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TURFGRASS TRENDS

BALL-MARK RECOVERY

Golf Ball-Mark Recovery Affected by Surface Firmness and Repair Tool

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Unrepaired golf ball marks can leave localized necrotic scars, raised turf prone to mower scalping, loss of surface smoothness and the potential for weed (*Poa annua*) encroachment (Beard, 2002).

The traditional repair method suggested by the Golf Course Superintendents Association of America and encouraged by golf professionals involves inserting a traditional metal tool with equal-length tongs (3 centimeters) and employing a knit-and-twist method intended to pull healthy turf from the perimeter (GCSAA, 2009). This method and tool choice has been scrutinized because it may damage roots, especially if used improperly. Novel repair tools, including those with shorter tongs (1 centimeter) and utilizing a perimeter pushing method have been commercialized. These tools are designed to push healthy turf forward into the ball mark scar areas resulting in less damage to roots than tools designed to lift soil and twist canopy surfaces. However, rootzone moisture status as well as surface firmness on ball mark recovery time is unclear.

Effects of Surface Firmness on Recovery

A field study was conducted at the W.H. Daniel Turfgrass Research and Diagnostic Center at Purdue University in West Lafayette, Ind., on a creeping bentgrass sand-based research putting green built to United States Golf Association specifications. The study area was maintained to emulate moderate golf course putting green conditions, including mowing at .140 inches with a triplex mower six times weekly; fertilizing with 3 pounds of nitrogen per 1,000 square feet per year; and irrigation via an overhead system to supplement rainfall every one to two days, providing approximately 1 inch per week.

Prior to initiating the experiment, the study area was divided into two areas to create "firm" and "soft" locations. The firm area was repeatedly rolled with a sidewinder roller until an average surface hardness value of 145 gmax (peak deceleration) was achieved as measured by a Clegg Impact Soil Tester. The Clegg is a commonly used method of measuring surface hardness (Lush, 1985; Linde, 2005). Units were recorded in Clegg Impact Values (CIV's) which were converted to gmax using the equation gmax =10 (CIV) (Bregar and Moyer, 1990).

The surface hardness value for the soft area was 100 gmax. The soft area was not rolled, but heavily hand-watered the day of study initiation until surface pond-

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Repeated rolling was conducted and surface hardness measurements were taken to create the "firm" study area.

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ing occurred. Volumetric water content of each area was measured using a portable soil moisture probe. The average surface moisture contents at the 0 to 2 inches depth were 20 percent and 28 percent for the firm and soft areas, respectively.

Ball marks were created in June 2007 by hitting golf balls from a distance of 100 yards into both research areas using a pitching wedge. Four ball-mark repair tools plus an unrepaired ball mark were randomly assigned to the marks within each location and repaired according to repair tool manufacturer's directions. The GCSAA method for the traditional tool (TT) was employed because of its widespread use on golf courses.

Briefly, the tongs were inserted at the backside of the mark, and a twisting action was used four to five times around the perimeter until the turf canopy enclosed the ball mark. The angled traditional tool (ATT) was inserted at the back of the mark and by pressing down on the head of the tool a lifting action was used to lift the center of the mark three to four times around the perimeter and lightly tamped flat.

The wooden golf tee (WGT) was chosen for this study because golfers often have this tool in their pocket for launching golf balls from teeing grounds and can also be used to repair ball marks. The WGT was inserted around the mark four to five times until the turf canopy completely enclosed the ball mark. The GreenFix Wizard (GFW) was pushed into the ball mark surround four to five times at a 45-degree angle, starting at the back of the mark, pushing the turf back into the disturbed area.

Scar areas were calculated by measuring each mark with a ruler in two perpendicular directions to the nearest millimeter and calculating an average diameter, which was used to calculate the area of a circle. Initial ball-mark cavity volumes were determined for eight ball marks in each location by placing a thin sheet of plastic food wrap over the ball mark and pouring dry sand into the depressed area until the sand was level with the green surface and then weighed.

Repair Tool Affects Scar Area and Recovery

Initial ball mark volumes for the soft and firm surface areas resulted in mean sand masses of 9.08 and 5.01 grams, respectively. Not surprisingly, increased moisture in the soft area resulted in larger ball-mark volumes, potentially prolonging ball-mark recovery time.

All repair tools resulted in a smooth surface immediately following repair with little or no disruption visible but resulted in small necrotic spots where the ball mark had previously been repaired, which is consistent with other research (Fry et al., 2005; Munshaw et al., 2007).

As expected, scar areas were largest on the first rating date. Ball-mark scars left unrepaired in the soft area were substantially larger, 640 vs. 459 square millimeters (mm2), than those in the firm area. Scar area decreased over time and by 28 days after repair (DAR) all tools resulted in equivalent scar areas in both areas. Significant differences were observed early in the study. For example, scar areas ranged 156 to 509 mm2 in the soft area and 210 to 356 mm2 in the firm area at five DAR, which was expected with the larger scar cavities produced in the soft areas.

For both areas the lowest numerical scar area was measured for the GFW, although not statistically different from the TT on any measurement date.

By 21 DAR the GFW was equal to both long-tong tools. This is consistent with a pre-

(Left photo) Traditional tools employed when using the GCSAA ball mark repair method are angled traditional tools, standard wooden golf tee and the GreenFix Wizard. A circle shows an unrepaired ball mark. (Right photo) A front view of tools shows the angular nature of the angled tool and the push lever of the GreenFix Wizard.

vious study (Munshaw et al., 2007) reporting that using tools with the push technique, such as the GFW, resulted in no significant difference in ball-mark diameter compared to using a standard long-tong tool and the traditional method.

Surprisingly, one of the worst-performing tools in this study was the WGT, which was similar to an unrepaired mark on all measurement dates in the firm area and six of seven dates in the soft area. Additionally, the ATT was not substantially different from the unrepaired marks on four of seven measurement dates for the soft area and all dates in the firm area. Aside from improving surface smoothness by reducing the scar cavity, it appears there is no major benefit to using the ATT and WGT to repair ball marks.

Summary and Recommendations

In this study, the TT and the GFW resulted in the fastest ball-mark recovery time. The ATT was not significantly different from the unrepaired marks on four of seven measurement dates for the soft area and all dates in the firm area. The longest recovery was associated with the WGT, which was similar to an unrepaired mark on most rating dates making it an undesirable choice for ball-mark repair.

Furthermore, it is clear from this study that many factors affect ball-mark recovery. Surface firmness and repair tool both play an important role in recovery time. Maintaining drier and firmer surfaces by rolling, irrigating deep and infrequently, and using management practices that decrease organic matter such as core cultivation and sand topdressing could provide better resistance to ball marks and decrease the recovery period by ensuring smaller initial ball mark scar cavities.

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