

COMPOST AS AN AMENDMENT FOR TOPDRESSING CREEPING BENTGRASS PUTTING GREEN TURF.

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Sponsor: AllTreat Farms
Natural Sciences and Engineering Research Council of Canada

Objectives

The objective of this research was to evaluate two composts as organic amendments in topdressing creeping bentgrass putting green turf.

Materials and Methods

Two composts were chosen from five composts studied in greenhouse trials (reported elsewhere in this issue). Composts were provided by the sponsor, AllTreat Farms. The composts are produced from proprietary recipes, but all are Type AA composts (organic matter content >50%, minimal heavy metals, no pathogens, no inert contaminants). The analysis of the two composts at maturity is presented in Table 1.

Table 1. Analysis of mature composts.

Component	Compost number	
	1	2
Organic matter %	Analysis 1 55.90	50.50
	Analysis 2 56.00	48.00
Organic carbon %	27.60	25.20
Nitrogen %	1.83	1.71
Phosphorus %	2.00	1.29
Potassium %	0.96	0.81
Magnesium %	1.32	1.82
Calcium %	11.21	10.73
Arsenic	1.00	1.10
Cadmium	1.40	1.65
Chromium	42.97	61.79
Cobalt	1.10	1.20
Copper	42.74	32.93
Lead	5.00	5.00
Mercury	0.03	0.02
Molybdenum	3.29	3.80
Nickel	56.83	94.11
Selenium	0.81	0.77
Zinc	304.17	275.45
Sodium %	0.27	0.33
Manganese	763.42	730.54
Carbon / nitrogen ratio	15.08	14.74

Eight topdressing treatments were used (Table 2). The composts were applied at an equivalent of 25, 50 and 100 pounds per thousand square feet of dry material. The actual application rates reflect differences in moisture content.

Treatments were applied by hand, brushed into the turf, and irrigated in. Treatments were applied July 14, August 11, September 17, and November 4, 1998. Mowing was withheld for three days following treatment to prevent pickup of the material.

Table 2. Topdressing treatments applied to creeping bentgrass putting green turf.

Treatment	Application rate / m ²
1 Compost 1-25	200 g
2 Compost 1-50	400 g
3 Compost 1-100	800 g
4 Compost 2-25	225 g
5 Compost 2-50	450 g
6 Compost 2-100	900 g
7 Compost 1+sand (20:80 by volume)	3.2 litres
8 Compost 2+sand (20:80 by volume)	3.2 litres
9 control	-

Data Collection

Cores were collected and the thatch thickness measured at the start of the experiment (July 13). Weekly visual readings of color and percent cover of turf were taken during the experiment. Clipping samples were collected on October 23, and analysed for dry weight and tissue elemental concentration of N, P, K, Ca, Mg, Mn, Cu, Zn, and B. Volumetric water content of the top 50 mm of rootzone in each plot was measured with frequency-domain reflectometry on November 23.

Results

The average thatch thickness in the plots pre-treatment was 0.89 cm. There was no pattern of variation among the plots. Changes in thatch thickness will be measured in 1999.

There was no significant response measureable in color or cover changes due to any of the treatments in 1998 (Table 3).

There was no significant difference among treatments in growth rate as measured by clipping yields on October 23 (Table 4). Because of the limited amount of leaf tissue taken with the clipping measurements, replicated samples and statistical analysis of the tissue elemental analysis was not possible. The tissue levels are presented in Table 4. There were no obvious trends in tissue nutrients.

There were some slight but significant differences in volumetric water content (Table 5).



The two heaviest compost topdressings and the control had the highest water contents.

Conclusions

Very few effects were observed from any of the topdressing treatments. The green where the plots are located suffered a significant drought stress event in the spring of 1998, and had not fully recovered by the time this experiment began (hence the relatively low cover levels for the turf). The second and subsequent seasons for this project are likely to provide more information on the potential value of these topdressing treatments.

Table 3. Color and cover in topdress treated plots.

