Removal of Coarse Sand from Topdressing Applied to Putting Green Turf

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INTRODUCTION

- Very low rates of topdressing sand (dusting) are used to minimize interference with play and dulling of cutting edges from particles that do not incorporate.
- Topdressing with sand sized <0.5-mm can minimize interference to play and mowing; however, it is not clear whether finer-textured sands have undesirable effects to the surface and turf.

OBJECTIVE

1) Determine the effects of eliminating coarse particles from topdressing sand (subsequently increasing the quantities of medium, fine and very fine particles) on the performance of creeping bentgrass putting green;
2) Assess the impact of core cultivation and backfilling holes with medium-coarse sand to ameliorate the potential negative effects of finer-textured topdressing sands on turf performance and the physical properties of the rootzone.

MATERIAL S & METHODS

EXPERIMENTAL DESIGN

- 3 x 2 x 2 factorially arranged randomized complete block design with four replications was initiated in May 2016. A non-topdressed control at both levels of cultivation were also included.
- The factors include:
  1) Sand Size: Medium-coarse vs. Medium-fine vs. Fine-medium (Table 1)
  2) Topdressing Rate: Low (2,441 kg/ha) vs. High (4,882 kg/ha)
     Ten treatments applied every 14-day from May to October
  3) Cultivation: Cored plus backfill (May and October) vs. non-cored.
     Coring holes backfilled with medium-coarse sand

Table 1. Sand particle size distribution of trial rootzone and three sand sizes.

	Size Class/Particle Diam. (mm)				
	V. coarse	**Coarse**	**Medium**	**Fine**	**V. Fine**
	1.0-2.0	0.5-1.0	0.25-0.5	0.15-0.25	0.05-0.15
	%	%	%	%	%
USGA Guidelines	≤ 10	≥ 60		≤ 20	≤ 5
Rootzone	6.9	25.3	44.6	17.2	4.1
Topdressing Sand Size					
Medium-coarse (MC)*	0.0	29.6	59.9	9.6	0.8
Medium-fine (MF)	0.0	0.0	74.4	23.6‡	2.0
Fine-medium (FM)	0.0	4.0	27.2	47.7	21.0

‡ Red font indicates failure to meet USGA guidelines

Applying topdressing sand.

Core cultivation before backfill.

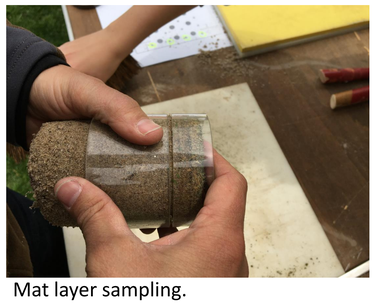
GENERAL MAINTEANCE

- 'Shark' creeping bentgrass was seeded in September 2014
- Daily walk-behind or triplex mower at 2.8 mm bench setting
- N sprayed at 4.9 kg / ha every 14-day (136.7 kg / ha in 2016)
- Irrigation applied at 50% ET and wash-in fertilizer
- Fungicides applied preventatively to avoid disease damage

DATA COLLECTION AND ANALYSIS

- Sand Incorporation was visually assessed after topdressing.
- Turf color, density and quality was visually rated June through October.
- Sand and clippings collected in the mower basket were sampled from each plot three times per year to determine sand weight and particle size distribution.
- Volumetric water content of the surface 0- to 38-mm depth zone.
- Core samples of the mat layer were collected after one year of treatment to determine depth, organic matter content and sand particle size distribution.
- Analysis of variance performed on data using a 3 x 2 x 2 RCBD. Means separation using Fisher's protected LSD at α = 0.05 and planned orthogonal contrasts.

Sand and clipping collection.



Mat layer sampling.

Table 2. Analysis of variance of sand picked up with one pass of a mower (1.9 m^2) on the day after topdressing during 2016.

