Screening for Charcoal Rot Resistance Under field Environment

Soybean Breeders Workshop
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Soybean (*Glycine max*)

- Charcoal rot is a soil borne fungus caused by *Macrophomina phaseolina*
- It causes a seedling blight, root rot or stem rot of at least 500 species of plants including many wild and cultivated species

Host Range

- *Macrophomina phaseolina* infects a wide range of plant species.

- **Soybean**
- Corn
- Sorghum
- Sunflower
- Beans


W712
40b

Environmental Conditions

1. Soil Temperatures between 82 – 95 ^{o}F favors the disease
2. Favors limited soil Moisture
3. It is a nutrient scavenger. It thrives and competes well in nutrient depleted soils.

Agronomic Impact of Charcoal Rot

- Charcoal rot can reduce plant height, root volume, and root weight by more that 50%.
- Damage to the root system is most evident during the pod formation and filling stages.
- Because diseased plants have smaller root systems, seeds tend to be fewer and lighter.
- Diseased plants will mature several weeks earlier, which further contributes to yield loss.

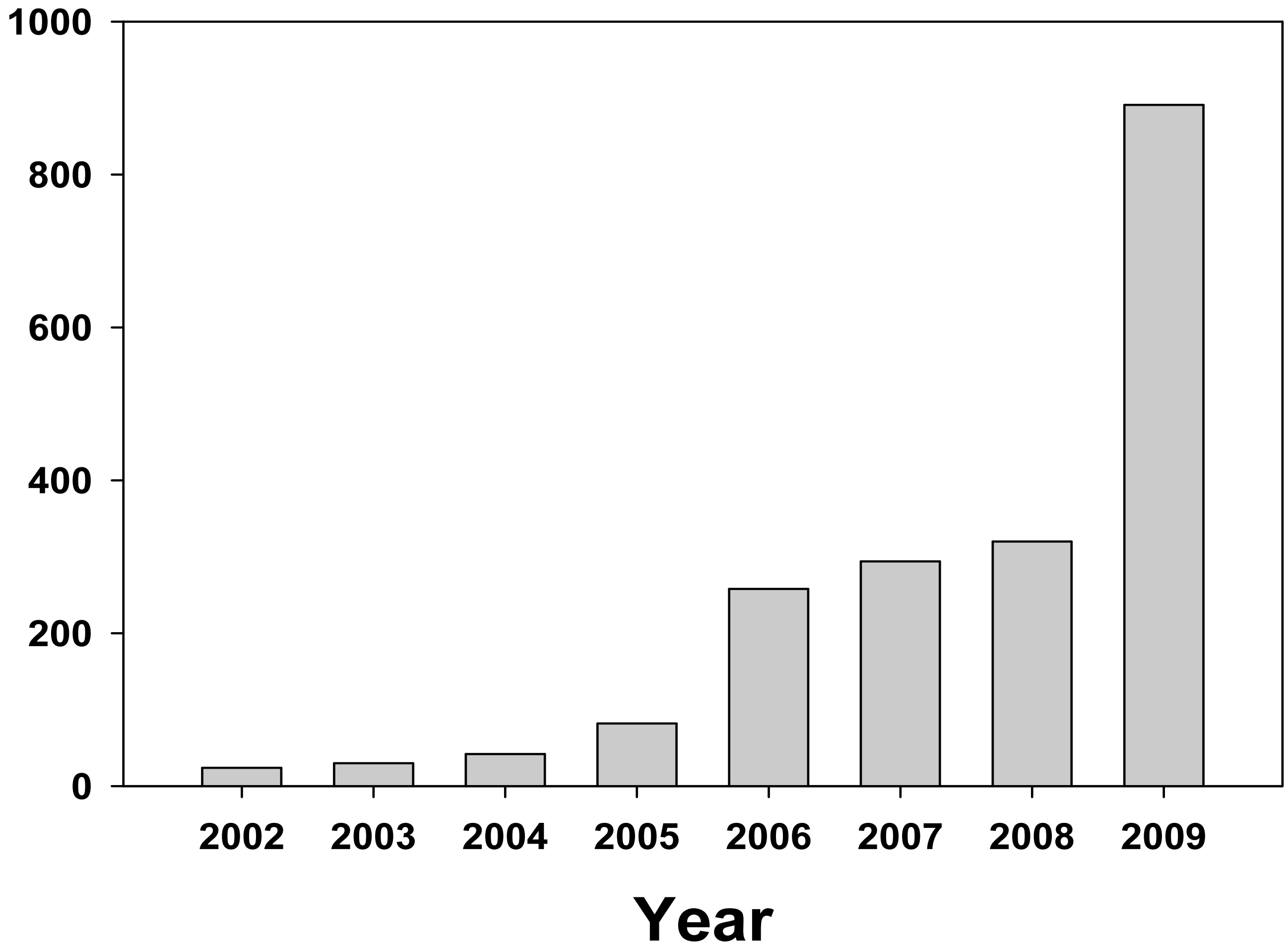
Management Approaches Attempted

1) Crop rotation with a less susceptible crop
2) Minimizing plant stress by avoiding excessive seeding rates
3) Fertilizing when necessary
4) Irrigating to keep soil moisture high during pod development periods
5) Efficacy of fungicides applications to seed and soil to reduce or inhibit fungal germination and infection.

Genetic Resistance

- There is no commercial cultivar that is completely resistant to charcoal rot but a tolerant cultivar has been identified and released as a germplasm.
- However, still new sources of resistance are needed.

Number of Soybean Lines Tested Each year for Charcoal Rot Evaluation for Resistance Between 2002-2009



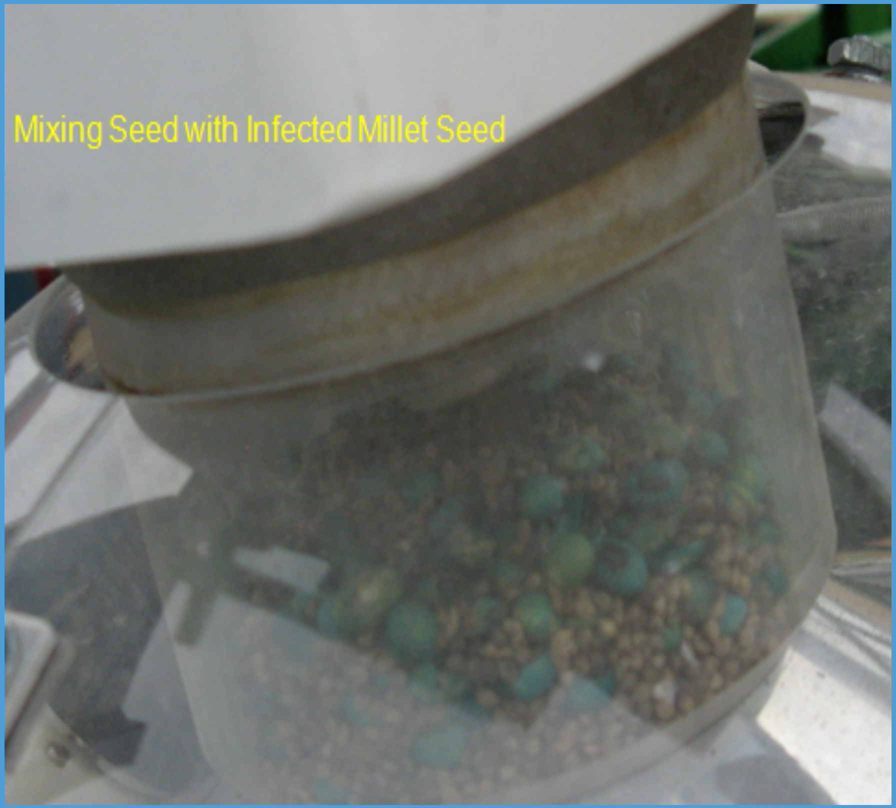
Screening For Resistance

- Evaluation of breeding lines
- Commercial RR cultivars
- Conventional (non-RR) cultivars
- Germplasms

