

APPLICATION FOR APPROVAL OF __X__ CULTIVARS ____ ASSOCIATE CULTIVARS

(Please check appropriate type of application)

1. **Crop:** Soybean (*Glycine max* L. Merr.)
2. **Experimental no. or name:** G99-G104111
3. **Pedigree and history:** This strain originated from the DNA marker-assisted backcross of Prichard (4) x [a F2 plant from Resnik(2)-RR]. Prichard is a productive MG VIII cultivar developed at University of Georgia. Resnik(2)-RR F2 seed was provided to the University of Georgia Research Foundation, Inc. (UGARF) by the Monsanto Company in May 1996 via a research agreement (Monsanto-UGARF RR Agreement). Resnik is a MG III cultivar developed at Ohio State University. The donor of the Roundup Ready® (RR) transgene that was initially crossed with Resnik was not disclosed to UGARF in the Monsanto-UGARF RR Agreement. It can be inferred from the literature that the RR transgene in Resnik(2)RR was derived directly from 40-3-2 or a line derived from 40-3-2 (Padgett, et al., 1995). The glyphosate tolerant line 40-3-2 was developed by transformation of cultivar A5403 with the bacteria 5-enolpyruvylshikimate-3-phosphate synthase enzyme from *Agrobacterium* sp. strain CP4. The Monsanto-UGARF RR Agreement requires the use of Roundup herbicide (active compound = glyphosate) in all screening experiments for glyphosate tolerance and its application on all seed increases of potential cultivars developed with the RR transgene.

The initial cross of Prichard x Resnik(2)RR was made in August 1996. The BC1F1, BC2F1, and BC3F1 generations were produced by crossing glyphosate-tolerant F1, BC1F1, and BC2F1 plants with Prichard. In the BC3F1 generation 42 glyphosate tolerant plants were selected. Additional data on these 42 BC3F1 plants were collected for 58 polymorphic simple sequence repeat (SSR) markers. These markers were selected to achieve an even marker distribution across the soybean genome (approximately three equally spaced markers/linkage group) (Cregan et al., 1999). Three BC3F1 plants were selected that were homozygous for Prichard marker alleles at 55 of the 58 markers.

In October of 1998 seed of the BC3F2 generation were planted in the greenhouse and in Puerto Rico. Three weeks after planting the plants were screened for glyphosate tolerance. The glyphosate-tolerant plants were assayed for the SSR markers that were heterozygous for the Prichard marker alleles in the BC3F1s (maximum of three markers/BC3F1 family). Forty-four plants were selected that were homozygous for the Prichard marker alleles at all but one marker. It was assumed that the one SSR marker at which we were unsuccessful in identifying plants homozygous for the Prichard marker allele resides near the RR transgene. The Monsanto-UGARF RR Agreement prohibits the University of Georgia from mapping the RR gene or disclosing its genomic location.

A plant row of each selected plant (plants that were homozygous for Prichard alleles at 57 of the 58 markers) was grown in Puerto Rico from February 1999 to May 1999. Based on the three backcrosses to Prichard and the marker selection for Prichard SSR alleles (57 of 58 markers homozygous for Prichard marker alleles), the lines derived from these 44 plants are assumed to be similar to conventionally derived BC5 lines. Roundup was applied to the plant rows to identify rows that were homogenous for the RR transgene. Twelve lines that were homogenous for glyphosate tolerance were individually harvested and their seed returned to Georgia.

During the summer of 1999 the 12 lines were evaluated in two replicated field tests, in several replicated greenhouse nematode tests, and the remnant seed was increased at the Plant Sciences Farm near Athens GA. Three lines that were similar to Prichard in agronomic performance (Table 1), resistance to soybean cyst nematode, *Heterodera glycines*, Race 3 [SCN(R3)] and Race 14 [SCN(R14)] and southern root-knot nematode (*Meloidogyne incognita*) (Table 5), and phenotypic appearance were composited to create breeder seed of G99-G104111. The Georgia Seed Development Commission obtained two cycles of winter seed increase of G99-G104111 (planted November 1999 and March 2000 near Ponce, Puerto Rico). During the summer of 2000 G99-G104111 was evaluated in Georgia and Florida Variety Trials and 340 acres of foundation seed was planted in Georgia.

4. Description: G99-G104111 is a Maturity Group VIII, glyphosate-tolerant strain (Table 7) with white flowers, gray pubescence, and tan pod walls. In Georgia, it averages the same day in maturity as Prichard (Tables 1, 2, and 3). It has yellow seeds with shiny seed coats and buff hila. Seed of G99-G104111 average 6 to 8 mg/seed smaller than Prichard (Tables 1, 2, and 3). G99-G104111 possesses resistance to SCN(R3), SCN (R9), SCN(R14), southern root-knot nematode, and stem canker (*Diaporthe phaseolorum* var. *meridionalis*) (Table 5). G99-G104111 is similar to Prichard in protein and oil composition (Table 6). G99-G104111 is susceptible to reniform nematode (*Rotylenchulus reniformis*), peanut root-knot nematode (*M. arenaria*), and javanese root-knot nematode (*M. javanica*).

