

Evaluation of Various Establishment Techniques Implemented to Reduce Sediment and Runoff Loss, 2007 Purdue University

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Objectives:

This field study was conducted to determine sediment and phosphorus (P) losses during seedling establishment and develop the best management practices to minimize phosphorus and sediment loss on calcareous subsoil during establishment.

Rationale:

Home lawns are perceived by the public and regulatory community to be a significant contributor to environmental contamination. Nutrient runoff, especially P loss to fresh surface waters contributes to accelerated eutrophication (Figure 1) of lakes and streams (Levine and Schindler, 1989), a process whereby increased aquatic plant causes a reduction of water clarity, habitat loss, and decreased dissolved oxygen levels which can lead to taste/odor problems and widespread fish kills (Mercias and Malone, 1984). Although Indiana soils generally contain adequate to high (>13 mg P kg⁻¹) levels of available P, many new home lawns are established on inherently low-P subsoil because contractors remove topsoil or bury it with a low-P subsoil removed during construction. Using ineffective methods to quickly establish a dense healthy turf could lead to increased sediment and nutrient loss.

How it was done:

Forty-eight individual plots (1.83 x .76 m) were established on calcareous clay loam subsoil separated by aluminum barriers in a complete randomized block design with four replications. A 3.5% slope was developed by burying the topsoil and grading the subsoil on the surface. Plots were seeded with 'Da Vinci' tall fescue at 488 kg ha⁻¹, sodded with Kentucky bluegrass, and a buffer strip and straw blanket were used on two seeded plots. Plots received various amounts of P (0, 73 and 195 kg ha⁻¹) and nitrogen (0, 97, 244 kg ha⁻¹) as either traditional starter fertilizer (0-46-0 + 50:50 mix of sulfur coated urea and urea) or as an organic source (Earthworks 5-4-5) at seeding or one week prior to rainfall event.

Two rainfall events (39 and 44 mm hr⁻¹) on 9/24/07 and 10/22/07 were simulated using a variable intensity rainfall simulator mounted 2.3 meters above plots. Nutrient and sediment loss were measured taking samples at 5 minute intervals.

Results to date:

- Sediment loss for the first rainfall event was higher than the second event as expected due to the maturation of the turf in the plots (Table 1).
- Sediment loss was lowest during event 1 for the sod and straw blanket. Sediment loss was delayed for the sod, buffer strip and plots with straw blankets compared to other treatments (Table 2).
- All treatments, except bare soil and the plot seeded two weeks before rainfall event 2, resulted in low amounts of sediment loss after a 30 minute rainfall.
- Nutrient loss is currently being analyzed and will be available in next year's research summary.

Acknowledgements:

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References:

Levine, S.L. and D.W. Schindler. 1989. Phosphorus, nitrogen and carbon dynamics of experimental Lake 303 during recovery from eutrophication. *Can. J. Fish. Aquat. Sci.* 46:2-10

Mercias, C. and R.F. Malone. 1984. A phosphorus based fish kill response function for use with stochastic lake models. *North American Journal of Fisheries Management* 4(4B) 556-565.



Figure 1. Establishing a home lawn on calcareous subsoil on slopes can be difficult and can result in nutrient loss to water sources. Calcareous subsoils are generally low in nutrients and organic matter which can hinder establishment of home lawns.





Figure 3. A portable rainfall simulator was used to apply 39 and 44 mm hr⁻¹ per rainfall event respectively. Runoff and sediment loss was collected every five minutes over a period of 30 minutes. Nutrient and sediment loss was measured.

Table 1. Effect of various establishment techniques on total sediment loss for two rainfall events at 39 and 44 mm hr⁻¹.

