

Sand under the microscope

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Sand quantity

Managing Organic Matter in Putting Greens

Effectively managing organic matter will help create the firm and smooth putting greens that golfers have come to expect.

BY ADAM MOELLER AND TODD LOWE

Soft playing conditions, deep ball marks, inconsistent green speed, and bumpy putting surfaces frustrate golfers and golf course superintendents. If golfers and superintendents both want firm and smooth putting greens, why do some facilities struggle to achieve these conditions? Putting greens might be temporarily soft or inconsistent for many reasons, such as recent rainfall, but when there are chronic issues the underlying problem is often excessive organic matter just beneath the putting surface.

Core aeration, verticutting, and topdressing are the primary agronomic practices used to manage organic matter, but they are disliked by most golfers. The choice for superintendents is a difficult one: Upset golfers by failing to produce the desired playing conditions, or upset them by occasionally implementing disruptive programs that are necessary to produce the desired conditions. Since course conditioning



“the underlying problem is often excessive organic matter just beneath the putting surface. Core aeration, verticutting, and topdressing are the primary agronomic practices used to manage organic matter, but they are disliked by most golfers.”

Moeller & Lowe, 2016

“There are many agronomic programs that influence the playability and health of putting greens, but organic matter management is arguably the most important.”

Moeller & Lowe, 2016

“In general, organic matter accumulates when programs that dilute organic matter are not keeping pace with organic matter production.”

Moeller & Lowe, 2016

“0.5-1.5 cubic feet per 1,000 square feet every 7-14 days effectively dilutes organic matter throughout the growing season”

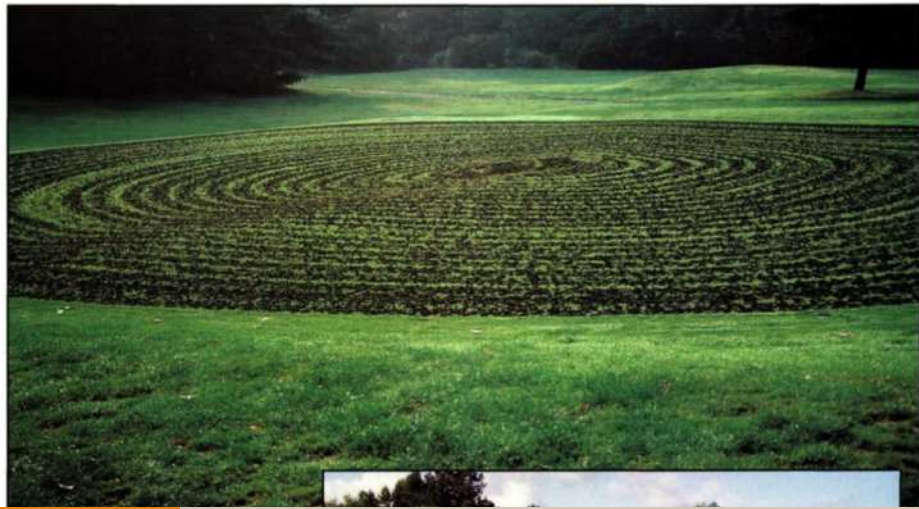
Moeller & Lowe, 2016

That is 0.15 to 0.45 mm of sand every 7 to 14 days. That's 2,400 to 7,200 kg/ha every 7 to 14 days.

CORE AERATION BY THE NUMBERS

Explaining the need for aeration is often easier if you use specific numbers.

by CHRIS HARTWIGER and PATRICK O'BRIEN



“To keep organic matter content below 3-4 percent in the upper rootzone, these articles recommend core aeration treatments that impact 15-20 percent of the putting surface each year and topdressing programs that incorporate at least 40-50 cubic feet of sand per 1,000 square feet annually.”

Moeller & Lowe, 2016

That's 12 to to 15 mm of sand per year. That's 190 to 240 tons/ha per year.

