TESTING - SUMMARY
GATOR GUARD WATTLES VS OLD TECHNOLOGY

WHAT'S IMPORTANT? - kg of SOIL LOSS from a CONSTRUCTION SITE.

BASIS: 10-yr Los Angeles Basin storm event on 3H:1V dirt slope.



	Gator Guard Wattle	Straw Wattle	No Treatment
10-yr Storm:	1-kg soil loss	20-kg soil loss	45-kg soil loss
% effective:	98%	55%	0%

CONCLUSION: Gator Guard Wattles Have 20-Times Less Soil Loss Than Straw Wattles

About the Tests: Tests were performed at San Diego State University - Soil Erosion Research Laboratory SDSU-SERL in 2001 and 2008 using the same basic equipment, but different rainfall intensities.

The straw wattle tests performed in 2001 were adapted from portions of the testing protocols developed for Slope Stabilization for Temporary Slopes - SSTS study (Caltrans 1999) and the Erosion Control Pilot Study - ECPS (Caltrans 2000). Simulated Rainfall was applied at 0.2-in/hr for 30-min, 1.6-in/hr for 40-min, and 0.2-in/hr for 30-min, for a total precipitation of 1.2-inches in 100-minutes. This rainfall represents a 10-yr storm event as modeled from L.A. Basin hydrologic data.

The Gator Guard wattle tests performed in 2008 are based on rainfall intensities currently under review by ASTM for slope interrupter type BMP's. Simulated Rainfall was applied at 2-in/hr for 20-min, 4-in/hr for 30-min, and 6-in/hr for 30-min, for a total precipitation of 5.7-inches in 80-minutes. This rainfall is much more intense than the 2001 experiments, with 4.5 times the rainfall applied and 15 times the sediment eroded from the slope. THESE EXTREME TEST INTENSITIES TAKE PRODUCTS BEYOND PRACTICAL LIMITS to fully evaluate performance and limitations of each product tested.

Although the above tests are not directly comparable, the results can be evaluated for an L.A. Basin 10-yr storm equivalent based on soil loss for the no-treatment experiments. The 2001 no-treatment tests had a 45kg soil loss in 100-minutes, while the 2008 no-treatment tests had a 45-kg soil loss in 16-minutes. Corresponding results for the 2001 straw wattle test was 20-kg soil loss in 100-minutes compared to 1-kg of soil loss in 16-minutes for the 2008 Gator Guard test. Each of the above test results represents the mean values for three separate test runs. Differences in storm intensity tend to skew the results in favor of the 2001 straw wattle tests, suggesting that Gator Guard wattle soil loss could be even less than 1-kg using actual 2001 test rainfall intensities and durations.

The complete SDSU report for Gator Guard tests is available in pdf format at www.gatorguard.com. A 19-second must-see time-lapse test video and test photos are also available.

Additional 2008 test results:	Gator Guard Wattle	No Treatment
0 to 20-minutes	2-kg soil loss = 97% effective	64-kg soil loss
0 to 50-minutes	76-kg soil loss = 77% effective*	336-kg soil loss
0 to 80-minutes	406-kg soil loss = 41% effective*	689-kg soil loss

* In hi-flow areas use 2 or more Gator Guard wattles in parallel to minimize soil loss.

Evaluation Results from the
Soil Erosion Research Laboratory
San Diego State University

For Gator Guard Environmental Products Inc
Sediment Treatment Product (Gator Guard)

Prepared For

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1. Introduction

The purpose of this project was to evaluate the effectiveness of a sediment treatment product (Gator Guard) supplied by Gator Guard Environmental Products Inc. at the San Diego State University, Soil Erosion Research Laboratory. The sediment treatment product was evaluated on a tilting soil bed using overhead rainfall simulators. Product effectiveness was determined by comparing product performance to results from experiments with no treatment product. The following sections describe the SERL facilities, experimental design, and product results.

2. Soil Erosion Research Laboratory

SERL is fully equipped to implement or design a suite of soil erosion and related environmental, hydraulic or hydrologic experiments including sample analyses. The following highlights the tilting soil test bed, hydraulic flume, rainfall simulators and water treatment system. The soil test bed is a 3 m wide by 10 m long metal frame resting on a series of pivots located at the lower end of the bed and is supported by two hydraulic cylinders near the upper end of the bed. These telescopic cylinders extend to tilt the test bed from its horizontal position to a maximum 2H:1V slope gradient. The sides and ends of the soil test bed are constructed of steel frame-supported 1 cm (0.4 in) thick Plexiglas that allows ambient light onto the soil surface, and facilitates viewing of the effects of rainfall impact and runoff. The total usable surface area of the soil bed is 3 m wide by 10 m long, but during testing only a portion of the treated bed, 2 m wide by 8 m long, is generally delineated for evaluation by the use of plastic edging. Runoff and sediment are collected at the toe of the slope by a metal flume.

Rainfall was applied to the soil bed using a Norton Ladder Rainfall Simulator, developed at the USDA-ARS National Soil Erosion Research Laboratory. SERL uses two six-head simulators installed above the bed to uniformly apply precipitation over the entire plot area. Each six-head simulator is a self-contained unit that includes six spray nozzles each with a dedicated pressure gauge, drive motor, oscillating mechanism and sweep rate controller. The spray nozzles are Veejet 80100 nozzles spaced evenly over the bed and 2.5 m above the soil surface. For uniform intensity across the plot, the centers of the spray patterns from two laterally adjacent nozzles meet at the plot surface. The simulators provide a 2.25 mm (0.09 in) median drop diameter, a nozzle exit velocity of 6.8 meters per second (22.3 fps), and a spherical drop with a soil surface impact velocity approximately equal to the impact velocities of drops from natural rainstorms. Rainfall intensity can be changed instantaneously during operation. The maximum intensity is approximately 160 mm/hr (6.3 in/hr). A full range of rainfall intensities can be achieved by adjusting either one, or both of the following parameters: (a) the number of sweeps per minute (spm) for the spray nozzles, ranging from 20 to 200 spm or (b) the water pressure within the supply system (i.e., the flow rate to the spray nozzle). Each simulator has a system of valves that allow internal water pressure to be adjusted from a low of 27.6 kPa (4 psi) to a high of 55.2 kPa

(8 psi), with a typical pressure of 41.4 kPa (6 psi) providing a flow rate of approximately 14.7 lpm (3.2 gpm) from each nozzle.

The water treatment system consists of a reverse osmosis unit, preceded by one activated carbon vessel and two softening vessels arranged in series (i.e. carbon/softener/softener). The system, which is capable of producing 1,140-2,270 liters per day (300-600 gallons per day), also includes a pre-filter to remove particulates greater than 5 microns in size that may escape the service vessels. Treated water is stored in a 3,785 liter (1,000 gal) polyethylene storage tank. The delivery of water to the rainfall simulators positioned above the soil test bed is by a pump attached to hard plumbing and flexible hoses. A key aspect of the Norton design is that unused water from within the simulators is returned to the holding tank for reuse. Flexible plumbing is installed to accommodate this return flow.

3. Sediment Treatment Product

One product, Gator Guard (GG), was tested on SERL's tilting soil test bed at a 3:1 slope using a design storm similar to the one outlined in ASTM 6459-99. Three replicate tests were conducted using bare soil with no treatment products. Three replicate tests were conducted using the Gator Guard product. Results from the product tests are combined and compared to the no treatment results to determine product effectiveness. In the Results section, the three treatment experiments (i.e., Gator Guard experiments) are combined and referenced as Treatment Experiments (T).

