GAMETE SELECTION FOR SIMULTANEOUSLY PYRAMIDING AND INTROGRESSING WHITE MOLD RESISTANCE FROM *PHASEOLUS* SPECIES INTO PINTO BEAN

Shree P. Singh[1] and Howard F. Schwartz[2]

With Technical Support Provided by

Laura Crane, Carlos Centeno & Henry Terán – University of Idaho[1]; and Kristen Otto - Colorado State University[2]

ABSTRACT

Partial white mold [WM, caused by *Sclerotinia sclerotiorum* (Lib.) de Bary] resistance is found in large-seeded Andean and small and medium-seeded Middle American dry and green bean (*Phaseolus vulgaris* L.) and in interspecific breeding lines (IBL) derived from *P. coccineus* and *P. costaricensis* of the secondary gene pool. Resistance of individual genotype, irrespective of its evolutionary origin, is inadequate for combating WM in the USA. Furthermore, no effort has been made for pyramiding resistance from *Phaseolus* species and introgressing high levels of pyramided WM resistance (PWMR) into cultivars. The goal of this research is to pyramid WM resistance from *Phaseolus* species of the primary and secondary gene pools and introgress the highest levels of the PWMR into pinto bean, the largest market class in the USA and North America. Subsequently, the effectiveness of PWMR across environments will be determined. These objectives support the Sclerotinia Initiative area of Crop Germplasm Resources and Genetics. White mold reaction of 11 common bean (A 195, CORN 501, CORN 601, G 122, 'ICA Bunsi', L 192, MO 162, PC 50, VA 19, USPT-WM-1, and 'Chase') and eight IBL derived from *P. coccineus* and *P. costaricensis* (VCW 54, VCW 55, VRW 32, 92BG-7, I9365-25, 0785-120-1, 0785-121-1, and 0785-227-1) was verified in two greenhouse environments in Idaho and Colorado (June 2008 to December 2010). The complementation test among five Andean dry bean (A 195, G 122, MO 162, PC 50, and VA 19) and three IBL derived from *P. coccineus* (VCW 54, 92BG-7, and 0785-220-1) was performed (June 2008 to May 2009). Four single-crosses among selected WM resistant parents of diverse evolutionary origins were made (June to September 2010), which were used to make three-way and double-crosses (October to December 2010). The latter will be used to make multiple-parent crosses (January to May, 2011). These crosses should allow simultaneous pyramiding of high levels of WM resistance from across *Phaseolus* species of the primary and secondary gene pools and transfer into pinto bean. Also, 78 F_5 families developed from two double-crosses, namely USPT-WM-1/CORNELL 601//USPT-CBB-1/92BG-7 and Chase/I9365-25//ABL 15/A 195 made for a doctoral dissertation, and over two thousand early generation progenies from additional crosses were screened in the greenhouse (June to December 2010). From the initial screenings it is encouraging to note that some of the recombinants exhibited higher levels of WM resistance than the individual parents. Also, some of these recombinants had pinto-like seed. However, because these are only in early segregating generations it will take several selection and progeny testing cycles to develop breeding lines uniform for WM resistance reaction and assess their true potential.

CONTACT Information: Dr. Shree P. Singh, University of Idaho Research & Extension Center, 3793 No. 3600 East, Kimberly, ID 83341; 208-423-6609; singh@kimberly.uidaho.edu

GOAL - to improve common bean resistance to white mold caused by *Sclerotinia sclerotiorum*.

OBJECTIVES - pyramid and introgress high levels of WM resistance into dry bean cultivars:

- Pyramid resistance from *Phaseolus* species of the primary and secondary gene pools,
- Introgress the highest levels of pyramided resistance (PWMR) into pinto beans, and
- Distribute the PWMR germplasm lines and cultivars to public and private clientele.

