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University of Arizona scientists investigated the use of different mowing heights, nitrogen rates, and rolling as management tools to affect putting speed of seashore paspalum maintained as putting greens. Regular rolling and lower mowing heights increased ball roll distance, as expected, but no differences were found in plots receiving different rates of nitrogen fertilization.

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PURPOSE

The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 225 projects at a cost of $25 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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Ball Roll Distance of 'Sea Isle 2000' Paspalum in Response to Mowing Height And Nitrogen Fertility

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SUMMARY

University of Arizona scientists investigated the use of different mowing heights, nitrogen rates, and rolling as management tools to affect putting speed of 'Sea Isle 2000' seashore paspalum maintained as putting greens. Their findings include:

- Ball roll distance was affected by mowing height more than any other factor tested in this study (nitrogen rates, one-time rolling on the day ball roll distances were measured). Maximum ball roll distance were observed on plots receiving 1/8-inch mowing height.
- Nitrogen rates did not affect ball roll distance of greens-height 'Sea Isle 2000' seashore paspalum.
- Rolling on the day that ball roll distance measurements were taken significantly increased ball roll distance.

P*aspalum vaginatum* is a warm-season grass which has increased interest in use in turf. Cultivars such as 'Excalibur' and 'Adelaide' released in the 1970s have been used with some success in southern California, Texas, and gulf areas of the southeastern United States. Attributes of this species include: 1) moderate growth rate, 2) heat tolerance, 3) salinity tolerance and 4) tolerance to flooding (4, 5, 6)). Limitations to date have included: 1) vegetative establishment requirements, 2) scalping tendency, and 3) yellow-green turf color (2, 3).

One of the most popular new cultivars is 'Sea Isle 2000' which has a low growth habit. 'Sea Isle 2000' has been used on putting greens in the humid Southeast as a grass option where saline water is used for irrigation.

Previous literature and correspondence with scientists and turf managers alike who observed it in humid environments note that *P. vaginatum* is a low nitrogen user compared to most bermudagrass cultivars. With the investigation of the turf performance of newer cultivars, it is critical to investigate the response of new cultivars to various levels of nitrogen. Likewise, it is necessary to determine mowing height responses on clones which have short internodes and are subjected to frequent and close mowing. Therefore a two year test was conducted to: 1) investigate the response of 'Sea Isle 2000' to mowing heights, and 2) determine the response of this grass to nitrogen fertilization in a semi-arid environment.

As expected, lower mowing heights increased ball roll distance of 'Sea Isle 2000" seashore paspalum maintained as putting greens.

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2000

	July 13	July 28	August 31		Sept. 26		Oct. 31	Nov. 7
	(inches)							
Mowing Height								
(inches)								
1/8	70.1	73.2	80.3	87.8*	87.0	88.1*	94.1	105.8*
5/32	66.8	71.7	76.3	80.8*	81.5	83.9*	86.5	94.4*
3/16	58.4	59.6	68.3	76.5*	87.9	88.1*	90.5	98.2*
$LSD_{(0.05)}$	1.4	4.6	2.1	4.2	6.1	3.1	n.s.	3.6
Nitrogen Rate								
(lbs. N/1000 sq. ft./ month)								
0.25	64.0	69.8	75.4	82.3*	87.8	87.2*	81.2	99.1*
0.38	66.1	66.4	75.0	82.0*	84.1	87.1*	89.6	100.1*
0.50	64.8	67.4	74.8	81.2*	84.0	86.7*	92.2	100.0*
0.75	65.4	68.9	74.7	81.3*	86.0	85.8*	88.4	98.7*
$LSD_{(0.05)}$	n.s.	2.8	n.s.	n.s.	n.s.	n.s.	3.1	n.s.

