NEW TECHNIQUES TO SCREEN PEA SEEDLINGS FOR RESISTANCE TO SCLEROTINIA WHITE MOLD

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Sclerotinia white mold can be a devastating disease of peas, especially under irrigated conditions. The causal fungus, Sclerotinia sclerotiorum, produces hard black structures (sclerotia) which allow the pathogen to survive in the soil for as long as 10 years. Whenever cool moist periods prevail, the sclerotia germinate, giving rise to mushroom-like apothecia which form billions of spores that are disseminated by wind. Pea plants are susceptible to infection by these spores at all stages of growth. The initial symptoms are water-soaked lesions which usually occur at the base of the stem. Under warm humid conditions the lesions expand rapidly, which causes rotting of the lower leaves and girdling of the stem. Wilting and the death of the plant usually follow.

Field evaluation of pea genotypes for resistance to S. sclerotiorum is difficult. The sporadic nature of the disease necessitates numerous replications to detect significant genotypic differences. The plot size in Sclerotinia white mold trials must also be great enough to test the effect of canopy structure on disease avoidance since the microclimate under the plant canopy can affect the incidence of white mold (2). Because of the problems encountered in screening under field conditions, several screening techniques were developed to allow preliminary evaluations for disease resistance in the greenhouse and laboratory.

Breeding lines and plant introductions were screened in greenhouse mist chambers maintained at approximately 18C and 90% relative humidity (1). Ten days after planting, the pea seedlings were predisposed by misting for 24 hours. The predisposed plants were inoculated by placing one Sclerotinia-infested oat kernel in contact with the base of each stem.

Highly significant differences in disease reaction were detected by visually scoring the length of stem lesions three days after inoculation (Table 1). The pea variety 'Garfield' was found to be very susceptible to white mold and was used as the susceptible check in all greenhouse screenings. Lines with lesions 50% shorter than Garfield were considered resistant. A winter-hardy pea, ID 89-1 (which was selected from a 'Perfection' x AWP cross), and several genotypes from a Perfection origin were found to be resistant. The results of two separate screening trials were highly correlated (r= 0.84) indicating this method was repeatable. Although most of the 388 plant introductions tested were susceptible to S. sclerotiorum in the greenhouse, several lines exhibited a level of resistance equal to that found in Perfection (Table

A faster and simpler technique for testing plants for resistance to S. sclerotiorum was developed using culture filtrates of the fungus. Flasks containing a basal salt medium (3) with 1% pectin were inoculated with a mycelial plug and incubated in a shake culture for six days at room temperature The mycelium was filtered through cheesecloth and 20 ml of the filtrate placed in vials. Six cm tall plants were removed from the vermiculite growing media, washed, and the stem excised just above the seed while immersed in water. The stem was then placed in the fungus filtrate. The pea genotype ID 89-1 which had been resistant to the fungus in the greenhouse test did not wilt within 4 hours, whereas the susceptible 'Lilaska' wilted severely in the same time period (Fig. 1).

Table 1. Mean disease severity ratings— of 20 genotypes of peas evaluated in the greenhouse for seedling resistance to white mold.

Line or cultivar	Source[2/]	Disease severity Trial 1	Trial 2
ID 89-1	1	2.5 [3/]	1.5 ab
Dark Skin Perfection	2	-	1.3 a
Perfection 132	2	-	1.4 ab
ID 2	1	-	1.7 abc
Wisconsin Perfection	2	-	1.8 abcd
ID 36	1	2.7 ab	1.9 abcde
Romack	1	-	2.0 abcde
ID 68	1	2.7 ab	2.1 abcde
Fenn	1	2.8 ab	2.2 abcde
ID 88	1	2.9 ab	2.0 abcde
ID 113	1	2.9 ab	2.3 bcde
Melrose	1	-	2.2 abcde
WA 788	3	-	2.2 abcde
Latah	3	-	2.2 abcde
Tracer	3	-	2.5 cde
ID 209	1	3.0 ab	2.7 de
4683	3	3.2 b	2.8 e
ID 29	1	-	2.6 cde
Lilaska	3	3.3 bc	2.6 cde
Garfield	3	3.9 c	2.6 cde

[1/] Disease severity rating assigned based on lesion length: 1 = no lesion, 2 = less than 1.0 cm, 3 = 1.1-2.0 cm, 4 = 2.1-3.0 cm, 5 = 3.1-4.0 cm, and 6 = greater than 4.1 cm.

[2/] 1 = University of Idaho, 2 = University of Wisconsin, 3 = Washington State University.

[3/] Means within a column not followed by the same letter differ at the 0.05 level of probability by Duncan's new multiple range test.

