Ball Lie of Creeping and Colonial Bentgrass Cultivars Under Fairway Conditions

Dan Strunk[1], Joey Young[1], Doug Karcher[1], Mike Richardson[1], and Aaron Patton[2]

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Photo by Dan Strunk

Equipment used to evaluate ball lie on creeping bentgrass and colonial bentgrass cultivars.

Summary. The position of a golf ball in the canopy of turf, or ball lie, can have a significant effect on a golf shot. As turf breeders develop improved cultivars for use on golf course fairways and tees, the National Turfgrass Evaluation Program oversees the testing of these improved cultivars in differing climatic regions throughout North America. The University of Arkansas was selected as a test site for the 2008 bentgrass fairway/tee trial which included 27 bentgrass cultivars (colonial or creeping bentgrass). Ball lie was measured on 23, 24, and 25 September in 2009. Plots were maintained at a 0.5 inch height of cut, and data were collected at zero, one, and two days after mowing. Average ball lie was affected by bentgrass cultivar on each day of evaluation. Ball lie was considerably better directly after mowing than after one and two days of growth. When ball lie measurements were averaged for each cultivar across evaluation days, 12 creeping bentgrass cultivars were in the top statistical group.

Abbreviations: NTEP, National Turfgrass Evaluation Program

[1] University of Arkansas, Department of Horticulture, Fayetteville, Ark. 72701
[2] University of Arkansas, Cooperative Extension Service, Department of Horticulture, Fayetteville, Ark. 72701

Fairways are an integral part of a golf course and serve as a reward to accurately placed golf shots. Following a stroke into a fairway, a ball should sit high in the turf giving the golfer the most control on the subsequent shot. This position in the canopy, or ball lie, can have a significant effect on the golfer's ability to accurately hit controlled shots, and is dependent on a variety of factors such as mowing height, uniformity, and shoot density (Cella and Voigt, 2001). Poor ball lie is associated with an increased probability of an errant shot. There are several turf species available that produce adequate shoot density and tolerate close mowing for use in fairways (Morris, 2008). Among these species are numerous cultivars with differing growth characteristics. It is important to understand the variability of ball lie among cultivars of the same species for proper selection of cultivars that are better suited for optimal playing conditions.

In 2001, researchers at the University of Illinois developed a tool, the Lie-N-Eye, which was capable of measuring ball lie in of a turf canopy at a height range of 0.6 to 1.0 inch (Cella and Voigt, 2001). The Lie-N-Eye uses a platform, which is set on top of a mown canopy, and an adjustable digital caliper to measure the distance between the top of the ball and the turf canopy. Cella and coworkers also developed the Lie-N-Eye II in 2004 to measure ball lie on turf mown at 0.5 inch (Cella et al., 2004). However, with recent applications of digital image analysis in agriculture, and more specifically turf, the University of Arkansas constructed a tool utilizing a digital camera mounted on a platform to measure ball lie (Richardson et al., 2010). Adjustable legs on the platform allow for precise positioning at a variety of mowing heights. Digital images are taken of a golf ball sitting in the canopy, and then analyzed to determine the total number of pixels of the ball visible. The number of pixels of the golf ball in the treated image is compared to the total number of pixels possible of a completely visible golf ball to determine the ball lie of the turf.

The National Turfgrass Evaluation Program (NTEP), a part of the U.S. Department of Agriculture, conducts turfgrass cultivar evaluations at numerous sites throughout North America. In 2008, the University of Arkansas was selected as a test site for a bentgrass fairway/tee trial. There were 23 cultivars officially included in the trial along with four additional cultivars selected due to common use in Arkansas or performance in previous trials (Summerford et al., 2009). The objective of this research was to evaluate ball lie and the change of ball lie over time following a mowing event of 20 cultivars of creeping bentgrass (*Agrostis stolonifera*) and seven cultivars of colonial bentgrass (*Agrostis capillaris*) included in the 2008 NTEP bentgrass fairway/tee trial in Fayetteville, Ark.

Materials and Methods

The evaluation of ball lie was conducted at the University of Arkansas Research and Extension Center in Fayetteville in September 2009 on 27 cultivars of bentgrass (Table 1). The experimental area was established on a native silt loam soil on 1 October 2008, and contained three replicates of 27 cultivars in a randomized complete block design. The experimental area was maintained under typical fairway conditions with a height of cut at 0.5 inch (Table 2).

Three balls were rolled onto each plot using a ramp that consistently released the ball at a similar height and speed. Ball lie was then measured using a device developed by the University of Arkansas (Richardson et al., 2010). The device, which is comprised of a digital camera mounted on a platform, was used to take digital images of the golf balls. A midpoint wire on the device prevented changing the focal length between images. Images were captured using an Olympus SP-510UZ Digital Camera (Olympus Corporation, Center Valley, Pennsylvania). The digital camera was set with an exposure time of 1/250 s and an aperture of F4.5. Analysis of digital images using SigmaScan Pro (v5.0, SPSS, Chicago, Ill.) determined the percentage of total golf ball visible above the turf canopy (Fig. 1). Ball lie was measured on 23, 24, and 25 September 2009, corresponding to zero, one, and two days after mowing, respectively.

