A Method for Estimating Turfgrass Nutrient Requirements

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Chief Scientist | Asian Turfgrass Center

23 September 2013
Icelandic Green- and Groundskeeping Association
Hafnarfjörður, Iceland

different K application to creeping bentgrass

Ithaca, New York

grass performance
evaluated year round

Ithaca, New York

soil samples collected from research putting green

nutrient research, Cornell University

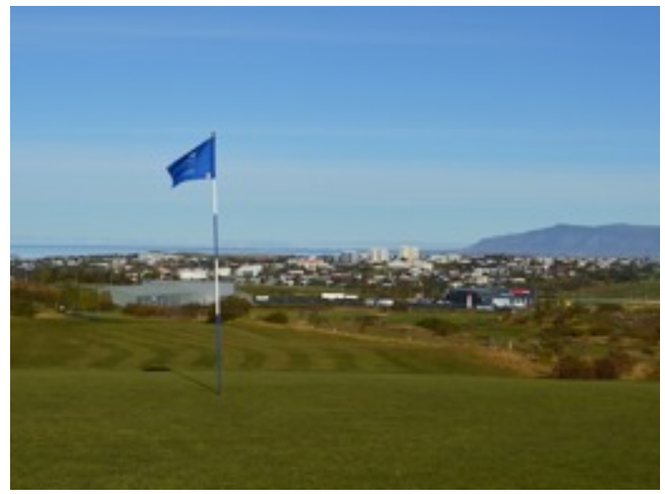
1. The elemental content of fertilized turfgrass leaves is relatively constant

2. The amount of nitrogen supplied to the grass controls growth and uptake of the other nutrients

3. A temperature-based growth potential can predict how much nitrogen the grass will use

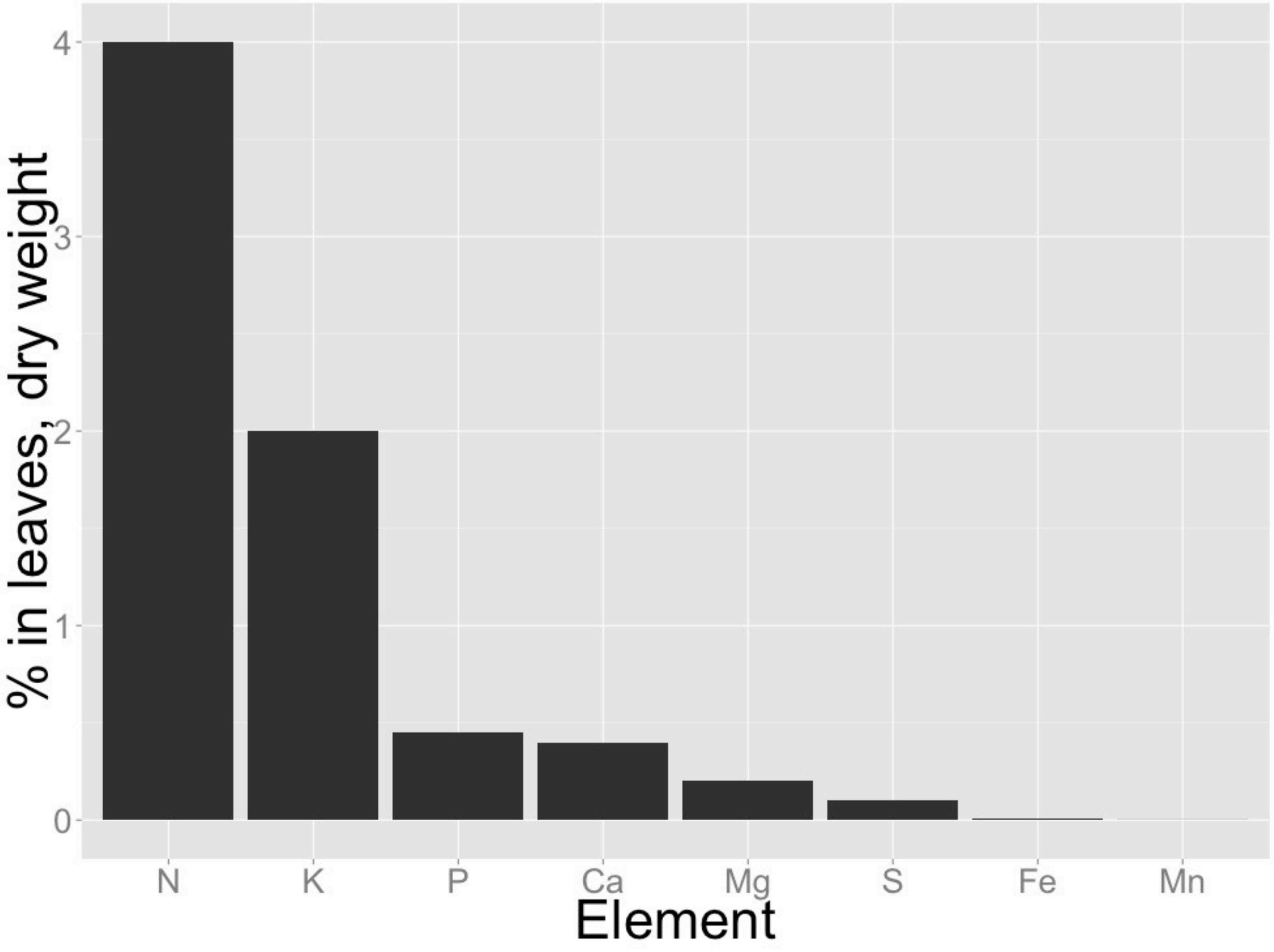
4. The MLSN guidelines ensure that soil nutrient levels remain high enough to produce excellent turf conditions