Ground cover [§]	P fertilizer source [¶]	P rate	N rate	Sediment loss [†]	
				Event 1 [‡]	Event 2
				----- (kg ha ⁻¹) -----	
Seed	--	0	0	582.5 bc	88.8 b
Seed	Trad	73	97	791.3 b	99.4 b
Seed + straw blanket + compost	Trad	73	97	119.2 d	--
Seed + fertilized at seeding	Trad	195	244	426.3 bcd	51.3 b
Seed + fertilized at seeding	Organic	195	244	528.1 bcd	103.8 b
Seed	Trad	195	244	791.3 b	61.9 b
Seed + buffer strip	Trad	195	244	154.4 cd	71.3 b
Seed	Organic	195	244	596.3 bc	76.4 b
Seed + compost	Trad	195	244	633.1 b	80.0 b
Seed + straw blanket + compost	Trad	195	244	399.4 bcd	--
Sod	Trad	195	244	94.4 d	246.3 b
Straw blanket + fertilized day before rainfall	Trad	73	97	--	101.3 b
Seeded two weeks prior to rainfall	Trad	73	97	--	615.0 a
Bare	--	0	0	2363.1 a	633.1 a
ANOVA					
Treatment				***	***
Rep				NS	NS

[†] Sediment loss was measured by weighing collecting soil for one minute every five minutes, dried and weighed.

[‡] Event 1 was run on 9/24/07 with a rainfall intensity of 39 mm hr⁻¹. Event 2 was run on 10/22/07 with a rainfall intensity of 44 mm hr⁻¹.

[§] “DaVinci” tall fescue (*Lolium arundinaceum* (Schreb.) S.J. Darbyshire) was seeded at 488 kg ha⁻¹. A Kentucky bluegrass (*Poa pratensis* L.) sod buffer strip measuring 76.2 x 30.5 x 3.8 cm was placed at the base of each plot for the buffer strip treatment. Scotts Organic Choice compost was mixed into the top 1inch of the soil profile. Kentucky bluegrass sod was cut in strips measuring 76.2 x 182.9 x 3.8 cm. Straw blankets were cut and placed on top of the seed, fertilizer and compost and were discarded after the first run because of unacceptable turf growth. Straw blankets + compost were replaced with seeding two weeks prior two second rainfall and a straw blanket + fertilizer one day before rainfall.

[¶] Traditional fertilizer treatments consisted of 0-46-0 + sulfur coated urea & urea (50:50). Earthworks 5-4-5 fertilizer was used for the organic P source.

* Means in the same column followed by the same letter are not significantly different according to Fisher’s protected LSD t-test (P=0.05). NS refers to non-significant.

Table 2. Effect of various establishment techniques on sediment loss after a 39 mm hr⁻¹ rainfall event.

Ground cover [§]	P fertilizer source [¶]	P rate	N rate	Sediment loss [†]						
				Event 1 [‡]						
				5 min	10 min	15 min	20 min	25 min	30 min	
				----- (kg ha ⁻¹) -----						
Seed	--	0	0	108.1 bc	203.1 bc	295.0 bc	396.9 bc	486.9 bcd	582.5 bc	
Seed	Trad	73	97	130.0 b	255.0 b	356.3 b	480.6 b	595.0 b	713.1 b	
Seed + straw blanket + compost	Trad	73	97	20.8 d	38.3 c	70.0 c	86.7 cd	101.7 ed	119.2 d	
Seed + fertilized at seeding	Trad	195	244	71.3 bcd	136.3 bc	205.6 bc	281.3 bcd	350.6 b-e	426.3 bcd	
Seed + fertilized at seeding	Organic	195	244	83.8 bcd	173.1 bc	265.6 bc	355.6 bcd	445.0 b-e	528.1 bcd	
Seed	Trad	195	244	146.3 b	273.1 b	408.8 b	545.6 b	680.6 b	791.3 b	
Seed	Organic	195	244	105.6 bcd	219.4 bc	305.6 bc	409.4 bc	513.1 bc	596.3 bc	
Seed + buffer strip	Trad	195	244	23.8 cd	50.6 c	81.9 c	101.9 cd	128.8 cde	154.4 cd	
Seed + compost	Trad	195	244	82.5 bcd	170.6 bc	276.9 bc	388.1 bcd	513.8 bc	633.1 b	
Seed + straw blanket + compost	Trad	195	244	65.6 bcd	128.1 bc	198.1 bc	262.5 bcd	333.1 b-e	399.4 bcd	
Sod	Trad	195	244	20.6 d	40.0 c	50.6 c	67.5 d	80.0 e	94.4 d	
Bare	--	0	0	555.6 a	1049.4 a	1434.4 a	1775.6 a	2073.1 a	2363.1 a	
ANOVA										
Treatment					***	***	***	***	***	***
Rep					NS	NS	NS	NS	NS	NS

[†] Sediment loss was measured by weighing collecting soil for one minute every five minutes, dried and weighed.

