

Funded Plan of Work: White mold resistant dry bean lines selected at multiple sites in the USA and using laboratory/greenhouse tests

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Figure 1. *Sclerotinia sclerotiorum* infection in a bean field.

Introduction: No complete resistance to *Sclerotinia sclerotiorum*, cause of white mold, has been found in common bean, *Phaseolus vulgaris* (Figure 1). The development of bean cultivars with partial physiological resistance and architectural avoidance to white mold would reduce disease losses and require no input costs of growers. Thus, this plan of future investigation proposes to determine useful screening methods and identify sources of resistance in adapted common bean lines. These objectives will be addressed by testing putative sources of resistance at multiple sites located in most of the major bean production areas of the USA. In addition, direct and indirect screening methods will be used to evaluate the disease reaction of the putative resistance sources. Rank correlation statistical analysis will be used to determine the most widely effective sources of resistance and screening methods. Breeders can use identified lines to improve white mold resistance. Some background information exists for the test methods and thus prospects for finding partial resistance and disease avoidance are excellent. Past inconsistent correlations between screening methods and identification of sources of resistance may be due to genetic variation of the pathogen. No previous study on pathogen variation in bean-production areas in the USA has been done. Thus, mycelial compatibility grouping, aggressiveness (virulence), and ribosomal DNA polymorphism will be used to identify isolate variation that might influence resistance evaluation studies. The use of isolates from each resistance screening site will permit us to sample a broad range of bean production areas and directly assess the pathogen isolates used in screening.

Materials and Methods

Field Screening. Twelve lines/cultivars were selected for testing based on their preliminary reaction to *S. sclerotiorum* (Table 3). The plot design for the field screening trials was a randomized complete block with three replications. Approximately 400 seeds per line/cultivar were planted in two rows of each test entry, 15 feet (~4.5 m) long, and three replications. Each plot is two rows of test entry, plus one row of local susceptible, which was provided by each collaborator (Figure 2). The disease severity was determined by the percent of above ground plant canopy with white mold symptoms/signs: bleached and pithy, shredded stems often with sclerotia at or near plant maturity. Severity was converted to a ranking of 1-12 or each test.

Two sclerotia of *S. sclerotiorum* from a plant in each of three reps of each of the following three entries: Ex Rico 23 (Bunsi), G122, and Beryl were to be collected at each site. Thus a total of 18 sclerotia per location or state will be available for pathogen phenotyping and genotyping.

Greenhouse/Lab Screening. Seeds of each line/cultivar were sent to collaborators conducting a greenhouse/lab screening experiment (Table 1). The screening methods used were the straw, oxalic acid, and detached leaf tests. The individual readings and means were analyzed for rankings at the University of Nebraska-Lincoln. Five sclerotia of the *S. sclerotiorum* isolate used in that lab were also sent to the University of Nebraska-Lincoln.

Figure 2. Map of USA collaborators locations involved in the 2003 greenhouse/lab and field screening of *S. sclerotiorum* on dry bean



Results and Discussion. In 2003, six sites ranging from states on the west coast to the Midwest had sufficient white mold severity in field nurseries to allow ranking of putative partial resistance sources. Beryl was consistently ranked as the highest in disease severity (Table 2). Two lines, G122 and Cornell 501 ranked as the lowest in disease severity in the field (Table 2) as well as in the greenhouse/laboratory screening tests (Table 3). Cornell 601 was in the middle of the field rankings, while exhibiting the lowest mean disease severity in greenhouse/lab tests. AN-37 was also in the lower mean disease severity rankings in both the field and greenhouse/lab tests. The extreme variation in disease reaction found in field nurseries is demonstrated with Cornell 501 which ranged from lowest disease severity ranking to second highest. The local pathogen variation in virulence and in other characteristics may contribute to this range of reaction rankings, and this will be tested in 2004. The same lines will be tested in field nurseries in 2004 because five sites did not have white mold in 2003.

Table 1. Collection of isolates of *S. sclerotiorum* used in greenhouse/lab screening of bean germplasm.

Participant	Date	Location	Host
Phillip Griffiths (New York)	Oct. 1989	Murray township, Orleans Co. NY	Snap beans growing in producers field.
Howard Schwartz (Colorado)	Sept. 1996	CO front range bean field	Collected from culls of Pinto beans.
Phil Miklas (Washington)	1996-1997	Quincy, Washington	Newport Navy beans in field.
Ken Kmieciak (Wisconsin)	2002	Wisconsin	Snap bean
James Myers (Oregon)	Fall 1998	Corvallis, Oregon	Beans in variety trials.
James Steadman (Nebraska)	1980	Mitchell, Nebraska	From culls of Great Northern beans.
Ken Grafton (North Dakota)	Sept. 1995	Scottsbluff, NE	Great Northern beans in the field.
Jim Kelly (Michigan)	2003	Montcalm, MI	Black beans in the field.

Figure 3. Greenhouse/Lab screening methods



Figure 3. Greenhouse/lab screening methods. Figure 3A-The Oxalate Test. Figure 3B-The Detached Leaf Test (DLT). Figure 3C-The Straw Test.

Table 2. Disease severity rankings of putative white mold resistant common bean lines from

Lines	Disease severity rankings by state					
	ND	WA	MN	OR	CA	MI
G122	4*	1	6	2	3	5
N02 302	3	3	5	3	5	2
Cornell 501	2	4	4	1	11	3
AN-37	7	2	7	4	7	1
Ex Rico	8	7	1	6	1	7
Cornell 601	1	6	8	10	4	4
AN-1	11	9	2	8	2	9
USWA-6	5	5	10	5	10	6
IO1892-115M	6	8	3	11	6	8
AN-69	10	10	9	9	8	10
Co75944	9	11	11	7	9	—
Beryl	12	12	12	12	12	11

* Ranking is from most resistant-1 to most susceptible-12.

Table 3. Disease severity rankings of greenhouse/lab screening from each location.

Lines	Disease severity rankings for state			
	NY	MI	CO(St)	CO (Ox)
Cornell 601	1*	6	2	1
Cornell 501	2	5	4	6
G122	4	3	7	2
IO1892-115M	6	2	6	11
Dwarf Bees	7	1	1	8
AN-1	3	12	11	10
AN-69	11	4	5	9
Ex Rico	5	11	10	4
AN-37	9	7	3	5
USWA-6	8	9	8	3
Beryl	10	8	12	12
N02 302	12	10	9	7

* Ranking is from most resistant-1 to most susceptible-12.

**Ox=oxalate test; St=straw test

Research Plans for 2004

Once all of the sclerotia are collected, they will be used to study within field and between field isolate variation as well as screening isolate variation using phenotypic and genotypic methods. Mycelial compatibility grouping (MCGs) (Figure 4) (January/February 2004), tests of aggressiveness (Spring 2004), and molecular genotyping (June/July 2004), will be conducted on the greenhouse/lab isolates, which are a complete set. A test of the same lines at all field sites in 2004 will allow expansion of the field isolate collection.

Figure 4 (right). The Mycelial Compatibility Grouping (MCG) technique.