3.1 Experimental Design

Simulated rainfall-runoff experiments were performed in SERL and were similar to those outlined in ASTM 6459-99 for the determination of erosion control blanket performance in protecting hillslopes from rainfall-induced erosion. The primary modification was the rainfall durations. An ASTM standard for slope interrupter type BMPs is currently in review and states that the simulated rainfall shall be 2 in/hr for 20 min, followed by 4 in/hr for 30 min, followed by 6 in/hr for 30 min compared to the blanket ASTM which states 20 minutes for all rainfall rates.

The experiments were performed on SERL's tilting soil bed at a 3:1 slope using typical southern California topsoil sieved to 2 inches. The particle size distribution for the soil used in all experiments is shown in Figure 1. Based on the USDA textural classification system, the test soil is Loamy Sand (approximately 85% sand, 14% silt, and 1% clay). The soil was purchase from A1-Soils in San Diego, CA. The experiments were performed on a test area 2 meters wide by 8 meters in length. Runoff from the test area was directed into a flume and collected at the outlet. Prior to each test, wetted soil on the bed was removed to expose untested soil and additional soil was added to maintain a consistent bed height. The added soil was moisturized, tilled and hand-compacted to uniform consistency. Prior to testing, the surface of the compacted soil was loosely raked to add surface roughness to the bare soil. For the treatment experiments, the products were installed based on manufacturer recommendations.

Simulated rainfall consisted of an initial intensity of 2 in/hr (51 mm/hr) for 20 minutes followed by 4 in/hr (102 mm/hr) for 30 minutes and then the peak intensity of 6 in/hr (152 mm/hr) for 30 minutes. Once a simulation begins, all runoff was collected at the downstream (toe) end of the flume in a container with a known stage-volume relationship. While rainfall was simulated for 80 minutes, runoff did not occur until the soil bed was saturated. Once runoff occurred, runoff samples were collected and runoff volumes were recorded every 3 minutes. The runoff volume during each 3 minute interval plus the volume of the collected water sample was used to determine the average volumetric flow rate for each 3 minute interval. Each sample was measured (volume) and dried in an oven to determine the weight of dry sediment in each sample. The initial volume of each runoff sample was then used to determine the average sediment concentration (mg/l) for each 3-minute interval during the runoff period. The measured volumetric flow rates and calculated sediment concentrations were then used to determine the total runoff (volume) and dry sediment (weight) collected. Note, due to the 3-minute sampling interval, the total experiment lasted 81 minutes.

3.2 Runoff and Sediment Results

Six experiments were performed: three for no treatment (NT) and three for treatment (T). Tables 1-15 and Figures 2-17 summarize the results from the six experiments. Appendix A provides photographs of each experiment at times 0, 9, 18, 27, 36, 45, 54, 63, 72 and 81 minutes. At 80 minutes, the no treatment experiments resulted in a mean peak runoff rate of 44 lpm, a mean total runoff volume of 2,145 liters, a mean peak sediment concentration of 470 g/l, and mean total sediment export of 690 kg. At 20 and 50 minutes into the experiment, the mean total sediment export was 64 and 336 kg, respectively. The treatment experiments resulted in a mean peak runoff rate of 41 lpm, total runoff volume of 1,769 liters, a peak sediment concentration of 359 g/l, and total sediment export of 406 kg. The treatment product reduced total runoff volume by approximately 376 liters (18%) and reduced total sediment export by 283 kg (41%) as compared to no treatment simulations. The treatment product reduced peak discharge rates by 3 lpm (7%), and reduced peak sediment concentrations by 110 g/l (24%). Tables 2 and 5 show the product reduced total sediment export by 63 kg (97%) and 260 kg (77%) at 20 and 50 minutes in the experiment, respectively. Note, the cumulative rainfalls at 20, 50, and 80 minutes into the experiment were 1.6, 6.2, and 14.2 cm (0.6, 2.4, and 5.6 inches), respectively.

As outlined in ASTM 6459-99, the effective runoff curve number (CN), Rational Model C-coefficient, and RUSLE practice factor were determined. The effective runoff curve number for each experiment and rainfall period was determined in two steps. First, the CN model equation:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}; \qquad \text{where} \qquad S = \frac{1000}{CN} - 10 \tag{1}$$

was solved for *S* with *Q* equal to the measured depth of runoff (runoff volume/bed area, i.e., inches) and *P* equal to the simulated rainfall depth (inches). Next, CN was determined as CN = 1000/(S +10). Table 14 provides CN values for the cumulative runoff at the end of each rainfall period for the mean runoff values from each treatment condition (NT and T). CN value ranged from 97 to 99 for NT and 89 to 94 for T. These values are also consistent with the measured runoff volume from each experiment. Note, these CN values are higher than typically reported values for bare soil because the total runoff volume used to determine CN contains sediment.

To determine the effective rational C-coefficient, C, the rational model:

$$Q = F(C \cdot I \cdot A) \tag{2}$$

was solved for *C* with *Q* equal to the measured peak discharge rate, *I* equal to the peak rainfall intensity (in/hr), *A* equal to the drainage area (ac) of SERL's tilting erosion bed, and *F* equal to 1.008 for converting English units. Table 14 provides *C* coefficients for the cumulative runoff at the end of each rainfall period for the mean runoff values from each treatment condition (NT and T). *C* ranged from 0.86 to 0.96 for NT and 0.64 to 0.81 for T. Again, these values are consistent with the measured runoff rates from each experiment.

As an alternative method, *C* was estimated by determining the slope of the linear regression line through the origin of *Q* vs. *I* (i.e., $Q = n\ I$), where the slope is equal to the static variables of equation 2.

$$n = F \cdot C \cdot A \tag{3}$$

Equation 3 can be re-written as:

$$C = n_x/0.004 \tag{4}$$

where n_x is the slope of the *Q* vs. *I* relationship for either No Treatment or Treatment experiments. Using the slopes shown in Figure 16 and equation 4, the Rational model C-coefficients for No Treatment and Treatments are 1.05 and 0.94, respectively. These values are similar to the above referenced values as shown in Table 14.

The effective Practice Factor (P-factor) in the Revised Universal Soil Loss Equation (RUSLE):

$$A = R \cdot K \cdot LS \cdot C \cdot P \tag{5}$$

was determined in two steps. First, the soil erodibility factor, K, was determined from the bare soil, no treatment experiments were the cover factor, C, and support practice factor, P, are equal to 1.0. Equation 5 can then be re-written as:

$$K = A/(LS \cdot R) \tag{6}$$

where A is the sediment yield (tons/ac/simulation period) from the soil bed with bare soil and no treatment conditions, LS is the slope-length factor equal to 2.12 for SERL's tilting soil bed at a 3H:1V slope (USDA ARS Agriculture Handbook 703), and the R is the rainfall-runoff erosivity factor which is equal to $_n\mathrm{EI}_{30}(10^{-2})$ where E is the total storm kinetic energy and I_{30} is the maximum 30 min rainfall intensity. For the rainfall intensities used in this project, the R factor is approximately 8, 96, and 383 at times 20, 50, and 80 minutes, respectively. Therefore, K is equal to 1.08, 0.46, and 0.24 at times 20, 50, and 80 minutes, respectively, based on the mean results for the bare soil experiments (see Table 15).

