RAPD Primers and Sensitivity to Oxalic Acid As Markers of Resistance of White Bean to White Mold.

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Forty lines and cultivars of white bean were evaluated for relationships among their resistance to natural infection by *Sclerotinia sclerotiorum* in the field, reaction of their DNA segments to RAPD primers, and sensitivity of their leaves to oxalic acid. Mean white mold severity (DS) of entries, on a scale of 0 (no disease) to 4 (76-100% of the plant scaffold affected by white mold) following natural infection in the field over the years 1992-1995, ranged from 0.5 to 1.8 (Table 1).

The petioles of detached leaves were immersed in 80 mM oxalic acid. The area of the leaf showing necrosis or water-soaking was measured on a scale of 0 (none) to 5 (76-100%). The sensitivity of each entry (OA), averaged over the three trials, is shown in Table 1. Sensitivity of leaves to oxalic acid was significantly and moderately correlated with resistance to white mold, with correlation coefficients ranging from 0.50 ($P = 0.001$) to 0.61 ($P < 0.0001$) in the three trials. However, moderate to high sensitivity to oxalic acid occurred in some entries with above average resistance to white mold (e.g. OAC Rico, OAC 92-2, HR44-1285). Similarly, moderate to high resistance to oxalic acid occurred in some entries with above average susceptibility to white mold (e.g. T9203, OAC 91-2). No level of sensitivity to oxalic acid consistently distinguished resistant from susceptible entries. For example, within the 20 most susceptible entries, sensitivity to oxalic acid ranged from 2.5 to 4.4 and five entries gave values of 3.0 or less. Within the 20 most resistant entries, sensitivity to oxalic acid ranged from 2.0 to 4.7 and seven entries produced values >3.0.

Of 420 RAPD primers tested, 63 showed polymorphisms in bean genomic DNA, and 10 of these appeared to be especially useful in grouping the entries according to their resistance to the disease (Table 1). For example, primer 575_{2050} was absent from the top 16 entries and present in the bottom 10 entries and in a further 6 entries with intermediate resistance. Using this primer alone, 16 of the 23 most susceptible entries could be eliminated. No single marker was uniquely associated with the most resistant entries. However, the absence of primers $575A_{3100}$ and 575_{2050} and the presence of primer 225_{2036} was associated with resistance, while the absence of primers 634_{4072}, 603_{4000}, 510_{4000}, and 686_{4072} was associated with susceptibility. Four patterns, based on the presence or absence of six markers, occurred only in the top 15 entries. These were 1) the absence of markers 575_{2050}, $575A_{3100}$, $575A_{3054}$, and 579_{506} (seven entries), 2) the presence of one of these markers, $575A_{3054}$, and the absence of the other three (two entries), 3) the presence of markers 330_{3000}, 510_{4000}, and 579_{506} and the absence of markers 575_{2050}, $575A_{3100}$ and $575A_{3054}$ (three entries), and 4) the presence of markers 330_{3000}, 510_{4000}, $575A_{3054}$, and 579_{506}, and the absence of markers 575_{2050} and $575A_{3100}$ (three entries).

Within this collection of individual beans, molecular signatures derived from RAPD primers appear to be more useful than sensitivity to oxalic acid as markers of resistance to white mold.

Table 1. Severity of white mold in the field, response to RAPD primers, and sensitivity to oxalic acid exhibited by 40 white bean lines and cultivars.

Entry	DS	[1] Marker/size										OA
		225	634	603	575A	510	330	686	575A	579	575	
		2036	4072	4000	3054	4000	3000	4072	3100	506	2050	
Vista	0.5	1	0	1	0	0	0	0	0	0	0	2.0
ExRico23	0.5	1	0	0	0	1	1	1	0	0	0	2.1
W14456-45494	0.6	1	1	0	0	0	1	0	0	0	0	2.1
Stinger	0.6	1	1	0	1	1	1	1	0	1	0	2.5
OAC92-2	0.6	0	0	1	0	0	0	0	0	0	0	3.2
Harowood	0.6	1	0	1	0	1	1	0	0	0	0	3.1
GTS525	0.6	1	1	0	0	1	1	0	0	1	0	2.3
T9201	0.7	1	0	1	1	1	1	0	0	1	0	3.0
OACRico	0.7	1	1	0	0	1	1	0	0	1	0	3.4
OACGryphon	0.7	1	1	0	0	1	1	0	0	1	0	2.8
OAC92-4	0.7	1	1	0	1	0	1	1	0	0	0	2.7
HR45-1657	0.7	1	0	0	0	0	1	1	0	0	0	3.1
Crestwood	0.7	1	1	1	1	1	1	1	0	0	0	2.6
OACLaser	0.8	1	0	0	0	0	0	1	0	0	0	2.8
HR40-1285	0.8	1	1	0	1	1	1	1	0	1	0	2.9
Avanti	0.8	1	0	0	1	0	1	0	0	1	0	3.3
Anchor	0.8	0	0	1	1	0	0	0	1	1	1	2.3
HR43-1582	0.9	1	1	1	1	1	0	1	0	1	0	3.3
Centralia	1	1	1	0	1	1	0	1	0	1	0	2.4
T9006	1	0	1	0	1	0	0	1	1	1	1	2.7
OAC92-23	1	0	1	0	0	0	1	0	1	0	1	3.1
HR40-1285	1	1	0	1	1	0	1	0	0	1	0	2.9
GTS0786-2	1.1	0	0	0	1	0	1	0	1	1	1	3.5
Shetland	1.1	1	0	1	1	0	1	0	0	1	0	4.1
Schooner	1.1	1	0	0	1	0	0	0	0	1	0	3.0
OACSeaforth	1.2	0	1	0	1	0	0	0	1	1	1	3.2
T9203	1.2	1	0	0	0	0	0	1	0	1	0	2.5
Dresden	1.3	1	0	0	1	0	1	0	0	1	0	3.9
OACCygnus	1.3	0	0	0	0	0	1	0	1	1	1	3.4
OAC92-1	1.5	1	0	0	1	0	1	1	0	1	0	2.8
T9202	1.5	0	0	0	1	0	1	0	1	1	1	3.6
T9004	1.5	0	0	0	1	0	1	0	1	1	1	4.0
Mitchell	1.6	0	0	0	0	0	1	0	0	1	1	3.6
Rocket	1.6	0	0	0	0	0	1	0	1	1	1	3.9
OACSprint	1.6	0	0	0	0	0	1	0	1	1	1	3.2
Fleetside	1.7	0	0	0	1	0	0	0	1	1	1	4.3
Wesland	1.8	0	0	0	1	0	0	0	1	1	1	3.0
OACSpeedvale	1.8	0	0	0	0	1	0	0	1	1	1	3.8
OAC91-2	1.8	0	0	0	1	0	0	0	1	1	1	2.9
Midland	1.8	1	0	0	1	1	0	0	0	1	1	3.3
[2]R(1)		17	11	7	10	11	13	10	2	11	2	
R(0)		3	9	13	10	9	7	10	18	9	18	
S(1)		7	2	2	13	2	12	2	12	19	14	
S(0)		13	18	18	7	18	8	18	8	1	6	

[1]RAPD primers identified by code numbers, 1 = band present, 0 = band absent. [2]Presence (1) or absence (0) of band in 20 most resistant (R) or most susceptible (S) entries.