Potassium Fertilization Affects Microdochium Patch Severity on Creeping Bentgrass

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Introduction/Objective

- Turfgrass managers often apply more potassium than nitrogen – the average application to golf course putting greens was 190 kg/ha (GCSAA, 2016)
- Potassium fertilization is associated with heat and drought stress tolerance, cold stress tolerance, traffic tolerance, increased rooting, disease pressure
- While potassium has no know environmental consequences, supplies of potassium are non-renewable and available reserves are expected to be exhausted in <300 years
- The objective of this research was to quantify the relationships among potassium status (through tissue, soil, and fertilization) and turfgrass performance
- The goal of this work is to identify soil and tissue levels below which problems may arise in a creeping bentgrass putting green on a sand-matrix root zone.

Methods/Materials

- Randomized complete block design with four replications (plot size 2.9 m^2)
- Treatments consisted of liquid application of K_2SO_4 made every other week during the growing season from May 2011 to October 2016
  - 10 kg/ha Ca as granular $CaSO_4$
  - Non-fertilized control
  - 5 kg/ha K_2O (~50 kg/ha annually)
  - 10 kg/ha K_2O (~100 kg/ha annually)
  - 300 kg/ha K_2O (~300 kg/ha annually)
- Traffic was applied by making six passes per week using a golf cart traffic simulator from 2011-2015. Traffic was discontinued in 2015 because of a mechanical failure.
- Root zone was built to USGA particle size specifications with no organic matter in 2008. The soil pH was initially 8.2, but 6.9 at the initiation of the study in 2011. The grass was seeded to 'A4' creeping bentgrass (*Agrostis stolonifera*)
- Irrigation applied at 70% of estimated ET calculated from on-site weather station
- Mowed at 3 mm 5x per week
- Fertilized with 10 kg/ha N every other week using urea. Season total ~150 kg/ha N
- Lightly sand topdressed every 2-3 weeks during growing season
- Core cultivation and heavy topdressing in October annually
- Fungicides applied only three times during study period, never after August
- Data collected:
  - Visual quality (1-9, 9=best) and chlorophyll index (1-999, 999=greenest) every other week
  - Dry matter yield monthly
  - Soil nutrient status monthly (Mehlich-3)
  - Diseases evaluated as needed using incidence (infection centers/plot) and severity (% area affected) using the grid method.

Results/Discussion

- Few significant differences in visual quality, chlorophyll index, or dry matter yield over six years. Differences that did exist showed no consistent trend related to K input

Table 2. Bentgrass quality, chlorophyll index (CI), and dry matter yield (DMY) 2011-2016

Treatment	----------- 2011 -----------			---------- 2012 ----------			--------- 2013 ---------		
	C.I.	Quality	DMY	C.I.	Quality	DMY	C.I.	Quality	DMY
	1-999	1-9	g/m^2	1-999	1-9	g/m^2	1-999	1-9	g/m^2
10 kg/ha Ca (gypsum)	219 A	6.3 A	2.5 A	239 A	6.2 A	2.9 A	238 A	6.1 A	2.3 A
Control (no application)	217 A	6.1 A	3.1 A	227 A	6.2 A	2.9 A	236 A	6.1 A	2.4 A
5 kg/ha K_2O (K_2SO_4)	215 A	6.3 A	2.4 A	229 A	6.1 A	2.0 A	232 A	5.8 A	2.0 A
10 kg/ha K_2O (K_2SO_4)	217 A	6.4 A	2.7 A	235 A	6.1 A	2.2 A	231 A	5.8 A	2.2 A
30 kg/ha K_2O (K_2SO_4)	214 A	6.1 A	3.1 A	235 A	6.2 A	2.7 A	232 A	5.9 A	2.1 A

