

# Heat stress separates old and new bentgrasses

Cultivars vary in their responses to summertime stress.

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For much of the 20th century, Southeastern U.S. golf courses used bermudagrasses (*Cynodon dactylon* and hybrids) for putting greens. However, the harsh winters of 1984 and 1985 inflicted damage to many greens and prompted many Southern golf course superintendents to use creeping bent-

grass (*Agrostis palustris*) — particularly Penncross (2) — despite the species' poor acclimation to extreme heat.

Since then, the number of creeping bentgrass cultivars has increased. Many of the newer cultivars have greater shoot densities, finer leaf texture and more upright growth than Penncross



Photo courtesy of Michael Toubakarlis

Heat-tolerant bentgrass cultivars have become common on Southern golf courses, such as the Walker Course at Clemson University, which features Crenshaw on its greens.

## KEY POINTS

- Newer bentgrass cultivars produce higher quality turf under Southern summer heat stress than older cultivars.
- When recovering from midsummer mechanical injury, Penncross, an older creeping bentgrass variety, can still outperform even the best new cultivars.
- Fall mechanical injuries heal more quickly in some stands of the newer cultivars than in older varieties.

(2,3), which was long the industry standard. Still, even these advanced creeping bentgrass cultivars often decline in the hot and humid summers of the Southeast (1,4).

A cool-season (C<sub>3</sub>) turfgrass species, creeping bentgrass is adapted to summertime temperatures of 60 to 75 F (1), but temperatures in the Southeast often

exceed 95 F in summer. Southern golf courses with bentgrass often devote a majority of their labor to managing heat and other everyday summer stresses. The consequences of these temperatures include increased disease susceptibility, shortened roots, wilting or dry spots, slowed recovery from play and a decrease in turf quality.

## Summer quality

Variety	1998	Variety	1999
Penn A-4	8.4 a	Penn A-4	8.3 a
Penn A-1	8.2 a	Penn G-2	8.3 a
Penn G-2	8.2 a	Penn A-1	8.2 a
Crenshaw	7.8 b	Lofts L-93	7.9 b
Penn G-6	7.8 b	Penn G-6	7.8 b
Lofts L-93	7.8 b	Penn G-1	7.8 b
Penn G-1	7.8 b	Crenshaw	7.7 bcd
Crenshaw/Cato blend	7.7 bc	SR 1020	7.7 bcd
SR 1020	7.6 bcd	Cato	7.7 bcd
SR 1119	7.4 de	Crenshaw/Cato Mix	7.6 de
Cato	7.4 de	Pennlinks	7.6 de
Providence (SR 1019)	7.4 de	Viper	7.5 ef
Viper	7.3 ef	Dominant Mix	7.4 f
Dominant blend	7.3 ef	SR 1119	7.3 fg
Southshore	7.3 ef	Putter	7.3 fg
Putter	7.3 ef	Southshore	7.2 g
Pennlinks	7.2 f	Providence (SR 1019)	7.2 g
Regent	7.0 fg	Mariner	7.0 h
Mariner	6.9 g	Regent	6.9 h
Penncross	6.8 g	Penncross	6.9 h

Quality ratings are based on a visual scale of 1-9, with 1 representing dead turf, and 9 representing highest-quality turf. Ratings were taken weekly for June, July and August, and data shown are averages (means) of these. Means followed by the same letter are not significantly different from each other.

**Materials and methods**

A study at Clemson University during 1998 and 1999 investigated 20 creeping bentgrass cultivars for turf quality and recovery ability in a heat stress environment.

Twenty creeping bentgrass cultivars were grown on a USGA-style research green in full sunlight at Clemson (5).