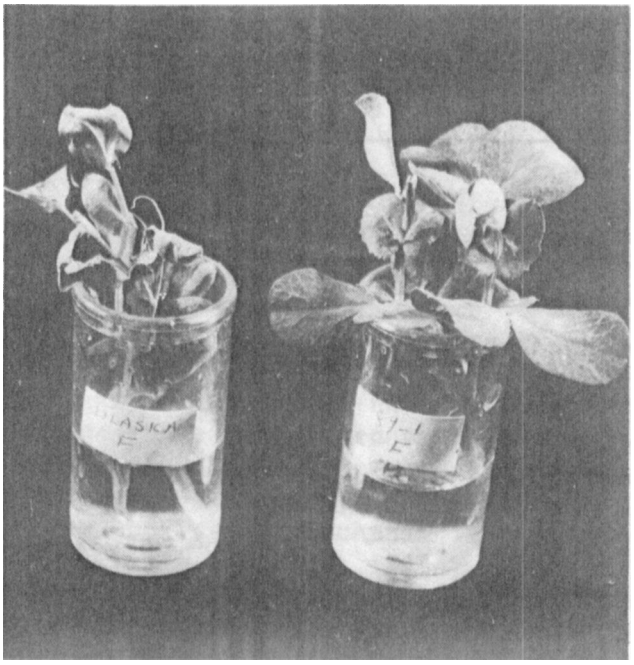

Fig. 1. Wilted 'Lilaska' pea seedlings (left) compared with non-wilted ID 89-1 peas (right) in culture filtrate of Sclerotinia sclerotiorum for five hours.

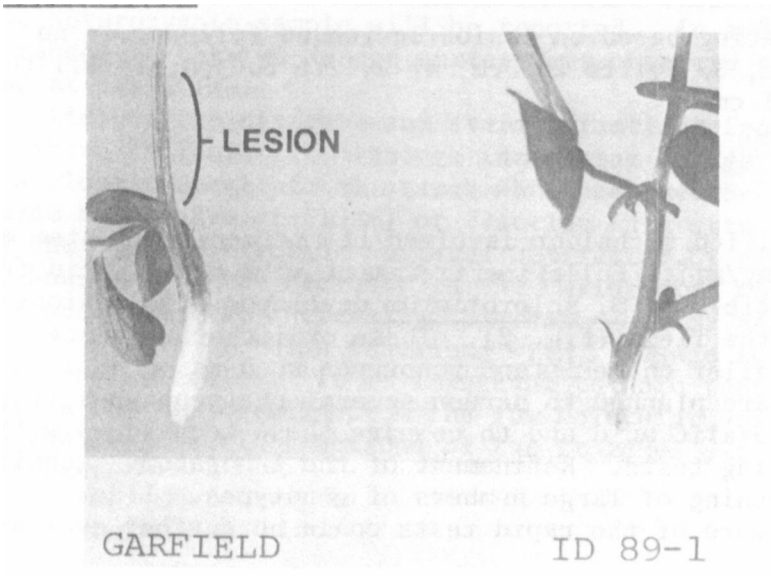

Fig. 2. Lesion development on 'Garfield' and ID 89-1 pea seedlings exposed to .85 mg/ml of oxalic acid for ten hours.

Table 2. Plant Introductions of peas screened in the greenhouse for seedling resistance to white mold.

Genotype	Source	Disease severity rating[1/]	Standard deviation
ID 89-1	Idaho	1.4	0.65
PI 189171	Netherlands	1.4	0.57
PI 272205	Germany	1.4	0.60
PI 155109	USA	1.7	0.78
PI 262189	Costa Rica	1.7	1.01
PI 263027	France	1.7	0.91
PI 166188	India	1.8	0.95
PI 261622	Spain	1.8	0.94
PI 272191	Germany	1.8	0.87
PI 272209	Germany	1.8	0.85
PI 171813	Turkey	1.9	1.29
PI 179448	Turkey	1.9	0.93
PI 222069	Afghanistan	1.9	0.93
PI 164568	India	2.0	0.95
PI 173058	Turkey	2.0	1.10
PI 173778	Turkey	2.0	1.19
PI 174322	Turkey	2.0	0.96
PI 162910	Argent na	2.1	1.04
PI 167363	Turkey	2.1	1.34
Garfield	Washington	3.4	1.45
LSD - p=0.05		0.7	

[1/] Disease severity rating based on lesion length as follows: 1= no lesion, 2= less than 1.0 cm, 3= 1.1 to 2.0 cm, 4= 2.1 to 3.0 cm, 5= 3.1 to 4.0 cm, 6= greater than 4.1 cm.

A further simplified technique involved the screening of stem cuttings in oxalic acid (0.85 mg/ml). Following treatment with oxalic acid for 8 to 10 hours, peas susceptible to S. sclerotiorum developed stem lesions similar to those observed in the field (Fig. 2). These oxalic acid-induced lesions were significantly smaller on resistant genotypes such as ID 89-1.

Future studies are planned to screen several pea genotypes in both the culture filtrate and oxalic acid and to compare these techniques with field and greenhouse screening tests. Refinement of the laboratory techniques may permit rapid screening of large numbers of genotypes. Lines showing resistance in one or more of the rapid tests could be further evaluated in the field.

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