

Minimum levels for sustainable nutrition (MLSN).

Larry Stowell, PACE Turf LLC and Micah Woods, Asian Turfgrass Center

Introduction: Increased economic and environmental concerns have caused many golf courses to re-assess turf management strategies so that inputs and costs are minimized, while golfer expectations are still met. However, there are currently no soil nutrient guidelines that specifically address this growing need. In this study, PACE Turf and the Asian Turfgrass Center pooled soil test data collected over the past 20 years that has all been analyzed by a single laboratory -- Brookside Laboratories, New Knoxville OH. The data was analyzed to determine the minimum level of each key soil nutrient that would sustain acceptable turf growth and quality. The non-negative log-logistic distribution provided a significant fit for all parameters using Kolmogorov Smirnov goodness of fit. The nutrient level that coincides to the 10th percentile ($p(x) = 0.1$, or 10% of the samples report lower values than x) using the best fit log-logistic distribution was used to define the Minimum Level for Sustainable Nutrition (MLSN) for each nutrient.

Methods: Data for analysis were selected from the PACE Turf database of more than 16,000 individual soil samples. In order to identify minimum nutrient guidelines, only soils with cation exchange capacities (calculated by summation of Mehlich-3 extracted cations) of less than 6 cmol/kg and soil pH between 5.5 and 7.5 were included in the analysis. Olsen phosphorus guidelines were developed for soils reporting a pH greater than 7.5. Data were analyzed using EasyFit distribution-fitting software from Mathwave (www.mathwave.com) and the three-parameter log-logistic distribution was used to identify the MLSN guidelines.

Results: The table below reports the Minimum Levels for Sustainable Nutrition (MLSN) for each soil nutrient, and the values for alpha, beta and gamma for the three-parameter log-logistic fit provided by EasyFit software.

Method/element ¹	Number of samples	Alpha	Beta	Gamma	Kolmogorov Smirnov (p)	MLSN Log-Logistic $p(x) = 0.1$
M3 K	1544	2.91	74.20	0.00	0.038	35
M3 P	1517	2.56	45.15	-1.72	0.017	18
Bray 2 P	1538	2.75	54.49	0.00	0.033	25
Olsen P	270	3.25	12.84	-1.11	0.048	5.4
M3 PSI	1409	3.00	0.25	-0.02	0.020	0.1
M3 Ca	1544	71.82	7490.30	-6905.10	0.044	360
M3 Mg	1544	9.02	182.92	-89.54	0.033	54
M3 S	1532	2.37	28.94	1.29	0.030	13
M3 Na	1544	3.01	44.19	0.10	0.042	21
KCl NO ₃ -N	1133	1.49	2.11	0.00	0.041	0.5
KCl NH ₄ -N	1133	2.12	2.41	0.00	0.072	0.9
KCL (NO ₃ -N + NH ₄ -N)	1113	2.07	4.94	0.87	0.024	2.5

¹All values are mg/kg unless otherwise noted. M3 = Mehlich 3 extraction; Olsen = Olsen extraction; Bray 2 = Bray 2 extraction; PSI = phosphorus saturation index (M3 P mmol/kg)/(M3 Fe mmol/kg + M3 Al mmol/kg); KCL = 1N KCl extraction and cadmium reduction.

Larry Stowell, Ph.D., PACE Turf, 1267 Diamond Street, San Diego, CA 92109; Micah Woods, Ph.D., Asian Turfgrass Center, 97 Serithai Road, Kwang Kannayao, Khet Kannayao, Bangkok 10230, Thailand.

*Corresponding author: (stowell@paceturf.org).