Results and Discussion

There were differences in average ball lie

at zero, one, and two days after mowing, when averaged across cultivars (Table 3). Average ball lie decreased 2.4% and 4.0% after one and two days of growth, respectively. This confirms that ball lie on a bentgrass fairway declines as the turf recovers and grows following mowing. In addition, changes in the height of the turf canopy has a significant effect on ball lie, as suggested in previous studies on bermudagrass (McCalla et al., 2008) and Kentucky bluegrass (Cella and Voight, 2001).

There were also differences present in ball lie among cultivars when averaged over the three measurement dates (Table 4). There were twelve high-performing cultivars regarding ball lie, all of which were creeping bentgrass. The highest ranking cultivars included CY-2, Declaration, A08-TDN2, SR-1020, HTM, Pennlinks II / Penneagle II, T-1, Memorial, Tyee, LTP-FEC, MVS-Ap-101, and PST-OJD. The highest ranking colonial bentgrass cultivars were A08-FT12, BCD, and Tiger II, but they were significantly less than the highest creeping bentgrass cultivar. Lower ball lie ratings for the colonial bentgrass cultivars, as compared to creeping bentgrass, may have resulted from the more open canopy and upright growth characteristics inherent to colonial bentgrass. When cultivars were contrasted, creeping bentgrass cultivars had two percent more ball exposed on average than the colonial bentgrass cultivars ($P < 0.0001$). No significant interactions were found between days after mowing and bentgrass cultivar.

In summary, creeping bentgrass is a better choice for fairway turf than colonial bentgrass based upon ball lie. In this study, twelve cultivars of creeping bentgrass out-performed the remaining colonial and creeping bentgrass cultivars, indicating that there are differences among cultivars. Although overall quality and stress resistance may be more important when selecting a cultivar for golf course fairway or tee use, ball lie should be considered and may aid in the differentiation of cultivars with similar quality and resistance.

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Table 1. Bentgrass cultivars in the 2008 NTEP bentgrass fairway/tee trial in Fayetteville, Ark.

Entry	Species	Entry	Species
Penncross	Creeping	SRP-1WM[z]	Creeping
007	Creeping	T-1	Creeping
CY-2	Creeping	BCD	Colonial
LTP-FEC	Creeping	Benchmark DSR	Creeping
PennlinksII/PenneagleII[y]	Creeping	Declaration	Creeping
Princeville	Creeping	MVS-Ap-101[z]	Creeping
A08-EBM[z]	Colonial	Tyee[y]	Creeping
A08-TDN2[z]	Creeping	A08-FT12[z]	Colonial
Authority	Creeping	HTM	Creeping
L-93	Creeping	PST-R9D7[z]	Colonial
Memorial	Creeping	Tiger II	Colonial
Crystal Bluelinks	Creeping	Alister[y]	Colonial
PST-OJD[z]	Creeping	Greentime	Colonial
SR-1020[y]	Creeping		

[y] Not an official entry of the 2008 NTEP bentgrass trial but included as an Arkansas standard.
[z] Entry is experimental and at this time not commercially available.

Table 2. Management of plots in the 2008 NTEP Bentgrass fairway/tee trial.

Management	Description
Mowing	Three times/week at 0.5 inch with a Toro Greensmaster 1600 (Toro Company, Bloomington, MN)
Fertility	0.5 lbs Nitrogen/1000 ft^2 per month during active growth
Irrigation	Summer – 3x/week or as needed to prevent drought stress Spring/Fall – as needed to prevent drought stress
Cultivation	None
Sand Topdressing	As needed to smooth plots
Wetting Agents	None
Plant Growth Regulators	Primo Maxx (trinexipac-ethyl) at 6 oz/acre on 3 July 2009 and 4 September 2009.
Pesticides	Applied as needed for curative purposes

Table 3. Average ball lie at 0, 1, and 2 days after mowing, averaged across cultivars, in September 2009 on the 2008 NTEP bentgrass fairway/tee trial in Fayetteville, Ark.

Days after mowing[y]	Measurement date	Average ball lie
		----------(%)----------
0	23 September	94.2 A[z]
1	24 September	91.8 B
2	25 September	90.2 C

[y] Plots were mown with a Toro Greensmaster 1600 at 0.5 inch.
[z] Means followed by the same letter do not differ significantly at α=0.05.

Table 4. Ball lie of colonial and creeping bentgrass cultivars in the 2008 NTEP bentgrass fairway/tee trial in Fayetteville, Ark. Measurements were averaged across 0, 1 and 2 days after mowing in September 2009.

