Nitrogen and Phosphorus Leaching and Runoff from Golf Greens and Fairways

University of Georgia

Larry M. Shuman

Start Date: 1998
Number of Years: 3
Total Funding: $75,000

Objectives:

1. *Quantify the amounts of nitrogen and phosphorous that leach from USGA greens under various management practices.*
2. *Determine the amounts of nitrogen and phosphorous that runoff from a Southeastern piedmont soil under various management practices including the effect of buffer zone width and irrigation scheduling with respect to fertilizer application.*
3. *Determine the effects of forms of phosphorous, dissolved organic carbon (DOC), soil compaction and crusting, and climatic variables on phosphorous leaching and runoff. This information will be incorporated existing fate prediction models.*
4. *Develop best management practices to limit leaching and runoff on nitrogen and phosphorous form golf course greens and fairways.*

This project was initiated in 1998 to determine the potential transport of nitrogen and phosphorus by surface water runoff from fairways and by leaching through golf greens. Experiments on leaching are being carried out at two venues (one greenhouse and one field) and runoff experiments at one field site on campus. A fourth site involves monitoring leachate from two greens at an Atlanta golf course. Highlights of results for this year are reported for each of the four venues.

Two runoff experiments were carried out in 1999 on bermudagrass plots with a 5% slope. The first tested a granular 16-25-12 starter fertilizer and the second a combination of ammonium nitrate and treble superphosphate. Both P sources resulted in the greatest transport at the first simulated rainfall event decreasing dramatically in the three subsequent events. Step-wise increases in P concentration and mass were found for the first event for the 11 and 21 kg ha^{-1} rates. The total mass of P transported combining all rainfall events were 21% for the superphosphate for each rate and 14 and 29% for the two rates, respectively, for the 16-25-12.

The greenhouse experiment carried out this year was for four rates of ammonium nitrate-superphosphate and a water soluble 20-20-20 on columns made to USGA specifications for greens and sodded with bermudagrass. The rates were added twice. A peak for transport was seen at weeks 18-19 for P and week 17 for N. Phosphate concentrations in the leachate were higher for the soluble source at the peak than for the superphosphate. There were little, if any, differences in N leaching found between the ammonium nitrate and the soluble source.

Table 1. Phosphorus leaching concentration (mg/kg) and mass (mg) averages for individual collection dates by year for four years for two USGA golf greens at the Cherokee Town and Country Club, Atlanta GA.

Year	Green 1			Green 2		
	Phosphate P concentration (mg/kg)					
	Mean	Min.	Max.	Mean	Min.	Max.
1995	**3.21**	0.65	6.07	**8.53**	5.55	13.27
1996	**1.14**	0.05	6.79	**1.30**	0.16	6.02
1997	**0.93**	0.05	5.34	**1.72**	0.15	4.11
1998	**0.68**	0.01	13.51	**0.58**	0.01	3.55
	Phosphate P mass (mg)					
1995	**7.06**	0.04	23.03	**22.34**	0.06	77.04
1996	**2.72**	0.03	20.29	**2.89**	0.06	13.53
1997	**2.90**	0.16	13.14	**4.41**	0.10	15.75

Four treatments at three rates were made to field lysimeters in 1999 with the sources being a granular sulfur and poly coated 13-13-13 and a water soluble 20-20-20. Phosphorus showed little transport for any source or rate giving a slight response to treatments only once. The tendency was for the concentration and mass of transported P to decrease during the course of the year despite repeated fertilizer applications as high as 11 kg ha^{-1}. Nitrogen applications showed transport responses for each application and the soluble source gave much higher transport than did the granular coated source. In fact, the granular source only showed peaks slightly above control for two of the four treatments.

Phosphorus concentrations and mass continued to decrease in the leachates from the two putting greens located at an Atlanta country club as they have been for the four years we have been monitoring (Table 1). The bentgrass greens were constructed in the fall of 1994 and were fitted with three lysimeters each. Nitrate levels were generally low (below the 10 mg L^{-1} drinking water standard) for most of the year, but did increase to 20-25 mg L^{-1} late in the year in response to a high N application (0.88 lb. N/1000 sq. ft. as KNO_3). In 1999 one of these greens was removed and two new playing greens were equipped with three lysimeters each.