Annual Bluegrass Response to Potassium and Calcium Fertilization and Soil pH

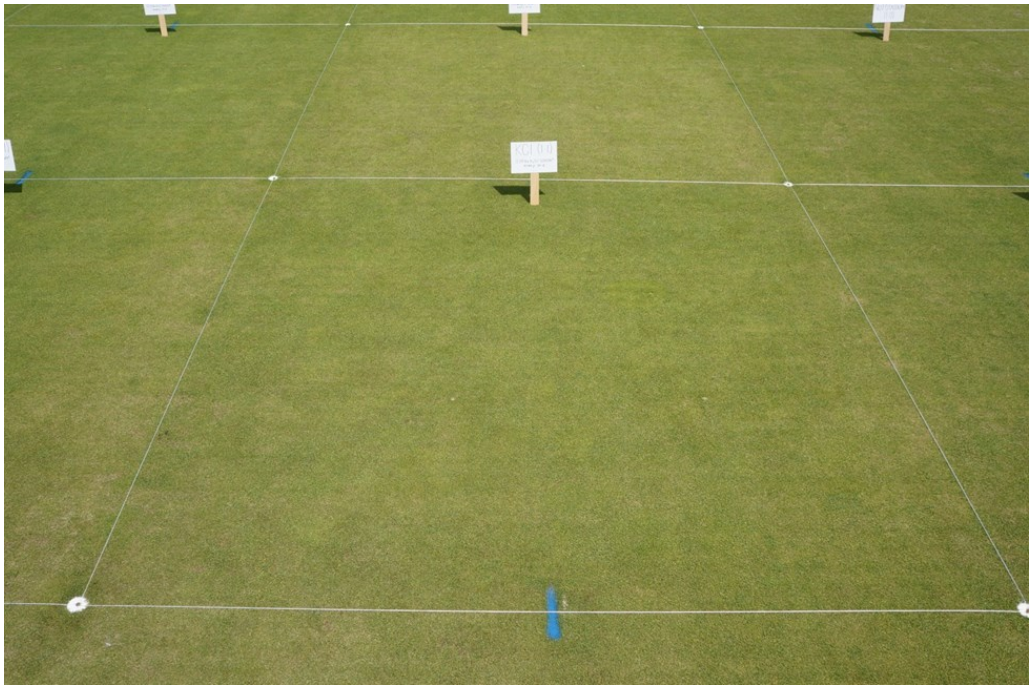
James Murphy, Charles Schmid, and Bruce Clarke
Rutgers University

Turfgrass and Environmental Research Online
Volume 13, Number 2 | March–April 2014

Objectives:

The goal of this project is to develop sufficiency ranges for potassium, calcium, and soil pH. Our specific objectives are to 1) establish sufficiency ranges for potassium based on soil test level, tissue concentration, and turf performance of annual bluegrass; 2) determine whether potassium source influences annual bluegrass growth and quality; 3) quantify the responses of annual bluegrass over a range of soil pH and determine a critical level; and 4) confirm that the response to soil pH adjustments is not due to calcium nutrition.

Annual bluegrass (ABG) is one of the most common species grown on putting green surfaces throughout temperate climatic regions. Despite its prevalence in golf course turf, there is limited information about the nutritional requirements of annual bluegrass. Improvements have been made in our understanding of nitrogen requirements for annual bluegrass turf. However, our recent work indicates that sufficiency levels for other nutrients including potassium and calcium, and soil pH could be determined from annual bluegrass performance in field trials.



Anthracnose severity on potassium research plots (N:K of 1:1; KCl source) in North Brunswick, NJ; photo taken 31 July 2013.

Potassium *(Objectives 1 & 2)*

A study to determine the effect potassium source and rate on ABG turf quality and anthracnose severity was initiated spring 2012. Four potassium (K) sources [potassium chloride (KCl), potassium sulfate (K2SO4), potassium nitrate (KNO3), potassium carbonate (K2CO3)] were applied at 1:1 elemental N:K ratio. Potassium chloride and potassium sulfate were also applied at 2:1 and 4:1 ratios. A no nitrogen check (with KCl applied at a rate equal to the 1:1 treatments) and no potassium check were included. Treatments were applied in unison with the biweekly applications of urea at 0.1 lb N 1000 ft^{-2} to all plots except for the no nitrogen check and KNO3 treatment, beginning in April and continuing through October. In 2013, treatments that received both N and K had significantly less anthracnose severity than either nutrient applied alone (Figure1). A rate difference became apparent by early August 2013; 4:1 treatments had greater disease severity than 2:1 and 1:1 treatments. As disease pressure

