Field efficacy of formulation of fungal bioagents against bacterial leaf blight of rice caused by Xanthomonas oryzae pv. oryzae (Uyeda and Ishiyama) Dowson

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Abstract: In the present study, Trichoderma harzianum, T. hamatum, T. virens and three isolates of Trichoderma spp. were evaluated for their comparative efficacy against bacterial leaf blight of rice, under field conditions. All the bioagent formulations were significantly effective in reducing disease severity over check during Kharif season 2006 and 2007. T. harzianum was found to be most effective and resulted 48.26 and 59.22 % reduction in disease severity during Kharif season 2006 and 2007, respectively. Maximum increase in grain yield (16.21%) was recorded with T. harzianum followed by isolate 40 (14.58%), during Kharif season 2006. Whereas during Kharif season 2007, maximum increase in grain yield (18.95%) was recorded with T. harzianum which is followed by T. virens (14.65%) and isolate 40 (12.57 %). Present study revealed that T. harzianum (isolated from rice phylloplane) was found to be most effective in reducing disease severity and increasing grain yield as compared to other isolates obtained from different sources.

Keywords: Bacterial leaf blight of rice, Field efficacy, Trichoderma hamatum, Trichoderma harzianum, Trichoderma virens, Xanthomonas oryzae pv. oryzae,

INTRODUCTION

Bacterial leaf blight of rice caused by Xanthomonas oryzae pv. oryzae is the disease of great economic importance in all rice growing areas of the world and is particularly destructive in South East Asia during the heavy rains of monsoon season (Mew et al., 1993). Non-availability of effective chemical control measures and inconsistent performance of resistant rice varieties have forced the plant pathologists to look for new approaches of disease management (Buddenhagen, 1983; Kaul & Sharma, 1987; Mew, 1987). Interest in biological management has increased considerably in the recent past due to their added advantage over the other methods of plant disease management (Whipps and Mequilken, 1993; Dube, 1995; Pankhurst and Lynch, 1995). The microbial antagonists occurs in nature are host specific, virulent, self perpetuating and genetically stable. Hence, biological control has emerged an alternative and most promising means of the management of plant pathogens. Many workers reported the effectivity of Trichoderma spp., T. harzianum, T. hamatum and T. virens (Manmeet and Thind, 2002; Nzoijobiri et al., 2003; Gangwar and Sinha, 2010a,b; Gangwar and Sinha, 2012a,b) and phylloplane microflora (Sindhan et al., 1997) against X. oryzae pv. oryzae causing bacterial leaf blight disease in rice.

Trichoderma harzianum, T. hamatum, T. virens and 49 isolates of Trichoderma spp. (isolated from different sources and locations) were screened for comparative antagonistic potential against X. oryzae pv oryzae (Xoo) in vitro (Gangwar and Sinha, 2010a; Gangwar and Sinha, 2012a) and ten potential fungal bioagents (seven isolates of Trichoderma spp. and T. harzianum, T. hamatum and T. virens) were selected for their evaluation against bacterial leaf blight of rice, under glass house conditions (Gangwar and Sinha, 2012b). Among these, six potential fungal bioagents were selected for testing field efficacy against bacterial leaf blight of rice. In the present study, these six potential bioagents were evaluated for their comparative efficacy against bacterial leaf blight of rice, under field conditions.

MATERIALS AND METHODS

In the present study, comparative efficacy of six potential fungal bioagents viz. Trichoderma harzianum, T. hamatum and T. virens and three isolates of Trichoderma spp. (isolate 25, 31 and 40) which were isolated from different sources (Table 1) were tested against bacterial leaf blight of rice, under field conditions.

Mass multiplication of fungal bioagents and preparation of formulation: The fungal bioagents were mass multiplied on barnyard millet (Echinochloa frumentacea). Grains colonized by Trichoderma spp. were air dried in open shade and ground with the help of Willy Mill to get fine powder. This powder was passed through 50 and 80
mesh sieves simultaneously to obtain spore powder and diluted with talcum powder (mesh = 350 with 95% whiteness) and 1% carboxyl methyl cellulose (CMC) to get desired concentration (10^6 cfu/g).

**Field experiment:** The experiment was carried out in Kharif season during the year 2006 and 2007 at Crop Research Center, G. B. Pant University of Agriculture and Technology, Pantnagar using randomized block design (RBD). Topographically, Pantnagar is located at 29°N latitude, 79.3°E longitude and at an altitude of 243.84 meter above the mean sea level in the humid and subtropical regions of North West Plain Zone at the foothills of Shivalik range of Himalayas. The average relative humidity was highest (70-90%) in July-August and December-January and lowest (35-40%) in April-May. Susceptible rice cultivar Jaya was used for the experiment.

General agronomic practices were followed for cultivation of experimental plots. Pathogen was inoculated in the morning at maximum tillering stage by clipping off the leaf tip @ 10^6 cell/ml inoculum (Kaufman et al., 1973).

**Application of treatments:** Formulations of fungal bioagents were applied 10 g/l as foliar spray next day of inoculation of pathogen in the evening hours to avoid exposure to hot sunshine. Two foliar sprays of bioagents formulations and chemical treatments were given at one week interval. Check plots were sprayed with sterilized water. Each treatment was replicated thrice.

