Resistance to *Phomopsis* Stem Canker in Cultivated Sunflower – 2011 Field Trials

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Phomopsis Increasing in U.S. Sunflower Fields

Phomopsis Incidence in U.S. Sunflower Fields

Phomopsis Severity in U.S. Sunflower Crop

*Note: The graph shows an increasing trend in Phomopsis severity from 2005 to 2011.*
Objectives

- Search for resistance in cross-section of USDA Plant Introduction collection
- Data to be used in association mapping project
- Evaluate U.S. commercial hybrids & compare with *Phomopsis* resistant hybrids from Novi Sad program (Serbia)
Methodology

- Test sites located in Red River Valley (Crookston, Grandin, Rothsay) and one in north-central SD.
- All four locations relying on natural infection and dryland conditions.
- In total – 8 single rows replications of PIs. Hybrids planted at 3 locations, 4 reps each.
Methodology

- Plant stands counted once, at maturity
- Phomopsis infected plants rated once, in late September (any # of lesions)
- Disease severity expressed as % infected plants.
- Three pathologists rated all three trials.
Distances to four Phomopsis plots:

Grandin (35 mi), Rothsay (45 mi), Crookston (75 mi), Java (280 mi)
Lack of rainfall from August on at Grandin led to no Phomopsis... Natural Phomopsis did develop at Rothsay, Crookston, and Java, SD. Multiple stalk samples collected from each location to determine Phomopsis species present.
Phomopsis Stem Lesions – 2011 - August

Note how when lesion enlarges (2 stems on right) the stems collapse and lodge (as the pith is destroyed and the stem becomes hollow).
Histograms of PI Ratings at three 2011 test plots

Crookston, MN - 2011

Histogram showing the frequency of Phomopsis infestation (%) for three test plots in 2011.
Rothsay, MN - 2011

Phomopsis infestation (%) vs. Frequency
Java, SD - 2011

Phomopsis infestation (%)

Frequency
Three locations mean

39 of 260 entries had < 5% Phomopsis infected plants, averaged over three locations (6 reps)
Most Resistant Cultivated Plant Introductions -

18 entries had < 2% infected plants.

These 18 entries originated from Hungary, Spain, Zimbabwe and China.

Relatively tall entries, generally in the 6.5 to 10' range.

Also fairly late in flowering, average = 75 days.

BUT three resistant entries flowered in 62 days, and were 4 to 5½' tall.
Examples of stem lesions observed
Commercial hybrids

- Seven companies submit entries, for a total of 72 entries + 10 hybrids from Novi Sad, Serbia.
- Each company requested to have 2 released hybrids, along with experimental.
- Oilseed and confection hybrids included.
Commercial Hybrids - Phomopsis ratings - 2011

Averaged over two locations (Rothsay & Crookston), 8 reps.
Yellow bars are Novi Sad hybrids.
Disease severity from 1 to 39%, mean = 11%
2010 Ada MN Phomopsis Severity on 100 Sunflower Hybrids

Disease severity - from 0 to 97%, mean = 42%
Hybrids most resistant to Phomopsis stem canker -

- Five NS-hybrids in top ten.
- Entries from Seeds2000, CHS, Mycogen, Triumph and Croplan with < 5% infection.
Phomopsis species present -

- Based on morphological and DNA sequence analysis, all three locations predominantly had *Phomopsis helianthi*.

- Ms. Febina Mathew, NDSU PhD student funded by NSA, is continuing her analysis of *Phomopsis* isolates from across the U.S. production area to determine which other *Phomopsis* species may be present in the U.S.
Conclusions

- In 2011, we succeeded in having natural infection at 3 of 4 locations, all of which had the same *Phomopsis* species.

- Disease severity was less than observed in 2010, primarily due to drier weather.

- Entries with high levels of resistance were observed both within USDA public germplasm and commercial hybrids.
An effective *Phomopsis* field screening program would benefit from artificial inoculation.

Association mapping & SNPS on the 260 USDA entries will lead to marker-assisted selection for *Phomopsis* resistance.

*Phomopsis helianthi* was present at all three 2011 locations. We do not know whether these ‘resistant’ entries would also be resistant to the other *Phomopsis* species recently identified in Australia as sunflower stem pathogens (see Thompson poster).