

Nitrogen Fertilization Effects on Three Lawn Species in Indiana

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Objectives

- To reevaluate Purdue's current nitrogen (N) fertilizer recommendations and investigate alternative N rates and application timings for the three cool-season turfgrass species primarily used in home-lawns.
- To determine environmentally responsible N fertility programs that maximize turfgrass quality and health with minimal fertilizer N inputs.

Rationale

Purdue's current N fertilization recommendations for cool-season turfgrasses are 20 years old and recommend that greater than 60 % of N be applied in the fall. These N recommendations were based on research data primarily conducted using Kentucky bluegrass. However, a majority of the home-lawns in Indiana contain other cool-season turfgrass species such as perennial ryegrass and more recently, turf-type tall fescue. For the typical homeowner, N fertilizer is hard to find or purchase in the fall due to the fact that most home improvement stores turn their garden centers into seasonal decorations centers for Halloween and Christmas. Therefore, the purpose of this study is to not only re-evaluate Purdue's current N fertilizer recommendations, but to investigate alternative N application timings and rates for all of the commonly used cool-season turfgrass species used in home lawns. Since nitrate (NO_3^-) leaching from fertilizers applied to turfgrass sites has been proposed as a major source of nitrate contamination of groundwaters in suburban areas where turfgrass is a major land use, these N fertilization programs will be also be assessed for their effect on soil nitrate (NO_3^-) levels.

Procedures

This field experiment was conducted from September 2003 through December 2005 at the W. H. Daniel Turfgrass Research and Diagnostic Center, West Lafayette, IN. Plots (1.5 x 1.5 m with 0.3 m borders) were seeded in May, 2003 with three cool-season turfgrass species: Kentucky bluegrass, perennial ryegrass, and turf-type tall fescue. Fertilizer applications began in September 2003 and continued for two years. Overall, eight N fertility programs were evaluated which varied in annual N quantity, ranging from 0, 1, 1.5, 2.5, and 4 lbs N 1000 ft² yr⁻¹ and application timing (Table 1). Nitrogen was supplied either as sulfur coated urea (SCU: controlled-release, 31-0-0), urea (water soluble, 46-0-0) or a 50:50 (w/w) mixture depending on the season of application season and specific N sources are footnoted in Table 1. Plots were maintained at 6.4 cm with a rotary mower and supplementally irrigated to promote growth and maintain the soil near field capacity.

Clippings were harvested weekly throughout the growing season (April-Nov.), dried at 82°C for 72 h and then weighed to determine dry matter yield. A sub-sample from each week's clipping harvest was analyzed for leaf tissue N content using the LECO CHN-2000 analyzer. Visual turfgrass quality ratings (scale 1-9) were taken weekly and disease occurrence was taken every two weeks during outbreaks assessed as percent turf blight. Canopy greenness was quantified using a hand-held chlorophyll meter (FieldScout CM-1000, Spectrum Technologies Inc.).

Soil samples were taken the first week of December at three depths (0-15, 15-30, and 30-45 cm). These samples were oven-dried, and then ground to determine inorganic soil N using a KCl extraction procedure. In-situ soil solution samples were collected from each experimental plot using suction cup lysimeters located 45 cm below the soil surface (Figures A-C). Samples were collected one week before N application, then three and ten days following. Soil solution samples were analyzed for the presence of ammonia (NH_3^+) and nitrate (NO_3^-) which were determined colorimetrically using a Lachat Quikchem autoanalyzer.



Figures A-C. Lysimeters were installed at 45 cm below the soil surface using a guide and a soil probe.

