Received: 23 May 2019 | Accepted: 31 August 2019 | Published online: 11 February 2020

DOI: 10.1002/plr2.20018

Journal of Plant Registrations

REGISTRATION

Cultivar

Registration of 'S14-15146GT' soybean, a high-yielding RR1 cultivar with high oil content and broad disease resistance and adaptation

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Funding information
Missouri Soybean Merchandising Council, Grant/Award Number: MSMC 301

Registration by CSSA.

Abstract

S14-15146GT (Reg. no. CV-534, PI 691841) is a late-maturity group IV (relative maturity 4.6) indeterminate glyphosate-tolerant soybean [*Glycine max* (L.) Merr.] cultivar developed and released by the University of Missouri Fisher Delta Research Center Soybean Breeding program. High global demand for soybean oil and US southern growers' preference for taller soybean plants with early maturity led to the release of this cultivar. S14-15146GT was evaluated in 130 environments across 10 states and showed high yield potential and wide adaptation in Missouri and other southern states. It is resistant to Phytophthora root rot, stem canker, sudden death syndrome, frogeye leaf spot, and charcoal rot. S14-15146GT has white flowers, tawny pubescence, and tan pod walls. Seeds of S14-15146GT have black hilum, yellow cotyledon, and intermediate luster. S14-15146 GT seed averages 235.5 and 390.8 g kg^{-1} oil and protein content, respectively. The early maturity with the first-generation Roundup Ready trait, high yield potential, high oil content, broad disease resistance package, and wide adaptation make S14-15146GT an excellent choice for southern growers.

1 | INTRODUCTION

The increasing interest of growers in the southern United States in taller soybean [*Glycine max* (L.) Merr.] plants and early maturity for more flexibility at harvest has led to an increased demand for indeterminate late-maturity group IV

Abbreviations: AYT, advanced yield trial; CR, charcoal rot; FLS, frogeye leaf spot; PRR, Phytophthora root rot; PYT, preliminary yield trial; RKN, southern root-knot nematode; RM, relative maturity; RR, Roundup Ready; SC, stem canker; SCN, soybean cyst nematode; SDS, sudden death syndrome

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soybean. Herbicide-tolerant soybean cultivars represent 94% of soybean acreage in the United States (USDA-ERS, 2018). The expiration of the patent for the first-generation Roundup Ready (RR) (Monsanto) trait in 2015 (Monsanto, 2017) provided an opportunity for the growers to continue adopting this technology without paying technology fees and facing contractual restrictions, which reduced seed costs (Orazaly et al., 2019).

Soybeans are desired for their oil and protein content. However, genetic variation for protein content is greater than that for oil content (Clemente & Cahoon, 2009). The increasing world demand of soybean oil for food, livestock feed, and biofuel applications has brought attention to soybean breeding programs to develop improved soybeans with high oil content (Clemente & Cahoon, 2009). These local and global demands have driven the development and release of the new cultivar S14-15146GT (Reg. no. CV-534, PI 691841) by the University of Missouri Fisher Delta Research Center Soybean Breeding program.

S14-15146GT is a late-maturity group IV (relative maturity [RM] 4.6) indeterminate glyphosate-tolerant soybean developed through conventional breeding from the cross 'S09-10871' × 'S08-9727RR1'. It has high oil content (235.5 g kg^{-1}) and a broad disease resistance package, including resistance to Phytophthora root rot (PRR) (caused by *Phytophthora sojae* M.J.Kaufmann & J.W. Gerdemann), stem canker (SC) (caused by *Diaporthe aspalathi* Jansen, Castlebury & Crous, formerly *Diaporthe phaseolorum* var. *meridionalis*), sudden death syndrome (SDS) (caused by *Fusarium virguliforme* O'Donell & T. Aoki), frogeye leaf spot (FLS) (caused by *Cercospora sojina* Hara), and charcoal rot (CR) (caused by *Macrophomina phaseolina* Tassi Goid). S14-15146GT was tested in 130 environments across 10 states and demonstrated high yielding potential in Missouri and other mid-south and southern states, including Arkansas, Tennessee, Louisiana, Alabama, North Carolina, Mississippi, and Kentucky. It has been licensed to a private entity for commercialization.