	07/20	07/27	08/04	08/10	08/17	08/26	09/02	09/09	09/14	09/25	10/02	10/14	Mean
	Color (visual ratings 0-10, 10=darkest green, 6=acceptable)												
Control	4.0 d	6.3	7.0	7.0	7.3	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.2
C1+sand	6.8 a	6.5	7.0	7.0	8.0	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.5
C1-100	7.0 a	6.8	7.0	7.0	8.0	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.6
C1-25	5.3 c	6.3	7.0	7.0	7.8	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.4
C1-50	5.8 bc	6.0	7.0	7.0	7.8	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.4
C2+sand	6.8 a	6.5	7.0	7.0	8.0	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.5
C2-100	7.0 a	6.8	7.0	7.0	7.8	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.5
C2-25	5.3 c	6.8	7.0	7.0	7.8	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.4
C2-50	6.0 b	6.5	7.0	7.0	8.0	8.0	8.0	8.0	7.0	8.0	8.0	8.0	7.5
Lsd p=0.05	0.5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Cover (percent of plot area covered with turf)												
Control	52.5 c	55.0	62.5	55.0	52.5	52.5	50.0	50.0	57.5	52.5 d	77.5	68.8 bcd	57.2 c
C1+sand	75.0 a	65.0	72.5	67.5	65.0	65.0	57.5	62.5	62.5	60.0 cd	71.3	78.8 abc	66.9 a
C1-100	67.5 ab	62.5	62.5	55.0	72.5	62.5	57.5	60.0	63.8	77.5 a	85.0	82.5 a	67.4 a
C1-25	60.0 bc	62.5	60.0	60.0	57.5	55.0	52.5	50.0	55.0	55.0 cd	60.0	67.5 cd	57.9 c
C1-50	67.5 ab	62.5	67.5	62.5	60.0	57.5	57.5	52.5	60.0	55.0 cd	65.0	63.8 d	60.9 bc
C2+sand	70.0 ab	65.0	72.5	67.5	60.0	65.0	62.5	65.0	63.8	57.5 cd	72.5	80.0 ab	66.8 a
C2-100	72.5 ab	62.5	67.5	57.5	62.5	55.0	55.0	52.5	60.0	70.0 ab	82.5	78.8 abc	64.7 ab
C2-25	60.0 bc	57.5	60.0	57.5	57.5	55.0	55.0	50.0	55.0	57.5 cd	65.0	65.0 d	57.9 c
C2-50	65.0 abc	62.5	65.0	60.0	60.0	57.5	57.5	50.0	57.5	62.5 bc	62.5	66.3 d	60.5 c
Lsd p=0.05	12.8	NS	NS	NS	NS	NS	NS	NS	NS	9.6	NS	11.5	4.0



Table 4. Tissue samples from clippings.

Treatment	Dry weight g m ⁻²	N	P	K	Ca	Mg	Mn	Cu	Zn	B
		--- % ---						--- mg kg ⁻¹ ---		
Control	13.03	3.39	0.357	1.68	0.85	0.45	17	54	42	16
C1+sand	13.01	3.34	0.331	1.83	1.47	0.38	15	53	47	14
C1-100	13.56	3.47	0.408	1.96	0.95	0.43	15	52	34	14
C1-25	12.91	3.45	0.391	1.75	0.92	0.41	23	58	39	16
C1-50	13.67	3.31	0.358	1.65	0.89	0.40	18	51	45	12
C2+sand	11.71	3.35	0.356	1.66	1.46	0.59	17	60	54	18
C2-100	12.57	3.48	0.416	1.80	0.80	0.36	14	54	45	11
C2-25	12.27	3.44	0.412	1.75	1.06	0.44	17	59	57	16
C2-50	14.10	3.39	0.41	1.85	1.00	0.44	17	56	51	13

Table 5. Volumetric water content in top 50 mm of rootzone, measured with Theta probe frequency domain reflectometer.

Treatment	Volumetric water content (%) ^a
Control	26.3 abc
C1+sand	23.7 ef
C1-100	23.9 a
C1-25	21.6 cd
C1-50	24.8 de
C2+sand	25.8 f
C2-100	25.1 ab
C2-25	23.0 cd
C2-50	21.8 bc
lsd p=0.05	14.25

^a Mean of 3 readings x 4 replicates; means followed by the same letter are not significantly different (p=0.05, Fishers protected lsd test).



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Eight topdressing treatments were used (Table 1). The composts were applied at an equivalent of 25, 50 and 100 pounds per thousand square feet of dry material. The actual application rates reflect differences in moisture content.

Treatments were applied by hand, brushed into the turf, and irrigated in. Treatments were applied August 9, September 9, October 12, and November 9, 1999. Mowing was withheld for three days following treatment to prevent pickup of the material.

