

2017-24-634

Title: Impact of Cultural Practices on Putting Green Speed and Plant Health

Project Leader: John Kaminski

Affiliation: Pennsylvania State University

Objectives:

1. Determine the effect of mowing frequency and height of cut on ball roll distance and health of three turfgrass species.
2. Quantify the effect and consistency of various combinations of cultural practices used in tournament preparation programs on putting green performance.
3. Elucidate influences of weather variables on ball roll distance.
4. Survey various golf course tournament preparation programs used by golf course superintendents.

Start Date: 2017

Project Duration: One year

Total Funding: \$5,000

Summary Text:

Rationale

Golf course putting greens are arguably the most intensely managed playing surface on golf courses. Ball roll distance, often referred to as “green speed”, and trueness of the ball’s roll across a green have a major impact on the playability of putting surfaces. Green speed is the most requested information on golf course conditions by players (Nikolai, 2005). Golf course managers, therefore, strive for consistently fast and smooth playing surfaces on putting greens while maintaining acceptable turfgrass quality.

Research involving green speed has mostly focused on quantifying the impact of individual cultural practices on ball roll distance. The goal of most research on ball roll distance has been to identify cultural practices that maintain a reasonable ball roll distance during day to day operations while lowering the stress caused to turfgrass through standard cultural practices such as mowing frequency and height of cut (Gilhuly, 2006; Soller, 2013). Beyond daily play, turfgrass managers are routinely charged with preparing for tournaments which often require the production of abnormally fast green speeds. In preparing putting greens for a tournament, managers are faced with integrating several cultural practices into a program to develop the best possible playing surface for a short period of time.

While faster green speed is a primary goal for golf course tournaments, turfgrass managers must balance the use of cultural practices to achieve desired putting green speeds while not overly compromising the health of the turfgrass (Zontek, 1997). Some components of a greens tournament preparation program are not limited to but may include: lowering the height of cut, increasing the frequency of mowing events, lightweight rolling, topdressing, grooming or vertical mowing, as well as adjustments in fertility and irrigation regimens (Nikolai, 2005; Zontek, 1997). Integrating all or some of these potential cultural practices into a program that produces the required greens conditions for a short time period is the goal of a tournament preparation program.

While there have been many studies elucidating the influence of individual or even limited combinations of factors on ball roll distances, there has been little research into the synergistic effects of a programmatic approach to increasing ball roll distances and their influence on plant health. The

influence of environmental conditions also must be taken into consideration. Ultimately, the ability to predict ball roll distance based on multiple inputs under various conditions would be a valuable tool for golf course superintendents.

Methods

Mowing height and frequency

Field studies are being conducted on various research putting greens at the Valentine Turfgrass Research Facility located in University Park, PA. All studies are being conducted on three sand-based putting greens consisting of either: 1) 100% annual bluegrass (*Poa annua* L.). 2) 98% “Penn A-4” creeping bentgrass (*Agrostis stolonifera* L.) with 2% annual bluegrass and 3) 90% “Bridgeport II” fine fescue (*Festuca rubra* L.) and 10% “Alister” colonial bentgrass (*Agrostis capillaris* L.). All studies will be repeated in subsequent years.

All studies are designed as a 3 x 3 factorial arranged in a randomized complete block design with 3 replications. Main effects will consist of mowing height and mowing frequency. For experiments conducted on annual bluegrass and creeping bentgrass, mowing heights will be set to a bench height of 2.1 mm, 2.5 mm, and 2.9 mm. For the fine fescue putting green, heights will be 4.0 mm, 4.5 mm, and 5.0 mm. For the main effect of mowing frequency, individual plots will be mowed either once, twice, or four times per day. Single cut (SC) treatments involved one single pass through each plot with the mower in the morning. Double cut (DC) treatments will consist of two passes of the mower down and back along the same line in the morning. Double-double cut (DD) treatments will consist of a DC in the morning and again in the afternoon.

Playability data will be collected two times per day for the 14-day duration of each experiment. Data collected included: ball roll distance (BRD) using a USGA Stimpmeter, surface firmness (TF) using a Fieldscout TruFirm True Firmness Meter, ball roll physics (BRP) characteristics using the Sphero Turf Research App and putting green trueness (PGT) using a Greenstester.

Plant health data will be collected daily for the 14-day duration of each experiment. Data collected includes: normalized difference vegetative index (NDVI) using a Fieldscout TCM 500 meter, chlorophyll content (CM) using a Fieldscout CM 1000 Meter, and surface temperature/stress using a FLIR-ONE Thermal imaging device. Visual ratings will also be used to assess turfgrass quality and color.

Environmental data will also be collected for the duration of each experiment. Data collected includes: soil moisture (SM) at 3.8 cm and 7.6 cm using a Fieldscout TDR 300 meter, air temperature (AT) and relative humidity (RH) using a Kestrel 3000 Weather Meter. Additional weather data will be obtained from an on-site weather station at the Valentine Turfgrass Research Facility.