2001

	May 22		June 27		July 20		Aug. 21	Aug. 23	Sept. 26		October 10	
	(inches)											
Mowing Height												
(inches)												
1/8	78.9	84.9*	100.4	107.9*	89.4	92.4*	86.8*	84.8	82.2	85.3*	86.0	90.7*
5/32	73.0	75.7*	72.2	76.3*	74.3	74.3*	81.8*	80.5	76.9	80.0*	79.8	83.0*
3/16	68.6	70.4*	64.9	70.7*	67.4	69.4*	72.7*	70.5	70.8	71.2*	72.1	75.9*
$LSD_{(0.05)}$	2.3	1.8	5.2	8.1	3.6	2.3	3.3	5.4	5.2	3.6	4.1	5.0
Nitrogen Rate												
(lbs. N/1000 sq. ft./ month)												
0.25	74.1	78.8*	76.9	86.6*	78.7	79.8*	81.2*	78.0	77.9	79.7*	79.9	85.1*
0.38	72.7	78.4*	79.2	84.2*	76.7	78.2*	79.9*	79.0	75.4	78.3*	78.6	83.3*
0.50	73.9	77.5*	80.1	84.6*	76.0	77.4*	80.4*	79.9	78.3	80.1*	80.0	82.1*
0.75	73.3	76.6*	80.4	84.4*	76.9	79.4*	80.1*	77.6	74.9	77.2*	78.8	82.2*
$LSD_{(0.05)}$	n.s.	n.s.	3.1	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

* Indicates ball roll distance measurements were taken after a single pass with a water-filled roller.

Table 1. Ball roll distances for plots of 'Sea Isle 2000' seashore paspalum receiving different mowing heights and rates of nitrogen fertility for 2000 and 2001.

Materials and Methods

Test Site

Starting in 2000, 'Sea Isle 2000' was mowed at three mowing heights (1/8"), (5/32") and (3/16"). Each different mowing height plot received monthly applications of nitrogen (0.25, 0.38, 0.50 and 0.75 lb N/1000 ft^2) per growing month. Ammonium nitrate (33-0-0) was used as the nitrogen source. Potash was applied monthly

