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Cool Season Nitrogen Fate in Cool Season Turfgrass As Affected By Temperature and Evapotranspiration Rate

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Introduction and Objectives

Late fall nitrogen fertilization has many benefits (fall and spring color) from a turfgrass management viewpoint. However, as plant growth and nutrient utilization slows as temperature drops in late fall, the risk to nitrate (NO3-N) leaching increases dramatically (Petrovic, 2004; Mangiafico and Guillard, 2006). Empirical models have been used to develop predictive scenarios of pest occurrence and irrigations needs for turf managers based on weather forecasts. It would be very useful to also have late fall nitrate leaching risk forecast model based on predicted weather. The data needed for such an empirical model would be NO3-N leaching as a function of one or more weather forecast parameters. Thus the object of this study is to determine the extent of NO3-N and NH4-N leaching as a function of temperatures (0-10 C) and evapotranspiration rate (ET) rates (1-5 mm/d) typically observed in late fall period (October through January) for cool-season turfgrasses.

Materials and Methods

The study was conducted in a plant growth facility to regulate temperature and ET rate independently under the following parameters:

- Soils: sandy loam with 62% sand, 24% silt, 14% clay and 1.1% OM in containers (60 cm X 40 cm X 36 cm deep).
- Sodded with Kentucky bluegrass (*Poa pratensis* L., Midnight II and Bedazzle) and mixture (80/20) of tall fescue (Wolfpack) and fine fescue (Reliant) 12 months before study was initiated.
- Urea applied at 49 kg N ha^{-1} followed by 6 mm irrigation.
- Treatments were replicated 5 times.
- The 18 combinations of 6 temperatures (0, 2, 4, 6, 8, 10 C) and 3 ET rates (1.02, 2.54 and 5.08 mm/d) were run with a 2 week interval between runs. 10 hrs of daylight was provided (HID lights).
- 10-11 days following fertilization the containers were leached with water equivalent to 2 pore volumes (15.12 L) to leach soluble N from the containers.
- Leachate was analyzed for NH_4-N and NO_3-N.