[‡] Event 1 was run on 9/24/07 with a rainfall intensity of 39 mm hr⁻¹.

[§] “DaVinci” tall fescue (*Lolium arundinaceum* (Schreb.) S.J. Darbyshire) was seeded at 488 kg ha⁻¹. A Kentucky bluegrass (*Poa pratensis* L.) sod buffer strip measuring 76.2 x 30.5 x 3.8 cm was placed at the base of each plot for the buffer strip treatment. Scotts Organic Choice compost was mixed into the top 1 inch of the soil profile. Kentucky bluegrass sod was cut in strips measuring 76.2 x 182.9 x 3.8 cm. Straw blankets were cut and placed on top of the seed, fertilizer and compost and were discarded after the first run because of unacceptable turf growth. Straw blankets + compost were replaced with seeding two weeks prior two second rainfall and a straw blanket + fertilizer one day before rainfall.

[¶] Traditional fertilizer treatments consisted of 0-46-0 + sulfur coated urea & urea (50:50). Earthworks 5-4-5 fertilizer was used for the organic P source.

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Table 3. Effect of various establishment techniques on sediment loss at five minute intervals after a 44 mm hr⁻¹ rainfall event.

Ground cover [§]	P fertilizer source [¶]	P rate	N rate	Sediment loss [‡]					
				Event 2 [‡]					
				5 min	10 min	15 min	20 min	25 min	30 min
				----- (kg ha ⁻¹) -----					
Seed	--	0	0	13.8 c	26.3 b	39.4 b	54.4 b	70.0 b	88.8 b
Seed	Trad	73	97	16.9 c	34.4 b	50.0 b	67.5 b	81.3 b	99.4 b
Seeded two weeks prior to rainfall	Trad	73	97	120.0 a	231.3 a	331.3 a	428.8 a	521.3 a	615.0 a
Straw blanket + fertilized day before rainfall	Trad	73	97	23.1 c	41.3 b	56.9 b	71.9 b	87.5 b	101.3 b
Seed + fertilized at seeding	Trad	195	244	10.0 c	18.8 b	26.3 b	33.1 b	41.9 b	51.3 b
Seed + fertilized at seeding	Organic	195	244	18.1 c	33.1 b	51.3 b	66.9 b	84.4 b	103.8 b
Seed	Trad	195	244	9.4 c	19.4 b	31.3 b	40.0 b	51.9 b	61.9 b
Seed	Organic	195	244	15.6 c	24.4 b	37.5 b	49.4 b	63.1 b	74.4 b
Seed + buffer strip	Trad	195	244	16.9 c	31.3 b	42.5 b	50.0 b	62.9 b	71.3 b
Seed + compost	Trad	195	244	15.0 c	29.4 b	42.5 b	56.3 b	65.6 b	80.0 b
Sod	Trad	195	244	47.5 bc	93.1 b	124.4 b	168.1 b	210.0 b	246.3 b
Bare	--	0	0	83.8 ab	179.4 a	278.8 a	389.4 a	502.5 a	633.1 a
ANOVA									
Treatment				***	***	***	***	***	***
Rep				NS	NS	NS	NS	NS	NS

[‡] Sediment loss was measured by weighing collecting soil for one minute every five minutes, dried and weighed.

[‡] Event 2 was run on 10/22/07 with a rainfall intensity of 44 mm hr⁻¹.

[§] “DaVinci” tall fescue (*Lolium arundinaceum* (Schreb.) S.J. Darbyshire) was seeded at 488 kg ha⁻¹. A Kentucky bluegrass (*Poa pratensis* L.) sod buffer strip measuring 76.2 x 30.5 x 3.8 cm was placed at the base of each plot for the buffer strip treatment. Scotts Organic Choice compost was mixed into the top 1 inch of the soil profile. Kentucky bluegrass sod was cut in strips measuring 76.2 x 182.9 x 3.8 cm. Straw blankets were cut and placed on top of the seed, fertilizer and compost and were discarded after the first run because of unacceptable turf growth. Straw blankets + compost were replaced with seeding two weeks prior two second rainfall and a straw blanket + fertilizer one day before rainfall.

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