Another recommendation

“Increasing sand topdressing frequency to every 7 to 14 days and applying at least 20.3 ft³/1000 ft² topdressing sand annually, combined with routine soil cultivation to ensure sand incorporation, are practices that can be utilized to manage SOM.”¹

That's 6 mm sand per year. That's 100 tons/ha per year.

¹Schmid C.J., Gaussoin R.E., and S.A. Gaussoin. 2014. Organic matter concentration of creeping bentgrass putting greens in the continental U.S. and resident management impact. *Applied Turfgrass Science*.

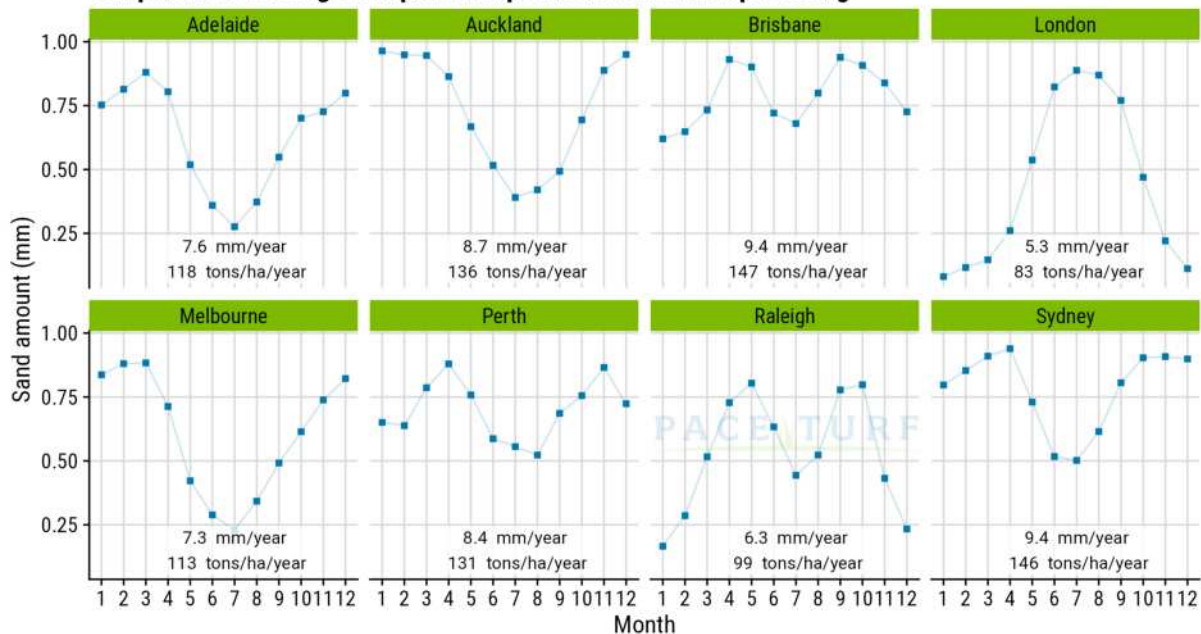
Another recommendation

“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.”²

That's 8–11 mm sand per year. That's 120–170 tons/ha per year.

²Whitlark, B. and C. Thompson. 2019. USGA Green Section Record.

Temperature-based growth potential prediction of sand topdressing



Sand topdressing to clipping volume ratios

OM246 sand Clipping topdress turf math

Micah Woods

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In 2020 I suggested that adding 1 mm of sand (see [conversions to common units here](#)) for every 1 L/m² of clipping volume might be a topdressing rate that would keep OM246 constant.

Since then, I've studied—at multiple golf courses—how much sand has been applied, how many clippings have been collected, and how the OM246 test results have changed. It turns out that the 1:1 ratio of sand added for clippings removed isn't enough, at most places, to keep OM246 constant. If you add the 1:1 ratio, OM246 will tend to increase.

It finally occurred to me why this is. The amount of organic material we start with in the rootzone plays a significant role in how much sand is required to keep the same organic material percentage for every increment of added organic material.



