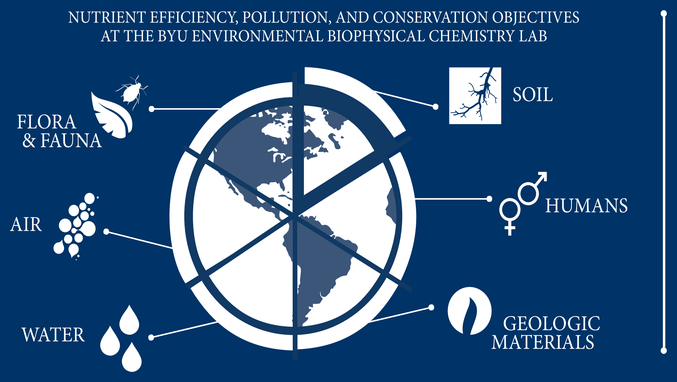

Nitrogen and Irrigation Water Interactions in Drought-Stressed Kentucky Bluegrass

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STUDY OBJECTIVES

- ALLOW FOR AESTHETICS AND FUNCTIONALITY OF URBAN TURFGRASS SYSTEMS
- SUSTAIN SOIL HEALTH AND CARBON SEQUESTRATION
- CONSERVE N FERTILIZER MANUFACTURING RESOURCES
- CONSERVE WATER
- IMPROVE PLANT HEALTH AND INCREASE SUSTAINABILITY IN DROUGHT CONDITIONS

ABSTRACT

There is increasing pressure in arid regions to conserve water, especially during drought cycles. Turfgrass is the irrigated crop of greatest acreage in the United States and is coming under scrutiny in urban ecosystems. The purpose of this study is to evaluate Kentucky bluegrass (*Poa pratensis* L.) under various irrigation and nitrogen (N) regimes. A study was conducted in an environmentally controlled growth chamber with established Kentucky bluegrass. The grass was grown in pots with a depth of 11 cm in calcined clay rooting media. The two moisture regimes were 60 or 100% evapotranspiration (ET) daily replacement values with three N regimes of deficient, optimal, and excessive. Average daily ET was 7.1 mm for the fully irrigated treatment, with 4.3 mm for the limited irrigation treatment. The N rates were 48.8, 146.5, and 439.6 kg ha^{-1} for the deficient, optimum, and excessive treatments, respectively. Nitrogen application was applied in the form of 50% urea and 50% polymer coated urea. For the fully irrigated grass, the excessive N resulted in 14% greater water use and the deficient N had 12% less compared to the optimum N. For the drought stressed plants, excessive N resulted in 9.6% greater water use and deficient N 18% less water use. These results indicate that N management influences ET in Kentucky bluegrass. Reducing N can result in water conservation, but the effects on turf health and appearance must be considered. NDVI readings for the fully irrigated turfgrass increased linearly with increasing N rate with values 0.637, 0.694, and 0.725 for deficient, optimum, and excessive N, respectively. The same trend occurred with the drought stressed plants with values of 0.621, 0.662, and 0.698 for deficient, optimum, and excessive N, respectively. The results suggest that water conservation might be achieved by optimizing the interaction of N and water supply. In one case, limiting N may reduce ET of fully irrigated grass. In another case, high N may help maintain green grass when water supply is limited.

INTRODUCTION

- Turf is beneficial for aesthetic, cooling, health, and soil health/carbon reasons
- Need to conserve water in semi-arid/arid regions
- Need to reduce nitrogen, air, and water pollution
- Much is known about water and nitrogen, but need to understand interaction better
- Proper turfgrass management, especially in drought conditions is necessary

MATERIALS AND METHODS

- Established Kentucky bluegrass rooted in calcined clay
- Grown in an environmentally controlled growth chamber
- Randomized complete block design with 4 reps
- 3 N rates: 49.0, 147, and 440 kg ha-1 for the deficient, optimum, and excessive treatments respectively
- 2 irrigation rates: 60 and 100% of ET
  - 60% - Daily rate calculated as a percentage of the 100% rate for each treatment
  - 100% - Daily rate determined by gravimetric moisture loss for each treatment
- NDVI and thermal (FLIR) imagery taken weekly
- Biomass and N concentration at 28 days

