PROGRESS REPORT

BIOLOGICAL CONTROL OF PLATE ROT IN ONIONS

Gary Beaver, Extension Onion and Potato Specialist
University of Idaho Research & Extension Center
Parma, Idaho

and

Abd Alla El-Shehaby, Plant Pathologist
Plant Pathology Research Institute
Agricultural Research Center
Giza, Egypt

Plate rot caused by \textit{Fusarium oxysporum} is a serious disease of onions. Under field conditions the disease rots the plate and root system causing loss in plant stand and in bulb size. Infected onions may be further damaged by progression of the disease in storage.

Soil fumigation coupled with good cultural practices can reduce disease severity but losses of ten to twelve percent may still occur. Fungicide applications have been of little help.

The use of antagonistic microorganisms as biological control agents has been successful in some cases. \textit{Fusarium} wilt caused by \textit{Fusarium oxysporum} and \textit{Rhizoctonia} root rot caused by \textit{Rhizoctonia solani} have been reduced with \textit{Trichoderma harzianum}.

This study was undertaken to determine if antagonistic microorganisms might be present in soils cropped to onions and if those organisms might be manipulated in some manner to reduce the incidence of plate rot in onions either under field conditions or in storage.

PROCEDURES

Isolation of the pathogen

\textit{Fusarium} sp. were isolated from a variety of onions showing symptoms of \textit{Fusarium} plate rot using selective media under laboratory conditions. Pure cultures were established by dilution plating and isolation of single colonies. All cultures were examined microscopically and for growth habit on potato dextrose agar. Culture identities were confirmed by Dr. James Cook, USDA, Washington State University, Pullman, Washington.

Isolation of antagonistic microorganisms

Soil samples were collected from a variety of fields previously cropped to onions. In addition soil samples from the root zone (rhizosphere and rhizoplane) of growing onions were collected. Isolations of bacteria, fungi and actinomycetes were made from each soil sample by the dilution plate technique on selective media. Each organism isolated was placed in pure culture and numbered for future reference.
Test of pathogenicity

All organisms isolated were tested for pathogenicity to onion seed, seedlings and mature onion bulbs. Seeds were coated with spores of the various organisms and germinated under moist blotter paper in petri dishes. Germinated seedlings were immersed in spore suspensions of the various organisms and transplanted to pots in the greenhouse. Seedlings were evaluated for disease 3 to 4 weeks after transplanting.

Mature onions were inoculated with and without wounding on the plate, side and shoulder of the bulb with the various organisms. Inoculated bulbs were incubated in moist chambers and observed for symptom development over a one month period.

Lab test for antagonism

Fusarium cultures were plated on agar media and challenge inoculated with antagonist cultures individually and in all combinations. Cultures exhibiting antagonistic qualities towards Fusarium were retained for further studies.

Greenhouse test for antagonism

Cultures exhibiting antagonistic qualities towards Fusarium were grown on agar media, quantified and added to pots containing sterilized field soil and sterile soil amended with barley, bean or alfalfa straw. Onion seed was planted in the test pots 1 day and 1 week after the amended soil was placed in the pots. Onion seedlings were grown for 3 months and evaluated at biweekly intervals for signs of infections. Final emergence counts were made for each treatment.

RESULTS

Pathogen

Fusarium oxysporum cepae is the cause of plate rot in onions. Isolation and pathogenicity testing showed F. oxysporum cepae to be present and caused plate rot symptoms in all tests. In addition Fusarium solani was isolated from diseased onions and also caused a plate rot in onions to which it was inoculated. Both species appear to play a roll in plate rot development in onions.

Antagonistic microorganisms

Two fungi isolated were shown to be antagonistic to F. oxysporum and F. solani on culture media; Penicillium purpureescens and a second culture ultimately identified as a mixture of P. islandicum and P. janthinellum. Further tests need to be conducted to confirm the antagonistic characteristics of the latter two organisms.

Three unidentified species of actinomycetes and three unidentified species of bacteria were also isolated and demonstrated to have antagonistic effects towards both Fusarium pathogens.
Antagonistic organisms were tested against Fusarium inoculated onions in pots under greenhouse conditions (Table 1). Fusarium alone caused a 30 percent reduction in surviving seedlings. When antagonistic microorganisms were added to the soil only actinomycete 87 reduced seedling loss significantly. Losses were reduced from 30% to 9.4% by the antagonist.

Table 1. Effect of Fusarium plus antagonistic microorganisms on the survival of greenhouse grown onion seedlings.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. surviving plants out of 20[a/]</th>
<th>% reduction from sterile</th>
<th>Significance of treatment from Fusarium control at t = .05[b/]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterile soil control</td>
<td>16.00</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Fusarium control</td>
<td>11.25</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Fusarium + P. Pur.</td>
<td>12.75</td>
<td>20.4</td>
<td>NS</td>
</tr>
<tr>
<td>Fusarium + Act. 83</td>
<td>11.00</td>
<td>31.2</td>
<td>NS</td>
</tr>
<tr>
<td>Fusarium + Act. 87</td>
<td>14.50</td>
<td>9.4</td>
<td>S</td>
</tr>
<tr>
<td>Fusarium + Bact. 115</td>
<td>11.50</td>
<td>28.2</td>
<td>NS</td>
</tr>
<tr>
<td>Fusarium + Bact. 120</td>
<td>14.25</td>
<td>11.0</td>
<td>NS</td>
</tr>
</tbody>
</table>

\[a/\] average of 4 replications  
\[b/\] S = Significant, NS = non-significant

These results are encouraging and further testing will be conducted to determine what environmental conditions will permit maximum activity of one or more of the antagonistic organisms identified. Additional greenhouse and field testing will be required.