Each cultivar was replicated three times, in individual plot sizes 4.5 feet by 7.5 feet, in a randomized complete design. Plots were seeded on Oct. 1, 1997, at 1.5 pounds per 1,000 square feet. The green was maintained by the Walker Golf Course crew and mowed at  $\frac{1}{64}$ - to  $\frac{1}{32}$ -inch height and received approximately  $\frac{3}{4}$  inch of irrigation every three to four

## Bentgrass recovery from June injury

Variety	1998			1999		
	2 weeks	6 weeks	10 weeks	2 weeks	6 weeks	10 weeks
Penncross	8 a	43 a	83 a	3 a	33 a	76 a
Southshore	8 a	41 ab	77 a-e	2 ab	32 ab	69 ab
Putter	7 abc	41 ab	79 abc	1 ab	32 ab	71 ab
Viper	7 abc	38 a-d	74 a-f	1 ab	29 a-e	69 ab
Mariner	6 a-d	39 abc	70 c-g	1 ab	31 abc	67 bcd
SR 1020	6 a-d	37 a-d	73 b-f	1 ab	24 d-g	55 gh
Pennlinks	6 a-d	41 ab	82 ab	0 b	32 ab	70 ab
Cato	6 a-d	30 cde	69 d-h	1 ab	28 a-g	64 b-f
SR 1119	6 a-d	37 a-d	73 b-f	0 b	25 c-g	60 d-g
Crenshaw/Cato blend	5 b-e	31 cde	65 f-i	2 ab	30 a-d	68 abc
Lofts L-93	5 b-e	36 a-e	68 e-h	1 ab	26 b-g	60 d-g
Dominant blend	4 c-f	34 a-e	76 a-e	2 ab	30 a-d	65 b-e
Regent	4 c-f	36 a-e	78 a-d	0 b	28 a-f	70 ab
Crenshaw	4 c-f	33 b-e	68 d-h	0 b	25 c-g	61 c-g
Penn A-1	3 def	30 cde	60 hi	1 ab	23 efg	61 c-g
Penn G-1	3 def	30 cde	63 ghi	2 ab	22 g	57 fgh
Providence (SR 1019)	3 def	29 de	68 d-h	2 ab	26 b-g	64 b-f
Penn G-2	3 def	32 b-e	68 d-h	1 ab	26 b-g	58 e-h
Penn G-6	3 def	27 e	58 i	0 b	23 fg	59 d-g
Penn A-4	2 f	29 de	61 ghi	2 ab	25 c-g	51 h

Recovery ratings were measured two, six and 10 weeks after divoting on a scale of 0-100 percent cover. On 5-centimeter divots in the turf, zero represents no turfgrass recovery, and 100 represents complete recovery. Divots were taken on June 23, 1998 and June 20, 1999.

Within each column, averages (means) followed by the same letter are not significantly different from each other.

days during summer months.

Overall turf performance was a visual rating including color, texture, freedom from disease and plot uniformity. Cultivars were rated weekly from June 1 to Sept. 1 in 1998 and 1999 on a scale of 0-9, with 0 indicating a dead stand and 9 reflecting ideal turf.

In mid-June and August, divots were taken in the form of 2-inch (5-centimeter) diameter cores — two per plot, totaling six per cultivar — and holes were filled with similar greens mix (5). Holes were measured every two weeks for percent recovery on a 0 to 100 scale, with 100 indicating full recovery.

## Bentgrass recovery from August injury

Variety	1998			1999		
	2 weeks	6 weeks	10 weeks	2 weeks	6 weeks	10 weeks
Crenshaw	16 a	45 ab	100 a	8 cde	32 efg	81 d-h
Pennlinks	13 ab	33 cd	98 abc	8 cde	33 def	83 b-f
Lofts L-93	13 ab	45 ab	100 a	12 abc	35 b-e	82 c-g
Putter	12 abc	39 abc	99 ab	14 a	44 a	88 abc
Dominant blend	12 abc	46 a	99 ab	11 a-d	40 a-d	89 ab
Regent	11 abc	35 a-d	98 abc	14 a	43 ab	89 ab
Crenshaw/Cato blend	10 bc	37 a-d	98 abc	6 e	30 e-h	80 e-i
Penn A-4	10 bc	35 a-d	94 c	8 cde	26 fgh	72 jk
Penn G-6	10 bc	33 cd	96 abc	9 b-e	26 fgh	74 h-k
Cato	10 bc	37 a-d	98 abc	9 b-e	33 def	80 e-i
Viper	9 bc	37 a-d	96 abc	9 b-e	37 a-e	83 b-f
Penn A-1	8 bc	35 a-d	97 abc	8 cde	29 e-h	70 k
Penn G-2	8 bc	36 a-d	97 abc	7 de	23 h	73 ijk
SR 1020	8 bc	35 a-d	98 abc	11 a-d	35 b-e	87 a-e
Southshore	8 bc	36 a-d	99 ab	8 cde	32 efg	82 c-g
Providence (SR 1019)	8 bc	35 a-d	100 a	9 b-e	31 efg	78 f-j
Penncross	8 bc	33 cd	98 abc	13 ab	42 ab	92 a
Mariner	7 c	28 d	98 abc	12 abc	41 abc	88 a-d
Penn G-1	7 c	30 cd	94 c	6 e	24 gh	76 g-k
SR 1119	7 c	34 bcd	95 bc	8 cde	33 def	82 c-g

