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‘ST-5’, a Shade-tolerant Turf Bermudagrass

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‘ST-5’ turf bermudagrass is an interspecific [*Cynodon transvaalensis* Burt-Davy × *C. dactylon* (L.)] shade-tolerant triploid (2n = 3x = 27 chromosomes) hybrid cultivar released cooperatively by the University of Georgia College of Agricultural and Environmental Sciences and the U.S. Department of Agriculture, Agricultural Research Service. ‘ST-5’ was selected in 1993 from 27,700 hybrids made in 1992. This cultivar is a male and female sterile perennial plant that is vegetatively propagated. It has been tested from 1993 through 2007 in numerous replicated tests and at a number of locations. ‘ST-5’ has performed well under normal sunlight in the National Turfgrass Evaluation Program (NTEP) and under up to 70% continuously reduced photosynthetically active radiation light in the 400- to 700-nm wavelength range at Tifton, GA, measured with a Spectrum Technologies, Inc. Dual Radiation Meter (Spectrum Technologies, Inc., Plainfield, IL) at the level of the bermudagrass sod. Shade studies were conducted under a rain-out shelter (opposite end of the shelter used for drought tolerance research) with a fiberglass roof 1.8 m above the plots and which extended 2.7 m beyond the perimeter of the experiments (each plot was 1.8 × 1.8 m in size). Plots had continuous shade except when it rained and the shelter cover moved to the drought-tolerance plots.

Origin

Bermudagrass cultivars are widely used in landscaping, home lawns, and on golf courses, but in general do not tolerate shade. The overall turfgrass breeding program at Tifton includes improving the genetic diversity and shade tolerance of ‘Tift’ hybrids. In 1992, we crossed six *C. transvaalensis* breeding lines (“T” numbers) from Tifton (T572, T573, T574, T575, T576, and T577) selected for their persistence under low management in our breeding nursery with four *C. dactylon* [T90 and T110 (selected for persistence under close mowing) and ‘Quickstand’ and ‘VaMont’ (selected for cold tolerance)] parents at Tifton, GA. Crosses were made in the field by surrounding each *C. transvaalensis* parent with a *C. dactylon* parent in 1.8-m square plots. All crosses were in close proximity of each other so we cannot rule out intercrossing between and among plots. On 7 May 1993, we planted over 27,700 progenies from the 24 cross combinations on 45-cm centers. Once established, plots were mowed three times per week at a 6-mm height. In the fall of 1993, we selected 260 plants (194 were triploid hybrids) that maintained density, color, and tawny mole cricket (*Scapteriscus vicinus Scudder*) resistance for further testing. One selection, 93-92, was later tested as 94-18, 97-4, 00-07, and Tift #4 and became ‘ST-5’ (ST for shade-tolerant). In the fall of 1993, we made a note that ‘ST-5’ was a “nice dwarf.” It has been tested since 1997 in three field (three replications per test) and three shade (four replications per test) at Tifton, GA, in 23 tests in 19 states in the NTEP trials in one test each in Texas and Arizona and in three tests for insect resistance at Griffin, GA. ‘ST-5’ has also been evaluated in six nonreplicated lawn and golf course roughs and tee plantings. In nonreplicated lawns, ‘ST-5’ rated 7 or 8 for turf quality (1 = poor and 9 = excellent) under up to 70% shade. At greater than 85% shade (where Tifway would not grow), ‘ST-5’ rated 4 for turf quality. At Tifton, GA, ratings are taken monthly from April to November and no insecticides, fungicides, or herbicides [except for 1.12 kg·ha^{-1} of Atrazine (Helena Chemical Company, Collierville, TN) in March] were applied to the plots. Plots with and without shade at Tifton, GA, received 4.9 g·m^{-2} nitrogen per month and were mowed three times per week at 12 mm. The “turf quality” rating is a general rating in which density, color, texture, pest resistance, and so on, are considered for evaluating the desirability of the turf. Experiments were randomized complete blocks and data were analyzed using PROC GLM of PC SAS (Statistical Analysis Institute, 2004).

Description and Performance

In 1993, we classified the selections we made in the fall of 1993 into very dwarf, dwarf, and ‘Tifway’ types. ‘ST-5’ was in the dwarf class and therefore one of our original controls in the 1997 planted test were Tifdwarf (Burton, 1966b). ‘ST-5’ has shown significantly more shade tolerance (1 = poor, 9 = excellent) than Tifway (Burton, 1966a) and TifSport (Hanna et al., 1997), especially after the first year of establishment (Table 1). Another replicated test planted in 2000 in

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Table 1. Mean turfgrass quality of ‘ST-5’ and bermudagrass cultivars evaluated under 70% continuous shade[z] (planted May 2002) at Tifton, GA.

