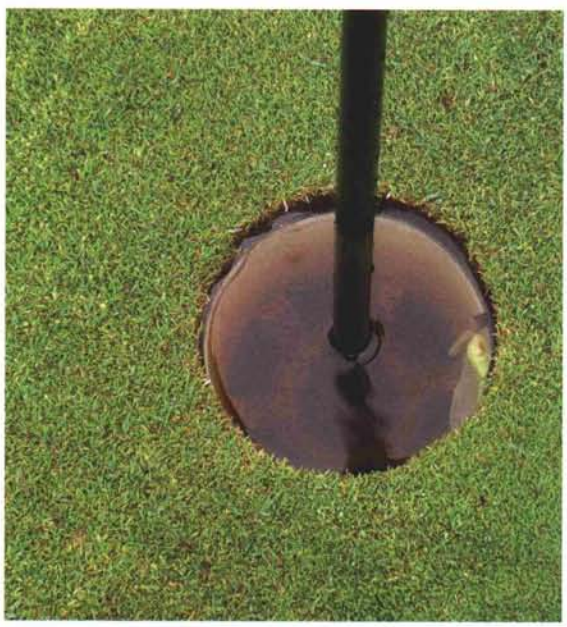
Customized Cultivation

What is the goal of your cultivation program? The most effective long-term benefits are achieved from customized cultivation.

BY BOB VAVREK



Standing water in the hole after moderate to heavy rainfall is an indication that greens would benefit from more aggressive cultivation. Deep-tine or deep-drill cultivation can improve internal drainage through old soil-based greens.

Cultivation . . . the word is derived from the Latin word *cultus*, to till. Cultivating or tilling the land became important long ago when prehistoric people evolved from nomadic hunter-gatherers to farmers. Indeed, cultivation was around long before golf courses. How long? References regarding cultivation can be found very early in the Bible (Genesis 3:23).

There aren't many references made about cultivation in early turf management publications. Authors of the few early references were generally skeptical about the benefits of cultivating established turf due to the potential damage to root systems and disruption of the playing surface.

Over time, the importance of modifying soil structure to improve growing conditions for turf became apparent to astute observers like Tom Mascaro. He invented and patented the first aerifier for turfgrass in 1946 and the verticutter in 1952, tools to remove thatch from greens. The need for more aggressive cultivation equipment coincided with the increasing popularity of golf and heavier play on old soil-based greens. Since then, play and the use of motorized carts have increased dramatically. Consequently, the importance of developing a sound cultivation program is greater than ever.

Today's playing surfaces need to be cultivated for two primary reasons. They are affected either by compaction or excess organic matter (OM) accumulation. When one of the primary problems occurs, many secondary problems are sure to follow. For example, severe soil compaction can lead to weed encroachment, decreased root growth, low soil oxygen, poor drainage, and wet spots. Excess OM can lead to black layer, puffiness, scalping, localized dry spots, footprinting, and shallow rooting.

Turf managers often treat the symptoms of compaction and excessive OM accumulation and tend to ignore the primary problem. For example, raising the height of cut to alleviate scalping across a thatchy playing surface reduces stress to the turf but does not address the problem of excess organic matter accumulation.

COMPACTION

Soil compaction causes an increase in bulk density (mass/unit volume) due to a decrease in soil porosity. Pore space is necessary to get oxygen to the roots, hold water for the turf, and aid rooting. Foot traffic, cart traffic, construction traffic, and maintenance equipment traffic are the common causes of compaction on golf courses.

There is never a shortage of compaction at popular, heavily played courses. When traffic becomes concentrated, compaction increases, particularly when soil is wet. Tees, fairway turf adjacent to bunkers, and turf along the entrance and exits to greens are often affected by compaction. Initial golf course construction and construction associated with renovation will cause localized compaction as well.

Water injection tends to fall in and out of favor among superintendents. Limitations of slow ground speed and short-lived benefits are more than offset by its ability to relieve compaction and enhance water movement through the soil profile while causing relatively little disruption to the playing surface.

EXCESS OM ACCUMULATION

Excess OM accumulation is a common cause for failure of or problems with new sand-based greens.[1] OM is constantly recycled into the upper rootzone of greens when shoots, roots, stolons, and other plant parts die back and are replaced throughout the season. Soil microbes decompose OM and under optimal conditions the rate of OM decomposition can keep pace with the rate of production. However, this rarely occurs on a golf course, where watering, high inputs of nutrients, shade, climate, and other factors either increase tissue production or inhibit microbial degradation.

