Screening For Resistance To White Mold In Dry Beans

J. R. Steadman and D. P. Coyne

University of Nebraska-Lincoln

Resistance to Sclerotinia sclerotiorum was observed first in scarlet runner bean (Phaseolus coccineus) by Anton de Bary nearly a century ago. Confirmation of this observation did not come, however, until the early 1970's. Bean plants inoculated with mycelium as colonized oat kernels or ascospores and incubated in a greenhouse or growth chamber demonstrated resistance in P. coccineus and in progeny of P. coccineus X P. vulgaris crosses (Adams et al., 1973; Abawi et al., 1978). All P. vulgaris cultivars and lines tested by these methods were relatively susceptible. At about the same time, field tests in western Nebraska identified P. vulgaris cultivars with white mold resistance (BIC 17:19; BIC 18:89). The difference between plot tests showing P. vulgaris resistance appears to be in the length of time which favors disease development. Controlled environment tests have created conditions which optimize pathogen development throughout the course of the experiment, wheareas field tests, particularly in semiarid regions, favor pathogen development during dew periods for 11 - 14 hr each night at optimal temperatures. The daytime 10 - 13 hr, on tthe other hand, often lack the minimal leaf moisture for pathogenesis and also may have high temperatures limiting the growth of the pathogen. Thus, field conditions may allow plants to react to S. sclerotiorum infection during unfavorable environmental conditions and result in a slower rate of disease development.

The white mold screening program at Nebraska has been conducted primarily in field plots in order to utilize P. vulgaris resistance. To obtain adequate levels of infection, the following list of procedures has been used.

1) Plant field corn around the perimeter of the plot when the beans are planted. This creates a windbreak effect and raises relative humidity and dew duration within the bean plant canopy. 2) Plant in a location with adequate sclerotial populations ($\sim$1 k/g of soil) and where white mold has been observed in previous seasons. Inoculation with S. sclerotiorum-infested fields. 3) Irrigate the plots with 2-3 inches of water each week after full bloom. 4) Plant breeding lines and cultivars so that canopy coverage is maximized (i.e. do not leave alleys or open areas). 5) Plant susceptible cultivars randomly within the plot to aid in determining possible disease escape areas in plot. Where there is adequate seed, resistant lines can be interplanted with a susceptible cultivar that produces a heavy canopy and minimizes escapes. Replication should be used as much as possible.

While escapes, particularly single plants, are possible in field plots, resistant family selections can be made successfully in early generations and when seed is available, single selections can be tested in row plots (Coyne et al., 1977). In recent years

our program also has utilized covered greenhouse ground beds for testing white mold resistance of field selections. In this test, beans are planted in soil infested with physiologically mature sclerotia or in uninfested soil. Where uninfested soil is used, petri plates of germinated sclerotia at 6 apothecia per 4 ft (1.2m) of row are placed in the plots at flowering. Sclerotia are germinated in moist vermiculite in standard petri plates. Whatever inoculation method is employed, ascospores must be available at full bloom. By keeping the soil moist and covering the ground beds with clear plastic for 15 hr each day, leaf wetness is sufficient to promote ascospore discharge and subsequent infection. Differences observed in disease development in tests conducted in mid-winter compared with tests conducted in late winter and early spring may reflect day length influences on duration of vegetative and reproductive growth states. Previous reports have discussed these canopy influences on white mold development (BIC 19:72; BIC 19:78 and Blad et al., 1978).

Table 1 containes examples of white mold severity comparisons between field and greenhouse screening trials. Severity was quite variable in Black Turtle Soup between trials using infested soil and trials using germinated sclerotia (apothecia) for inoculum. Both field and covered ground bed screening tests have inherent variability in disease reaction. Thus, a more reliable, less variable test that allows the expression of the resistant reaction in P. vulgaris is needed. Methods such as those reported by Huang and Dorrell (1978) and Blanchette and Auld (1979) are being tested on beans.

References

1. Abawi, G. S., R. Provvidenti, D. C. Crozier and J. E. Hunter. 1978. Inheritance of resistance to white mold disease in Phaseolus coccineus. J. Heredity 69:200-202.

2. Adams, P. B. C. J. Tate, R. D. Lumsden and J. P. Meiners. 1973. Resistance of Phaseolus species to Sclerotinia sclerotiorum. Rept. of Bean Improv. Coop. 16:8-9.

3. Blad, B., J. R. Steadman and A. Weiss. 1978. Canopy structure and irrigation influence white mold disease and microclimate of dry edible beans. Phytopathology 68:1431-1437.

4. Blanchette, B. L. and D. L. Auld. 1979. A rapid screening technique to determine plant resistance to Sclerotinia sclerotiorum. Phytopathology 68:913 (Abstr.).

5. Coyne, D. P., J. R. Steadman and H. F. Schwartz. 1977. Genetic variation, inheritance, and breeding strategy for resistance to Sclerotinia sclerotiorum in beans (Phaseolus vulgaris L., Rept. of Bean Improvement Coop. and Nat. Dry Bean Council. Biennial Conference, Nov. 8-10, 1977, Emeryville, CA pp. 19-21.

6. Huang, H. C. and D. G. Dorrell. 1978. Screening sunflower seedlings for resistance to toxic metabolites produced by Sclerotinia sclerotiorum. Can. J. Plant Sci. 58:1107-1110.

Table 1. White mold severity as percentage of Phaseolus vulgaris cultivars infected by Sclerotinia sclerotiorum in selected field and covered greenhouse ground bed screening trials.

Cultivar	Field Plot	% White Mold[1] Greenhouse bed	
		infested soil[2]	germinated sclerotia[2]
Black Turtle Soup	5-20	4	35
Charlevoix Red Kidney	15-30	32	62
Venezuela 350	5-15	5	--
Great Northern[3]	90-100	72	100

[1]Severity as % of above-ground plant infected by S. sclerotiorum.

[2]Inoculum source.

[3]Great Northern 'Star', 'Tara' or 'Valley'.

* * * * *