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CUTT

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Does Mower Type Effect Turf Performance

Introduction

This study was designed to investigate the effect of various walk-behind putting green mowers on putting green performance. This report represents results from the second year of the study.

Methodology

This study was conducted from June 6, 2006 to September 27, 2006. The 2006 growing season (Figure 1) was among the top ten wettest in recorded weather history, therefore, supplemental irrigation was rarely required.

Due to the excessive precipitation, there were some days when the experimental area was too saturated to mow. On such occasions, data collection was postponed until normal mowing conditions could be resumed without collateral damage to research area.

Experimental plots were established at the Cornell University Turfgrass and Landscape Research and Education Center in Ithaca, NY on a mixed stand of creeping bentgrass (60%)/ annual bluegrass (40%) (*Agrostis palustris/Poa annua*) soil-based putting green (pH = 6.7). The research area has been heavily modified with coring and straight sand topdressing for the last four years resulting in a significant sand layer above the native soil green.

The research area was maintained to championship conditions with light frequent liquid fertilization applied weekly during the season. Total nutrient rates for the season was 3.15 lbs. N, 1.1 lbs. P and 1.5 lbs. K, all per 1000 square feet, with supplemental liquid iron for color.

In addition, light frequent sand topdressing was applied every two to three weeks depending on growth and performance. Due to the high disease pressure present throughout the season, pest management was conducted on a preventative basis. Therefore, no disease data were collected this year.

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This Times

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Feature Story

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In general turf quality ratings were higher in 2006 compared to 2005 (data not shown). This is most likely related to preventative fungicide use to address increased disease pressure associated with warm and wet conditions.

When averaged across all three dates, the Toro 1000 had significantly fewer uncut blades than all except the Jacobsen e-Walk mower.

Golf traffic is simulated daily during the season using a modified traffic device with two 0.5 meter diameter rollers that spin at different speeds to create slipping. The rollers are fitted with SoftSpikes. The amount of spikes and passes used are designed to simulate 30,000 rounds of golf.

Six walk-behind putting green mowers from the three major equipment manufacturers in the US were evaluated for their effect on putting green performance (Table 1). Mowing heights were established to ensure a consistent field height of 0.100″ (2.5 mm). This was accomplished by setting mowers to baseline heights from previous observations and then operating the mowers on a level test area at 90º angles so that the cut path of the mowers interact. The TurfChek Prism was used to determine consistency between mowers and then mowers were adjusted accordingly. All mowers were fitted with full (smooth) rollers to avoid differences in roller types.

Each mower was evaluated using three mowing frequency regimes. The regimes were one mow per day seven days per week; one mow per day five days per week and two mows per day two days per week; and one mow per day four days per week and two mows per day three days per week.

Mowers were only used for the study and not for other mowing at the Research Center. To ensure accurate mower set up and performance, mowers were evaluated for height and cut quality adjustments seven days per week (except on days when excessive rainfall prevented mowing). The mowers were maintained by Research Center staff under the supervision of the Equipment Technician (30 years experience) at the Robert Trent Jones Golf Course at Cornell University.

Data were collected for cut quality, turf quality, chlorophyll, ball roll, surface hardness (Gmax), and clipping production. Data analysis was conducted using linear mixed models with compound symmetric covariance structure to assess overall treatment effects when repeated measurements were made on the same experimental unit over time. Treatment differences at individual measurement events were evaluated using analysis of variance and Fisher's protected least significant difference (LSD). The MIXED and GLM procedures in SAS/STAT software version 9.1 (SAS, Cary, NC) were used to perform the analyses.

Results

Cleanliness of Cut

Mower cut quality was assessed at three dates during the study. While there was a significant main effect of mower type at each rating, frequency had no significant effect, nor was there an interactive effect. This continues to confirm previous reports that indicate increased frequency of cuts (double cutting) does not benefit cleanliness of cut.

Among the mower types, the fixed head mowers, specifically, the Toro 1000 and Jacobsen e-Walk had the fewest number of uncut blades for all three dates. The Toro 1000 provided the cleanest cut of the gas-powered mowers, while the Jacobsen 518A had the most uncut blades on two dates and the John Deere 180B had the most uncut blades on one date.

When averaged across all three dates, the Toro 1000 had significantly fewer uncut blades than all except the Jacobsen e-Walk mower.

