Hydrological and Biogeochemical Investigations of Irrigation and Nutrient Management Effects on Surface Runoff from St. Augustinegrass Lawns

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Introduction

St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze) performance under conservation irrigation is poorly described. Further, the effect of summer drought stress on the lawn ecosystem could have unforeseen implications for storm water runoff quantity and quality. To address these concerns, a field study was conducted in College Station, TX, to examine the relationships between St. Augustinegrass health, conservation irrigation management, and surface runoff chemistry. The experiment was conducted at a state-of-the-art surface runoff capture and measurement facility. The study site was graded to an approximately 4% slope and grassed with 'Raleigh' St. Augustinegrass. Three levels of irrigation (well-watered, moderate stress, and severe stress) and three levels of fertility (0x, 2x, and 4x applications per year) were assigned as treatments to 24 plots in a randomized complete block design. Over a two-year period, runoff volume and chemistry were monitored from approximately 32 runoff events. Primary objectives of the study were to quantify NO_3-N losses due to irrigation and fertility management and investigate the relative partitioning among N species in runoff from warm-season turfgrass lawns.

Results

Despite its negative public perception, St. Augustinegrass tolerated relatively severe water conservation schedules. Deficit irrigation programs caused temporary plant attrition, but seasonal rainfall patterns were enough to promote full recovery within 4 to 6 weeks during the fall. Reduced runoff volumes associated with deficit irrigation equated to a short-term reduction in NO_3-N exports. However, the enhanced retention of N fertilizer under deficit irrigation programs ultimately led to higher NO_3-N concentrations in the long-term, presumably due to N

saturation. Higher fertility generally increased NO_3-N concentration in runoff throughout the study period, although the effect was most important under severe deficit irrigation. Seasonally, NO_3-N concentration in runoff was typically below 5 mg L^{-1}, but demonstrated peaks in excess of 20 mg L^{-1} during late winter in one year. Aside from this atypical peak, the largest portion of total dissolved N (TDN) was in the organic form (DON), while NH_4-N was typically the smallest portion.

Conclusions

Under typical environmental conditions for central Texas, moderate deficit irrigation programs (~75% of well-watered) can sustain St. Augustinegrass lawns with minimal long-term damage to turf health. The drier soil conditions of moderate or severe deficit irrigation can incur a positive feedback wherein greater water retention, which if accounted for, would promote further water conservation. Although the reduction in runoff associated with deficit irrigation reduced N exports in the short-term, careful fertility management is required to ensure N saturation does not occur under the enhanced N use efficiency expected under conservation irrigation schedules. Inter-annual variability in NO_3-N losses appears to be most important during the winter when colder temperatures incur complete dormancy of the turf canopy. It may be advisable to physically remove dormant turf during the late winter in order to reduce a potential source of N pollution. Dissolved organic N as an export from turf has largely been ignored by previous research. These data suggest DON could be the primary species of N leaving turf sites, and further study on the relative lability and quality of N in runoff is warranted.