See the PACE Turf table with sand amounts for soils from 3 to 15% organic material: [Sand and clipping volume](#)



Total organic material time series

0 to 2 cm



The horizontal dashed line marks the average value (50th percentile) of all bentgrass samples.

Sand quality



**USGA RECOMMENDATIONS
FOR A METHOD OF**

Putting Green Construction



2018 REVISION

FOR NEARLY 60 YEARS the USGA

recommendations for putting green construction have been the most widely used method of putting green construction throughout the United States and other parts of the world. When built and maintained properly, putting greens built in accordance to the USGA recommendations have provided consistently good results for golf courses over a period of many years. These recommendations are periodically reviewed and updated as a result of scientific research and as new techniques and materials are proven reliable.

This document specifically represents the USGA's recommendations for putting green construction. It does not include a discussion of construction techniques or methods. Additional documents are available from the USGA that describe construction methods, offering tips for success and providing guidance for putting green management.

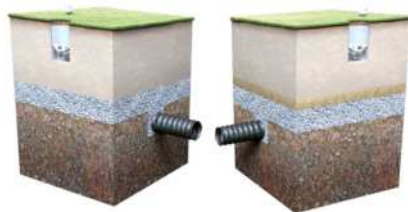
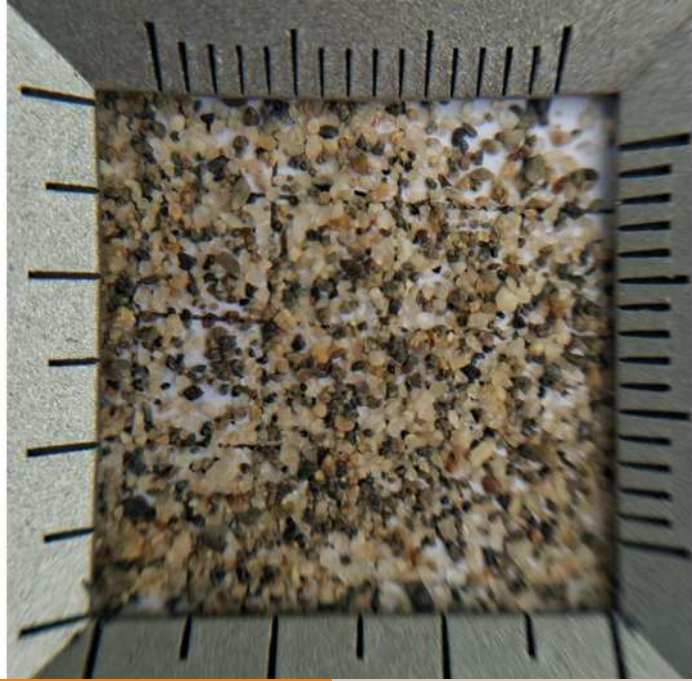


