HYDROJECT EFFECTS ON THE MIXING OF A SAND TOPDRESSING LAYER AND UNDERLYING NATIVE SOIL

D.E. Karcher, P.E. Rieke, E.R. Snider, and M.A. Smucker
Departments of Crop and Soil Sciences and Entomology
Michigan State University

Introduction

Sand topdressing has become a popular practice on golf course putting greens as a tool to maintain a uniform putting surface while diluting the thatch layer. After many years of regular topdressing, a sand layer builds to a point where it is the primary medium for root growth. Some turfgrass managers have suggested that using the HydroJect on these greens may blast underlying native soil to the surface of the putting green. This soil could possibly "seal" the surface of the green, negatively impacting soil aeration and infiltration rates. A study was initiated in 1994 to determine the mixing of soil layers from regular HydroJect use and hollow tine cultivation on a putting green that contains a significant sand layer overlying a native, finer textured soil.

Materials and Methods

This research was conducted at the Hancock Turfgrass Research Center at Michigan State University. Creeping bentgrass putting green sod, growing on a loam soil, was removed on May 17, 1994. A two inch layer of topdressing sand was placed on the native soil. The green was sodded on May 27 with 'Penncross' creeping bentgrass sod, grown on sand. Treatments began in August, 1994. Treatments included three frequencies of HydroJect operation (weekly, biweekly and monthly), hollow tine cultivation in the spring and fall and a control. Treatments were replicated three times.

A Ryan Greensaire was used for hollow tine cultivations set at a 3" by 2" spacing, using 3/8" tines. A Toro HydroJect 3000 provided by the Toro Co. of Minneapolis was used for water injections. HydroJect treatments were initiated on August 16 when the sod had rooted down well and continued until September 29. Hollow tine cultivations were performed October 13. Treatments ran from May 15 to October 15 in 1995, and from May 17 to October 25 in 1996. Sand topdressing was applied on a light, frequent basis throughout the duration of the study.

Soil samples were taken in September, 1995 at one inch depth intervals, to a depth of five inches for particle size analysis. These samples were used to assess the degree of mixing of the sand topdressing layer with the underlying native soil and vise versa. Soil samples were taken at one and two inches above, and below, the topdressing-native soil interface in September 1996 to decrease sampling variability. Undisturbed soil cores were taken in October, 1995 and 1996 to determine saturated hydraulic conductivity, bulk density and pore size distribution.

Turfgrass quality ratings were taken monthly, based on a scale from 1 to 9 with 1 being dead turf, 5 being acceptable, and 9 being excellent. Stimpmeter readings were taken weekly, on days of treatment. Readings were taken on all plots prior to treatment, and immediately after for only those plots receiving treatment.

Results

Quality rating data for the 1995 growing season are summarized in Table 1. The hollow tine treatment ranked significantly lower in quality than the other treatments on the May 11 rating due to evidence of aerification holes from cultivation the previous fall. The weekly HydroJect treatment declined significantly in the latter part of the growing season. This treatment ranked significantly lower in quality than the control and hollow tine treatments on the August 1 rating, and ranked significantly lower than the HydroJect monthly and hollow tine treatments on the September 7 rating. The weekly treatment probably stressed turfgrass roots and visual symptoms became apparent during periods of stressful weather conditions. Weather conditions were more conducive to healthy turf during the 1996 growing season and no differences in turfgrass quality were observed between the cultivation treatments.

Particle size analysis data for the five soil depths that samples were taken in 1995 are summarized in Table 2. There were no significant differences in clay or sand content, for all five depths, between the weekly HydroJect treatment and the control after a total of 27 treatments with the HydroJect. There were no significant differences in either clay or sand content between any of the treatments at all depths. Sand accumulation around the injection holes was noted on a few occasions, but seemed to have originated from the topdressing layer.

Table 3 summarizes the particle size analysis data from the 1996 soil sampling. These data suggest that mixing of the sand topdressing layer and underlying native soil occurred after 48 weekly HydroJect treatments and 27 biweekly HydroJect treatments. Mixing of the soil layers is evident at the topdressing-native soil interface, but not further than an inch on either side of the interface. Soil mixing at this depth should not contribute to surface sealing and subsequent decreases in aeration and infiltration. Bulk density, pore size distribution and hydraulic conductivities were not significantly different between any cultivation treatments during 1995 and 1996.

Table 1. Quality ratings of sand topdressed putting green. 1995.

	11-May	13-Jun	1-Aug	7-Sep
Treatment^	9=excellent, 6=acceptable, 1=dead			
Check	6.2 ab*	6.2 a	5.3 ab	6.0 ab
HydroJect weekly	6.2 ab	6.3 a	4.2 c	5.0 b
HydroJect biweekly	6.7 a	6.0 a	4.5 bc	5.8 ab
HydroJect monthly	5.5 ab	6.3 a	4.7 abc	6.5 a
Hollow tine spring and fall	4.8 b	5.0 a	5.5 a	6.5 a

^ All treatments were initiated 5/26/95.

* Within each column, numbers with the same letter are not significantly different at the 0.05 level of probability.

Table 2. Effect of cultivation treatment on mixing of soil layers at various depths of a sand topdressed green. Samples collected 9/18/95.