5. Station(s) where developed: College and Georgia

6. Participating scientist(s): H.R. Boerma, R.S. Hussey, and D.V. Phillips

Copy of the appropriate and adequate data comparing proposed release to standard cultivar must be attached to this form.

7. In what respect is the new cultivar superior to the cultivar now in use? or reasons for proposing release as an associate cultivar.

The USDA Crop Reporting Service has estimated that 55% of U.S. soybean acreage was planted Roundup Ready® soybean cultivars in 2000. In the southeastern USA soybean growers prefer MG VII and VIII soybean cultivars. There are few MG VII or VIII Roundup Ready® cultivars on the market. Of the ones that are available only Hartz H7550RR is currently recommend in Georgia. In 2000, the Monsanto Company elected to discontinue testing Hartz H7550RR in the Georgia and Florida Performance Trials.

G99-G104111 is tolerant to applications of recommended herbicidal rates of glyphosate. Herbicidal rates of glyphosate (Roundup Ultra) were applied to G99-G104111 in replicated field tests (Athens, 1999; Griffin, 2000; Plains, 2000), and in all of its seed increases (Puerto Rico, February 1999; Athens, 1999; Puerto Rico November, 1999; Puerto Rico March 2000; and Georgia 2000). In a December 2000 greenhouse experiment we applied recommended rates of Roundup Ultra to 25 plants each of G99-G104111 and Prichard. Five days after treatment all 25 Prichard plants were severely stunted while the 25 G99-G104111 plants appeared healthy. In 2000 a replicated experiment that evaluated several herbicidal treatments of Roundup Ultra was grown at three Georgia locations (Table 7). Even at the highest treatment rate (V1,V3+3 treatment, total of 96 oz. of Roundup Ultra), there was not a significant yield reduction to G99-G104111 when compared to the hand-weeded control treatment (0 oz. of Roundup Ultra). The

Monsanto Company defines commercial glyphosate tolerance or "Roundup Ready®" as a cultivar that shows no significant difference in yield at the 95% confidence level between the control treatment and treatments receiving applications of 64 oz. of Roundup Ultra (i.e., V3 or V3+3 treatments). Thus, G99-G104111 meets the required level of tolerance to be labeled as Roundup Ready®.

Prichard is recommended for both early and late planting in Georgia's Coastal Plain and Piedmont regions. G99-G104111 is glyphosate tolerant (Roundup Ready®) and similar to Prichard in agronomic performance (Tables 1, 2, 3, and 4), pest resistances (Table 5), and seed composition (Table 6).

8. **Method of propagation:** seed
9. **Amount of breeder seed stocks available (if applicable):** 8 bu. (Spring/2001)
10. **Amount of foundation seed stocks available:** 500 bu. (Spring/2001) and 10,000 bu. of certified seed (Spring/2001)
11. **Amount of cutting or bud material available for vegetatively propagated material for nursery distribution (if applicable):**
12. **Is there likely to be unusual difficulty encountered in the production of any class of seed stocks? Explain.** No
13. **Three suggested names for the cultivar:** It is recommended that the organization that obtains a license from UGARF to market G99-G104111 be allowed to participate in selection of the name (or number) of this cultivar.
14. **Name approved by plant cultivar and germplasm release committee:**
15. **Form of intellectual property protection:** Plant Variety Protection Act
16. **Is a royalty assessment recommended:** Yes No

Literature Cited:

Cregan, P.B, R. Jarvik, A.L. Bush, R.C. Shoemaker, K.G. Lark, A.L. Kahler, N. Kaya, T.T. VanToai, D.G. Lohnes, J. Chung, and J.E. Specht. 1999. An integrated genetic linkage map of the soybean genome. *Crop Sci.* 39:1464-1490.

Padgett, S.R., K.H. Kolacz, X. Delannay, D.B. Re, B.J. LaValle, C.N. Tinus, W.K. Rhodes, Y.I. Otero, G.F. Barry, D.A. Eichholtz, V.M. Peschke, D.L. Nida, N.B. Taylor, and G.M. Kishore. 1995. Development, identification, and characterization of a glyphosate-tolerant soybean line. *Crop Sci.* 35:1451-14621.

RECOMMENDED BY:

A. H. Roger Boerman
Originating Scientist 12/12/00

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APPROVED:

Dean and Director
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Table 1. Range and mean of the three lines composited to create G99-G104111 across two locations (Athens and Plains, GA) in 1999.

Strain	Seed yield bu/a	Maturity date	Plant height in.	Lodging rating ¹	Seed weight mg/seed
Range of three lines composited to create G99-G104111	36.8 to 37.1	11-6 to 11-7	40 to 41	3.0 to 3.0	129 to 134
Range of four entries of Prichard	36.6 to 39.6	11-6 to 11-7	40 to 41	3.0 to 3.0	137 to 139
G99-G104111	36.9a ²	11-6a	40a	3.0a	132a
Prichard	38.2a	11-6a	40a	3.0a	138a

¹Rating: 1 (all plants erect) to 5 (over 80% of plants prostrate).

