A Year of Measuring Putting Green Performance

Taking the time to collect information about putting green performance pays off with more insight and improved management efficiency.

BY CHRIS HARTWIGER

As an agronomist, I am curious about what well-performing putting greens have in common. Are there things that good putting greens have in common, or are there many different paths to the same destination? How does performance fluctuate during a year, or among many years? When I ask these questions in the field, I find there are few golf courses that collect and consolidate information about putting green performance and management inputs that would allow them to provide definitive answers.

In 2018, USGA agronomist Addison Barden and I embarked on a project with six different golf courses to answer these questions by collecting daily putting green management information. Through this process of data collection and analysis, we hoped the participating golf course superintendents would use this newly accumulated information to make decisions that would smooth out the peaks and valleys in putting green performance and optimize the allocation of resources in managing their putting greens. This article will share a few details about the project, what we learned, and how you might use data collection to improve management at your golf course.

Collecting and visualizing data of key surface performance indicators and inputs enables superintendents to efficiently achieve specific surface performance goals with greater consistency.

THE PROJECT

When we embarked on this putting green surface management data collection project, we wanted to make data collection as efficient as possible by measuring only the variables that would provide the most helpful information. We chose to keep the project simple and asked for measurements to be taken on only one putting green for each course. We asked the superintendents to select an average putting green and avoid their best or worst putting greens.

STEP 1: WHAT TO MEASURE

Our first decision was to determine how we were going to measure performance. Ultimately, we identified green speed and clipping volume as our key performance indicators. Each day, superintendents measured green speed from the exact same location on the same putting green. They also collected clippings from that green.

Next, we identified the variables we thought contributed most to those performance indicators. In other words, we had to decide which inputs and practices contributed most to green speed and clipping volume. We created a spreadsheet for each course and asked them to enter information every day about 12 distinct items that fit under the broad categories of key performance indicators, cultural inputs, and surface maintenance practices.

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KEY PERFORMANCE INDICATORS

- Green speed
- Clipping volume

CULTURAL INPUTS AND CONDITIONS

- Nitrogen applications and rates
- Topdressing applications and rates
- Plant growth regulator applications and rates
- Temperature — daily high and low

SURFACE MAINTENANCE PRACTICES

- Mowing height
- Mowing frequency
- Vertical mowing
- Grooming
- Brushing
- Rolling

STEP 2: VISUALIZE THE DATA WITH GRAPHS AND TABLES

As data were collected, we created simple graphs and tables that showed the key performance indicators over time and summarized the frequency and quantity of maintenance practices and inputs. This exercise proved to be helpful but challenging. The graphs were helpful because they showed the data in a form other than numbers on a spreadsheet. Expressing the information in graph form proved to be challenging because there are an almost unlimited number of graphs or tables that can be created. Along the way, we received helpful feedback from participating superintendents on what they found to be most useful and we adjusted data presentation accordingly.

STEP 3: STATISTICAL ANALYSIS

The participating courses were collecting data, but how did we know if we were measuring the variables that accounted for daily fluctuations in those key performance indicators? They answer is we didn't know, but we could see if we were on the right track by using a multivariable regression analysis.

Dr. Andy Tiger, a professor at Angelo State University, conducted a multivariable regression analysis to see how well the variables we chose to measure explained the variations in the key performance indicators. The analysis of green speed revealed coefficient of multiple determination values (r2 values) of 70%, 90%, 44%, 97%, 65%, and 72% at the six courses. The closer an r2 value is to 100%, the more confidence there is that the variables measured explained the variability in the key performance indicators. All the values except the 44% r2 value showed a strong predictive relationship. Interestingly, we observed that the course with the 44% r2 value made the most day-to-day adjustments in their inputs and practices. Overall, we felt confident that we were measuring the inputs and practices that had the most explanatory effect on the key performance indicators.

Another part of the analysis was to assess whether an individual variable, such as mowing frequency or topdressing had a statistically significant relationship to the key performance indicators — i.e., the relationship is not attributed to chance. If a variable was significant, we wanted to determine the relative influence it had on the key performance indicators.

