Field and Straw Test Reactions to White Mold in a RIL Population (A 55/G 122)

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White mold caused by *Sclerotinia sclerotiorum* (lib.) de Bary is one of the most important fungal diseases of common bean (*Phaseolus vulgaris* L.) worldwide. Combining physiological resistance with avoidance mechanisms (upright plant architecture, open canopy), is the current breeding strategy for minimizing yield losses due to white mold in common bean. Information pertaining to the mode of inheritance of physiological resistance, as detected by the greenhouse straw test (5), and its relationship with field resistance is lacking (4). Our objective was to gain a better understanding of resistance to white mold in dry bean accession G 122 (2, 3), evaluate the heritability of physiological resistance as detected by the straw test, and compare physiological resistance as detected by the straw test with field resistance.

Sixty-seven F_8-derived RILs from a cross between A 55 and G 122 were generated by Steve Magnuson (Harris Moran Seed Co., San Juan Bautista, CA) and Paul Gepts using the single seed descent method. The RILs and parents were screened twice in the straw test (Petzoldt and Dickson, 1996) using a RCBD with six replications. An individual plant of each line represented a replicate and was rated for disease score (1 to 9) where 1 = no symptoms, 3 = invasion of the stem to the first node, 5 = invasion to the middle of the internode, 7 = invasion slightly past the 2nd node, and 9 = total plant collapse. A RCBD with three replications was used in the field. Field data collected included disease score (1-9), where 1 = no diseased plants ; 3 = 20-30% diseased plants and/or 5-10% infected tissue; 5 = 4 0-50% diseased plants and/or 20-30% infected tissue; 7 = 60-70% diseased plants and/or 40-50% infected tissue; and 9 = 80 to 100% diseased plants and/or 60 to 100% infected tissue; relative maturity (1 - 7), where 1 = very early, 4 = intermediate, and 7 very late; canopy height (cm); and canopy porosity (1 to 5), where 1 = an open canopy with the soil surface between rows completely visible, 3 = canopy moderately open with some soil surface visible between rows, and 5 = completely closed canopy with no soil visible. All significant QTLs ($P < 0.001$) were located on the genetic linkage map previously developed and anchored to the core map by Johnson (1997).

Physiological resistance to white mold, as detected by the straw test, is moderately heritable and correlates with field resistance. A single major-effect QTL (36 and 35%) for physiological resistance was detected by both straw tests on linkage group B7 near the *Phs* (Phaseolin) locus (Miklas et al., 1999). This same QTL (23%) was expressed in the field (Table 1 and Fig. 1). A QTL (20%) for relative maturity also mapped near *Phs*, with lateness and less disease correlated (Table 2). A second QTL (22%), on linkage group B1 near the *fin* locus for determinate growth habit, most likely conditioned avoidance, because a QTL (35%) for porosity mapped to the same general region. Open canopy was correlated with less disease. A tall canopy also correlated with less disease, but no QTL for canopy height was detected. All the QTL associated with less disease in the straw test and field derived from G 122. In summary, G 122 provides breeders with a heritable source of physiological and field resistance for improving white mold resistance in common bean.

Table 1. List of markers linked with major QTL (>LOD 3.0) conditioning physiological resistance or avoidance to white mold in a population of 67 F_8 derived RILs from the cross A 55/G 122.

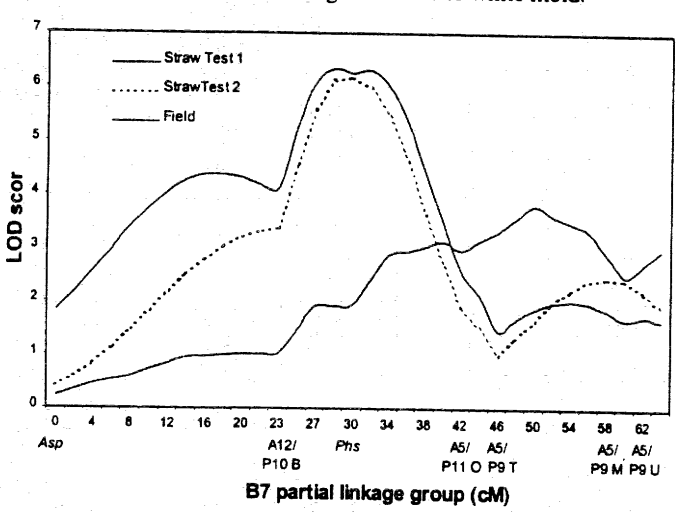
Trait	Resistance effect	Marker	Linkage group	LOD	R2	Means† A 55	Means† G 122
						Disease score (1-9)	
Straw Test 1	Physiological	*Phs*	B7	6.2	36	8.19	6.30
Straw Test 2	Physiological	*Phs*	B7	6.2	35	6.86	5.18
Field	Physiological	A05/P09 T	B7	3.8	23	4.36	2.89
	Avoidance	*fin*	B1	3.5	22	4.39	2.95
Agronomic traits							
Canopy porosity (1-5)	Avoidance	*fin*	B1	6.3	35	2.98	1.70
Relative maturity (1-7)	Combined	*Phs*	B7	3.1	20	3.06	4.49

†Means of RILs possessing the parental alleles for the QTL-linked marker.

Table 2. Simple correlation coefficients (r) among agronomic traits and disease scores from greenhouse and field tests for reaction to white mold in population of 67 F_8 derived RILs from the cross A 55/G 122.

	Straw Test 2	Field reaction	Relative maturity	Plant height
Straw Test 1 (1-9)	0.45***	0.43***		
Straw Test 2 (1-9)		0.25**		
Canopy porosity (1-5)		0.27**	0.45***	0.11
Relative maturity (1-7)		-0.41***		0.33***
Plant height (cm)		-0.20**		

Figure 1. QTL on B7 conditioning resistance to white mold.



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