

Multi-site Screening for *Sclerotinia sclerotiorum*: A Successful Approach to Identifying Resistance in Dry and Snap Beans

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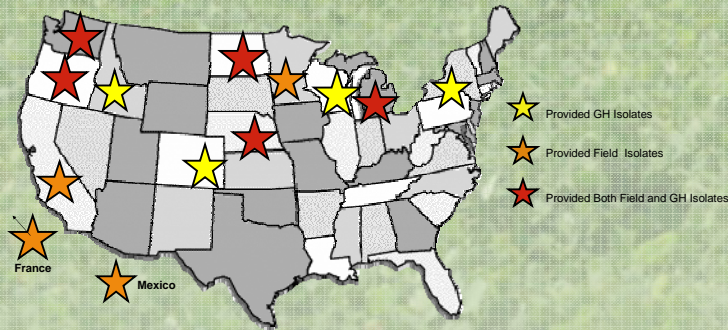
There is no known resistance to white mold (*Sclerotinia sclerotiorum*) in any crop, including common bean (*Phaseolus vulgaris*). The development of white mold resistant cultivars would reduce disease losses and require no input costs to the growers. Multiple sites in major production areas are now being used to validate new putative sources of resistance in common bean using field and greenhouse screening tests (Figure 1).

In the past there have been inconsistent correlations in screening results between greenhouse screening methods/field screening locations and identification of sources of resistance. Reasons for the poor correlation may be genetic variation of the pathogen, different screening tests and/or disease evaluation system.

Objective 1: Determine isolate variability in the nursery locations used to screen bean lines for putative resistance sources and cultivar release using mycelial compatibility grouping (MCG) and virulence assays.

In total, 146 isolates were collected from the sites that conducted field screening nurseries, all from three common control cultivars. Another 10 isolates represented greenhouse screening isolates plus a control.

Figure 1. Locations of collaborative screening sites and collection of screening isolates.



Isolates were tested for clonality using Mycelial Compatibility Groupings (MCGs) on DS medium (Cubeta et al., 2001) and for aggressiveness using the Straw Test (Petzoldt and Dickson, 1996).

When the 156 greenhouse and field screening isolates were compared, 65 MCGs were found (Figure 2); 37 of the MCGs were composed of a single unique isolate. Six MCGs were sampled frequently over multiple screening locations (Table 1).

Differences in isolate aggressiveness could be detected among the 156 screening isolates ($p < 0.0001$). Highly significant differences were also found among the MCG groups ($p < 0.0001$), however isolates within an MCG did not differ in aggressiveness ($p = 0.4216$).

Figure 2. 65 MCGs formed by the 156 isolates, by location

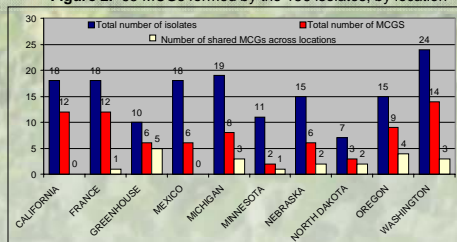


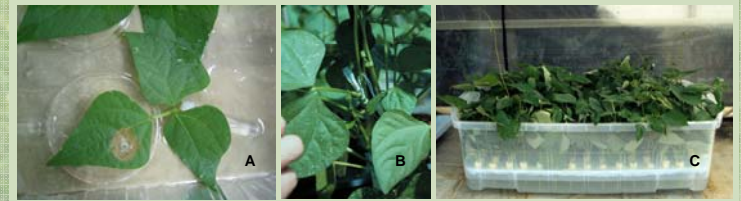
Table 1. Number of MCGs formed by greenhouse isolates with field isolates

	GH locations		Field locations			
	WA	OR	MI	ND	CO	NE
NE & OR	2	2	3	1	0	0
WI & NY	2	5	0	6	1	0
CO	0	0	0	0	1	0
MI	0	0	0	1	0	0
ID	0	0	0	0	0	0
WA	4	1	0	0	0	0
ND	0	0	0	0	0	0

Objective 2: Determine the best *S. sclerotiorum* resistance test for common bean

A second possible explanation for difficulties encountered in verifying sources of resistance among a number of investigators is different screening methods. The detached leaf, straw and oxalate tests (Figure 3) were all used to screen putative sources of resistance to *S. sclerotiorum*. We found that the Straw Test was substantially more sensitive than the Detached Leaf Test for isolate aggressiveness and for screening plants with sources of resistance (L. Otto-Hanson et al., 2009). Similarly unpublished data supported the Straw Test over the Oxalate Test.

Figure 3. Screening tests- A) Detached Leaf Test; B) Straw Test; C) Oxalate Test



Objective 3: Derive a common disease severity scale

Another problem arose from investigators using different scales for both greenhouse and field screenings. The use of the Teran et al (2006) modified Petzoldt and Dickson scale by all investigators reduced the error of interpreting distance of infection on the bean stems. Similarly, the use of the CIAT (1987) scale reduced interpretation errors of infection in field nurseries.

The latest complete results from field and greenhouse (2008) show that there is more agreement in finding entries with *S. sclerotiorum* resistance (Tables 2 and 3.). Differences in severity of the straw tests is likely related to the isolate aggressiveness; whether to use these differences to give a wider test severity or use a common isolate(s) to create uniformity has not been decided.

Table 2. Mean straw test rating* with t Grouping** used to measure white mold resistance in bean lines at 7 greenhouse screening locations.