Next, the practice factor was determined with equation 5, where A is the sediment yield (tons/ac/simulation period) from the soil bed with the treatment product, LS is 2.12, C is 1.0, R and K vary with simulation period (R = 8, 96 or 383) and (K = 1.08, 0.46 or 0.24). Table 15 shows the effective Practice factors for both products. The P-factors ranges from 0.03 to 0.59 for the treatment product. For the total 80-minute experiment, the P-factor was 0.55.

As an alternative method, K and P were estimated by determining the slope of the linear regression line through the origin of A vs. R (i.e., $A = m\ R$), where the slope is equal to the static variables of equation 5.

$$m = K \cdot LS \cdot C \cdot P \tag{7}$$

For bare soil, no treatment experiments, equation 7 can be re-written as:

$$K = m_{NT}/2.12 \tag{8}$$

For Treatment experiments, equation 7 can be re-written as:

$$P = m_T/2.12K \tag{9}$$

Figure 17 shows the relationship between A and R. For no treatment conditions, the slope (m_{NT}) is 0.53. For the treatment experiments, the slope is 0.29. Solving equations 6 and 7 yields K = 0.25, P = 0.55.

A third method was also used to verify the estimated P-factors. The practice factor is ratio of sediment yield from bare soil with a specific treatment to the sediment yield from bare soil with no treatment. Thus, for the total 80-minute experiment, the P-factor for the treatment product was 0.55 as shown in Table 15.

4. Summary

The San Diego State University, Soil Erosion Research Laboratory evaluated sediment treatment product (Gator Guard) supplied by Gator Guard Environmental Products Inc. The treatment product reduced total runoff volume by approximately 376 liters (18%) and reduced total sediment export by 283 kg (41%) as compared to no treatment simulations. As shown in Table 15, the effective practice factor (P-factor as used in the RUSLE equations) for the product ranged from 0.03 to 0.59 during the simulation period with an overall effective value of 0.55. Looking at the three periods of rainfall, the product resulted in a mean reduction in sediment export of 97% for the 0-20 min period (rainfall rate of 2 in/hr); for 0-50 min (2 in/hr for 20 min followed by 4 in/hr for 30 min), the mean reduction in sediment export was 77%; and for the entire 0-80 min period (2 in/hr for 20 min followed by 4 in/hr for 30 min, followed by 6 in/hr for 30 min), the mean reduction in sediment export was 41%. Overall, product performance was consistent from run-to-run and resulted in a significant reduction in sediment export (ranging from 41-97%). As with most perimeter treatment or slope interrupter treatment devices, these results are dependent upon proper installation.

5. Tables

Table 1: Total runoff and sediment export, and peak runoff rate and sediment concentration results from 0-20 minutes for No Treatment (NT) experiments.

No Treatment Experiments	Runoff (liters)	Sediment (kg)	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)
NT-1	168	53	12.1	322,000
NT-2	223	69	12.7	311,000
NT-3	236	71	16.5	493,000
Mean	209	64	13.7	375,000

Table 2: Total runoff and sediment export from 0-20 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results.

Treatment Experiments	Runoff (liters)	Sediment (kg)	Runoff Reduction	Sediment Reduction
T-1	59	0.5	71.8%	99.2%
T-2	160	4.3	23.4%	93.4%
T-3	84	1.1	59.7%	98.4%
Mean	101	1.9	51.6%	97.0%

Table 3: Peak runoff rate and sediment concentration from 0-20 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results; negative peak runoff reduction indicates an increase in peak runoff rate.

Treatment Experiments	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)	Peak Runoff Reduction	Peak Sediment Conc. Reduction
T-1	6.4	12,000	53.5%	96.8%
T-2	12.7	25,000	7.6%	93.3%
T-3	8.9	10,000	35.1%	97.3%
Mean	9.3	16,000	32.1%	95.7%

Table 4: Total runoff and sediment export, and peak runoff rate and sediment concentration results from 0-50 minutes for No Treatment (NT) experiments.

No Treatment Experiments	Runoff (liters)	Sediment (kg)	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)
NT-1	870	331	25.3	455,000
NT-2	1,041	363	31.6	461,000
NT-3	1,036	313	29.1	493,000
Mean	982	336	28.7	469,000

Table 5: Total runoff and sediment export from 0-50 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results.

Treatment Experiments	Runoff (liters)	Sediment (kg)	Runoff Reduction	Sediment Reduction
T-1	644	44	34.4%	86.8%
T-2	767	70	21.9%	79.0%
T-3	694	113	29.4%	66.2%
Mean	702	76	28.6%	77.3%

Table 6: Peak runoff rate and sediment concentration from 0-50 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results.

Treatment Experiments	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)	Peak Runoff Reduction	Peak Sediment Conc. Reduction
T-1	21.5	134,000	25.0%	71.4%
T-2	21.5	199,000	24.9%	57.6%
T-3	26.6	321,000	7.3%	31.6%
Mean	23.2	218,000	19.1%	53.5%

Table 7: Total runoff and sediment export, and peak runoff rate and sediment concentration results from 0-80 minutes for No Treatment (NT) experiments.

No Treatment Experiments	Runoff (liters)	Sediment (kg)	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)
NT-1	2,039	768	40.6	455,000
NT-2	2,189	681	47.4	461,000
NT-3	2,207	620	43.0	493,000
Mean	2,145	689	43.7	469,000

Table 8: Total runoff and sediment export from 0-80 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results.

Treatment Experiments	Runoff (liters)	Sediment (kg)	Runoff Reduction	Sediment Reduction
T-1	1,785	443	16.8%	35.8%
T-2	1,742	300	18.8%	56.4%
T-3	1,780	476	17.0%	31.0%
Mean	1,769	406	17.5%	41.1%

Table 9: Peak runoff rate and sediment concentration from 0-80 minutes for Treatment (T) experiments, where reductions are based on individual product results and mean No Treatment results.

Treatment Experiments	Peak Runoff (lpm)	Peak Sediment Conc. (mg/l)	Peak Runoff Reduction	Peak Sediment Conc. Reduction
T-1	41.7	424,000	4.5%	9.6%
T-2	39.2	277,000	10.2%	40.9%
T-3	40.5	376,000	7.4%	19.8%
Mean	40.5	359,000	7.4%	23.5%

Table 10: NT – Incremental results for each rainfall period for No Treatment (NT) experiments; sediment export provided in total kg, total kg divided by total runoff, and yield in metric tons/ha.

Run-ID (n/a)	Time (min)	Rainfall (cm/hr)	Runoff (L)	Sediment (kg)	Export-1 (kg/L)	Export-2 (M-ton/ha)
NT-1	20	4.7	168	53	0.32	33
NT-1	50	9.3	702	278	0.40	174
NT-1	80	16.0	1,169	436	0.37	273
NT-2	20	4.7	223	69	0.31	43
NT-2	50	9.3	819	294	0.36	184
NT-2	80	16.0	1,148	317	0.28	198
NT-3	20	4.7	236	71	0.30	44
NT-3	50	9.3	800	242	0.30	151
NT-3	80	16.0	1,171	307	0.26	192
NT-Mean	20	4.7	209	64	0.31	40
NT-Mean	50	9.3	773	271	0.35	170
NT-Mean	80	16.0	1,163	354	0.30	221

Table 11: NT – Cumulative results for each rainfall period for No Treatment (NT) experiments; sediment export provided in total kg, total kg divided by total runoff, and yield in metric tons/ha.

