Mechanisms and transfer of resistance in common bean

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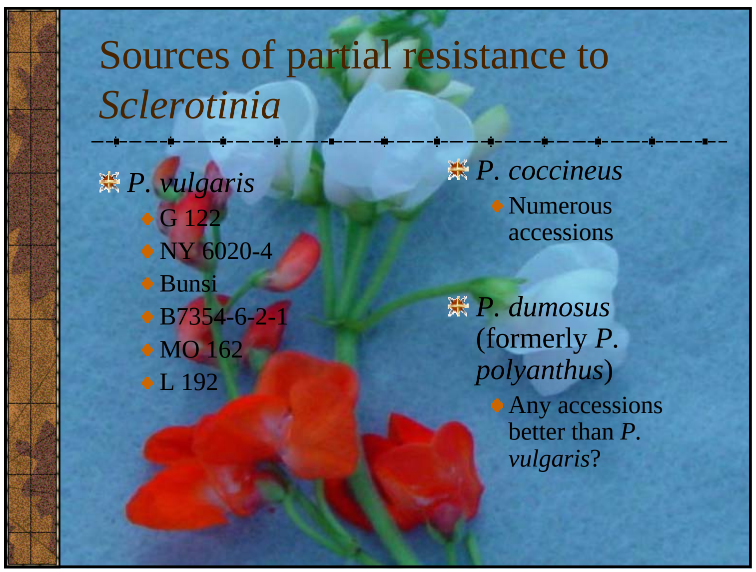
Topics covered:

- Nature of resistance in *Phaseolus* and efforts at interspecies transfer
- Mechanisms of resistance in *Phaseolus*



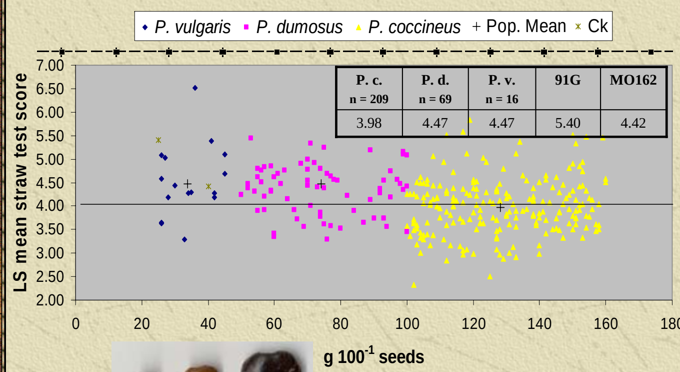
Sources of partial resistance to *Sclerotinia*

- *P. vulgaris*
  - G 122
  - NY 6020-4
  - Bunsi
  - B7354-6-2-1
  - MO 162
  - L 192
- *P. coccineus*
  - Numerous accessions
- *P. dumosus* (formerly *P. polyanthus*)
  - Any accessions better than *P. vulgaris*?

QTL associated with WM resistance in common bean:

Accession	*QTL*	*Trait & % V_P explained*	*Reference*
NY 6020-5	**B6, B8**	**ST 12, 38%; Fld 13, 26%**	**Miklas et al., 2003**
G-122	**B1, B7**	**B1 (fin, 18%); B7 (phs, Fld 26% ST 38%)**	**Miklas et al., 2001**
PC 50	**B4, B7, B8, B11**	**B7 (ST 12%)**	**Park et al., 2001**
Bunsi	**B2, B7**	**B2 (Fld 12%); B7 (Fld 17%) & Ox tol. (16%)**	**Kolkman and Kelly, 2003**

Why *P. coccineus*?