2 | METHODS

2.1 | Parent selection and pedigree

S14-15146GT was derived from the cross 'S09-10871' × 'S08-9727RR1'. S09-10871 is a late-maturity group IV conventional line derived from the cross 'S04-10364' × 'S04-12412'. S09-10871 has high oil content (249.4 g kg^{-1}) and is resistant to SC, southern root-knot nematode (RKN) [*Meloidogyne incognita* (Kofold & White) Chitwood], and SDS. S08-9727RR1 is an early-maturity group V glyphosate-tolerant line derived from the cross 'S04-8952' × 'S03-1904'. S08-9727RR1 has high oil content (232.3 g kg^{-1}) and is resistant to PRR, FLS, and CR. Both parental lines have excellent yield potential and were developed by the University of Missouri Fisher Delta Research Center.

The cross 'S09-10871' × 'S08-9727RR1' was made in summer 2012 at the Fisher Delta Research Center in Portageville, MO. The F_1 to F_4 generations were grown in an off-season nursery in Costa Rica from 2012 to 2013. The F_1 generation was grown under lights to enhance production of F_2 seed under the short topical days. The F_2 to F_4 populations were advanced using the modified single-pod descent method (Fehr, 1987). About 150 single F_4 plants were harvested and threshed separately. The F_5 seeds from the selected F_4 plants were grown in individual progeny rows in 2014 at the Fisher Delta Research Center. The row designated as experimental line S14-15146GT was selected based on visual appearance and yield potential at maturity. Seeds from the selected $F_{4:5}$ row were bulked as a pure line for further agronomic, disease, and yield evaluation.

2.2 | Evaluation of agronomic performance

S14-15146GT was evaluated in a total of 130 environments across 10 states, including 18 locations in the preliminary yield trials (PYTs) and advanced yield trials (AYTs) at the University of Missouri Fisher Delta Research Center from 2015 to 2018; 31 locations across nine states in the USDA Southern Uniform Soybean Tests from 2015 to 2018; and 81 environments across 10 states in the Soybean State Variety Test programs.

In the Fisher Delta Research Center trials, S14-15146GT was initially tested in a 2015 PYT. The PYT was a non-replicated test and was conducted at three environments (two loam soil and one clay soil). Subsequently, S14-15146GT was tested from 2016 to 2018 in replicated AYTs. The AYTs were conducted in a randomized complete block design with three replications and five environments in each year (two on loam soil, two on clay soil, and one on sandy soil). Plots consisted of four rows that were 3.66 m long and spaced 0.76 m apart. The two center rows of each plot were used for agronomic and disease evaluation and harvested with a plot combine for yield and seed traits.

In the USDA Southern Uniform Soybean Tests, S14-15146GT was first evaluated in the Uniform Preliminary Group IV test in 2016, and later in the Uniform Tests in 2017 and 2018 (Gillen & Shelton, 2017, 2018, 2019). The experimental design was a randomized complete block with two replications in the Uniform Preliminary Group IV tests and three replications in the Uniform Tests. Plots were four rows with variable length (3.66–6.1 m) and 0.76 m width, and the

TABLE 1 Agronomic and seed quality traits of 'S14-15146GT' soybean in the USDA Southern Uniform Soybean Tests (2016–2018). Traits observations are based on the values averaged across the locations and years

