

Light and Frequent Topdressing Programs

A combination of field observations and recent research shed new light on the type of sand and quantity of topdressing needed to manage thatch and organic matter accumulation in putting greens.

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Visible water squeezed from a putting green's surface layer is a good indication that more sand is required to dilute thatch and organic matter.

Sand topdressing is one of the most important practices for producing smooth putting surfaces and diluting thatch and organic matter. Despite this fact, some courses only apply sand during aeration or infrequently during the golf season to avoid disrupting golfers and dulling mower blades and bedknives. The consequences of an inadequate topdressing program may not be observed immediately, but eventually there will be significant negative impacts on playability and turf health. This article will provide recommendations on sand selection, topdressing rates, and application

frequency to help ensure that your topdressing program delivers the best results.

WHAT HAPPENS WHEN GOLF COURSES DON'T APPLY SAND TOPDRESSING?

In the absence of adequate sand topdressing, putting greens accumulate excess thatch and organic matter. This results in soft, spongy surfaces that retain elevated levels of soil moisture. Putting surfaces of this nature are also susceptible to mower scalping and disease problems. Footprints, tire tracks from maintenance equipment,

and deep ball marks are also problematic on soft greens. An infrequent sand topdressing program also creates distinct layers of sand and organic matter, which restricts water movement, oxygen diffusion, and root development.

WHAT IS THE GOAL OF A SAND TOPDRESSING PROGRAM?

Everyone agrees that putting greens are the most important playing areas of any golf course. Maintaining smooth, firm but receptive, healthy greens with good pace is of paramount importance. A regimented sand topdressing pro-



These creeping bentgrass greens were core aerated twice annually but received relatively infrequent topdressing. Organic matter accumulation caused soft conditions and localized dry spot.



Two growing seasons after initiating a topdressing program that applied no less than 30 cubic feet of sand per 1,000 square foot annually, organic matter has decreased by 30 percent and surface performance has improved significantly.

gram that considers the sand type, application rate, and frequency is essential to achieve optimal playing surfaces.

Creating and maintaining a surface zone comprised of intermingled sand and organic matter is ideal for providing smooth, firm putting surfaces that hold up well to traffic. Additionally, greens that contain a healthy mixture of sand and organic matter will dry more evenly than greens containing excess thatch and organic matter. This means less localized dry spots and hand watering.

ASSESS ROOTZONE PHYSICAL CHARACTERISTICS

Before selecting an appropriate sand for topdressing, it is critical to identify the physical characteristics of the existing rootzone material and evaluate the performance of the greens. There are a number of questions to answer in this process. Is there excess organic matter near the surface? Do the

greens contain excess fine material, such as silt and clay? Do the greens hold too much or too little water? Do the greens rut when driving a riding mower or sprayer across the surface? Are the greens too firm or too soft? Is there an abundance of deep ball marks on greens?

While light and frequent sand topdressing will benefit all courses, some circumstances will require an accelerated program to improve rootzone conditions and playability. Field observations have revealed that significant improvement in turf performance and playability can be achieved in as little as 12-18 months if adequate sand is applied to dilute thatch and organic matter.

SAND SELECTION

Selecting the appropriate sand for routine topdressing and aeration begins with identifying the particle size range that will produce the desired outcome. The primary goal for any

sand topdressing program is to dilute organic matter and produce smooth, firm putting surfaces while minimizing golfer and mower impact. Additional considerations include sand shape and mineralogy, cost, consistent quality, and long-term availability.

Field observations and research demonstrate that two or more sand materials can provide an effective greens topdressing program. One type of sand can be used for aeration and topdressing when playability is not a priority — e.g., using a coarse sand to topdress greens prior to winter dormancy or during overseeding. Another, less-coarse sand could be used for routine topdressing when minimizing disruption to playability is important. Concerns with using two different sand materials for topdressing greens will be discussed later in this article.

Aeration sand — Sand used to fill aeration holes should closely match the physical characteristics of the sand used to construct the greens, assuming

the greens were built according to USGA recommendations or there is confirmation that the rootzone mix has desirable physical performance characteristics. For more information on selecting a rootzone material for putting greens, read the [USGA Recommendations for a Method of Putting Green Construction](#). For native soil greens, it is often recommended to use sand that is coarser than the existing rootzone material to improve aeration porosity and water infiltration.