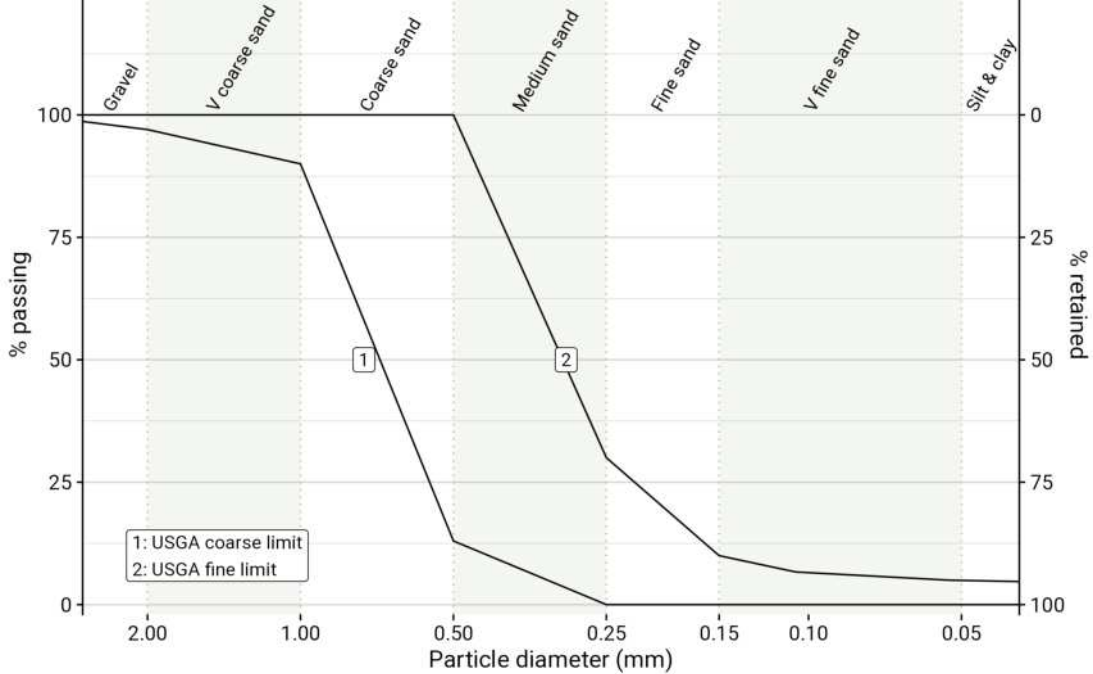
TABLE 3. Recommended Particle Size Distribution for a Putting Green Rootzone Mixture

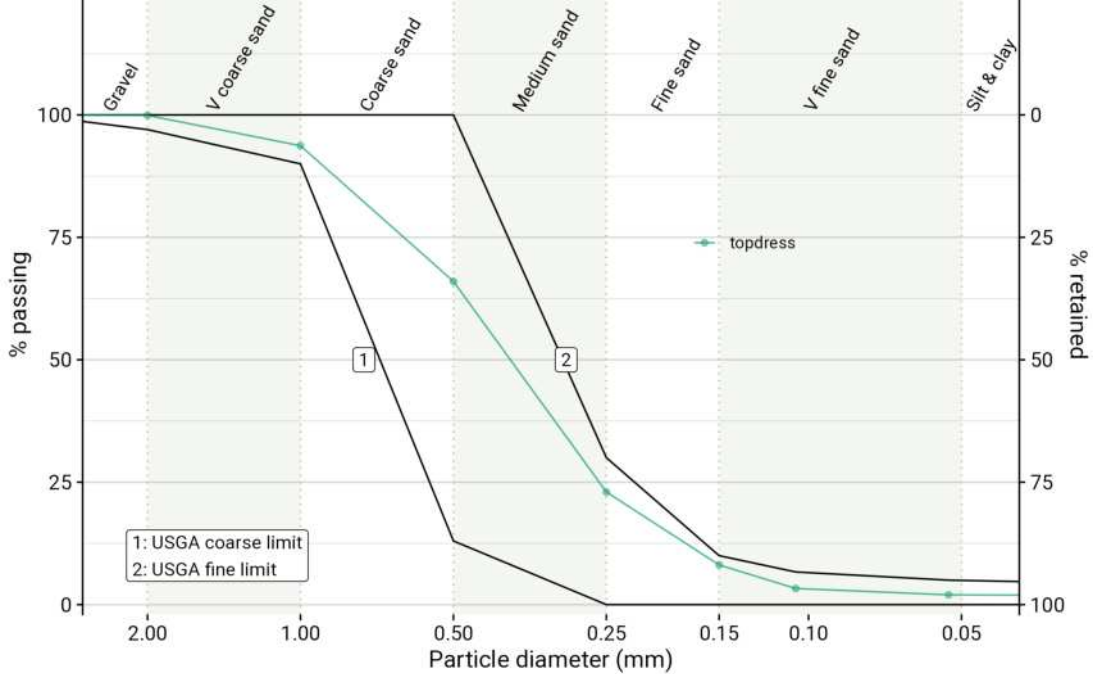
PARTICLE	DIAMETER	SIEVE	% BY WEIGHT
Coarse gravel	> 4 mm	No. 5	0%
Fine gravel	2.0 – 3.4 mm	No. 10	≤ 3% gravel
Very coarse sand	1 – 2 mm	No. 18	≤ 10% combined in this range
Coarse sand	0.5 – 1.0 mm	No. 35	≥ 60% of the particles in this range
Medium sand	0.25 – 0.5 mm	No. 60	
Fine sand	0.15 – 0.25 mm	No. 100	≤ 20%
Very fine sand	0.05 – 0.15 mm	No. 270	≤ 5%
Silt	0.002 – 0.05 mm		≤ 5%
Clay	< 0.002 mm		≤ 3%
Total fines	Very fine sand + silt + clay		≤ 10% combined
Coefficient of Uniformity (D60/D10)		1.8 - 3.5	Rootzone mixtures with peat
		2.0 - 3.5	Rootzone mixtures with inorganic amendments
		2.0 - 3.5	Pure sand rootzone mixtures