Our results in this analysis varied from site to site. Factors such as mowing frequency and temperatures always were significant and were major contributors to performance. This was not surprising. However, it has proven difficult to quantify the relative impact of inputs such as growth regulators and nitrogen because their impact lasts multiple days or weeks and does not necessarily appear on the day they are applied. Further, the impact of these inputs may vary from day to day during that window of time.

As we refine the analysis, it may be possible to develop predictive modeling for green speed and clipping volume for one, two, or three days into the future after various practices or applications. Think of it this way — if we are measuring the variables that contribute the most to the key performance indicators, and if there is a large enough data set — e.g., a year or more — to assess their relative impact, we may be able to develop a predictive model that allows superintendents to test different combinations of inputs and maintenance practices in the model before implementing them in the field. If the model proves to be accurate, this will offer superintendents an opportunity to be both more efficient and effective in reaching their goals.

WHAT WE LEARNED

Below are six items we learned throughout this project:

1. Data collection was not unnecessarily burdensome. We had 100% participation for one year's worth of data collection at all but one of the courses. This course had a change in superintendents during the year and their data collection was disrupted. Participating superintendents said that their teams made the data collection a part of the daily routine. They usually assigned the logging of data into the spreadsheet to an assistant superintendent and had a backup for days the assistant was not working.

2. Data collection is worth the effort. They say a picture is worth a thousand words and a graph probably is worth a thousand numbers. Two of the most valuable graphs were green speed over time and clipping volume versus green speed. Just seeing the data in graph form provided valuable insights that were not apparent when looking at columns of numbers in a spreadsheet.

Graph 1 shows 6 months' worth of green speed values. A user-defined green speed range was added. This helped the turf management team quickly see times of the year when it was difficult to stay within the range or the impact of their core aeration program. When staff wanted a more detailed understanding of why performance veered from the target range, they could take a look at the underlying data.

Graph 2 shows clipping volume versus green speed. There is a sweet spot for clipping volume at a given green speed and a graphical representation makes this easy to identify. In a way, a quick check of clipping volume each day is an indicator of where green speed will be. Too much

