Comparing Two Devices Used to Measure Green Speed on Golf Course Putting Greens

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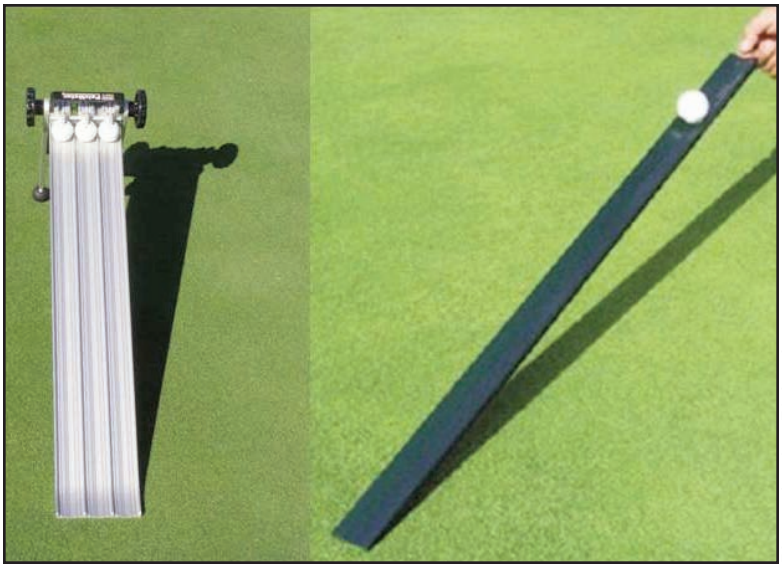

Photos by Jay Richards

Devices used for measuring putting green speed. Pelzmeter (left) and Stimpmeter (right).

Additional index words: Stimpmeter, Pelzmeter, ball roll distance, *Agrostis stolonifera*, *Poa annua*

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Summary. The Stimpmeter and Pelzmeter are two devices to measure putting green speed, but it is unclear how these meters compare for measuring putting green speed. The research objective was to compare the measurement variability of the two devices when measuring putting green speed and to determine if the meters give similar results on the same putting surface. This study was conducted at four sites: the University of Arkansas (Fayetteville, Ark.), the University of Tennessee (Knoxville, Tenn.), the University of Connecticut (Storrs, Conn.), and Michigan State University (East Lansing, Mich.). At each site, multiple evaluators used each device to measure putting green speed on plots with varying green speeds. There were few differences in putting green speed values between the Pelzmeter and the Stimpmeter when measuring the same turf. Measurement repeatability (as measured by standard deviation) was similar between the two devices when different evaluators measured the same plot. Golf course superintendents and turf researchers can choose the green speed measuring device that fits their situation best because both meters produced similar results.

Abbreviations: ARK (University of Arkansas), CONN (University of Connecticut), MSU (Michigan State University), TENN (University of Tennessee), USGA (United States Golf Association)

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Putting green speed is an important aspect of a putting green's overall quality. Putting green speed is the distance a ball travels after being released from an inclined plane, such as a Stimpmeter, or after being struck with a putter. According to a Golf Course Superintendents Association of America survey, golfers are more concerned about the speed of the putting greens than any other aspect of the golf course (Umminger, 2002). In the 1970s, the United States Golf Association (USGA) recognized that green speed was an important aspect of the game of golf and commissioned for the development of an instrument that could be used to measure the speed of a putting green. Though the Stimpmeter was developed by Eddie Stimpson in the 1930s, an improved design of the Stimpmeter was released in 1977 and today is the only tool accepted by the USGA for measuring putting green speed (Thomas, 1983). The Stimpmeter is a tool that provides a way to measure putting green consistency throughout the golf course (Fig. 1b). The Stimpmeter has been the prominent tool used in turfgrass research where putting green speed is evaluated. Past studies used the Stimpmeter to measure putting green speed as affected by nitrogen fertilization and the growth regulator trinexapec-ethyl (McCullough, 2006); bermudagrass (*Cynodon* spp.) genotypes (Busey, 1997); overseeding 'Tifdwarf' bermudagrass (*Cynodon trasvaalensis*) putting greens (Grossi, 2008); different mowing equipment (Jang, 2004); and lightweight rolling (Hartwiger, 2001). In fact, until recently, the Stimpmeter was the only tool used for research to measure putting green speed.