Table 1. Topdressing treatments applied to creeping bentgrass putting green turf.

Treatment	Application rate / m²
1 Compost 1-25	200 g
2 Compost 1-50	400 g
3 Compost 1-100	800 g
4 Compost 2-25	225 g
5 Compost 2-50	450 g
6 Compost 2-100	900 g
7 Compost 1+sand (20:80 by volume)	3.2 litres
8 Compost 2+sand (20:80 by volume)	3.2 litres
9 control	-

Data Collection

Weekly visual readings of color and percent cover of turf were taken during the experiment. Volumetric water content of the top 50 mm of rootzone in each plot was measured with Theta-probe7 frequency-domain reflectometer on March 31, May 17, and July 28, 1999, and May 15, 2000

Results

Dollar spot control. There was significant reduction of dollarspot infestation with all treatments compared to the control (except for Compost 1 at 50 lb rate) Table 2). Dollarspot infections were natural (not inoculated).

Moss infestation. There were significant differences among the treatments in susceptibility to an invasion of moss which occurred in 1999. All treatments were better than the control, with the highest compost rates and sand topdressing having the least moss (Table 3).

Soil water. At field capacity, the plots with the 100 lb rate of compost had significantly higher volumetric water content than the control (Table 4). Sand topdressing reduced the soil water content. Under drought stress, the differences in water content were not significant, though the trends were the same.

Visual color ratings. Generally, there were not significant differences among the treatments early in the season (prior to the first application) (Table 5). By mid-September, the heavier compost applications (100 lb and 50 lb) had darker green color than other treatments, and the overall mean was similar. The sand topdressing treatments had poorer color than the control.

Quality, uniformity, and density (visual). These features followed the same pattern as the visual color (Table 6, 7, 8).

Instrumental color. Lightness (L) and hue angle (H) which are the most meaningful instrumental color measurements, followed a similar pattern to the visual color (Table 9, 10, 11). By mid-September the heavier compost treatments were darker (L) and greener (H) than the control plots. The sand topdressing generally produced a lighter color, though still greener than the control.

Cover. There were few significant differences in cover rating among the treatments over the course of the season (Table 12). Where differences were significant, the sand and high rate compost treatments generally had better cover values.

Conclusions

The compost topdressing treatments produced a significant improvement in the color and quality of the turf, particularly at the higher rates. There was also a significant decrease in dollar spot and moss infestation. Soil moisture generally was better under the heavier topdressing treatments, but sand

topdressing decreased the soil moisture.

Table 2: Dollarspot infestation in topdress trials. Rated 99/06/17 and 99/07/06

Treatment	Percent of plot area affected
control	24.0 a
P1-50	17.9 ab
P2-50	14.4 bc
P1-25	14.4 bc
P1+sand	11.4 bc
P2-25	10.5 c
P2+sand	10.1 c
P1-100	9.1 c
P2-100	8.5 c

Table 3: Moss infestation in topdress trials. Rated 0526, 0602, 0609, 0615, 0622, 0629, 0706 (1999) and 0308 (2000)

Treatment	Moss rating 0 - 10 (0 = no moss)		% of plot affected (2000)
	Mean 1999	2000	
control	2.4 a	3.5	13.8 ab
P2-25	1.9 ab	4.3	17.0 a
P2-50	1.4 bc	3.3	12.8 abc
P1-25	1.0 cd	3.3	9.8 abc
P1-50	0.7 de	2.8	7.0 bcd
P2-100	0.6 de	1.5	3.3 cd
P1-100	0.6 de	1.5	3.3 cd
P1+sand	0.4 e	0.5	0.0 d
P2+sand	0.3 e	0.5	0.0 d

Table 4: Volumetric water content in topdress plots. Percent water measured with ThetaProbe.

Treatment	03/31/99	05/17/99	07/28/99	05/15/2000
P1-100	26.0 a	13.9	25.7 a	18.9 a
P2-100	25.6 a	13.6	22.7 ab	19.2 a
P1-25	23.9 b	12.5	21.5 ab	16.2 bc
P2-50	23.6 bc	12.3	17.7 bc	15.9 bc
control	23.5 bc	12.9	24.7 a	18.9 a
P1-50	22.9 bcd	10.8	17.7 bc	16.3 bc
P1+sand	22.4 cde	8.9	15.1 c	14.0 c
P2-25	22.2 de	11.8	21.1 abc	19.0 a
P2+sand	21.7 e	10.0	16.4 bc	16.8 ab

Table 5: Visual color rating in topdress trials.