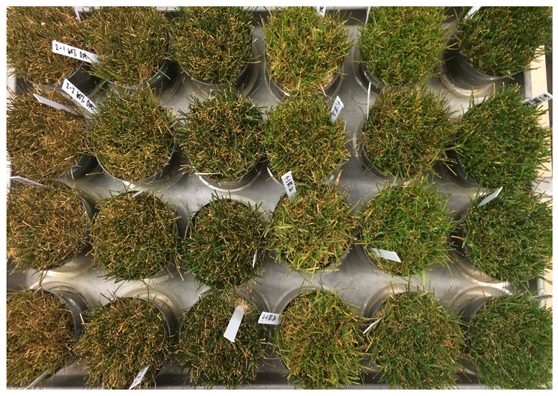
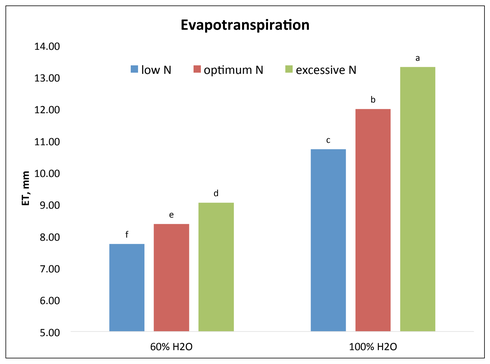


Fig. 1. NDVI gradient is evident in turfgrass treated with 60% ET and deficient N on the left to 100% ET and excessive N on the right.

RESULTS



- For both irrigation levels, increasing nitrogen rates increased evapotranspiration
- Nitrogen management can be employed for water conservation efforts

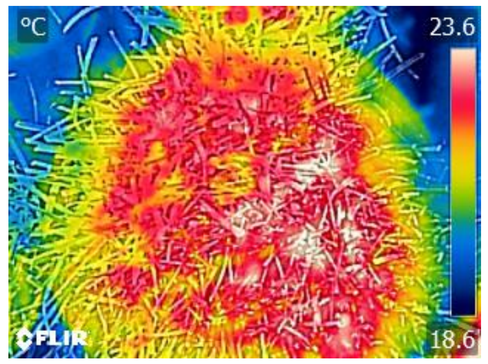
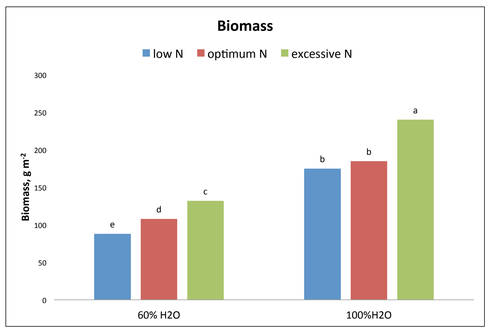
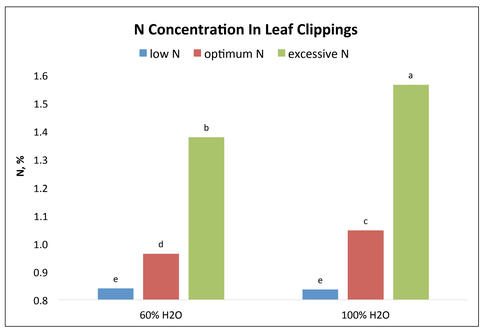


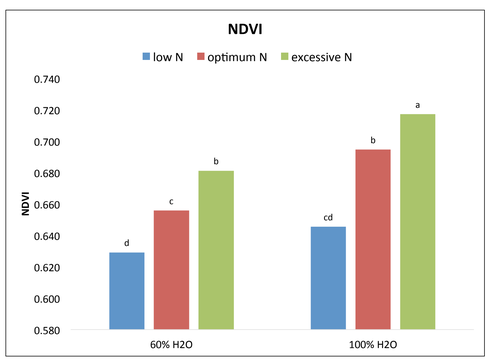
Fig. 2. Thermal canopy photo showing temperature of turf treated with optimum N and 60% ET



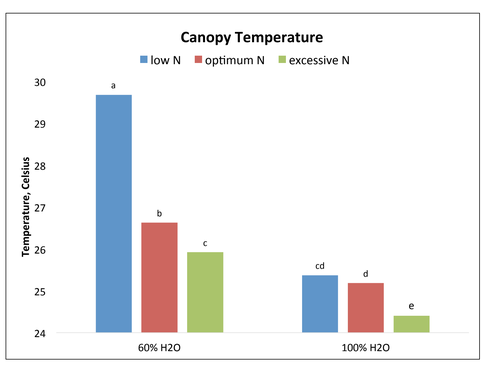
- Biomass increased with increasing N and irrigation rates
- Combined management of water and fertilizer can reduce mowing frequency



- Large differences in tissue N concentration were observed among N treatments
- The N concentration was lower for the deficit irrigated turf at the optimum and excessive rates of N but not at the deficient rate of N



- At both irrigation levels, NDVI (a measure of plant health) increased with increasing N
- While N can be managed to conserve water, a balance with turf health must be achieved



- Reduced irrigation resulted in more plant stress, indicated by higher canopy temperatures
- The magnitude of the N impact was much greater at deficit irrigation

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