Thermal images will be analyzed using Flir Tools software (FLIR Systems, North Billerica, MA) to determine and average infrared signature for each plot. All data will be subjected to analysis of variance using PROC MIXED and means were separated at $P \leq 0.05$ according to Fisher’s Protected least significant difference test. Preplanned contrasts will be determined for select comparisons and assessed using SAS MIXED procedure (SAS, Inc., Cary, NC).

Mowing patterns, fertility and plant growth regulators

Based on preliminary results from a previous study which indicated that mowing patterns influenced ball roll distances, a field study will be conducted on a research putting green at the Valentine Turfgrass Research Facility located in University Park, PA. The experiment will be initiated in 2017 and repeated in

2018. The site consists of a stand of 98% “Penn A-4” creeping bentgrass with 2% annual bluegrass. The study is designed as a 3 x 4 factorial arranged in a randomized complete block design with 3 replications. Main effects will consist of mowing patterns and various cultural practices.

For the main effect of mowing pattern, individual plots will be mowed by: 1) a single cut (SC) treatment involving one single pass through each plot with the mower in the morning; 2) a double cut (DC) treatment involving two passes of the mower down and back along the same line in the morning; or 3) a cross cut (CC) involving two mower passes in perpendicular directions two each other. All plots will be mowed to a height of 2.5 mm. For the main effect of cultural practices, plots will receive: 1) 6 kg N/ha; 2) 0.4 L Trinexapac-ethyl/ha; 3) N + Trinexapac-ethyl; and 4) and non-treated control. Nitrogen and plant growth regulator treatments will be applied every two weeks for the duration of the 6 week study.

Playability, plant health, turfgrass quality and environmental conditions mentioned previously will be periodically collected throughout the study. All data will be subjected to analysis of variance using PROC MIXED and means were separated at $P \leq 0.05$ according to Fisher’s Protected least significant difference test. Preplanned contrasts will be determined for select comparisons and assessed using SAS MIXED procedure (SAS, Inc., Cary, NC).

Vertical mowing and brushing

A field study will be conducted on a research putting green at the Valentine Turfgrass Research Facility located in University Park, PA. The experiment will be conducted on a stand of 98% ‘Penn A-4’ creeping bentgrass with 2% annual bluegrass and a stand of 100% annual bluegrass. The study will be arranged in a randomized complete block design with 4 replications. Treatments will include various cultural practices around vertical mowing and brushing. The influence of vertical mowing depths and frequencies as well as various brush types and stiffness on turfgrass quality and ball roll distances will be assessed. The exact number of treatments will depend upon equipment and space limitations.

Playability, plant health, turfgrass quality and environmental conditions mentioned previously will be periodically collected throughout the study. All data will be subjected to analysis of variance using PROC MIXED and means were separated at $P \leq 0.05$ according to Fisher’s Protected least significant difference test.

Preplanned contrasts will be determined for select comparisons and assessed using SAS MIXED procedure (SAS, Inc., Cary, NC).

Green speed as influenced by weather parameters

Data collected from the previously mentioned field studies as well as data collected specifically for this experiment will be used to elucidate the influence of weather variables on daily green speed. In addition to the aforementioned studies, an observational study will be conducted on a research putting green at the Valentine Turfgrass Research Facility located in University Park, PA. The experiment will be conducted on a stand of 98% ‘Penn A-4’ creeping bentgrass with 2% annual bluegrass. Height of cut will be set to a bench height of 2.5 mm.

Ball roll distance will be collected three times per day using a USGA Stimpmeter. Data will be collected throughout the growing season. Environmental conditions will be continually recorded for the duration of the experiment. Data collected included: soil moisture (SM) utilizing a Toro Turf Guard soil monitoring unit. Air temperature, RH, wind speed (WS), wind direction (WD), and leaf wetness (LW) using Stevens on site weather station. All data will be subjected to a multivariate and correlation analyses in an attempt

to develop a mathematical model designed to predict maximum green speeds based on select cultural practices and environmental conditions.

Tournament preparation survey

A survey of golf course superintendents will be developed with the purpose of compiling information on common cultural practices believed to enhance golf course putting green playability. The survey will be made available to all turfgrass managers, but also directed towards golf courses hosting professional golf events.

Literature Cited

Gilhuly, L. 2006. Green speed: Trick or treat. USGA Green Section Record. July-August:17-19.

Nikolai, T.A. 2005. The superintendent's guide to controlling putting green speed. John Wiley & Sons, Hoboken, NJ.

Soller, D. 2013. Putting greens: It's time to set a speed limit. USGA Green Section Record. 51:1-4.

Zontek, S.J. 1997. Preparing your greens for that all-important tournament. USGA Green Section Record. July/August 1997:1-4.