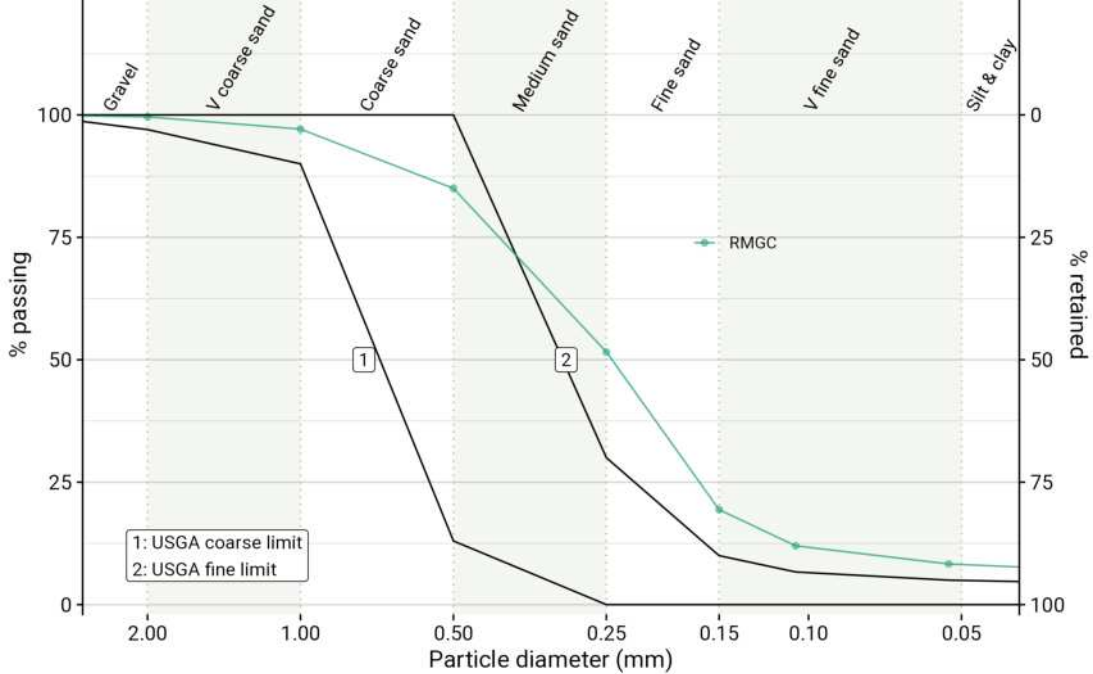




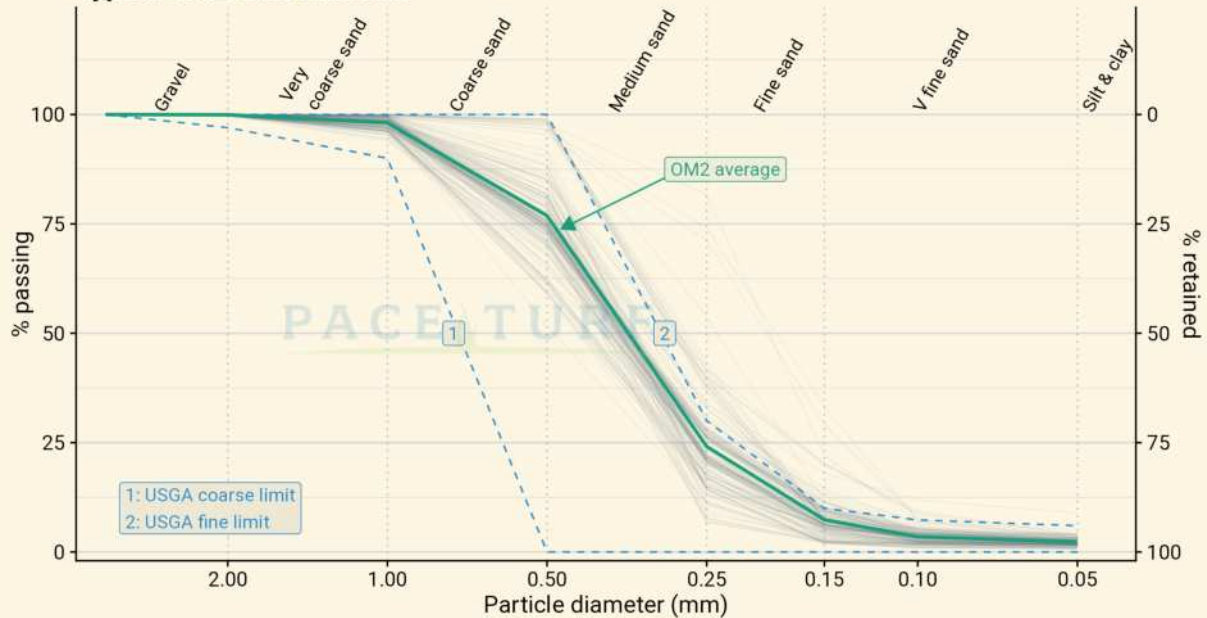






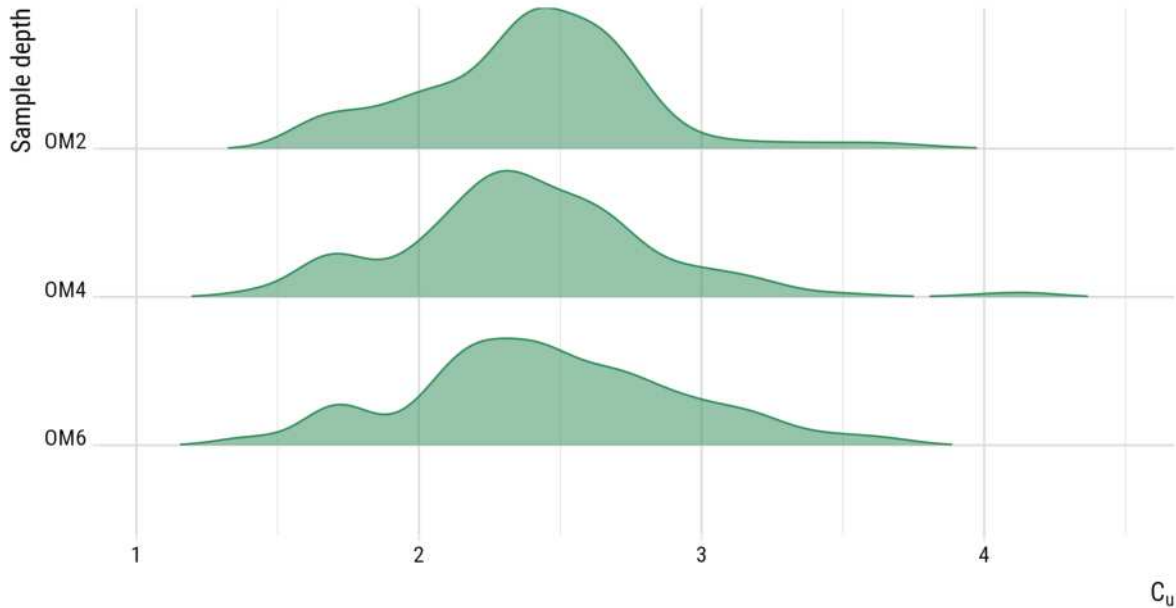


Typical OM2 sand fractions

