Turfgrass and Environmental Research Online

…Using Science to Benefit Golf

Researchers at Rutgers University used a pneumatic device to fire golf balls on putting greens-height plots of creeping and velvelt bentgrass. Data collected included initial ball mark injury and recuperative ability of 15 cultivars. In general, less damage and more rapid recovery occurred on the newer bentgrass cultivars, notably A-4 and G-2.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 215 projects at a cost of $21 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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Ball Marks on Bentgrass

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SUMMARY

Field experience and research are scarce when it comes to the durability and recuperative ability among the newer cultivars of bentgrass, especially as it relates to ball marks. The objective of this project was to evaluate the rate of ball mark recovery among 13 creeping bentgrass and two velvet bentgrass cultivars without the confounding effects of age, construction, topdressing medium, cultural management, and growing environment.

- In general, less damage and more rapid turf recovery occurred on the newer bentgrass cultivars, notably 'A-4' and 'G-2'. The velvet bentgrass cultivars 'SR 7200' and 'MVB' also ranked among the best in regard to injury and recovery.
- Older cultivars like 'Penncross' incurred the most damage from ball marks and also took the longest time to heal.
- Cultivars that received only compaction treatment did not respond differently to ball marking compared to non-trafficked cultivars, indicating that wear damage, more than compaction, exacerbates the problem of ball mark damage.
- Results from 2002 suggest that an additional year of turf maturation narrowed differences among cultivars and helped to expedite recovery from ball marks.
- Management efforts to substantially reduce either wear or compaction should improve turf tolerance to ball marking, as well as recuperation.

Growth of the game of golf and advancements in turfgrass breeding have led to the construction of new putting greens or resurfacing of existing greens with new and improved bentgrass cultivars. In general, the newer bentgrass cultivars possess finer leaf texture, greater shoot and root density, and improved tolerance to pests and environmental stress compared to earlier-released cultivars, many of which are still commercially available. Nonetheless, it is common to hear superintendents who now manage the newer cultivars say that they would prefer growing older, longstanding cultivars like 'Penncross'.

Why is this so? One of the most common reasons given is that the newer cultivars are perceived to be less aggressive with regard to growth habit and recovery from divots or ball marks. Poorly repaired, or not repaired at all, ball marks are a major factor that limits turf quality and playing conditions on putting greens.

Field experience and research are scarce when it comes to the durability and recuperative ability among the newer cultivars of bentgrass, especially as it relates to ball marks. Although observations about growth rate and recuperative ability on the golf course may be accurate, interpretations and conclusions based upon these observations can be confounded by a number of other factors beyond the effect of the cultivar itself.

Important factors that can contribute to the severity of ball mark damage and rate of recovery include the age of the turf (maturity of the thatch and mat layers), rootzone mix and its physical properties, topdressing material, cultural manage-

Ball marks were simulated by pneumatically ejecting golf balls from a PVC cylinder at a static pressure of 6, 8, or 10 p.s.i. Two or three marks were made in each plot. Visual assessments were made for initial severity as well as recovery of ball marks.

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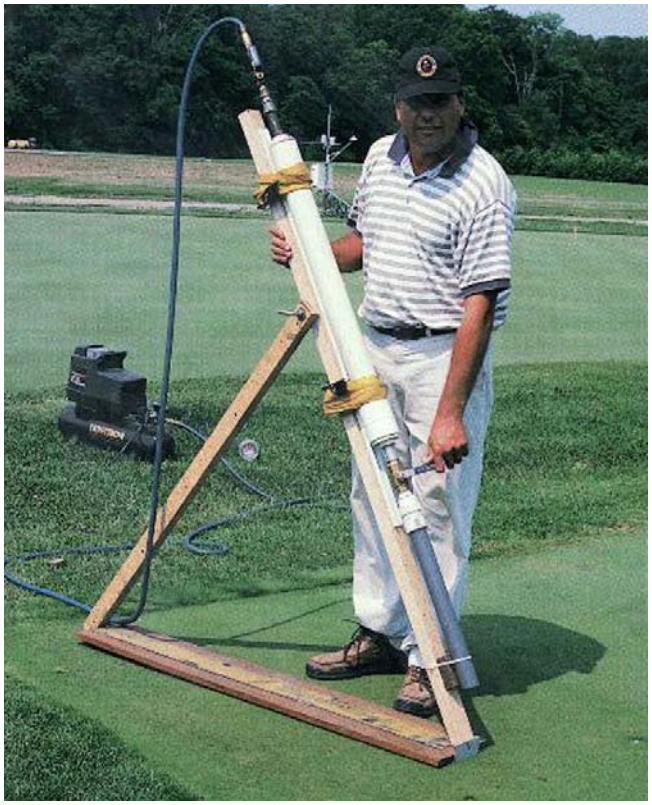
ment, growing environment, and turfgrass cultivar. A sound assessment of each factor, independent of the other factors, is needed to properly conclude which contributes to damage and recuperation from ball marks on putting greens.