Routine topdressing sand — Historically, the industry has worked under the notion that the physical characteristics of topdressing sand should closely match sand used to construct greens. While this philosophy remains sound, research and field

observations have revealed that golf courses can use sand with fewer coarse particles without compromising the integrity of the greens. Courses in the southeastern United States have recognized this and have been using less-coarse sand for topdressing for more than 20 years with good success. Until only recently, researchers have more closely examined the impact on putting green performance when using sand containing fewer coarse particles than the existing rootzone.

Sand used to routinely topdress putting greens can be less coarse than the sand used to fill holes during aeration. A general guideline is to select a sand that has a minimum of 50 percent of its particles in the medium-sized fraction (0.25-0.50mm

in diameter) and 15 to 40 percent in the coarse fraction (0.5-1.0mm in diameter). The fine sand fraction (0.15-0.25mm) should not exceed 25 percent, and the very fine fraction (0.05 - 0.15mm) should not exceed 5 percent. Ideally, the material should have no particles greater than 1.0 mm in diameter, given the difficulty in getting these larger particles to work down into the turf canopy. It is recommended to use a material with a coefficient of uniformity (CU) greater than 1.8. If the sand is too narrowly graded, which will produce a low CU, this may result in soft, unstable surfaces. However, the CU is not the only determining factor in stability — sand shape also plays a role, with angular sands being more stable. Utilizing a



A drop-style topdresser can deliver sand to the putting surface with high precision. This operator is applying 1 cubic foot of sand per 1,000 square feet.

TABLE 1

Sand size distributions of the three topdressing sizes, mat layer, and the underlying rootzone at the initiation of the experiment; USGA construction recommendations provided for reference (reproduced from Murphy et al., 2019).

Topdressing Sand Size	Particle Diameter (mm)/Size Class				
	2.0 - 1.0 Very Coarse	1.0 - 0.5 Coarse	0.5 - 0.25 Medium	0.25 - 0.15 Fine	0.15 - 0.05 Very Fine
	% Retained (by weight)				
Medium-Coarse	0	33.8	57.7	8.4	0.1
Medium-Fine	0	0.1	76.7	22.7	0.5
Fine-Medium	0	5.7	25.8	66.8	1.7
Mat Layer †	0.2	25.3	56.4	15.4	2.7
Rootzone	7.0	25.8	45.5	17.5	4.2
USGA Construction Recommendation	≤ 10	≥ 60		≤ 20	≤ 5

† Size distribution of sand in 45 core samples of the mat layer collected before the initiation of treatments in May 2016.

coarser sand during aeration will create more stability.

Fear of layering — Topdressing with sand with few or no particles greater than 1mm in diameter and only 10 to 40 percent in the coarse sand fraction (0.5-1.0mm) is not a concern. Removing this larger sand fraction will not create agronomic problems such as increased moisture retention and reduced infiltration rate. However, topdressing with sand with greater than 25 percent fine material (0.15-0.25mm) could potentially lead to increased moisture at the surface of the greens. Superintendents are encouraged to collect soil cores and analyze for physical characteristics every few years to monitor putting green performance.

Mineralogy — While silica sands containing predominantly quartz and feldspars are most desirable due to their high tolerance to weathering, calcareous sands have been used successfully for many decades. However, it is recommended to avoid sand containing very high levels of calcium carbonate — i.e., limestone — such as coral sands.

Cost — The cost of quality topdressing sand for greens ranges considerably throughout the U.S. While some courses will pay \$100 or more per ton of sand, the cost is worth every penny

if this material makes the difference between good and great putting surfaces.

WILL TOPDRESSING WITH TWO DIFFERENT SAND MATERIALS CAUSE POOR WATER INFILTRATION OR INCREASE SOIL MOISTURE RETENTION?

Researchers at Rutgers University are experimenting with topdressing sand much finer than described in this article to investigate whether there would be any negative impact on a creeping bentgrass green (Murphy et al., 2019). The finest material used in this study contained 69 percent fine sand (0.15-0.25mm) and was referred to as the fine-medium sand in Table 1. The medium-fine sand contained 23 percent fine particles and 77 percent medium particles, and the medium-coarse sand contained only 8 percent fine particles and 58 percent medium particles. Although soil moisture content has increased with the fine-medium sand compared to topdressing with coarser materials, plots topdressed with the fine-medium sand have had lower soil moisture content when compared to plots that have never been topdressed. Furthermore, when core aeration is applied to the fine-medium topdressed plots and aeration holes

are filled with the medium-coarse sand, the infiltration rate and soil moisture retention have been similar to that of the plots topdressed with coarser materials and not core aerated. Therefore, the preliminary results of this research indicate that topdressing with a much finer material than described in this article is better than no topdressing at all. Additionally, any reduction in infiltration rate associated with using the finer sand can be offset by aeration and filling the holes with a coarser material. This Rutgers study is confirmation for superintendents using two different sand materials for topdressing greens — one for routine topdressing and a coarser material that matches the existing rootzone to fill holes following aeration.