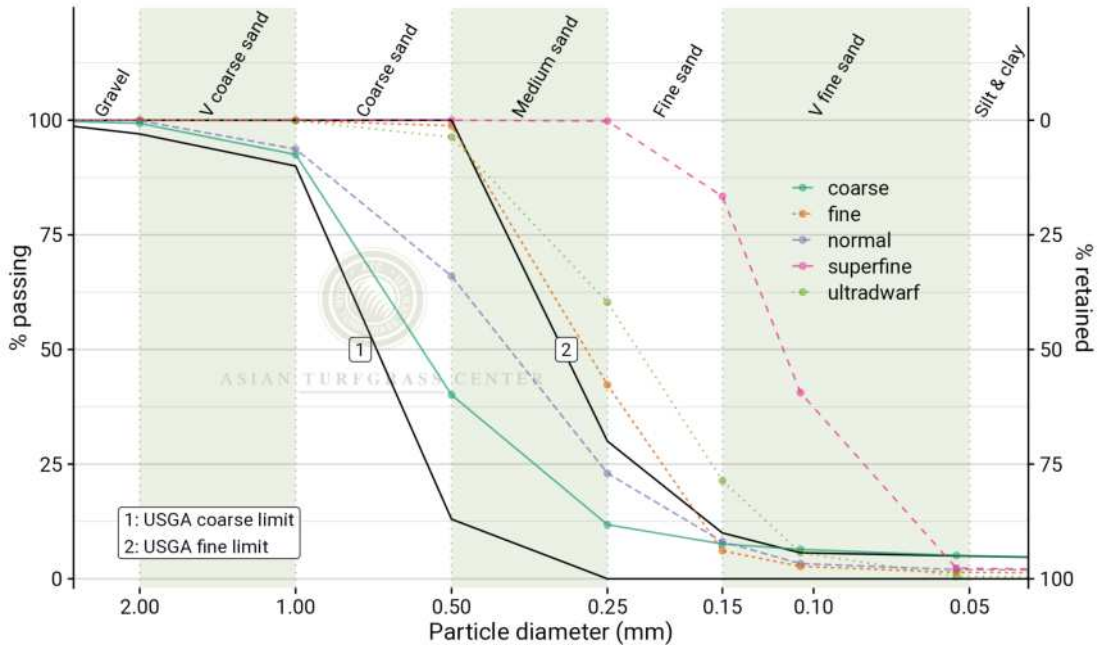


Particle size distributions from 150 OM2 samples after removing organic material by burning

