Evaluation of Fertilizer Application Strategies for Preventing or Recovering from Large Patch Disease of Zoysiagrass

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Large patch caused by *Rhizoctonia solani* AG2-2 LP is a perennial disease that causes severe damage on zoysiagrass fairways in the United States transition zone. Control of this disease is difficult, and reliant on preventive fungicide applications in the fall and spring to achieve adequate control. Nitrogen fertilization during large patch development has been discouraged since brown patch in cool season turfgrasses, caused by a different *R. solani* anastomosis group, is more severe in over-fertilized turf. Recent research from Kansas State University, however, found fertilization with urea during the spring and fall resulted in less large patch severity. This information, along with the dramatic impact that ammonia-based nitrogen fertilization has had on reducing severity of other turfgrass diseases, necessitates a more thorough examination of nitrogen fertilization practices and the large patch pathosystem. The objectives of this research are to 1) determine the influence of nitrogen source on the growth and biology of the large patch pathogen, and 2) evaluate the impact of fertilization with different nitrogen sources on the large patch incidence and disease recovery in the greenhouse and field.

Laboratory assays utilizing ammonium sulfate as a sole nitrogen source consistently demonstrate a loss of hyphal pigmentation in large patch pathogen isolates. In pH buffered (with fumaric acid) and unbuffered media, subsequent studies have demonstrated increased mycelial growth of large patch pathogen isolates on calcium nitrate, intermediate growth on ammonium sulfate, and lowest growth on urea (**Fig. 1**). Greenhouse studies are being conducted to determine if these morphological changes subsequently result in a loss or reduction in pathogen virulence.

In 2013, a 3-year field experiment was initiated at the University of Missouri in Columbia, MO and Kansas State University in Manhattan, KS. Urea, calcium nitrate, and ammonium sulfate were applied to asymptomatic zoysiagrass at 0.75 lb N/1000 ft^2 when 5-day soil temperature averages taken at the 2" depth were either 60°F or 70°F in the spring, or 70°F in the fall. A standard program consisted of urea at 0.5 lb N/1000 ft^2 applied in June, July, and August.

Ammonium sulfate applied in fall and spring provided more green cover in spring 2014 on several rating dates during periods of large patch activity, providing some evidence an acidifying nitrogen source may reduce large patch severity compared to neutral or alkaline-inducing sources. Future studies are necessary to confirm this effect, however, since the result was inconsistent between the two sites in 2014, and was not observed again the following spring in Kansas. Fertilizer applications made in late spring to zoysiagrass (70°F soil temperature threshold) during active large

patch epidemics resulted in decreased large patch severity (higher percent green cover) on several rating dates in Missouri, but was similar to the summer standard treatment in Kansas (**Fig. 2**). Though the nature of the difference among sites is unclear, spring nitrogen applications did not increase large patch severity at either site as previously believed. A fall application when soil temperatures declined to 70°F extended green color in the fall, but did not consistently promote earlier greenup in the spring or affect large patch severity.

A second field experiment was initiated in fall 2014 in Columbia, MO investigating the impact of timing, continued use of the same N source throughout the summer, and integration of a single spring fungicide application into a large patch control program. After the first year of study, spring nitrogen applications resulted in higher green cover percentage (i.e. lower large patch severity) during periods of large patch severity (**Fig. 3**). This finding substantiates our previous research indicating nitrogen applications made during the infection period do not result in increased large patch severity, but may instead encourage disease recovery or tolerance.

Bullet Points

- Fall and/or spring nitrogen applications at the soil temperature thresholds and rates examined in this study do not result in higher large patch severity.
- Conversely, these non-summer applications may result in desired effects of earlier spring greenup and sustained fall color, and on established 'Meyer' zoysiagrass can be used without the apprehension of increasing large patch damage or decreasing cold tolerance.
- The impact of nitrogen source on large patch severity is unclear, but usage of a particular source may need to be sustained over a longer period to impact disease occurrence.