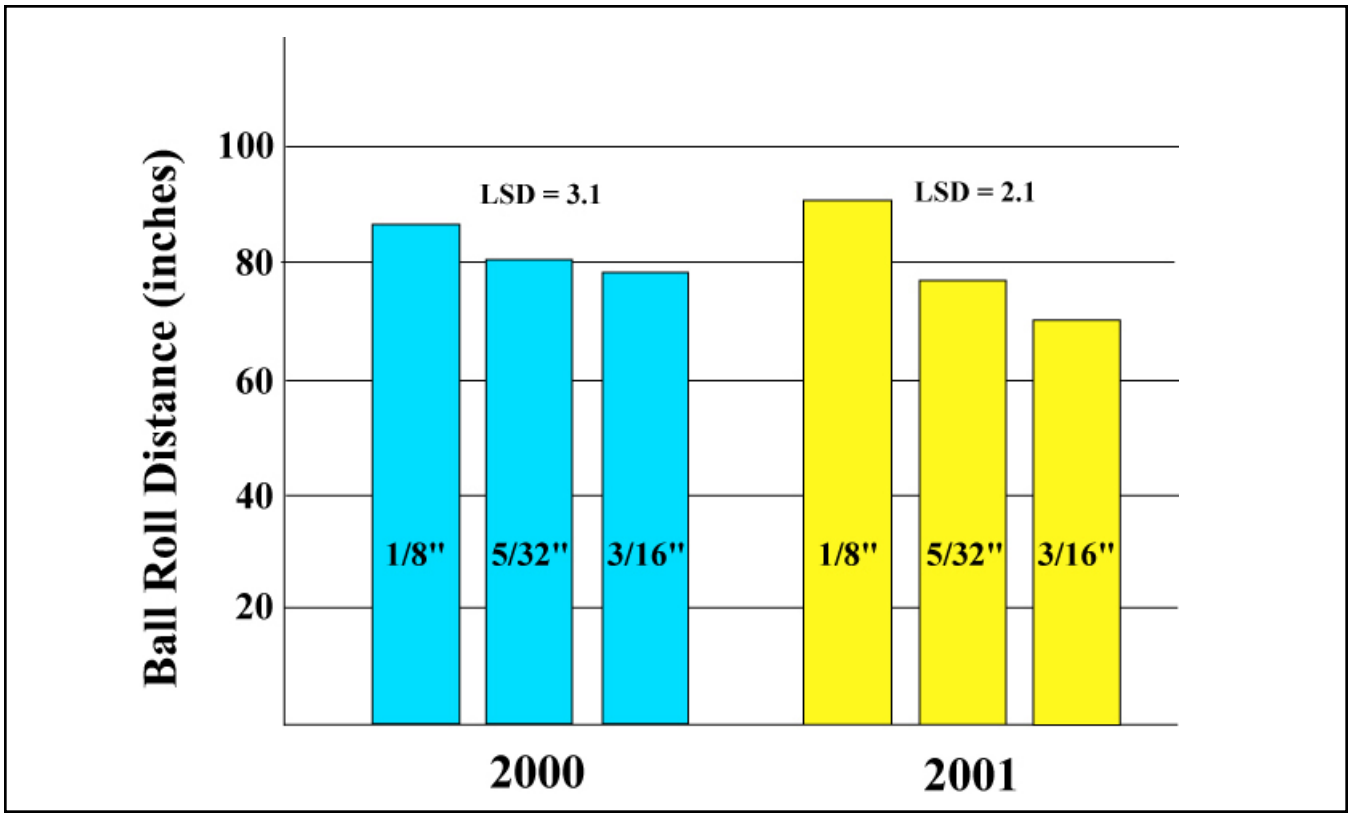

Figure 1. As expected, lower mowing heights signicantly increased ball roll distance of greens-height seashore paspalum in both 2000 and 2001.

at 0.50 lb K/1000 ft^2 using potassium sulfate (0-0-50) as the potassium source, while phosphorus was applied at 0.50 lb P/1000 ft^2 using either single superphosphate (0-27-0) or treble superphosphate (0-45-0) as the phosphorus source every other month.

Each mowing height and fertilizer combination was replicated four times in the field. Plots were mowed six times per week as mowing heights were maintained by interchanging cutting unit heads adjusted for each respective mowing height. Turf was not overseeded between years, as this would interfere with nitrogen uptake and seasonal responses to fertility and mowing.

Turf Responses

Ball roll distance (BRD) was measured monthly from three ball rolls (in two directions) using a standard USGA stimpmeter. Ball roll distance was measured right after the green was double mowed at a 45-degree cross-hatch pattern. After the first ball roll distance values were recorded, the turf was then rolled with an 875 lb. water-filled smooth roller. Immediately after rolling, ball roll distance was measured again. The average of six BRD measurements was averaged for each plot, which represented a specific mowing height X monthly Napplication combination. For ease of presentation and interpretation, data are expressed in terms of BRD mean values for mowing heights, and nitrogen rates.

Results and Discussion

Year 1

Ball roll distance was measured on eight dates in Year 1. Five measurements were taken immediately after a simple double mowing, and three after double mowing followed by rolling in one direction with a 685 lb. barrel roller. In year two, there were twelve ball roll measurement dates (one after mowing and one after mowing and rolling per month).

In 2000, mowing height as a main effect was significant for ball roll distance on seven of