Run-ID (n/a)	Time (min)	Rainfall (cm)	Runoff (L)	Sediment (kg)	Export-1 (kg/L)	Export-2 (M-ton/ha)
NT-1	20	1.6	168	53	0.32	33
NT-1	50	6.2	870	331	0.38	207
NT-1	80	14.2	2,039	768	0.38	480
NT-2	20	1.6	223	69	0.31	43
NT-2	50	6.2	1,041	363	0.35	227
NT-2	80	14.2	2,189	681	0.31	425
NT-3	20	1.6	236	71	0.30	44
NT-3	50	6.2	1,036	313	0.30	196
NT-3	80	14.2	2,207	620	0.28	387
NT-Mean	20	1.6	209	64	0.31	40
NT-Mean	50	6.2	982	336	0.34	210
NT-Mean	80	14.2	2,145	689	0.32	431

Table 12: T – Incremental results for each rainfall period for Treatment (T) experiments; sediment export provided in total kg, total kg divided by total runoff, and yield in metric tons per ha; treatment effectiveness provided as % reduction and effective practice-factor.

Run-ID (n/a)	Time (min)	Rainfall (cm/hr)	Runoff (L)	Sediment (kg)	Export-1 (kg/L)	Export-2 (M-ton/ha)
T-1	20	4.7	59	0.5	0.01	0.3
T-1	50	9.3	585	44	0.08	27
T-1	80	16.0	1,141	398	0.35	249
T-2	20	4.7	160	4.3	0.03	2.7
T-2	50	9.3	607	66	0.11	41
T-2	80	16.0	975	230	0.24	144
T-3	20	4.7	84	1.1	0.01	0.7
T-3	50	9.3	609	112	0.18	70
T-3	80	16.0	1,087	362	0.33	226
T-Mean	20	4.7	101	1.9	0.02	1.2
T-Mean	50	9.3	601	74	0.12	46
T-Mean	80	16.0	1,068	330	0.31	206

Table 13: T – Cumulative results for each rainfall period for Treatment (T) experiments; sediment export provided in total kg, total kg divided by total runoff, and yield in metric tons per ha; treatment effectiveness provided as % reduction and effective Practice-factor.

Run-ID (n/a)	Time (min)	Rainfall (cm)	Runoff (L)	Sediment (kg)	Export-1 (kg/L)	Export-2 (M-ton/ha)
T-1	20	1.6	59	0.5	0.01	0.3
T-1	50	6.2	644	44	0.07	28
T-1	80	14.2	1,785	443	0.25	277
T-2	20	1.6	160	4.3	0.03	2.7
T-2	50	6.2	767	70	0.09	44
T-2	80	14.2	1,742	300	0.17	188
T-3	20	1.6	84	1.1	0.01	0.7
T-3	50	6.2	694	113	0.16	71
T-3	80	14.2	1,780	476	0.27	297
T-Mean	20	1.6	101	1.9	0.02	1.2
T-Mean	50	6.2	702	76	0.11	48
T-Mean	80	14.2	1,769	406	0.23	254

Table 14: Product evaluation summary with cumulative results for each rainfall period; effective CN and Rational-C coefficient provided for each product; note units are in commonly used English units; (1) Rational C-coefficient determined using equation 2 and (2) Rational C-coefficient determined using equation 4.

Run-ID (n/a)	Time (min)	Rainfall (in)	Runoff (in)	Peak Runoff (cfs)	Sediment Yield (tons/ac)	Effective CN (n/a)	Effective Rational "C" (1)	Effective Rational "C" (2)
NT	20	0.6	0.5	0.007	18	99	0.99	n/a
NT	50	2.4	2.4	0.017	93	99	1.14	n/a
NT	80	5.6	5.3	0.025	192	97	0.99	1.05
T	20	0.6	0.2	0.005	0.5	94	0.64	n/a
T	50	2.4	1.7	0.013	21	92	0.90	n/a
T	80	5.6	4.4	0.023	113	89	0.93	0.94

Table 15: Product evaluation summary with cumulative results for each rainfall period; effective Support Practice "P-factors" provided for each time period; note units are in commonly used English units; (1) P-factor determine using equation 5, (2) P-factor determine using equation 9, and (3) P-factor determine using the ratio of sediment yield with treatment product to yield with no treatment.

Run-ID (n/a)	Time (min)	Rainfall (in)	Sediment Yield (tons/ac)	Rainfall-runoff Erosivity R-factor	Effective Soil Erodibility K-Factor	Effective Cover P-Factor (1)	Effective Cover P-Factor (2)	Effective Cover P-Factor (3)	Treatment Effectiveness (%)
NT	20	0.6	18	7.8	1.08	n/a	n/a	n/a	n/a
NT	50	2.4	93	96	0.46	n/a	n/a	n/a	n/a
NT	80	5.6	192	383	0.24	n/a	n/a	n/a	n/a
T	20	0.6	0.5	7.8	1.08	0.03	n/a	0.03	97.0%
T	50	2.4	21	96	0.46	0.23	n/a	0.23	77.3%
T	80	5.6	113	383	0.24	0.59	0.55	0.59	41.1%