	Plant height				Lodging[b]				100-seed weight				Protein[c]				Oil			
	16	17	18	3-yr[a]	16	17	18	3-yr	16	17	18	3-yr	16	17	18	3-yr	16	17	18	3-yr
Cultivar	cm				1–5				g				g kg^{-1}							
S14-15146GT	97	79	86	87.2	2.4	1.7	2.2	2.1	13.9	15.1	14.8	14.6	404	389	379	390.8	235	231	240	235.5
Check average	92	83	85	84.6	2.1	1.7	2.2	2.0	14.1	14.4	14.7	14.3	409	392	397	399.4	230	223	235	229.3
Test average	94	76	86	86.0	2.4	1.8	2.3	2.1	13.5	14.3	14.6	14.1	414	402	395	403.8	229	219	238	228.5
Locations	10	12	8	30	10	12	8	30	9	11	8	28	8	12	8	20	8	12	8	20
CV	8.0	12.0	8.0	–	–	32	21.8	–	6.1	6.4	6.3	–	1.8	2.2	2.6	–	1.8	2.1	2.1	–
LSD	5.1	5.1	5.1	–	–	0.4	0.4	–	0.7	0.7	0.8	–	6.9	6.9	11.5	–	4.6	3.5	5.7	–

Note. Check cultivars: AG 3934, AG 4135, AG 4232, AG 43 × 7, AG 4632, AG 4835, Ellis, LD06-7620.

[a]Three-year weighted average based on number of locations.

[b]Lodging was scored on a scale of 1 to 5, where 1 = all plants erect, 2 = either all plants leaning slightly or a few plants down, 3 = either all plants leaning moderately or 25 to 50% of the plants down, 4 = either all plants leaning considerably or 50 to 80% of the plants down, and 5 = all plants lodged.

[c]Protein and oil amount are on a dry weight basis.

center rows were used to measure agronomic and seed traits including yield, maturity, height, lodging, seed protein and oil content, and 100-seed weight. Seed yield was expressed as kilograms per hectare at 130 g kg^{-1} moisture. Maturity was recorded as days to R8 (Fehr, Caviness, Burmood, & Pennington, 1971) and was presented as days either earlier or later than the reference check cultivar Ellis (maturity = 0; Pantalone et al. [2017]), which has a RM of 5.0. Lodging was recorded on a visual scale of 1 to 5, where 1 indicates that all plants are erect and 5 indicates that all plants are lodged. Plant height was measured from the center rows of the plots and expressed in centimeters. Seed size was measured using 100-seed weight and expressed in grams per 100 seed. Oil and protein were analyzed by near-infrared reflectance using 25- to 30-g random composite seed samples from all replications for each genotype, and measurements were converted to a dry-weight basis (Gillen & Shelton, 2017).

In the Soybean State Variety Test programs, S14-15146GT was tested from 2017 to 2018 in Alabama (nine environments) (Beasley & Patterson, 2019), Arkansas (three environments) (Bond, Still, & Carlin, 2019; Bond, Still, & Dombek, 2018;), Indiana (one environment) (DeVillez & Foster, 2018), Kentucky (13 environments) (Claire & Roberts, 2018, 2019), Louisiana (10 environments) (Spivey et al., 2018, 2019), Maryland (seven environments) (Wight, 2018, 2019), Missouri (11 environments) (Wiebold, Knerr, Grissum, Cravens, & Nichols, 2018, 2019), Mississippi (11 environments) (Burgess & Bullard, 2018), North Carolina (six environments) (Heiniger, 2019), and Tennessee (10 environments) (Sykes et al., 2018, 2019). The experimental design used was randomized complete block design, and yield data were collected from two center rows of four-row plots of 6.1 m length and 0.76 m width.

2.3 | Disease resistance and salt tolerance evaluation

S14-15146GT was screened in the USDA Uniform Soybean Test for SC, RKN, and soybean cyst nematode (SCN) (*Heterodera glycines* Ichinohe) races 2 (H.G Type 1.2.5.7), 3 (HG Type 5.7), and 5 (HG Type 2.5.7) (Gillen & Shelton, 2017, 2018, 2019). At the University of Missouri, S14-15146GT was evaluated for SC; FLS; SCN races 1, 2, 3, 5, and 14; and salt tolerance. S14-15-15146 was also screened for PRR resistance at the Ohio State University; SDS resistance at Southern Illinois University; CR resistance at USDA-ARS in Jackson, TN; RKN resistance at University of Georgia; and reniform nematode (*Rotylenchulus reniformis* Linford & Oliveira) resistance at University of Arkansas. In addition, resistance alleles for SCN and RKN were confirmed using proper molecular markers at University of Missouri. Rhg1-2 and S18-1 markers were used for establishing Rhg1 haplotype: PI 88788-type vs. Peking-type vs. W82-type (Chr. 18) (Kadam et al., 2016). Rhg4-5 marker was used to detect resistant haplotype of Rhg4 (Chr. 8) (Kadam et al., 2016). GSM0040 and GSM0041 were used to detect resistance to RKN (Chr. 10 and 18, respectively) (Pham, McNally, Abdel-Haleem, Boerma, & Li, 2013).