Turf Quality

In general turf quality ratings were higher in 2006 compared to 2005 (data not shown). This is most likely related to preventative fungicide use to address increased disease pressure associated with warm and wet conditions.

Table 2. Effect of mower type on cleanliness of cut (# of uncut blades).

Mower	11-Jul	20-Jul	8-Sept
Toro 1000	2.0	2.1	2.1
Toro Flex 21	4.2	3.9	3.9
Jacobsen 22	3.3	3.5	3.5
Jacobsen 518A	5.2	5.6	5.1
Jacobsen E-Walk	2.6	2.7	2.6
John Deere 180B	5.9	4.5	3.7
LSD (p = 0.05)	1.2	0.9	1.0

Table 3. Effect of frequency of mowing on cut quality (# of uncut blades).

Frequency	11-Jul	20-Jul	8-Sept
7 day single	4.1	4.2	3.5
5 day single + 2 day double	3.9	3.4	3.4
4 day single + 3 day double	3.6	3.6	3.5
LSD (p = 0.05)	NS	NS	NS

Table 1. Technical specifications for the mowers used in the study are presented below.

Mower	Width Of Cut	Weight	Wt. Dist. (lbs)	Reel	ReelRPM	Ground Speed	FOC	Bedknife Position	Bench Ht.
Toro 1000	21″	208 lbs. (94.3 kg)	**168.5 (rear)** 34.5 (front)	11 blades, 5″ dia.	2010	3.24	0.141	20 mm	0.125
Toro Flex 21	21″	238 lbs. (108 kg)	**190.5 (rear)** 52.5 (front) 87.0 (head)	11 blades, 5″ dia.	2340	3.52	0.121	16 mm	0.121
Jacobsen T-22	22″	206 lbs. (93.5 kg)	**188.0 (rear)** 42.0 (front) 76.0 (floathead)	9 blades, 4″ dia.	2310	4.10	0.166	20 mm	0.115
Jacobsen 518A	18″	215 lbs. (97 kg)	**185.0 (rear)** 24.0 (front)	11 blades, 5″ dia.	1730	3.19	0.173	15 mm	0.139
Jacobsen E-Walk	22″	223 lbs. (101 kg)	**192.0 (rear)** 36.5 (front)	11 blades, 5″ dia.	2107	3.84	0.152	15 mm	0.125
John Deere 180B	18″	203 lbs. (92.3 kg)	**181.5 (rear)** 24.0 (front)	11 blades, 5″ dia.	2118	4.03	0.131	17 mm	0.137

Table 4. Effect of mower type on turf quality.

	Turf Quality						
Mower	13-Jun	20-Jun	5-Jul	11-Jul	17-Jul	24-Jul	8-Aug
Toro 1000	7.5	7.2	6.4	6.8	7.1	6.8	6.9
Toro Flex 21	7.5	7.4	6.5	6.5	7.1	6.9	6.8
Jacobsen 22	7.3	7.3	6.4	6.6	6.9	7.0	6.7
Jacobsen 518A	7.4	6.9	6.3	6.6	6.9	6.8	6.4
Jacobsen E-Walk	7.4	7.3	6.3	6.7	7.1	6.7	6.7
John Deere 180B	7.6	7.0	6.2	6.5	7.2	6.9	6.6
John Deere 220B	7.4	7.2	6.2	6.8	7.0	7.0	6.6
LSD (p=0.05)	NS	0.2	NS	NS	NS	NS	NS

Turf quality is assessed on a scale of 1 to 9; where 1 = poor quality, 9 = excellent quality, and 6 = acceptable quality.

	Turf Quality						
Mower	16-Aug	22-Aug	31-Aug	6-Sept	12-Sept	18-Sept	27-Sept
Toro 1000	6.6	7.2	7.0	7.1	7.1	7.2	6.9
Toro Flex 21	6.4	6.6	6.5	7.1	6.9	7.1	6.8
Jacobsen 22	6.3	6.6	6.6	7.0	6.8	7.1	6.7
Jacobsen 518A	6.3	6.5	6.4	7.0	6.7	6.9	6.6
Jacobsen E-Walk	6.3	6.5	6.6	6.9	6.7	6.8	6.7
John Deere 180B	6.5	6.8	6.7	7.0	6.9	7.0	6.7
John Deere 220B	6.7	6.8	6.7	6.9	6.9	7.0	6.8
LSD (p=0.05)	NS	0.4	0.3	NS	NS	NS	0.1

There were significant main effects for mower type on four of the fourteen rating dates (Table 6). The Jacobsen 518A consistently had among the lowest turfgrass quality ratings on dates when significance was noted and the Toro 1000 among the highest ratings. However, when averaged across all rating dates, there was no significant difference in turf quality regardless of mower type.