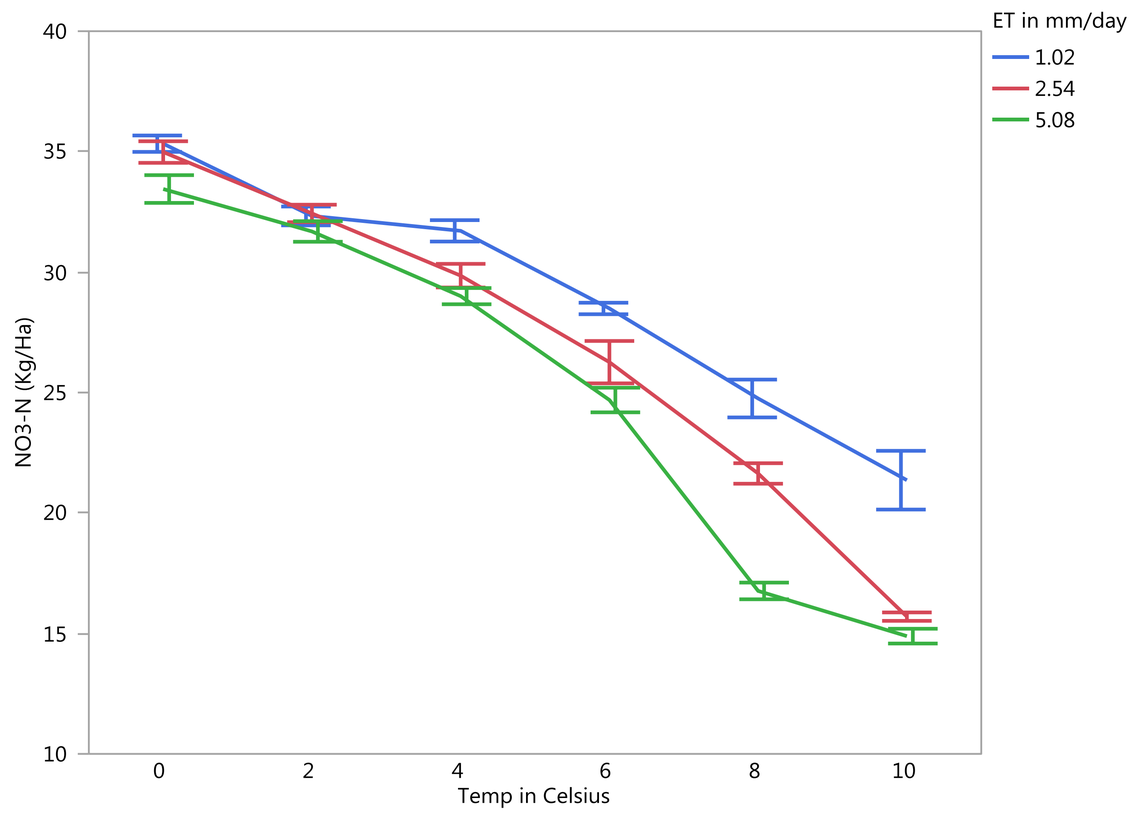

Figure 1. The amount (Kg/ha) nitrate-N that leached 10-11 days after application as affected by temperature and ET rate.

Table 1. Analysis of variance of the mass (kg/ha) of nitrate-N and NH4-N that leached 10-11 days after application.

Source	df	Sum of squares	F ratio	Probability>F
Ammonium				
Turf Type	1	45.1	2.26	0.1343
Temp in Celsius	5	104.4	1.05	0.3911
ET in mm/day	2	63.3	1.59	0.2073
Turf Type*Temp in Celsius	5	138.5	1.39	0.2310
Turf Type*ET in mm/day	2	52.3	1.31	0.2720
Turf Type*ET in mm/day*Temp in Celsius	10	245.2	1.23	0.2756
ET in mm/day*Temp in Celsius	10	212.4	1.07	0.3913
Nitrate				
Turf Type	1	7.2	2.61	0.1082
Temp in Celsius	5	6710.4	485.55	<.0001*
ET in mm/day	2	462.2	83.61	<.0001*
Turf Type*Temp in Celsius	5	17.9	1.29	0.2687
Turf Type*ET in mm/day	2	10.4	1.88	0.1560
Turf Type*ET in mm/day*Temp in Celsius	10	42.2	1.53	0.1353
ET in mm/day*Temp in Celsius	10	245.6	8.88	<.0001*

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Results and Discussion

- The turfgrass types, temperatures and the ET rates or their interactions did not have a significant effect on NH4-N leaching (Table 1.).
- The amount in NH4-N leaching ranged from 6.7 to 10.2 Kg/ha or 13.7 to 20.8% of the amount of N applied.
- The amount of nitrate-N leaching was significant effected by temperature, ET rate and the interaction of temperature-ET rate (Table 1). However, the type of turfgrass had no affect on NO3-N leaching under the late fall weather conditions of this study.
- As expected when temperatures drop from 10 to 0 C the amount of NO3-N leaching dramatically increases, from a low of 35 to 71% of the amount of N applied.
- As ET rate dropped from 5.08 to 1.02 mm/d there also was an increase in the amount on NO3-N leaching, from a low of 51 to 59 % of the amount of N applied.
- The lowest ET rate (1.02 mm/d) had the greatest affect on NO3-N leaching, most apparent at temperatures from 4 to 10 C. When compared to highest ET rate, the NO3-N leaching increased by 8 to 16 % of the amount of N applied.
- These results show the increased risk of NO3-N leaching when applying soluble N in the as temperatures drop below 10 C. The NO3-N leaching risk is incrementally greater as the temperature drops and when weather conditions favor low ET rates.
- These results can be used to develop an empirical model to reduce the NO3-N leaching risk as a function of temperature and ET rate using these weather forecasting parameters.

References

Petrovic, A.M. 2004. Nitrogen source and timing impact on nitrate leaching from turf. 2004. Acta Horticulturae 661:427-432.

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.

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