For Screening for Charcoal Rot Resistance

1. Inoculum Increase

2. Field Innoculation



Symptoms

Early Foliar Symptoms

Symptoms

Responses of different soybean lines to charcoal rot

Ultimate Damage of Charcoal Rot

Comparison of Disease Measurements

- Colony forming Unit (CFU)
- Stem Severity Rating
- Percent height of discoloration
- Foliar Symptom taken @ R7 growth stage
- Foliar Symptom taken @ R1, R3, R5, R7 and calculate the Area Under the disease progress curve (AUDPC)

In developing a method for assessment

- We used five methods
- 24 cultivars in MG 3, 4 and 5.

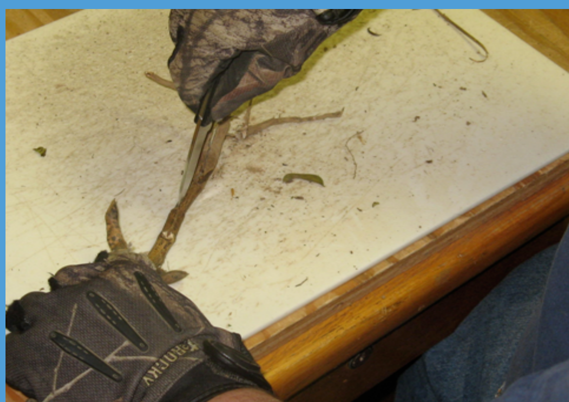
Symptoms

Early Foliar Symptoms

Disease Assessment

3 & 4.

