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Healthy Ecosystem

The goal of the research and outreach project is to develop a sod production fertilization program that will minimize the contribution of nitrogen fertilization to groundwater quality degradation.

Reducing Nitrogen Groundwater Contamination from Sod Production on Long Island, NY

Many of the surface waters in the US, including New York State and the New York City watershed, as well as most of the northeastern US are at risk from the negative impacts of nitrogen and phosphorus runoff and leaching into groundwater. For example, fertilization during sod production on Long Island results in groundwater consistently above drinking water standards (nitrate concentration averaged 18.6 mg/L in 2001 and 24.8 mg/L in 2002). The Peconic Estuary Program recommends a 25% reduction in nitrogen loading from sod production with the implementation of Best Management Practices (BMP's). Sod production, accounting for about 3,000 acres on Long Island, is constantly in the establishment phase where the potential for nitrogen leaching is the greatest. During spring and fall, leaching losses of nitrogen and phosphorus can be significant. Furthermore, the application of soluble nutrients needed to establish a dense stand of turf has the potential to contaminate ground and surface water. The need to develop sound best management practices for nitrogen management for sod production is imperative.

The goal of the research and outreach project is to develop a sod production fertilization program that will minimize the contribution of nitrogen fertilization to groundwater quality degradation. A great deal of work has been done on nutrient losses from agricultural crops, however, due to the nature of turfgrass systems (i.e. perennial ground cover, no tillage) application of crop research to turfgrass can lead to erroneous conclusions. Our hypothesis is that BMP's (nitrogen rate and sources) can be developed to minimize the contamination of groundwater from managed turfgrass areas such as sod production while maintaining an acceptable sod production rate.

The study was initiated in early Fall 2005 and continued through 2006 when sod was harvestable. The site was a sod production field in eastern Long Island (Delea Sod Farms). The soil at the site is Haven loam (HaA). Following the normal establishment practices and seeding, two 30 cm dia. by 30 cm long polyvinalchloride (PVC) lysimeter were installed in each plot.

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We did notice with this project that you could have really great looking turf on a plot but the sod failed to be harvestable when placed on the sod stretcher. This was very true on the high nitrogen plots that were dark green and dense but tore easy. Conversely, plots with little or no N applied looked off color but still some what dense and had good sod strength.

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An ion exchange resign bag was placed at the bottom of each lysimeter to capture nitrate and ammonium leaching past the root zone. Plots are 3 m X 3 m, with 4 replications of each fertilizer treatment and plots arranged in a completely random design. Plots were seeded on Sept 15, 2005 with 75%-25% Midnight Moon Kentucky bluegrass-Fescue mix at a rate of 100-120 lbs/acre.

Fifteen treatments included: the conventional establishment fertilization practice at full rate and half nitrogen rate that the sod farm uses (growers program), three nitrogen sources (quick, moderate and slow release sources) applied at 2, 4, 6 and 8 lbs N/1000 sq.ft. /yr (6 lbs. N/1000 sq. ft./yr is the standard rate for sod production on Long Island), a BMP program using slower release sources, and an unfertilized control plot to determine the amount of residue N in the soil and the amount of N that was mineralized during the study. Plots were fertilized on September 15, 2005, Oct. 20, 2005, May 2, 2006 and July 25, 2006.

For the grower treatment and the BMP a starter fertilizer (12-26-12) was applied at the time of seeding. All other plots received 2 lbs. of P_2O_5 and 1 lb. K_2O/1,000 sq.ft. at seeding. The sod grower accidentally applied a nitrogen fertilizer (16-8-8 Lebanon at about 1.5 lbs. N/1,000 sq.ft.) once in March of 2006 on more than half of the plots, thus, potentially affecting the results as discussed later. Sod strength measurements were done on July 25, 2006, Aug 24, 2006, Sept. 18, 2006, and Oct. 25, 2006. Sod was cut with an 18″ wide sod cutter at a length of 4′ by ¾-1″ thick. Each plot had two tensile measurements taken per date per plot. Once the sod strength reached the value for commercially harvestable sod (99 lbs. as determined from samples of sod from Briarcliff Sod Farm), the resin bags were then removed, in this case on Oct. 25, 2006 from all plots.

Sod harvestability: strength and quality

Sod is determined to be harvestable when it is dense, dark green foliage and will not fall apart when handled. In the first year of this study we record sod strength measurements over time. Generally, the source or rate of fertilizers applied had little effect on sod strength. Commercially available sod (Briarcliff Sod Farm) was determined to have an average sod strength measurement of 99 lbs. Based on the sod strength measurements from the first year of the study, almost all fertilizer sources and rates had acceptable sod strength by Oct 25, 2006, 13 months after seeding. Only on the August 24, 2006 sampling date the slow release sources of Nitroform (1X rate), half the amount of the grower's program was statistically higher than the regular grower's program.

There were no formal visual quality ratings taken because we believed that sod would most likely have acceptable visual quality to have the sod strength necessary to be harvestable. We did notice with this project that you could have really great looking turf on a plot but the sod failed to be harvestable when placed on the sod stretcher. This was very true on the high nitrogen plots that were dark green and dense but tore easy. Conversely, plots with little or no N applied looked off color but still some what dense and had good sod strength.