2.4 | Statistical analysis

Yield and other agronomic traits at the University of Missouri Fisher Delta Research Center Soybean Breeding program trials were analyzed with Agrobase Generation II (Agronomix Software, 2019). Data from the USDA Uniform Soybean Tests were analyzed in a mixed model (Proc Mixed) in the SAS software (SAS Institute, 2010) with replications within location as random and cultivars as fixed effects. Data from

TABLE 2 Summary of 'S14-15146GT' soybean yield performance in 130 environments across 10 states. Observations are based on average yield in each individual trial

Year	Test[a]	Locations	Reps.	Entries	S14-15146GT	Check mean[b]	Test mean	LSD	Relative ranking[c]	Check cultivars
				n	kg ha^{-1}				%	
2015	MO-PYT	3	1	24	4808.4	4379.3	4368.6	255.6	12.5	AG 3832, AG 4034, AG 4135, AG 4232, AG 4632
2016	MO-AYT	5	3	28	4573.0	4349.7	4273.7	139.2	10.7	AG 4135, AG 4232, AG 4632, AG 4633, P47T36R
2017	MO-AYT	5	3	32	3597.9	4085.4	3315.4	201.8	34.4	AG 43 × 7, AG 4632
2018	MO-AYT	5	3	32	4189.7	4242.1	4008.1	128.7	37.5	AG 43 × 7, AG 4632, AG 46 × 7, P48T27X
Avg.	4234.9	4251.3	3949.5	173.1	25.0	–				
2016	USDA-UP	10	2	24	4465.4	3920.7	3974.5	385.3	4.2	AG 3934, AG 4135, AG 4232, LD06-7620
2017	USDA-UT	13	3	24	3900.5	4140.4	3934.1	342.9	70.8	AG 4632, AG 4835, Ellis, LD06-7620
2018	USDA-UT	8	3	15	4505.7	4232.1	4176.3	490.9	20.0	AG 4135, AG 4232, AG 43 × 7, LD06-7620
Avg.	4238.9	4093.2	4009.6	394.8	36.2	–				
2017	AR-VT	3	3	33	4703.7	–	4808.4	410.2	66.7	–
2017	KY-VT	8	3	8	4391.4	–	4593.2	289.2	76.5	–
2017	LA-VT	5	3	5	4149.3	–	4357.8	396.8	81.1	–
2017	MD-VT	3	3	3	4075.4	–	4317.4	329.5	96.3	–
2017	MO-VT	4	3	4	3106.9	–	3705.5	228.6	97.3	–
2017	MS-VT	11	3	11	4382.9	–	5070.6	699.4	93.5	–
2017	TN-VT	6	3	6	3900.5	–	4371.3	538.0	95.3	–
2018	AL-VT	9	3	30	3443.2	–	3712.2	316.1	70.9	–
2018	IN-VT	1	3	12	4626.8	–	4916.0	403.5	83.3	–
2018	KY-VT	5	3	68	3914.0	–	3766.0	215.2	45.6	–
2018	LA-VT	5	3	40	3550.8	–	3665.1	423.7	72.0	–
2018	MD-VT	4	3	19	4586.5	–	4996.7	652.3	90.8	–
2018	MO-VT	7	3	49	4875.6	–	5097.6	800.3	72.9	–
2018	NC-VT	6	3	59	3766.0	–	3987.9	517.8	76.3	–
2018	TN-VT	4	3	81	4304.0	–	4290.6	773.4	54.3	–
Avg.	4092.4	–	4382.5	484.0	78.4	–				

[a]AL, Alabama; AR, Arkansas; AYT, advanced yield trial; IN, Indiana; KY, Kentucky; LA, Louisiana; MD, Maryland; MO, Missouri; MS, Mississippi; NC, North Carolina; PYT, preliminary yield trial; TN, Tennessee; UP, Uniform Preliminary Group IV; UT, Uniform Tests; VT, State Variety trial.