5. By considering the previous points, mathematically, the minimum nutrient requirement can be determined



How can this method be applied here?

1. The elemental content of fertilized turfgrass leaves is relatively constant


% in leaves, dry weight
4
3
2
1
0
N
K
P
Ca
Mg
S
Fe
Mn
Element

N:P:K ratio in leaves is about 8:1:4

leaf clippings contain nutrients

2. The amount of nitrogen supplied to the grass controls growth and uptake of the other nutrients

“N supply was the primary determinant of turfgrass growth rate, plant nutrient demand, and nutrient uptake. Nitrogen uptake accounted for over 88% of uptake of all other nutrients. Uptake of P and K were strongly related to tissue N content irrespective of soil test levels.”

(Kussow et al., 2012)

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Research Article

Evidence, Regulation, and Consequences of Nitrogen-Driven Nutrient Demand by Turfgrass

Wayne R. Kussow, Douglas J. Soldat, William C. Kreuser, and Steven M. Houlihan

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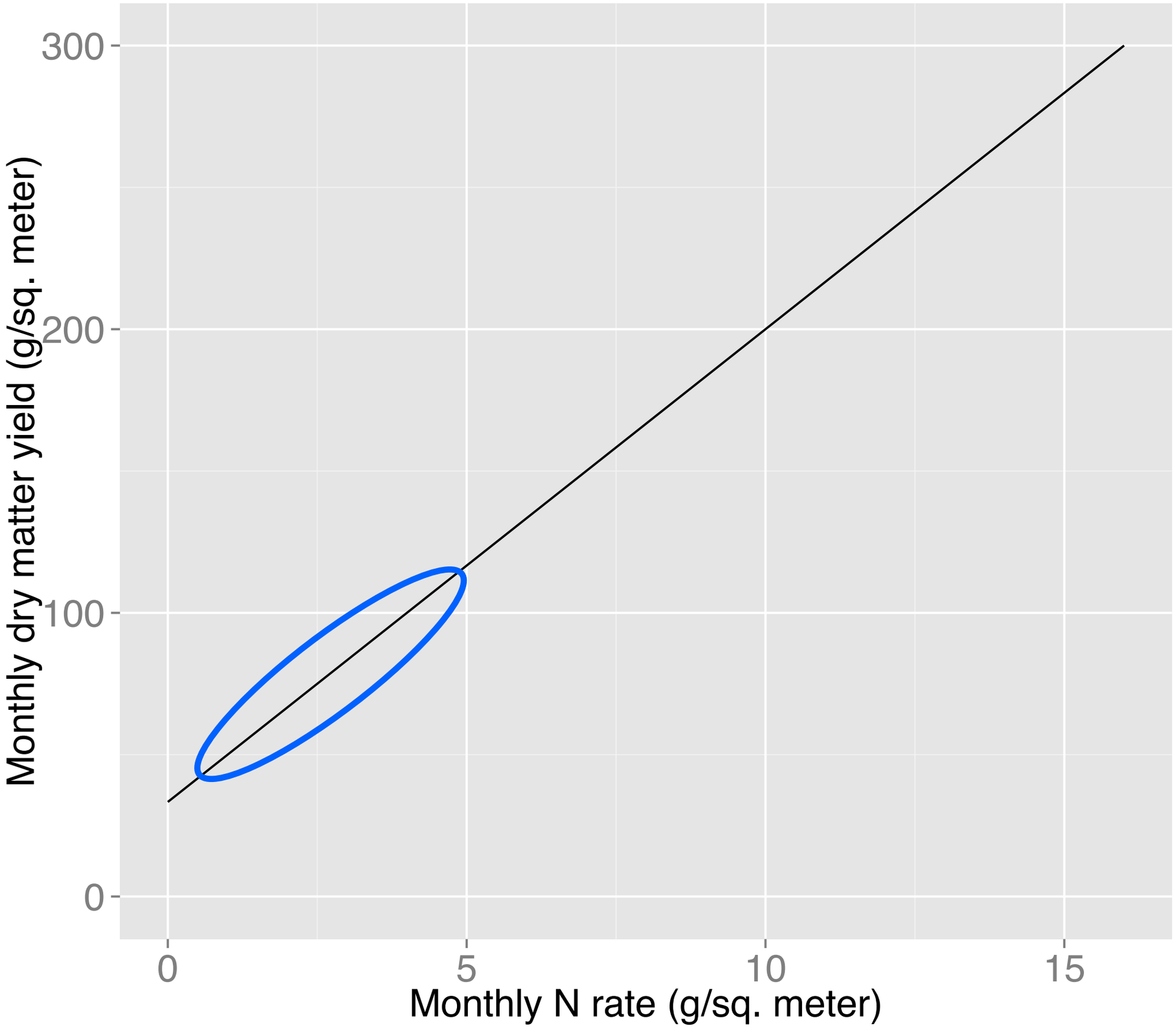

300
200
100
0
Monthly dry matter yield (g/sq. meter)
0
5
10
15
Monthly N rate (g/sq. meter)