In general there was very little effect of mowing frequency on turfgrass quality (Table 7). However, when averaged across all dates, plots receiving the 7 day single cut treatment had higher turf quality (average of 0.2 higher) ratings than plots receiving the 4 day single cut + 3 day double cut treatment. This suggests a significant increase in stress when double cutting more than two days per week.

Ball Roll

Ball roll was determined on 19 occasions with a modified USGA-Stimpmeter using standard ball roll measurement techniques. Ball roll measures were taken on double cut days within two hours after mowing. On three occasions, a second ball roll measurement was taken approximately six to eight hours after mowing.

There were significant differences among mowers on four of the 19 measurement dates/times, and a significant mower*frequency interaction on two occasions (20 and 26-July). In general, when significant differences were noted the greatest ball roll distances were achieved with the Jacobsen e-Walk and the John Deere 180B among the least. However, when averaged over the season, there were no differences in ball roll distance among mowers or frequencies.

Contrary to popular belief there continues to be no significant effect of time of day when ball roll measurement was taken nor related to mowing frequency.

Clippings

Clippings were collected on three occasions during the study using the mower assigned

Table 5. Effect of mowing frequency on turf quality.

	Turf Quality						
Frequency	13-Jun	20-Jun	5-Jul	11-Jul	17-Jul	24-Jul	8-Aug
7d single	7.6	7.2	6.4	6.7	7.1	6.8	6.8
5d single+2d double	7.5	7.2	6.3	6.7	7.0	6.9	6.6
4d single+3d double	7.4	7.1	6.3	6.5	7.0	6.8	6.7
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	NS

Turf quality is assessed on a scale of 1 to 9; where 1 = poor quality, 9 = excellent quality, and 6 = acceptable quality.

	Turf Quality						
Frequency	16-Aug	22-Aug	31-Aug	6-Sept	12-Sept	18-Sept	27-Sept
7d single	6.5	6.9	6.8	7.0	7.0	7.0	6.8
5d single+2d double	6.4	6.6	6.6	7.0	6.8	6.9	6.7
4d single+3d double	6.3	6.6	6.5	7.0	6.8	7.0	6.7
LSD (p=0.05)	NS	NS	NS	NS	NS	NS	0.08

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In general there was very little effect of mowing frequency on turfgrass quality (Table 7). However, when averaged across all dates, plots receiving the 7 day single cut treatment had higher turf quality (average of 0.2 higher) ratings than plots receiving the 4 day single cut + 3 day double cut treatment. This suggests a significant increase in stress when double cutting more than two days per week.

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Contrary to popular belief there continues to be no significant effect of time of day when ball roll measurement was taken nor related to mowing frequency.

In addition, since conducting the preliminary work, alterations in mower set up and field height adjustments have significantly altered results. There appears to be more parity among mowers for quality and performance.

to each plot. A strip was mowed down the center of the plot, clippings collected, dried and weighed.

There was a main effect for mower type at each collection date, and also for frequency on the August 24 collection date (Table 14 & 15). In general the Toro 1000 consistently recorded among the highest clipping amounts among the gas-powered mowers with the Jacobsen T-22 and John Deere 180B. In fact, when averaged across all collection dates, the Toro 1000 had the greatest clipping yield.

When averaged across all collection dates, there was no main effect for frequency. There was no mower frequency interaction.

Mower Adjustments

Prior to daily mowing of the experimental plots, all mowers were checked for bedknife and height adjustment.

Summary to Date

The 2006 growing season presented significantly more challenges than 2005, with increased rainfall and high temperatures. This season was more consistent with the preliminary research season of 2004 that demonstrated severe anthracnose infestations. In addition, since conducting the preliminary work, alterations in mower set up and field height adjustments have significantly altered results. There appears to be more parity among mowers for quality and performance.

That said there are differences among mower types such as fixed head versus flex or floating head relative to turf quality and ball roll, however these differences do not appear to be substantial.