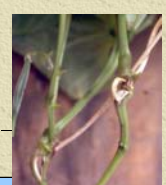
P. c. n = 209	P. d. n = 69	P. v. n = 16	91G	MO162
3.98	4.47	4.47	5.40	4.42

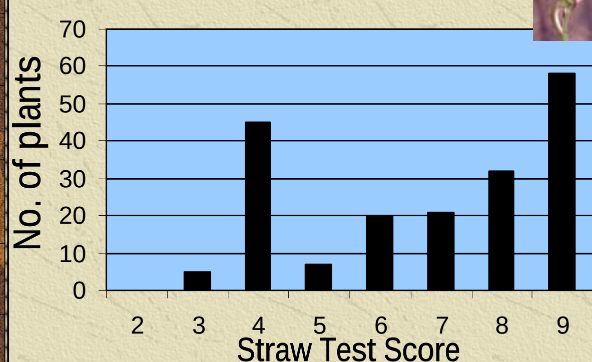
Gilmore, B., J.R. Myers and D. Kean. 2002. Completion of testing of *Phaseolus coccineus* plant introductions (PIs) for white mold, *Sclerotinia sclerotiorum*, resistance. Ann. Rep. Bean Impr. Coop. 45:64-65.

Inheritance of resistance from *P. coccineus*:

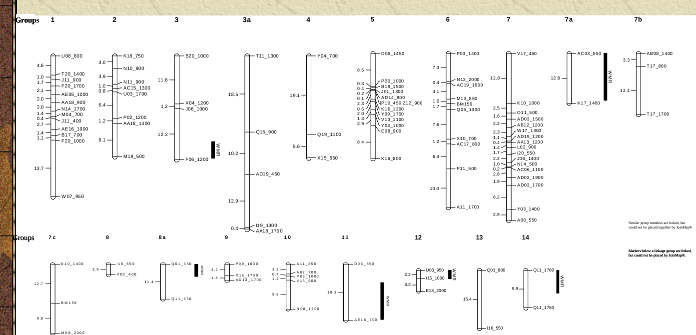
- Interspecific
  - *Qualitative* resistance: Single dominant gene – Abawi et al., 1978; Schwartz et al., 2004
  - *Quantitative* resistance: Adams et al., 1973; Fuller et al., 1984; Lyons et al., 1987
- Intraspecific
  - *Quantitative* resistance: Gilmore and Myers, 2004

Straw test results for WP x PI 255956 F_2 (*P. coccineus*)





Nature of resistance w/in *P. coccineus* (Wolven Pole x PI 255956 F_2)



6 QTL; 9-12% V_P individually; 63% V_P overall

Interspecific hybridization issues

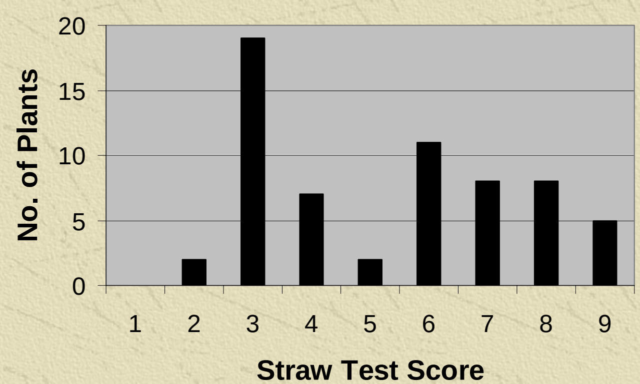
- Species incompatibility barriers exist
- Can only cross unilaterally to common bean parent without embryo rescue
- Distorted segregation & unequal transmission of alleles
- Reversion to species “allele complexes”
- Linkage drag

Inheritance of resistance in interspecific crosses

How to transfer resistance?

- Backcross-inbred method with molecular marker tagging of QTL (Advanced backcross QTL method)
- Congruency backcross method

Straw test score for OR 91G x PI 255956 BC_2F_2



Part II: Mechanisms of resistance

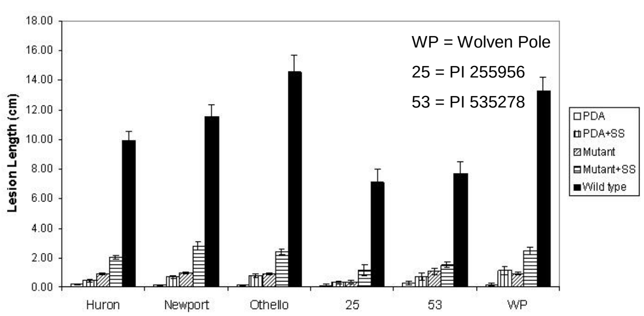
- Oxalate, secreted by *Sclerotinia*, affects a number of physiological processes in the host plant and facilitates pathogenesis.
- Oxalate is the predominant pathogenicity factor
- Pathogenesis would be limited if lack of recognition and no host-pathogen communication

