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Title: The Impact of Putting Green Management on Visible Wear Caused by Golf Cleat/Sole Designs

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Summary Text and Objectives:

In recent years, some superintendents and golfers have protested that newer golf cleat/sole designs are too aggressive on their putting surfaces. Trade journal articles have quoted individuals claiming that some of these newer designs are worse than banned spikes from the past. Conversely, golf course clientele in similar regions have not reported any putting surface disruption caused by any cleat/sole designs. Given this conundrum, there appears to be a need for scientific evidence regarding how putting green management may affect visible damage caused by foot traffic from various cleat/sole designs.

To address the issue a two-year study to quantify the impact of putting green management on the visible wear caused by golf cleat/sole designs was initiated at Michigan State University(MSU) in partnership with The University of Arkansas(UA) in the summer of 2016. Objectives of the research include:

1) **identify particular components of golf cleat sole designs that result in the least to greatest perceived differences in regard to green friendliness**

2) **identify putting green management practices that negate the visible damage caused by the most intrusive and/or destructive of the current golf cleat/sole designs and**

3) **search for correlations between surface firmness (as measured by a TruFirm device) and TDR measurements (0 to 1.5 inches) when collecting data regarding turfgrass management practices.**

To address Objective 1, golf cleat/sole traffic studies were performed at 20 locations (Michigan, Arkansas, Florida and Scotland) with over 20 cleat/sole designs. The studies were conducted on various cultivars and ages of creeping bentgrass, annual bluegrass, ultradwarf bermudagrass, seashore paspalum, and fine fescue putting greens. At each location, 3 x 3 foot plots were trafficked with different cleat/sole designs, with each design designated as a treatment. Each plot received 30 simulated rounds of golf with the exception of a non-trafficked treatment. Following traffic, golfing clientele rated the putting surface smoothness using the following scale:

1 = Excellent; no visible traffic
2 = Very good; I think I see foot traffic
3 = Good; some visible foot traffic but I would not mind putting on the surface
4 = Fair; visible foot traffic that would most likely deflect my putt and
5 = Poor; terrible putting conditions recommend banning the cleat/sole from our golf course.

To address Objectives 2 and 3 research putting greens at MSU and UA were managed under identical cultural and mechanical practices. Management treatments included different levels of grooming (none

vs. 3x weekly), lightweight rolling (none vs. 3x weekly), sand-topdressing (none vs. every other week), and fertility (low N vs. high N). Research putting greens at MSU included a 1-year old 'Declaration' creeping bentgrass green grown atop a USGA specification root zone and a 11-year old push-up annual bluegrass putting green. At UA a 1-year old 'Pure Distinction' creeping bentgrass established on a USGA root zone and a 'Tifeagle' ultradwarf bermudagrass putting green established on a 10 inch sand cap (sand particle size is within USGA recommendations). Each green was evaluated for foot traffic tolerance on at least three occasions during both years of the study. Other data collection included green speed measurements, total biomass (measured in place of thatch thickness) from surface to a one inch depth, surface firmness as measured with the Spectrum Tru-Firm, and volumetric water content to a 1.5 inch depth using a Spectrum TDR 300.

Summary Points:
The most repeatable observation from Objective 1 was:

1. golf sole and cleat designs from the 20th century (including but not limited to the 8 and 6 mm) resulted in more visible foot traffic at most every site compared to the most aggressive of today's cleat/sole designs (Fig. 1).

Results from Objective 2 and 3 include:

1. When statistical difference occurred, topdressing on creeping bentgrass and annual bluegrass resulted in less visible wear following 20 simulated rounds of golf.
2. Topdressing also resulted in firmer (less ball mark depression measured with the Tru Firm) on creeping bentgrass and annual bluegrass at MSU
3. Topdressing also decreased VWC on creeping bentgrass and annual bluegrass.
4. Annual bluegrass plots that were not groomed or topdressed resulted in the greatest ball mark depression compared to all other treatments as measured with the Tru Firm.
5. On creeping bentgrass high fertility resulted in greater ball mark depression (less firm surfaces) as measured with the Tru Firm.
6. Although there was a significant relationship between VWC and Tru Firm measurements, VWC explained less than 30% of the variability among Tru Firm measurements. Therefore, predicting Tru Firm values from VWC alone is not practical.