Nitrate Leaching

The extent of nitrate leaching was determined as at the time of harvest, covering the time period from seeding to harvest. In this way we can compare the extent of leaching between different nitrogen fertilizers applied at different rates.

We are not able to determine when in

the production cycle the nitrate leaching occurred. The unfertilized check is used to determine what might leach unrelated to fertilizing, and reflects the amount of nitrate leaching that comes from mineralization of soil organic matter, from rainfall, and from irrigation. About 50 lbs/acre or 1 lb of nitrate/1,000 sq.ft. leached from the unfertilized plots. Because of the unexpected application of fertilizer made by the grower in March 2006 to part of the plots, only data from 2 of the 4 replicates were evaluated.

The purpose of this study was to evaluate if the release rate and the amount of nitrogen applied during a sod cropping period affected the amount of nitrate leaching. Looking at the source and rate part of the study two trends were noted. First, except for one treatment (Nitroform at 1.5 lbs N/1000 sq.ft. rate), the degree of leaching was linked to how fast the N was released, i.e., fats release leaches more. Thus, urea had more leaching than IBDU that was greater than Nitroform. Second, increasing N rate increased nitrate leaching. This was most evident for urea and less apparent with the other sources, especially with Nitroform. Many of the moderate-release (IBDU) to slow release (Nitroform) treatments had about the same amount or less nitrate leaching than the unfertilized

The bases of the BMP were to modify the growers program with seasonally adjusted N sources to hopefully reduce the extent of N leaching. Both of growers' programs had 3 times the amount of leaching and the BMP had over 4 times the amount of leaching than the unfertilized control.

Table 1. The fertilization treatments including sources and rates applied.

	Fertilizer	analysis	Rate	Total amount of N
			bs/1000 sq.ft.	
1	Control	unfertilized check		
2	Grower program*			6.8
	starter	10-26-12	0.8 N	
	urea	45-0-0	2.0 N	
3	½ Grower program*			3.4
	starter	0-26-12	0.4 N	
	urea	45-0-0	1.0 N	
4	IBDU (moderate)	31-0-0	0.5 N	2.0
5	"	"	1.0 N	4.0
6	"	"	1.5 N	6.0
7	"	"	2.0 N	8.0
8	Nitroform (slow)	38-0-0	0.5 N	2.0
9	"	"	1.0 N	4.0
10	"	"	1.5 N	6.0
11	"	"	2.0 N	8.0
12	Urea (quick)	46-0-0	0.5 N	2.0
13	"	"	1.0 N	4.0
14	"	"	1.5 N	6.0
15	"	"	2.0 N	8.0
16	BMP*			6.0
		10-26-12 (starter)	0.8 N	
		IBDU	1.2 N	
		Nutralene	2.0 N	
		Nitroform	2.0 N	

** Starter fertilizer applied at seeding (Sept. 15, 2005) and the three other applications were made on Oct. 20, 2005, May 2, 2006 and July 25, 2006*

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This data suggests that the application of quickly available N sources at seeding may result in large amount of nitrate leaching. Other studies have also observed that N leaching is the greatest during the establishment period.

check.

The other fertilizer treatments included the standard grower fertilizer practice (including half the amount of N applied) and one based on BMP, designed to reduce leaching. Both grower's programs leached 3 times more N than the BMP and had over 4 times the amount of leaching than the unfertilized control. This data suggests that the application of quickly available N sources at seeding may result in large amount of nitrate leaching. Other studies have also observed that N leaching is the greatest during the establishment period.

The amount of nitrate leaching as expressed on a percent applied basis showed that five of the 15 treatments resulted in less than 15 % of the applied N that leached. There were 9 of the 15 treatments that had < 50 % of the applied N that leached. In other studies we have conducted in Long Island on established Kentucky bluegrass, the greatest percent of leaching was about 50. There should be caution in over emphasizing the results of this first year study since we only considered two of the four replicates.

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Table 2. Impact of fertilizer sources and rates on sod strength for 2006.

Treatment	7/25/2006	8/24/2006	9/18/2006	10/25/2006
	--------------------------- lbs ---------------------------			
Urea at 0.5X	45a*	70ab	93a	110a
Urea at 1X	48a	73ab	87a	96a
Urea at 1.5X	49a	68ab	78a	96a
Urea at 2X	42a	57ab	73a	95a
IBDU at 0.5X	58a	67ab	85a	109a
IBDU at 1X	59a	65ab	90a	108a
IBDU at 1.5X	52a	72ab	87a	101a
IBDU at 2X	49a	65ab	82a	100a
Nitroform at 0.5X	52a	72ab	87a	110a
Nitroform at 1X	52a	80a	90a	112a
Nitroform at 1.5X	51a	76ab	86a	114a
Nitroform at 2X	46a	70ab	85a	101a
Control (unfertilized)	49a	70ab	87a	105a
BMP	48a	65ab	77a	95a
Grower Program at 0.5X	48a	82a	83a	99a
Grower Program at 1X	46a	53b	74a	93a

*lbs of sod tensile strength, average of 2 samples per plot and 4 replicates. Values in the same column not connected by same letter are significantly different. Commercially acceptable sod strength based on this equipment is about 98 lbs.