Reference

FEBRUARY, 2012

Minimum Levels for Sustainable Nutrition Soil Guidelines

Minimum Level for Sustainable Nutrition (MLSN) is a new, more sustainable approach to managing soil nutrient levels that can help you to decrease 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 Knoxville, OH.

	MLSN Soil Guideline
pH	>5.5
Potassium (K ppm)	50
Phosphorus (P ppm); pH<7.5, Mehlich 3	25
Phosphorus (P ppm); pH<7.5, Bray 2	30
Phosphorus (P ppm); pH>7.5, Olsen	6
Phosphorus Saturation Index; pH<7.5	0.10
Calcium (Ca ppm)	330
Magnesium (Mg ppm)	45
Sulfur as sulfate (S ppm)	15
Sodium (Na ppm)	<110
Electrical conductivity (EC dS/m)	<2
Nitrogen as nitrate (N ppm)	5
Nitrogen as ammonium (N ppm)	<7
Total Nitrogen (N ppm)	<10

Managing sodium and salts: In locations where poor quality irrigation water makes it difficult to meet the guideline of <110 ppm sodium or <2 dS/m salts, MLSN guidelines and overall management practices may need to be modified on a site-specific basis. For more information on salinity and sodium management, see Carrow RN and Duncan R., 1998. Salt affected turfgrass sites: assessment and management. Sleeping Bear Press, 173 pp.

How the guidelines were developed

The guidelines are based on a review of data from 6500 turf soil samples that were rated average to good by turf managers.

- **Soil pH** is set at or above 5.5 to prevent aluminum toxicity that can occur at lower pH values
- **Sodium** is set at < 110pm and electrical conductivity at <2 dS/m to prevent plant stress
- **Phosphorus, calcium, magnesium and sulfur** levels are set at 1/3 of the median value from all samples analyzed
- **Nitrate, ammonium, total nitrogen and potassium** levels are based on field and lab observations generated at the Asian Turfgrass Center and at PACE Turf over the past 25 years.

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Analytical methods used to develop the Minimum Levels for Sustainable Nutrition Soil Guidelines

Electrical conductivity (1:2) converted to saturated paste equivalent, 1:2 soil method. Reference: Soil, Plant and Water Reference Methods for the Western Regions S-2.210, 2003.
Values converted to saturated paste equivalent using following equation:

Saturated paste equivalent EC dS/m = 2.1 * (1:2 EC dS/m) + 0.5)

pH (1:1 in water). Reference: McLean, E.O. 1982. Soil pH and lime requirement. *in* Page, A.L. ed. Methods of soil analysis, part 2. Agronomy Monograph 9, 2nd ed. American Society of Agronomy and Soil Science Society of America, Madison, WI; pp. 199-223.

Mehlich III extractable sulfur, calcium, magnesium, potassium, sodium and phosphorus. Reference: Mehlich, A. 1984. Mehlich-3 soil test extractant: a modification of Mehlich-2 extractant. Comm. Soil Sci. Plant Anal. 15:1409-1416.

Inorganic nitrogen (1 N KCl cadmium reduction). Reference: Dahnke W.C. 1990. Testing soils for available nitrogen. Westerman, R.S. ed. Soil testing and plant analysis. Soil Sci. Soc. Am. Book Series 3, Agronomy Society of America, Madison, WI; 1996: 961-1010.

Bray II Phosphorus. Reference: Bray, H.R. and L.T. Kurtz. 1945. determination of total, organic, an available forms of phosphorus in soils. Soil Science 59:39-45.

Olsen Phosphorus:. Reference: Olsen, S.R. and L.E. Sommers. 1982. Phosphorus. Page, A.L. eds. Methods of soil analysis, part 2. Agronomy Monograph 9, 2nd ed. American Society of Agronomy and Soil Science Society of America, Madison, WI; 1982: 403-430.

Phosphorus saturation index (PSI): Mehlich III extractable phosphorus, iron and aluminum:

$$\text{PSI} = \frac{\text{P mmol/kg}}{\text{Fe mmol/kg + Al mmol/kg}}$$

Sustainability Metrics

Decreases in these 7 inputs can document your progress towards sustainability

The goal of "sustainable turf" is a worthy one, but there has been too little technical discussion of what it means, how it can be achieved, and how to measure progress towards sustainability. We have selected the seven parameters below because reductions in each can produce significant improvements in costs and environmental inputs, and because each can be easily quantified:

1. **Reduce number of total maintained acres**. Reduce turf or heavily landscaped acres, and you will reduce water, equipment, manpower, fertilizer and pesticide inputs.
2. **Reduce total water used**. Accomplish this by switching to reclaimed water, improving irrigation efficiency, reducing turf acres.
3. **Reduce total nutrients applied**. Get more efficient with nitrogen, phosphorus, potassium and other key elements. The MSLN guidelines can help you here.
4. **Reduce total pounds and toxicity levels of pesticides applied.** Implement an IPM plan and track reductions in total pounds on the ground. You can also document incorporation of safer, Class 3 pesticides and biocontrol approaches, and decreases in more toxic Class 1 and Class 2 pesticides.
5. **Reduce manpower costs**
6. **Reduce fuel use costs and volumes**
7. **Reduce electrical use costs and kWhs used**

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