

Phosphorus Runoff from Turfgrass - Research Update

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Even though statewide restrictions on applying phosphorus fertilizer to turfgrass went into effect in 2005, there is still interest over the impact that this legislation has on water quality and turfgrass health. In order to determine the agronomic and environmental effects of restricting phosphorus in turfgrass fertilizer, a dedicated research facility was established at the Turfgrass Research, Outreach and Education (TROE) Center on the St. Paul Campus at the University of Minnesota during the 2004 growing season. The objectives of this ongoing study are to:

- (1) Determine the extent of P runoff following fertilization of turfgrass;
- (2) Evaluate the effects of clipping management on P runoff;
- (3) Assess the effects of various management practices on turf health;
- (4) Identify best management practices to minimize the potential movement of P from turfgrass.

Methods

Plots for this study were constructed in 2003 and treatments were initiated in fall 2004 following sodding of the TROE site with Kentucky bluegrass. Eight treatments are being evaluated: 4 fertilizer treatments with and without clippings removed. Fertilizer treatments include: control (no fertilizer), N + K, N + K + low P, and N + K + high P. Fertilizer was applied in the spring, early fall and mid-fall in three equal applications. Nitrogen was applied at 3 lb N/1000 sq. ft.-yr and K was applied at 1.4 lb K₂O/a-yr. From fall 2004 to summer 2005, low P was 1 lb P₂O₅/1000 sq. ft.-yr and high P was 3 lb P₂O₅/1000 sq. ft.-yr. In fall 2005, the P application rates were reduced to one-third of the first year rates to reflect recommendations for an established lawn.

The 8'x24' plots are equipped with a stainless steel gutter at the lower end, which collects runoff and delivers it to a

35-gallon bucket with a 5-gallon insert. Runoff volume in the 5-gallon bucket is measured by weighing; larger flows are pumped to the 35-gallon bucket via a metered pump. This allows complete collection of runoff. This study is unique in that runoff has been collected throughout the year, including during winter melt events. Sample collection started in the fall of 2004 and has continued through 2007. Total P and soluble P have been quantified using standard laboratory procedures.

Results

Total P and soluble P in runoff increased at the highest P application rate in 2005 (Figures 1 and 2 and Table 1). Throughout the year, soluble P comprised 58% to 79% of total P (Table 1). A striking result was that about 80% of P runoff occurred during winter melt events,

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which have not previously been measured in lawn and turf runoff studies, may be a very important part of annual nutrient export. In 2006, when P rates were reduced to reflect more realistic levels for established turfgrass, soluble P runoff tended to be highest when no fertilizer was applied followed by the treatments receiving P fertilizer (Figures 3 and 4). Lowest soluble P runoff was found when N and K fertilizer was applied with no P fertilizer (Table 2 and Figure 4). As in the previous year, soluble P comprised a high percentage of the total P runoff ranging from 57% to 76% (Table 2 and Figure 4). Surprisingly, highest total P runoff in 2006 was in plots receiving not receiving any fertilizer. The relatively high runoff in the 0 fertilizer treatment is likely due to poor turf health, resulting in losses of soluble P from dead tissue (Figure 5). Clipping management did not significantly affect P fertilizer not significantly affect P fertilizer runoff over the 2-year time-frame of this study (data not presented).