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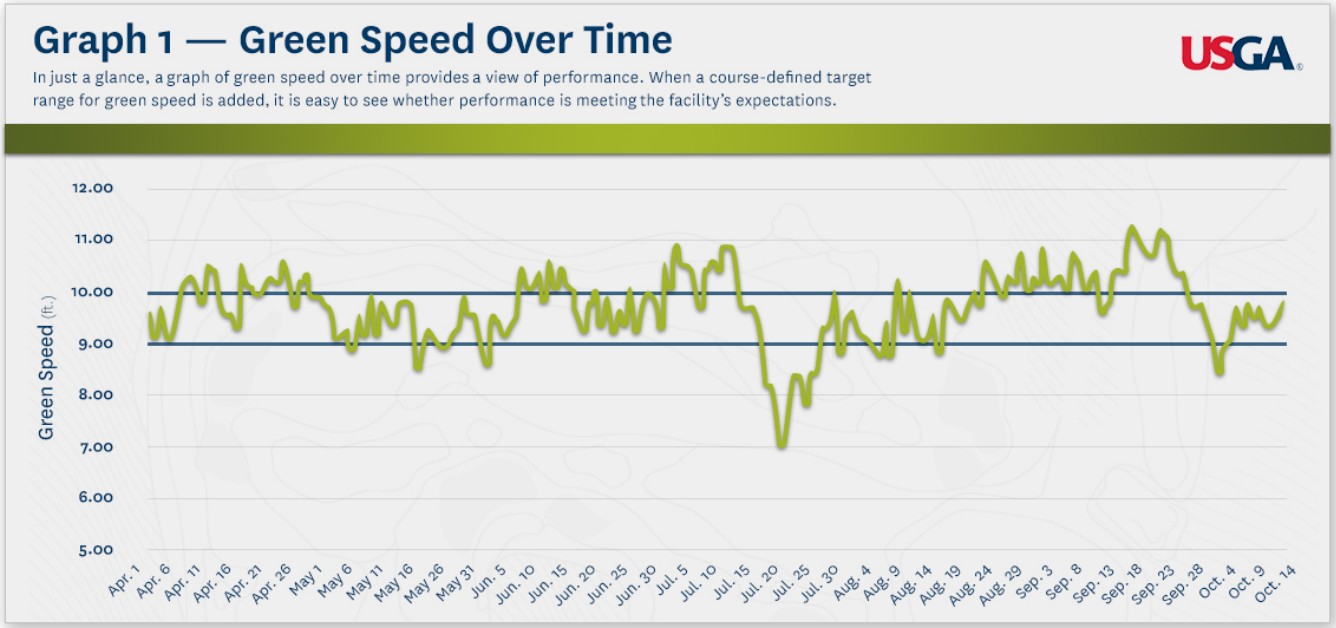
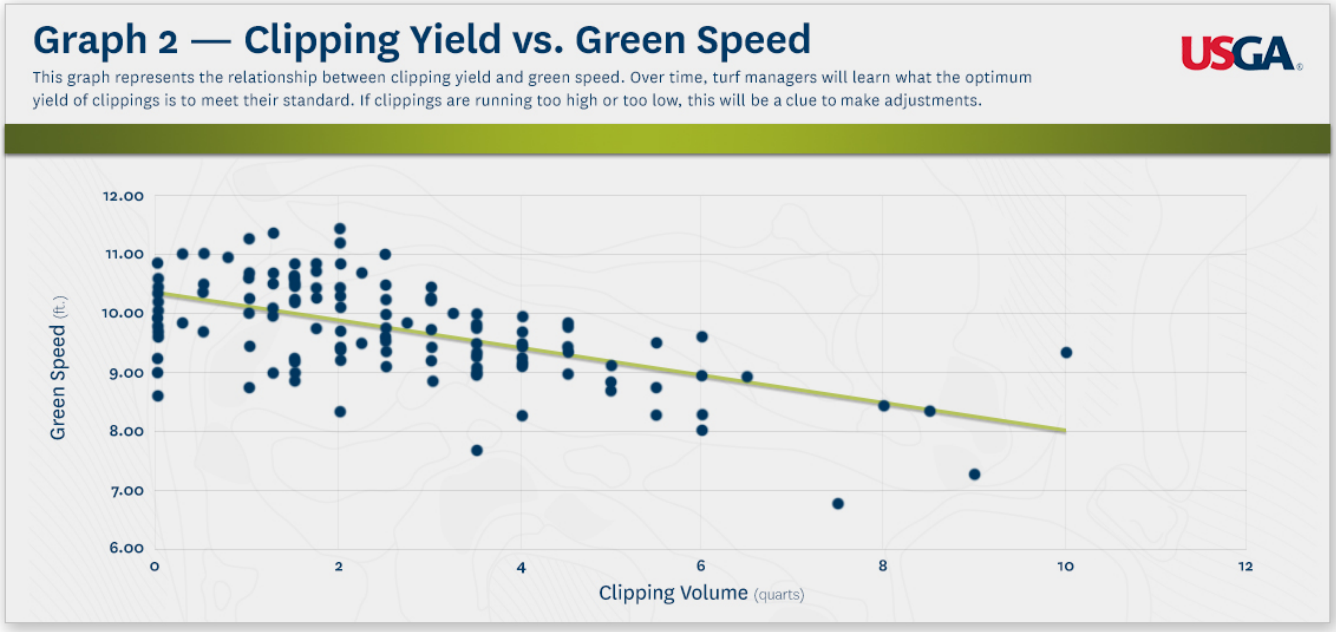


grass collected will make the target range harder to achieve. Too little grass collected may push speeds toward the upper end of the target range.