Recovery ratings were measured two, six and 10 weeks after divoting, using a scale of 0-100 percent cover. On the 5-centimeter divots in the turf, 0 represented no turfgrass recovery, while 100 represented complete recovery. Divots were taken on Aug. 18, 1998 and Aug. 24, 1999.

Within each column, means (averages) followed by the same letter are not significantly different from each other.

### Turfgrass quality

Among the 20 creeping bentgrass cultivars examined, turf quality ranged from 6.8 to 8.4 in 1998 and 6.9 to 8.3 in 1999. Penn A-4, Penn A-1 and Penn G-2 exhibited the best overall turfgrass quality in the summers of 1998 and 1999. In 1998, A-4, A-1 and G-2 were followed by Crenshaw, G-6, Lofts L-93, G-1, a blend of Crenshaw and Cato, and SR 1020. In 1999, A-4, A-1 and G-2 were followed by L-93, G-6, G-1, Crenshaw, SR 1020 and Cato. Regent, Mariner and Penncross had the lowest quality ratings for both years.

Following June 1998 divoting, Penncross exhibited the highest turfgrass recovery at two, six and 10 weeks after damage. Following June 1999 divoting, Penncross again displayed highest turf recovery at two and 10 weeks, whereas at six weeks after damage, Penncross was similar to Putter. In August 1998, Crenshaw exhibited highest turf recovery two weeks after divoting, but Dominant blend was best after six weeks, and L-93, Providence (SR 1019) and Crenshaw were best at 10 weeks. Regent and Putter exhibited highest turf recovery in August 1999 two weeks after damage, whereas Putter was best at six weeks and Penncross at 10 weeks.

Statistically however, these top-performing cultivars were not always significantly better than runners-up.

### Conclusions

Quality ratings were consistent with those from the National Turfgrass Evaluation Program. The newer cultivars (the A series, the G series, L-93, Crenshaw and SR 1020) consistently ranked among the top in both 1998 and 1999. They displayed higher shoot densities, which improves wear tolerance and restricts light penetration, possibly reducing *Poa annua*, moss and algae. Higher shoot density also increases surface uniformity and smoothness. Typically, cultivars with higher shoot densities have finer leaf texture.

The older bentgrass cultivars (particularly Penncross) exhibited quicker

recovery rates for June and August 1998 and 1999. Typically, the older cultivars have lower shoot densities and wider leaf texture, and often thin as cutting heights are reduced below ¼ inch (2). Differences possibly occur as the older cultivars tend to be more stoloniferous, resulting in faster recovery from their lower shoot densities and thicker leaf texture.

### Old vs. new

Because of the species' increased popularity in the Southeast, turfgrass developers are introducing new creeping bentgrass cultivars yearly. This obliges researchers to examine closely the characteristics of these cultivars, particularly their heat tolerance and recuperative abilities. Research at Clemson University indicates that the new cultivars perform better in heat stress than older cultivars, although they prove inferior in summertime turf recovery compared with older cultivars.

In addition to research on turf quality and recovery, we also examined disease occurrence, ball-roll distance, root mass and root length, shoot density and width, and thatch/mat layer for the 20 creeping bentgrass cultivars. We also looked at a replication of this trial where no fungicide treatments were applied to assess disease susceptibility of these cultivars. More reports are forthcoming from these studies. ■

#### Literature cited

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