Cultivar and Germplasm Release

RELEASE OF PR0968-1-1 AND PR0968-16-2 FORAGE SOYBEAN GERMPLASM LINES[1]

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J. Agric. Univ. P.R. 100(2):263-266 (2016)

Poor forage quality, especially during the dry season, is a major constraint for livestock producers in the Caribbean. Livestock in the humid tropics often lack sufficient protein in their diets resulting in reduced growth rates and lower milk production (Adjei, 1995). The production of forage from legumes such as soybeans [*Glycine max* (L.) Merr.] may be an option for livestock producers. Forage soybean cultivars can produce good quality forage with high yields of crude protein (Seiter et al., 2004; Sheaffer et al., 2001). These soybean cultivars also need the capacity to produce acceptable yields of high-quality forage. The performance of soybean cultivars developed for forage production (Devine and Hatley, 1998) has been tested in different regions of the United States (Rao et al., 2005; Seiter et al., 2004; Sheaffer et al., 2001). Less information is available, however, concerning the performance of forage soybeans in the tropics. Most maturity groups of soybeans planted in the lower latitudes of the tropics are short and yield insufficient amounts of biomass for forage production. The long-juvenile (LJ) trait delays flowering of soybeans under short-day conditions (Ray et al., 1995). This LJ trait, which is controlled by a simple recessive gene, can be introgressed into soybeans to increase biomass production for forage production in the tropics and sub-tropics. This approach led to the development and release of 'Hinson Long-Juvenile' forage soybean in Florida (Blount et al., 2003). The main objective of this research was to select soybean lines that are adapted to the humid tropics and capable of producing high-quality forage. A secondary objective was to identify soybean lines capable of producing adequate yields during the winter months for seed production. PR0968-1-1 and PR0968-16-2 are soybean germplasm lines adapted to the humid tropics that were developed and released cooperatively in 2015 by the UPR Agricultural Experiment Station and the USDA-ARS.

Origin

The F_2 seed was obtained from Dr. Tom Devine (formerly USDA/ARS/Beltsville, MD) in 2008. The cross was between a tall, forage soybean line and a long-juvenile line from Dr. Kuel Hinson's soybean breeding program at the University of Florida. The pedigrees of both PR0968-1-1 and PR0968-16-2 are 'Donegal' x F85 1138 (GHS 95-96)'. 'Donegal' is a Maturity Group V forage soybean (Devine and Hatley, 1998). F85-1138 is a MG VIII long-juvenile selection from a cross between 'Will' (MG III) and an experimental long-juvenile line with the pedigree [('Kirby' x 'Forrest') x PI 159925] (Blount et al., 2003). The F_2 seed was planted at the Isabela Substation of the Agricultural Experiment Station of the University of Puerto Rico. Tall, erect indeterminate plants were selected. The F_3

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and F_4 generations were planted at the Isabela Substation in January and August 2009. Taller, erect plants with good agronomic traits were selected. The $F_{4:5}$ lines, planted at the Isabela Substation in February 2010, were evaluated for agronomic traits and seed yield. Seed of the most promising lines was bulked. The advanced generation lines were planted in yield trials at the Isabela Substation in October and December 2012; January, October and November 2014. The testing site in Puerto Rico is located on the northwestern coastal plain (18.3° N, 67.3° E). The soil is a Coto acidic clay (very-fine, kaolinitic, isohyperthermic Typic Eutrustox). The mean maximum and minimum temperatures are 29.3° C and 20.0° C, respectively; monthly precipitation ranges from 76 mm in January to 192 mm in May. A Randomized Complete Block Design with six replications was used. The experimental unit was a single 3-m row. Plant height and lodging were evaluated at harvest maturity. Lodging was evaluated on a 1 to 5 scale where 1 = all plants erect and 5 = all plants prostrate. Seed yield was also measured.