TERO Vol. 13(2):2–4 | March–April 2014.
USGA ID#: 2013–09–470
TGIF Number: 240121

increased, turf quality decreased, especially when either nutrient was applied alone. Turf quality for N alone and K alone was below acceptable quality (< 5) from July through October in 2013; whereas the turf quality of N:K treatments were always acceptable (Figure2). Soil test data from 2012 indicates that potassium treatments increased soil K levels in the mat layer (Table 1). It appears that a soil K level in the moderate range (51–116 ppm) is sufficient to reduce disease severity compared to lower soil K levels; however, it is not clear whether soil K levels above the moderate range are beneficial. Further analysis of soil and tissue samples from 2012 and 2013 are ongoing; soil and tissue K data will be used to establish a sufficiency range for ABG turf.

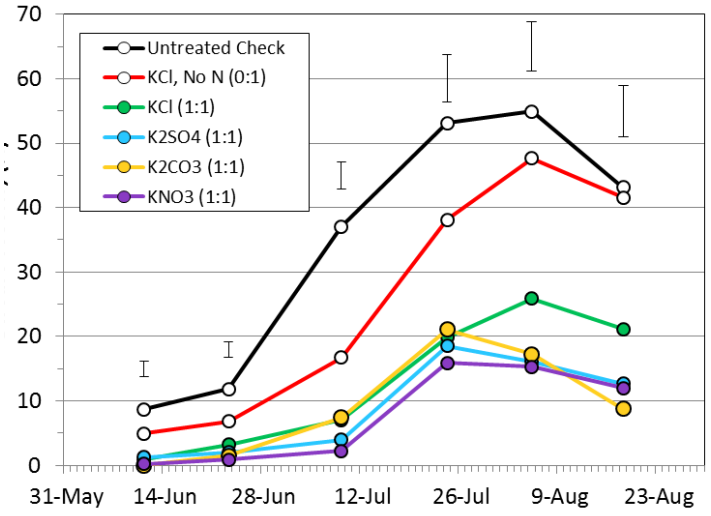


Figure 1. Effect of potassium (2:1 and 4:1 treatments excluded) on anthracnose severity of annual bluegrass turf in North Brunswick, NJ during 2013.

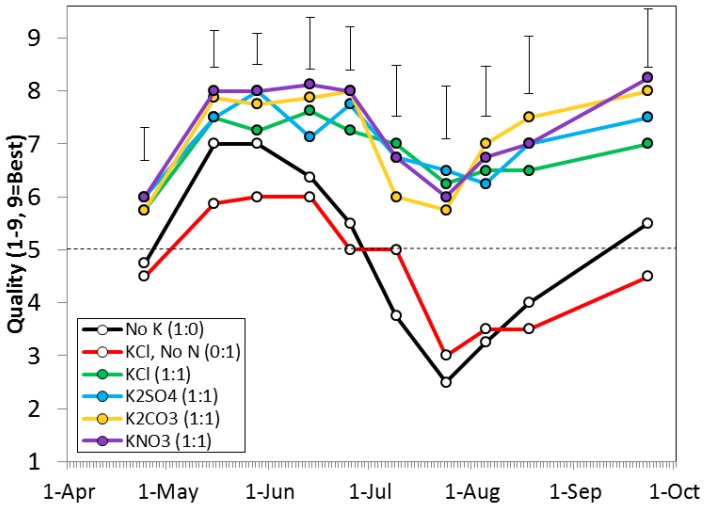


Figure 2. Effect of potassium source (2:1 and 4:1 treatments excluded) on turf quality of annual bluegrass in North Brunswick, NJ during 2013.

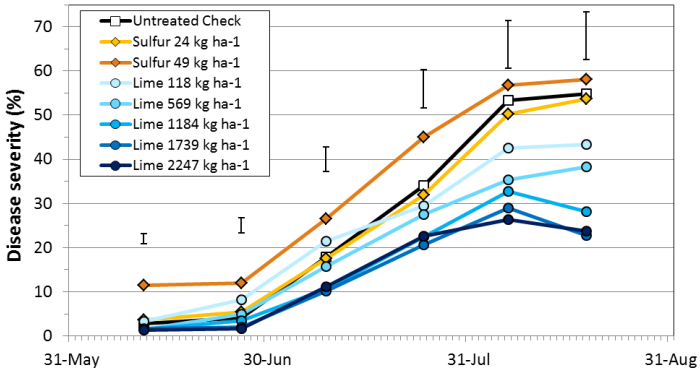


Figure 3. Anthracnose severity responses to soil pH modification treatments on annual bluegrass turf in North Brunswick, NJ during 2013.

