The Agricultural Research Service, U.S. Department of Agriculture, the North Dakota State Agricultural Experiment Station, and the Agricultural Experiment Station of Michigan State University announce the release of USPT-WM-1 and USPT-WM-2 pinto bean (Phaseolus vulgaris L.) germplasm lines with partial resistance to white mold caused by the fungal pathogen Sclerotinia sclerotiorum Lib. deBary. Scientists participating in the development of this germplasm were Phil Miklas (USDA-ARS, Prosser, WA), Ken Grafton (North Dakota State University), Darrin Hauf (North Dakota State University), and James Kelly (Michigan State University). White mold is rated the number one economic disease problem of dry bean production in the U.S., and is a major problem in pinto beans, which are highly susceptible to the disease. The disease is endemic in all production regions of the U.S., and is most problematic under moist conditions resulting from rains or excess irrigation during flowering and mid-pod fill stages from late July through August. The resistance in USPT-WM-1 and USPT-WM-2 is conferred in part by two QTL that derive from ICA Bunsi navy bean (synonymous with Ex Rico 23 in Canada).

USPT-WM-1 and USPT-WM-2, previously tested as AN-37 and AN-69, respectively, derive from a recombinant inbred population from the cross 'Aztec'/ND88-106-04. Aztec is a semi-upright pinto bean cultivar from Michigan State University that is susceptible to white mold. ND88-106-04, from the cross N85007/ICA Bunsi, is an upright navy bean breeding line from North Dakota State University with resistance to white mold putatively derived from ICA Bunsi. USPT-WM-1 and USPT-WM-2 are F5 derived bulk lines from separate F2 plants that underwent generation advance by random single-seed descent method for four generations (F2:3:4:5) from F2 to F5.

Initially, F5:7 bulks of USPT-WM-1 and USPT-WM-2 were selected based on superior partial resistance to white mold and agronomic characteristics across four white mold field environments in ND and WA in 2001 and 2002. Across environments, mean disease score based on a scale from 1 to 9, where 1 is no visible infection and 9 is a completely susceptible reaction, was 3.7 and 4.0 for USPT-WM-1 and USPT-WM-2, respectively, compared to 6.8 for Aztec and 5.0 for ICA Bunsi. The lines also exhibited upright Type IIb/IIIa growth habits with disease avoidance characteristics including open canopy scores of 2.4 and 3.8, respectively, based on a 1 to 5 scale where 1 is a completely open and 5 a completely closed canopy, compared to scores of 2.7 for Aztec and 3.7 for ICA Bunsi; taller canopy heights of 49 and 50 cm, respectively, compared to 41 and 44 cm for Aztec and ICA Bunsi; reduced lodging scores of 3.9 and 5.0, where 1 is no lodging and 9 completely lodged, compared to 6.2 and 6.3 for Aztec and ICA.
Bunsi; and slightly later maturity of 94 and 97 days compared to 90 and 96 days for Aztec and ICA Bunsi. Both lines exhibit stay-green stem trait with scores of 2.6 and 3.8 based on a 1 to 5 scale, where 1 = 0 to 20% and 5 = 80 to 100% stay-green stem, compared to 1.8 and 3.8 scores for Aztec and Bunsi, respectively. Seed size based on weight of 100 seeds was 33.6 and 34.7 g for USPT-WM-1 and USPT-WM-2, respectively, and 33 g for Aztec. Yield was 2908 and 2667 lbs/A compared to 2552 lbs/A for Aztec.

In 2003, both lines were tested in the international Bean White Mold Nursery administered by Jim Steadman, University of Nebraska. Average mean ranking for resistance among 13 entries across 12 separate greenhouse and field tests was 5.1 for USPT-WM-1 and 7.5 for USPT-WM-2 compared to 6.2 for ICA Bunsi. In a 2004 white mold nursery conducted in Michigan, USPT-WM-1 and USPT-WM-2 had the second and third highest yields, 4370 and 4250 lbs/A, respectively, of 64 entries. ‘Buster’ pinto at 3600 lbs/A was the next closest pinto bean in yield. The weight of 100 seeds in this trial was 35 and 38 g compared to 34 g for Buster. Harvest maturity of the lines was 1 and 4 days later than the 92 days for Buster. Desirability scores were 5.0 and 6.5 for USPT-WM-1 and USPT-WM-2, respectively, compared to 5.0 for Buster, based on a 1 to 7 scale where 1 is undesirable and 7 highly desirable plant growth appearance. The desirability score for USPT-WM-2 was the highest observed among the 64 lines and cultivars tested. The mean white mold disease score based on percentage infection was 41 and 30% compared to 37% for ICA Bunsi and 56% for Buster.

Seed appearance for both lines is in the pinto bean market class, but the background color is darker than commercial cultivars, which may be due in part to the I gene for resistance to Bean common mosaic virus that is present in both cultivars being derived from the navy bean parent ND88-106-04. The I gene and its tight association with the B locus, depending upon source, is known to cause seed darkening in pinto, red, and pink bean market classes. Both lines were susceptible to bean rust Race 53 in greenhouse pathogen tests conducted at North Dakota State University and exhibited moderate susceptibility to Beet curly top virus in Washington.

USPT-WM-1 and USPT-WM-2 will be most useful for incorporating resistance to white mold primarily in the pinto bean market class, but also in the medium-seeded great northern, pink, and small red market classes as well. Seed will be maintained by USDA-ARS at Prosser, WA, and provided in small quantities upon written request. We ask that appropriate recognition of source be given when this germplasm contributes to the development of a new cultivar or germplasm line.

Authorship: Miklas, Grafton, Hauf, and Kelly