In 2004, a new apparatus, the Pelzmeter, was released for measuring putting green speed (Fig. 1a). The Pelzmeter was designed to reduce the variability associated with the Stimpmeter by implementing a bubble-level system to ensure the ball is released from a consistent height, and a tapered ramp, which releases the ball horizontally onto the green to minimize ball bounce. The Pelzmeter's three side-by-side grooves help to minimize ball tracking effects (Pelzmeter User Manual, 2004). Because it is relatively new to the turf industry and is not endorsed by the USGA, the Pelzmeter has been used much less than the Stimpmeter for putting green speed research. However, recent studies have used the Pelzmeter to determine the effect that various mowing treatments and rolling treatments had on putting green speed (Richards, 2008), and the Pelzmeter was also used to determine the speed of nine putting greens that were mowed using various bedknife thicknesses (Carson, 2007).

Research using the Stimpmeter and the Pelzmeter to measure green speed is currently being conducted. Therefore, it is important to know how to compare putting green speed measurements from the two devices. Also, there is a need to substantiate claims that the Pelzmeter reduces measurement variability that is associated with the Stimpmeter. The objective of this study is to determine which device measures putting green speed with the least variability and to determine if the meters give similar results on the same putting surface.

Materials and Methods

Experimental area. This study was conducted at four sites: the University of Arkansas (ARK), Fayetteville, Ark., the University of Tennessee (TENN), Knoxville, Tenn., the University of Connecticut (CONN), Storrs, Conn., and Michigan State University (MSU), East Lansing, Mich. The experimental area at each site is summarized in Table 1. Putting green root zones and species varied across sites. At ARK and TENN, putting greens were built on a USGA specification rootzone (USGA, 1993). However, at CONN and MSU, putting greens were built on native soil.

Meter evaluations. This study contained two main treatment factors: the device for measuring putting green speed (Pelzmeter and Stimpmeter) and the evaluator using the device (three evaluators at each site). At each site, ball roll distance was measured by each evaluator with each device on each of eight plots varying in green speed. A range of green speeds was present on the plots at each location as the result of a concurrent study

comparing the effects of different mowing heights, mowing frequencies, and rolling frequencies on putting green speed and turf quality (Richards, 2008, 2009).

Putting green speed was determined by measuring ball roll distance using the Pelzmeter and the Stimpmeter according to standard procedures (Pelzmeter Manual 2004; Hoos, 1982). On each plot, three evaluators were assigned to use each device three times in a random order. However, at MSU, each evaluator used each device only once per plot.

Statistical analysis. Regression analysis was computed using PROC REG in SAS (SAS Institute Inc., Cary, N.C.) to compare the putting green speeds as measured by the Pelzmeter to those measured by the Stimpmeter. For each device, standard deviations (with 95% confidence intervals) were calculated to determine measurement repeatability with each device. Standard deviations were calculated for the variation among different evaluators when measuring the same plot with the same device and for the variation within a single evaluator when repeatedly measuring the same plot with the same device.

Results and Discussion

Regression analysis revealed a strong linear relationship ($R^2 = 0.94$) between the Stimpmeter and the Pelzmeter across a wide range of ball roll distances (8.7 to 11.8 ft) (Fig. 2). A strong linear relationship with a slope near 1.0 (0.96) was present across all four experimental sites, which included a variety of grass species and soil types (Table 1). This indicates that green speed measurements taken with the Pelzmeter can be expected to be very similar to those measured with the Stimpmeter. Therefore, ball roll distances from previous research with the Stimpmeter can be compared to studies that use the Pelzmeter.

Little difference in measurement variability was found between the Stimpmeter and the Pelzmeter when different evaluators measured the same plot (Fig. 3). There was evidence that the Pelzmeter reduces measurement variability among evaluators at the CONN site (Fig. 3). However, there were no significant differences among the meters at the other three sites. Measurement variation was higher at MSU than at the other sites (Fig. 3). This is likely due to evaluator ball roll distances being calculated from a single sample at MSU, whereas three subsamples were averaged per evaluator at the other three sites. Considering these results, variation in green speed measurements on the same turf should not be attributed to the device or the evaluator, as long as standard operating procedures for each device are followed. Variation is most likely the result of other factors, such as varying wind speed and direction during measurement, nonuniform surface conditions, and differences in turf orientation due to grain or mowing patterns.