Entry	CA	FR	GH	ME	MI	NE	ND	OR	WA	WASH
37-2 (PTO)	4.9	4.1	5.8	4.2	5	6.4	5.8	5.2		HI
Cornell 605 (RK)	4.3	4.8	6.7	5.6	5.1	2.1	8.2	5.3		GHI
G122 (CRAN)	4.1	4.9	7.1	4.8	4.8	3.9	8.1	5.4		F GHI
29C-6 (GN)	4.8	4.5	5.3	6.7	4.5	6.9	7.2	5.7		E F GHI
Tapia (Romano)	4.7	6.3	5.3	5.8	5.1	8.2	8.1	6.2		D E F GHI
Stampede (PTO)	4.8	6	6	4.3	6.1	8.5	8.5	6.3		C D E F G
NE1-07-12 (GN)	4.9	5.5	7	4	5.9	8.4	9	6.4		B C D E F
NE2-06-8 (PTO)	4.6	4.8	7	7.1	5.2	8.5	7.8	6.4		B C D E F
Roma II (Romano)	4.2	6.6	5.4	7.4	5.2	9	7.4	6.5		B C D E F
38-4 (GN)	4.8	5.9	7.1	4.9	6.6	8.8	9	6.7		B C D E
NE2-07-10 (PTO)	4.2	5.7	7.4	9	4.8	7	9	6.7		B C D E
B07104 (BLK)	4.9	5.4	6.7	6.8	6.5	8	8.9	6.7		B C D E
WM31-2008 (PTO)	5	6	8	5.1	5.5	8.9	9	6.8		B C D
P07863 (PTO)	5	6.2	6.1	6.9	5.9	8.6	9	6.8		B C D
Ex Rico (Bunsi) (Navy)	4.8	6.7	7.2	6.7	5.1	8.9	9	6.9		A B C D
Avalanche (Navy)	4.9	6.8	7.1	7.6	5.1	8.9	9	7.1		A B C D
Lariat (PTO)	5.2	6.7	7.5	7.9	5.7	8.6	9	7.2		A B C D
NE1-06-12 (GN)	5.8	7.1	7.3	8.2	6.5	7.7	9	7.4		A B C
Beryl (GN)	5.5	8.5	7.2	7.8	6.3	7.7	8.8	7.4		A B
NE1-07-2 (GN)	5.8	8.6	7.6	9	6.6	8.7	9	7.9		A
Eclipse (BLK)	5	8.5	7.8	9	7.4	9	9	8.0		A

* ST Rating (1-3 = resistant, 4-6 = intermediate, 7-9 = susceptible)

** Alpha = 0.5, LSD = 1.08

BLK = Black, CRAN = Cranberry, GN = Great Northern, PTO = Pinto, and RK = Red Kidney

Table 3. Mean infection rate using the CIAT scale and t Grouping* in field screening plots from six white mold resistance screening locations.

Entry	NE	WA	ND	MI	OR	ID	Mean	t Grouping
Cornell 605 (RK)	2.0	3.1	5.0	1.0	2.4	4.7	3.0	C
38-4 (GN)	2.4	3.0	3.7	3.0	2.6	4.7	3.2	B C
G122 (CRAN)	2.0	2.3	6.0	1.5	2.3	5.6	3.3	B C
37-2 (PTO)	2.1	2.9	4.7	2.0	3.5	4.7	3.3	B C
WM31 (PTO)	3.8	3.3	4.3	2.0	1.6	6.3	3.6	B C
Cornell 603 (RK)	2.0	1.8	8.0	1.0	3.2	6.0	3.7	B C
B0-7104 (BLK)	4.5	4.0	7.7	2.0	2.3	3.0	3.9	B C
P0-7863 (PTO)	2.1	4.1	7.0	3.0	3.2	4.3	4.0	B C
11A-39 (PTO)	3.6	2.2	7.0	1.0	4.1	6.3	4.0	B C
ExRico (Bunsi) (Navy)	3.8	3.6	6.0	2.5	3.4	6.0	4.2	B
Orion (GN)	5.0	6.2	8.0	5.0	7.9	8.0	6.7	A
Beryl (GN)	4.6	7.2	8.3	4.5	7.7	8.0	6.7	A

* Alpha = 0.05, LSD = 1.17

BLK = Black, CRAN = Cranberry, GN = Great Northern, PTO = Pinto, and RK = Red Kidney

References:

- CIAT (Centro Internacional de Agricultura Tropical). 1987. Standard system for the evaluation of bean germplasm. Van Schoonhoven, A. and M.A. Pastor-Corrales (compilers). Cali, Colombia. 54 p.
- Cubeta, M.A., D.N. Sermons, and B.R. Cody. 2001. Mycelial interactions of *Sclerotinia minor*. Phytopathology 91: S19.
- Petzoldt, R. and M.H. Dickson. 1996. Straw test for resistance to white mold in beans. Ann. Rep. Bean Improv. Coop. 39: 142-143.
- Otto-Hanson, L.K., K.M. Eskridge, J.R. Steadman, G. Madisa. 2009. The Sensitivity Ratio: A Superior Method to Compare Plant and Pathogen Screening Tests. Crop Sci. 49:153-160.
- Teran, H.M., Lema, H., Schwartz, R., Duncan, R., Gilberston, and S. Singh. 2006. Modified Petzoldt and Dickson scale for white mold rating of common bean. Ann. Rep. Bean Improv. Coop. 49: 115-116.

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