Bermudagrass cultivar[y]	June		Aug.		Nov.	Oct.	Mean	
	2003	2004	2003	2004	2003	2004	2003	2004
	Turfgrass[x] quality							
Tifway	4.5	5.5	4.1	4.5	5.0	4.4	4.4	4.5
TifSport	4.1	5.5	4.1	3.8	4.9	5.1	4.2	4.6
ST-5	7.9	7.8	8.1	6.1	8.4	8.0	7.8	7.3
LSD[w]	2.0	2.1	2.1	1.8	1.1	2.0	1.1	1.2

[z]Measured photosynthetically active radiation at ground level relative to conditions under full sunlight under a rain-out shelter with a fiberglass roof 1.8 m above the plots.
[y]Test was a randomized complete block with four replications and included four additional putative shade-tolerant hybrids.
[x]Visual turfgrass quality rating on scale of 1 to 9 with 1 = poor and 9 = excellent. A rating of 7 is considered acceptable turf quality.
[w]Least significant difference at the $P \leq 0.05$ level.

Table 2. Mean turfgrass quality of 'ST-5' and bermudagrass cultivars evaluated under full sunlight in Tifton, GA [29 entry test planted as randomized complete block (three replications) in 2000], Maricopa, AZ (planted in 1997), and College Station, TX [15 entry test planted as split block (six replications) in 1997] at varying mowing heights.

	Georgia						Arizona	Texas
	2001[z]	2002[y]	2003[x]		2004[w]		1997[v]	1998[u]
	Mowing ht (mm)							
Bermudagrass cultivar	12	12	6	12	6	12	6	4.6
	Turfgrass quality[t]							
Tifdwarf	6.6	5.3	2.3	3.7	2.9	2.1	4.8	5.1
Tifway	7.2	7.0	6.4	7.8	6.1	6.7	5.1	5.2
TifSport	7.3	6.9	6.2	7.0	5.6	6.2	—	—
ST-5	7.1	6.8	7.9	6.9	6.7	7.7	6.8	5.4
LSD[s]	0.3	0.2	0.2	0.2	2.0	1.4	0.7	0.6

[z]Mean of two evaluation dates.
[y]Mean of six evaluation dates.
[x]Mean of four evaluation dates.
[w]Mean of seven evaluation dates.
[v]Rated on 8 Oct.
[u]Mean of seven evaluation dates.
[t]Visual turfgrass quality rating on a scale of 1 to 9 with 1 = poor and 9 = excellent. A rating of 7 is considered acceptable turf quality.
[s]Least significant difference at the $P \leq 0.05$ level.

Table 3. Measurements on bermudagrass cultivars[z] for resistance to dollar spot and spring dead spot in the National Turfgrass Evaluation Program (2003–2006 trial, www.ntep.org).

Bermudagrass cultivars	Turf quality[y]	Dollar spot rating[x]	Spring dead spot infection area per plot (cm^2)[w]
Highest ranked cultivar	6.3	8.7	3
Tifway	6.2	8.3	137
TifSport	6.3	7.7	4
ST-5	6.2	8.2	258
Lowest ranked cultivar	5.0	6.7	1586
LSD[v]	0.2	0.9	869

[z]Trial contained 42 bermudagrass entries.
[y]Visual turfgrass quality rating on a scale of 1 to 9 with 1 = poor and 9 = ideal turf.
[x]Dollar spot rating: 9 = no disease.
[w]Spring dead spot: mean of measurements from Oklahoma from 2004–2006.
[v]Least significant difference at the $P \leq 0.05$ level.

60% continuous reduced light in the 400- to 700-nm range showed similar results with end-of-year turf quality rating (for 2000 and 2001) of 5.5 and 5.3, 6.0 and 6.0, and 6.3 and 7.8 for Tifway, TifSport, and 'ST-5', respectively (least significant difference $\leq 0.05 = 1.6$ and 1.1 in 2000 and 2001, respectively). Turf quality for 'ST-5' under normal light is as good or better than Tifway and TifSport (Table 2). Mean turf quality ratings for 'ST-5' were not significantly different ($P \leq 0.05$) from the top performing cultivars among 42 entries tested at 21 locations in 18 states in the 2003–2006 NTEP trials (www.ntep.org) (Table 3). In the same NTEP trials, 'ST-5' was not significantly different ($P \leq 0.05$) for dollar spot, *Sclerotinia homoeocarpa*, and spring dead spot, *Ophiosphaerella* sp., than the most resistant cultivars (Table 3). It produces a small seed head on a thin peduncle in late May and June (typical of bermudagrass). In most years, 'ST-5' tends to produce significantly more seed heads than Tifway and TifSport under nonshade conditions at a 12-mm mowing height, but the number of seed heads can be reduced 25% to 37% by treating monthly with trinexapac-ethyl (4-cyclopropyl-a-hydroxy-methylene-3,5-dioxocyclohexanecarboxylic acid ethyl ester) or Primo (data not shown). Seed heads were also reduced by 65% when mowed three times per week at a height of 24 mm compared with 12 mm (data not shown). 'ST-5' is a naturally darker green grass. 'ST-5' plant color is as good or better than for Tifway or TifSport (Table 4). In field plots where other grass cultivar/genotypes were present, 'ST-5' had significantly better tawny mole cricket resistance than Tifway or TifSport (Table 5). However, in greenhouse studies under no-choice conditions, 'ST-5' had a higher population of mole crickets after 30 d than TifSport but showed a similar-response as Tifway and Tifdwarf (Table 6). These data indicate a nonpreference type of resistance under field conditions. 'ST-5' has similar resistance to the two-lined spittle bug [*Prosapia bicincta* (Say)] and fall army worm [*Spodoptera frugiperda* (J.E. Smith)] as Tifway, Tifdwarf, and TifSport (data not shown), but less resistance to the bermudagrass mite [*Aceria cynodoniensis* (Sayed)] (Table 7); however, the bermudagrass mite is mainly a problem on stressed grass.