6. Figures

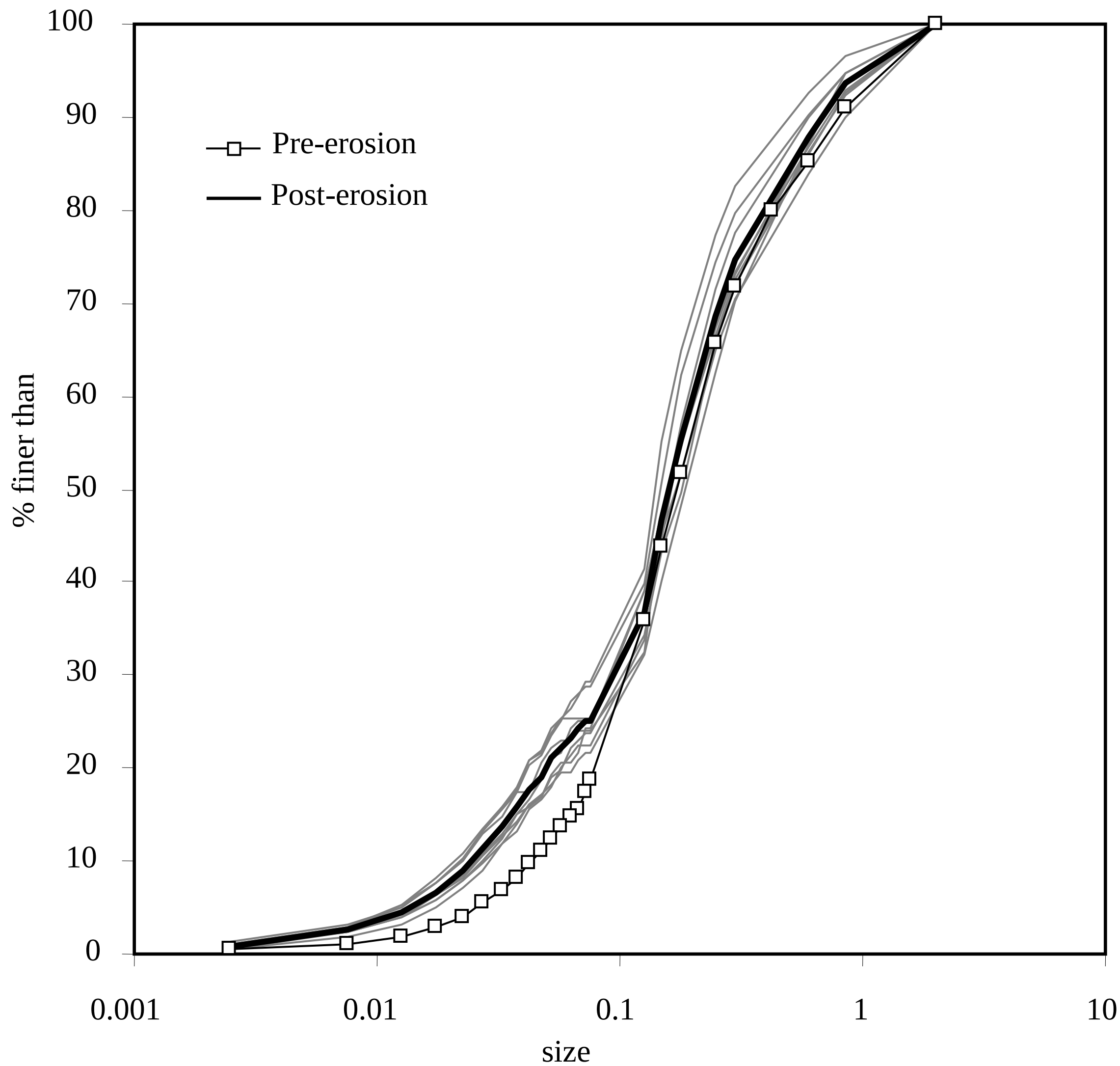

Figure 1: Particle size distributions for typical laboratory soil used in erosion experiments (Pre-erosion) and sediment samples obtained from bare soil, no treatment experiments (Post-erosion).

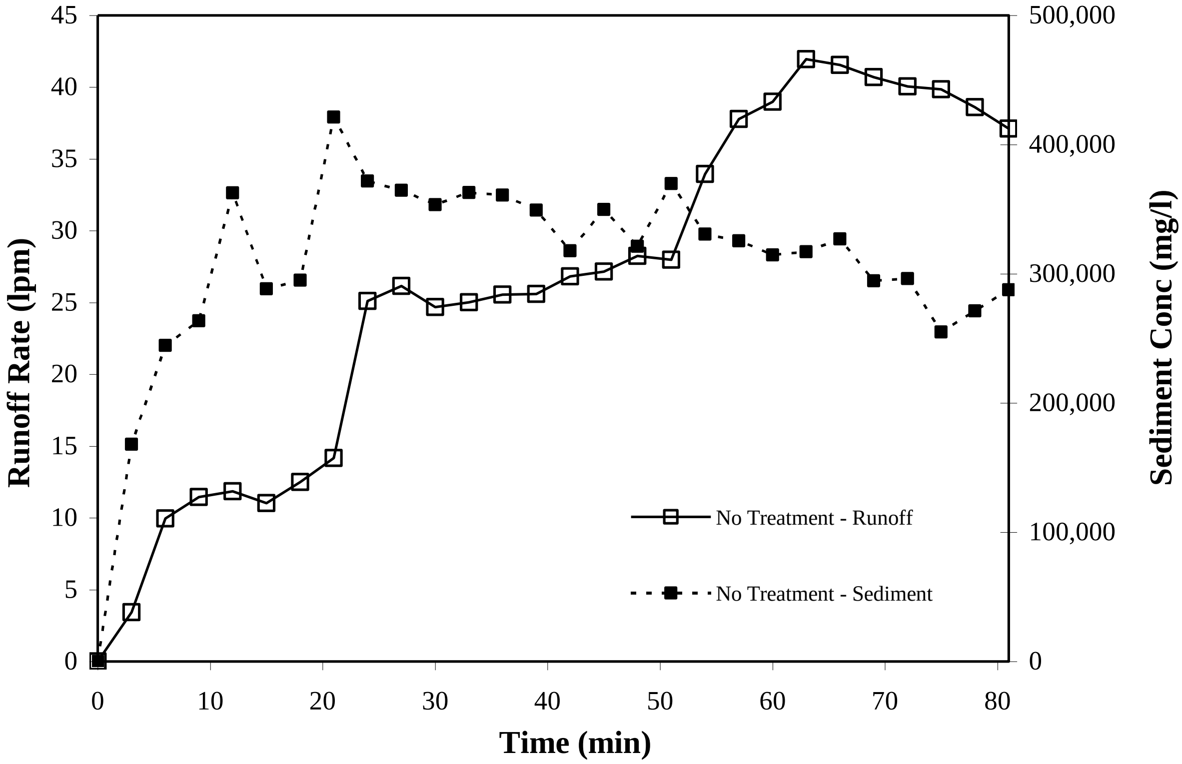

Figure 2: Mean runoff rates and sediment conc. for the No Treatment (NT) experiments.