Results to Date

- Turf-type tall fescue produced the greatest amount of dry matter yield followed by Kentucky bluegrass and then Perennial ryegrass (Figures 1-3). Perennial ryegrass, however, had greater dry matter yield during early spring than Kentucky bluegrass due to the slow green-up of this Kentucky bluegrass blend in the early spring months.
- As expected, for turf-type tall fescue, the higher N fertility programs did produce greater dry matter yield. However, the higher N fertility programs (4 lbs. N) were not significantly different than the medium N fertility programs suggesting that turf-type tall fescue doesn't require higher amounts of N to provide a healthy dense turf.
- For Kentucky bluegrass, late fall N fertilization is necessary for spring green-up and therefore greatly affects dry matter yield. For Perennial ryegrass, medium to high amounts of N fertilizer are required to prevent disease incidence (red thread and dollar spot). Disease outbreaks greatly reduced dry matter yield for this species, however, the higher N programs (4 lbs. N) seemed to increase recovery after disease outbreaks by increasing dry matter yield.
- Annual leaf tissue N content for Kentucky bluegrass ranged from 3.0-3.4 % for 2004 and 3.0-3.7 % for 2005. For Perennial ryegrass leaf tissue N content ranged from 3.2-3.6 % for 2004 and 3.2-3.6% for 2005. For turf-type tall fescue leaf tissue N content ranged from 2.7-3.2% for 2004 and 2.7-3.4% for 2005. For all three turfgrass species, those plots that received greater amounts of N fertilizer had higher % N in their leaf tissue.
- For the chlorophyll readings, which were a quantitative measure of canopy greenness, the greater amounts of N applied in the fall lead to faster spring green-up for Kentucky bluegrass. The spring only N program is just as "green" as the higher N programs but only from July to October. The April 15 N application did not aid in promoting spring green-up in Kentucky bluegrass.
- Nitrate (NO_3^-) concentrations from soil cores (0-15 cm) for Kentucky bluegrass were greatest in December 2003 (2.80 mg kg^{-1}) and 2005 (4.38 mg kg^{-1}) for the November only N program but were not significantly different from the two high N fertilizer programs. These results indicate that the November urea-N recommendation of 1.5 lbs. N 1000 ft^2 is not too high and should not affect our groundwater.
- Nitrate (NO_3^-) concentrations found in soil solution were the greatest during the late fall of 2003 and in the spring of 2004 for perennial ryegrass and especially Kentucky bluegrass. However, these nitrate (NO_3^-) concentrations never exceeded the nitrate-N drinking water standard of 10 mg L^{-1} set by the EPA for human safety.

Acknowledgements

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Table 1. Nitrogen fertility programs for use on cool-season turfgrass lawn species.

Application Timing	Annual Nitrogen Rate†	Monthly Nitrogen Rate					
		Apr.	May	July	Sept.	Oct.	Nov.
------(lbs./1000 ft ² -----)							
Sept. only	1.0	0.0	0.0	0.0	1.0	0.0	0.0
Nov. only	1.5	0.0	0.0	0.0	0.0	0.0	1.5
Spring only	2.5	1.0	0.75	0.75	0.0	0.0	0.0
Sept. & Nov.	2.5	0.0	0.0	0.0	1.0	0.0	1.5
Sept., Oct., & May	2.5	0.0	0.5	0.0	1.0	1.0	0.0
S, N, M, & July	4.0	0.0	0.75	0.75	1.0	0.0	1.5
S, O, N, A, & May	4.0	0.5	0.5	0.0	1.0	1.0	1.0
Untreated	0.0	0.0	0.0	0.0	0.0	0.0	0.0

† Nitrogen (N) was supplied as urea alone in Oct. and Nov., in July sulfur coated urea (SCU) was applied alone, and all other times a 50/50 (w/w) mixture of urea and SCU was applied.

Figure 1. 2004 and 2005 dry matter yield for turf-type tall fescue.