New ultra-dense varieties of bentgrass and bermudagrass are especially susceptible to excessive OM accumulation due to high shoot density and their ability to grow a deep, dense root system in a sand-based rootzone material. Working topdressing into a tight canopy of turf is a challenge, and much of the sand can be removed with the clippings. Undiluted OM will quickly clog pore space and make the surface of the new greens wet and spongy. Excess moisture at the surface creates playability issues, such as pitted ball marks and footprinting. Secondary concerns include moss/algae encroachment, scalping, black layer, and shallow rooting.

Excess OM is not difficult to diagnose; you can see it and feel it. A discrete dark, spongy layer in the upper soil that holds excess water is hard to miss, yet many turf managers are in denial.

Quantifying the amount of OM in the soil profile is another story. Different labs use different tests and unique methods for preparing a sample. Don't compare the results from one lab to another. However, measuring and comparing the OM content from healthy versus problem greens can be helpful and provide the baseline values needed to monitor the progress that occurs over time when cultivation and topdressing programs are modified.

MAKE THE RIGHT CHOICE

Cultivation can help relieve compaction and manage OM accumulation. The key is to choose the right cultivation tool for the job . . . remember the classic line from the movies — "You don't

bring a knife to a gunfight." Far too often the least disruptive, and least effective, cultivation technique is used to minimize golfer inconvenience, with little chance of addressing the problem. The following outline can help guide you through the process of choosing the most appropriate form of cultivation. Keep in mind that serious problems generally require a serious and often disruptive remedy. OM buildup and compaction usually develop over a period of years, so it takes time for corrective management practices to begin to improve the condition.

OM MANAGEMENT OPTIONS

Highly Effective

Standard ½" - ⅝" hollow-tine cultivation

Advantages

- Removes organic matter from soil profile when cores are removed.
- One pass with ⅝" tines on 1.25" centers affects ≈ 13% of the surface.

Disadvantages

- Temporary surface disruption.
- Significant cleanup.
- Close center cultivation causes surface instability.

Comment

- Topdressing and rolling can alleviate post-cultivation instability.

Deep Scarification (Graden, Sisis, etc.)

Advantage

- Wide blades and close spacing can affect ≈ 11% of the playing surface.
- Removes significant amounts of OM.

Disadvantages

- Labor-intensive cleanup.
- Surface instability.
- Lines in greens distract golfers long after initial turf recovery.

Comment

- Ideal cultivation tool for sodded greens and new sand-based greens where excess OM is located near the surface.

Effective

Carbide-Tipped Vertical Mowing

Advantages

- Capable of removing OM in the upper soil profile while causing minimal surface disruption.
- An excellent pre-treatment for greens before topdressing.
- Useful for management of ultra-dense bentgrass/bermudagrass.

Disadvantage

- Considerable turf thinning/injury.

¼" Hollow-Tine Cultivation (Quadratines)

Advantages

- Removes OM from the upper soil profile.
- Minimal disruption and rapid recovery.

Disadvantage

- Only affects 2% to 3% of the surface, depending on the spacing. Has limited impact with one treatment.

Deep-Tine Cultivation (Hollow Tines)/ Deep Drill

Advantages

- Deeper penetration than standard coring operations.
- Removes minimal OM from the soil profile.

Disadvantages

- Slow recovery following use of large-diameter tines.
- Affects minimal amount of surface.

Comment

- Should not be used as a substitute for standard hollow-tine cultivation where excess OM is a primary problem.

High-tech options for cultivation are great, but don't forget that plenty of simple, inexpensive, and effective cultivation equipment can be found on many courses.

Marginally Effective/Ineffective

Standard Vertical Mowing

Advantage

- Effective pre-treatment to topdressing greens.

Disadvantages

- Limited depth of penetration.
- Removes minimal amounts of OM.

Solid Tine/Water Injection/Air Injection

Advantage

- Can create temporary channels through an OM layer to improve balance of air/moisture in the soil profile.
- Limited to no surface disruption.

Disadvantages

- Does not remove OM.
- Transient benefits.

Spiking

Advantage

- Can improve balance of air/moisture in upper soil profile affected by excessive OM accumulation.

Disadvantages

- Does not remove OM.
- Transient benefits.

COMPACTION MANAGEMENT OPTIONS

Highly Effective

Standard Hollow-Tine Cultivation

Advantage

- Leaving holes open will reduce bulk density when side walls collapse.

Deep-tine aeration is commonly employed across greens, but this operation is just as effective across tees, fairways, and roughs.

Disadvantages

- Relatively shallow depth of penetration.
- Surface disruption.
- Labor-intensive cleanup.
- Potential for hardpan development.

Deep Tine/Deep Drill

Advantages

- Affects soil beyond depth of standard hollow-tine cultivation.
- Adjustable depth of penetration relieves/prevents hardpan development.
- Kicking action of deep tine fractures soil.