Both of these instruments are suitable for measuring green speed if they are used properly, and each provides certain advantages and disadvantages for the user. The Stimpmeter is less expensive and easier to handle and transport, but may have a greater potential for operator error. Evaluators in this trial had previous experience using the Stimpmeter; so the chance of operator error was minimized. However, untrained operators are more likely to cause errors by raising the Stimpmeter with a rapid motion or by not holding the ramp steady as the golf ball is rolling off. The Pelzmeter takes longer to set up; however, operator error is minimized. Therefore, golf course superintendents and turf researchers can choose the green speed measuring device that best fits their situation. The strong linear relationship that exists between the two devices should provide researchers and golf course superintendents with confidence that the Pelzmeter and the Stimpmeter are similarly effective for evaluating putting green speed.

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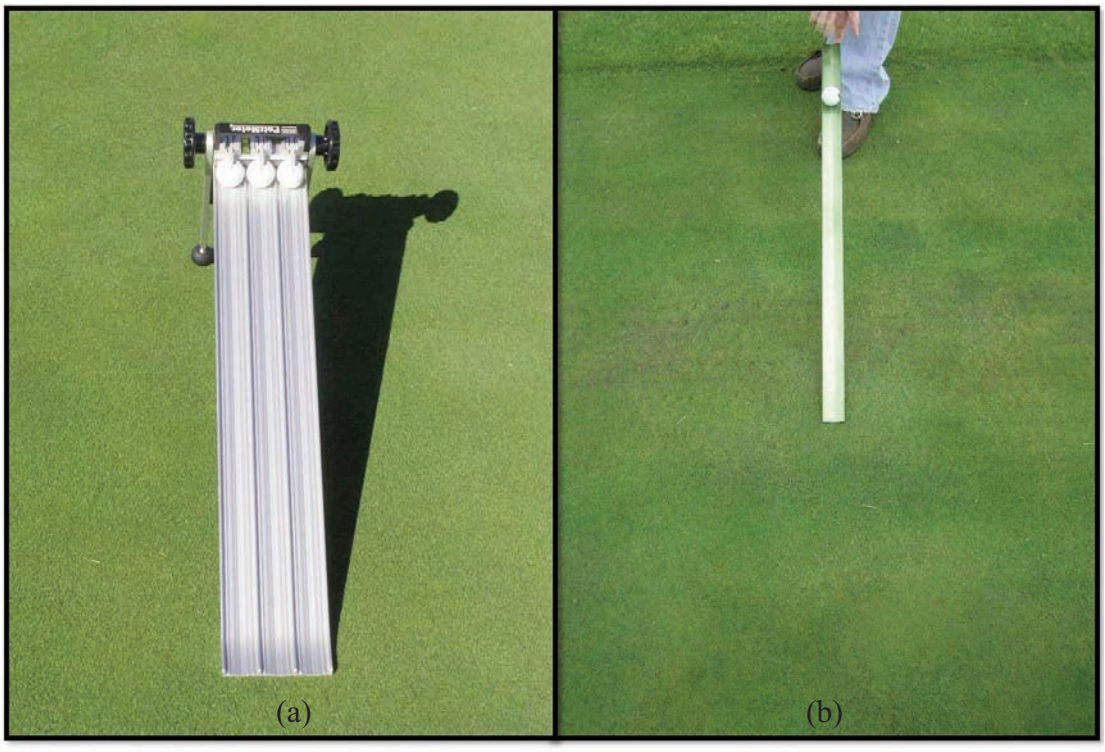

Fig. 1. Turf researchers using the Pelzmeter (a) and the Stimpmeter (b) to measure putting green speed.

