Sclerotinia Initiative
Strategic Plan

Germplasm Enhancement

Soybean

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

- Differential reaction among cultivars
- No documented complete resistance
- Have CV x CV and CV x PI crosses

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

Baseline

Advanced lines tested in cooperative field testing program and controlled environment tests

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

Target 2005

- ✓ *Released germplasm line, AxN-1-55, with increased level of resistance*
- ✓ *Released cultivar Skyla, high yield, resistance similar to NKS19-90*

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

Target 2007

- *Release at least one germplasm line or cultivar with improved resistance + yield combination*

- *Know reaction to SCN, BSR, PRR*

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

Target 2007 *(cont'd)*

- *Initiate studies to investigate interaction among resistance genes for Sclerotinia, BSR, PRR, SCN*
- *Initiate development of elite lines with multiple pest resistance, including sclerotinia*

PM 1.6.1: Release soybean germplasm and cultivars with resistance to Sclerotinia stem rot

Target 2009

- *Know initial results of resistance gene interaction studies*

- *Advance populations; begin evaluation of lines from crosses to develop sclerotinia resistant lines with other fungal and pest resistances*

PM 1.6.2: Combine resistance genes from different sources of *Glycine*

6,415 PI accessions, MG O to IV screened for resistance in multiple field tests – NCSRP

Identified several with good resistance

PM 1.6.2: Combine resistance genes from different sources of Glycine

Baseline

Populations that combine genes from different resistance sources are being developed

PM 1.6.2: Combine resistance genes from different sources of Glycine

Target 2005

- ✓ *Five PIs w/ resistance were crossed with Skylla*
- ✓ *Infected petioles on part. resistant genotypes drop off stem earlier than susc. genotype*
- ✓ *Resistance reaction sensitive to PAR in some genotypes*

PM 1.6.2: Combine resistance genes from different sources of Glycine

Target 2007

- *Release at least one line with a different source of improved resistance than is available in previous releases*
- *Evaluate field resistance in regional sclerotinia disease nurseries and evaluation programs*
- *Use improved resistance sources in new soybean cultivar development programs*

PM 1.6.2: Combine resistance genes from different sources of Glycine

Target 2009

- *Develop breeding populations to incorporate confirmed resistance QTL into elite germplasm*

PM 1.6.2: Combine resistance genes from different sources of Glycine

Target 2009 *(cont'd)*

- *Initiate development of near-isogenic lines for specific QTL and candidate genes*

  -- understand mechanisms related to specific QTL/resistance genes (See PM1.6.4)

  -- genotype x genotype and genotype x environment interactions (See PM1.6.3)

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Markers associated with resistance in soybean have been identified in RxR, RxS, and SxS crosses

ID QTL to further expand range of resistance sources

Includes QTL identified from otherwise "susceptible" genotypes

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Baseline

Develop and initiate testing of populations from crosses among new resistant and susceptible genotypes not yet characterized in soybean

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Target 2005

- ✓ *Identified two new QTL in mapping project with PI 391589B*
- ✓ *Identified new putative resistance QTL on MLG L, E, & B1 using TRAP markers in analysis of F4:5 lines in the cross Merit x PI 194639*

TRAP = Target Region Amplification Polymorphism

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Target 2005 *(cont'd)*

- ✓ *Identified 4 QTL for resistance in NKS 19-90 x PI153282 (RxR)*
- ✓ *Developed a population Kottman x PI91589A, evaluated reaction to Sclerotinia using petiole inoculation*

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Target 2007

- *Develop populations to incorporate confirmed resistance into elite germplasm*
- *Evaluate the resistance phenotype of lines in regional disease nurseries*

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Target 2007 *(cont'd)*

- *Begin to understand role of environment in characterizing resistance phenotypes – light, temperature, moisture, nutrition – and interactions with genotype – both the plant and the pathogen*

PM 1.6.3: Use DNA markers for resistance genes in soybean for MAS

Target 2009

- *Initiate studies to understand interaction among genotypes (both plant and pathogen) and environmental factors for resistance to sclerotinia in soybean*

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

- Resistance QTL identified on multiple LGs
- Some QTL in clusters of R genes
- Favorable QTL allele may come from S parent

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Goal *– combine QTL from multiple sources into single lines to enhance overall resistance*

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Baseline

F2-derived F3 lines (F2:3) from 3 different populations were grown and over 1200 individual F3 plants were screened for 21 microsatellite (SSR) markers to ID genotypes at up to 10 QTL

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Target 2005

- ✓ *Evaluated 48 F4:5 lines representing 35 F4 families*
- ✓ *Identified 10 F4 families that had significantly smaller avg. lesion size compared w/ the most resistant parent in the cross*

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Target 2007

Release at least one breeding line with pyramided resistance QTL

Evaluate yield and agronomic traits of multi-QTL lines in multiple environments

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Target 2007

Initiate crosses to incorporate enhanced resistance into elite cultivars

Evaluate sclerotinia resistance in regional disease nurseries

Begin to pyramid additional new QTL from other sources into a new set of multi-QTL lines

PM 1.6.4: Pyramid QTL for resistance genes in soybean germplasm

Target 2009

Know preliminary results of studies to ID mechanisms involved in reaction to S. sclerotiorum for some of the identified QTL/resistance genes

Initiate crosses to combine complimentary QTL from the best multi-QTL lines identified to date

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

- Introduction of genes from unrelated plants or other sources may provide complementary and useful approaches for effective control of white mold in soybean and other species

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Baseline

Developed Perlka-resistant soybean lines; initiated yield tests in field

Developed T1 plants possessing an antifungal peptide, D4E1

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Target 2005

- ✓ *Cah gene results indicate no difference between the parental line and the transgenic lines for yield and disease resistance (DSI). The 400 kg ha-1 Perlka treatment resulted in higher yield*

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Target 2005

- ✓ *No significant differences in lesion size between the controls and the transgenic lines containing the D4E1 peptide*
- ✓ *Introducing a revised codon-optimized gene expression cassette that contains the barley alpha-amylase signal sequence to export the peptide to the apoplast*

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Target 2007

- *Possible regional testing of Ca-cyanamide resistant lines (cah-gene)*
- *Know results of field and controlled-environment tests on transgenic soybean lines containing the antifungal peptide*
- *Initiate seed increase of the best lines for tests and regulatory approval*

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Target 2007

- *Possible regional testing of lines*
- *Initiate crosses with elite soybean germplasm if effectiveness and regulatory approval look promising*
- *Investigate nematicidal effects of Perlka on soybean cyst nematode (*Heterodera glycines *Ichinohe)*

PM 1.6.5: Evaluate transgenic approaches for control of *S. sclerotiorum* in soybean

Target 2009

Know effects of new antifungal peptide transgenic event for resistance to S. sclerotiorum

Begin evaluation of yield and agronomic performance in multiple environments