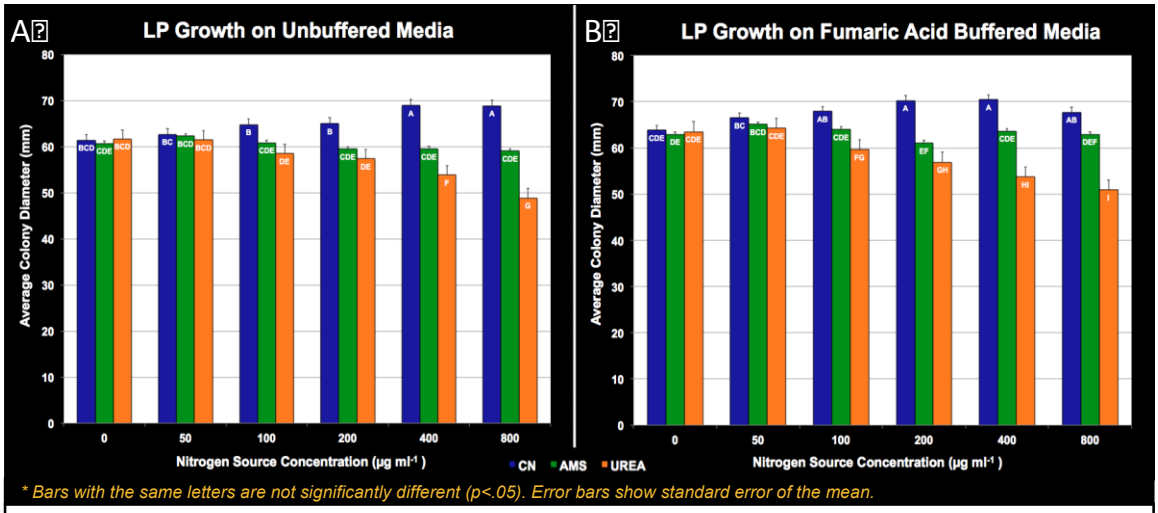

Figure 1. Growth of large patch isolates on nitrogen amended media.

A. Radial growth of *R. solani* AG 2-2 LP on media amended with either calcium nitrate, ammonium sulfate, or urea as the nitrogen source at concentrations from 0 to 800 µg ml^{-1}.

B. Radial growth of *R. solani* AG 2-2 LP on media buffered with 200 µg ml^{-1} of fumaric acid and amended with either calcium nitrate, ammonium sulfate, or urea as the nitrogen source at concentrations from 0 to 800 µg ml^{-1}.