In summary, little if any visual differences were apparent among mechanical and cultural treatments with the exception of days the plots were trafficked, however, data suggest proper cultural and mechanical practices can minimize wear from the most destructive golf cleat/sole designs and from ball marks (Fig. 2).

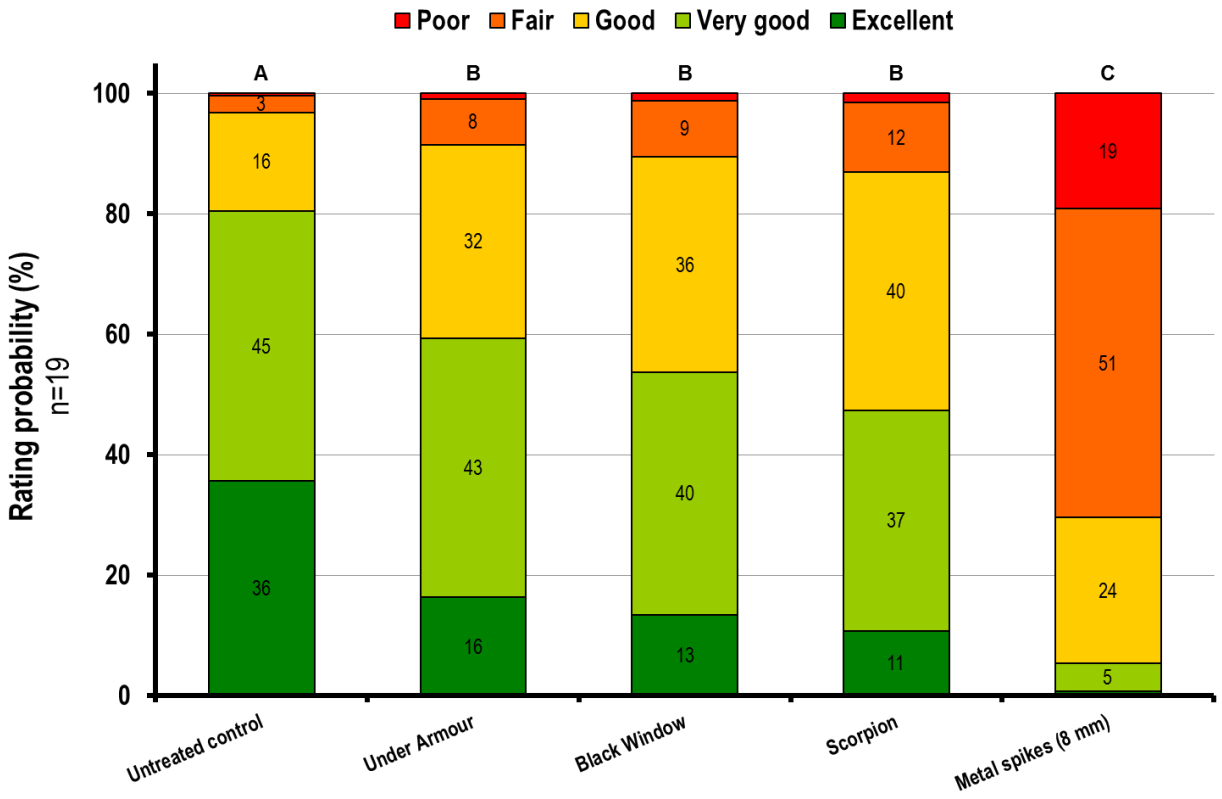

Figure 1. Predicted probabilities of spike treatments to be rated as either "Excellent", "Very Good", "Good", "Fair", or "Poor". Probabilities were estimated using logistic regression analysis of data collected from 3 replicate plots evaluated on St Andrews Golf Club Jubilee, St. Andrews Scotland on a 10-year old fine creeping red fescue, colonial bent and *Poa annua* mix putting green April 4, 2017. Data was generated from 19 raters and bars that do not share a letter are significantly different ($\alpha = 0.05$).

Figure 2. Though statistical differences resulted from measuring devices among the treatments, the plots were visually similar until traffic was applied.