Evaluation of Onion Soil Amendment to Control White Rot

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- Vegetable seed crops (carrot, garlic, onion)
- Bluegrass seed
- Wheat (seed and production)
- Alfalfa (hay and seed)
- Mint (oil and tea leaf)
- Seed potatoes
- Parsley, mustard, radish, dill, flower seed
- Hay, legumes
- Drip, wheel-line, center-pivot, furrow irrigation
Allium Seed Acreage in Central Oregon

<table>
<thead>
<tr>
<th>Year</th>
<th>Garlic seed Acres</th>
<th>Onion seed Acres</th>
<th>Garlic value</th>
<th>Onion value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>1200</td>
<td>100</td>
<td>$3,500,000</td>
<td>$500,000</td>
</tr>
<tr>
<td>2008</td>
<td>1100</td>
<td>200</td>
<td>$3,000,000</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>2009</td>
<td>1000</td>
<td>300</td>
<td>$2,500,000</td>
<td>$1,500,000</td>
</tr>
<tr>
<td>2010</td>
<td>900</td>
<td>400</td>
<td>$2,000,000</td>
<td>$2,000,000</td>
</tr>
<tr>
<td>2011</td>
<td>800</td>
<td>500</td>
<td>$1,500,000</td>
<td>$2,500,000</td>
</tr>
<tr>
<td>2012</td>
<td>700</td>
<td>600</td>
<td>$1,000,000</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>2013</td>
<td>600</td>
<td>700</td>
<td>$500,000</td>
<td>$3,500,000</td>
</tr>
</tbody>
</table>
Allium White Rot

- Caused by the fungus *Sclerotium cepivorum*
- Leaves decay at the base, turn yellow, wilt, and collapse
- Fluffy mycelium on rotted roots and bulbs
- Watery, decayed bulbs
- Outer scales dry, shrink and crack
- Small sclerotia (0.02 inch, about the size of a poppy seed) form in and on the surface of affected bulb parts
White Rot in the Pacific Northwest

- 1918: First confirmation in the United States in La Grande, Union Co., OR
- 1957-1958: Documented in various locations in California and in the areas of Walla Walla, WA
- 1982: One widely infested field in Jefferson Co., OR
- 2008: White rot reported in Crook Co., OR
- Various reports from home gardens
- May 2014: Identified in a direct-seeded onion seed crop in Grant Co., WA (white rot quarantine area)
White Rot in the Pacific Northwest

White Rot Epidemiology

- Affects only *Allium* spp. (e.g. onion, garlic, leek, and shallot)
- Sclerotia from an initially high population may survive 20 to 30 years or more in soil without a host
- Easily spreads from plant to plant
- Fungus is favored by cool soils and is restricted above 75°F
- White rot can continue to decay infected bulbs in storage if humidity is not kept low
- Sclerotia germinate in to sulfur-containing root exudates from Alliums (C-C-C-S)
Sclerotia Germination Stimulants and Fungicides

• Garlic juice, garlic oil, garlic powder, onion oil, onion compost
• Diallyl disulfide (DADS) mimics natural garlic and onion sulfur compounds and can reduce sclerotia populations by 80-98% (Coley-Smith, McDonald, Davis, Crowe)
• Alli-Up™
• DADS, combined with tebuconazole with or without penthiopyrad and/or fludioxonil, improves control and marketable yields (Ferry and Davis)
Onion Soil Amendment

• Produced by TOP Onions USA (Ontario, OR)
• Byproduct of onion oil distillation
  • Onions are washed, ground, pressed and juice is distilled, separated, and purified
  • di-1-propyl disulfide and other propyl sulfide compounds
• Available in large quantities
• Inexpensive
Onion Soil Amendment

- Water soluble
- pH: ~4.1
- Bacteria, yeasts, fungi
- 5.8% dry matter
  - 2.30% N
  - 0.78% P
  - 1.81% K
  - 36.0% C
  - 0.37% S
Materials and Methods

• 30’ x 10’ field plots were established in a previously infested field at COARC

• Soils were sampled from each plot prior to treatments to establish pre-treatment populations of white rot sclerotia

• Up to 50 sclerotia were tested for viability by plating on agar

• Mean initial sclerotia populations = 80 sclerotia/liter soil
  • Range = 73 to 110 sclerotia/liter soil
Materials and Methods

Treatment factors:

1. Onion soil amendment
   • (0-, 2-, and 5 gal/acre)

2. Tarp covering for 6 days after onion soil amendment application
   • (tarp and no tarp)

3. Tebuconazole applied in-furrow at planting
   • (0- and 20.5 gal/acre)

Treatments replicated 4 times
Plots were arranged in a split-split block design
Materials and Methods

- Onion soil amendment applications were performed on May 15 when the mean soil temperature at a 4 in depth was 62° F
- Applications were made using five XR TeeJet 8008VS nozzles arranged on a boom mounted to a 4-wheeler
- Plots were irrigated after onion soil amendment applications and 6 mm clear polyethylene tarps were installed the following day
- Post-treatment soil samples were taken on June 25-26 and August 27 and assayed for white rot sclerotia
Materials and Methods