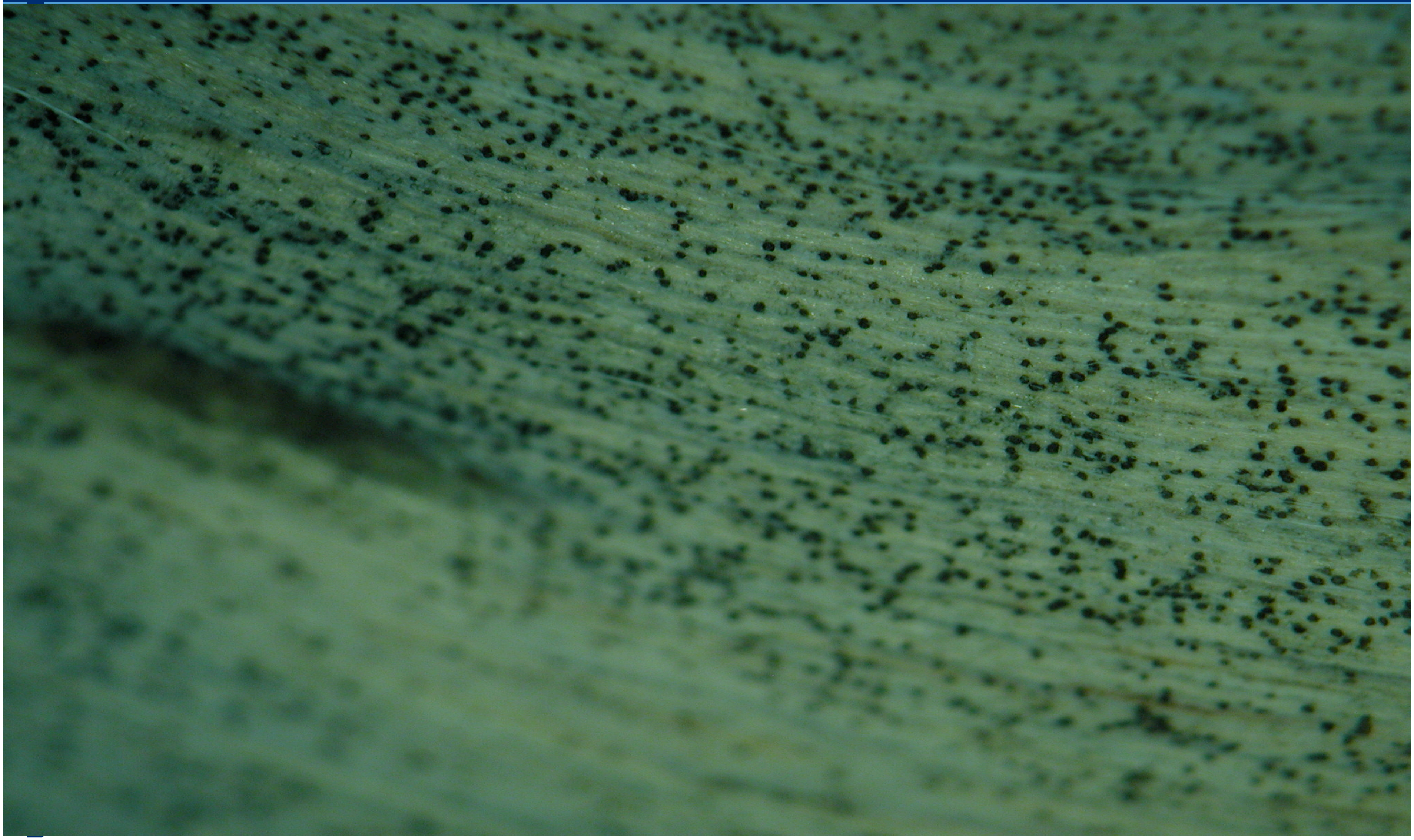
R7 - R8



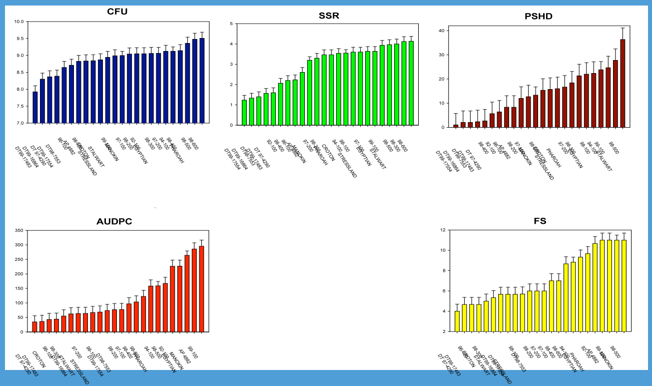
5.