Treatment	Mean rating 0 - 10 (10 = darkest green)							
	0517	0528	0604	0614	0622	0629	0706	0713
C1-25	7.5	7.8	7.0	6.8	7.0	7.5	7.0	7.0
C1-50	7.0	7.5	7.0	7.0	6.8	7.3	7.0	6.8
C1-100	7.8	7.8	7.8	7.5	7.6	7.8	7.8	7.8
C1+sand	7.3	7.0	7.5	7.0	6.8	7.0	6.8	7.0
C2-25	7.3	7.3	7.0	6.5	7.0	7.3	7.0	7.0
C2-50	7.3	7.3	7.3	6.8	6.5	7.5	7.0	7.0
C2-100	7.5	7.8	7.3	7.5	7.6	7.8	7.8	7.3
C2+sand	6.8	7.3	7.0	7.0	7.0	7.3	7.3	6.5
control	7.5	7.5	7.3	6.8	7.3	8.0	7.3	7.3
lsd p=0.05	NS	NS	NS	0.6	NS	NS	NS	NS
	0721	0728	0805	0816	0824	0902	0909	0916
C1-25	7.0	7.5	7.0	8.0	8.0	7.8	7.5	7.8
C1-50	6.5	6.8	6.5	7.8	7.8	7.5	7.3	7.8
C1-100	7.8	7.5	7.8	8.0	8.0	8.0	8.0	8.0
C1+sand	6.8	7.0	6.5	7.8	7.8	7.3	7.3	7.0
C2-25	7.0	7.0	7.0	7.5	7.8	7.5	7.5	8.0
C2-50	6.8	7.3	7.0	7.5	8.0	8.0	7.8	8.0
C2-100	7.5	7.5	7.5	8.0	8.0	7.8	7.8	8.0
C2+sand	6.8	7.0	6.5	7.8	7.5	7.3	7.3	7.3
control	7.5	7.5	7.5	7.8	7.8	7.8	7.8	7.5
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	0.5
	0921	0928	1008	1022	1029	Mean		
C1-25	7.3	7.3	7.5	7.3	7.0	7.3		
C1-50	7.3	7.0	7.3	8.0	7.3	7.2		
C1-100	8.0	8.0	8.0	8.0	8.0	7.8		
C1+sand	7.3	7.0	6.8	7.8	7.3	7.1		
C2-25	7.3	7.0	7.3	7.3	6.8	7.2		
C2-50	7.8	7.5	7.3	8.0	7.3	7.4		
C2-100	8.0	7.8	8.0	8.0	7.8	7.7		
C2+sand	7.0	7.3	7.3	8.0	7.3	7.1		
control	7.0	7.0	7.3	7.0	6.8	7.4		
lsd p=0.05	0.5	NS	NS	0.4	0.6	0.2		

Table 6: Visual quality rating in topdress trials.