For the management of ultradwarf bermudagrass greens, a current study conducted at Texas A&M University is evaluating the impact of sand topdressing with fewer coarse particles than that used to construct the greens (McInnes et al., 2019). Researchers are using rootzone characteristics such as sand particle size, organic matter content, and bulk density from multiple greens on nine golf courses to predict soil moisture content and field-measured infiltration rate. Modeling efforts are ongoing, but some information can be gleaned from preliminary

data. As expected, infiltration rate generally decreases with decreasing particle size and increasing organic matter content, though there are outliers. Even so, the infiltration rate of the majority of sampled greens meets or exceeds the minimum recommendation of six inches per hour, and the putting greens are performing well. These preliminary results indicate that desirable infiltration rate and surface moisture content can be maintained with the use of medium-graded topdressing sands.

WHY REMOVE THE LARGER SAND PARTICLES?

Large sand particles create playability and mower problems. A Rutgers University study on creeping bentgrass putting greens revealed that the particle size of the topdressing sand significantly impacted the size of the sand harvested in mower baskets when mowing the day after topdressing (Murphy et al., 2019). On average, approximately 60 percent of the sand in mower baskets fell in the coarse sand fraction (greater

than 0.5 mm) when using the medium-coarse sand (the medium-coarse sand contained approximately 34 percent coarse particles and 58 percent medium-sized particles) for topdressing. By comparison, less than 10 percent of the sand found in mower baskets consisted of coarse particles when topdressing with the medium-fine sand (0.1 percent coarse particles and 77 percent medium particles). Clearly, the coarser the sand, the more sand will be harvested by the mower. The particles picked up will also be the larger-sized particles — those that have the greatest impact on playability and mowing equipment.

Interestingly, the Rutgers study, as well as two recent studies at Michigan State University and the University of Tennessee (Strunk et al., 2018; Dickson et al., 2019), found that mowers collect 1-5 percent of the sand in a single mowing one or two days after topdressing. More sand will be harvested with subsequent mowing, especially if topdressing occurs every few weeks as recommended in this article. The

fact remains that applying larger sand particles will lead to more sand harvesting by mowers, increased equipment maintenance, and more negative impact on the putting surfaces.

APPLICATION RATE AND FREQUENCY

There are two important rates to consider in a topdressing program: the sand application rate for each topdressing event and the annual rate achieved from the sum of all topdressing events, including sand applied to backfill aeration holes. The rate for an individual event must be considered simultaneously with application frequency because these factors are inversely related. As application frequency increases, the topdressing rate needed for each application decreases. The benefits of lighter rates include ease of application and incorporation, and reduced mower wear. Perhaps the greatest benefit is less disruption to the playing surface when compared to heavier sand application rates. In fact, one can argue that greens will be



The medium-coarse sand topdressed plot on the left has significantly better turf density and lower surface moisture than the core-aerated, non-topdressed plot on the right, which is has darker green color due to surface algae.



Light topdressing rates of 0.50 to 0.75 cubic feet of sand per 1,000 square feet are used during periods of minimal growth.

smoother and offer a better playing surface on the day of topdressing if the right sand is applied at a light rate.

ANNUAL TARGETS

Planning to reach a predetermined amount of sand for the season is a

good place to start with rate and frequency considerations. The goal is to match the growth rate of turf to dilute organic matter that accumulates throughout the season. In search of a benchmark, researchers from the University of Nebraska surveyed 308

putting greens on 104 different U.S. golf courses. They determined that putting greens receiving at least 20.3 cubic feet of sand per 1,000 square feet per year accumulate less organic matter (Schmid et al. 2014a) than courses topdressing with lower annual amounts. In a related experiment, the same research group tested the effects of various cultivation strategies on organic matter accumulation but observed no differences among cultivation treatments (Schmid et al., 2014b). All cultivation treatments in the study, including an uncultivated control, received 22 cubic feet of sand per 1,000 square feet per year, and the researchers concluded that the benefits of their topdressing program partially limited their ability to detect differences among cultivation treatments. Trends observed by USGA agronomists suggest that 25 to 35 cubic feet of sand per 1,000 square feet per year is a good annual target to adequately dilute organic matter. Depending on the other factors described below, more or less than this range may be appropriate.

