

CORE CULTIVATION VS. GRADEN CULTIVATION

J.T. Vanini, J.R. Crum and J.N. Rogers, III

Michigan State University

Introduction

The purpose of this study is to evaluate the difference in two cultivation methods on a putting green surface in regards to organic matter content and infiltration rates. Even though core cultivation will disrupt the putting surface, the benefits of this practice have obviously been well documented, both in terms of soil physical properties and turf quality. However, the Graden cultivation machine is a fairly new product with little to no documented research. Briefly, it operates similar to a verticutting machine, but is able to penetrate down to into the soil profile as deep as 1.5". Furthermore, it has been calculated that the Graden will disrupt twice as much surface area versus core cultivation. Therefore will the Graden cultivation machine be twice as effective in removing organic matter and improving infiltration rates?

Materials and Methods

The experimental design was a 1 x 5 (cultivation x treatments) randomized complete block design with three replications. Each plot was measured to 1.67 m x 1.67 m. The plots were located at the Hancock Turfgrass Research Center on the Michigan State University campus. *Agrostis palustris* "Penncross" was established at the site. Two cultivation machines were used; the first, a Toro Greens Aerifier (Minneapolis, MN) using 3/8" (0.95 cm) tines and 2" x 2" (5.1 x 5.1 cm) spacing had a width of 27" (68 cm). Second, a Graden cultivation machine (Victoria, Australia) with vertical blades had a band width of 17" (43 cm) wide. There are 12 blades measured to 2 mm thick with 1" (2.5 cm) spacing in between each blade. The depth of the Toro aerifier was at 3" (7.6 cm), and the depth of the Graden was at 1" (2.5 cm) for the first two applications. The treatments consisted of a check (no cultivation), aerified with the Toro once (T1), aerified with the Toro twice (T2), aerified with the Graden once (G1), and aerified with the Graden twice (G2). Treatments were applied on 14 August, 2001, 21 May and 2 September 2002. Grass, plugs and soil debris were removed and then the treatments were topdressed and dragged in. Mowing height was maintained just above 1/8" (135 mm) throughout the study. Fertility, additional topdressing and IPM practices were applied on an as needed basis.

Organic matter content was evaluated on 19 September 2001 and 3 October 2002 at depths of 0 - 0.5", 0.5 - 1.0", and 1-2" (0 - 1.27 cm, 1.27 - 2.54 cm and 2.54 - 5.08 cm). The soil probe had a diameter of 0.75" (1.9 cm). Organic matter was determined by weight through loss by ignition (MSU Soil Laboratories, 2002). Infiltration rates were recorded on 10 September 2001 and 10 October 2002. The double ring infiltrometer test was conducted using a constant head with the outside ring having a diameter of 8.9" (22.7 cm) and the inside ring having a diameter of 4.9" (12.5 cm).

Results and Discussion

Organic matter content was not significant on both dates except at the 0-1.27 cm depth on 3 October (Table 1). However, it was measured and observed that the organic matter layer was

decreasing with the Graden treatments versus the core cultivation and check treatments. Therefore sampling procedures for this study do not demonstrate significant differences with the data. Two factors play a role here; first, more extensive sampling as well as increasing the number of subsamples, and second, the data reflects only three treatments in a 14 month window. Thus, it is surmised over time, significant differences among the treatments would take place.

In Table 2, infiltration rates were not significant on 10 September 2001 but were significant on 10 October 2002. This is not surprising because the organic matter layer was approximately two inches and the core cultivation tines were able to penetrate to a three inch depth. As sand gets back-filled into the holes, a continuum of sand is formed between the surface and the underlying sand profile thus allowing water to move quicker. The Graden blades, on the other hand, were only penetrating down to about 1.5” and were not breaking through the layering problem. However, the cultivation treatments did show a trend of infiltration rates improving with time.

Table 1. Organic matter content measured on a putting green at the Hancock Turfgrass Research Center, East Lansing, MI .

	19 September, 2001				3 October, 2002		
Depth (cm) -->	0-1.27	1.27- 2.54	2.54- 5.08		0-1.27	1.27- 2.54	2.54- 5.08
	---- % ----						
Treatment							
Check	13.2	4.5	1.4		5.9	10.7	4.3
Core 1X	9.7	7.3	1.7		4.2	10.7	4.9
Core 2X	13.6	9.0	1.0		4.1	10.7	5.7
Graden 1X	12.5	5.3	0.8		8.0	14.4	1.8
Graden 2X	11.5	3.8	0.8		7.1	9.2	1.8
LSD (0.05)	NS	NS	NS		1.7	NS	NS
NS – not significant							
Significance at the 0.05 level							

Table 2. Infiltration rates (cm/hr) measured on a putting green at the Hancock Turfgrass Research Center, East Lansing, MI.

	10 September, 2001		10 October, 2002
	---- cm/hr ----		
Treatment			
Check	3.1		4.5
Core 1X	5.5		12.3
Core 2X	4.3		19.8
Graden 1X	3.4		9.3
Graden 2X	2.8		8.8
LSD (0.05)	NS		6.8
NS – not significant			
Significance at 0.05 level			

Take Home Message

Currently, our discussion is limited with our comparisons due to the shortness of the experiment. We have only cultivated three times at the time of this publication. However, we would anticipate seeing some significant results and notable trends in the upcoming year with our organic matter and infiltration data. Although the Graden can be labor intensive in cleaning up debris (due to debris being scattered versus “nice” clean plugs), in theory, you disrupt twice as much surface area with one pass versus a core cultivation pass. A smoother putting surface can result after use of the Graden as well. The Graden has uses for any sand-based root zones albeit greens, tees, sports fields, etc. just as much as core cultivation. If the golf course superintendent or sports field manager is in a curative basis, core cultivation and Graden cultivation will complement each other and should be rotated every 7-10 days pending on growth, time of year and depth of the Graden blades. If on a preventative basis, the Graden or core cultivation are excellent tools for controlling organic matter content and improving water moving through the soil profile. Obviously, topdressing must complement this process in order to improve soil and plant properties.