3. A temperature-based growth potential can predict how much nitrogen the grass will use

$$GP = \frac{1}{e^{0.5\left(\frac{t - t_o}{var}\right)^2}}$$

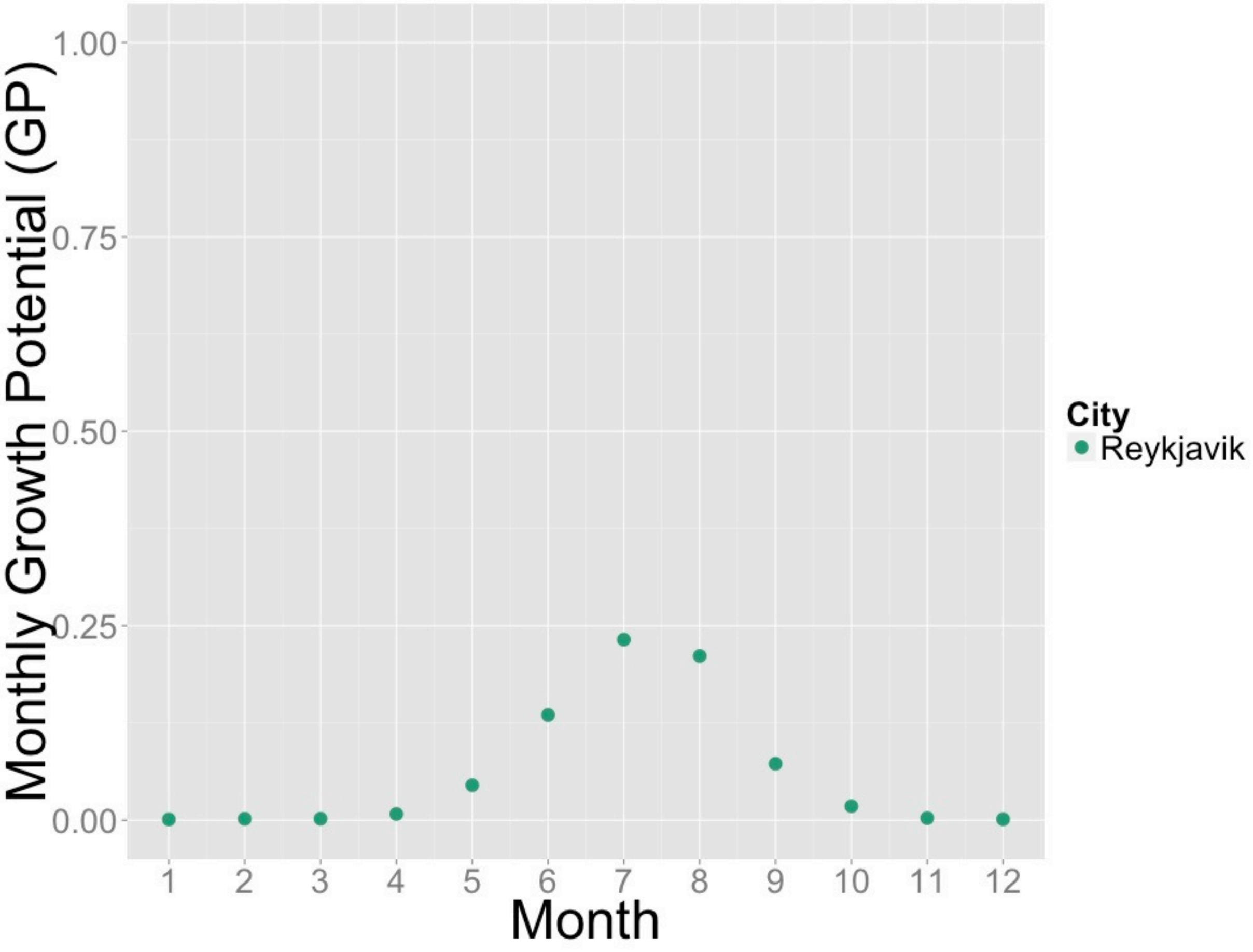
GP = growth potential, on a scale of 0 to 1