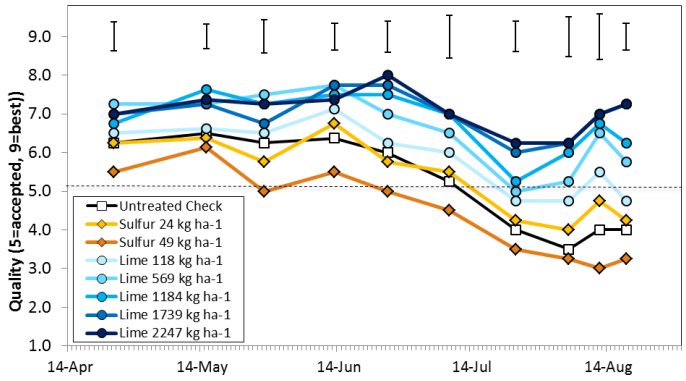


Figure 4. Turf quality response to soil pH modification treatments on of annual bluegrass turf grown in North Brunswick, NJ during 2013.

TERO Vol. 13(2):2–4 | March–April 2014.
USGA ID#: 2013–09–470
TGIF Number: 240121

Table 1. Potassium source and rate effect on mat and soil potassium levels under annual bluegrass turf grown in North Brunswick, NJ during 2012.

Treatment [a b]	Mat K level [c d]			Soil K level		
	20–Jun	6–Aug	17–Sep	20–Jun	6–Aug	17–Sep
	---------- mg kg^{-1} ----------					
No Potassium (1:0)	46	29	34	77	66	59
KCl (4:1)	55	42	53	77	66	62
KCl (2:1)	67	51	69	78	70	67
KCl (1:1)	109	77	97	82	87	93
K_2SO_4 (4:1)	62	42	54	75	74	61
K_2SO_4 (2:1)	66	58	68	77	72	79
K_2SO_4 (1:1)	108	72	100	78	84	96
K_2CO_3 (1:1)	90	78	85	75	86	80
KNO_3 (1:1)	99	81	102	81	82	92
KCl, No Nitrogen (0:1)	121	83	93	80	87	96
LSD $_{(P \leq 0.05)}$ [e]	20	9	20	---	9	9

[a] Treatments applied every 14–d at 0.34, 0.17 and 0.08 lbs K2O 1000 ft–2 for the 1:1, 2:1, and 4:1 (N:K) treatments, repsectively, from 25 April to 6 Nov 2012
[b] Nitrogen applied every 14–d from 25 April to 6 Nov 2012 at a rate of 0.1 lbs N 1000 ft–2
[c] Soil K levels estimated using the Mehlich III extractant method
[d] 1 mg kg–1 = 2 lb A–1
[e] Treatments separated using Fisher's Protected LSD

Soil pH and Calcium *(Objectives 3 & 4)*

A study to determine the effect soil pH and calcium nutrition on ABG turf quality and anthracnose severity was initiated December 2011. Five liming (CaCO3) treatments were applied on 12 Dec. 2011 at a rate of 118, 569, 1184, 1739, and 2247 kg CaCO3 ha^{-1} based on target pH levels of 5.8, 6.3, 6.8, 7.3, and 7.8, respectively, in the mat–thatch layer. Elemental sulfur was applied at a rate of 24 and 49 kg S ha^{-1} to decrease pH. Two gypsum ($CaSO_4$*$2H_2O$) treatments were included to assess the equivalent rate of calcium applied in the 569 and 1184 kg $CaCO_3$ ha^{-1} treatments. By the end of 2012, the greatest soil pH (5.8) was observed in the 2247 kg CaCO3 ha^{-1} treatment and the lowest pH (4.3) was observed in the 49 kg S ha^{-1} treatment. In 2013, anthracnose severity was most severe in the sulfur treatments and untreated check (Figure 3), which caused a significant decrease in quality from July through September 2013 (Figure 4). Lime rates of 1739 and 2247 kg CaCO3 ha^{-1} decreased anthracnose severity and increased quality compared to lower lime rates and sulfur treatments. Soil samples from 2013 and tissue samples from both 2012 and 2013 will be analyzed and correlated with ABG color, quality and anthracnose severity to determine a sufficiency range for soil pH.

Summary Points

- Biweekly applications of potassium in combination with nitrogen reduced disease severity and provided the best turf quality; either nutrient alone (N or K) did not provide acceptable quality during disease stress.
- Soil K levels within the moderate range (51–116 ppm) result in higher turf quality and less severe anthracnose severity compared to lower soil K levels.
- Low soil pH (< 5) decreased turf quality and resulted in increased anthracnose severity.

TERO Vol. 13(2):2–4 | March–April 2014.
USGA ID#: 2013–09–470
TGIF Number: 240121