Influence of Preemergent Herbicides on Nitrogen and Phosphorus Uptake and Leaching from Tifway 419 Bermudagrass

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Introduction

Nutrients applied according to the best management practices (BMPs) for Florida golf courses contribute little to nonpoint source pollution when applied to healthy turfgrass. However, some pre-emergent herbicides are documented to inhibit root growth and are applied simultaneously with nitrogen as a sparged fertilizer. Applying both pesticides and nutrient in a single application has been a common practice since the late 1970's. Sparged applications have proven to be an effective method of managing pests while reducing application costs by reducing applications from two (fertilizer and pesticide) to one (sparged fertilizer). However, Florida BMPs do not account for the influence of the root inhibition that may occur following the application of pre-emergent herbicides, particularly when applied simultaneously with N. This scenario has not been investigated and may result in increased N leaching within the boundaries of current BMPs.

Hypothesis

Pre-emergent herbicides applied simultaneously with N will increase N leaching and decrease N uptake from "Tifway" bermudagrass [*Cynodon dactylon* (L.) Pers. × *C. transvaalensis* Burtt-Davy].

Materials and Methods

Location: UF/IFAS Ft. Lauderdale Research and Education Center (26°03'N lat; 80°13'W long)
Start date: 06/09/2017
Grass cultivar: Tifway bermudagrass
Establishment phase: grass sprigged February 23rd at a rate of 33 kg m^{-2}
Soil: 90:10 sand:peat
Experiment design: RCBD – 5 treatments x 4 replications
Fertilizer: 15-05-15 applied at 48.82 kg of N ha^{-1} every two months
Treatments: T1: No turf
T2: Turf + Fertilizer
T3: Turf + Fertilizer + Oxadiazon → herbicide rate: 4.48 kg a.i. ha^{-1}
T4: Turf + Fertilizer + Prodiamine → herbicide rate: 0.54 kg a.i. ha^{-1}
T5: Turf + Fertilizer + Indaziflan → herbicide rate: 0.02 kg a.i. ha^{-1}
Application timing: Treatments are applied with every other fertilizer application
Evaluations:

- N Leached: Leachate collected as needed and analyzed for NO_3-N and NH_4-N.
- Tissue: Collected monthly for yield and N uptake
- Turf quality (scale of 1 to 9 → 1= dead turf; 6= minimum acceptable; 9= optimal healthy turf)
- Reflectance (NDVI)
- Root: two samples from 0-5 cm and 5-15 cm depth collected 4 and 8 weeks after treatment (WAT) and analyzed for root length (cm), root surface area (cm^2), and root length density ($cm\ cm^{-3}$)

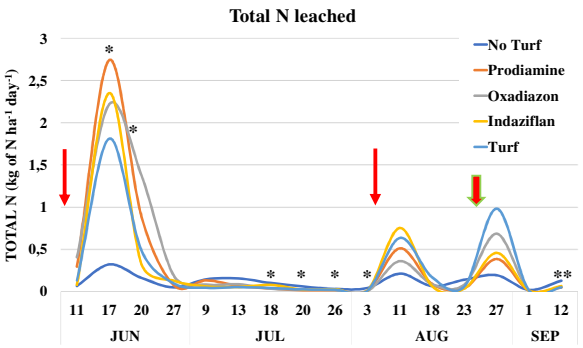
Statistics: Data analyzed using GLIMMIX and means separated using Tukey-Kramer at $P < 0.05$

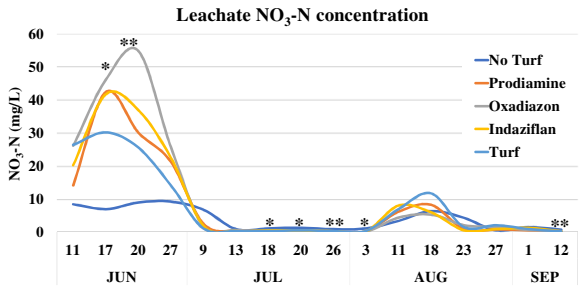
Lysimeters structure

- Stainless-steel container of 40 L capacity (35 cm of diameter by 40 cm deep)
- Top rim 25 cm bellow soil surface
- 15 cm reservoir was left at the bottom
- Leachate is pumped out from every lysimeter through pipes connected to a vacuum pump
- Erlenmeyer flasks collect the liquid from each plot



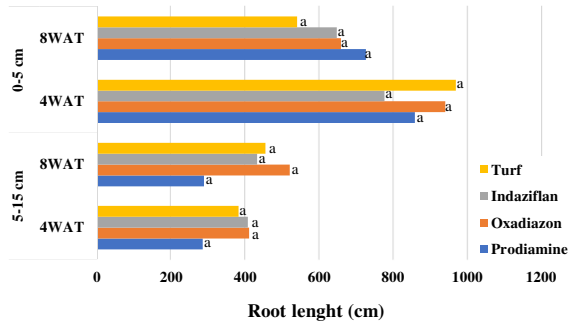
Preliminary Results





- Fertilizer application dates (06/09 and 08/09)
- * Significance at $P \leq 0.05$.
- ** Significance at $P \leq 0.01$.
- Hurricane Irma: 200 mm of rainfall from 08/24 to 08/27

Preliminary Results



- Bars with the same letters are not significantly different based Tukey-Kramer at $P < 0.05$

Discussions

No difference in root length were observed at either 0-5 cm or 5-15 cm. This differs from previous research, as the one conducted by Fagerness et al. (2002) that observed that a fall application of prodiamine at 1.1 kg ha^{-1} significantly postponed the establishment of Tifway bermudagrass sprigs the following summer in more than seven weeks compared to a non-treated control, which indicates root stunting does occur from prodiamine and indaziflan type of herbicide (root inhibitors). While root stunting has not yet been observed, root sampling has only occurred once since the study was initiated. As the study progresses and herbicides continued to be applied, root pruning may become more pronounced.

Total N leached peaked on June 17th and declined to background levels by June 27th. Increased leaching following turfgrass establishment has been noted by other investigators (Fagerness et al., 2004) who found that NO_3-N concentration in the leachate peaked five to seven days after fertilizer application and declined to near 0 mg L^{-1} seven to ten days later. On June 20th Oxadiazon resulted in an 210% increase in NO_3-N concentration compared to the first collection on June 11th. Similar to total N leaching data, NO_3-N concentrations declined to background levels by July 9th. Bowman et al. (2002) presented this same pattern in his research where NO_3-N concentration peaked eight days after N application and declined seventeen days later. With exception of the initial fertilizer application following establishment, total N and NO_3-N concentrations were greater from fallow plots than from treated turfgrass. Because all plots were planted on the same soil (90:10, sand:peat) the decrease in N leaching from turfgrass plots indicates that turfgrass was able to uptake applied N as well as mineralized N that would have naturally leached to groundwater.

Conclusions

To date, we have failed to reject the null hypothesis that pre-emergent herbicides increase N leaching and decrease N uptake. These conclusions are based upon one herbicide application during the initial four months of the study. Because this study will run for two years and incorporate three herbicide applications per year, results may differ over time. The inclusion of turfgrass reduced N leaching compared to non-turf plots indicating turfgrass may provide an ecological benefit by reducing the amount of N that leaches naturally.

Acknowledgements

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