Cool-Season Lawn Turf Response to Fall Applied Nitrogen Programs Across the North Central States

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Lawns provide numerous benefits, particularly in urban areas. Traditional lawn maintenance practices include mowing and periodic fertilization, using mostly nitrogen (N) based fertilizer sources. Cool-season lawn grasses require periodic N fertilization to maintain green color, growth and vigor and ensure stand persistence. A properly fed turf is also more tolerant of pests and environmental stress. Traditional lawn fertilizer programs for cool-season grasses involve applying N fertilizer one to four times annually with an emphasis on applications during the late-summer and autumn months. In response to declining water quality concerns, several states have proposed or passed legislation that limits overall N-rates, and application timing.

Study Goals: Optimize fertilizer nitrogen applications for cool-season lawn turf areas that maximize turf health and aesthetic benefits while preserving and protect water quality. Provide clearer regional guidelines to homeowners and professionals regarding optimum regional nitrogen fertilizer timings.

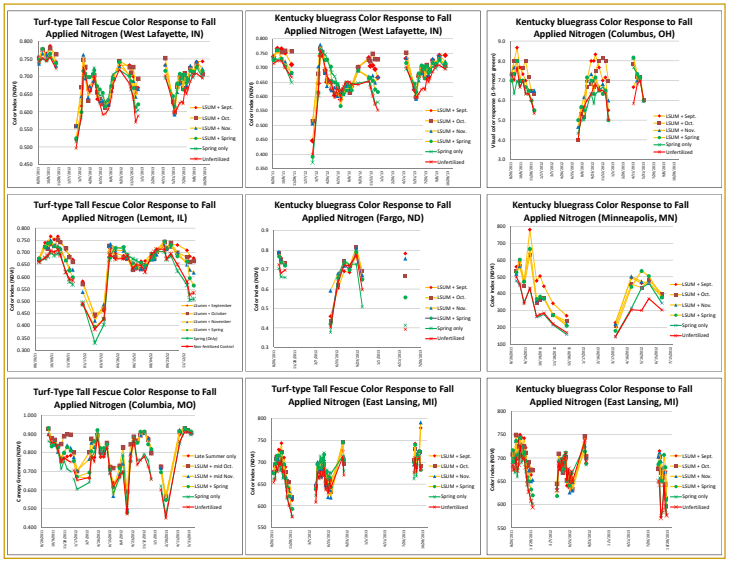
Table 1. Overview of the fall applied nitrogen treatments.

Treatment	Application timing	Nitrogen (N) quantity applied	N-Source†
		--- kg N ha^{-1} ---	
1	Late-summer (LSUM) = middle/3rd week of Aug. + mid-Sept.	49 + 49	STB + STBW
2	LSUM + mid-Oct.	49 + 49	STB + STBW
3	LSUM + mid-Oct	49 + 49	STB + STBW
4	LSUM + mid-Oct	49 + 49	STB + STBW
5	Spring only (late-March to early April)	49	STB
6	Unfertilized control	0	None

† Fertilizer nitrogen was applied to the cool-season lawns turf using granular applications of readily accessible commercially available products designed for homeowner use, Scotts TurfBuilder™ (STB) or Scotts TurfBuilder w/ Wintergaurd™ (STBW containing 80% Water soluble N).

Rationale: Although lawns provide numerous societal and environmental benefits, the general public and many lawmakers generally view turf areas as having an overall negative effect on the environment, primarily due to declining water quality concerns. Thus, management inputs like fertilization practices are under increased scrutiny and in some regions becoming regulated. Nitrogen application to cool-season grasses during autumn months has a long history and aesthetic and physiological benefits have been documented (Powell et al., 1967a; 1967b). Recent studies, however, have reported strong concerns for N applied during mid to late autumn due to limited N uptake and potential for leaching loss (Miltner et al., 2001; Guillard and Koop, 2004; Mangiafico and Guillard, 2006; Frank et al., 2006; Lloyd et al., 2013). Some of these authors have directly suggested "additional work is required to determine the appropriate late-fall N fertilizer rates, sources, and timings for cool-season grasses in northern climates, while understanding that recommendations should be based on seasonal variability." (Bauer, et al., 2012; Lloyd et al., 2011). Thus, the purpose of this regional study was to assess the effects (e.g. canopy greening response) of several granular nitrogen fertilizer programs across the region where cool-season lawn grasses are commonly grown.