MATERIALS AND METHODS:

- White mold reactions of large seeded Andean (A 195, CORN 501, CORN 601, G 122, L 192, MO 162, PC 50, VA 19) and small and medium seeded Middle American (ICA Bunsi, USPT-WM-1, Chase) dry and green bean materials; and interspecific breeding lines (IBL) derived from secondary gene pool species (VCW 54, VCW 55, VRW 32, 92 BG-7, I9365-25, 0785-127-1, 0785-121-1, and 0785-220-1) were verified in greenhouse environments in Idaho and Colorado.

- Five large seeded genotypes (A 195, G 122, MO 162, PC 50, VA 19) and three small seeded IBL (VCW 54, 92BG-7, 0785-220-1) derived from *P. coccineus* and one IBL (VRW 32) derived from *P. costaricensis* were selected for the complementation study.

- Approximately 50 seeds were produced for each single cross made with these white mold resistant parents. The parents and part of the seed from the F_1 of eight single-crosses were evaluated for reactions to WM to determine complementation or lack thereof and produce the F_2 seed during 2009.

RESULTS AND DISCUSSION:

✓ All 5 large-seeded Andean dry beans and their four F_1 were resistant to WM, indicating that they probably carried similar resistance genes/QTL.

✓ The VCW 54 / 0785-220-1 F_1 also was resistant, but in crosses with 92BG-7 both IBL exhibited a susceptible WM reaction. It is very likely that VCW 54 and 0785-220-1 have the same resistance genes/QTL, but both possess different genes/QTL from 92BG-7.

PROGRESS IN PYRAMIDING WHITE MOLD RESISTANCE:

✓ Four single-crosses between diverse breeding lines and germplasm accessions with partial WM resistance were made between June and September 2010. These were used to make three-way and double-crosses between October and December 2010, which subsequently will be used to make multiple parent crosses during January to May 2011.

✓ All crosses will be made only among parents possessing partial resistance to WM and of diverse evolutionary origins representing the primary and secondary gene pools of the common bean. These parents will include: A 195, G 122, Chase, CORN 501, CORN 601, I9365-25, MO 162, USPT-WM-1, VA 19, VCW 54, VCW 55, VRW 32, 92BG-7, 0785-220-1, 0785-221-1, and 0785-127-1.

✓ These crosses should allow simultaneous pyramiding of high levels of WM resistance from across *Phaseolus* species of the primary and secondary gene pools and transfer into pinto bean.

✓ 78 F_5 families developed from two double-crosses [USPT-WM-1/CORNELL 601//USPT-CBB-1/92BG-7 and Chase/I9365-25//ABL15/A 195] and over 2000 early generation progenies form additional crosses were screened in the greenhouse.

✓ Some of the recombinants exhibited higher levels of WM resistance than the individual parents. Also, some of the recombinants had pinto-like seed. However, because these are only in early segregating generations it will take several selection and progeny testing cycles to develop breeding lines uniform for WM resistance reaction and assess their true potential.

ACKNOWLEDGEMENTS: The authors gratefully acknowledge funding provided by the USDA-ARS Sclerotinia Initiative, Idaho and Colorado Agricultural Experiment Stations, and edible bean producers and handlers in the Western Region of the U.S.A.

REFERENCES:

Coyne, D.P., D. S. Nuland, D. T. Lindgren, and J.R. Steadman. 1994. HortScience 29:44-45.

Griffiths, P. 2009. HortScience 44:463-465.

Griffiths, P., M. Jahn, and M. Dickson. 2004. HortScience 39:1507-1508.

Miklas, P.N. 2007. Crop Science 47:935-942.

Miklas, P.N., K.F. Grafton, D. Hauf, and J.D. Kelly. 2006. Crop Science 46:2339.

Miklas, P.N., K.F. Grafton, J.D. Kelly, H.F. Schwartz, and J.R. Steadman. 1998. Crop Science 38:1728.

Singh, S.P., H. Terán, M. Lema, H.F. Schwartz, and P.N. Miklas. 2007. J. Plant Regist. 1:62-63.