Culture

'ST-5' can be vegetatively propagated by sprigs, sod, or plugs using standard equipment in the turf industry. Fertilization requirements are similar to Tifway and TifSport. Clipping removal is recommended when 'ST-5' is grown in full sun to reduce thatch development. The 'ST-5' genotype appears to be stable and has maintained morphological uniformity. No seed or pollen is produced by 'ST-5', so the cultivar

Table 4. Mean turfgrass color of 'ST-5' and bermudagrass cultivars evaluated under full sunlight in Tifton, GA [29 entry test planted as randomized complete block (three replications) in 2000] at varying mowing heights.

	2001[z]	2003[y]	
	Mowing ht (mm)		
Bermudagrass cultivar	12	6	12
	Turfgrass color[x]		
Tifdwarf	6.8	2.8	6.0
Tifway	7.5	6.4	7.0
TifSport	7.8	6.2	7.0
ST-5	7.8	7.9	8.3
LSD[w]	0.3	0.2	0.2

[z]Mean of 26 Oct. and 19 Dec. evaluation dates.
[y]Rated on 7 Sept.
[x]Visual turfgrass color rating on a scale of 1 to 9 with 1 = brown and 9 = dark green.
[w]Least significant difference at the $P \leq 0.05$ level.

Table 5. Mean bermudagrass cultivar response to the tawny mole cricket (*Scapteriscus vicinus*) were evaluated under full sunlight in Tifton, GA [29 entry test planted as randomized complete block (three replications) in 2000] at varying mowing heights.

	2001[z]	2002[y]	2003[x]		2004[w]	
	Mowing ht (mm)					
Bermudagrass cultivar	12	12	6	12	6	12
	Turfgrass damage[v]					
Tifdwarf	3.3	5.3	9.0	8.3	8.2	7.8
Tifway	2.0	2.0	6.0	3.0	2.2	2.7
TifSport	2.3	2.7	5.3	3.0	2.7	3.4
ST-5	1.7	2.0	1.0	1.7	1.8	2.2
LSD[u]	0.4	0.5	0.2	0.2	0.3	0.8

[z]Rated 19 Dec.
[y]Rated 8 Sept.
[x]Rated 7 Sept.
[w]Mean of three evaluation dates.
[v]Visual turfgrass damage rating on a scale of 1 to 9 with 1 = no damage and 9 = severe damage. A rating of less than 3 is desirable.
[u]Least significant difference at the $P \leq 0.05$ level.

Table 6. Mean turfgrass cultivar response to tawny mole cricket (*Scapteriscus vicinus*) as evaluated in no-choice greenhouse trials.[z]

Bermudagrass cultivar	Dry root wt (% of control)	Eggs after 30 d (number)	Crickets after 30 d (number)
Tifdwarf	44	7.9	3.0
Tifway	52	5.2	2.8
TifSport	67	0.0	1.8
ST-5	35	22.0	2.8
LSD[y]	NS	13.0	1.0

[z]This trial contained 10 additional experimental hybrids.
[y]Least significant difference at the $P \leq 0.05$ level.
NS = nonsignificant.

basically stays where you plant it. 'ST-5' is recommended for lawns, tees, fairways, roughs, and other landscapes where sunlight is reduced up to 70%.

Table 7. Mean turfgrass response of 'ST-5' and bermudagrass cultivars to the bermudagrass mite (*Eriophyes cynodoniensis*) as evaluated in no-choice experiments.

Bermudagrass cultivar	Expt. A[z]	Expt. B[z]
	Turfgrass resistance[y]	
Tifway	5.6	4.8
TifSport	4.6	4.9
ST-5	3.7	3.0
LSD[x]	0.7	0.6

[z]Each value is a mean of 24 replications.
[y]Visual turfgrass resistance rating on a scale of 1 to 9 with 1 = no resistance and 9 = high resistance.
[x]Least significant difference at the $P \leq 0.05$ level.

Availability

A U.S. Plant Patent for 'ST-5' has been applied for on behalf of the University of Georgia. Breeder planting material is maintained in the breeder nursery at Tifton, GA. As a patented cultivar, 'ST-5' can only be produced by licensed growers under guidelines established by the University of Georgia Research Foundation in conjunction with the Georgia Seed Development Commission. Contact the GSDC (http://www.gsdc.com) for information on availability.

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