Rice blast disease (*Pyricularia oryzae* Cav.) incidence, severity, genotype reaction and management in Tanzania

PhD Research Progress

**Ibrahim Hashim** (SUA & ICIPE)

**Supervisors:** Delphina P. Mamiro (PhD) (SUA),
Robert B. Mabagala (PhD) (SUA)
Tadele Tefera (PhD) (ICIPE)

Annual Planning Meeting 24-26 July 2018, ICIPE, Nairobi, Kenya
Introduction

- Rice blast (RBD) is a fungal disease caused by *Pyricularia oryzae* Cav.
- It is found everywhere in the world where rice (*Oryza sativa* L.) is grown
- The damage is in all growth stages of rice plants (Pooja and Katoch, 2014)
- Globally the disease cause yield losses of 10-100% (Nalley *et al.*, 2016, Kihoro *et al.*, 2013; Chuwa *et al.*, 2015)
- Control is through **resistant rice varieties**, **synthetic fungicides** and **cultural practices**

PHOTO: Ibrahim Hashim, 2018
Introduction cont

Overall objective
• To enhance rice blast disease management by establishing the disease incidence, severity and genotypes reaction in upland rice in Tanzania

Specific objective are to:-

i. Investigate smallholder farmers’ knowledge, perception and management of rice blast disease

ii. Evaluate the effect of microbial-fungicides on management of rice blast disease

iii. Evaluate the efficacy of selected seed treatment methods on rice blast disease

iv. Establish the incidence and severity of rice blast disease in upland rice ecosystem

v. Determine the effect of rice blast disease on yield of selected upland rice genotypes grown in Tanzania
Objective 1

Smallholder farmers' knowledge, perception and management of rice blast disease in upland rice production in Tanzania

• Farmers’ household survey was conducted in 5 districts namely Mvomero, Morogoro rural, Ulanga, Korogwe and Muheza in April and May 2017

• Data collected from 138 farmers through face-to-face interviews

• Semi-structured questionnaire and series of colored photograph
Results

• Rice blast disease (RBD) observed in the farmers’ field in the past 3 to 10 years
• High RBD severity occurred in April to May each year
• 92.3% of farmers use local rice genotypes
• 7.7% use improved varieties
• 69.6% of respondents shared information among themselves
• 17.4% from extension staff and
• 13.0% trainings
Objective 2

*In vitro and in vivo evaluation of microbial agents for management of rice blast disease* (*Pyricularia oryzae* Cav.) in Tanzania

- Experiments were conducted in the laboratory and screen house
- Evaluation of *Trichoderma asperellum* and *Bacillus subtilis* and Linkimil 72 WP (fungicide) against rice blast disease
Results

*In vitro* evaluation

Plate 1: Effect of A = *Trichoderma asperellum*, B = *Bacillus subtilis*, C = Linkimil 72WP and D = negative control on inhibition of growth of *Pyricularia oryzae* after incubation for 14 days
The effects of microbial agents on *P. oryzae* radial growth inhibition and disease incidence and severity

- *T. asperellum* and *B. subtilis* had highest percentage radial growth inhibition
- Linkimil 72 WP had significantly lower PIRG
- Negative control had zero PIRG
Table 1: The effects of microbial agents on percentage filled grains, unfilled grains, panicle weight and dry shoot weight

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Number of lesions/leaf</th>
<th>Lesion size (mm)</th>
<th>Number of tillers/plant</th>
<th>Filled grains (%)</th>
<th>Unfilled grains (%)</th>
<th>Panicle weight (g)</th>
<th>Grain weight (g)</th>
<th>Dry shoot weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichoderma</td>
<td>8.0 a</td>
<td>4.3 a</td>
<td>3.0 a</td>
<td>71.6 b</td>
<td>29.0 a</td>
<td>9.6 b</td>
<td>8.7 b</td>
<td>23.6 b</td>
</tr>
<tr>
<td>Bacillus</td>
<td>25.0 b</td>
<td>6.9 a</td>
<td>3.0 a</td>
<td>73.8 b</td>
<td>27.5 a</td>
<td>11.0 b</td>
<td>10.2 b</td>
<td>26.3 b</td>
</tr>
<tr>
<td>Linkimil 72WP</td>
<td>11.0 a</td>
<td>5.7 a</td>
<td>3.0 a</td>
<td>73.3 b</td>
<td>27.6 a</td>
<td>10.5 b</td>
<td>10.1 b</td>
<td>23.3 b</td>
</tr>
<tr>
<td>Control</td>
<td>58.0 c</td>
<td>46.3 b</td>
<td>2.0 a</td>
<td>57.4 a</td>
<td>43.2 b</td>
<td>5.8 a</td>
<td>5.4 a</td>
<td>17.5 a</td>
</tr>
<tr>
<td>Mean</td>
<td>19.0</td>
<td>15.8</td>
<td>2.51</td>
<td>69.0</td>
<td>31.8</td>
<td>9.2</td>
<td>8.6</td>
<td>22.7</td>
</tr>
<tr>
<td>S.E.</td>
<td>2.2</td>
<td>12.8</td>
<td>0.13</td>
<td>0.1</td>
<td>12.6</td>
<td>2.5</td>
<td>2.5</td>
<td>4.1</td>
</tr>
<tr>
<td>CV%</td>
<td>26.9</td>
<td>81.3</td>
<td>32.4</td>
<td>14.3</td>
<td>39.7</td>
<td>27.5</td>
<td>28.5</td>
<td>18.1</td>
</tr>
</tbody>
</table>
Objective 3