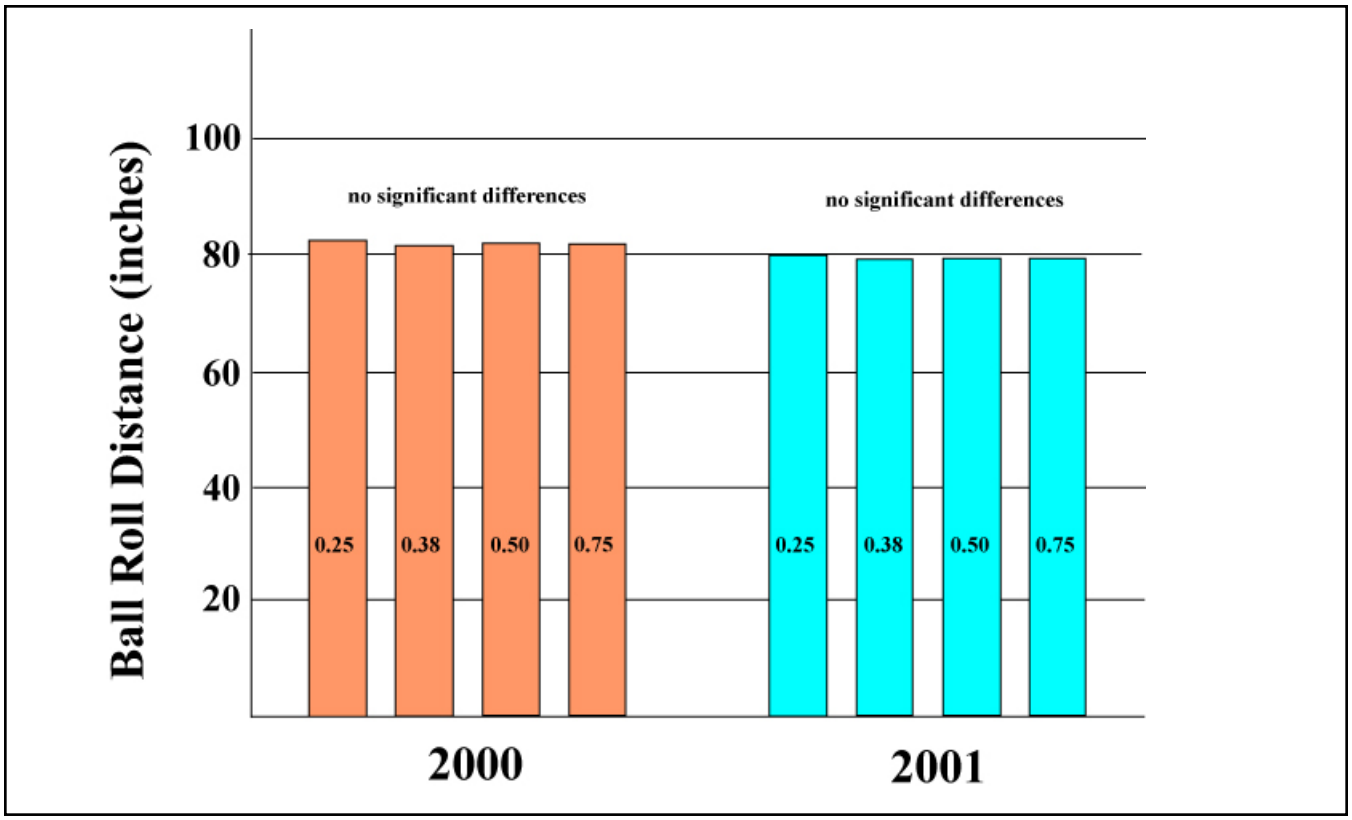

Figure 2. No significant differences in ball roll distance were observed in plots receiving different rates of nitrogen fertility ranging from 0.25 to 0.75 lbs. N/1000 ft^2/growing month in either 2000 or 2001 for 'Sea Isle 2000' seashore paspalum maintained at putting green height.

eight measurements. Decreased mowing height has shown to increase putting speeds in other turf species (7). Mean ball roll distance ranged from 58.4 inches to 94.1 inches among mowing heights, when averaged over fertilizer application rates (Table 1, Figure 1). The 1/8" mowing height produced the greatest mean ball roll distance on six of eight measurement events in 2000. When mowed only (without rolling), in July and August, mean ball roll distance was greater for the 5/32-inch mowing height than turf maintained at 3/16 inch, but not during the late summer or early fall (September, October).