Why the disparity between current research and industry trends? The answer to this question is complex. The basic premise is that the 20.3 cubic feet of sand per 1,000 square feet per year from survey data is essentially an average of the minimum annual rate that was related to lower organic matter concentrations among golf courses. This amount is an average from 104 golf courses in 14 states with diverse turf maintenance programs. Optimal annual topdressing rates don't directly translate across golf courses, especially across different regions.

Optimal topdressing rates are most dependent on the length of the growing season and quality of the growing environment. The turfgrass species and cultivar, nitrogen fertilization program, and traffic intensity also determine how much sand is needed annually. Turfgrass growing in an ideal environment over a long season with plenty of nutrition and few stresses, like shade and traffic, will produce more organic matter and subsequently require more topdressing. However, turfgrass under stress for any reason

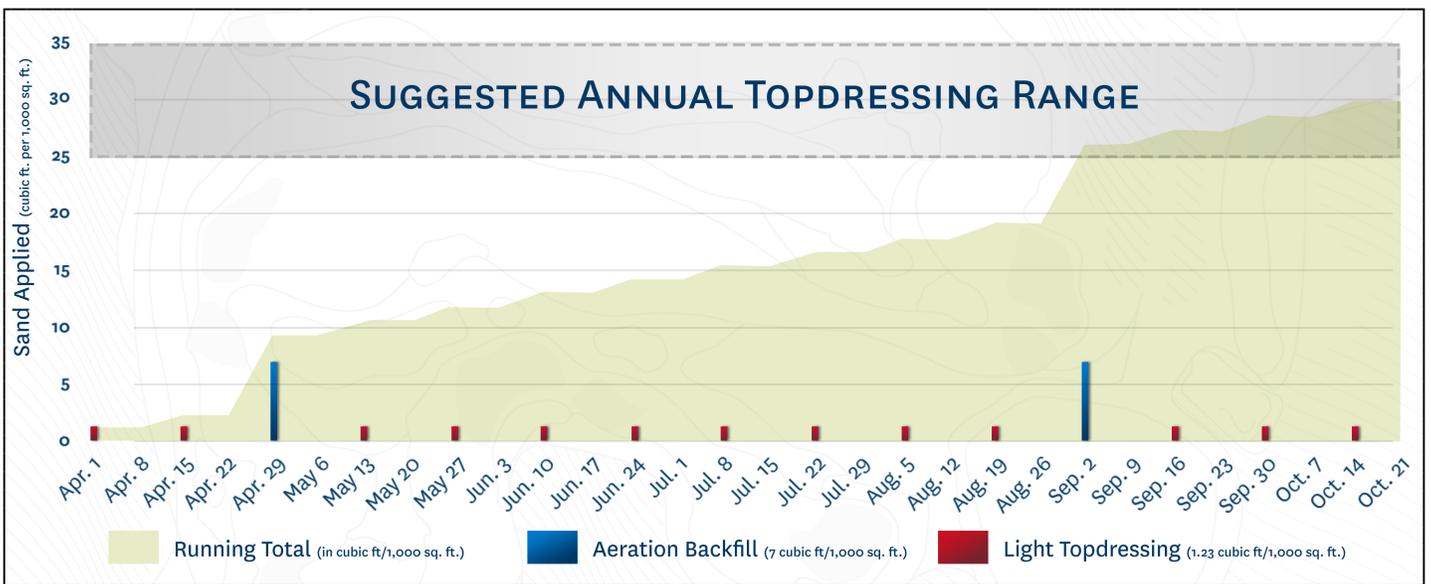


Figure 1. An example of a light, frequent topdressing program designed to achieve an annual topdressing rate of 30 cubic feet per 1,000 square feet for a course with a 30-week growing season. The suggested annual topdressing range (gray box) is based on off-field observations and research for both cool- and warm-season putting greens.

or grown over a shorter season will require less annual topdressing. Regarding species, 79 percent of surveyed superintendents who have converted putting greens from creeping bentgrass to ultradwarf bermudagrass report using more sand with ultradwarf bermudagrass (O'Brien and Hartwiger, 2014). So, an annual rate of 20.3 cubic feet is a starting point and may be sufficient in some situations. However, in other settings, more sand is typically required on an annual basis to mitigate organic matter accumulation.