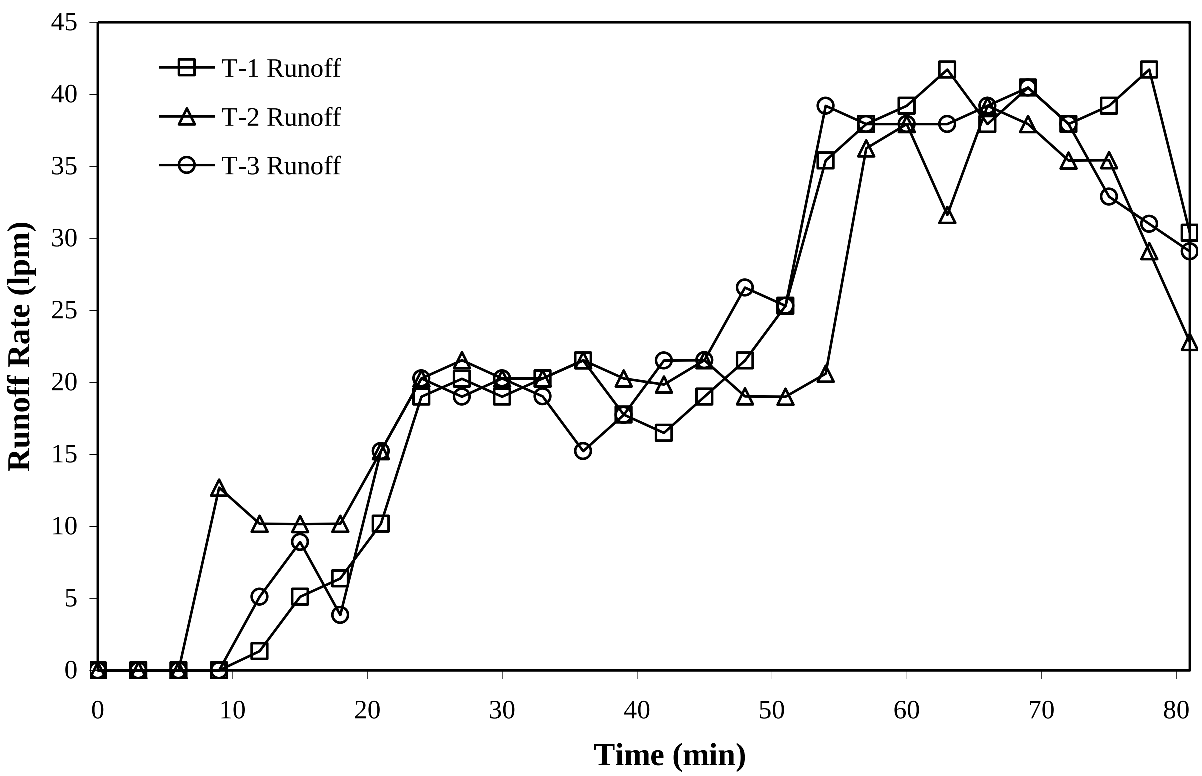

Figure 3: Runoff rates for individual No Treatment (NT) experiments.

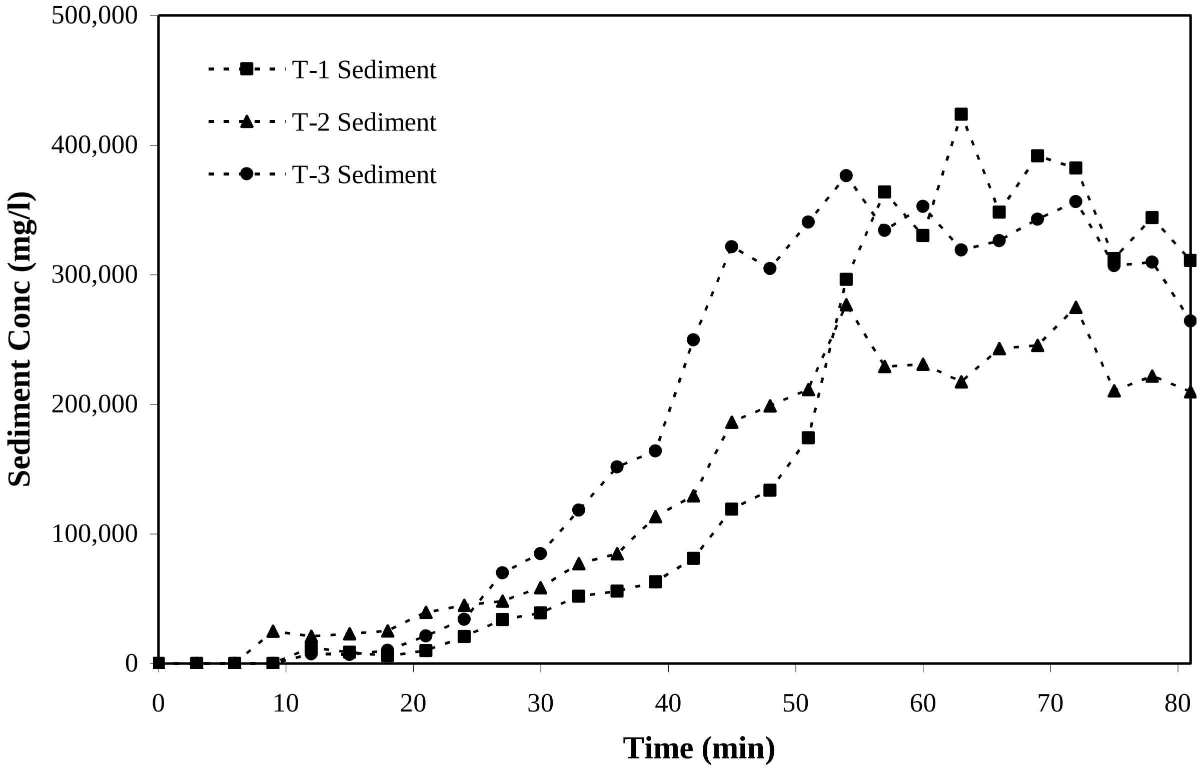

Figure 4: Sediment concentrations for individual No Treatment (NT) experiments.

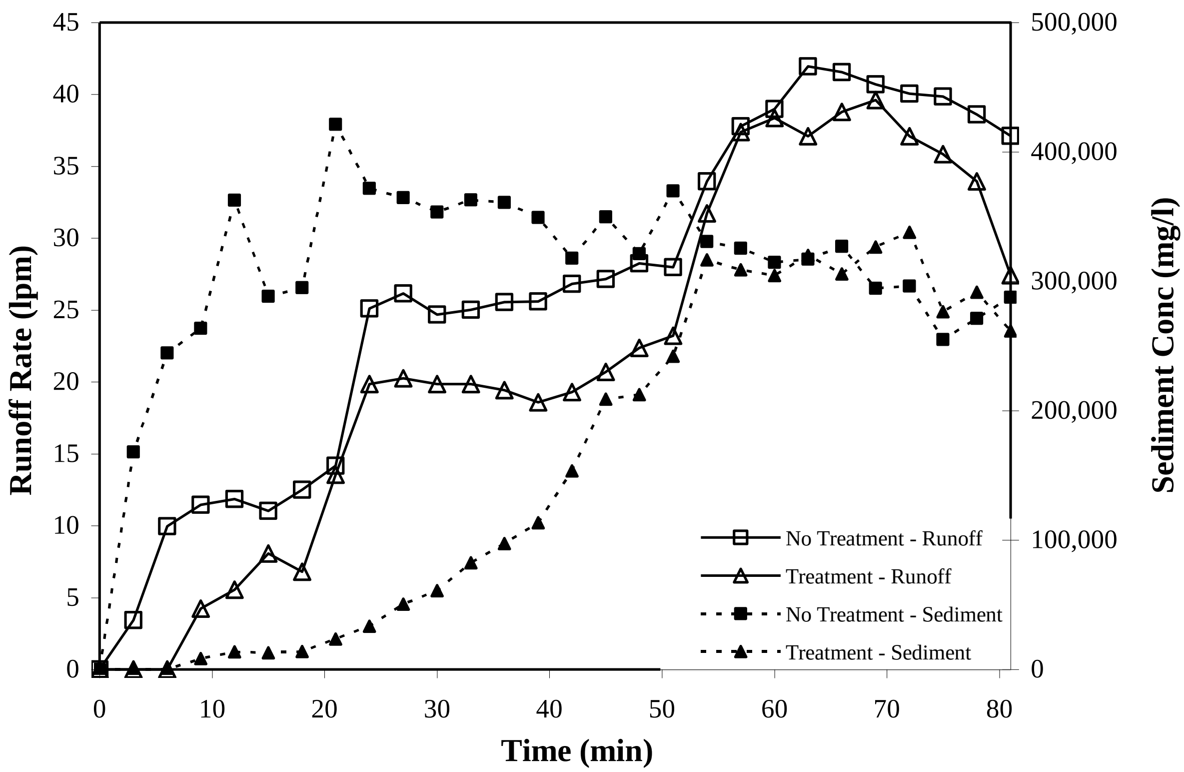

Figure 5: Mean runoff rates and sediment conc. for No Treatment (NT) and Treatment (T) runs.