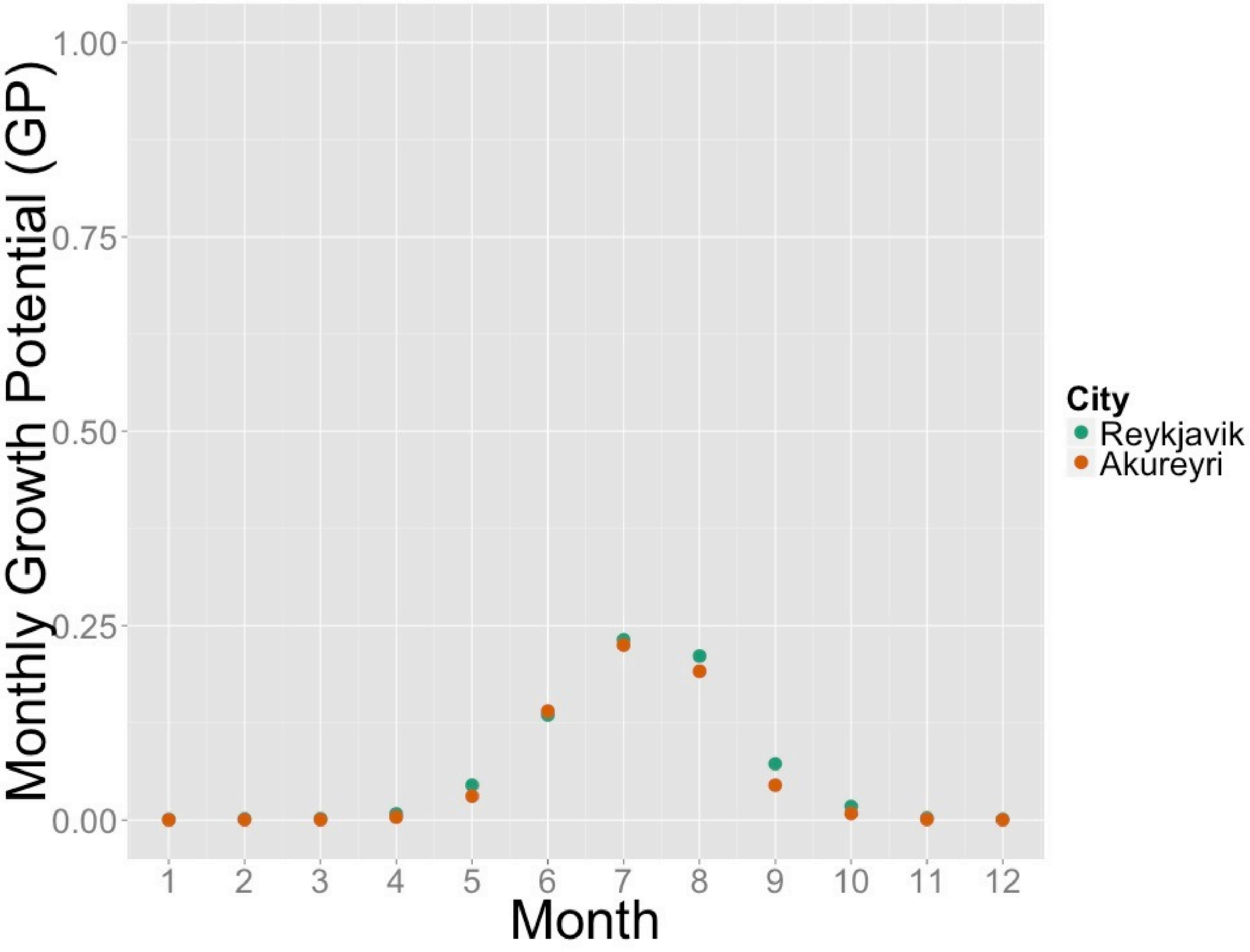
e = 2.71828, a mathematical constant

t = average temperature for a location, in °C

t_o = optimum temperature, 20 for C_3 grass, 31 for C_4 grass

var = adjusts the change in GP as temperature moves away from t_o; I use 5.5 for C_3 and 8.5 for C_4