Oxalate may compromise host defenses in one of several ways:

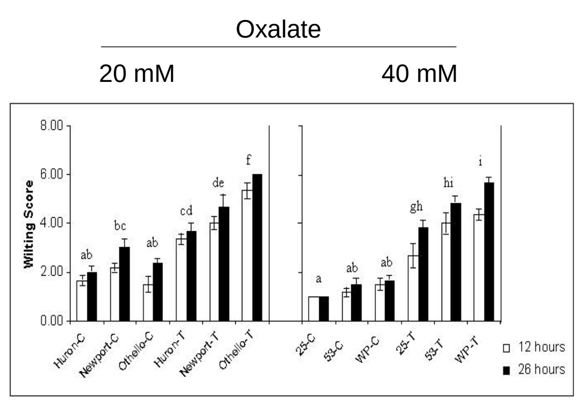
- 1) Shifts apoplastic pH so that pectolytic enzyme activities are enhanced
- 2) Directly toxic to plant cells
- 3) Chelates Ca ions & compromises Ca - dependent plant responses
- 4) Suppresses ROS production & suppresses host defense responses
- 5) Stomatal opening and wilting facilitates disease

P. vulgaris & *P. coccineus* susceptibility to oxalate-producing & deficient *S. sclerotiorum*

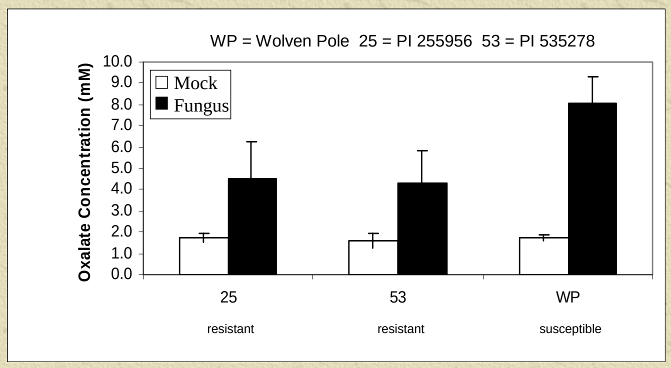
Chipps, T.J., B. Gilmore, J. Myers, H.U. Stotz. 2005. Evidence for oxalate insensitivity and oxalate oxidase in determining partial resistance of *Phaseolus coccineus* to *Sclerotinia sclerotiorum*. Phytopathology (in press).



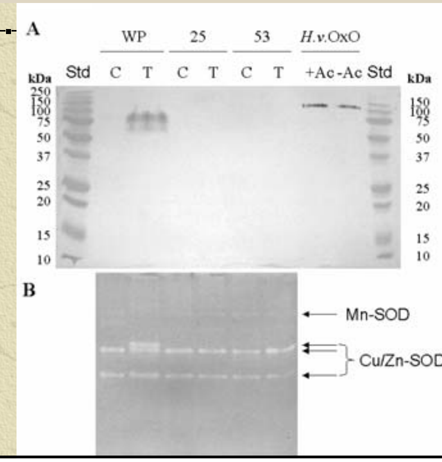
P. coccineus & *P. vulgaris* sensitivity to oxalate



Oxalate concentrations in uninfected & infected stems of *P. coccineus* accessions



Oxalate oxidase and SOD activities in uninfected and infected *P. coccineus* stems



Nature of resistance in *Phaseolus*

- Insensitivity to oxalate is associated with partial resistance to *Sclerotinia* in common and runner bean
- Oxalate oxidase does not appear to inactivate oxalate in *P. coccineus*
- Underlying reason for oxalate tolerance is unknown

Further questions?

- Is resistance in *P. coccineus* caused by an active oxalate "detoxification" mechanism or by reduced fungal growth (& oxalate production)?
- What is the role of plant anatomy?
- Do phytoalexins play a role?

Two questions about methodology:

- What is effect of wounding?
- How does induced resistance affect results?

Two stages in developing WM resistant varieties:

Oxalate resistance/tolerance/insensitivity;

Host-pathogen recognition