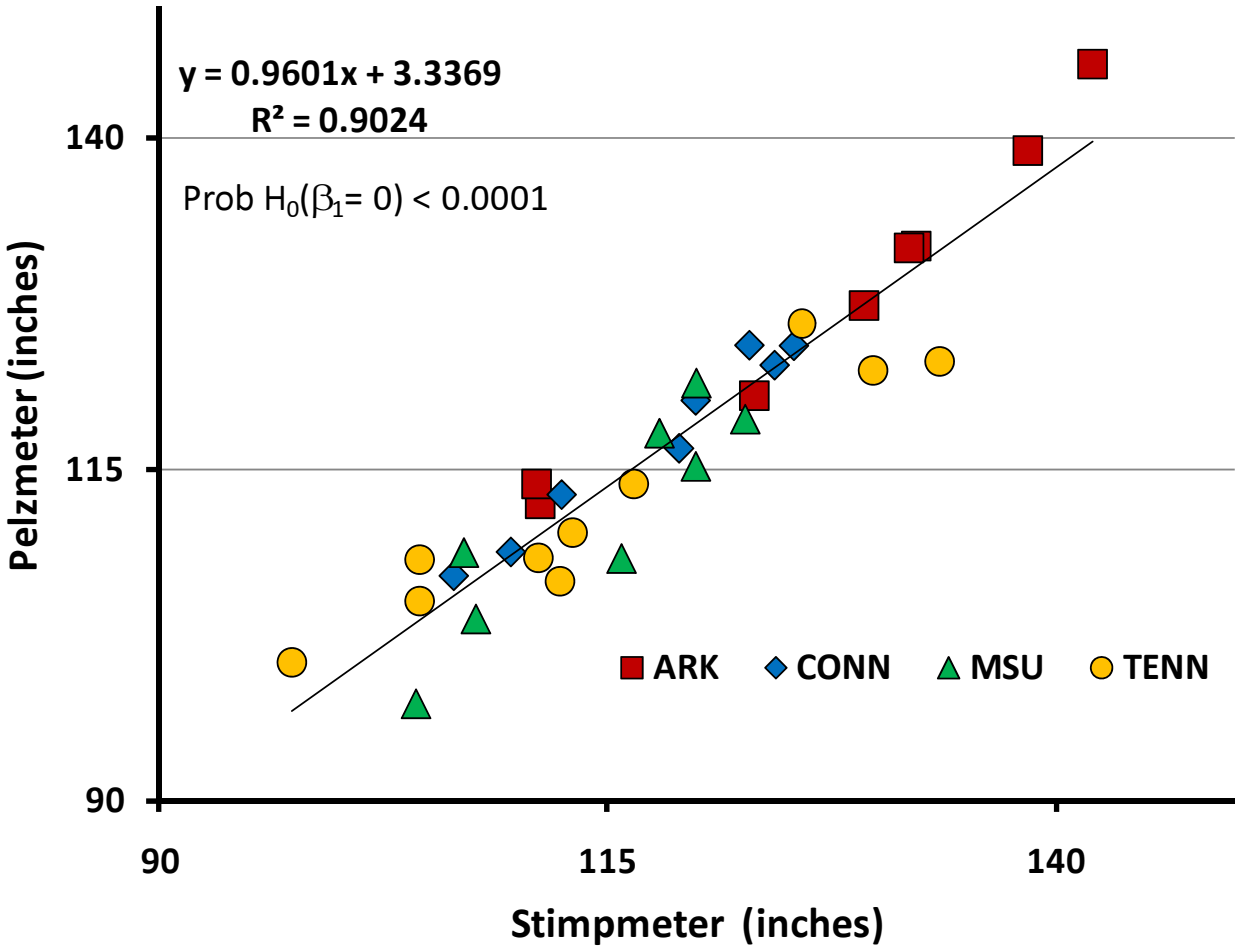

Fig. 2. Regression analysis comparing putting green speeds measured by the Pelzmeter to those measured by the Stimpmeter.