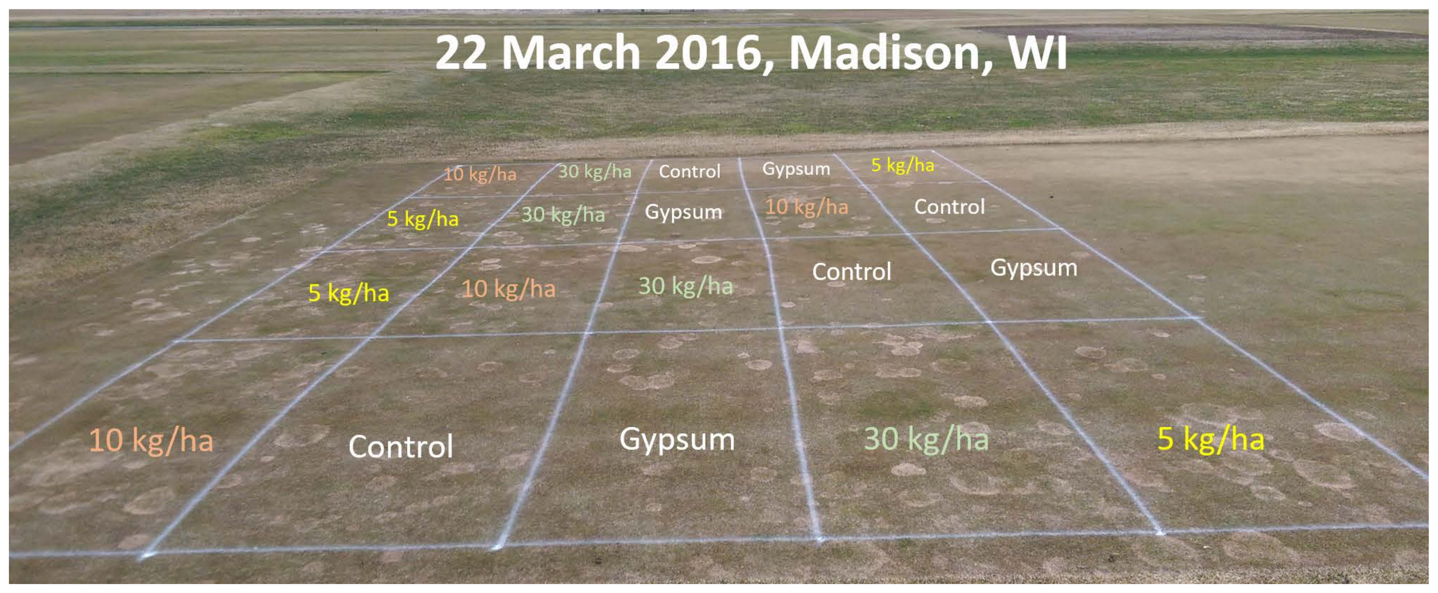
Treatment	---------- 2014 ----------			----------- 2015 -----------			----------- 2016 -----------		
	C.I.	Quality	DMY	C.I.	Quality	DMY	C.I.	Quality	DMY
	1-999	1-9	g/m^2	1-999	1-9	g/m^2	1-999	1-9	g/m^2
10 kg/ha Ca (gypsum)	209 B	4.6 A	3.1 A	192 A	4.8 A	4.76 A	295 A	5.3 C	No Data
Control (no application)	210 AB	4.6 A	2.7 A	185 A	5.2 A	5.17 A	292 A	6.0 A	No Data
5 kg/ha K_2O (K_2SO_4)	208 B	4.7 A	2.9 A	192 A	5.1 A	4.76 A	295 A	5.4 BC	No Data
10 kg/ha K_2O (K_2SO_4)	216 A	4.8 A	2.9 A	192 A	5.3 A	4.46 A	295 A	5.8 AB	No Data
30 kg/ha K_2O (K_2SO_4)	212 AB	4.8 A	2.7 A	187 A	5.3 A	4.66 A	293 A	5.7 AB	No Data

Results/Discussion (cont)

Table 3. Potassium consistently increased microdochium patch incidence and severity

	Spring 2013		Spring 2014		Spring 2015		Spring 2016	
	Incidence	Severity	Incidence	Severity	Incidence	Severity	Incidence	Severity
Treatment	centers/plot	% plot	centers/plot	% plot	centers/plot	% plot	centers/plot	% plot
10 kg/ha Ca	2.5 ab	No data	0.5 b	0.0 b	3.8 b	0.8 c	9.9 b	5.6 b
Control	2.0 b	No data	1.0 b	0.5 b	2.3 b	2.0 c	8.8 b	4.8 b
5 kg/ha K20	6.3 a	No data	6.0 ab	2.5 a	14.3 a	8.5 b	33.5 a	22.5 a
10 kg/ha K20	5.5 ab	No data	9.8 a	3.3 a	16.3 a	12.0 a	31.2 a	22.5 a
30 kg/ha K20	5.5 ab	No data	8.8 a	3.5 a	14.8 a	7.8 b	30.0 a	20 a

5 kg/ha 10 kg/ha 30 kg/ha Control Gypsum



Where is the K coming from???

- We haven't added K in 6 years, turfgrass performance is excellent
- Potassium removal drastically exceeds soil exchangeable K supply
- Soil exchangeable K supply is relatively steady despite substantial removal
- K is likely being extracted from potassium feldspars (non-exchangeable) in the sand
- Because of sand topdressing practices, this pool will never be exhausted
- Potassium fertilization appears to be completely unnecessary for this system

- Total Soil K
  - 0.023% K of soil mass
  - Root zone weight (15 cm): 2,540,000 kg/ha
  - Total soil K = **576 kg/ha**
- Exchangeable K: 20 mg/kg Mehlich-3, or 50 kg/ha
  - Declining at a rate of 2.5 mg/kg/yr, or 6 kg/ha
- Plant uptake: 73 kg/ha
- This mass balance model suggests that the plant must remove entire exchangeable pool plus 17 kg/ha in non-exchangeable K (3% of total soil K). This model ignores leaching

- **Other data (not shown)**
  - No impact on dollar spot (huge sample size every year)
  - Minor influence on brown patch (K makes brown patch more severe, but sample size small)
  - Winter kill or other diseases/stresses were not observed during the study period

Conclusions/Implications

- **Bentgrass appears to be able to efficiently extract K from non-exchangeable soil pools**
- **Following soil testing guidelines may result in increased microdochium disease pressure**
- **Soil K should be adjusted to soil testing thresholds in spring and summer, while avoiding fall applications on bentgrass**