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TURFGRASS TRENDS

BENTGRASS AND TOLERANCE

What Makes Some Bentgrass Species More Wear Tolerant?

By Scott Ebdon and Michelle DaCosta

Traffic can be broken down into two stresses: wear and soil compaction. Recent studies show that injury caused by wear is the principal stress under traffic accounting for 90 percent of the injury compared to soil compaction. Creeping bentgrass (*Agrostis stolonifera* L.) and velvet bentgrass (*Agrostis canina* L.) are important turfgrasses for golf putting greens. Velvet bentgrass reportedly performs better under traffic than creeping bentgrass does. Investigations into wear tolerance mechanisms (plant factors) are limited in both velvet and creeping bentgrass, and knowing this would help in selecting and breeding wear tolerant genotypes.

Various anatomical and morphological plant characteristics have been identified to be important in wear tolerance of cool season turfgrasses. Cool season species with superior wear tolerance have been associated with plant characteristics, including greater total cell wall content (thicker cell walls), wide leaf width (coarse leaf texture), greater leaf tensile strength, and high shoot density. Also, more recent research has shown the importance of plant morphology such as leaf angle in imparting better tolerance to wear.

Increased shoot density provides more tissue for cushioning that is available to absorb the impact of the injury caused by traffic. Greater total cell wall components enable plants to withstand pressure (bending and crushing) compared to thinner-walled plants. Biologically, leaf angle in wear tolerance is significant because genotypes with a more upright leaf orientation will have less tissue exposed to the vertical forces present in wear stress compared to leaf tissue on a horizontal plane.

The objective of our research was to investigate genetic variation in creeping and velvet bentgrasses' anatomical, morphological and physiological characteristics and relate them to wear tolerance in the field.

Genotype selection and wear tolerance

Fourteen genotypes were selected from the 2003 National Turfgrass Evaluation Program (NTEP) bentgrass trial located at the Joseph Troll Turf Research Center, South Deerfield, MA, University of Massachusetts Amherst. Seven velvet bentgrass genotypes were evaluated, including Greenwich, Legendary, SR-7200, Venus, Vesper, Villa and an experimental entry. Seven creeping bentgrass genotypes also were

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TABLE 1: WEAR TOLERANCE

GENOTYPES	TCW	LEAF ANGLE§	TILLER ANGLE§	TILLER DENSITY
Creeping bentgrass	**%**	**----1 to 4----**	**----1 to 4----**	**Tillers dm^{-2}**
Authority	54.2c‡	1.7e	1.5d	1683de§
Bengal	53.5cd	2.6d	1.3d	1783de
CY-2	48.5e	3.2c	2.2c	1616de
Declaration	51.5c-e	2.3d	2.2c	1917de
Independence	51.1c-e	1.8e	2.2c	1016e
Penn A-1	50.1de	2.4d	1.8cd	1500e
Penncross	53.7cd	2.3d	1.2d	1033e
Creeping mean	51.8	2.3	1.8	1500
Velvet bentgrass	**%**	**----1 to 4----**	**----1 to 4----**	**Tillers dm^{-2}**
Experimental	61.7ab	3.3c	4.0a	3150bc
Greenwich	61.4ab	3.6a-c	3.8ab	3683bc
Legendary	60.4ab	3.8ab	3.8ab	5000a
SR-7200	58.7b	2.6d	3.2b	2683cd
Venus	63.5a	3.4bc	3.3b	3900b
Vesper	61.8ab	3.3c	3.7ab	3300bc
Villa	58.7b	3.9a	3.8ab	3983ab
Velvet mean	60.9	3.4	3.7	3667

‡ Numbers within the same column followed by the same letter(s) are not significantly different (SD=0.05).
§ Rating: 1= horizontal, 2 = semi horizontal, 3 = semi-vertical, 4 = vertical.

Genotype means for total cell wall (TCW) content, leaf and tiller angle, and total density in Agrostis species established as space plants in the greenhouse from vegetative plantings from field plots (2-year averages for 2006 and 2007 are shown).

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included in the test, including Authority, Bengal, CY-2, Declaration, Independence, Penn A-1 and Penncross.

Wear treatments were applied using 50 passes with a Toro Greensmaster Flex 21 fitted with a grooming brush. The brush was adjusted in a free floating position in contact with the turf canopy. This method of simulating wear was chosen because of its ability to create scuffing, crushing and brushing action to the plant while minimizing pressure to the soil and limiting soil compaction and disruption of the putting surface. All plots were mowed at the 0.125 inch height of cut prior to the application of grooming brush wear.