²Means followed by a different letter are significantly different based on LSD (0.05).

Table 2. Mean performance of G99-G104111 and Prichard in 11 Georgia and Florida trials in 2000.

Strain	Seed yield bu/a	Maturity date	Plant height in.	Lodging rating ¹	Seed weight mg/seed	Seed quality rating ²
G99-G104111	46.9a	10-24a	36a	1.6a	135a	1.4a
Prichard	44.6a	10-24a	36a	1.7a	143b	1.4a

¹Rating: 1 (all plants erect) to 5 (over 80% of plants prostrate).

²Rating: 1 (very good) to 5 (very poor).

³Means followed by a different letter are significantly different based on LSD (0.05).

Table 3. Mean performance of G99-G104111 and Prichard at two soybean cyst nematode Race 3 infested environments (Athens and Midville, GA) in 2000.

Strain	Seed yield bu/a	Maturity date	Plant height in.	Lodging rating ¹	Seed weight mg/seed	Seed quality rating ²
G99-G104111	42.4a ³	10-26a	38a	2.0a	126a	1.0a
Prichard	42.2a	10-25a	37a	1.3a	133b	1.0a

¹Rating: 1 (all plants erect) to 5 (over 80% of plants prostrate).

²Rating: 1 (very good) to 5 (very poor).

³Means followed by a different letter are significantly different based on LSD (0.05).

Table 4. Mean seed yield of G99-G104111 and Prichard in 15 environments in 1999 and 2000.

Strain	1999 tests (2) ¹	2000 variety tests (11)	2000 SCN (R3) tests (2)	Grand mean (15)
	-----bu/a-----			
G99-G104111	36.9a ²	46.9a	42.4a	45.0a
Prichard	38.2a	44.6a	42.2a	43.4a

¹Number of environments

²Means followed by a different letter are significantly different based on LSD (0.05).

Table 5. Mean ratings for southern root-knot nematode, peanut root-knot nematode, and stem canker and reaction to three races of soybean cyst nematode of G99-G104111, Prichard, and check cultivars .

Strain	Southern root-knot			Peanut root-knot			Soybean cyst			Stem canker	
	1999	2000	Mean	1999	2000	Mean	Race 3	Race 9	Race 14	2000	Calhoun
	rating ¹			rating ¹			reaction ²			rating ³	
G99-G104111	1.0	1.0	1.0	3.0	4.0	3.5	R	R	R	0.0	0.0
Prichard	1.0	1.0	1.0	4.3	4.2	4.2	R	R	R	0.0	0.0
Haskell	1.0	1.2	1.1	1.3	2.0	1.6	S	S	S	0.3	0.3
Gasoy17	5.0	4.8	4.9	5.0	3.8	4.4	S	S	S	-	-
CNS	-	5.0	5.0	5.0	4.2	4.6	S	S	S	-	-
Bossier	5.0	5.0	5.0	-	3.5	3.5	S	S	S	-	-
TN6-90	-	4.8	4.8	-	4.0	4.0	R	R	R	-	-
G81-2057	-	-	-	-	-	-	-	-	-	8.3	8.3
Hutton	-	-	-	-	-	-	-	-	-	8.0	8.0
LSD(0,05)	1.1	1.2	-	1.4	1.3	-	-	-	-	1.4	1.4

¹Rating: 1 (few galls) to 5 (many galls).

²Reaction: R=resistant and S=susceptible.

³Rating: 0 (0% dead plants) to 9 (90 to 100% dead plants).

Table 6. Seed protein and oil composition of G99-G104111 and Prichard in 1999 and 2000.

Strain	1999 (mean of 2 locations)		2000 (mean of six locations)	
	Protein	Oil	Protein	Oil
	%	%	%	%
G99-G104111	42.7a ¹	18.3a	43.1a	19.3a
Prichard	42.2a	18.6a	43.5a	19.3a

¹Means followed by a different letter are significantly different based on LSD (0.05).

Table 7. Effect of various Roundup Ultra applications on the seed yield of G99-G104111 in 2000.

Roundup Ultra application ¹	Athens, GA	Midville, GA	Plains, GA	Mean
	bu/a	bu/a	bu/a	bu/a
None	50.9a ²	40.2ab	52.6a	47.9a
V3	47.3a	39.1a	53.2a	46.5a
V3+3	45.5a	46.4b	47.1a	46.3a
V1, V3+3	48.2a	44.4ab	50.4a	47.7a

¹ V3 = 64 oz. of Roundup Ultra applied at the third soybean trifoliolate leaf stage; V3+3 = 64 oz. of Roundup Ultra applied at 3 weeks after the third soybean trifoliolate leaf stage; V1, V3+3 = 32 oz. of Roundup Ultra applied at the first soybean trifoliolate leaf stage followed by 64 oz. of Roundup Ultra applied at 3 weeks after the third soybean trifoliolate leaf stage.

²Means followed by a different letter are significantly different based on LSD (0.05).