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Core Cultivation: A Necessary Evil?

There are few practices that turf managers feel are more vital and users of turfgrass areas feel are more disruptive to play than the process of core cultivation. In fact, a 1996 golfer survey conducted by the GCSAA indicated that 77% of respondents ranked "recently aerified greens" as the most bothersome aspect of golf turf management.

Core cultivation is a preferred term to aeration in that cultivation will often improve water movement, which is as or more important than aeration. The aeration concept actually is derived from one of the first mechanical cultivation devices developed by the late Tom Mascaro.

Regardless of semantics, a perennial discussion occurs each year on golf courses throughout the country, among golfers and turf managers, on the essential nature of cultivation. "Can it be after the Labor Day tournament?", "Do we have to do it every spring?", "The golf season is short and aeration disrupts the surface for a month." Many superintendents hold firm, some are flexible, others stop altogether.

Kurt Theummel at Walnut Hills Country Club in East Lansing, MI has not aerified his greens for almost 20 years. "Why should I aerify if my greens are in good shape, I don't have thatch accumulation, and I don't have compaction?" All good questions that beg other questions regarding why as an industry we are so committed to core aerification?

Why Cultivate?

Core cultivation has been the primary means of managing the inherent traffic a turf receives and the subsequent soil compaction that is typically confined to the upper few inches. Soil compaction is defined as the pressing together of soil particles into a more dense soil mass. The degree of compaction is often determined by measuring the soil bulk density.

Bulk density is simply the dry weight of the soil particles contained in a specific volume, reported as grams per cubic centimeter (g/cc). The more particles crammed into a specific volume, the less pore space, the higher the bulk density, and consequently the less air-filled porosity (aeration).

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This Times

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Core Cultivation

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Interestingly, the increased adoption of sand based root zones originated with the thought that properly sized sands would resist compaction. In addition, the high percentage of air filled pores would allow for improved drainage and better root growth. Also, in the last decade there has been an increase in the use of straight sand topdressing.

The question remains, if we have more sand than ever in the greens, and sands are supposed to resist compaction, why are we cultivating so much? Is it from layered profiles that result from poor material specification? Is it due to organic matter accumulation? Is it because of poor quality water that brings particulate matter or possibly calcareous sands that degrade and "plug" pores pace? The answers are yes.

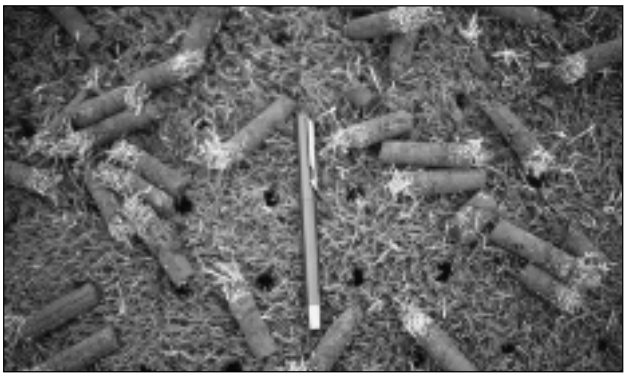
Regular core cultivation is employed to reduce organic matter (OM) accumulation at the surface. The undecomposed or partially decomposed organic matter that is referred to as thatch is thought to be reduced through regular cultivation. This would be accomplished by increasing aeration and mixing soil with OM, thereby enhancing degradation. However, very few studies bear this out.

Art or Science

The science in support of core cultivation has not been consistent. Some have found an increase in water infiltration rates and oxygen levels, others have found decreases. Several researchers have reported no effect on thatch accumulation, other have reported decreases.

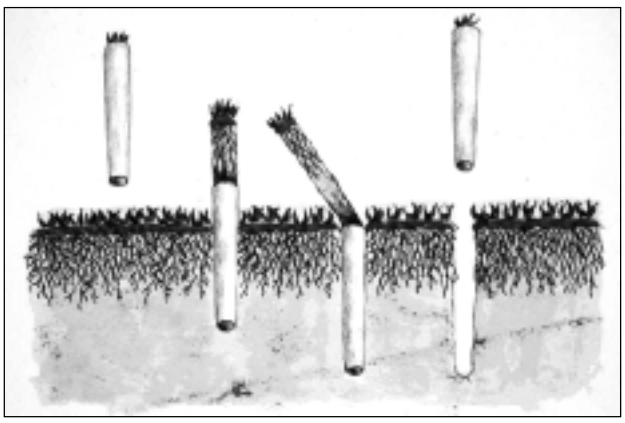
An interesting study conducted in the late 1970's by Marty Petrovic working with Paul Rieke at Michigan State University measured increased compaction around the walls of a soil recently cultivated with a hollow tine unit. They also noted increased compaction at the base of the core that persisted for 90 days. This was the first confirmed report of the development of a "cultivation pan" at the base of the coring operation. As a result of this and others' work, mechanical units that go below the normal 4" depth to break up the compacted pan layer, are more widely used.