The objective of this project was to evaluate the rate of ball mark recovery among 13 creeping bentgrass and two velvet bentgrass cultivars without the confounding effects of age, construction, topdressing medium, cultural management, and growing environment.

How was the study conducted?

This study was conducted during 2001 and 2002 on a sand-based putting green located at the Rutgers Horticultural Research Farm II in North Brunswick, NJ. The putting green was constructed in 1998 according to USGA recommendations using a mix consisting of 85% sand and 15% peat (by volume). Creeping bentgrass cultivars were seeded in May, 1999, at a rate of 0.75 pounds per 1000 square feet. The velvet bentgrass entries, SR 7200 and MVB, were seeded at 0.44 and 0.88 pounds per 1000 square feet, respectively.



Dr. Jim Murphy demonstrates the ball mark simulator during Rutgers field day.

During the study, turf was mowed six to nine times per week at 0.115 inches and fertilized with 3.9, 2.8, and 2.9 pounds of N, P_2O_5, and K_2O per 1000 square feet, respectively, in 2001 and 1.8, 0.6, and 0.6 pounds of N, P_2O_5, and K_2O per 1000 square feet in 2002. The plots were cultivated with solid tines once or twice and topdressed three to five times per season with a medium sand. Some layering of topdressing and thatch was evident, but this did not produce management or performance problems related to excessive puffiness, scalping of the turf, poor water infiltration, or rooting of the green. The combined thickness of the thatch and mat layers was less than one inch during the evaluations reported here. Irrigation and fungicides were applied as needed to avoid drought and disease stresses.

Traffic treatments were initiated in October, 1999. Wear and compaction treatments were applied four times/week using a modified walk-behind Sweepster and a Brouwer water-filled turf roller, respectively, from May through September. Compaction treatments also were applied using a one-ton Wacker pavement roller that was operated with vibration applied to the rollers.

The experimental design consisted of a split-plot factorial arrangement of treatment combinations: four levels of traffic (no traffic, wear, compaction, and wear plus compaction) represented the main plots and 15 bentgrass cultivars represented the sub-plots, with three replications of each combination.

Ball marks were simulated by pneumatically ejecting golf balls from a PVC cylinder at a static pressure of 6, 8, or 10 p.s.i. Two or three marks were made in each plot. Visual assessments were made for initial severity as well as recovery of ball marks.

How did the results turn out?

Significant differences in ball mark damage and recovery were found among the bentgrass cultivars grown on sand on most rating dates in 2001 (Table 1). In general, less damage and more

Cultivar	Initial Damage (8/14/01)	Damage Rating (Days After Marking)			Initial Damage (10/20/01)	Damage Rating (Days After Marking)
		7	32	74		7
	Rating (9 = least, 1 = greatest)					
G-2	6.4	4.2	6.6	8.1	5.1	3.1
A-4	5.9	3.7	6.9	8.1	4.2	2.2
Century	5.6	3.7	6.8	7.9	4.7	2.9
SR 7200	6.1	4.8	6.8	7.8	5.3	2.5
L-93	4.7	3.5	5.8	7.7	5.0	2.5
Cato	5.5	3.7	6.6	7.7	5.3	2.8
Southshore	5.6	4.0	6.6	7.7	5.4	2.5
MVB	6.2	4.0	6.2	7.4	4.7	2.8
SR 1020	4.6	3.6	6.0	7.4	5.9	2.6
Putter	4.5	3.6	6.1	7.3	4.6	1.8
SR 1119	5.1	3.7	5.8	7.2	6.1	2.7
Pennlinks	5.1	3.8	5.9	7.1	6.4	2.3
Penneagle	4.7	4.0	5.9	6.8	6.3	2.8
Providence	4.6	3.4	6.0	6.7	5.5	2.3
Penncross	3.9	3.4	5.6	6.4	6.3	2.3
LSD $_{(0.05)}$	0.9	0.8	0.8	0.9	1.3	NS
Traffic						
None	5.9	3.8	6.4	7.7	--	--
Compaction	6.0	4.1	6.8	7.9	5.5	2.6
Wear & Compaction	3.8	3.4	5.6	6.7	5.3	2.5
LSD $_{(0.05)}$	1.3	NS	NS	0.7	NS	NS
CV$_{(\%)}$	18.4	21.0	13.4	13	20.3	34.8