Monthly Growth Potential (GP)
1.00
0.75
0.50
0.25
0.00
1
2
3
4
5
6
7
8
9
10
11
12
Month
City
Reykjavik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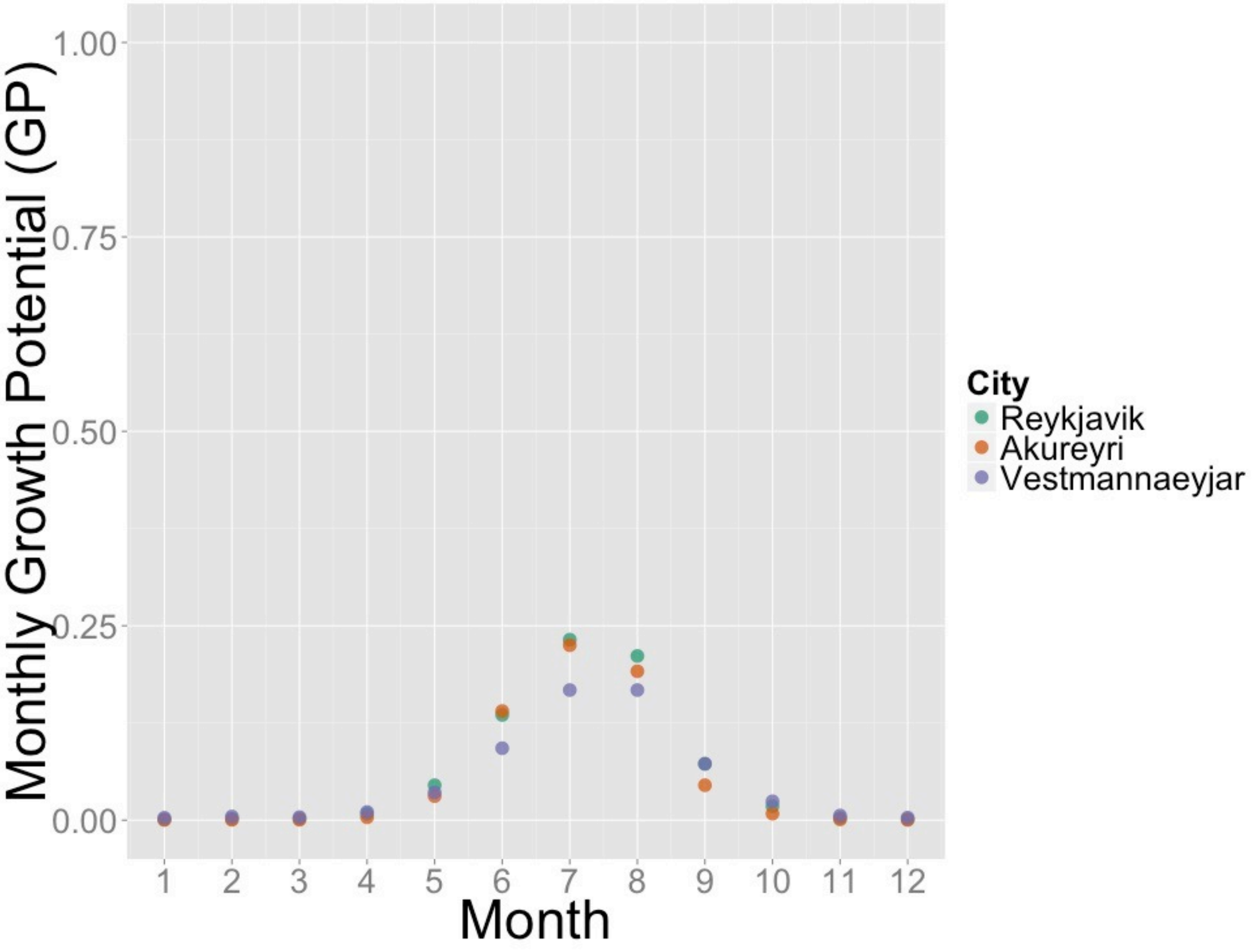
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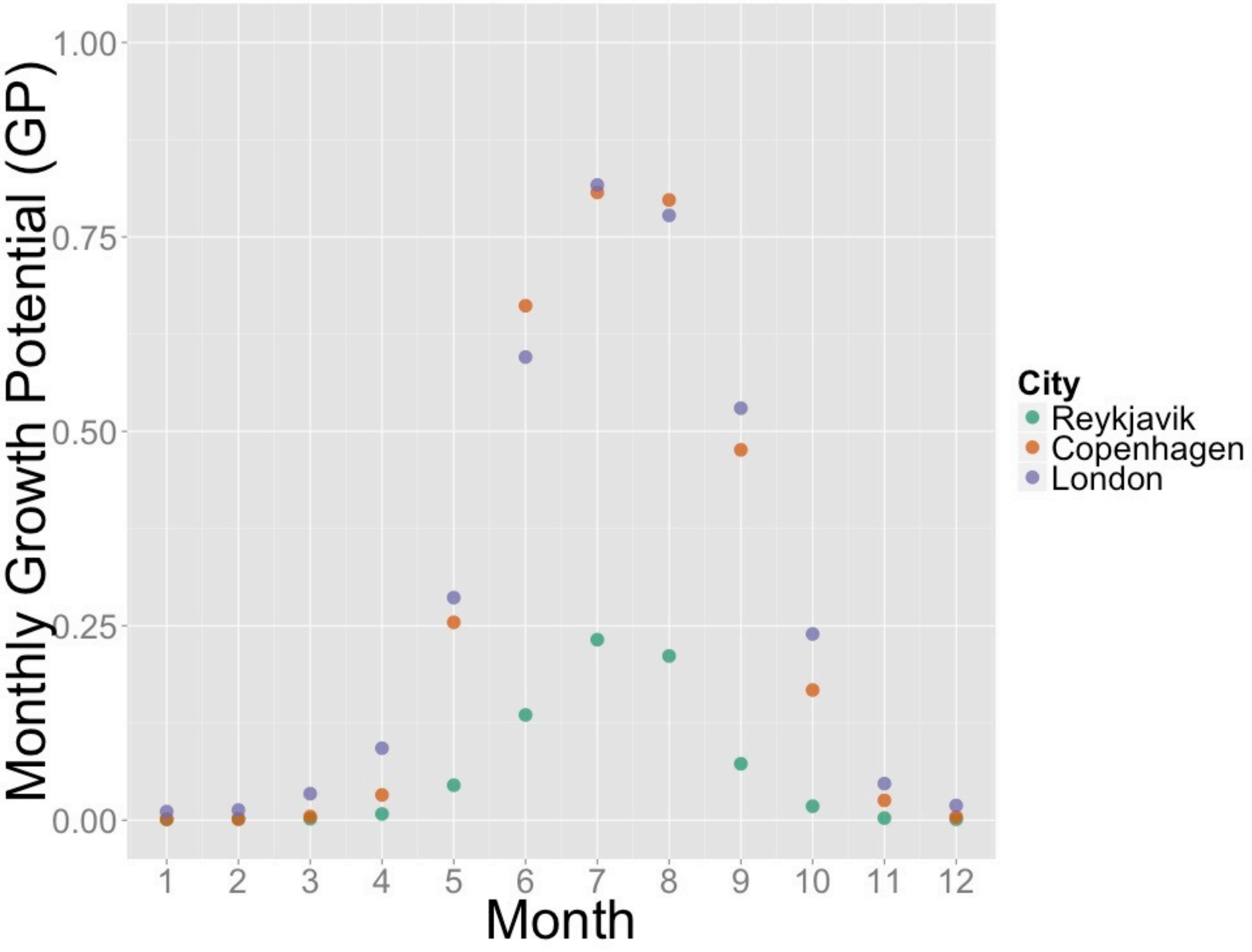
Vestmannaeyjar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0.75
0.50
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0.00
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10
11
12
Month
City
Reykjavik
Copenhagen
London

