New Sources of Phomopsis Stem Canker Resistance in USDA Plant Introductions

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Phomopsis symptom development

Phomopsis leaf infection, growing down midvein to petiole
From petiole to stem canker
Stem canker leading to pith rotting & lodging
Mid-stem lodging resulting in yield loss
Objectives -

- To complete a multi-year test of 250 Plant Introductions & elite USDA inbreds for resistance to Phomopsis stem canker.
- Same group of germplasm that has been tested for Sclerotinia head rot and stalk rot at multiple locations.
- Data used to identify sources of resistance for breeding, AND to be used in Association Mapping.
Progress -

- 2011 - Four field trials planted, with aid of seed companies, in ND, MN and SD, relying upon natural infection.
- Three of four sites have disease and yield data.
2012 -

- Same material planted again in four sites (Grandin, ND; Crookston and Rothsay, MN and Eureka, SD), relying on natural infection.
- One of four sites had sufficient disease.
- Two years (8 plots) yielded four datasets.
Comparison of 2011 vs 2012 Phomopsis infection (natural) across 12 most susceptible PIs

<table>
<thead>
<tr>
<th></th>
<th>Grandin</th>
<th>Rothsay</th>
<th>Eureka</th>
<th>Crookston</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 average = 42%</td>
<td>13%</td>
<td>61%</td>
<td>35%</td>
<td>18%</td>
</tr>
<tr>
<td>Range: 29 – 62%</td>
<td>3-70%</td>
<td>24-94%</td>
<td>0-100%*</td>
<td>9-32%</td>
</tr>
</tbody>
</table>

2012 Eureka: 61% of rows had no *Phomopsis*, plus confounding with downy mildew infection
Summer Rainfall Trends 2010 to 2012

2010 was 128% of the 30 yr average, while 2012 was 47%.
Histograms of four *Phomopsis* datasets

**Phomopsis - mean of 4 datasets**

- Crookston 2011
  - Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
  - Phomopsis infestation (%)

- Rothsay 2011
  - Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
  - Phomopsis infestation (%)

- Rothsay 2012
  - Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
  - Phomopsis infestation (%)

- Phomopsis - mean of 4 datasets
  - Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
  - % Diseased plants

**Java SD 2011**
- 10 17 17 18 14 14 27 26 19 13 22 12 17 6 8 4 2 6 33 2
  - Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
  - Phomopsis infestation (%)

**Rothsay 2011**
- Frequency
  - 10 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
  - Phomopsis infestation (%)

**Rothsay 2012**
- Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
  - Phomopsis infestation (%)

**Phomopsis - mean of 4 datasets**
- Frequency
  - 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
  - % Diseased plants
Comparison of Phomopsis and Sclerotinia head rot data on same PIs
Comments on top 25 entries

- Top entries had 0 to 3% *Phomopsis* infection, averaged across 4 trials.
- Countries represented: Hungary (11), Spain (8), Zimbabwe (2), Netherlands (1), Poland (1), and Zambia (1).
- Eleven of the top 25 for *Phomopsis* were also in the top 25 for head rot resistance.
- PI 531366 from Poland combined good stalk rot, head rot and *Phomopsis* resistance.
## Phomopsis & Head Rot Rot resistant entries

<table>
<thead>
<tr>
<th>PI</th>
<th>Country</th>
<th>Phomopsis (%)</th>
<th>Head Rot (%)</th>
<th>Head Rot Rank</th>
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<tbody>
<tr>
<td>507917</td>
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<td>1</td>
<td>0</td>
<td>1</td>
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<tr>
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<td>Netherlands</td>
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<td>16</td>
<td>25</td>
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</tbody>
</table>
Conclusions

- Large group of PIs and inbreds (250) evaluated in multiple field trials over two years.
- Moderate levels of natural infection have identified material with apparently good resistance, but need further tests with artificial inoculation for confirmation.
- Reliance upon natural infection and sufficient rainfall is chancy, as shown by 50% success rate (4 of 8 trials over two years).
- Unknown whether “resistant” accessions will stand up to both *Phomopsis* species.
 Plans for 2013

- Natural infection by *Phomopsis* is unpredictable, and rain dependent.
- Lab trials to develop mass production of *Phomopsis* inoculum on natural substrates.
- Trials at Carrington, ND & Staples, MN will compare different inoculation methods & duplicate trials will be under overhead irrigation and dryland conditions.
Acknowledgements

- Plot land, planting and plot maintenance graciously supplied by **Croplan** (Crookston), **CHS** (Grandin), **Mycogen** (Rothsay) and **Seeds2000** (Eureka and Java, SD)

- **Megan Ramsett** and other USDA technicians

- **Laura Marek**, Sunflower Curator, for multiple years’ of seed requests from PI Collection.

- **NSA** for funding of this project.