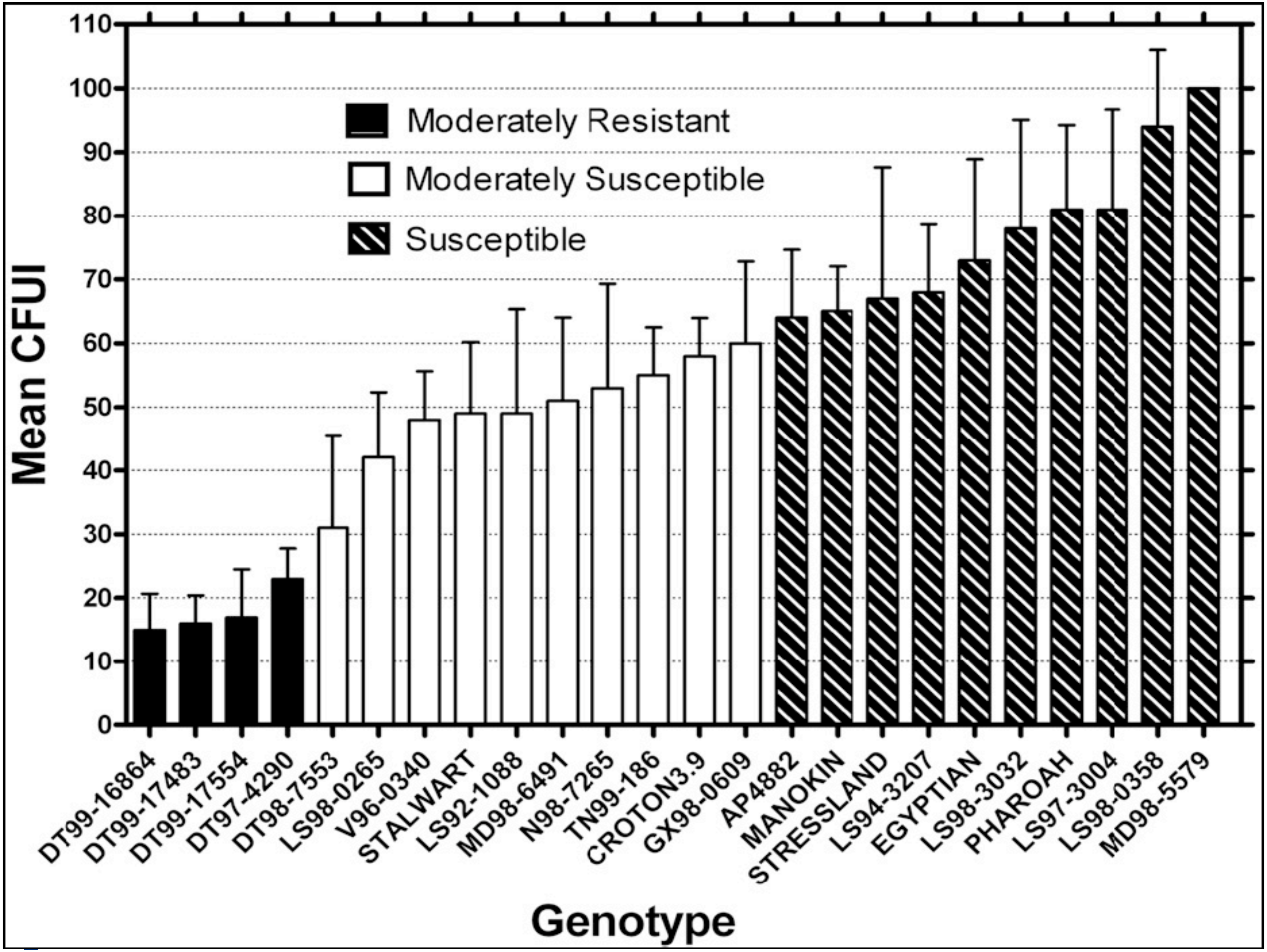
Root & Stem Sections ground

Sclerotia of *Macrophomina phaseolina* on lower stem & root sections



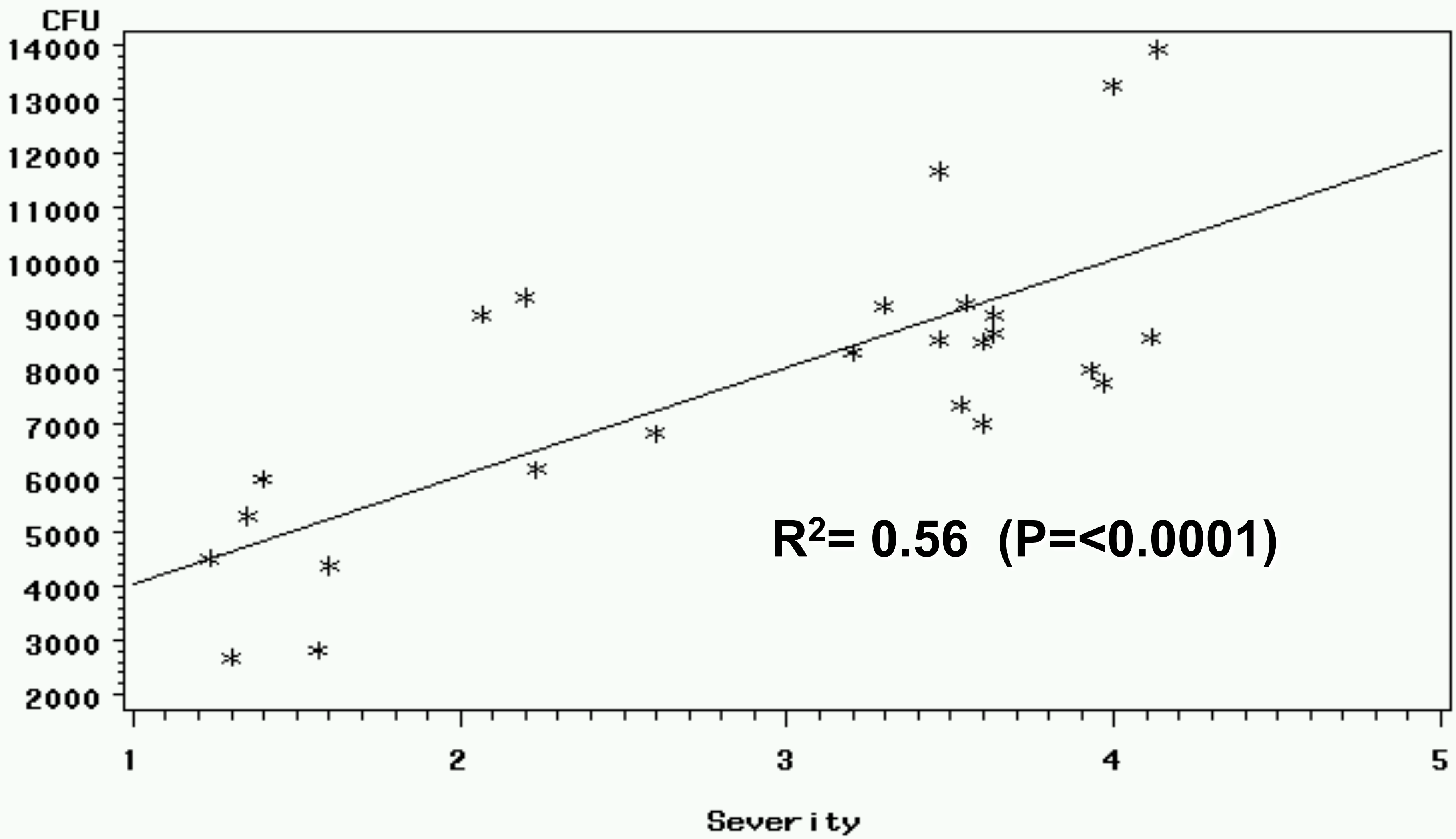
Comparison of Five Methods for Charcoal Assessment





Moderately Resistant
Moderately Susceptible
Susceptible
Mean CFUI
0
10
20
30
40
50
60
70
80
90
100
110
DT99-16864
DT99-17483
DT99-17554
DT97-4290
DT98-7553
LS98-0265
V96-0340
STALWART
LS92-1088
MD98-6491
N98-7265
TN99-186
CROTON3.9
GX98-0609
AP4882
MANOKIN
STRESSLAND
LS94-3207
EGYPTIAN
LS98-3032
PHAROAH
LS97-3004
LS98-0358
MD98-5579
Genotype

Relationship Between SSR and CFU of *M. Phaseolina*




DT97-4290

Additional Resistant Lines

- DT99-16864, DT99-17483, DT17554
- We are currently working on potential resistant lines:
  - Six PI Lines
  - Several SCN and conventional selections

- We now know that there is genetic variability in soybean germplasm for reaction to charcoal rot.
  - We have identified more soybean lines that are moderately resistant to charcoal rot.
  - Identified soybean lines with higher level of resistance. These lines, require further validation and testing over the next two years.
  - Ultimately these lines will be used by public and private breeders for cultivar development.

