Mowing Height and Vertical Mowing Frequency Effects on Putting Green Quality

by Tom Salaiz

Upon reading the title to this column, some of you are probably saying to yourselves, "Gee, I didn't realize they were already doing research out at the Noer facility; I thought the place was just completed last year."

Well you're right. The research I will be sharing with you in this column was work I conducted at the University of Nebraska-Lincoln while working on my Master of Science Degree.

The purpose of my research was to evaluate the effects of mowing height and vertical mowing frequency on putting green quality. Many cultural practices are involved in managing creeping bentgrass putting greens. Developing a greens management program that will maintain adequate putting speed yet produce a healthy turf is a difficult task for many golf course superintendents.

There are many cultural practices involved in the management of greens, and some of them such as mowing height, if altered to increase putting speed, may be detrimental to the health of the turfgrass. Research is lacking not only in determining the effects of cultural practices on putting quality, but also in determining their effects on the turf microenvironment and how a turf responds to such changes.

Knowing which cultural practices optimize putting green quality and maintain a healthy turf will help the golf course superintendent develop a sound greens management program. Part of such a program may involve raising the mowing height to improve the physiological condition of the turf and utilizing vertical mowing to enhance putting quality. This hypothesis formed the basis for my research.

The study was conducted on a Penncross creeping bentgrass green established in 1986 at the John Seaton Anderson Turfgrass Research Facility located near Mead, Nebraska. Data was collected from June 1989 through October 1990. Light sand topdressing was applied biweekly. The study site was not aerified due to potential interference with thermocouple wires located 1 inch beneath the soil surface. Fertilization was applied to the test area at 4 lb N, 2 lb P, and 4 lb K per 1000 ft-2 per season, using urea, treble superphosphate, and potassium sulfate as the sources of N, P, and K, respectively. Urea and potassium sulfate were applied in 16 applications from April through mid-November. Treble superphosphate was applied in four applications, two in spring and two in fall. Daily irrigation was based on a three day replacement of 80% potential evapotranspiration accumulated over the previous three days.

Mowing height treatments were 1/8, 5/32, and 3/16 inch. The study was mowed five to six times per week and mowing direction was changed daily. Vertical mowing frequency treatments were 0, 1, and 2 times per month. Vertical mower knife spacing was 0.5 inch, and the depth was set so that the knives entered the canopy surface only, providing a grooming affect. It is important to keep in mind that actual vertical mowing gangs were used, not true grooming units. Mowing height and vertical mowing frequency treatments were arranged so that all possible treatment combinations were studied.

Turfgrass Color and Quality Ratings

Color and quality ratings were taken every two weeks in 1989 and more frequently in 1990. Color ratings were based on a one to nine scale with 1 = straw brown, 6 = light green, and 9 = dark green. Turfgrass quality ratings were based on a one to nine scale with 1 = poorest, 6 = acceptable, and 9 = best putting green quality. Uniformity, density, texture, growth habit, smoothness, and color were taken into account in making turfgrass quality ratings.

Putting Speed

A Stimpmeter was used to give an indication of putting speed by measuring the distance of ball roll. Distance of ball roll can then be related to putting speed. The United States Golf Association (USGA) has conducted extensive research on the Stimpmeter. They have evaluated Stimpmeter measurements on golf courses throughout the United States, including championship courses. From their research, general ranges for putting green speed have been determined (Table 1). In my research, two measurements were taken in each of four directions on each plot. The eight measurements per plot were averaged and recorded as the putting speed for that day.

Table 1. *Reference chart relating Stimpmeter measurements to speeds for membership and tournament play.*

Relative green speed	Stimpmeter Measurement			
	Membership Play		Tournament Play	
	(m)	(ft.)	(m)	(ft.)
Fast	2.6	8.5	3.2	10.5
Medium-Fast	2.3	7.5	2.9	9.5
Medium	2.0	6.5	2.6	8.5
Medium-Slow	1.7	5.5	2.3	7.5
Slow	1.4	4.5	2.0	6.5

From: Hoos, D.D. 1982. The green section's Stimpmeter: Most think friend-some think enemy. USGA Green Section Rec. July/Aug. 1982. pp. 9-10.

Rooting Distribution

To evaluate treatment effects on root distribution, six soil core samples per plot were obtained three times during the season. Each 12 inch soil core was divided into three 4 inch sections in 1989 and four 3 inch sections in 1990. The core samples were hand washed to remove all soil, and the remaining roots were dried and weighed.

Soil Temperature

Since soil temperature extremes have a large affect on turfgrass root production, hourly soil temperatures at one inch depth were measured for each plot using thermocouples. Maximum, minimum, and average daily soil temperatures were recorded.

Results and Discussion

Vertical mowing at 1 and 2 times per month did not influence color and quality in either 1989 or 1990. This was a little surprising since it was anticipated that vertical mowing would provide a smoothing effect and improve turf quality. Mowing height, on the other hand, had the greatest influence on turf color and quality as expected. At the higher mowing heights, the added vegetation makes for darker green color and increased quality. In 1989, color increased by 0.5 of a rating unit for each 1/32 increase in mowing height, while quality increased by 0.3 of a rating unit for each 1/32 increase in mowing height. In 1990, the changes were more drastic, with both color and quality increasing by 0.8 of rating unit for each 1/32 increase in mowing height.

As with the turfgrass color and quality ratings, vertical mowing frequency had no affect on putting speed, root distribution, and soil temperature. Again, these parameters were influenced by changes in mowing height. A lack of grain due to foot and vehicle traffic may explain why vertical mowing had no effect on ball roll. One of the benefits of vertical mowing as a grooming process is a reduction or prevention of grain. Therefore, if grain is lacking to begin with, then vertical mowing may not be beneficial. Putting speed differed among mowing heights in 1989 and 1990. Distance of ball roll was reduced in both years by increasing the mowing height from 1/8 to 3/16 inch. However, based on USGA membership standards, putting speeds rated fast for all mowing heights in 1989. In 1990, putting speeds rated fast for the 1/8 inch mowing height, and medium-fast for the 5/32 and 3/16 inch mowing heights. The light frequent sand topdressing and a sound management program were sufficient in producing high quality putting green conditions in both years.

Vertical mowing had no affect on root distribution in either year. Differences in root distribution among mowing heights did not begin to show up until 1990. Root production at the lower sampling depths increased as the mowing height increased. This is due to increased leaf area and, therefore, increased photosynthesis and photosynthate (carbohydrate) supply. The higher mowing height also provides for a cooler environment for root growth as the soil temperature showed. Maximum daily soil temperatures were lowest under the higher mowing heights due to increased insulating and evaporative cooling effects of the vegetation.

Based on the relatively fast and medium-fast putting speeds observed at the highest mowing heights in both years, recommending higher mowing heights on putting greens can be justified. Golf course superintendents can obtain acceptable putting speed at relatively high mowing heights by maintaining a sound management program. Lowering the mowing height to increase putting speed causes the turfgrass to undergo physiological changes that increase its susceptibility to environmental stresses such as temperature and drought. Although vertical mowing at the frequencies studied did not affect any of the parameters measured, future research should address more frequent vertical mowing using greens conditioners or groomers since many turfgrass managers experiment with these. Traffic should be incorporated into future investigations to simulate actual playing conditions.