Coefficient of uniformity (C_u) by OM246 depth

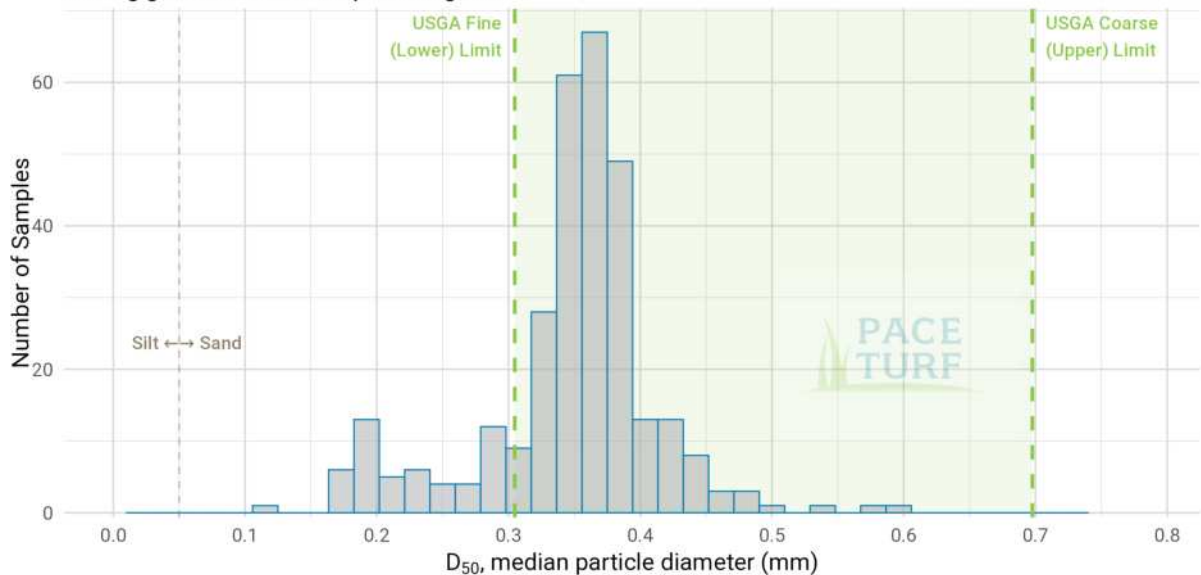


Particle size distribution curves for five distinct rootzone sands



Average particle diameter, D_{50}

Putting green rootzone & topdressing sands





Chemical

Reference



September, 2014

Minimum Levels for Sustainable Nutrition Soil Guidelines

The Minimum Level for Sustainable Nutrition (MLSN) Guideline is a new, more sustainable approach to managing soil nutrient levels that can help you to decrease fertilizer inputs and costs, while still maintaining desired turf quality and playability levels. The MLSN guidelines were developed in a joint project between PACE Turf and the Asian Turfgrass Center. All soil analyses were conducted at Brookside Laboratories, New Bremen, OH.

	MLSN Soil Guideline
pH	>5.5
Potassium (K ppm)	37
Phosphorus (P ppm)	21
Calcium (Ca ppm)	331
Magnesium (Mg ppm)	47
Sulfur as sulfate (S ppm)	7

Table 1: Summary of ATC database putting green (sands) soil tests for the past five years.

Element	Median	10 th Percentile
pH	6.5	
OM	1.29%	
K	59 ppm	23 ppm
P	50 ppm	21 ppm
Ca	499 ppm	261 ppm
Mg	71 ppm	35 ppm
S	9 ppm	5 ppm





Sand fractions by depth after burning

Fine gravel

recommended $\leq 3\%$



Sieve No. 10, > 2 mm

Very coarse sand

recommended $\leq 10\%$



Sieve No. 18, 1–2 mm

Coarse and medium sand

recommended $\geq 60\%$ in this range



Sieve Nos. 35 & 60, 0.25–1 mm

Fine sand

recommended $\leq 20\%$



Sieve No. 100, 0.15–0.25 mm

Very fine sand

recommended $\leq 5\%$



Sieve No. 270, 0.05–0.15 mm

Total fines

recommended $\leq 10\%$



Silt + clay + very fine sand
calculated as $100 - \text{total sand \%} + \text{very fine sand}$

- use the right amount of sand
- choose the sand/s you use carefully
- finer sands are generally preferable, but you need enough surface drainage
- sands don't hold many nutrients, so focus on supplying nutrients in the quantities used by the grass

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