Challenges

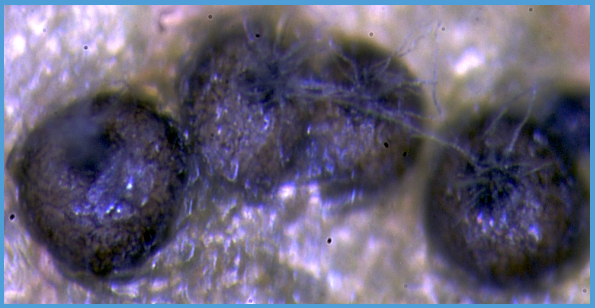
Challenges in Screening for Resistance

Macrophomina phaseolina

Base on a preliminary study:

- **We know that there is genetic variability within isolates of *M. phaseolina.***

- ✓ **It is a highly variable and quite heterogeneous, with isolates differing in microsclerotia size.**
- ✓ **Some isolate produce pycnidia and other not.**

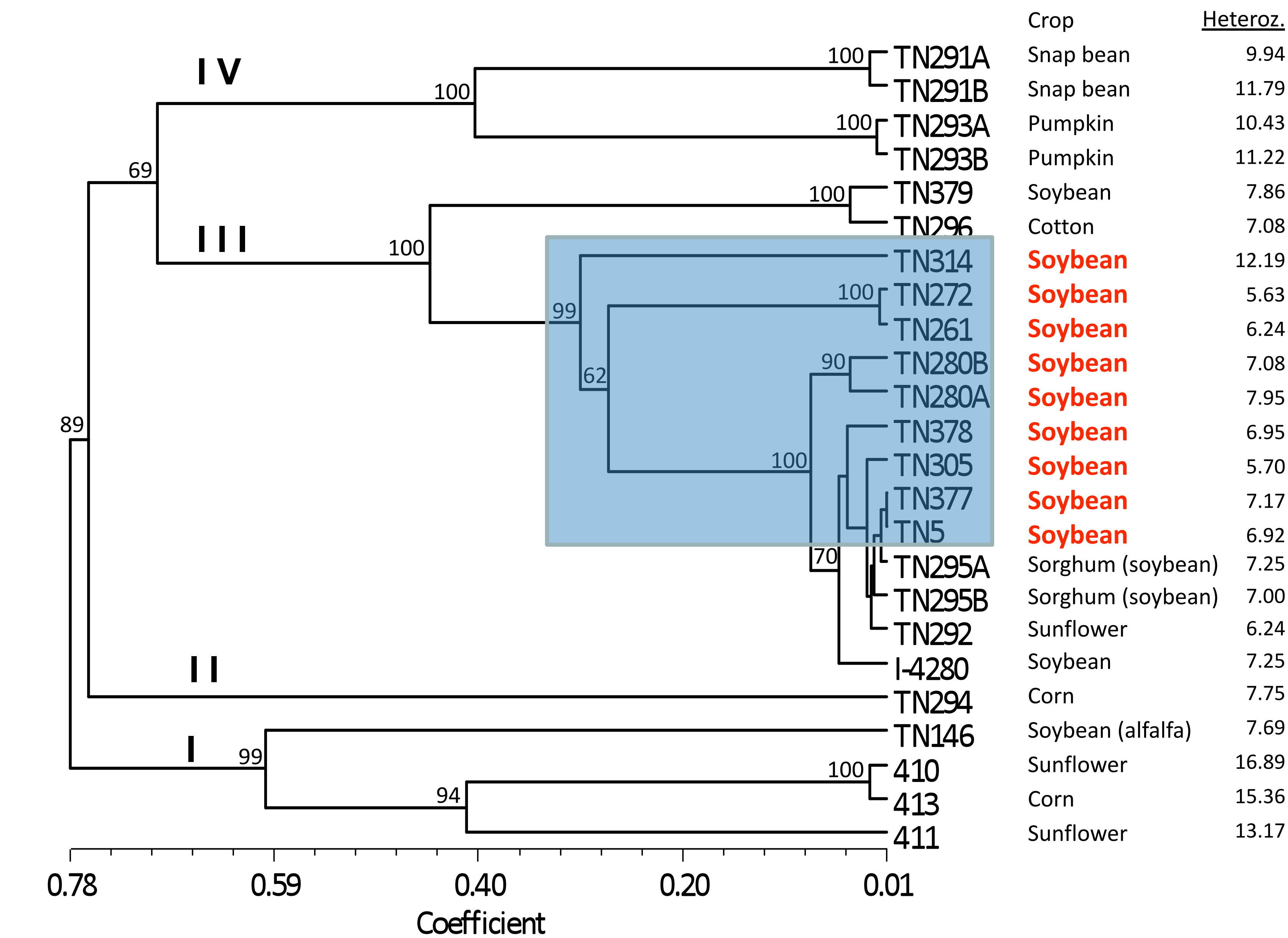


Macrophomina phaseolina isolates from different locations and hosts

ISOLATE	LOCATION	HOST
TN5	Ames, TN	Soybean (*Glycine max* (L.) Merr.)
TN146	Neosho, MO	Soybean (*Glycine max* (L.) Merr.)
TN261	Milan, TN	Soybean (*Glycine max* (L.) Merr.)
TN272	Stoneville, MS	Soybean (*Glycine max* (L.) Merr.)
TN280A†	Jackson, TN	Soybean (*Glycine max* (L.) Merr.)
TN280B	Jackson, TN	Soybean (*Glycine max* (L.) Merr.)
TN291A	Jackson, TN	Snapbean (*Phaseolus vulgaris* L.)
TN291B	Jackson, TN	Snapbean (*Phaseolus vulgaris* L.)
TN292	Milan, TN	Sunflower (*Helianthus annuus* L.)
TN293A	Jackson, TN	Pumpkin (*Cucurbita pepo* L.)
TN293B	Jackson, TN	Pumpkin (*Cucurbita pepo* L.)
TN294	Milan, TN	Maize (*Zea mays* L.)
TN295A	Dyer Co., TN	Sorghum (*Sorghum bicolor* (L.) Moench)