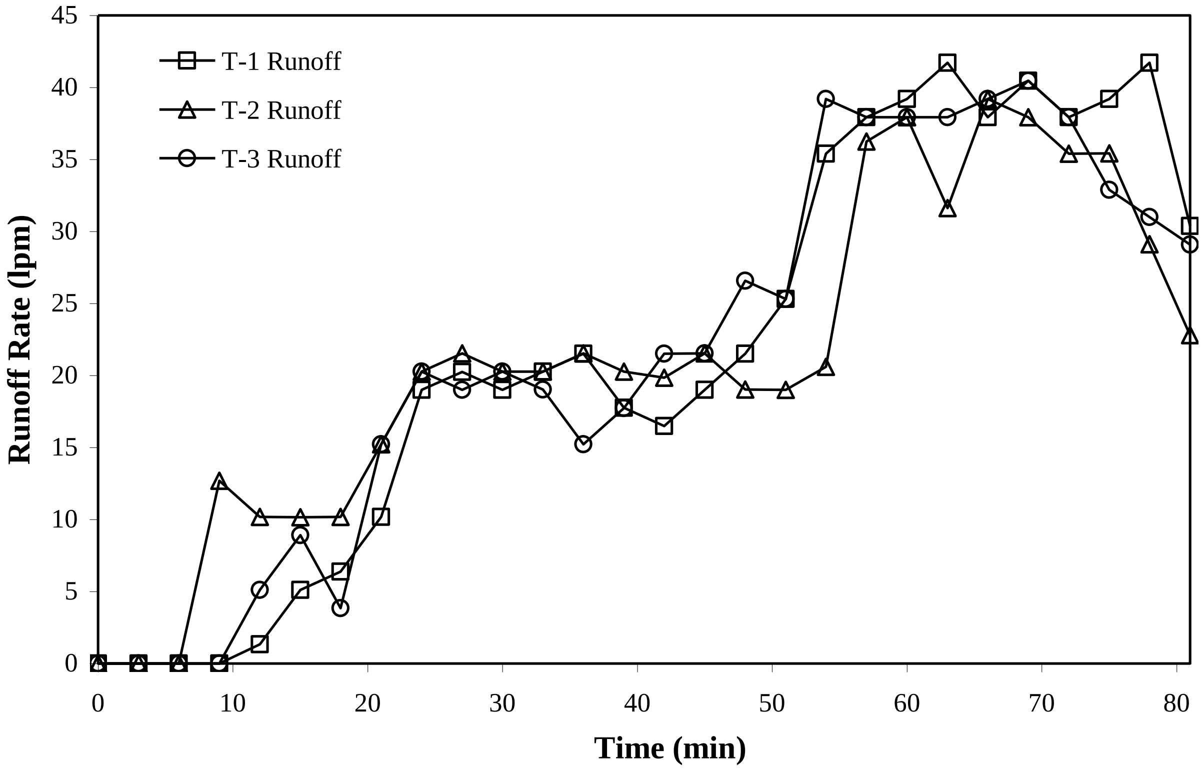

Figure 6: Runoff rates for individual Treatment (T) experiments.

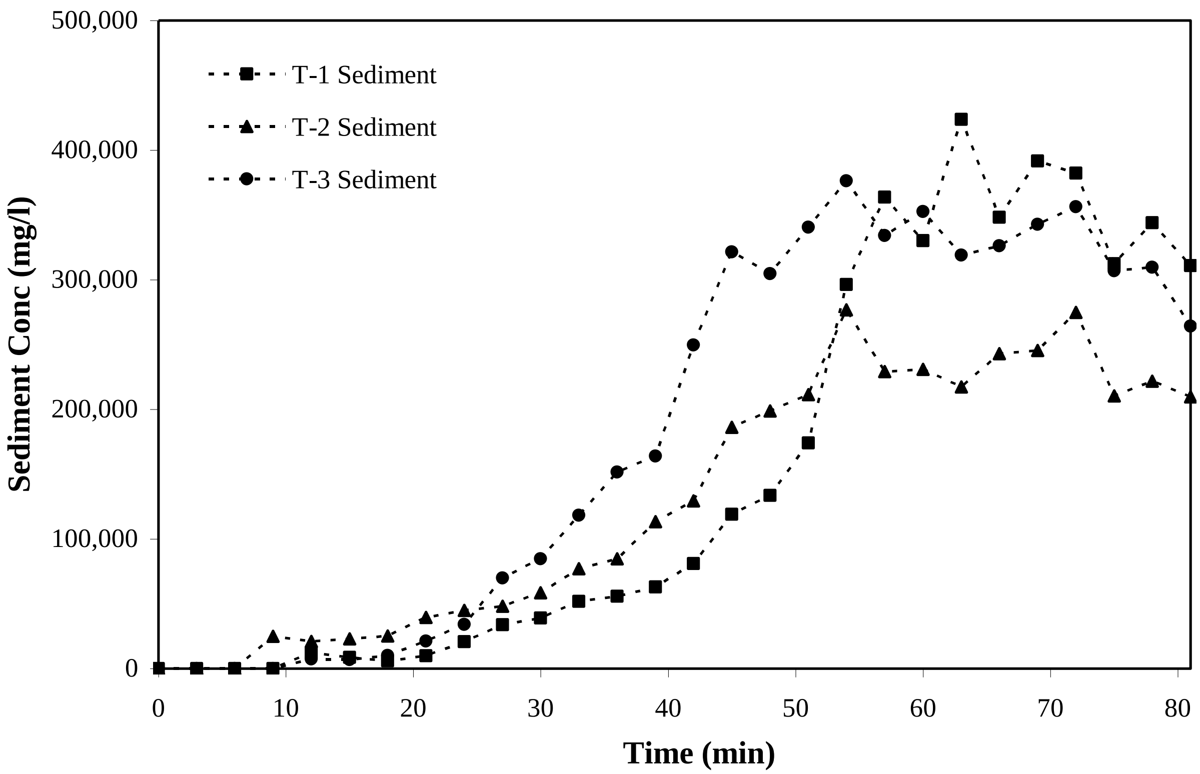

Figure 7: Sediment concentrations for individual Treatment (T) experiments.

