Aerification directly reduces organic matter percentages.

ARTICLE AND PHOTOS BY KEVIN J. ROSS, CGCS

THE RIGHT COMBO

Aerification and topdressing provide the best potential for managing organic matter in sand-based greens

Recently, there's been a lot of discussion about organic matter management in sand-based greens, primarily the U.S. Golf Association-specified green. Research has shown controlling the levels of organic matter in greens will have the greatest effect on the quality, performance and longevity of sand-based greens. Therefore, it's understandable that managing organic matter has risen to the forefront of agronomic management programs for greens.

The first step to control organic matter accumulation is to have a basic understanding of its composition and production. It would be misleading to classify organic matter in greens as only thatch. The organic matter zone within a green can be separated into two distinctive groupings or stages.

First, stage one organic matter can be classified as true thatch, which is composed of the initial dead and dying plant tissue. Stage one organic matter is located just below the turfgrass surface. Generally, it makes up about half an organic matter zone.

The second group, or stage two, is a material that's humus in nature. This is material

Sampling all greens on a golf course can determine potential problems with indivdual greens.

that has undergone the entire degradation process. Stage two material is located in the bottom half of an organic matter zone and might be the most important area of this zone. It's composed of much finer textured material, which can cause extensive clogging of pore space within that area of the root zone. Presently, turfgrass researchers are investigating this stage-two layer and are only beginning to understand its dynamics in the performance of greens.

When it comes to organic matter accumulation in a sand-based growing environment, the odds are stacked against a turfgrass manager. When one combines an amazing ability to produce organic matter with a sterile growing medium (sand), accumulation can happen at a rapid rate. Dealing with this sterile, sand-based growing environment also limits the potential speed of organic matter degradation. The faster a plant grows, the quicker organic matter builds up. Therefore, each time turfgrass managers fertilize, it has a profound effect on the plant's growth rate and its organic matter accumulation potential.

As an example, when greens are constructed of an 80/20 root-zone mix, the organic matter content of that initial mix is about 0.7 percent by weight. Researchers have identified that within only a few short years the amount of organic matter skyrockets to a 3- to 4-percent range in the upper surface of a green.

CONTROL

Controlling organic matter accumulation in greens is achieved primarily through two methods: physical removal of the material and dilution of the material. Physical removal involves cultural practices, primarily core aerification and dethatching (liner aeration). Diluting the organic matter is achieved by adding sand via topdressing.

How much aerification is needed to control the buildup of organic matter is something most turf managers have guessed about for many years and really don't have any scientific basis to support their decision. The best information about the degree of aerification needed to control organic matter on sand-based greens comes from Robert Carrow, Ph.D., at the University of Georgia. His work was funded by a research grant from the USGA and is titled "Surface Organic Matter in Bentgrass Greens."

Carrow's research determined that a 4-percent level of organic matter by weight in the upper 2-inch zone is a breaking point for the performance of greens. He cites that a level greater than 4-percent organic matter should send a red flag to golf course superintendents, indicating potential problems could be on the horizon. His work points out, however, that the 4-percent guideline isn't a steadfast rule. Carrow indicates that in cooler climates greens might do fine above 4-percent organic matter. However, it can be especially critical in the southern-most zone where bentgrass can be grown.

This research is significant because it provides superintendents with a number to use

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when designing cultural practices. It can tell a superintendent directly if he needs to be aggressive with an aerification program.

Adopting the 4-percent rule to design aerification programs is simple. First, the percentage of organic matter in the upper 2-inch surface of each green needs to be identified. To accomplish this, samples must be tested by a qualified laboratory. This test is determined in the lab by ignition, and the result is organic matter percentage by weight. The results of this test can tell superintendents exactly how much material, if any, to remove through cultural practices to achieve their desired organic matter percentage level. These actual numbers are something superintendents never had in the past.

DESIRED LEVELS

After the organic matter levels have been identified, it's important for superintendents to set a desired level of organic matter they'd like to achieve. Although Carrow's work identified 4 percent as the possible break point, a desired level should be set lower.

For example, using a level of 3.5 percent as a targeted value is probably a good option. The organic matter reduction formula example (see figure 1) can be used to calculate the amount of surface area removal/impacted needed. In the example, a fictitious 4.49 percent organic matter tested result value is used. This tested result (4.49 percent) is subtracted from the desired value (3.5 percent) to calculate the percentage amount above the desired level (0.99 percent). Then, calculating the surface area removal/impacted needed is determined by setting up a fraction. The example shows that to achieve the desired level, 22 percent of the surface area needs to be removed.

It's important to note all greens may or may not need this amount removed. On most golf courses, all greens don't have the same environmental growing conditions, and therefore, most likely have different percentages of organic matter. If a superintendent adopts the 4-percent guideline, it might be important to analyze each green individually. This can help identify individual green problems and might lead superintendents to consider the aerification needs of individual greens, instead of lumping them together as a whole.