THE IMPORTANCE OF FREQUENCY

Around the turn of the 21st century, a standard topdressing strategy was to apply 2 to 4 cubic feet of sand per 1,000 square feet every three to four weeks during the growing season (Rieke, 1999). Lower rates and higher frequency were recommended for high-density cultivars or stressed areas. However, the previously mentioned survey data show that surveyed golf courses that cultivated at least twice a year and topdressed every 7 to 14 days had lower organic matter concentrations (Schmid, et al. 2014a). Topdressing every 7 to 14 days also is more common in successful ultradwarf bermudagrass putting green management programs (Lowe, 2013; O'Brien

and Hartwiger, 2014). To follow these recommendations, what topdressing rates would be required to reach the annual topdressing guideline of 25 to 35 cubic feet of sand per 1,000 square feet per year?

First, we should account for sand incorporated during aeration. An estimated 5 to 7 cubic feet of sand per 1,000 square feet is required for backfilling aeration holes, depending on overall surface disruption from tine size, spacing, and depth. Given this, a golf course that backfills two aerations annually could apply 14 cubic feet of sand per 1,000 square feet during aeration. During a 30-week growing season, assuming light topdressing is withheld the weeks immediately before and after aeration, 16 more cubic feet of sand per 1,000 square feet still would be needed over the remaining 24 weeks to reach 30 cubic feet per 1,000 square feet for the season (the middle of the suggested range). If remaining topdressing applications were conducted weekly, only 0.67 cubic feet of sand per 1,000 square feet would be required each week. The necessary rate would increase to 1.23 cubic feet per 1,000 square feet with a 14-day topdressing schedule (Figure 1).

It's often most manageable to determine a rate and frequency for each topdressing event based on

annual goals and stick with that plan unless adjustments are needed to match growth and organic matter accumulation. A rate of 0.5 to 1.5 cubic feet of sand per 1,000 square feet is generally a good range. Rates will likely be on the higher end during higher growth periods and lower when growth slows or when turf is stressed. A good rule of thumb is to delay a scheduled topdressing or reduce the planned rate if significant sand is still visible from the prior application.

In situations where the soil profile is already ideal, some superintendents effectively manage organic matter only with frequent topdressing and no core aeration. In the absence of core aeration, it is critical that golf courses meet or exceed the annual guideline of 25 to 35 cubic feet of sand per 1,000 square feet.

MINIMIZING SAND HARVESTING

Light sand topdressings can be effectively brushed, rolled, or irrigated into the turf canopy. Still, recent research has shown that mowing practices affect sand harvesting even with brushing after topdressing. Backtrack mowing — i.e., two passes in opposite directions over the same area — at a standard frequency of clip or increasing the frequency of clip during a single

pass, harvested the most sand following topdressing on both creeping bentgrass and ultradwarf bermudagrass putting surfaces (Strunk et al., 2018; Dickson et al., 2019). Cross cutting — i.e., mowing a putting green twice in perpendicular directions — at a standard frequency of clip also collected more sand than a single pass at a standard frequency of clip in the ultradwarf bermudagrass study, but not in the creeping bentgrass study. As a result, backtrack mowing and increasing the frequency of clip should be avoided following topdressing to reduce sand harvesting and wear on mowers. Additionally, it is helpful to note the amount of sand collected and adjust topdressing rates or incorporation practices if necessary.

CONCLUSION

Sand topdressing is the most important cultural practice for managing organic matter. Recent research confirms the benefits of light and frequent sand topdressing programs that provide less immediate disruption, better playing conditions, and better rootzone characteristics over time. It is critical to assess putting green performance and the quality of the rootzone to determine if circumstances warrant an accelerated program for improvement beyond what is possible with light and frequent topdressing. Regardless of the selected topdressing program, silica sand is preferred because of its tolerance to weathering. Aeration backfill should closely match the physical characteristics of the sand used at construction, but routine topdressing sand can be somewhat less coarse to ease incorporation and reduce wear on mowers. Ongoing research suggests that this will not impede infiltration or cause an

overly wet surface. Regardless of the selected topdressing program, it is wise to assess rootzone physical properties regularly by submitting core samples to a soil-testing laboratory.

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