Sampling Date	7-Jul		17-Aug		28-Sep	
Mowing Height	2.8 mm		2.8 mm		3.2 mm	
	Sand Picked Up‡	Portion of Sand Applied¶	Sand Picked Up‡	Portion of Sand Applied*	Sand Picked Up‡	Portion of Sand Applied*
	g/1.9-m^2	%	g/1.9-m^2	%	g/1.9-m^2	%
Source of Variation						
Sand Size (SS)	***	***	***	***	***	***
Topdressing Rate (TR)	***	*	***	***	***	***
SS*TR	***	ns	***	ns	*	ns
Core Cultivation (CC)	ns	ns	ns	ns	ns	ns
SS*CC	ns	ns	ns	ns	ns	ns
TR*CC	ns	ns	ns	ns	ns	ns
SS*TR*CC	ns	ns	ns	ns	ns	ns
Main Effect						
Sand Size						
Medium-coarse	37.1	5.1	50.1	7.0	12.0	1.7
Medium-fine	17.8	2.4	29.7	4.0	6.5	0.9
Fine-medium	17.6	2.5	16.8	2.3	5.5	0.8
LSD(5%)	4.0	0.5	4.6	0.6	1.2	0.2
Topdressing Rate						
2,441 kg/ha	14.5	3.1	19.3	4.1	5.0	1.1
4,882 kg/ha	33.8	3.6	45.1	4.8	11.0	1.2
LSD(5%)	3.2	0.4	3.8	0.5	1.0	ns
Core Cultivation						
None	22.7	3.1	30.3	4.2	7.4	1.1
Twice a Year	25.7	3.6	34.1	4.7	8.7	1.2
LSD(5%)	ns	ns	ns	ns	ns	ns

* Significant at p≤0.05; ** significant at p≤0.01; *** significant at p≤0.001; ns: nonsignificant
‡ Sand and clippings combusted at 360 °C for 24 hours and weighed after removal of ash.
¶ Weight of sand collected by mower ÷ weight of topdressing applied to mowing area x 100

Table 3. Orthogonal contrasts and analysis of variance of particle size distribution one-year after initiation of treatments.

	Size Class/Particle Diam. (mm)				
	V. coarse	Coarse	Medium	Fine	V. Fine
	2.0-1.0	1.0-0.5	0.5-0.25	0.25-0.15	0.15-0.05
	%	%	%	%	%
Orthogonal Contrasts					
Non-Cultivated: Topdress vs.	2.9 b¶	19.4 b	47.7 a	24.2 a	5.8 a
No Topdress	4.6 a	25.4 a	46.4 a	19.7 b	3.8 b
Cultivated: Topdress vs.	2.8 b	19.7 a	52.3 a	20.9 a	4.3 a
No Topdress	3.5 a	21.7 a	51.9 b	19.2 b	3.7 a
Source of Variation					
Sand Size (SS)	**	***	***	***	***
Topdress Rate (TR)	*	ns	ns	ns	**
SS*TR	ns	ns	***	***	***
Core Cultivation (CC)	ns	ns	***	***	***
SS*CC	ns	**	***	***	***
TR*CC	ns	ns	ns	ns	ns
SS*TR*CC	*	*	ns	ns	ns
SS * TR Interaction					
SS	TR				
MC	2,441 kg/ha	3.0	24.8	51.2	18.1	2.9
MC	4,882 kg/ha	2.8	25.2	52.6	16.6	2.8
MF	2,441 kg/ha	3.2	17.7	54.0	21.5‡	3.6
MF	4,882 kg/ha	2.9	15.8	56.4	21.4	3.6
FM	2,441 kg/ha	2.7	17.7	44.5	27.3	7.8
FM	4,882 kg/ha	2.4	16.2	41.4	30.4	9.5
	LSD (5%)	ns	ns	1.4	0.9	0.5
SS * CC Interaction						
SS	CC					
MC	Not Cultivated	2.9	26.6	50.5	17.2	2.8
MC	Core Cultivated	2.9	23.4	53.2	17.4	3.0
MF	Not Cultivated	3.1	15.6	54.5	23.0	3.9
MF	Core Cultivated	3.0	17.9	55.9	19.9	3.3
FM	Not Cultivated	2.6	16.1	38.0	32.4	10.9
FM	Core Cultivated	2.5	17.8	47.9	25.3	6.5
	LSD (5%)	ns	1.1	1.4	0.8	0.4

* Significant at p≤0.05; ** significant at p≤0.01; *** significant at p≤0.001; ns: not significant
¶ Different letter indicates statistically difference between treatments at α = 0.05
‡ Red font indicates failure to meet USGA guidelines

