Shockwave Aerification Performance Study

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Introduction

Athletic field safety is a growing concern on all levels from young children to professional sports. Finding time to close the field to relieve compaction often is difficult, but new technology offers a potential solution. The objective of this project is to compare the performance of Kentucky bluegrass (*Poa pratensis*) on native soil under simulated traffic subjected with various industry standard aerification methods and the Imants Shockwave. Safety parameters such as surface hardness and rotational resistance were tracked throughout the season to see if any benefits exist to athlete safety between treatments. This is the second year of a two-year study.

Materials and Methods

Research was conducted at the Iowa State University Horticulture Research Station on the Sports Turf Research Area over native soil rootzone. The experimental design was a randomized block with three replications. Five aeration treatments were tested: an untreated control (Control), hollow tine aerification (HT), solid tine aerification (ST), one pass with the Shockwave (S1x), and two perpendicular passes with the Shockwave (S2x). Aeration treatments were applied monthly during the 2017 and 2018 growing season with simulated traffic beginning at the same time as the Iowa high school football season. Traffic was applied with a modified Baldree Traffic Simulator (BTS), and plots received five simulated traffic events/week for nine weeks. Digital images were collected after every traffic event to track turfgrass performance with percent green cover. Percent green cover was determined using Digital Image Analysis. Surface hardness, soil moisture, and shear vane rotational resistance also were collected after every five simulated traffic events. Surface hardness was collected using a 2.25 kg Clegg Impact Soil Tester. Soil moisture was collected with the FieldScout TDR with 3-in. probes, and rotational resistance was collected with a TurfTec Shear Tester.

Results and Discussion

A significant date-by-treatment interaction was present, so individual dates are presented. Differences for surface hardness were present between treatments on three of six rating dates (Table 1). After five simulated traffic events, surface hardness was greater on the Control (50) as compared with the HT (43). After 10 simulated traffic events, the S1x (95), ST (94), and Control (91) all had a lower surface hardness than the S2x (105). After 20 simulated traffic events, the S2x (90) surface hardness was greater than S1x (75). S1x was in the lower surface hardness statistical grouping on most dates. This indicates S1x could help limit increases in surface hardness from foot traffic.

In year two of the study, hollow tine aerification treatments did not fully recover from traffic applied in year one, so levels were not at 100 percent cover to start the year. ST treatments had a higher percent cover on four of the six rating dates from all other treatments except the Control (Table 2). S1x had the same percent cover as the Control on every rating date. The loss of cover was higher in 2018 than 2017 due to the greater amounts of soil moisture present.

Differences between treatments were reported for rotational resistance (data not shown). HT resulted in lower shear values than all treatments other than S2x. This indicates HT and S2x reduced traction more than other treatments. Differences were present for soil moisture after 5, 10, 15, and 30 games (Table 3). Both S1x and S2x resulted in lower soil moisture than all other treatments on two of six rating dates. HT resulted in lower soil moisture than all treatments on one rating date and was similar to both S1x and S2x on one rating date. No differences were reported for infiltration rates, total porosity, or bulk density (data not shown).

Year two was very different from year one. A large majority of traffic events were applied to saturated or very wet field conditions. This caused a premature drop in percent cover and also kept surface hardness values much lower than in year one of this study. After 10 traffic events in year one, all treatments had over 65 percent cover. After 10 traffic events in year two, no treatment had over 45 percent cover. Surface hardness values show similar results. For instance, after 15 traffic events last year, surface hardness values were all above 100 with a surface hardness for HT of 162. This year after 15 traffic events no treatment had a surface hardness greater than 75. These results indicate that under excessive moisture conditions, differences between aeration treatments are not noticeable.

Table 1. Effect of various cultivation treatments on Kentucky bluegrass under simulated athletic traffic for surface hardness utilizing a 2.25kg Clegg Impact Soil Tester in 2018.