Methods: This multi-state field study evaluated the effects of four autumn N-fertilizer programs, 98 kg N ha^{-1} yr^{-1}, using a widely available granular homeowner fertilizer product. Programs varied by application timing: 49 kg N ha^{-1} in late-summer (LSUM) plus an additional 49 kg N ha^{-1} in Sept., Oct. or November (Table 1). These fall-based programs were compared to an unfertilized control and a 49 kg N ha^{-1} spring only application. Turf N response was primarily quantified by measuring canopy color with hand-held reflectance devices and/or visual ratings. Turf was maintained at approx 8 cm cutting heights and clippings returned during mowing.



This field study was conducted to evaluate the greening response from various N-fertilizer applications (emphasis on autumn N) to cool-season lawn turfs across ten locations throughout the cool-temperate region.

Color response or canopy greenness from the N-fertilizer was determined using quantitative reflectance devices (e.g., CM-1000: Spectrum Technologies) and/or visual assessments.

Generalized Turf Responses:

- Late-summer (LSUM: Aug.) and fall applied N resulted in enhanced seasonal canopy greenness and faster spring green-up at all locations compared to the unfertilized control or a spring only N application.
- In general, the LSUM + either a Sept. or Oct. N application provided the most sustained autumn green color response.
- Although some greening occurred from the LSUM + Nov. application, substantial color and greening benefits were delayed until the following spring.

Future Research: Additional studies should investigate the soil N status and potential N loss on these varying soil types. Further, the effect of these fertilizer programs on the carbohydrate status of the plants should also examined.

Autumn color retention for turf-type tall fescue in Lemont, IL with co-operator Dr. Derek Settle (photo: 4 Oct., 2012).

Late autumn (10 Nov., 2012: WL) green color retention for turf-type tall fescue (above) and Kentucky bluegrass (below).

Spring greening response for turf-type tall fescue (above: 9 Apr., 2013: WL) and Kentucky bluegrass (below: 14 Apr., 2013).

Literature Cited

Bauer, S., D. Lloyd, B.P. Horgan, and D.J. Soldat. 2012. Agronomic and physiological responses of cool-season turfgrasses to fall applied nitrogen. Crop Sci. 52:1-10.
Frank, K.W., J.R. Crum, R.N. Calhoun, and K.M. O'Reilly. 2006. The fate of nitrogen applied to a mature Kentucky bluegrass turf. Crop Sci. 46:209-215.
Guillard, K., and K.L. Kopp. 2004. Nitrogen fertilizer form and associated nitrate leaching from cool-season lawn turf. J. Environ. Qual. 33:1822-1827.
Lloyd, D.T., D.J. Soldat, and J.C. Stier. 2011. Low-temperature nitrogen uptake and use of three cool-season turfgrasses under controlled environments. HortScience 46:1545-1549.
Mangiafico, S.S., and K. Guillard. 2006. Fall fertilization timing effects on nitrate leaching and turfgrass color and growth. J. Environ. Qual. 35:163-171.
Miltner, E.D., G.K. Stahnke, and P.A. Backman. 2001. Leaf tissue N content and soil N status following monthly applications of nitrogen fertilizer to fairway turf. Int. Turf Res. Soc. J. 9:409-415.
Powell, A.J., R.E. Blaser, and R.E. Schmidt. 1967a. Physiological and color aspects of turfgrasses with fall and winter nitrogen. Agron. J. 59:303-307.
Powell, A.J., R.E. Blaser and R.E. Schmidt. 1967b. Effect of nitrogen on winter root growth of bentgrass. Agron. J. 59:529-530.

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