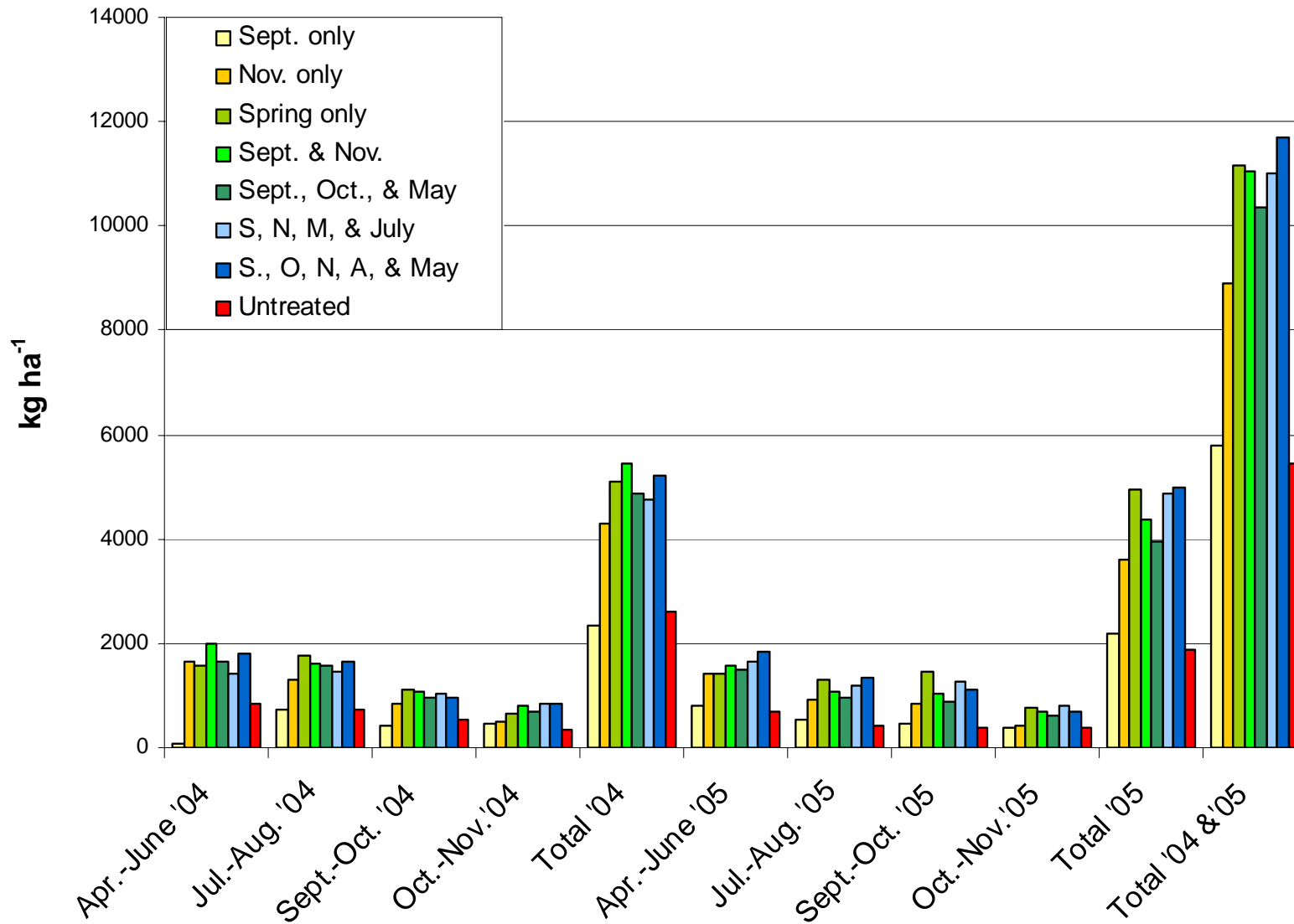


Figure 2. 2004 and 2005 dry matter yield for Kentucky bluegrass.