Cultivars in **boldface** print are velvet bentgrass species. All other cultivars are creeping bentgrass species.
LSD $_{(0.05)}$ = Least significant difference. There is a 95% probability that the difference between two means is due to cultivar effects if the difference between the two means is equal to or greater than the LSD value.
NS = Not significant. There is a 5% or less probability that the difference between two means is due to culti var effects.
CV$_{(\%)}$ = Coefficient of variation (expressed as a percentage). It is an indication of the degree of variability in measurements among cultivars at each rating date.

Table 1. Ball mark damage ratings on a sand putting green marked on August 14 and October 20, 2001. Entries are ranked according to recovery rating 74 days after initial marking.

rapid turf recovery occurred on the newer bentgrass cultivars, notably 'A-4' and 'G-2', which are increasingly being used on golf courses in the Northeast and throughout North America. Contrary to common perceptions, the velvet bentgrass cultivars 'SR 7200' and 'MVB' also ranked among the best in regard to injury and recovery. On the other hand, older cultivars like 'Penncross' incurred the most damage from ball marks and also took the longest time to heal.

Not surprisingly, ball mark injury was more severe and recovery time was slower on turf

Cultivar	Initial Damage (7/13/01)	Damage Rating (Days After Marking)			Initial Damage (7/26/02)	Damage Rating (Days After Marking)		
		7	25	41		11	19	27
	Rating (9 = least, 1 = greatest)							
Century	3.9	5.8	8.3	8.7	4.7	6.1	6.8	7.5
MVB	5.6	6.4	8.2	8.1	5.8	.8	7.1	7.3
A-4	5.0	6.1	8.3	8.3	4.7	5.9	6.5	7.0
SR 7200	5.2	6.7	8.0	8.2	5.0	5.7	6.3	6.8
L-93	3.9	5.0	8.5	7.8	4.6	5.4	5.9	6.8
Cato	2.7	3.8	7.9	7.3	4.7	5.3	5.3	6.3
G-2	4.9	6.1	8.7	8.6	5.0	5.3	5.5	6.1
Penncross	3.2	5.0	7.6	7.3	3.8	4.5	4.9	5.9
SR 1119	3.5	4.8	8.1	8.3	4.6	5.3	5.7	5.8
Putter	2.9	4.6	8.0	7.9	3.4	4.8	5.0	5.8
SR 1020	3.8	5.5	8.5	7.8	3.6	4.8	4.9	5.7
Southshore	4.8	5.6	8.2	7.8	4.3	4.6	4.9	5.7
Pennlinks	3.0	3.8	7.5	7.3	4.0	4.1	5.2	5.5
Penneagle	3.8	4.7	7.6	6.3	4.0	4.7	4.6	5.5
Providence	3.3	4.7	8.1	7.4	4.3	4.9	5.1	5.4
$LSD_{(0.05)}$	1.6	1.5	NS	NS	0.7	0.8	0.7	0.7
Traffic								
None	--	--	--	--	4.5	6.5	7.1	7.7
Wear	--	--	--	--	4.8	5.4	5.6	6.4
Compaction	--	--	--	--	3.7	5.2	5.8	6.8
Wear & Compaction	--	--	--	--	4.7	3.9	3.9	4.1
$LSD_{(0.05)}$	--	--	--	--	NS	NS	NS	NS
$CV_{(\%)}$	28.1	19.1	7.1	12.9	15.2	15.0	11.4	11.2

Cultivars in **boldface** print are velvet bentgrass species. All other cultivars are creeping bentgrass species.
$LSD_{(0.05)}$ = Least significant difference. There is a 95% probability that the difference between two means is due to cultivar effects if the difference between the two means is equal to or greater than the LSD value.
NS = Not significant. There is a 5% or less probability that the difference between two means is due to culti var effects.
$CV_{(\%)}$ = Coefficient of variation (expressed as a percentage). It is an indication of the degree of variability in measurements among cultivars at each rating date.