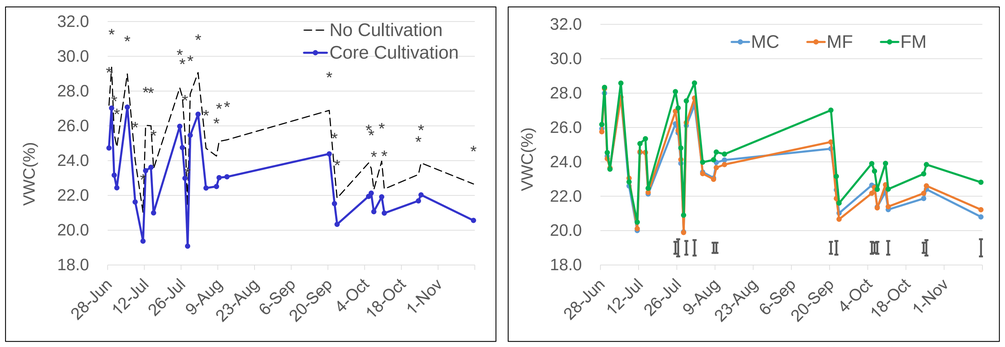


Figure 1. Volumetric water content at the 0- to 38-mm depth zone as affected by the main effects of core cultivation (left) and sand size (right) during 2016.

Table 4. Orthogonal contrasts and analysis of variance of mat layer depth and organic matter concentration one-year after initiation of treatments in May 2017. Mat layer depth was 6.3-mm at the initiation of treatments in May 2016.

	Depth	OM
	mm	%
Orthogonal Contrasts		
Non-Cultivated: Topdress vs.	17.4 a¶	6.7 b
No Topdress	13.7 b	9.2 a
Cultivated: Topdress vs.	17.0 a	5.5 b
No Topdress	15.2 b	7.1 a
Source of Variation		
Topdress Rate	***	***
Core Cultivation	ns	***
Main Effect		
Topdressing Rate		
2, 441 kg/ha	16.4 b	6.4 a
4,882 kg/ha	17.9 a	5.8 b
Core Cultivation		
None	17.4 a	6.7 a
Twice a Year	17.0 a	5.5 b

* Significant at p≤0.05; ** significant at p≤0.01; *** significant at p≤0.001; ns: not significant
¶ Different letter indicates statistically difference between treatments at α = 0.05

RESULTS AND DISCUSSION

Sand Collected by Mower

- Topdressing with medium-coarse sand increased the quantity and portion of sand collected during mowing compared to medium-fine and fine-medium sands (Table 2).
- The greater topdressing rate increased the potion of sand collected by the mower.

Sand Size Distribution in Mat Layer After One Year of Treatments

- Sand size had significant impact on mat layer sand size distribution and interacted with topdressing rate and cultivation (Table 3).
- Fine-medium sand topdressing increased the fineness of sand in the mat layer. A greater topdressing rate of fine-medium sand intensified this response. Core cultivation muted the increase in fineness of plots topdresed with fine-medium sand.
- Medium-fine also increased the fineness of sand in the mat layer but the increase in fineness with medium-fine sand was not strongly effected by topdressing rate. Core cultivation and backfilling with medium-coarse sand was able to offset the increase in fineness of plots topdresed with fine-medium sand.

Mat Layer Depth and OM Concentration

- Topdressing increased the depth of the mat layer and decreased the OM concentration compared to non-topdressed controls (Table 4).
- A greater topdressing rate increased thicker mat layer depth and lowered OM concentration compared to the lower topdressing rate.
- Core cultivation did not influence mat layer depth but did reduce OM concentration.

Volumetric Water Content (VWC)

- Core cultivation decreased VWC (0- to 38-mm depth zone) throughout the year compared to non-cultivated plots (Figure 1 left).
- Medium-coarse and medium-fine sand produced a drier surface compared to fine-medium sand later in the year (Figure 1 right).
- Under core cultivation, the VWC of non-topdressed control plots was similar to that of topdressed plots (data not shown).

CONCLUSIONS

1. Topdressing improved the putting surface:
   - reduced the OM concentration
   - produced a drier surface
2. Sand size had a significant impact on mat layer physical properties:
   - medium-fine sand increased the fineness of sand size in the mat layer but this did not appear to be enough to influence VWC since medium-coarse and medium-fine sand topdressing were similarly effective at reducing surface wetness.
   - fine-medium sand topdressing was not as effective at drying the surface due to the substantial increase in fine and very fine particles in the mat layer.
3. Core cultivation and backfilling with medium-coarse sand was effective at:
   - reducing surface wetness and OM concentration
   - reducing the fineness of sand in the mat layer of medium-fine and fine-medium topdressed plots.