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GERMPLASM

Registration of Soybean Germplasm SS93-6012 and SS93-6181 Resistant to Phomopsis Seed Decay

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ABSTRACT

Soybean [*Glycine max* (L.) Merr.] germplasm SS93-6012 (Reg. No. GP-362, PI 652442) and SS93-6181 (Reg. No. GP-363, PI 652443) were developed and released by the University of Missouri–Columbia in January 2006 as resistant to Phomopsis seed decay (PSD), caused by *Phomopsis* spp. Both lines were developed from a cross between MO/PSD-0259 (PI562694) (PSD-resistant MGIV germplasm) and 'Asgrow 3834' (PSD-susceptible MGIII cultivar) made in 1990 at the Bradford Research and Extension Center of the University of Missouri, Columbia, MO. The lines were composited in the F_5 generation and evaluated for yield and Phomopsis seed decay infection. These lines are highly resistant to *Phomopsis* spp. SS93-6012 has a relative maturity of 4.2, purple flowers, gray pubescence, an indeterminate growth habit, tan pods at maturity, yellow color seeds, buff hila, and seed weight of ~14 g per 100 seeds. SS93-6181 has a relative maturity of 4.0, purple flowers, tawny pubescence, an indeterminate growth habit, tan pods at maturity, yellow color seeds, imperfect black hila, and seed weight of ~16 g per 100 seeds. So far, PSD-resistant commercial soybean cultivars are not available, and these two lines may be used for development of PSD-resistant high-yielding soybean cultivars.

A number of soybean [*Glycine max* (L.) Merr.] farmers in the southern United States plant early-maturing soybean (MGIII and MGIV) cultivars in late March to mid-April so that pod fill can be completed before late-summer drought develops (in late July through August). This practice is known as the early soybean production system (ESPS) (Heatherly, 1999; Wrather et al., 2003), and yield and management advantages to this system were observed in some southern states, including Missouri (Wrather et al., 1996). Unfortunately, planting early-maturing cultivars in late March to mid-April enhances Phomopsis seed decay (PSD), an important seed disease of soybean that can significantly reduce crop production and seed quality (McGee, 1983; TeKrony et al., 1996; Wrather et al., 2003). Caused by *Phomopsis* spp., especially *P. longicolla*, PSD is endemic throughout the most soybean production areas of the world (Brown et al., 1987; Kulik and Sinclair, 1999). Yield suppression due to PSD varied among regions of the United States and years (Wrather et al., 1996), and soybean yield suppression was about 294,000 and 147,000 Mg in 2004 and 2005, respectively (Wrather and Koenning, 2008). The quality of oil derived from PSD-infected seeds is generally lower than that of oil extracted from healthy seeds (Hepperly and Sinclair, 1978). The severity of PSD depends on environmental factors such as high temperatures during pod fill and wet weather after seed maturation. Control measures for PSD include foliar application of fungicides at the R6 stage and planting in a way that pod fill occurs when temperatures are lower than midsummer (Wrather et al., 1996, 2003, 2004). This disease could be managed by planting *Phomopsis* sp.–resistant soybean cultivars (Wrather et al., 2004), but none are available. Our objective was to release PSD-resistant soybean germplasm to be used for development of PSD-resistant, high-yielding soybean cultivars.

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Abbreviations: BREC, Bradford Research and Extension Center; ESPS, early soybean production system; PI, Plant introduction; PSD, Phomopsis seed decay.

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Materials and Methods

Soybean line SS93-6012 (Reg. No. GP-362, PI 652442) and SS93-6181 (Reg. No. GP-363, PI 652443) (both MGIV) were developed from a cross between MO/PSD-0259 (PI562694) (PSD-resistant MGIV germplasm) and 'Asgrow 3834' (PSD-susceptible MGIII cultivar) in 1990 at the Bradford Research and Extension Center (BREC), Columbia, MO. MO/PSD-0259 is essentially a composite of 11 lines that resulted from the cross between PI417479 × Merschman 'Dallas' made at Columbia in 1984 and was registered as PSD-resistant germplasm in 1993 (Minor et al., 1993). The F_1 and F_3 generations were grown during the winters of 1990–1991 and 1991–1992 in Puerto Rico, respectively, while the rest of the generations were grown at the BREC. SS93-6012 and SS93-6181 were composited in the F_5 generation at the BREC.

Agronomic Performance and Disease Reaction

From 1998 to 2001, Wrather et al. (2003, 2004) conducted a series of experiments on planting date, yield (data not shown), seed quality, seed infection by *Phomopsis* sp., and foliar fungicide effects on *Phomopsis* spp. seed infection using these lines along with the susceptible parent, Asgrow 3834. Wrather et al. (2003) reported that seed infection on three different dates of planting averaged over years was 25.2% for Asgrow 3834, 3.2% for SS93-6012, and 2.8% for SS93-6181. Wrather et al. (2004) also reported that percentage of *Phomopsis* spp. seed infection for Asgrow 3834 averaged over years was 52.8% and was significantly greater than 2.8% seed infection for SS93-6012. They did not find any significant differences in percentage of *Phomopsis* sp. seed infection for SS93-6012 between the control and foliar fungicide treatment. Shannon et al. (unpublished data, 2008) have evaluated above lines along with 'Mustang' (Schmidt et al., 1997) and 'Maverick' (Sleper et al., 1998) as checks for yield and *Phomopsis* spp. seed infection at two locations in Missouri and one location in Mississippi each at two planting dates. A significant difference in seed infection was observed among the lines but yield differences were nonsignificant (Table 1). Based on the above results, researchers concluded that the most effective method for PSD management was to use PSD-resistant soybean lines.

Table 1. Yield performance and percentage Phomopsis seed infection of Phomopsis-resistant soybean lines SS93-6012 and SS93-6181 compared with check cultivars Mustang and Maverick, and Phomopsis spp. seed infection averaged over three locations at each of two planting dates in 2000.†

Line/cultivar	Yield	Seed infected
	kg ha^{-1}	%
SS93-6012	1279 a‡	9.9 c
SS93-6181	1297 a	12.6 c
Mustang	1313 a	18.4 b
Maverick	1246 a	28.4 a
$LSD_{0.05}$	279	4.8

†Planting dates in 2000 were 29 April and 21 May at Columbia, MO, 23 April and 16 May at Portageville, MO, and 12 April and 6 May at Stoneville, MS.

‡Values followed by the same letter are not significantly different ($P = 0.05$).

Characteristics

SS93-6012 is early group IV maturity (relative maturity of 4.2) with purple flowers, gray pubescence, an indeterminate growth habit, tan pods at maturity, yellow color seeds, buff hila and seed weight of ~140 mg seed^{-1}. SS93-6181 is also early group IV maturity (relative maturity of 4.0) with purple flowers, tawny pubescence, an indeterminate growth habit, tan pods at maturity, yellow color seeds, imperfect black hila and seed weight of ~160 mg seed^{-1}. Both SS93-6012 and SS93-6181 are susceptible to soybean cyst nematode (caused by *Heterodera glycines* Ichinohe) and Phytophthora root rot (caused by *Phytophthora sojae* M.J. Kaufmann & J.W. Gerdemann). SS93-6012 is highly resistant and SS93-6181 is susceptible to frogeye leaf spot (caused by *Cercospora sojina* K. Hara).

Availability of Seeds

Seeds of SS93-6012 (PI652442) and SS93-6181 (PI652443) have been deposited in the USDA Soybean Germplasm Collection Center and may be requested from the corresponding author for research purposes, including development and commercialization of new cultivars. We ask that the appropriate recognition be made if this germplasm contributes to the development of a new breeding line or cultivar.

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