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Figure 1

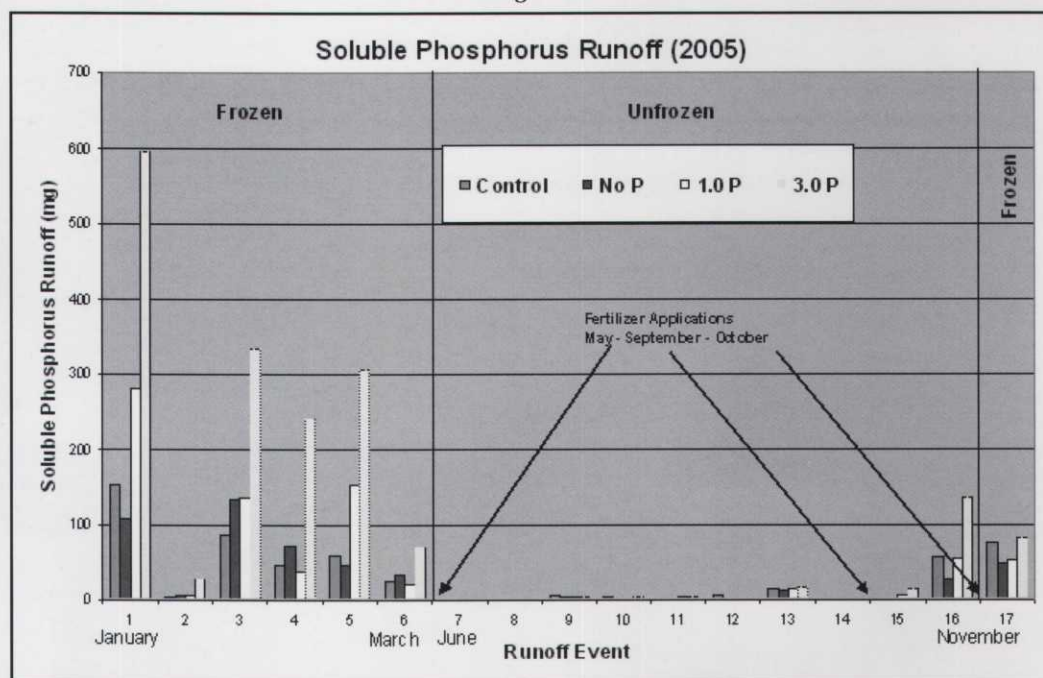


Table 1. Total and soluble P from frozen and unfrozen soil - 2005.

Treatment	Total P				Soluble P			
	Frozen	Unfrozen	Total	% of P Fertilizer Applied	Frozen	Unfrozen	Total	% of P Fertilizer Applied
	----- lbs P/A -----				----- lbs P/A -----			
Control	0.327	0.102	0.43	NA	0.234	0.049	0.28	NA
No P	0.377	0.068	0.45	NA	0.234	0.028	0.26	NA
1.0 P	0.459	0.092	0.55	2.88	0.356	0.045	0.40	2.09
3.0 P	1.078	0.146	1.22	2.13	0.864	0.093	0.96	1.66

Table 2. Total and soluble P from frozen and unfrozen soil - 2006.

Treatment	Total P				Soluble P			
	Frozen	Unfrozen	Total	% of P Fertilizer Applied	Frozen	Unfrozen	Total	% of P Fertilizer Applied
	----- lbs P/A -----				----- lbs P/A -----			
Control	0.088	0.125	0.21	NA	0.052	0.110	0.16	NA
No P	0.037	0.036	0.07	NA	0.017	0.023	0.04	NA
0.3 P	0.092	0.052	0.14	2.26	0.051	0.040	0.09	1.44
1.0 P	0.088	0.054	0.14	0.74	0.058	0.043	0.10	0.53

Summary

Most of the P runoff from turf occurred when the soils were frozen. Initially, P runoff increased with increasing P rate. By the second year, however, the unfertilized plots had similar P

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runoff amounts as plots receiving the highest P fertilizer rate. Fertilizers applied in late fall should not contain P fertilizer.

This research is being continued to determine long-term effects of P fertilizer and clipping management on P runoff as well as turf health and soil P levels over a wide range of weather conditions and scenarios.

