EVALUATION OF A RECOMBINANT-INBRED-LINE POPULATION FOR REACTION TO WHITE MOLD

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North Dakota dry bean (*Phaseolus vulgaris* L.) producers have rated white mold [*Sclerotinia sclerotiorum* (Lib.) deBary] as the leading disease problem every year since 1995 (Lamey et al., 2000). Losses to white mold occur annually, but the magnitude varies depending on environment and other factors. Plant architecture plays a critical role in disease development because of its influence on the microclimate within the plant canopy (Saindon et al., 1995). Genotypes with upright growth avoid white mold by allowing air movement between rows compared to genotypes with prostrate growth habit. Sources of genetic resistance to white mold are limited. Resistance has been identified in germplasm collections (Miklas et al., 1999), but is not adapted to North Dakota. Developing adapted white-mold-resistant cultivars has proven difficult because of lack of readily available and adapted sources of resistance. Green stem is observed in some dry bean genotypes including 'Bunsi', which has partial resistance to white mold. Green stem refers to the inability of the plant to mature uniformly, resulting in plants with mature pods that retain leaves and have actively growing green stems. Green stem is a harvest problem in commercial production due to non-uniform dry-down of the plant, resulting in stained seed and difficulty combining.

The primary objective of this research was to evaluate a recombinant-inbred-line (RIL) population for reaction to white mold and identify resistant lines. Evaluation of green stem characteristic, which has not been previously conducted in dry bean, was a secondary objective of this research. Evaluation of the green stem characteristic and a potential relationship with white mold reaction may lead to a better understanding of the type of white mold resistance displayed by Bunsi.

A RIL population comprised of 119 $_{F2:12}$ lines developed from hybridization of Bunsi x D76125 navy bean by Miklas and Grafton (1992) was evaluated. Bunsi is resistant to white mold, late maturing, has an upright growth habit, and displays green stem characteristic while D76125 is susceptible to white mold, early maturing, has a prostrate growth habit and uniform dry-down. Three replicates of the population, parents, and check navy cultivars 'Huron' and 'Midland' were planted in a randomized complete block design (RCBD) at eight locations from 1997 to 2000. To increase the chance of white mold infection the following procedures were implemented: Sprinkler irrigation, spreader rows, narrow-row spacing (45 cm), wind barriers, and artificial inoculation of each plot with 1.25×10^6 ascospores at peak bloom. White mold and green stem were visually evaluated on a whole plot basis as plants were near harvest maturity. White mold was evaluated using a 1-9 scale, where 1 = no infection and 9 = severe infection or plant death and green stem evaluation used a 1-5 scale, where 1 = no green stem and 5 = severe green stem. Combined analysis of all environments was performed using PROC ANOVA in Statistical Analysis System (SAS Institute, 1992). Pearson's correlation coefficients were calculated based on treatment means from individual environment analysis.

Parental means were significantly different at the 95% level of confidence with Bunsi and D76125 scoring 2.4 and 5.4 and 4.2 and 2.2 for white mold reaction and green stem, respectively. Population distribution for white mold reaction approached a normal distribution based on treatment means, suggesting polygenic control of white mold resistance. Two lines, ND1107 and ND1108, had white mold means lower than the resistant parent, Bunsi, suggesting

transgressive segregation for white mold resistance. The same two lines had green stem scores less than Bunsi, but were not significantly different. White mold x plant architecture measurements (plant height, plant width, and plant density) had positive, but low correlations (Table 1). White mold x plant density was equally correlated at each of the Carrington environments (r = 0.27). White mold x days to maturity and white mold x days to maturity both were negatively correlated (Table 1). White mold x days to maturity at Carrington 1999 had the highest correlation of any interaction (r = -0.60). These data suggest negative relationships between white mold and green stem and white mold and days to maturity.

Table 1. Correlation coefficients of variables measured at two environments in 'Bunsi' x D76125 RIL population.

Correlation	Carrington 1999	2000	Pooled†
	---------- r ----------		
White mold x plant height	0.20*	0.16	0.18
White mold x plant width	0.27**	0.21*	0.24
White mold x plant density‡	0.27**	0.27**	0.27
White mold x green stem	-0.50**	-0.20*	-0.36
White mold x days to maturity	-0.60**	-0.17	----

† Pooled correlation estimates calculated only after Chi-square homogeneity test
‡ Plant density = plant height x plant width

Summary

Two lines, ND1107 and ND1108, were identified that had lower white mold scores than the resistant parent, Bunsi. White mold means from three environments approached a normal distribution suggesting that white mold resistance in this population is quantitatively controlled. Late maturity and green stem are undesirable characteristics for commercial cultivars. Correlations between white mold x days to maturity and white mold x green stem generally were negative. Therefore, lines from this population with resistance to white mold will be later maturing and exhibit green stem, which are undesirable linkages for commercial cultivars. If linkage exists between white mold resistance, green stem, and/or late maturity, breakage of linkage may be difficult based on the apparent quantitative nature of white mold resistance. This research confirms the need for continued work to identify more sources of white mold resistance, as current sources are limited and often have unfavorable linkage.

References

Lamey, H.A., R.K. Zollinger, M.P. McMullen, J.L. Luecke, J.R. Venette, D.R. Berglund, K.F. Grafton, and P.A. Glogoza. 2000. Ext. Rep. 58. North Dakota State Univ. Ext. Serv., Fargo.

Miklas, P.N. and K.F. Grafton. 1992. Crop Sci. 32:943-948.

Miklas, P.N., R. Delorme, R. Hannan, and M.H. Dickson. 1999. Crop Sci. 39:569-573.

Saindon, G., H.C. Huang and G.C. Kozub. 1995. J. Amer. Soc. Hort. Sci. 120:843-847.

SAS Institute. 1992. SAS/STAT user's guide. Version 6. 4th ed. SAS Inst., Cary, NC.