Table 2. Ball mark damage ratings on a sand putting green marked on July 13 and 26, 2002. Entries are ranked according to recovery rating 27 days after final marking.

that received a combination of wear and compaction. Interestingly, cultivars that received only compaction treatment did not respond differently to ball marking compared to non-trafficked cultivars, indicating that wear damage, more than compaction, exacerbates the problem of ball mark damage. This suggests that the management practice of rolling for increased ball roll would only exacerbate ball mark damage when the turf was experiencing aggressive damage from wear. Cultivars receiving wear treatment only were not assessed in 2001.

The ball mark experiment on sand was repeated two additional times in 2002 (Table 2). Relative injury and recovery among cultivars was similar to 2001; however, results from 2002 suggest that an additional year of turf maturation narrowed differences among cultivars and helped to expedite recovery from ball marks. Although fewer significant differences were found with respect to the effects of traffic on ball mark injury and recovery, general trends once again indicated that ball injury and recovery time are exacerbated by the presence of both wear and compaction stress. Thus, management efforts to substantially reduce either wear or compaction should improve turf tolerance to ball marking as well as recuperation.

What can we learn from this?

Currently, some golf course superintendents and architects are reluctant to use improved and better adapted cultivars of bentgrass because of unsubstantiated field observations and conclusions that these newer cultivars are less aggressive and slower to recuperate when compared to earlier released cultivars like 'Penncross'. Thus, they continue to choose older cultivars largely because of the comfort with knowing their growth habit and performance characteristics. While turf vigor and recuperative ability are no doubt related to the cultivar genetics, it appears that other factors including turf maturity are more responsible for field observations of severe ball marking problems.

Injury and recovery ratings were taken in time following ball marking.

Results showed that ball mark injury and recovery were exacerbated by simulated wear using a modified walk-behind Sweepster.

Today, newer cultivars are established on rooting media that contain a high percentage of sand. In most cases, these greens have not had time to mature (develop a mat layer) to the point where performance and play are similar to older sand- or soil-based greens that superintendents are accustom to managing. Furthermore, superintendents should consider the possible role that annual bluegrass plays in their perception that older cultivars (e.g., 'Penncross') are more aggressive than the newer monostands of cultivars they now manage, especially during the spring when annual bluegrass growth is considerably more aggressive than bentgrass. Furthermore, observations of rapid healing of ball marks on older Penncross putting greens may be due to the rapid invasion of annual bluegrass seedlings into the damaged ball marks rather than healing from the bentgrass cultivar itself.

Age of a putting green turf is probably the most important confounding factor affecting people's perception of newer bentgrass cultivars. The highly attractive cover of a newer bentgrass cultivar on a recently established green may provide a false sense of maturity occurring under that turf cover. In reality, it likely will require two or more complete growing seasons before the subsurface mat layer and root zone stabilize and become resistant to the forceful impact and spin of a golf ball. This stability and impact resistance is largely a function of the soil structure that develops from the growth of crowns, stolons, and roots in

the upper surface layers of the putting green. Over time, these parts of the grass plants become integrated with the rootzone and topdressing material applied to the surface. Subsequently, as this interwoven mixture of grass and soil develops, a structure analogous to a fiber mat is formed, adding strength and stability to the putting surface. Much lecturing and discussion is focused on how to manage excessive layering of this mat relative to the health of the turf, when in fact the contribution of the mat layer to the durability of a putting green is often overlooked.

In summary, whether you're contemplating or currently managing newer bentgrass cultivars, recognize that time and patience are needed for maturation of new putting greens, and realize the cultural management that worked for older cultivars like Penncross may not be what's best for cultivars that are finer-textured and considerably more dense. One only has to look at the National Turfgrass Evaluation Program on-site putting green trials (http://ntep.org/onsite/ost.htm) to see how advancements in breeding have produced bentgrass cultivars with improved turf quality characteristics and tolerance to stress. Last, but certainly not least, did we fail to mention that it would be extremely helpful if golfers repaired their own ball marks?