Figure 3

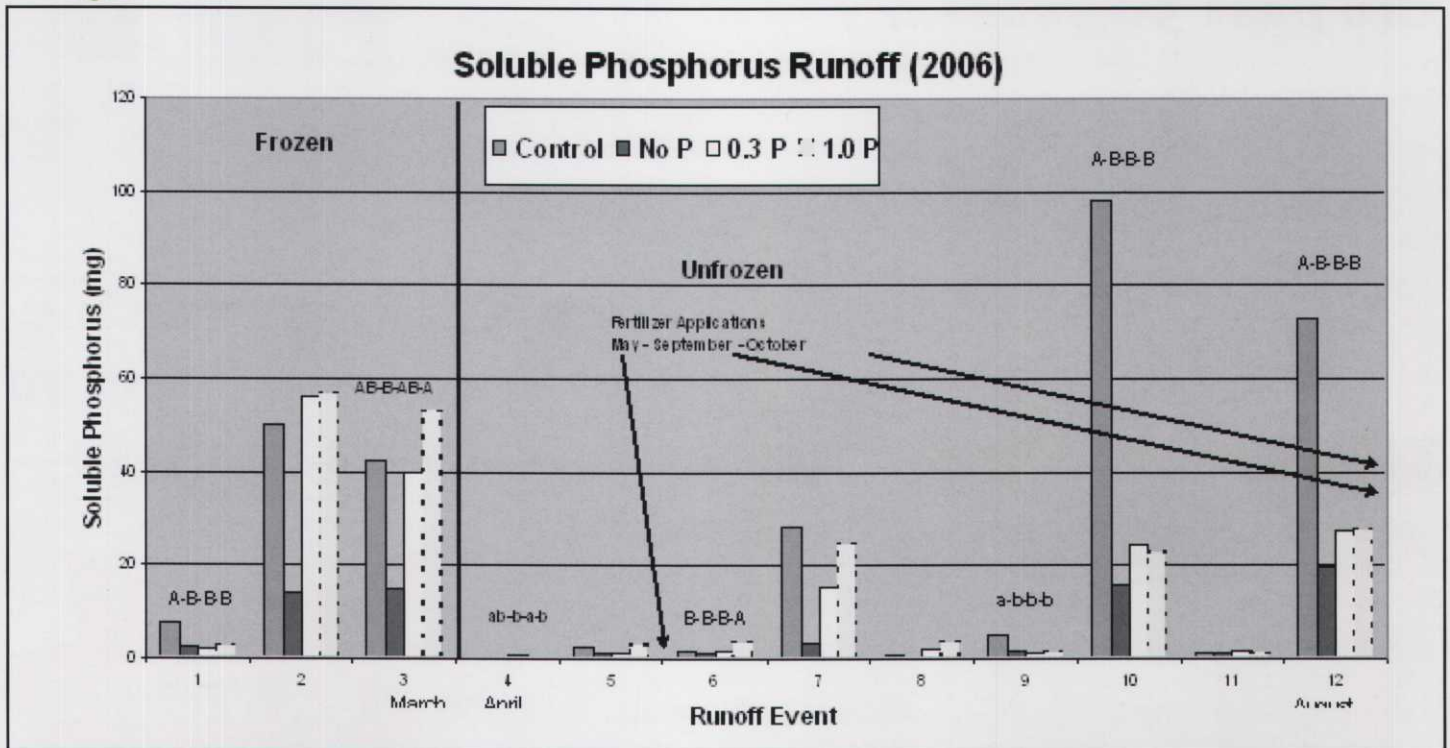
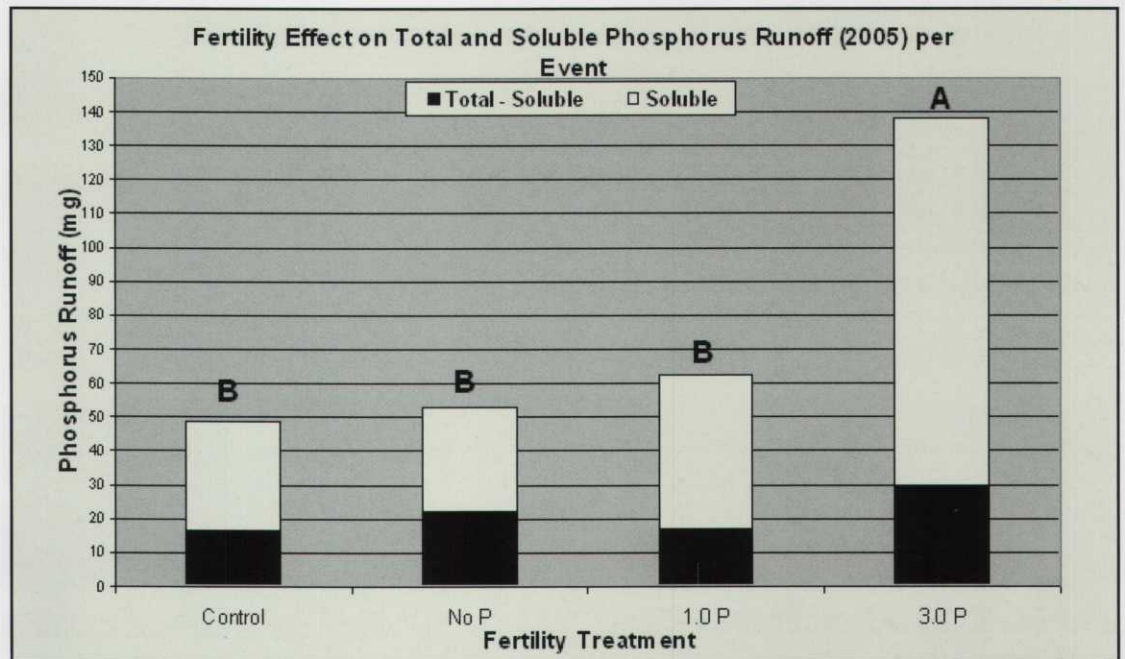


Figure 4

Figure 5 >