Depth	Treatment	Clay Content	Sand Content
		%	
0-1 inches	Check	1.3 a*	95.0 a
	HydroJect weekly (27)^	1.4 a	93.8 a
	HydroJect biweekly (15)	1.6 a	94.3 a
	HydroJect monthly (9)	1.1 a	94.7 a
	Hollow tine spring and fall (3)	1.3 a	94.5 a
1-2 inches	Check	1.0 a	97.3 a
	HydroJect weekly	1.9 a	89.1 a
	HydroJect biweekly	2.2 a	90.0 a
	HydroJect monthly	1.8 a	90.4 a
	Hollow tine spring and fall	1.0 a	94.9 a
2-3 inches	Check	10.2 a	64.9 a

	HydroJect weekly	8.2 a	66.6 a
	HydroJect biweekly	9.4 a	61.3 a
	HydroJect monthly	9.6 a	61.4 a
	Hollow tine spring and fall	8.9 a	62.4 a
3-4 inches	Check	9.1 a	60.6 a
	HydroJect weekly	9.4 a	59.3 a
	HydroJect biweekly	9.6 a	58.9 a
	HydroJect monthly	10.0 a	58.9 a
	Hollow tine spring and fall	10.2 a	58.3 a
4-5 inches	Check	9.0 a	57.9 a
	HydroJect weekly	10.3 a	57.1 a
	HydroJect biweekly	9.0 a	57.2 a
	HydroJect monthly	9.3 a	56.7 a
	Hollow tine spring and fall	10.6 a	57.0 a

** For each depth within each column, numbers with the same letter are not significantly different at the 0.05 level of probability.*

^ Total number of treatments applied before sampling.

Table 3. Effect of cultivation treatment on mixing of soil layers at various depths of a sand topdressed green. Samples collected 9/15/96.

Depth	Treatment	Clay Content	Sand Content
		%	
1-2 inches above interface	Check	2.1 a*	92.9 a
	HydroJect weekly (48)^	1.8 a	92.0 a
	HydroJect biweekly (27)	1.7 a	93.6 a
	HydroJect monthly (15)	1.2 a	93.6 a
	Hollow tine spring and fall (5)	2.0 a	93.4 a
0-1 inches above interface	Check	0.7 a	96.0 a
	HydroJect weekly	1.3 a	91.2 c
	HydroJect biweekly	1.4 a	93.4 bc
	HydroJect monthly	1.3 a	95.2 ab
	Hollow tine spring and fall	1.2 a	96.3 a
0-1 inches below interface	Check	9.2 a	57.3 c
	HydroJect weekly	6.8 b	64.4 a
	HydroJect biweekly	8.4 ab	60.9 b
	HydroJect monthly	7.5 ab	59.1 bc
	Hollow tine spring and fall	8.8 a	58.3 c
1-2 inches below interface	Check	9.1 a	57.2 a
	HydroJect weekly	7.8 a	59.8 a

HydroJect biweekly	8.4 a	58.9 a
HydroJect monthly	7.7 a	61.2 a
Hollow tine spring and fall	9.3 a	58.6 a

** For each depth within each column, numbers with the same letter are not significantly different at the 0.05 level of probability.*
^ Total number of treatments applied before sampling.

HydroJect Effects on Earthworm Populations in a Creeping Bentgrass Putting Green.

A significant amount of earthworm casts appeared on a cultivation study after heavy rains during the autumn of 1994. An earthworm cast count showed that plots receiving frequent HydroJect treatment exhibited significantly lower amounts of earthworm casts than other cultivation treatments. This earthworm cast count, and another taken in 1995 are summarized in Table 4. Earthworms are primarily beneficial creatures due to the air filled channels created from their burrowing activities, but casts left on putting greens can significantly disrupt ball roll, even after mowing. Regular HydroJect use decreases the potential for earthworm castings on putting greens becoming a problem for the turfgrass manager.

Decreased numbers of earthworm casts continued to occur on plots receiving HydroJect treatment during the 1996 growing season. To verify whether HydroJect treatments were allowing for subsurface casting of earthworms or if they were actually decreasing earthworm populations, soil excavations were performed in search of earthworm biomass. Excavations were performed for the HydroJect weekly treatment, a hollow tine cultivation in the spring and fall treatment, and a control. The results from the soil excavations are summarized in Table 5. Plots receiving HydroJect treatment and control plots had significantly less earthworm populations that plots receiving hollow tine cultivation. Although HydroJect treated plots had less earthworms, this difference was not statistically significant. Plots receiving hollow tine cultivation treatment probably had higher earthworm populations than control plots due to increased air filled pores near the surface. Decreased earthworm populations in plots receiving HydroJect treatment were probably the result of either worm death from the high pressure water jets or some other factor caused by the HydroJect that made the soil environment unfavorable for earthworm habitat.

Table 4. Effect of cultivation treatment on earthworm casting

Treatment	10/13/94	9/6/95
	mean earthworm casts per plot	
Control	72 a*	103 ab
Core Cultivate 2X/year	64 ab	151 a
Core Cultivate 3X/year	84 a	135 a
Core Cultivate 2"X1" 2X/year and HydroJect Biweekly	59 abc	115 ab
Core Cultivate 2X/year and HydroJect Biweekly	39 bc	98 ab
HydroJect Monthly	46 bc	99 ab
HydroJect Biweekly	42 bc	58 b
HydroJect Weekly	37 c	51 b

** means sharing a letter are not statistically different (P < 0.05)*

Table 5. Effect of cultivation treatment on earthworm populations. Samples taken 10/14/96

Treatment	Earthworm Biomass
	mg / cm^3
Control	0.091 b*
HydroJect weekly	0.033 b
Hollow tine spring and fall	0.225 a

** means sharing a letter are not statistically different (P < 0.05)*