• Garlic was hand-planted on September 29 and 30
• Two rows per 36 inch bed at a spacing of approximately 15 plants per foot row
• Tebuconazole (20.5 oz/acre) was applied in a 4 to 6 inch band over the furrow in a total volume of 40 gal/acre
• Garlic emergence, white rot incidence and severity were determined on January 24 when plants were at the 3 to 4 leaf stage.
  • White rot severity was rated using a 0 to 5 scale: 0 = no symptoms; 1 = chlorosis on 1 to 2 leaves; 2 = chlorosis on 3 or more leaves; 3 = necrosis on 1 to 2 leaves; 4 = necrosis on 3 or more leaves; and 5 = dead plant
Results: Soil Assays

![Bar chart showing the number of sclerotia for different conditions over time. The chart compares Nontreated vs. Tarped, and 2 gal/acre vs. 5 gal/acre, for Initial, Mid-season, and Final stages.](image)
## Results: Germination and Early Disease Evaluations

<table>
<thead>
<tr>
<th>Onion</th>
<th>Fungicide</th>
<th>Tarp</th>
<th>Emergence (no. plants)</th>
<th>Incidence (%)</th>
<th>Severity (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Control</td>
<td>N</td>
<td>34</td>
<td>100</td>
<td>5.0</td>
</tr>
<tr>
<td>Control</td>
<td>Tebuconazole</td>
<td>N</td>
<td>55</td>
<td>78</td>
<td>2.4*</td>
</tr>
<tr>
<td>2 gal/acre</td>
<td>Control</td>
<td>N</td>
<td>34</td>
<td>99</td>
<td>4.6</td>
</tr>
<tr>
<td>2 gal/acre</td>
<td>Tebuconazole</td>
<td>N</td>
<td>57</td>
<td>75</td>
<td>2.1*</td>
</tr>
<tr>
<td>5 gal/acre</td>
<td>Control</td>
<td>N</td>
<td>38</td>
<td>100</td>
<td>4.6</td>
</tr>
<tr>
<td>5 gal/acre</td>
<td>Tebuconazole</td>
<td>N</td>
<td>55</td>
<td>70*</td>
<td>2.1*</td>
</tr>
<tr>
<td>Control</td>
<td>Control</td>
<td>Y</td>
<td>31</td>
<td>99</td>
<td>4.5</td>
</tr>
<tr>
<td>Control</td>
<td>Tebuconazole</td>
<td>Y</td>
<td>66*</td>
<td>60*</td>
<td>2.1*</td>
</tr>
<tr>
<td>2 gal/acre</td>
<td>Control</td>
<td>Y</td>
<td>34</td>
<td>95</td>
<td>4.6</td>
</tr>
<tr>
<td>2 gal/acre</td>
<td>Tebuconazole</td>
<td>Y</td>
<td>59*</td>
<td>73</td>
<td>2.3*</td>
</tr>
<tr>
<td>5 gal/acre</td>
<td>Control</td>
<td>Y</td>
<td>44</td>
<td>88</td>
<td>4.0</td>
</tr>
<tr>
<td>5 gal/acre</td>
<td>Tebuconazole</td>
<td>Y</td>
<td>62*</td>
<td>63*</td>
<td>2.4*</td>
</tr>
</tbody>
</table>

A * indicates a significant difference from the control (no onion soil amendment, no tebuconazole, and no tarp) using Dunnett’s test.
Results
Conclusions

• A significant effect of onion soil amendment and/or tarping on sclerotia populations was not observed
  • Higher rates of onion soil amendment and/or a different method of application and incorporation may be more effective
• A significant ($P < 0.0001$) effect of tebuconazole was observed in January for garlic emergence, white rot incidence, and white rot severity
• The combined effects of fungicide treatment, onion soil amendment, and tarping on white rot symptoms, marketable yield, and post-harvest sclerotia populations will be determined at harvest in summer 2015
Acknowledgements

• Technical assistance:
  • Dr. Jeness Scott
  • Rhonda Simmons
  • Hoyt Downing
  • Mitchell Alley

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  • California Garlic and Onion Research Advisory Board
  • TOP Onions USA
  • Olam Spices and Vegetables
  • Bayer Crop Sciences
Questions and Discussion
White Rot Management

• Plant only pathogen-free material in pathogen-free soil.
• Hot water seed treatment kills sclerotia on clove surfaces but will not destroy all fungus within cloves.
• Avoid moving sclerotia-contaminated soil into new fields by washing equipment before it enters another field.
• If practical, dig out all plants in infested spots in the field and the healthy plants growing next to diseased ones. Remove some soil with both diseased and healthy plants. Dispose of the material in a landfill or hot composting operation.
• Flooding