[b]Check means for VTs are the same as test mean because all entries are elite high-yielding commercial and public cultivars.

[c]Relative ranking was calculated by the percentage of the line in comparison to the test. For example, ranking of 12.5% means the line is the top 12.5% of the test and yield better than 87.5% of the test.

the Soybean State Variety Tests program were analyzed individually by each program with their software of preference. Weighted averages for yields were calculated across tests, locations, and years, as appropriate for comparisons with checks and test means. S14-15146GT yields were compared with the check average and test mean as a percentile in all the trials. Overall relative ranking of S14-15146GT was calculated as percentages of yields in comparison to all lines tested in a trial.

3 | CHARACTERISTICS

3.1 | Botanical and seed quality traits

S14-15146GT is a late-maturity group IV (RM 4.6) indeterminate cultivar. It has white flowers, tawny pubescence, and tan pod walls. Seeds have black hilum, yellow cotyledon, and intermediate luster. S14-15146GT averaged 4 d earlier in maturity than the reference check Ellis (Pantalone,

TABLE 3 Yield of 'S14-15146GT' soybean in the preliminary yield trials (PYTs) and advanced yield trials (AYTs) at the University of Missouri Fisher Delta Research Center (2015–2018)

	Yield[a]				
	2015-PYT	2016-AYT	2017-AYT	2018-AYT	Average[b]
Cultivar	kg ha^{-1}				
S14-15146GT	4808	4573	3598	4190	4235
Check average[c]	4379	4350	4085	4242	4251
Test average	4369	4274.	3315	4008	3950
% Check	109.8	105.1	88.1	98.8	99.4
% Test mean	110.1	107.0	108.5	104.5	107.2
Relative ranking, %[d]	12.5	7.5	32.3	35.5	23.0
CV	8.4	9.0	18.0	10.4	–
LSD	255.6	139.2	201.8	128.7	–
Locations	3	5	5	5	–
Entries	24	28	32	32	–
Replication	1	3	3	3	–
Check cultivars	AG 3832, AG 4034, AG 4135, AG 4232, AG 4632	AG 4135, AG 4232, AG 4632, AG 4633, P47T36R	AG 43 × 7, AG 4632	AG 43 × 7, AG 4632, AG 46 × 7, P48T27X	

[a]Yield based on the average across all replications and locations.
[b]Weighted average calculated across all years of testing.
[c]Average of all check cultivars in the test across replications and locations.
[d]Relative ranking was calculated by the percentage of the line in comparison to the test. For example, ranking of 12.5% means the line is in the top 12.5% of the test and yield better than 87.5% of lines in the test.

Smallwood, & Fallen, 2017) and 3 d later than the reference check AG 4232 (Monsanto). The RM of S14-15146GT is ~4.6, which classifies as a late IV soybean. In the USDA Southern Uniform Soybean Tests (2016–2018), S14-15146GT plants averaged 87.2 cm tall, which is similar to the test average (86.0 cm) and check cultivars (84.6 cm) (Table 1). S14-1514GT seed weight averaged 14.6 g per 100 seeds, which is similar to the test average (14.1 g) and check mean (14.3 g). S14-15146GT seed protein content averaged 390.8 g kg^{-1} on a dry weight basis, which is numerically but not statistically lower than the test average (403.8 g kg^{-1}) and the check mean (399.4 g kg^{-1}). Seed oil content averaged 235.5 g kg^{-1} on a dry weight basis from 2016 to 2018. In 2016 and 2017, seed oil content was statistically higher than the test (229 and 223 g kg^{-1}, respectively) and check (230 and 219 g kg^{-1}, respectively) averages. In 2018, it was numerically but not statistically higher than the test (235 g kg^{-1}) and check (238 g kg^{-1}) averages. The lodging score of S14-15146GT was similar to checks and test mean.