Treatment	Mean rating 0 - 10 (10 = best)							
	0517	0528	0604	0614	0622	0629	0706	0713
C1-25	7.0	6.8	6.8	6.0	6.3	6.8	6.5	7.0
C1-50	7.0	6.5	6.8	6.0	6.3	6.5	6.3	6.3
C1-100	7.3	6.8	7.5	6.5	6.8	7.0	6.8	6.8
C1+sand	6.5	6.5	6.8	6.3	6.0	6.5	6.3	6.3
C2-25	7.3	6.3	6.3	5.8	6.5	6.8	6.3	6.8
C2-50	7.3	6.5	6.5	5.5	6.3	6.8	6.3	6.5
C2-100	6.8	6.8	7.0	6.8	6.8	7.0	6.8	6.8
C2+sand	6.8	6.3	6.5	5.8	6.3	6.8	6.3	6.5
control	7.3	6.3	6.8	6.0	6.3	7.0	7.0	6.8
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	NS
	0721	0728	0805	0816	0824	0902	0909	0916
C1-25	6.5	6.8	6.8	7.0	6.8	7.0	6.5	7.0
C1-50	6.3	6.3	6.3	6.8	6.5	6.5	6.3	7.0
C1-100	7.0	6.8	6.8	7.3	7.0	7.0	7.8	7.0
C1+sand	6.3	6.3	6.3	6.5	6.5	6.8	6.3	7.0
C2-25	6.5	6.5	6.5	6.8	6.5	6.8	6.5	7.3
C2-50	6.5	6.8	6.5	6.5	6.8	6.8	6.8	7.0
C2-100	6.8	6.8	6.8	7.3	6.8	7.0	7.3	7.0
C2+sand	6.5	6.3	6.3	6.8	6.8	6.8	6.5	6.5
control	7.0	7.0	7.0	7.0	6.8	7.0	6.5	7.0
lsd p=0.05	NS	NS	NS	NS	NS	NS	0.8	0.4
	0921	0928	1008	1022	1029	Mean		
C1-25	6.8	6.5	6.8	6.3	6.8	6.7		
C1-50	6.8	6.0	6.3	7.0	7.0	6.5		
C1-100	8.0	7.8	7.8	8.0	7.0	7.2		
C1+sand	6.5	6.0	6.0	6.8	7.0	6.4		
C2-25	7.0	6.0	6.5	6.5	6.5	6.5		
C2-50	7.0	6.3	6.5	7.0	6.8	6.6		
C2-100	7.8	7.5	7.5	8.0	7.0	7.0		
C2+sand	6.5	6.5	6.3	7.3	7.0	6.5		
control	6.8	6.3	6.3	6.0	6.5	6.7		
lsd p=0.05	0.6	0.8	0.7	0.5	NS	0.2		

Table 7: Visual uniformity rating in topdress trials.

Treatment	Mean rating 0 - 10 (10 = best)							
	0517	0528	0604	0614	0622	0629	0706	0713
C1-25	7.0	7.0	6.8	6.3	6.3	7.3	6.5	7.0
C1-50	7.0	6.5	6.8	6.3	6.3	7.0	6.3	6.5
C1-100	6.8	6.8	7.5	6.5	6.5	7.3	7.3	6.8
C1+sand	6.8	6.5	7.0	6.3	6.0	7.0	6.5	6.3
C2-25	6.5	6.5	6.3	6.0	6.0	7.0	6.5	6.8
C2-50	6.5	6.5	7.0	6.3	6.0	7.0	6.8	6.5
C2-100	6.8	6.8	7.0	6.5	6.5	7.3	6.8	6.8
C2+sand	6.5	6.3	6.8	6.5	6.0	7.0	6.8	6.5
control	7.0	6.5	6.8	6.0	6.5	7.0	7.3	6.8
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	NS
	0721	0728	0805	0816	0824	0902	0909	0916
C1-25	6.5	6.8	6.8	7.0	6.8	7.0	6.5	7.3
C1-50	6.3	6.3	6.3	6.8	6.5	7.0	6.3	7.0
C1-100	6.8	6.8	6.8	8.0	7.5	7.8	7.8	7.8
C1+sand	6.3	6.0	6.3	7.0	7.0	7.0	6.3	7.3
C2-25	6.8	6.3	6.5	6.8	7.0	6.8	6.8	7.3
C2-50	6.5	6.5	6.5	6.5	7.0	6.8	6.5	7.3
C2-100	6.5	6.8	6.8	7.8	7.5	7.5	7.3	7.5
C2+sand	6.5	6.3	6.3	7.0	6.8	7.0	6.5	6.8
control	7.3	7.0	7.0	7.0	7.0	7.0	6.8	7.3
lsd p=0.05	NS	NS	NS	0.5	0.6	0.5	NS	NS
	0921	0928	1008	1022	1029	Mean		
C1-25	6.5	6.5	6.8	6.5	6.8	6.7		
C1-50	6.5	6.3	6.3	7.0	7.0	6.6		
C1-100	8.0	7.8	7.8	8.0	7.3	7.3		
C1+sand	6.3	6.5	6.0	7.0	7.0	6.6		
C2-25	6.5	6.3	6.5	6.5	7.0	6.6		
C2-50	6.8	6.3	6.5	7.0	7.0	6.6		
C2-100	7.8	7.5	7.5	8.0	7.3	7.1		
C2+sand	6.5	7.3	6.3	7.5	7.0	6.7		
control	6.5	6.3	6.3	6.3	6.5	6.8		
lsd p=0.05	0.8	0.8	0.7	0.7	NS	0.2		

Table 8: Visual density rating in topdress trials.