Paul Rieke published another important study in 1993 with Jim Murphy of Rutgers University. A loamy sand soil supporting a Penneagle bentgrass putting green was subjected to seven hollow or solid tine core cultivations over a 3 year period. Cultivation had no effect on soil compaction, total porosity, and water infiltration unless significant compaction already existed. Soil strength, a measure of the resistance of the soil and thereby indirectly the compaction level, was decreased (less compact) one week following cultivation. However, three weeks after cultivation, the effect on soil strength had diminished. This point argues for increased frequency of coring operations, but concern remains for the development of a pan layer at the base of the tine depth.



While coring seems drastic, a typical operation affects less than 10% of the surface.

Core cultivation is best accomplished by the removal of a core as opposed to solid tine cultivation.



Organic matter accumulation in the Rieke and Murphy study was not reduced by core cultivation, in fact it actually increased! However, the percentage organic matter per unit of depth did decrease, suggesting a dilution of the OM with the incorporation of soil. This dilution concept

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Core cultivation has been shown to improve water infiltration.

has been enhanced recently by researchers from Penn State and Michigan State universities investigating the influence of topdressing material, frequency, and rate on thatch. While there was no significant reduction in organic matter (OM) from the 100% sand topdressing, when compared to peat and soil treatments, there was a significant reduction when compared to the non-topdressed plot. Coring was not a component of this study, however, if dilution is a primary means of managing thatch, can't we just topdress and skip the aeration?

The Deep

One consistent issue that is evident in golf turf systems is the presence of layered soil profiles. Sometimes these profiles are designed, such as the USGA Method for Putting Green Construction. Also, they occur as a result of changing materials for topdressing, or regular hollow or solid tine cultivation to a consistent depth, or even because organic matter has accumulated at the surface. More important than how they occur is where they occur.

Our research at Cornell University on a sand based putting green has shown that bentgrasses are prolific root producing grasses. In addition, over time the roots continue to be localized at the surface. Any removal of root material or reduction in rooting would be welcome. Unfortunately we have grown accustomed to enhancing root growth as means of improving turf. I wonder if more roots are always a good thing, especially if they are surface roots? Furthermore, if I would rather not core cultivate to disrupt the surface, it appears from previous research that topdressing will work to dilute surface OM accumulation.

But what can you do when the entire profile is compacted very deeply or the layering is below a 4" depth? Deep tine cultivation with the Vert-drain or other mechanical devices, such as the Floyd-Mckay drill that penetrate from 8" to 16", could be effective. There is limited research and what is available suggests that the effects of these processes diminishes from 3 to 8 months after treatment.

Un-Plugged

As long as turf receives traffic, is regularly watered and fertilized, and golf is played on it, the debate will rage on about the importance of cultivation. No reasonable agronomist would categorically eliminate the use of cultivation because each situation is different. For example, if Walnut Hills had exceptionally poor quality irrigation water, not coring would be foolish. Many management considerations must be integrated precisely for "not coring" to be successful.

In the absence of these unique conditions, many new technologies are on the market or coming. The use of high pressure water injection systems introduced by Toro and more recently by Deere and Textron, offer great potential for increased aeration and infiltration with reduced surface disruption. Quad-tine aerification units appear to be less disruptive and are widely used. But why do we always have to make holes?

If we want to get more oxygen into the root zone, why not inject it? This is the basis for the Sub-Air system that pumps various concentrations of oxygen through pipes under the ground. The jury is out on this approach, and clearly what we have to date cannot warrant the expense of retrofitting an existing green.

On the other hand, the solution to the coring controversy is to be clear about the objectives. Is it performed for reducing compaction? Is it for OM accumulation? Is it for overseeding or soil modification? Can any of these be accomplished without severe surface disruption? Should they be? In the end, we know precious little about the dynamics of the golf turf system, let alone the role of a sound cultivation program. Consequently it appears that the debate about this issue will continue.

Frank S. Rossi

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