Introduction

- Sustainable hop (Humulus lupulus) production in Wisconsin is hindered by pathogens introduced via propagative plant material.
- Growers are interested in screening for several primary pathogens in an effort to improve disease management.
- Multiple testing procedures were used to detect 6 pathogens: Pseudoperonospora humuli, the cause of hop downy mildew; Podosphaera macularis, the cause of powdery mildew; Apple mosaic virus (ApMV), Arabis mosaic virus (ArMV), Cucumber mosaic virus (CMV), and Carlaviruses (including American hop latent virus, hop latent virus, hop mosaic virus).1,3
- Our goals were to 1) determine the feasibility and cost associated with disease assays, and 2) survey diseases in hop propagative material from multiple sources in Wisconsin.

Materials & Methods

- All propagative material (leaves and stems of plantlets) was asymptomatic upon receipt, and was maintained at 4°C until processed.
- Immunostrip® tests were used for the detection of Arabis mosaic and Cucumber mosaic viruses.
- Apple mosaic virus was tested by ELISA.
- Carlaviruses were detected using RT-PCR with Carlavirus-specific primers.1
- P. humuli was detected in total genomic DNA from asymptomatic plants with specific primers.2
- Plant tissues were incubated on water agar amended with antibiotics and examined microscopically for signs of P. humuli & P. macularis.

Conclusions

- The pathogens P. humuli, ApMV, and Carlavirus were detected in asymptomatic plantlets, reinforcing the need for continued and more extensive disease screening of hop propagative material.
- The disease panel was repeatable and could be completed within a reasonable time period (~8 days).
- No rhizomes were sent by collaborators. In the future, this panel will have to be tested for the ability to accurately detect pathogens in below-ground material.
- Future goals include adding two viroid tests to the panel; hop latent viroid and hop stunt viroid have been reported in the United States but few facilities are capable of testing for these pathogens.1,3

Total Disease Detections

<table>
<thead>
<tr>
<th>Source</th>
<th># Samples Received</th>
<th>Number of samples positive for specific disease (% of total samples received)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P. humuli</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>3 (38%)</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>3 (10.34%)</td>
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</tbody>
</table>

References


Acknowledgements

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Disease detection in hop rhizomes and plantlets for clean yard establishment in Wisconsin
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Figure 1. Hop leaves showing A. Carlavirus symptoms, B. black/gray sporulation of hop downy mildew, and C. Apple mosaic virus symptoms.

Figure 2. Disease testing results from 10 Dec 2014 to 9 Mar 2015.

Figure 3. Representative hop sample as received from grower.

Figure 4. Positive Carlavirus detection indicated by ~300 bp band in lanes 4, 5, 7.

Figure 5. Positive P. humuli detection indicated by ~350-400 bp band in lanes 4-9.

Figure 6. Completed ELISA test for ApMV. Wells #5-6 are positive, well #7 is negative, wells 8 & 9 are negative and positive controls, respectively.

Figure 7. Agdia Immunostrip test for ArMV.

Figure 8. DNA extraction for hop downy mildew PCR-based test.