When subjected to rolling following mowing, the 1/8-inch turf produced, on average, an 8-inch increase in August, a 1-inch increase in September, and a 12-inch increase in late October from the additional rolling. The greatest ball roll distance for 1/8-inch turf was 105.8 inches in late October. The increase in ball roll distance was inversely proportional to a decrease in mowing height on all dates (mowed, and mowed and rolled). Interestingly enough, the taller turf (3/16 inch) when rolled provided a smoother surface than the intermediate cut turf (5/32 inch) during September and October (Table 1).

Nitrogen rate had little or no effect on ball roll distance (Figure 2). The effect of differering nitrogen rates was statistically significant for only two measurements (July 28 - no roll, and October 31 - no roll) as plots treated with 0.25 lbs. N/1000 ft^2 had ball roll distances that were 2-3 inches greater than turf on plots receiving other nitrogen rates (Table 1).

Year 2

As in Year 1, decreasing mowing height increased ball roll distance, whether the turf received supplemental rolling, or not (Table 1, Figure 1). In general, rolling added about 6 inches to ball roll distance over plots receiving similar nitrogen treatments in May and June for the 1/8-inch turf. However, rolling enhancement of ball roll distance did not occur during the mid-summer

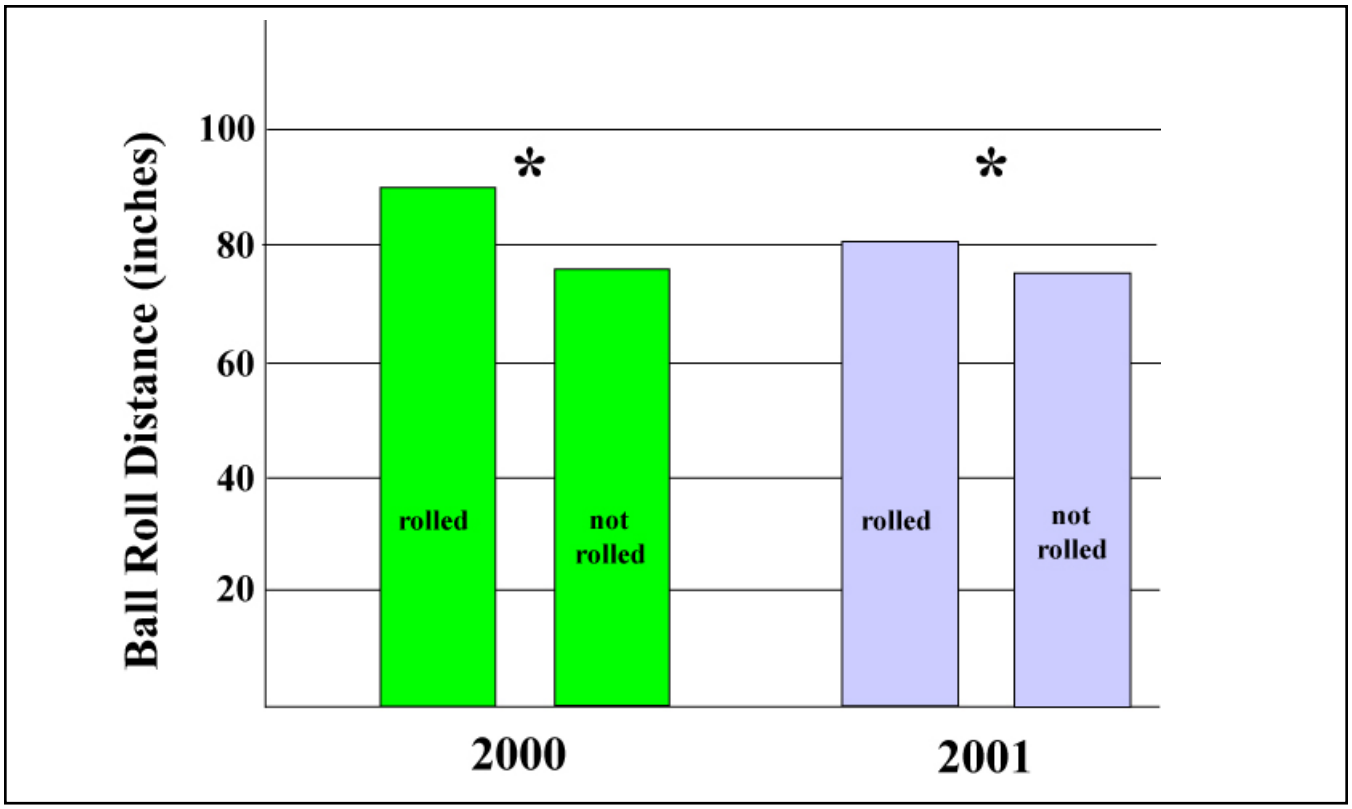

Figure 3. Rolling plots immediately after mowing on the day ball roll measurements were taken significantly improved ball roll distance in both 2000 and 2001 as noted by the asterisks above each treatment year.

months. During mid-summer months, ball roll actually decreased 3-4 inches after rolling. As in Year 1, nitrogen rates did not significanly affect ball roll distance (Figure 2).

The greatest ball roll distances were achieved in June (for both unrolled and rolled turf) at the 1/8-inch height. At this time, ball roll distances for 1/8-inch unrolled and rolled turf were 100.4 inches and 107.9 inches, respectively. When unrolled, increases in ball roll distance at 1/8" occurred with increases in N fertilization, but this effect was eliminated when rolling was added (Table 1).

While plots mowed at 1/8 inch always had the greatest ball roll distance, the effect of varying rates of nitrogen had little or no consequence on ball roll distance. In Year 2 when observed seasonally across all mowing heights, unrolled turf ball roll distances values ranged from 64.9 inches to 100.4 inches (Table 1). When observed seasonally across all mowing heights, rolled plot ball roll distances ranged from 69.4 inches to 107.9 inches. Each time ball roll distances were measured, however, increased mowing height resulted in decreased ball roll distances for both rolled and unrolled plots.