We made a concerted effort in 2006 to more fully characterize mower set up as evidenced by our calculations of FOC and assessment of bedknife position relative to the center-line of the reel. When taken together, the effects or interaction of bedknife position, mower weight, and frequency of clip will require further assessment.

Frank S. Rossi, Ph.D.

Table 8. The effect of mower type on clipping dry weight.

Mower	Dry Wt. (g)		
	15-Jun	25-Jul	24-Aug
Toro 1000	2.8	2.5	2.0
Toro Flex 21	1.0	1.6	1.5
Jacobsen 22	1.3	1.4	2.1
Jacobsen 518A	0.9	0.9	1.3
Jacobsen E-Walk	2.3	1.1	1.9
John Deere 180B	1.1	1.5	1.9
LSD (p = 0.05)	0.6	0.5	0.6

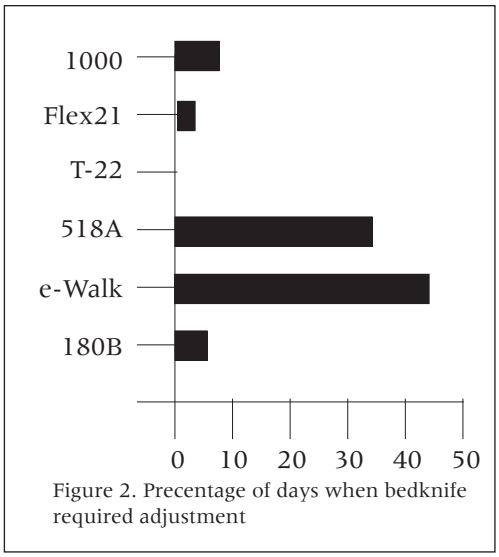

Figure 2. Precentage of days when bedknife required adjustment

Table 9. The effect of frequency on clipping dry weight (g).

Frequency	Dry Wt. (g)		
	15-June	25-Jul	24-Aug
7d s	1.8	1.7	2.2
5d s + 2d d	1.6	1.3	1.6
4d s + 3d d	1.3	1.5	1.6
LSD (p = 0.05)	NS	NS	0.4

Table 6. Effect of mower type on ball roll (continued)

Mower	Ball Roll Distance (in feet)						
	13-Aug	1-Sept(am)	1-Sept(pm)	7-Sept	17-Sept	20-Sept	27-Sept
Toro 1000	12.9	11.3	11.2	12.2	11.7	12.4	13.0
Toro Flex 21	13.1	10.9	10.8	11.7	11.3	12.2	12.2
Jacobsen 22	12.9	11.2	10.8	11.7	11.5	11.9	12.4
Jacobsen 518A	13.3	11.0	11.1	12.4	11.9	12.1	12.8
Jac. E-Walk	13.2	11.7	12.1	12.8	11.9	12.2	13.1
JD180B	12.6	10.9	11.1	12.0	11.4	11.9	12.4
LSD (p=0.05)	NS	NS	0.8	NS	NS	NS	NS

Table 7. Effect of mower type on ball roll.

Mower	Ball Roll Distance (feet)											
	11-Jun	18-Jun	25-Jun	5-Jul	6-Jul(am)	6-Jul(pm)	16-Jul	20-Jul	24-Jul(am)	24-Jul(pm)	26-Jul	7-Aug
Toro 1000	9.3	14.1	13.0	12.6	12.9	12.7	11.4	11.8	11.3	10.7	11.7	11.3
Toro Flex 21	9.6	13.4	12.4	12.2	12.6	12.0	10.9	11.4	11.1	10.5	11.2	10.8
Jacobsen 22	9.5	13.8	12.8	12.3	12.9	12.4	11.0	11.3	10.8	11.3	11.4	11.1
Jacobsen 518A	9.8	13.8	13.4	12.8	12.8	12.7	11.3	11.0	11.2	11.1	11.7	11.1
Jac. E-Walk	10.0	13.8	12.8	12.8	13.6	12.8	12.0	11.7	11.5	11.3	12.0	11.4
JD180B	9.4	12.6	12.1	11.7	11.9	12.0	10.7	11.0	10.5	10.5	11.1	10.9
LSD (p=0.05)	NS	0.9	NS	NS	0.9	NS	0.8	NS*	NS	NS	NS**	NS