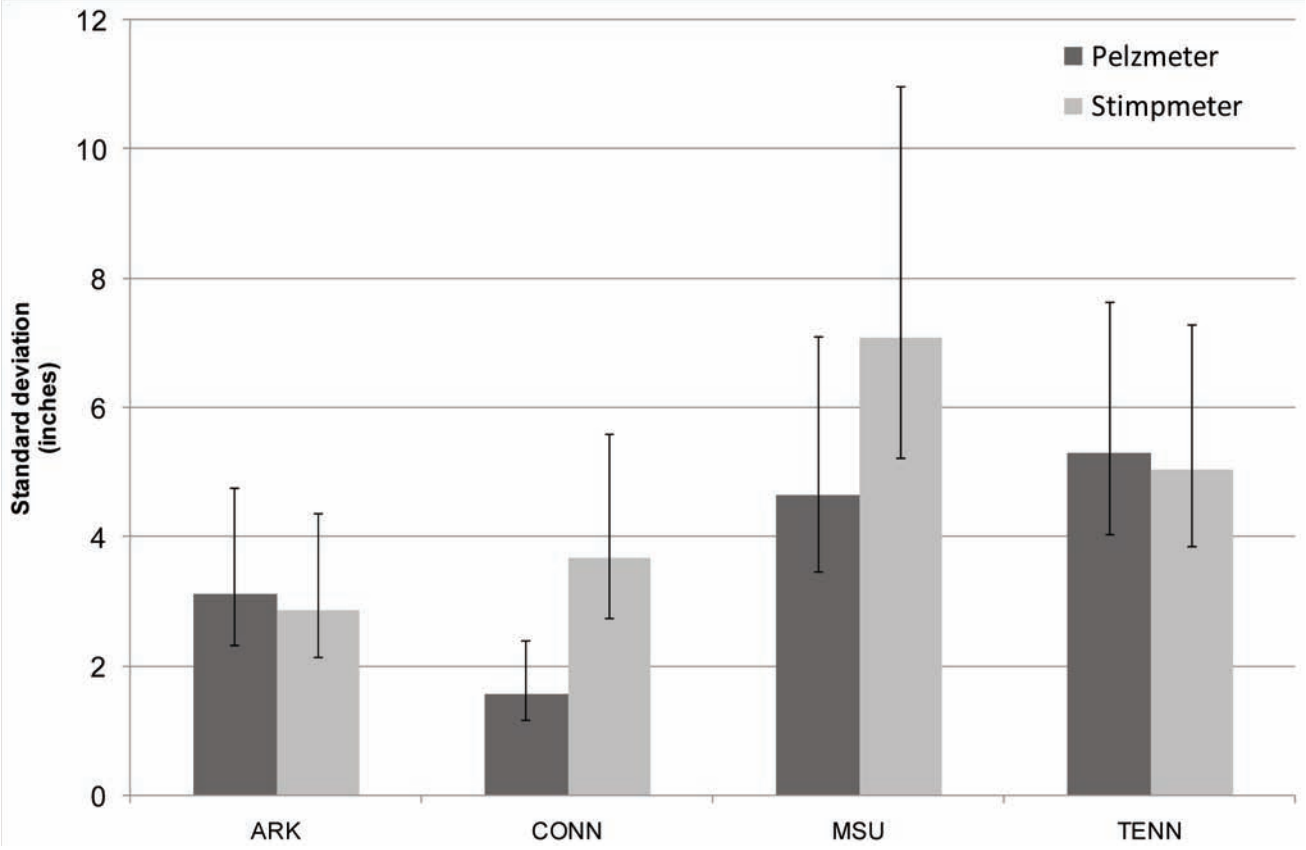

Fig. 3. Comparison of measurement repeatability of each device in determining putting green speed measurements taken at ARK, CONN, MSU, and TENN using the Pelzmeter and the Stimpmeter.

Table 1. Experimental areas at each research site.

	UARK	TENN	UCONN	MSU
Facility	Arkansas Agricultural Research and Extension Center	University of Tennessee East Tennessee Research and Education Center	University of Connecticut Plant Science Research and Education Facility, Storrs, CT	Hancock Turfgrass Research Center
Grass species	*Agrostis stolonifera*	*Agrostis stolonifera*	*Agrostis stolonifera*	*Poa annua*
Cultivar	'L93'	Dominant South Providence & SR 1119	'A-4'	'Reptans'
Soil Type	USGA sand based†	USGA sand based	Sandy Loam	Push-up
Age of Green	5 years	2 years	1 year	20+ years
Irrigation frequency	deep 2-3x wk^{-1}	deep 2-3x wk^{-1}	deep 2x mo^{-1}	minimal to prevent dry spots
Topdressing Frequency	every 2 weeks	every 2 weeks	every 3-4 weeks	every 2-3 weeks
Pesticide practices	Applied on curative basis	Applied on curative basis	Applied on a curative basis	Applied on curative basis
Annual N rate (lb. N M^{-2} yr^{-1})	4.0	6.0	4.0	4.0
Plot size (ft)	4.6 x 18.0	3.9 x 17.7	4.6 x 16	5.9 x 16
Mower	Toro Greensmaster 1000	Toro Flex 21	Jacobsen PGM 22	Toro Greensmaster 1000

† Constructed according to USGA specifications (USGA, 1993).