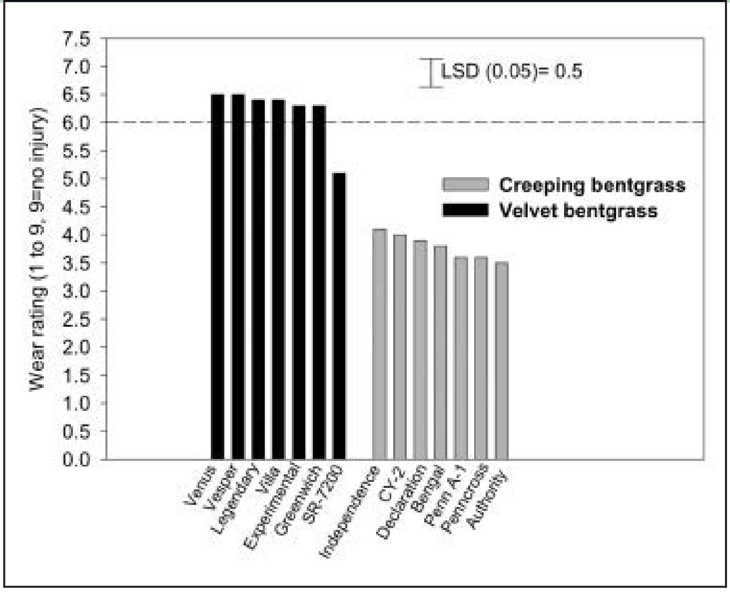
Four wear events were conducted – on October 27, 2005; June 16, 2006; October 25, 2006; and June 15, 2007. Ratings for wear tolerance following grooming brush injury were visually recorded as the percentage of leaf surface area retaining green color using a scale of 1 to 9 (9 = no injury or 100 percent green color, 1 = no green, 100 percent necrotic).

Velvet bentgrass consistently outperformed creeping bentgrass entries in wear tolerance on all evaluation-rating dates (Fig. 1). Velvet bentgrass clearly exhibited superior wear tolerance to creeping bentgrass during the spring and fall periods. Wear tolerance among all bentgrass genotypes was better under the more favorable growing conditions for shoot vigor of spring when compared to the fall period. Similar results have also been observed in Kentucky bluegrass (*Poa pratensis* L.) between the spring and summer-to-fall period (5).

Little difference was observed in wear tolerance among the different genotypes within the same species. However, SR-7200 was consistently lower in wear tolerance than other velvet bentgrass genotypes (Table 1). SR-7200 tolerance to wear, however, was better than all other creeping bentgrass entries. These results are consistent with those reported by other researchers.

Most velvet bentgrass genotypes exhibited acceptable wear tolerance (ratings > 6 on the 1 to 9 rating scale) with the exception of SR-7200, while no single genotype of creeping bentgrass afforded acceptable wear tolerance. These differences in wear tolerance can be explained by anatomical and morphological properties among the species.

FIGURE 1: WEAR TOLERANCE COMPARISON



Wear tolerance comparison (2-year average): Velvet (Agrostis canina) and creeping (Agrostis stolonifera).

Genotype and plant factors

Samples were taken from field plots during the same period when wear was applied in order to assess various anatomical and morphological characteristics. Velvet bentgrass tolerance to wear was due in large part to its leaf tissue exhibiting greater total cell wall (TCW) content than creeping bentgrass. Greater cell wall thickening imparts better resistance to bruising injury under traffic. In addition, the more upright "vertical" growth habit due to leaf orientation and tiller orientation of velvet bentgrass was associated with better tolerance to wear. The more horizontal growth habit of leaves and tillers in creeping bentgrass may expose aerial shoot tissue to greater wear injury.

The lower wear tolerance exhibited by SR-7200 velvet bentgrass may be a combination of its lower cell wall content and horizontal growth habit (leaf and tiller), which combined less durable aerial shoots with greater exposure to wear stress. Velvet bentgrass genotypes exhibited a 2.5 fold greater tiller (shoot) density over creeping bentgrass. Wear intolerant SR-7200 velvet bentgrass was consistently lower in shoot density among velvet genotypes.

SR-7200 was lowest in wear tolerance among velvet bentgrass and exhibited lower cell wall components, lower shoot density and a more horizontal tiller (and leaf) angle, which was consistent with the lower responses observed in creeping bentgrass. Breeders can improve overall wear tolerance in bentgrass species by giving priority to breeding for greater shoot density and cell wall content as well as by breeding for a more upright growth habit (tiller and leaf).

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REFERENCES

Beard, J. B. 1973. Turfgrass science and culture. Prentice-Hall. Englewood Cliffs, NJ.

Brosnan, J. T., J. S. Ebdon, and W. M. Dest. 2005. Characteristics of diverse wear tolerant genotypes of Kentucky bluegrass. Crop Sci. 45:1917-1926.

Cashel, R. H., H. Samaranayake, T. J. Lawson, J. A. Honig, and J. A. Murphy. 2005. Traffic tolerance of bentgrass cultivars grown on a sand-based rootzone. International Turfgrass Society Research Journal. Volume 10. p. 531-537.

Dest, W. M., J. S. Ebdon, and K. Guillard. 2009. Differentiating between the influence of wear and soil compaction and their interaction of turfgrass stress. International Turfgrass Society Research Journal. Volume 11. p. 1067-1083.

Park, B. S., T. J. Lawson, H. Samaranayake, and J. A. Murphy. 20107. Tolerance and recovery of Kentucky bluegrass subjected to seasonal wear. Crop Sci. 50:1526-1536.

Samaranayake, H., T. J. Lawson, and J. A. Murphy. 2008. Traffic stress effects on bentgrass putting green and fairway turf. Crop Sc. 48:1193-1202.

Shearman, R. C., and J. B. Beard. 1975a. Turfgrass wear mechanisms: II. Effects of cell wall constituents on turfgrass wear tolerance. Agron. J. 67:211-215.

Shearman, R. C., and J. B. Beard. 1975b. Turfgrass wear mechanisms: III. Physiological, morphological, and anatomical characteristics associated with turfgrass wear tolerance. Agron. J. 67:215-218.