TN295B	Dyer Co., TN	Sorghum (*Sorghum bicolor* (L.) Moench)
TN296	Jackson, TN	Cotton (*Gossypium hirsutum* L.)
TN305	Madison, WI	Soybean (*Glycine max* (L.) Merr.)
TN314	Columbus, Cherokee Co., KS	Soybean (*Glycine max* (L.) Merr.)
TN377	Dunklin Co., MO	Soybean (*Glycine max* (L.) Merr.)
TN378	Stoddard Co., MO	Soybean (*Glycine max* (L.) Merr.)
TN379	New Madrid Co., MO	Soybean (*Glycine max* (L.) Merr.)
TN4 (I-4280)	Jackson, TN	Soybean (*Glycine max* (L.) Merr.)
TN410	Jackson, TN	Sunflower (*Helianthus annuus* L.)
TN411	Milan, TN	Sunflower (*Helianthus annuus* L.)
TN413	Jackson, TN	Maize (*Zea mays* L.)

Dendrogram showing the relationships between isolates.

(Arias, et al. 2010)



Screening for Resistance

- Based on this finding, our future focus will be to characterize the soybean isolates even further and identify isolates that are more aggressive.

- Use the aggressive pathotype (s) to identify resistance.

Acknowledgments

Funding:

USDA ars

USB
UNITED SOYBEAN BOARD
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PROMOT

MSPB
Mississippi Soybean Promotion Board
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End Picture


THANK YOU