Aponte et al. (2015) evaluated the biomass production (kg/ha) and nutritional value [% crude protein (CP)] of PR0968-1-1 and PR0968-16-2 in trials planted at the Isabela Substation in September 2010 and January 2011. The soybean lines were harvested at the R2 and R5 stages of phenological development (Fehr et al., 1971). Lines PR0968-1-1 and PR0968-16-2 produced a mean dry matter yield (DMY) exceeding 5,000 kg/ha at the R2 stage of development and a DMY greater than 6,000 kg/ha when harvested at the R5 stage of development. These DMYs were lower than yields reported for forage soybeans in temperate environments (Hintz et al., 1989; Sheaffer et al., 2001). Tropical environments have shorter day lengths that reduce potential net photosynthesis and accelerate phenological development. Percent crude protein (CP) of PR0968-1-1 and PR0968-16-2 was at least 29.6% when harvested at the R2 stage of development and at least 23.0% when harvested at the R5 stage of development. These CP values are as good as those reported for alfalfa (*Medicago sativa* L.) produced in the United States (Broderick et al., 2001).

In performance trials conducted over three years at Isabela, Puerto Rico, PR0968-1-1 and PR0968-16-2 produced mean seed yields of 2,291 and 2,192 kg/ha, respectively (Table 1). These results suggest that it would be feasible to produce high quality seed during the winter months. Seed yield of the lines tended to increase as researchers at the Isabela Substation became more familiar with producing the crop.

TABLE 1.—*Mean seed yield (kg/ha) of soybean lines planted at the Isabela Substation in Puerto Rico.*

	Planting date					
Line	Oct. 2012	Dec. 2012	Jan. 2014	Oct. 2014	Nov. 2014	Mean
			— Seed yield (kg/ha) —			
PR0968-1-1	1636	1661	2624	2173	3359	2291
PR0968-2-2	1724	1795	1968	1892	3213	2118
PR0968-6-3	1622	1258	2289	1663	2624	1891
PR0968-16-2	1654	1384	2629	2094	3200	2192
PR0968-22-3	1904	1162	2213	1624	2538	1888
Hinson	—	1074	1559	1336	2464	1608
Mean	1560	1389	2212	1797	2900	1972
LSD (0.05)	272	329	486	148	593	
CV (%)	21.6	19.9	18.5	14.2	17.2	

TABLE 2.—*Plant height (cm) of soybean lines planted at the Isabela Substation in Puerto Rico.*

	Planting date					
Line	Oct. 2012	Oct. 2013	Jan. 2014	Oct. 2014	Nov. 2014	Mean
			— Plant height (cm) —			
PR0968-1-1	85	101	82	95	69	86
PR0968-2-2	85	92	74	96	78	85
PR0968-6-3	74	98	76	94	72	83
PR0968-16-2	72	104	77	98	70	84
PR0968-22-3	74	94	67	94	71	80
Hinson	—	53	37	57	38	46
Mean	78	90	69	89	66	78
LSD (0.05)	10	5	11	5	10	
CV (%)	10.4	4.8	13.1	4.8	12.4	

No major disease or pest problems were encountered. Pesticide was applied to control chrysomelid beetle (*Cerotoma ruficornis*) and leafroller (*Hedylepta indicate*) damage. It was not necessary to apply fungicides.

Lines PR0968-1-1 and PR0968-16-2 have an erect, indeterminate growth habit with mean plant heights of 86 cm and 84 cm, respectively (Table 2). When planted at the Isabela Substation from November to January, both PR0968-1-1 and PR0968-16-2 flowered approximately 44 d and matured 96 d after planting. Mean seed weight of PR0968-1-1 and PR0968-16-2 was 16.8 and 16.2 g/100 seed, respectively. Both PR0968-1-1 and PR0968-16-2 have white flowers and brown pubescence and had significantly shorter stature when planted from November to January, when day lengths in Puerto Rico are approximately 11 h. This behavior would be undesirable for forage production during that time of the year although seed yields of both lines planted from November to January averaged more than 2,000 kg/ha. Both lines had significantly taller plant height than cultivar 'Hinson', especially when planted during short day lengths.

Availability of seed

Small amounts of seed of PR0968-1-1 and PR0968-16-2 may be obtained from the corresponding author. Plant variety protection will not be sought for these germplasm lines.

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