Reduction of occurrence of rice blast (Pyricularia oryzae) inocula on rice seeds by microbial and hot water seed treatments

• *T. asperellum, B. subtilis* and hot water (50°C/15 min) seed treatments were evaluated in laboratory and the screen house

• Inoculated and treated rice seeds were tested for presence of *P. oryzae* using Blotter and direct plating on PDA
Results

Fig 1: Effect of seed treatments on percentage of *Pyricularia oryzae* infected rice seeds detected using the Blotter test

Fig 2. Mycelia (A) and spores (B) of *Pyricularia oryzae* isolated from inoculated rice seeds on Potato Dextrose Agar media
Results cont.

Seeds treated with *B. subtilis* reduced the incidence and severity of rice blast disease from 11.5% and 85.2% respectively.

Seed treated with *B. subtilis* and *T. asperellum* reduced the number of infected seeds and rice blast disease incidence and severity.

**Fig. 3.** Effects of seed treatment on rice blast disease incidence and severity under screen house conditions
Conclusion

• Use of microbial agents have a potential for effective management of rice blast disease

• Standardization of temperature and time for hot water seed treatment on different rice genotypes, to reduce any side effect on the seeds
## On going activities

<table>
<thead>
<tr>
<th>Season 1 Activities</th>
<th>Status</th>
</tr>
</thead>
</table>
| **Objective 2:** Evaluation of microbial agents for management of rice blast disease under field conditions | • Data collection  
• Data processing                                  |
| **Objective 4:** Field survey to establish incidence and severity of rice blast disease in upland rice ecosystem | • Data collection  
• Data processing                                      |
| **Objective 5:** Field experiment on the effect of rice blast disease on yield loss of selected upland rice genotypes grown in Tanzania | • Data collection  
• Data processing                                      |
Challenges

• Under field conditions rice blast disease is not predictable, evaluation of bio agents may need more that two seasons

• Field survey to establish rice blast disease status in upland rice was conducted in 4 district rather than 5 districts
## Plan for 2018/2019 Season

<table>
<thead>
<tr>
<th>S/N</th>
<th>Season 2 Activities</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluation of microbial agents for management of rice blast disease under field conditions</td>
<td>Feb – June 2019</td>
</tr>
<tr>
<td>2</td>
<td>Field survey to establish incidence and severity of rice blast disease in upland rice ecosystem</td>
<td>Apr – June 2019</td>
</tr>
<tr>
<td>3</td>
<td>Field experiment on the effect of rice blast disease on yield loss of selected upland rice genotypes grown in Tanzania</td>
<td>Feb – June 2019</td>
</tr>
</tbody>
</table>
## List of papers

<table>
<thead>
<tr>
<th>S/N</th>
<th>Title and authors</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Smallholder farmers' knowledge, perception and management of rice blast disease in upland rice production in Tanzania.</strong> <em>Journal of Agricultural Science,</em> <strong>Vol 10, No 7</strong> (2018), DOI: <a href="https://doi.org/10.5539/jas.v10n7p137">https://doi.org/10.5539/jas.v10n7p137</a> <strong>Ibrahim Hashim, Delphina Mamiro, Robert B. Mabagala, and Tadele Tefera</strong></td>
<td>Published</td>
</tr>
<tr>
<td>2</td>
<td><strong>In vitro and in vivo evaluation of microbial agents for management of rice blast disease (<em>Pyricularia oryzae</em> Cav.).</strong> <em>World Journal of Agricultural Science</em> <strong>Ibrahim Hashim, Delphina Mamiro, Robert B. Mabagala, and Tadele Tefera</strong></td>
<td>Accepted</td>
</tr>
<tr>
<td>3</td>
<td><strong>Reduction of occurrence of rice blast (<em>Pyricularia oryzae</em>) inocula on rice seeds by microbial and hot water seed treatments.</strong> <em>Australian Journal of Crop Science</em> <strong>Ibrahim Hashim, Delphina Mamiro, Robert B. Mabagala, and Tadele Tefera</strong></td>
<td>Accepted</td>
</tr>
<tr>
<td>4</td>
<td><strong>Effect of rice blast disease on yield of selected upland rice genotypes grown in Tanzania</strong> <strong>Ibrahim Hashim, Delphina Mamiro, Robert B. Mabagala, and Tadele Tefera</strong></td>
<td>Draft preparation</td>
</tr>
<tr>
<td>5</td>
<td><strong>Occurrence of rice blast disease in upland rice ecosystem in Tanzania</strong> <strong>Ibrahim Hashim, Delphina Mamiro, Robert B. Mabagala, and Tadele Tefera</strong></td>
<td>Draft preparation</td>
</tr>
</tbody>
</table>

www.icipe.org
Thank you