3.2 | Agronomic performance

S14-15146GT was evaluated in a total of 130 environments across 10 states and demonstrated consistently equal or superior performance in yield to the commercial and public checks (Table 2). In the University of Missouri Fisher Delta Research Center trials (2015–2018), S14-15146GT averaged 4235 kg ha^{-1}, which was higher than the test average (3950 kg ha^{-1}) and similar to the check average (4251 kg ha^{-1}) (Table 3). Based on individual years, S14-15146GT had yields that were significantly higher than the test mean in all 4 yr. In comparison with the check cultivars, S14-15146GT yielded significantly higher than the check cultivars in 2015 and 2016 but yielded less than the check cultivars in 2017 and 2018. This could be associated with the severe dicamba herbicide off-target damage observed in field plots (Table 2). S14-15146GT ranked third in 2015 and in 2016. Across 18 locations, S14-15146GT placed among top 23% of all the test entries (relative ranking) and performed 107.2% of the test average and 99.4% of the check average overall (Table 3).

In the USDA Southern Uniform Soybean Tests from 2016 to 2018, S14-15146GT averaged 4239 kg ha^{-1} in 31 locations across nine states, which was higher than the check average (4093 kg ha^{-1}) and the test average (4010 kg ha^{-1}) (Table 4). When compared in individual years, S14-15146GT yielded significantly higher than the checks and test means in 2016, only numerically higher in 2018, and slightly lower in 2017. However, S14-15146GT placed first in 2016 and third in 2018. On average, it placed in the top 30.9% of all test entries (relative ranking) and yielded 105.7% of the test average and 103.7% of the check average (Table 4).

S14-15146GT averaged 4092 kg ha^{-1} at 81 locations across 10 states in the Soybean State Variety Test programs, which

TABLE 4 Yield of 'S14-15146GT' soybean in the USDA Southern Uniform Soybean Tests (2016–2018)

	Yield[a]			
	2016 USDA-UP	2017 USDA-UT	2018 USDA-UT	Average[b]
Cultivar	kg ha^{-1}			
S14-15146GT	4465	3900	4501	4239
Check average[c]	3921	4140	4232	4093
Test average	3974	3934	4176	4010
% Check	113.9	94.2	106.5	103.7
% Test	112.4	99.1	107.9	105.7
Relative ranking[d]	1.0	64.0	14.3	30.9
CV	13.2	14.0	12.7	–
LSD	385.3	342.9	490.9	–
Locations	10	13	8	–
Entries	24	24	15	–
Replication	2	3	3	–
Check cultivars	AG 3934, AG 4135, AG 4232, LD06-7620	AG 4632, AG 4835, Ellis, LD06-7620	AG 4135, AG 4232, AG 43 × 7, LD06-7620	–

[a]Yield based on the average across all replications and locations. UP, Uniform Preliminary Group IV; UT Uniform Tests.
[b]Weighted average calculated across all years of testing.
[c]Average of all check cultivars in the test across replications and locations.
[d]Relative ranking was calculated by the percentage of the line in comparison to the test. For example, ranking of 12.5% means the line is in the top 12.5% of the test and yield better than 87.5% of lines in the test.