The greatest difference in ball roll distance occurred between the 5/32-inch and 3/16-inch mowing heights. In general, ball roll distance was greater and more consistent from month to month in Year 2 compared to Year 1. Greatest ball roll distances were measured in June followed by July measurements. Rolling increased ball roll distance values across the full range of treatments. Rolling provided the greatest benefit in the months of May and October, which represents the slowest growth periods within the accepted growth curve for a warm-season grass.

The effect of a single rolling event added about a 6-inch increase for plots mowed at 1/8 inch in May, June, and July. Rolling added only a 3- to 4-inch increase in September and October of Year 2 (Table 1, Figure 3). However, since it has been shown that golfers cannot notice increases in ball roll distance increases of less than 12 inches, rolling may be insignificant as a management tool

to noticeably increase putting speed on seashore paspalum.

Two-year summary

Mowing height had a greater effect on ball speed than did applied nitrogen fertilizer rates. Increased ball roll distances achieved by rolling were greater in Year 1 than in Year 2, noting that summer ball roll distances were generally overall greater in Year 2 (Table 1, Figure 3). The greatest ball roll distances were obtained in June 2001 (Year 2, 109 inches). In general, plots mowed at 1/8-inch mowing height were anywhere from 10 to 22 inches greater in ball roll distance than plots mowed at the 3/16-inch mowing height. The one-time rolling on the day of ball roll distance measurement added anywhere from 4 to 12 inches in ball roll distance. (Table 1, Figure 3). Note that these rolling events occurred only once per month where plots were rolled only on the day that ball roll distances were measured not as a regularly daily practice.

A ball roll distance of 100 inches qualifies with USGA standards as a Medium (just short of fast) for regular membership play (1). However, most ball roll distances at the 1/8-inch height, which averaged about 87 inches, would qualify as "Medium" in Regular Play. Under the conditions of this test, (vertical mow/topdress every 14 days) all other ball roll distances obtained from the 5/32-inch and 3/16-inch heights would be marginally acceptable for putting speed. Since 'Sea Isle 2000' seashore paspalum did tolerate the 1/8-inch mowing height, additional research is warranted for other management techniques to increase ball roll distance in seashore paspalum.

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