Decreased Pink Snow Mold Associated with Low Soil Potassium

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Potassium is an essential plant nutrient that plays an important role in osmotic regulation and stomatal movement (water relations), cell elongation, protein synthesis, enzyme activation, and photosynthesis. It is often described more simply as a "stress" nutrient that is important for minimizing traffic stress, heat stress, cold stress, and disease stress, among others. I wrote a two-part series in 2011 in the Grass Roots on the scientific evidence supporting each of these claims (part 1) and how I'd fertilize turf based on the weight of that evidence (part 2). In this article, I'll report on some interesting observations on the effect of potassium on pink snow mold (Microdochium nivale) incidence over the winter of 2013-14 from our ongoing soil test potassium calibration trial at the O.J. Noer Facility.

Here is a brief overview of the study methods. In 2011, we began a trial to attempt to identify the lowest level of soil potassium that would still provide high quality putting green quality. We also wanted to create severe potassium deficiencies to document those symptoms for teaching purposes. We used an 'A4' creeping bentgrass putting green on a 100% sand root zone. The green was previously used for the phosphorus soil test calibration study (Kreuser and Soldat, 2012). We mowed five days per week at 0.125", and fertilized with 0.2 lb urea N per 1000 ft2 every two weeks, and irrigation was applied as needed based on soil moisture.

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The treatments are different levels of potassium, including no potassium, and 0.1, 0.2, and 0.6 lbs K2O per 1000 ft2 every two weeks. An additional treatment of 0.2 lbs per 1000 ft2 of calcium sulfate was also included in the treatment list and was intended to decrease potassium in soil and tissue even more rapidly that the control. Liquid fertilizer treatments are sprayed every two weeks during the growing season in two gallons per 1000 ft2.

Beginning in 2012, we used a golf cart simulator to provide traffic stress three times weekly. Fungicides have not been applied since 2011 in order to quantify potential differences in disease. Each month, we collected data on turfgrass color, quality (1-9, 6 being acceptable), clipping mass, Mehlich 3 soil potassium, and tissue potassium content.

Visually, this study has been about as boring as it gets. In three seasons, we have yet to observe any statistical differences in color, quality, or clippings (Table 1). However, after the snow melted this spring, differences among the treatments in pink snow mold damage were apparent.

I counted infection centers in each plot and had Dr. Paul Koch estimate the percent of plot area affected by the disease. While disease pressure was low, it was clear that the snow mold damage was influenced by the potassium treatments. Treatments receiving no potassium were essentially free of damage, and treatments receiving 0.2 - 0.6 lbs K2O/1000 ft2 biweekly had roughly 10 infection centers per plot, covering about 3.5% of the turf.

The treatment receiving 0.1 lbs of K2O/1000 ft2 biweekly had statistically similar damage as the controls. As you'll notice in Table 2, as potassium in the leaf tissue increased, the calcium in the leaf tissue decreased. Magnesium was less affected by potassium than calcium was. Snow mold damage (infection centers or % damage) was positively correlated (r2=0.95) with tissue potassium and negatively correlated with tissue calcium (r2=0.91).

We do not yet understand the mechanism, but it is possible that the effect of potassium is to lower the calcium levels to a point where the plant becomes susceptible to fungal infection.

Table 1. Average turfgrass color, quality and daily clipping mass for the three study seasons. Color is measured using the Spectrum CM-1000 on a scale from 1-999 (greenest) and quality is rated using the NTEP scale of 1-9 (best). Results followed by different letters within each column are statistically different according to Fisher's Least Significant Difference (alpha=0.05).

Treatment	-------------- 2011 --------------			-------------- 2012 --------------			-------------- 2013 --------------		
	Color	Quality	Clippings	Color	Quality	Clippings	Color	Quality	Clippings
	1-999	1-9	g	1-999	1-9	g	1-999	1-9	g
0.2 lb Ca/M (gypsum)	219 A	6.31 A	2.5 A	239 A	6.17 A	2.9 A	238 A	6.15 A	2.3 A
Control (no application)	217 A	6.06 A	3.1 A	227 A	6.21 A	2.9 A	236 A	6.10 A	2.4 A
0.1 lb K_2O/M (K_2SO_4)	215 A	6.28 A	2.4 A	229 A	6.08 A	2.0 A	232 A	5.80 A	2.0 A
0.2 lb K_2O/M (K_2SO_4)	217 A	6.38 A	2.7 A	235 A	6.13 A	2.2 A	231 A	5.85 A	2.2 A
0.6 lb K_2O/M (K_2SO_4)	214 A	6.13 A	3.1 A	235 A	6.21 A	2.7 A	232 A	5.90 A	2.1 A

Table 2. Pink Snow Mold (PSM) Infection rates as a count of infection centers and percentage of plot area occupied by infection from 4/2/2014. Tissue and soil nutrient content data was collected on 9/28/2013, the most recent sampling date prior to winter. Results followed by different letters within each column are statistically different according to Fisher's Least Significant Difference (alpha=0.05).

Treatment	PSM Infection Centers	PSM Damage	9/28/2013 Tissue Content			9/28/2013 Mehlich 3 Soil Test		
	#/plot	-------%-------	--- % K ---	--- %Ca ---	--- %Mg ---	K (ppm)	Ca (ppm)	Mg (ppm)
0.2 lb Ca/M (gypsum)	0.5 B	0.0 B	1.42 D	0.69 A	0.46 AB	21.5 C	934 A	243 A
Control (no application)	1.0 B	0.5 B	1.45 D	0.61 B	0.48 A	26.2 BC	875 A	248 A
0.1 lb K_2O/M (K_2SO_4)	6.0 AB	2.5 A	1.81 C	0.57 B	0.47 AB	33.6 B	803 A	233 A
0.2 lb K_2O/M (K_2SO_4)	9.8 A	3.3 A	2.02 B	0.51 C	0.43 BC	33.1 B	930 A	252 A
0.6 lb K_2O/M (K_2SO_4)	8.8 A	3.5 A	2.19 A	0.48 C	0.41 C	45.9 A	848 A	234 A

Other researchers have observed increased snow mold with increasing potassium applications (see Soldat, 2011a for a list), so this finding is another brick in the wall of that body of work. Interestingly, researchers at Rutgers reported decreased anthracnose as potassium increased (Schmid et al., 2013). Details from that study have yet to be fully reported in the literature. However, these findings suggest that the optimum way to manage potassium on a sand root zone is to allow the soil potassium levels to drop near the PACE Turf/Asian Turfgrass Center's MLSN level of 35 ppm, then begin spoon feeding potassium in spring through summer, and stopping in August to allow the tissue levels to decrease and calcium levels to rise (which will happen naturally). I intend to continue managing the study until the point where the turf begins to show visual symptoms of potassium deficiency. I hope that happens sooner than later, but for now the study has finally yielded a piece of information that I hope you'll find useful as you plan your fertilizer programs for 2014. See you at field day!

References:

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Figure 1. Pictures from April 2, 2014 showing light pink snow mold damage, but highly correlated with potassium fertilization and soil and tissue potassium content. Dollar spot damage is also apparent from fall 2013. There were no significant differences in dollar spot damage among the treatments. Grass is 'A4' creeping bentgrass, root zone is 100% sand.