TABLE 5 Yield of 'S14-15146GT' soybean in the Soybean State Variety Test program (2017–2018) in 81 environments across 10 states

					Yield[a]				
				Entries	S14-15146GT	Test average	LSD	Test[b]	
Year	State	Locations	Replications	*n*	kg ha^{-1}			%	Ranking[c]
2017	AR	3	3	33	4704	4808	410	97.8	65.7
2017	KY	8	3	8	4391	4593	289	95.6	76.2
2017	LA	5	3	5	4149	4358	397	95.2	81.1
2017	MD	3	3	3	4075	4317	329	94.4	96.3
2017	MO	4	3	4	3107	3705	229	83.8	97.3
2017	MS	11	3	11	4383	5071	699	86.4	93.5
2017	TN	6	3	6	3900	4371	538	89.2	95.3
2018	AL	9	3	30	3443	3712	316	92.8	70.9
2018	IN	1	3	12	4627	4916	403	94.1	83.3
2018	KY	5	3	68	3914	3766	215	103.9	45.6
2018	LA	5	3	40	3551	3665	424	96.9	72.0
2018	MD	4	3	19	4586	4997	652	91.8	90.8
2018	MO	7	3	49	4876	5098	800	95.6	72.9
2018	NC	6	3	59	3766	3988	518	94.4	76.3
2018	TN	4	3	81	4304	4291	773	100.3	54.3
Average[d]	4092	4382	–	93.5	78.4				

[a]Yield based on the average across all replications and locations.
[b]Test represents the percentage of S14-15146GT to the test average.
[c]Relative ranking was calculated by the percentage of the line in comparison to the test. For example, ranking of 12.5% means the line is the top 12.5% of the test and yield better than 87.5% of lines in the test.
[d]Weighted average calculated over all environments of testing.

was similar ($LSD_{0.05}$) to the test average in 14 out of 15 trials (4382 kg ha^{-1}) (Table 5), indicating that S14-15146GT was competitive with current popular commercial cultivars and elite lines. Overall, it yielded 93.5% of the test average and placed in the top 78.4% of all test entries (relative ranking) (Table 5). The Soybean State Variety Test entries consisted of elite high-yielding commercial and public varieties.

Based on the USDA Southern Uniform Soybean Tests screening, S14-15146GT is resistant to stem canker and susceptible to SCN and RKN (Gillen & Shelton, 2017, 2018, 2019). It is resistant to FLS and PRR (disease scores similar to resistant checks; data not shown) and moderately resistant to sudden death syndrome and CR. S14-15146GT is a chloride includer that is widely adapted to all types of soils in the mid-south and southern states, but it is not recommended in areas where nematodes are a problem.

4 | AVAILABILITY

S14-15146GT was rogued for off-type plants on the basis of flower, pubescence and pod wall color, plant height, and maturity. Seeds were grown in foundation seed in 2017 (1.5 ha) and 2018 (5.5 ha) by the University of Missouri Foundation Seed Program, Columbia, MO. The Missouri Foundation Seed Program, managed by the Missouri Crop Improvement Association, will produce and distribute foundation seed of S14-15146GT. Breeder seed of S14-15146GT was screened for unintended transgenic traits by Eurofins BioDiagnostics for genetic purity. The breeder seed will be maintained by the Missouri Agriculture Experiment Station at the University of Missouri Fisher Delta Research Center. Seed of S14-15146GT has been deposited to the USDA Soybean Germplasm Collection at Urbana, IL, and to the USDA-ARS National Laboratory for Genetic Resources Preservation at Fort Collins, CO. A small quantity of seed for research purposes including the development of new cultivars may be obtained from the corresponding author during the next five years through a material transfer agreement. It is requested that proper recognition be made if S14-15146GT is used for breeding and contributes to a release of germplasm or cultivar.

ACKNOWLEDGMENTS

We thank Missouri Soybean Merchandising Council for the funding support that helped the development of this variety and Jared Brands, Jamie Manuel, Morgan Perkins, Billy Becker, Terkrisha Durden, Audrey Rogers, Mallary Hoggard, and John Chester for technical support in the development of S14-15146GT. Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the USDA. The USDA is an equal opportunity provider and employer.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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How to cite this article: Chen P, Shannon G, Scaboo A, et al. Registration of 'S14-15146GT' soybean, a high-yielding RR1 cultivar with high oil content and broad disease resistance and adaptation. *J. Plant Regist.* 2020;14:35–42. https://doi.org/10.1002/plr2.20018