4. The MLSN guidelines ensure that soil nutrient levels remain high enough to produce excellent turf conditions

Reference

November, 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 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 Knoxville, OH.

	MLSN Soil Guideline
pH	>5.5
Potassium (K ppm)	35
Phosphorus (P ppm); pH<7.5, Mehlich 3	18
Phosphorus (P ppm); pH<7.5, Bray 2	25
Phosphorus (P ppm); pH>7.5, Olsen	6
Calcium (Ca ppm)	360
Magnesium (Mg ppm)	54
Sulfur as sulfate (S ppm)	13
Sodium (Na ppm)	<110
Electrical conductivity (EC dS/m)	<2
Total Nitrogen (N ppm)*	<3

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.

For more information, see the Facebook MLSN page at: www.facebook.com/mlsnturf

PACE TURF

version 12110301

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5. By considering the previous points, mathematically, the minimum nutrient requirement can be determined

Using this method, the amount of fertilizer (***F***) to apply is:

F = Harvest (g/m^2) + MLSN (g/m^2) - soil test (g/m^2)

100 soil samples from putting greens in 5 countries in SE Asia

Median values

pH: 6.6
K : 84 ppm
P: 44 ppm
Ca: 519 ppm
Mg: 69 ppm

kg/ha

BROOKSIDE LABORATORIES, INC.