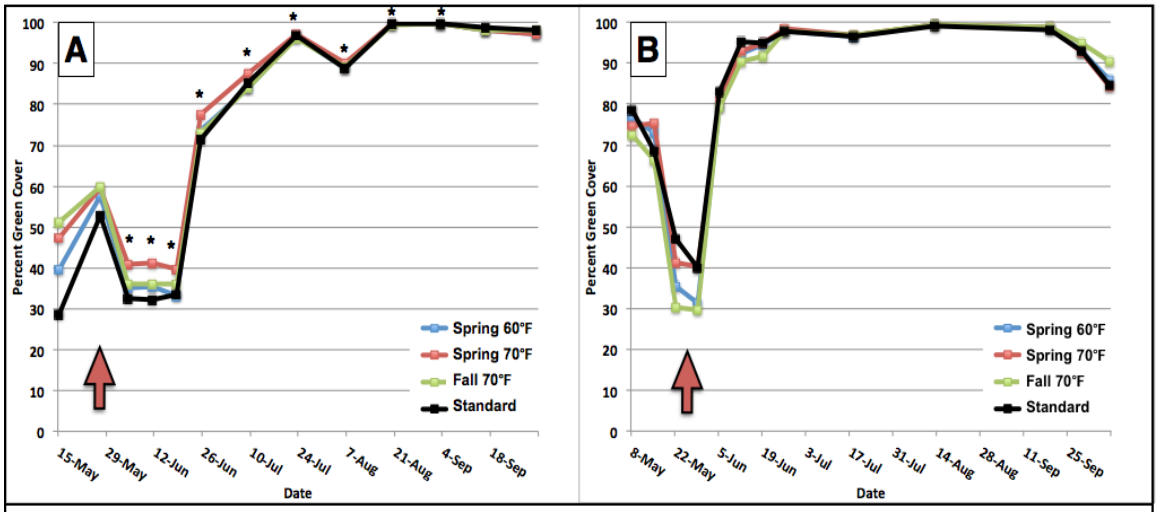

Figure 2: Effect of spring and fall nitrogen applications on large patch of zoysiagrass in A) Columbia, Missouri and B) Manhattan, KS in 2014. Nitrogen was applied at 0.75 lb N/1000 ft² at 60°F or 70°F soil temperatures in the spring or 70°F soil temperatures in the fall (5-day average @ 2 in). The summer (standard) treatment acted as a control, consisting of three summer applications of 0.5 lb N/1000 ft² in June, July and August. The total N applied to all plots was 1.5 lb N/1000 ft$_2$ per annum.
Adapted from Miller et al, 2016. Influence of nitrogen source and application timing on large patch of zoysiagrass. Crop, Forage & Turfgrass Management. First Look - doi: 10.2134/cftm2015.0189.

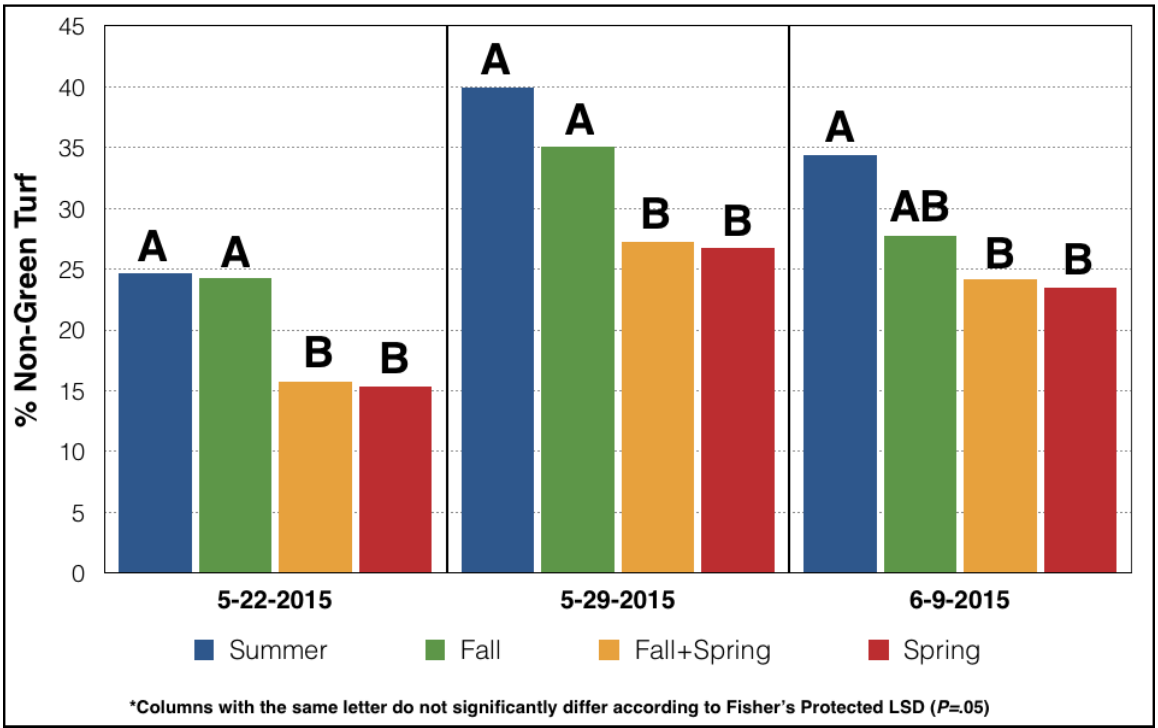

Figure 3: Effect of fall, spring and fall + spring nitrogen applications on large patch of zoysiagrass. Nitrogen was applied at 0.5 lb N/1000 ft^2 in fall, spring, and fall + spring treatments at 65°F soil temperatures (5-day average @ 2 in). The summer (standard) treatment acted as a control, consisting of three summer applications of 0.66 lb N/1000 ft^2 in June, July and August 2014. The total N applied to all plots was 2 lb N/1000 ft_2 per annum.