Treatment	Mean rating 0 - 10 (10 = best)							
	0517	0528	0604	0614	0622	0629	0706	0713
C1-25	7.0	7.0	6.8	7.0	6.8	6.8	6.8	6.5
C1-50	7.0	6.8	6.5	6.5	6.5	6.8	6.5	6.3
C1-100	7.5	7.0	7.5	7.0	7.3	7.3	7.0	6.8
C1+sand	6.5	6.8	6.5	7.0	6.8	7.0	6.5	6.3
C2-25	7.0	6.8	6.5	6.5	6.8	6.8	6.8	6.5
C2-50	7.5	6.8	7.0	6.5	6.5	7.0	6.5	6.5
C2-100	7.0	7.0	7.3	6.8	7.5	7.3	7.0	6.8
C2+sand	6.8	6.3	6.5	6.5	6.8	6.5	6.5	6.3
control	7.5	7.3	7.0	6.8	7.0	7.0	7.0	7.3
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	NS
	0721	0728	0805	0816	0824	0902	0909	0916
C1-25	6.8	7.0	6.8	7.0	7.0	7.0	7.0	7.8
C1-50	6.3	6.8	6.0	7.0	7.0	6.8	7.0	8.0
C1-100	7.0	7.0	7.0	7.0	7.0	7.0	7.8	8.0
C1+sand	6.5	6.5	6.3	6.5	6.8	7.0	7.0	7.8
C2-25	6.8	6.8	6.8	7.0	7.0	7.0	7.3	8.0
C2-50	6.5	7.0	6.0	7.0	7.0	7.0	7.0	8.0
C2-100	7.0	7.0	7.0	7.0	7.0	7.0	7.3	8.0
C2+sand	6.5	7.0	6.3	6.8	7.0	6.8	7.3	7.5
control	7.0	7.0	7.0	7.0	7.0	7.0	7.3	8.0
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	NS
	0921	0928	1008	1022	1029	Mean		
C1-25	7.0	7.0	6.8	7.0	7.8	7.0		
C1-50	7.0	7.0	7.0	7.3	7.8	6.8		
C1-100	8.0	7.8	7.8	8.0	8.0	7.4		
C1+sand	7.0	7.0	6.3	7.3	7.5	6.8		
C2-25	7.0	6.8	6.5	7.0	7.5	6.9		
C2-50	7.0	7.0	7.0	7.3	7.8	6.9		
C2-100	7.8	7.5	7.5	8.0	8.0	7.3		
C2+sand	7.3	7.3	6.3	7.5	7.5	6.8		
control	7.0	6.8	7.0	7.0	7.5	7.1		
lsd p=0.05	0.3	0.6	0.6	0.5	NS	0.2		

Table 9: Turf lightness (L) measured with CR310 colormeter.

Treatment	Mean L (0 - 100, 0 = black, 100 = white)								
	0507	0517	0603	0610	0623	0702	0708	0715	0728
C1-25	42.6	42.9	39.9	35.4	35.6	33.3	33.2	33.4	34.0
C1-50	42.7	42.4	40.2	35.3	35.9	34.2	33.4	34.4	33.3
C1-100	42.7	43.1	40.0	36.3	34.4	33.1	35.0	35.1	33.2
C1+sand	42.7	42.3	40.3	35.7	36.3	32.4	32.9	34.0	34.1
C2-25	42.2	42.3	39.3	34.9	35.7	32.9	36.3	33.8	34.0
C2-50	42.0	42.7	40.0	35.3	35.5	34.4	34.3	34.5	33.8
C2-100	42.6	42.9	40.4	35.3	35.8	36.8	33.7	34.2	34.5
C2+sand	42.4	42.9	40.3	35.5	35.5	33.9	32.6	33.7	33.2
control	42.9	41.8	38.9	34.9	34.7	33.8	34.3	35.1	35.2
lsd p=0.05	0.3	0.6	0.5	NS	NS	1.8	1.8	NS	NS
	0806	0901	0909	0916	0923	0930	1008	1025	mean
C1-25	36.7	29.7	36.2	35.5	38.7	33.8	37.0	32.8	35.9
C1-50	34.3	30.5	34.7	35.4	38.9	32.5	36.8	32.0	35.7
C1-100	34.3	31.0	32.5	34.2	37.9	32.9	37.3	30.2	35.5
C1+sand	40.2	29.9	35.1	35.9	39.5	32.4	37.5	32.2	36.1
C2-25	38.1	31.0	35.9	35.8	38.3	34.5	36.7	32.0	36.1
C2-50	37.3	30.5	34.2	36.1	39.0	33.4	37.8	32.0	36.0
C2-100	36.6	31.7	34.7	34.4	37.7	32.8	36.9	30.0	35.9
C2+sand	40.0	30.2	35.6	36.4	39.7	33.5	36.8	32.2	36.1
control	35.9	31.8	33.9	37.4	38.9	35.7	36.8	32.7	36.2
lsd p=0.05	2.4	NS	2.0	1.1	0.6	NS	0.8	1.3	NS