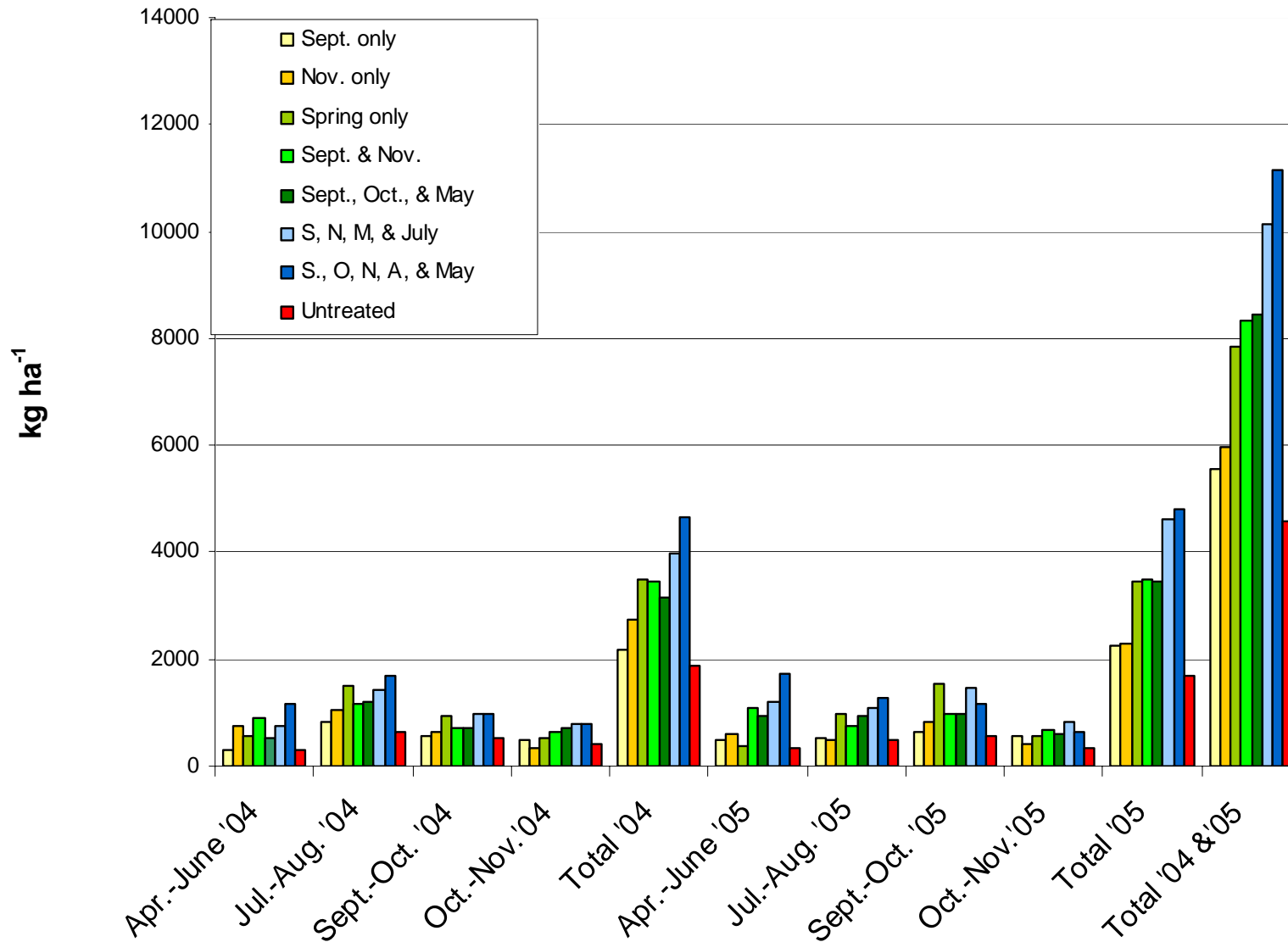


Figure 3. 2004 and 2005 dry matter yield for perennial ryegrass.