3. A simple method for sand topdressing calibration was discovered. A participating superintendent developed a simple method to estimate sand topdressing volumes. He uses a rimmed baking sheet lined with Enkamat® to catch the sand being distributed by the topdresser. The Enkamat® prevents sand from bouncing out of the baking sheet. To determine the volume of sand applied, the baking sheet is placed on a nursery green and then the area is topdressed. The application rate is the weight of sand in the baking sheet divided by the area of the baking sheet. This value can be easily converted to a more common measure, such as pounds per 1,000 square feet. It is advisable to repeat the process two or three times and take an average because topdressing uniformity can vary significantly from pass to pass.

In addition to its influence on putting green speed and the volume of clippings produced, knowing the amount of topdressing applied will be helpful in planning the core aeration and topdressing program used to manage organic matter in the upper rootzone.

4. Comparing periods year-over-year facilitates proactive adjustments. In the Southeast, the month of May is when things really begin to happen with bermudagrass growth. The month begins with some degree



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of bermudagrass growth, but it ends with bermudagrass in its maximum seasonal growth rate. For all but one of the courses, green speed trended down in May 2018, regardless of what their self-defined target range was. This required a quick and intensive correction by all of them in early June to stay within their target range.

Identifying this trend spurred the superintendents to be more proactive with their inputs and practices in May 2019. By closely examining the data, one course was able to avoid a decline in green speed in May 2019. By comparing a summary of data between May 2018 and May 2019, the biggest difference was fewer clippings were produced. Why? A closer look into the data shows more frequent growth regulator applications and more sand topdressing in May 2019. This insight ensures the staff at this course will be even better prepared for May of 2020.

5. Preserving a historical record is important. Most people have a short memory. It's difficult to remember how a course's putting greens performed last month or last year, let alone the total amount of inputs applied. Historical records are lessons that a course can learn from and they should be preserved. Also, members of a turf management team want to know if they succeeded in meeting expectations for the season and how they can be better next year. This is difficult without a historical record of performance, inputs, and cultural practices.

6. Visualizing data is a powerful communication tool. It is not uncommon for golfers to ask for and expect excellent putting greens. Unfortunately, sometimes their impression of putting green playing quality is only as good as their most recent round, and they often ignore the much larger body of work for the season or the year. Graphs and tables offer a way for superintendents to communicate how well the putting greens have performed over a given period of time. Also, a summary of key practices as described above is an easy way to show what it took to meet the standard. This is an asset in both communication and budgeting.

WHAT DOES THE FUTURE HOLD?

The commitment and enthusiasm of the first participating superintendents have shown us there is value in incorporating a putting green data collection program within the USGA Course Consulting Service. We increased the number of participating courses to 18 in 2019, and we focused on refining our dashboards and statistical analysis. We hope to significantly increase the number of courses participating in 2020.

GETTING STARTED ON YOUR OWN

The topic of data collection may have sparked your curiosity about how your putting greens performed last month, last year, or five years ago. If so, you are a perfect candidate to get started with a data collection program of your own. The best advice is to start with the basics below:

- Identify key performance indicators, such as green speed and clipping volume, that you will measure on a single putting green every day. If this is all you do, it is an improvement over not measuring anything.
- Decide which cultural inputs you want to track. Examples include nitrogen, growth regulators, and topdressing applications and rates.
- Decide which maintenance practices you want to track.
- Identify the putting green you are going to take measurements from.
- Label a container to measure the volume of your clippings. Obtain the supplies mentioned above to measure the rate of your topdressing applications.
- Create a spreadsheet to organize your data.
- Graph the data.
- Communicate your results with staff members and course officials.

CONCLUSION

After more than a year of measuring putting green performance and inputs, both USGA agronomists and the participating superintendents are pleased with the process, and the superintendents involved show no signs of slowing down when it comes to data collection. The project succeeded in the ways that we hoped. Collecting information and visually displaying it through charts and graphs provided superintendents with insights they would not have had otherwise. USGA agronomists who worked with these facilities better understood putting green performance at the individual courses, too. However, one of the most enjoyable aspects of the project was uncovering surprises that we did not expect. In the end, collecting a year's worth of data was well worth it.

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