Cultivation method	Number of simulated traffic events[1]					
	5	**10[7]**	**15**	**20**	**25**	**30**
Control[2]	50[8]	91	67	83	68	53
Hollow Tine[3]	43	99	72	87	69	55
Shockwave 1x[4]	47	95	64	75	70	50
Shockwave 2x[5]	48	105	70	90	71	57
Solid Tine[6]	49	94	65	83	70	57
LSD (0.05)[8]	6	9	13	14	10	11

[1]Simulated athletic events applied using a modified Baldree traffic simulator starting August 7, 2018.
[2]Control treatments did not receive any cultivation treatments.
[3]Hollow Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing June 20, 2018; July 20, 2018; and August 23, 2018.
[4]Solid Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing June 20, 2018; July 20, 2018; and August 23, 2018.
[5]Shockwave 1x treatment received one pass of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[6]Shockwave 1x treatment received two passes of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[7]Surface hardness values collected using a 2.25 kg Clegg Impact Soil Tester.
[8]Means were separated using Fisher's LSD and significant at the 0.05 level of significance.

Table 2. Effect of various cultivation treatments on Kentucky bluegrass under simulated athletic traffic for percent green cover in 2018.

Cultivation method	Number of simulated traffic events[1]					
	0[7]	5	10	15	20	25
Control[2]	89.4	77.7	38	21.4	17.7	10.5
Hollow Tine[3]	77.6	55	32.5	17.3	16.3	10.6
Shockwave 1x[4]	85	71.6	34	20.1	17.5	11.1
Shockwave 2x[5]	71	58.7	25.6	15.4	14.3	10.5
Solid Tine[6]	91.1	82.9	43.8	26	22	12.9
LSD (0.05)[8]	4.8	7.5	6.7	5.9	5.7	3.1

[1]Simulated athletic events applied using a modified Baldree traffic simulator starting August 7, 2018.
[2]Control treatments did not receive any cultivation treatments.
[3]Hollow Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing June 20, 2018; July 20, 2018; and August 23, 2018.
[4]Solid Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing June 20, 2018; July 20, 2018; and August 23, 2018.
[5]Shockwave 1x treatment received one pass of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[6]Shockwave 1x treatment received two passes of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[7]Percent green cover as determined with digital image analysis.
[8]Means were separated using Fisher's LSD and significant at the 0.05 level of significance.

Table 3. Effect of various cultivation treatments on Kentucky bluegrass under simulated athletic traffic for volumetric water content in 2018.

Cultivation method	Number of simulated traffic events[1]					
	0[7]	5	10	15	20	25
Control[2]	48.7	40.8	45.2	41.2	40.1	42.4
Hollow Tine[3]	48.5	37.6	43	39.8	38.1	39.
Shockwave 1x[4]	47.3	35.3	45	40.1	39.1	40.5
Shockwave 2x[5]	47.9	38.3	44.4	39.9	40.1	40.4
Solid Tine[6]	49.8	39.4	45.6	41.2	39.7	42.5
LSD (0.05)[8]	1.6	2.7	1.9	2.4	2.8	1.5

[1]Simulated athletic events applied using a modified Baldree traffic simulator starting August 7, 2018.
[2]Control treatments did not receive any cultivation treatments.
[3]Hollow Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing on June 20, 2018; July 20, 2018; and August 23, 2018.
[4]Solid Tine treatments were applied using a Toro Pro Core 648 with a 1.27-cm diameter tine on 7.62 cm x 7.62 cm spacing on June 20, 2018; July 20, 2018; and August 23, 2018.
[5]Shockwave 1x treatment received one pass of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[6]Shockwave 1x treatment received two passes of the Shockwave set at 25-cm depth June 20, 2018; July 20, 2018; August 23, 2018; and September 12, 2018.
[7]Volumetric water content as determined with TDR with 3-in. probes.
[8]Means were separated using Fisher's LSD significant at the 0.05 level.