Table 10: Turf color saturation (C, chroma) measured with CR310 colormeter.

Treatment	Mean L (0 - 60, 0 = grey, 60 = vivid)								
	0507	0517	0603	0610	0623	0702	0708	0715	0728
C1-25	12.3	13.5	12.2	11.7	10.4	11.9	10.9	10.0	8.4
C1-50	12.1	13.3	12.2	12.2	10.1	12.1	10.3	10.5	8.9
C1-100	12.8	14.1	12.6	12.4	9.6	10.8	11.8	10.5	9.0
C1+sand	12.0	13.2	12.4	11.7	10.1	11.2	10.4	10.8	9.7
C2-25	11.9	12.8	12.3	11.4	10.1	11.7	11.6	9.8	8.4
C2-50	12.8	13.1	12.2	11.1	10.5	13.4	11.4	10.8	8.3
C2-100	12.6	13.8	12.4	11.5	10.4	13.1	10.2	10.0	8.8
C2+sand	11.8	13.4	12.4	11.2	10.7	10.8	9.3	10.5	9.6
control	12.5	13.1	12.7	10.6	10.4	11.9	10.7	10.9	8.7
lsd p=0.05	0.4	0.5	NS	NS	NS	1.5	1.1	NS	NS
	0806	0901	0909	0916	0923	0930	1008	1025	mean
C1-25	11.2	10.5	9.7	9.4	11.2	11.5	11.7	12.5	11.1
C1-50	9.6	11.5	8.9	11.1	10.7	11.2	12.1	12.6	11.1
C1-100	9.6	10.4	7.1	8.8	10.9	11.4	12.4	11.8	10.9
C1+sand	11.8	11.4	9.1	9.2	10.7	11.7	12.1	10.7	11.1
C2-25	11.4	10.3	9.7	9.2	11.3	12.1	12.4	12.6	11.1
C2-50	9.5	11.2	8.5	9.8	11.0	13.0	12.2	13.0	11.3
C2-100	9.9	11.5	9.1	8.9	10.5	10.3	11.8	11.7	11.0
C2+sand	12.3	12.6	9.4	10.6	11.0	11.4	12.5	10.8	11.2
control	9.1	10.2	8.4	10.5	12.1	12.8	12.8	13.0	11.2
lsd p=0.05	1.7	NS	1.2	1.0	0.6	1.5	NS	0.9	NS

Table 11: Turf hue angle (H) measured with CR310 colormeter.