Disadvantage

- Limited ability for penetration into rocky soils.
- Slow operation.

De-compactors (Blec Ground Breaker, Verti-Quake, etc.)

Advantages

- 8" depth of penetration.
- Capable of fracturing compacted soils between slits.
- Minimal disruption.

Disadvantages

- Limited availability.
- Limited effectiveness in rocky soils.

Comment

- Good potential for relieving compaction following fairway regrading/renovation work.

Effective

Air Injection Tines (Sisis Aer-Aid System)

Advantages

- 5" depth of penetration.
- Injects air through tines.

Disadvantages

- Availability of equipment.
- Limited effectiveness in rocky soils.

Comment

- New cultivation option from Europe.

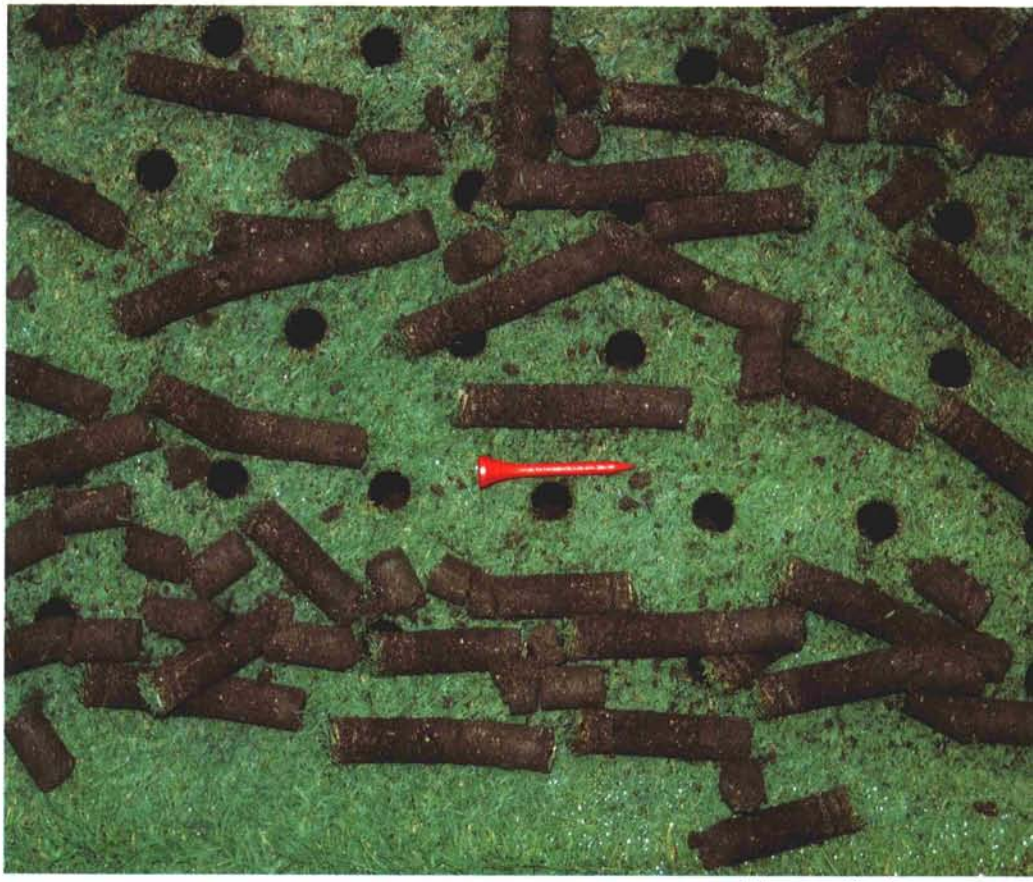
Water Injection/Air Injection

Advantages

- Deep penetration.
- Unaffected by rocky soils.

Disadvantages

- Cost of equipment/contract services.
- Slow ground speed.
- Short-lived benefit.



The most effective way to remove excess organic matter from the upper soil profile has not changed much over the years. Cultivate with hollow tines, remove the cores, and fill the open holes with sand.

Marginally Effective/Ineffective

Solid-Tine Cultivation

Advantages

- Can shatter soil under ideal soil moisture conditions.
- Speed, minimal disruption.
- No cleanup.

Disadvantage

- Potential for hardpan development.

Spikers

Advantages

- Speed and minimal disruption.
- Low-cost equipment.

Disadvantage

- Minimal depth of penetration.

REFERENCES

1. Carrow, R. N. 2003. Surface organic matter in bentgrass greens. [Online] *USGA Turfgrass Environ. Res. Online.* 2(17):p.[1-12].

BOB VAVREK *helps superintendents customize their maintenance operations at courses across Michigan, Minnesota, and Wisconsin.*