AERIFICATION

Once the removal amount is known, it's possible to calculate how much aerification is needed. When the amount of removal is high, it might be desirable to achieve that level using multiple cultural practices. It's also important to take into consideration the health of the greens. Healthy greens can withstand much more impact than weaker greens during a single cultural practice. There's also a limit of maximum removal based on cultural practice equipment.

To calculate how much material should be removed by aerification, two factors are needed. First, to calculate the surface area removal/impacted, calculate the area of the tine-spacings used (see figure 2). For example, if the spacings on a machine are 2 inches by 2 inches, then 4 square inches would be impacted. Or, if 1-inch-by-1-inch spac-

Figure 1

Organic matter reduction formula

Organic matter tested result
− Desired organic matter level
= Amount above level

4.49% OM tested
− 3.5% OM desired
= 0.99% above level

Amount above level ÷ OM tested result
= Amount of surface area removal/impacted (SARI) needed

0.99 ÷ 4.49 = 22% SARI Needed

Figure 2

Calculating surface area removal/impacted

Base the calculations on the area of one tine.

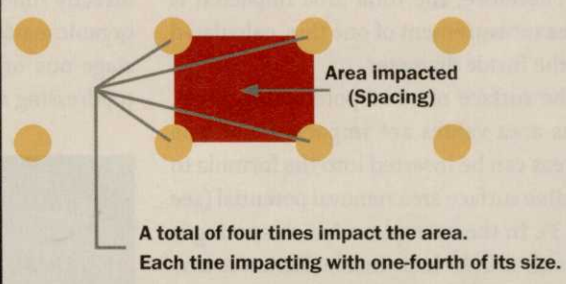


Figure 3

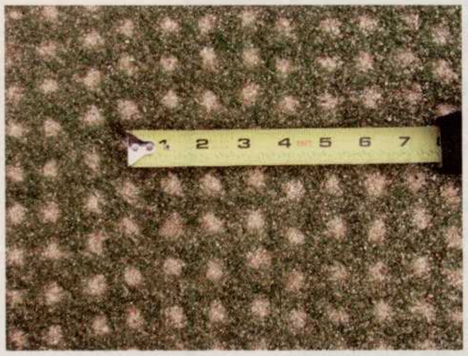
Surface area removal potential formula

ID area of one tine (area of a circle = $(3.14) \times (\text{radius})^2$ ÷ Square inches from spacing used.

Example below uses 1-inch x 1-inch spacings, with an inside diameter tine measuring 0.40 inch

$(3.14) \times (0.20)^2$ = 0.125 square inch ÷ spacings 1 inch x 1 inch = 1 square inch

0.125 square inch ÷ 1 square inch = 12.5% SARP



Close spacings offer the greatest surface removal potential.

ings were used, then one square inch would be impacted.

The second factor is determining the inside diameter of the tine used, or needed to be used, to reach the correct removal potential. With square spacings, four tines impact the area with one-fourth of each tine hitting the area. Therefore, the total area impacted is the area measurement of one tine, calculated using the inside diameter.

In the surface removal potential formula, various area values are impacted and tine size areas can be inserted into the formula to determine surface area removal potential (see figure 3). In the example, a 1-inch spacing is used with a 0.40-inch inside diameter tine measurement. This equates to a 12.5-percent surface area impacted potential. Remembering the previous test example, it would take two aerification events using the example set-up to lower the organic matter 22 percent.

TOPDRESSING

Sand topdressing also is an important part of managing organic matter build-up. Topdressing sand filters into stage one organic matter, with the end result having a diluting effect on the material. The dilution of this organic matter helps keep porosity levels sufficient for proper greens performance.

How much topdressing is needed to help keep the organic matter content below the 4-percent threshold? Some have suggested applying sand at a rate of about 50 cubic feet per 1,000 square feet per year. This said, there are two important factors that should be thrown into the equation before considering 50 cubic feet of sand per thousand as the all-important amount.

First is the length of the growing season. Some parts of the country have a growing season as short as three to four months, and other parts have a 12-month growing season. Should both these areas of the country be on a 50-cubic-feet-per-1,000-square-foot rule?

Secondly, and maybe more importantly to a topdressing program, is the plant growth rate. Remembering the most important fundamental aspect about topdressing, applications should be directly proportional to the plant's growth. The plant's growth directly influences the amount of stage one organic matter produced. Therefore, to dilute stage one organic matter with best results, topdressing volumes and frequencies should be increased as the growth rate increases. The same applies to the plant when growth decreases – topdressing volumes and frequencies should be decreased.

Topdressing has become more of a calendar cultural practice recently, instead of a true agronomic cultural practice.

BOTH ARE KEY

Even though sand-based greens have been around for many years, it seems we're still trying to understand the complexities of managing them, especially regarding organic matter. When it comes to core aerification and topdressing, neither is more important than the other. However, one thing is certain: The net effect of both practices combined will give superintendents the best potential for managing organic matter build-up and maintaining successful greens performance. GCI

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Diluting organic matter through sand topdressing is just as important as aerification or dethatching.