Treatment	Mean H (0 - 360, in the observed range a higher hue angle is greener, a lower angle is yellower)					
	0507	0517	0603	0610	0623	0702
C1-25	112.6	121.6	116.8	126.7	128.0	133.6
C1-50	111.8	121.1	115.8	127.9	125.5	129.4
C1-100	114.3	121.9	118.5	127.4	133.0	133.5
C1+sand	113.1	122.1	117.2	127.1	125.4	133.5
C2-25	110.8	118.7	116.7	125.6	127.0	131.8
C2-50	114.2	119.5	115.9	127.5	130.2	131.6
C2-100	112.3	120.7	116.3	127.5	129.1	126.6
C2+sand	111.9	121.3	116.6	127.6	127.7	128.5
control	113.0	122.4	119.2	127.7	130.2	133.2
lsd p=0.05	1.9	2.4	1.7	NS	4.0	4.3
	0708	0715	0728	0806	0901	0909
C1-25	125.6	131.6	127.0	121.7	128.8	118.9
C1-50	123.8	130.0	129.8	130.1	128.3	124.6
C1-100	127.0	129.6	133.9	129.0	131.2	127.8
C1+sand	125.0	133.0	130.6	111.3	130.4	124.5
C2-25	119.5	130.9	126.4	117.9	125.0	120.2
C2-50	126.2	132.0	129.1	119.5	130.4	127.7
C2-100	125.7	129.3	129.4	121.2	124.6	129.3
C2+sand	124.2	131.9	130.5	115.7	128.9	121.4
control	125.7	130.5	128.9	126.5	125.7	128.4
lsd p=0.05	NS	NS	NS	10.4	NS	5.9
	0916	0923	0930	1008	1025	mean
C1-25	108.6	115.5	132.2	117.7	119.3	122.7
C1-50	112.2	120.4	133.2	120.3	122.3	123.9
C1-100	106.0	124.3	142.2	123.0	130.1	126.6
C1+sand	102.4	119.7	133.8	120.9	123.8	123.2
C2-25	102.8	117.0	129.2	118.5	120.1	121.1
C2-50	111.1	117.2	134.1	119.3	122.5	124.0
C2-100	106.9	123.2	137.2	124.1	129.3	124.3
C2+sand	114.0	119.8	133.4	123.2	124.5	123.6
control	109.5	118.1	130.3	119.4	119.9	124.0
lsd p=0.05	7.7	5.0	6.6	2.7	3.8	1.5



Table 12: Visual cover rating in topdress trials.

Treatment	Mean rating 0 - 10 (10 = full cover)							
	0517	0526	0602	0609	0615	0622	0629	0706
C1-25	8.5	8.0	7.5	8.3	8.3	8.5	9.0	9.3
C1-50	8.5	8.3	7.8	7.8	8.5	9.0	8.8	10.0
C1-100	8.8	9.0	8.3	8.5	8.8	9.5	9.5	9.8
C1+sand	7.8	8.5	8.5	8.3	9.0	8.8	9.3	9.8
C2-25	7.8	7.3	6.8	7.5	7.3	8.0	8.3	8.8
C2-50	8.3	8.3	7.8	8.0	8.3	8.3	8.8	9.3
C2-100	8.5	8.8	7.8	8.3	8.8	9.5	9.8	9.8
C2+sand	7.8	8.0	8.0	7.8	9.0	8.5	9.0	10.0
control	8.8	8.0	7.0	7.3	7.5	8.3	8.3	9.0
lsd p=0.05	NS	NS	1.0	NS	NS	NS	NS	NS
	0713	0721	0728	0805	0816	0824	0902	0909
C1-25	9.8	10.0	9.3	9.3	9.5	9.3	8.8	8.8
C1-50	10.0	10.0	10.0	9.5	9.8	9.5	9.8	9.3
C1-100	10.0	10.0	9.3	9.8	9.5	9.3	9.8	9.8
C1+sand	9.8	10.0	9.8	9.8	9.8	9.0	9.3	9.3
C2-25	8.8	9.3	9.0	8.5	8.0	8.8	8.8	8.3
C2-50	9.8	9.0	9.5	8.5	8.5	8.5	8.5	8.3
C2-100	9.8	9.8	9.8	9.3	9.3	9.5	9.5	9.5
C2+sand	9.8	9.8	9.8	9.5	9.5	9.5	9.5	9.5
control	9.3	9.5	9.0	8.8	8.5	8.5	8.3	7.8
lsd p=0.05	NS	NS	NS	NS	NS	NS	NS	NS
	0916	0921	0928	1008	1018	1029	mean	
C1-25	9.0	9.3	9.0	9.0	9.0	9.0	8.9	
C1-50	9.8	9.8	9.5	9.5	9.5	9.8	9.3	
C1-100	9.8	7.5	7.5	9.8	9.5	9.5	9.2	
C1+sand	10.0	9.3	9.0	9.3	7.3	9.8	9.1	
C2-25	8.8	8.8	9.0	8.8	8.5	8.8	8.3	
C2-50	8.8	9.0	8.5	9.5	8.8	9.0	8.7	
C2-100	9.8	9.8	9.5	9.5	9.5	9.5	9.3	
C2+sand	10.0	9.8	10.0	9.5	7.5	9.8	9.1	
control	8.5	8.5	8.5	8.8	8.5	8.5	8.4	
lsd p=0.05	1.1	NS	NS	NS	NS	NS	0.3	