**Data collection:** Data was recorded as percent disease severity on artificially inoculated leaves (average 50 leaves/plot) at 14, 21 and 28 days after treatment application. After harvesting yield components (number of filled and unfilled grains per plant, grain yield and 1000 grain weight) were recorded.

**Statistical analysis:** Statistical analysis of the data obtained from field experiment was done using appropriate programme as per the requirement of the experiment. The critical difference (CD) was calculated at 5% level of significance for comparison of difference between the means of different treatments.

**RESULTS**

**Effect of fungal bioagent formulations on disease severity:** All the isolates of *Trichoderma* spp. significantly reduced disease severity of bacterial leaf blight over check during Kharif season 2006 and 2007 (Table 2). During Kharif season 2006 *T. harzianum* was found most effective and exhibited 48.26 per cent reduction in disease severity. Foliar spray with isolate 25, isolate 40 and *T. virens* was next in order to effectivity and exhibited 47.91 % reduction in disease severity. During Kharif season 2007 *T. harzianum* resulted in maximum reduction (59.22%) in disease severity followed by isolate 25 (57.97%).

**Effect of fungal bioagent formulations on number of filled grains per plant:** All the isolates of *Trichoderma* spp. were significantly effective in increasing number of filled grains per plant over check during Kharif season 2006 and 2007 (Table 3). The highest increase (36.84%) in number of filled grains was obtained with *T. harzianum* followed by isolate 40 (24.90%) and *T. virens* (23.87%) during Kharif season 2006. During Kharif season 2007, maximum increase (29.71%) in number of filled grains was obtained with *T. harzianum* followed by *T. virens* and isolate 31 which resulted in increase in number of filled grains per plant by 26.22 and 19.49 per cent, respectively.

**Effect of formulation of fungal bioagents on grain yield and 1000 grain weight:** The data obtained on the effect of *Trichoderma* spp. in increasing grain yield and 1000 grain weight was significantly higher over check during Kharif season 2006 and 2007 (Table 3). The highest increase (33.00%) in 1000 grain weight was observed with *T. harzianum* which is followed by *T. hamatum* (32.15%). During Kharif season 2007, Maximum increase in grain yield (16.21%) was recorded with *T. harzianum* followed by isolate 40 (14.58%) during Kharif season 2006. Maximum increase (33.00%) in 1000 grain weight was observed with *T. harzianum* which is followed by *T. hamatum* (32.15%). During Kharif season 2007, Maximum increase in grain yield (18.95%) was recorded with *T. harzianum* application followed by *T. virens* (14.65%) and isolate 40 (12.57%). Maximum increase in 1000 grain weight was recorded with *T. hamatum* (54.44%) which is followed by *T. virens* (50.67%) and *T. harzianum* (50.55%).

**DISCUSSION**

In the present investigation, six fungal bioagent formulations were evaluated against bacterial leaf blight disease of rice during Kharif season during the year 2006 and 2007. *T. harzianum* (rice leaf isolate) was found most effective in reducing disease severity and increasing grain yield. *Trichoderma* spp. (isolate 40) and *T. virens* were found next in order of effectivity in reducing disease severity and increasing the grain yield. This indicates that fungal bioagents could proliferate and establish on rice host surface which resulted in reduction in bacterial blight disease severity. Similar results were observed in glasshouse studies carried by Gangwar and Sinha, (2012b). Higher effectivity of *Trichoderma* isolates obtained from rice phylloplane against bacterial leaf blight disease.

**Table 1. List of fungal bioagents isolated from different sources.**

<table>
<thead>
<tr>
<th>Isolates of <em>Trichoderma</em> spp.</th>
<th>Sources</th>
</tr>
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<tbody>
<tr>
<td>Isolate 31</td>
<td>Soil of rice field</td>
</tr>
<tr>
<td>Isolate 40</td>
<td>Soil of rice field</td>
</tr>
<tr>
<td><em>T. harzianum</em></td>
<td>Rice phylloplane</td>
</tr>
<tr>
<td><em>T. virens</em></td>
<td>Rice phylloplane</td>
</tr>
<tr>
<td><em>T. hamatum</em></td>
<td>Rice phylloplane</td>
</tr>
</tbody>
</table>
A pathogen was reported by Gangwar and Sinha, (2012a). T. harzianum also found highly effective against bacterial blight pathogen X. oryzae pv. oryzae under in vitro screening (Gangwar and Sinha, 2010a; Gangwar and Sinha, 2012a). Evaluation of different antagonists for control of bacterial leaf blight pathogen in the field was carried out by Manmeet and Thind (2002) which revealed that significant reduction in the disease intensity was observed by T. harzianum application.

Conclusion

Present study revealed that efficacy of different Trichoderma spp. and isolates against bacterial leaf blight rice was varied. T. harzianum (isolated from rice phylloplane) was found to be most effective in reducing disease severity and increasing grain yield as compared to other isolates obtained from different sources. The observed results should be verified on large scale rice planting.

REFERENCES


Gangwar, G.P. and Sinha, A.P. (2010a). Comparative antagonistic potential of Trichoderma spp. against...