2.0-3.0) in moderately resistant cultivars and highest (3.5-8.5) in highly susceptible cultivars. Whereas, in moderately susceptible and susceptible cultivars the number of lesion ranged from 3.5-4.8 and 2.0-6.9 respectively. In wet rice fields where a standard water level of 2 inches is generally maintained, the lesions may extend as high up to 6.6 inches and above on the infected stems, above the level of the soil surface in highly susceptible cultivars. Whereas, it may be limited to only 4.0, 4.5 and 4.5 inches on moderately resistant, moderately susceptible and susceptible cultivars.

Sclerotia of the pathogenic fungus *S.oryzae*, floating on the surface of the water in the rice field are the principal source of inoculum of the disease (Kawai, 1955). These floating sclerotia easily come in contact with the rice leaf sheaths and germinate to form appressoria or infection cushion, leading to development of lesion of lesions symptoms etc. It may therefore be argued that, the level of water maintained in the field may influence the position of the site of infection, vis-à-vis position of lesions on the stem. It is note worthy that no stem rot lesion have been observed below the water line maintained (2") during the cropping period in the current studies. Nevertheless, such findings strongly suggest that the position of lesions on infected stem has considerable correlation with the type of reaction of the individual cultivars under a given field water level. Cralley (1936) reported that the degree of resistance is an independent character of the cultivars.

Hence, the characteristic size, number and position of lesions exhibited by individual cultivars on infection by stem rot of rice is a good visual indicator of the degree of susceptibility /resistance of the individual cultivars.
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