Entry	Species	Average ball lie	
		----------(%)----------	
CY-2	Creeping	93.4	A[x]
Declaration	Creeping	93.3	AB
A08-TDN2[z]	Creeping	93.2	ABC
SR-1020[y]	Creeping	93.1	ABCD
HTM	Creeping	93.0	ABCD
PennlinksII/Penneagle II[y]	Creeping	93.0	ABCD
T-1	Creeping	92.7	ABCD
Memorial	Creeping	92.7	ABCDE
Tyee[y]	Creeping	92.5	ABCDEF
LTP-FEC	Creeping	92.5	ABCDEF
MVS-Ap-101[z]	Creeping	92.5	ABCDEF
PST-OJD[z]	Creeping	92.3	ABCDEFG
L-93	Creeping	92.2	BCDEFGH
Crystal Bluelinks	Creeping	92.1	CDEFGHI
Authority	Creeping	92.1	CDEFGHI
Benchmark DSR	Creeping	92.1	CDEFGHI
007	Creeping	92.1	DEFGHI
SRP-1WM[z]	Creeping	92.0	DEFGHI
A08-FT12[z]	Colonial	91.6	EFGHI
BCD	Colonial	91.5	FGHI
Tiger II	Colonial	91.5	FGHI
Penncross	Creeping	91.5	FGHI
Princeville	Creeping	91.2	GHI
A08-EBM[z]	Colonial	91.1	HI
Greentime	Colonial	91.0	I
Alister[y]	Colonial	91.0	IJ
PST-R9D7[z]	Colonial	89.8	J
$LSD_{(0.05)}$		**1.1**	

[x] Means followed by the same letter do not differ statistically at $P < 0.05$.
[y] Not an official entry of the 2008 NTEP bentgrass trial but included as an Arkansas standard.
[z] Entry is experimental and at this time not commercially available.

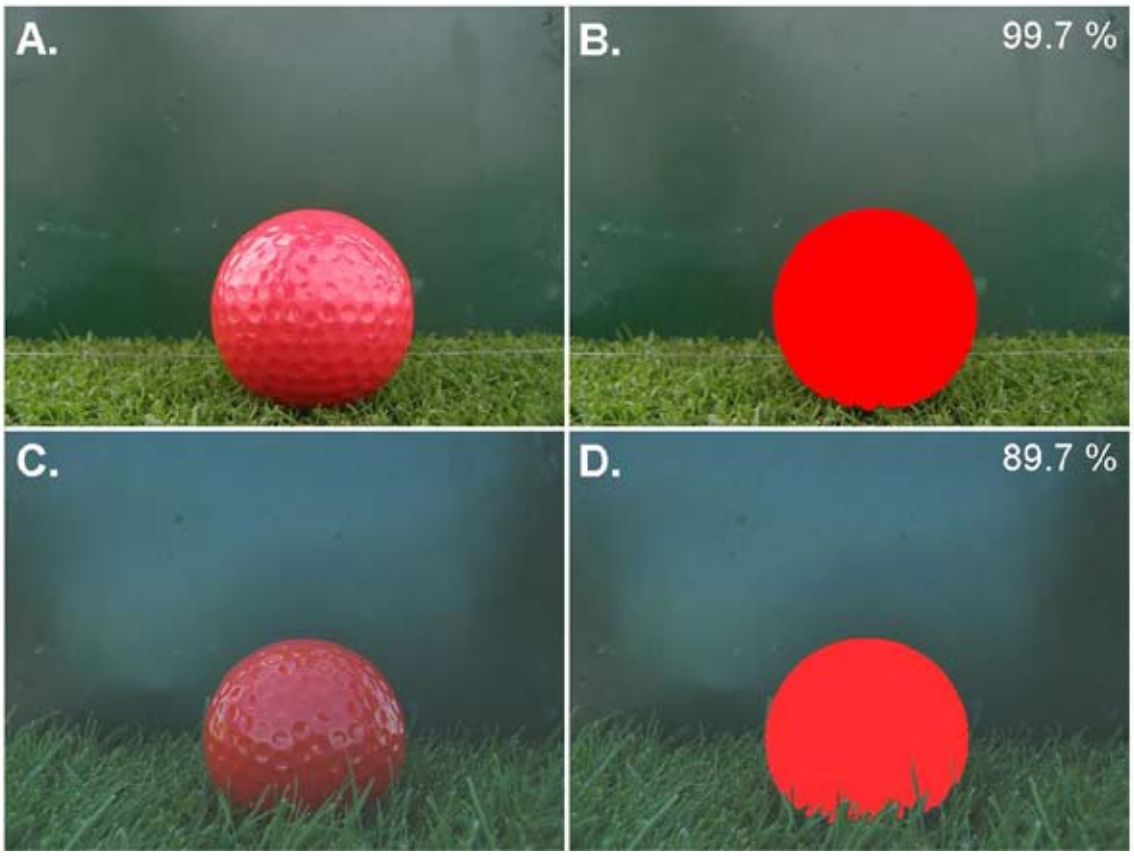

Fig. 1. Creeping bentgrass cultivar 'CY-2' ball lie image (A) and software analysis overlay (B). Colonial bentgrass cultivar 'PST-R9D7' ball lie image (C) and software analysis overlay (D). Percentages listed on pictures (B) and (D) indicate the number of red pixels visible out of the total number of red pixels possible.