Registration of TARS-SR05 Multiple Disease-Resistant Dry Bean Germplasm

TARS-SR05 (Reg. no. GP-263, PI 642779) was developed cooperatively by the USDA-ARS Tropical Agriculture Research Station (TARS) and Vegetable and Forage Crops Production Research Unit, Agriculture and Agri-Food Canada, the College of Agricultural Science, University of Puerto Rico, and the West Tennessee Experiment Station and jointly released by the USDA, University of Puerto Rico, and the Tennessee Agricultural Experiment Station in 2005 as a multiple disease-resistant, tropical small red dry bean (*Phaseolus vulgaris* L.) germplasm.

TARS-SR05 (previously tested as 98020-3-1-8-2) is derived from the cross DOR 557/XAN 176 and is available as an F5 derived bulk of 16 F2 single-plant progenies. DOR 557 (Rodriguez et al., 1995) is a small red germplasm line similar to those produced in Central America and is susceptible to common bacterial blight [caused by *Xanthomonas axonopodis pv. phaseoli* (Yap) (Smith) Vauterin et al.]. XAN 176 (Miklas et al., 2000) is a tropically-adapted small black germplasm line from CIAT with moderate resistance to *Xap* and *Rhizoctonia solani* Kühn (Canaday et al., 2002).

Seed of the F1 and F2 were produced in 1998 in a greenhouse at Mayaguez, PR. Seed of the F3 was produced by single-seed descent in the field in early 1999 at Isabela, PR and then field evaluated as F3 plants for agronomic traits during the summer of 1999 at Juana Diaz, PR. Selected F3 plants were evaluated for resistance to *Xap* (strain 484a from Puerto Rico) in the fall of 1999 in a greenhouse at Mayaguez, and F4 seed was harvested from resistant plants. The F4 plants were evaluated in early 2000 in a highly stressed field nursery (compacted, waterlogged, and monocultured soil naturally infested with *R. solani* and * Fusarium solani* (Mart.) Sacc. l. sp. *phaseoli* (Burkholder) W.C. Snyder and H.N. Hams.) at Isabela. Seed harvested from tolerant plants was evaluated as F4 plants for resistance to *Xap* during the summer of 2000 in a Mayaguez greenhouse. Selected single-plant-derived (F4–x) lines harvested from *Xap*-resistant plants in the greenhouse were then evaluated in 1-m row plots for seed yield in early 2001 to two adjacent Isabela field locations. One location had compacted and waterlogged soil infested with *R. solani* and *F. solani*, whereas the other location had minimum stress. Breeding line 98020-3-1-8-2 was selected based on its high geometric mean of stressed and non-stressed seed yield relative to elite tropical small red cultivar Tio Canela-75 (Rosas et al., 1997).

TARS-SR05 produced greater yield than Tio Canela-75, line VAX 6 (Singh and Muñoz, 1999), and cultivars Morales (Beaver and Miklas, 1999) and Rosada Nativa (Beaver et al., 1999) under short days at Isabela. In the summer at Juana Diaz, TARS-SR05 also yielded greater than Tio Canela-75, but yielded similarly to XAN 176 and VAX 6. TARS-SR05 had comparable yields to the small red cultivars NW63 (Burke, 1982) and UI-259 (Myers et al., 2001) at Prosser, WA in a minimally stressed trial, but yielded substantially lower than both cultivars in a trial with multiple stresses, including compaction, low-fertility, low-moisture, *Beet early top virus* (BCTV), and soil infested with *F. solani*.

Reaction to *Xap* strain 484a was evaluated on the first trifoliate leaf in a greenhouse (USDA, Mayaguez), using a 1 to 9 scale, where 1 = completely resistant with no symptoms of infection and 9 = complete necrosis of the inoculated area (Schoonhoven and Pastor-Corralles, 1987). Reactions were 1.9 for TARS-SR05, 3.6 for XAN 176, 8.4 for DOR 557, 8.8 for Tio Canela-75, and 1.2 for VAX 6. Field resistance to *Xap* at Isabela (UPR) was similar for TARS-SR05 and VAX 6 and both had better resistance than Morales and Rosada Nativa. Transgressive segregation appears to be the mechanism of higher *Xap* (strain 484a) resistance found in TARS-SR05 relative to its parents. TARS-SR05 likely derived resistance genes from GN 1 selection 27 through XAN 176, but apparently also derived additional resistance factors from DOR 557. In subsequent evaluations at Mayaguez (UPR) with *Xap* strains 1930 (from Nicaragua), 1934 (from Costa Rica), 3363 (fuscan type from Puerto Rico), and 3353 (from Puerto Rico), TARS-SR05 was susceptible to strains 1930, 1934, and 3363 and resistant to strain 3353, compared to the resistant reaction of VAX 6 to all four strains. TARS-SR05 was susceptible to a mixture of *Xap* strains (two fuscous, 12 and 118; and two non-fuscous, 18 and 98) (courtesy of B.N. Dhanvantari) at Harrow, Ontario.

In greenhouse assays (Harorw), TARS-SR05 was not different than Cornell 2114-12 (Beebe et al., 1981) for resistance to *F. solani*, but was less resistant than Cornell 2114-12 to a soil mixture of *F. solani*, *R. solani*, and * Pythium ultimum Trow*. In root rot field nurseries, TARS-SR05 was not different than Cornell 2114-12 for resistance to *F. solani*, *R. solani*, and *Pythium spp. at Harrow*, or for resistance to *R. solani*, * Macrophomina phaseolina* (Tassi) Goidanich and *F. solani* at Jackson, TN. Tests with molecular marker SW13 and inoculations with *Bean common mosaic virus* (BCMV) races 1 and 15 (Harow) indicated that TARS-SR05 carries the I gene for resistance to races 1 and 15 of BCMV.

TARS-SR05 has a tropical small red seed type and shiny seed coat when produced under cool conditions, but may vary in seed coat color from red to brown to ochre when produced under high temperature conditions. Plant height of TARS-SR05 was slightly taller (48.5 cm) and seed size smaller (24.0 g) than that of NW 63 (42.5 cm; 35.7 g 100-1 seed) and UI-259 (42.0 cm; 39.2 g 100-1 seed) in Prosser, WA. Also, TARS-SR05 has a narrow oblong seed shape, which is much different than that of NW 63. Hence, the 100-seed weight and shape do not fit the U.S. small red market class, while the seed coat color may be less than acceptable for the tropical small red market class. TARS-SR05 has an upright semi-determinate growth habit (IIa) and full-season maturity in Harrow, Ontario. It matures in approximately 80 d at Isabela.

TARS-SR05 represents a new source of resistance to some strains of *Xap* and to soil pathogens in a potentially high-yielding background. It may be useful for differentiating pathogenic isolates of *Xap*. It will be useful for improving disease resistance in tropical small red beans and its adaptation to temperate climates will also make it easy to utilize in temperate small red breeding programs. Hence, TARS-SR05 can be widely used to improve resistance to soil pathogens, BCMV, and *Xap* in dry edible bean.

A limited quantity of seed is available from the corresponding author. It is requested that appropriate recognition be made if this germplasm line contributes to the development of new breeding lines and cultivars.

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References