45519-1

Soil Audit & Inventory Report

Name Asian Turfgrass Center City Ayuddhaya State THAI

Independent Consultant Asian Turfgrass Center Date 11/21/200

Sample Location BLUE CANYON			CANYON	CANYON	CANYON	CANYON	
Sample Identification			F-16	G-5	G-7	G-15	
Lab No.			0401-1	0402-1	0403-1	0404-1	
Total Exchange Capacity (M.E./100 g)			5.57	4.26	4.47	5.21	
pH	SMP Buffer	Buffer (SMP)	7.1	7.4	7.5	7.5	
		H_2O (1:1)	5.7	6.7	6.7	6.9	
Organic Matter (humus) %			2.67	1.33	1.73	1.69	
ANIONS	SOLUBLE SULFUR	p.p.m.	14	14	18	17	
PHOSPHORUS	EASILY EXTRACTABLE kg/ha	P as P_2O_5	287	236	262	292	
		p.p.m. of P	56	46	51	57	
	BRAY II kg/ha	P as P_2O_5	775	492	385	631	
		p.p.m. of P	151	96	75	123	
	OLSEN kg/ha	P as P_2O_5					
		p.p.m. of P					
EXCHANGEABLE CATIONS	CALCIUM:	kg/ha	1304	1216	1391	1682	
		ppm	582	543	621	751	
	MAGNESIUM:	kg/ha	217	269	235	282	
		ppm	97	120	105	126	
	POTASSIUM:	kg/ha	175	65	67	72	
		ppm	78	29	30	32	
	SODIUM:	kg/ha	81	81	63	63	
		ppm	36	36	28	28	
	ALUMINUM (KCl Ext.):	kg/ha	31	25	18	25	
		ppm	14	11	8	11	
BASE SATURATION PERCENT							
Calcium	%		52.24	63.73	69.46	72.07	
Magnesium	%		14.51	23.47	19.57	20.15	
Potassium	%		3.59	1.75	1.72	1.57	
Sodium	%		2.81	3.67	2.72	2.34	
Other Bases	%		2.79	2.87	1.99	2.35	
Hydrogen	%		24.00	4.50	4.50	1.50	
EXTRACTABLE MINORS							
Boron (ppm)			< 0.20	0.66	0.40	0.61	
Iron (ppm)			264	212	206	256	
Manganese (ppm)			9	16	25	22	
Copper (ppm)			0.88	8.21	10.20	9.04	
Zinc (ppm)			1.41	5.23	5.83	6.28	
Aluminum (ppm)			415	162	168	164	
OTHER TESTS	Soluble Salts (mmhos/cm)						
	Chlorides (ppm)						
	NO_3-N (ppm)		4.5	4.8	4.3	5.8	
	NH_3-N (ppm)		12.2	3.7	4.3	4.1	
	Total Acidity (ME/100)		0	0	0	0	

Clipping yield = sum(5 x GP) / 0.04 = **x g/m^2**

5 g N/m^2 as maximum monthly N rate
GP = growth potential at a location
average 4% N in leaves
sum across all 12 months

Clipping yield = sum(5 x GP) / 0.04 = **x g/m^2**

Reykjavik, 92.5 g/m^2 clipping yield

at maximum monthly N of 2 g/m^2,
estimated clipping yield is 37.5 g/m^2

Potassium (K)

(92.5 x 0.02) + (5.2) - (12.5) = **-5.5 g/m²**

none is required as fertilizer

Phosphorus (P)

(92.5 x 0.005) + (2.7) - (6.6) = **-3.4 g/m²**

none is required as fertilizer

Calcium (Ca)

(92.5 x 0.0045) + (53.7) - (77.5) = **-23 g/m²**

none is required as fertilizer

Magnesium (Mg)

(92.5 x 0.002) + (8.1) - (10.3) = **-2 g/m²**

none is required as fertilizer

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Global Soil Survey

For Sustainable Turf

www.paceturf.org/journal/global_soil_survey

for more information:

www.blog.asianturfgrass.com/fertilizer/

www.asianturfgrass.com/turf-information.html

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