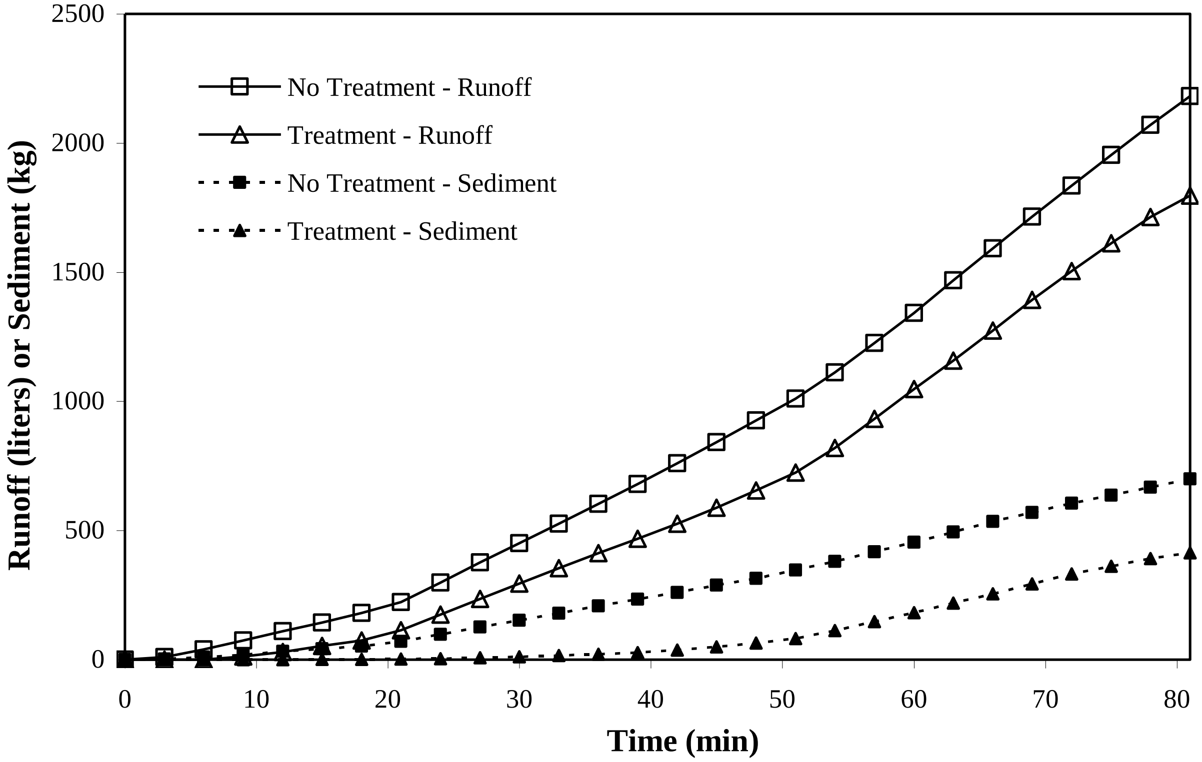

Figure 8: Mean cumulative runoff and sediment export from the No Treatment (NT) and Treatment (T) experiments.

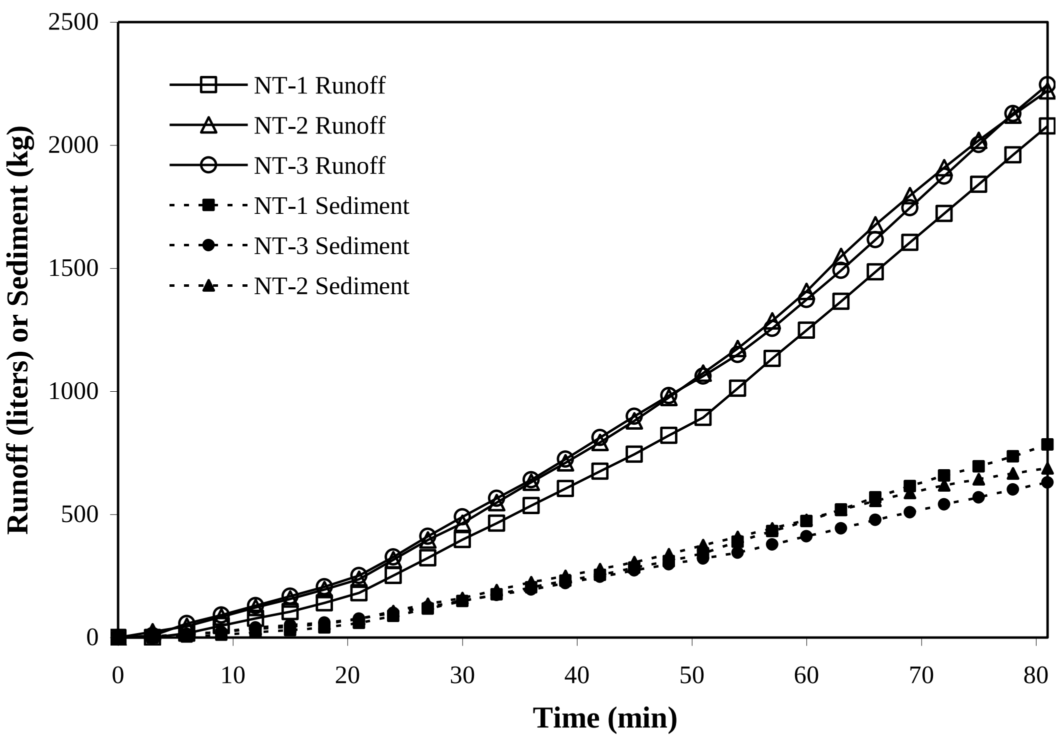

Figure 9: Cumulative runoff and sediment export from the No Treatment (NT) experiments.

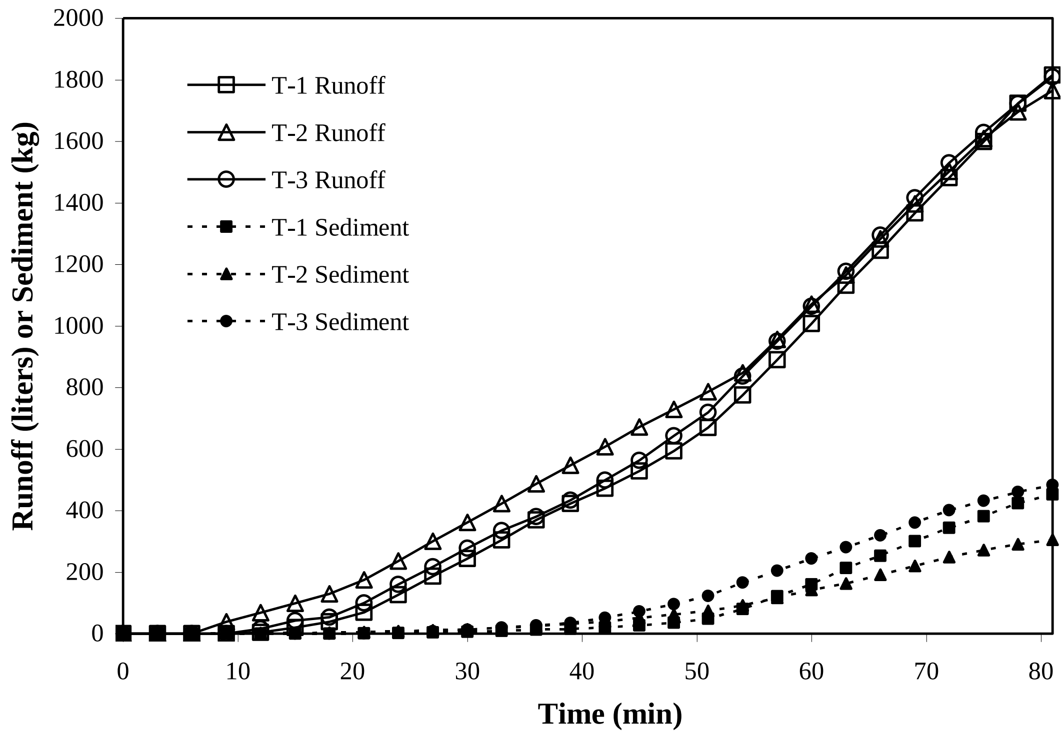

Figure 10: Cumulative runoff and sediment export from the Treatment (T) experiments.

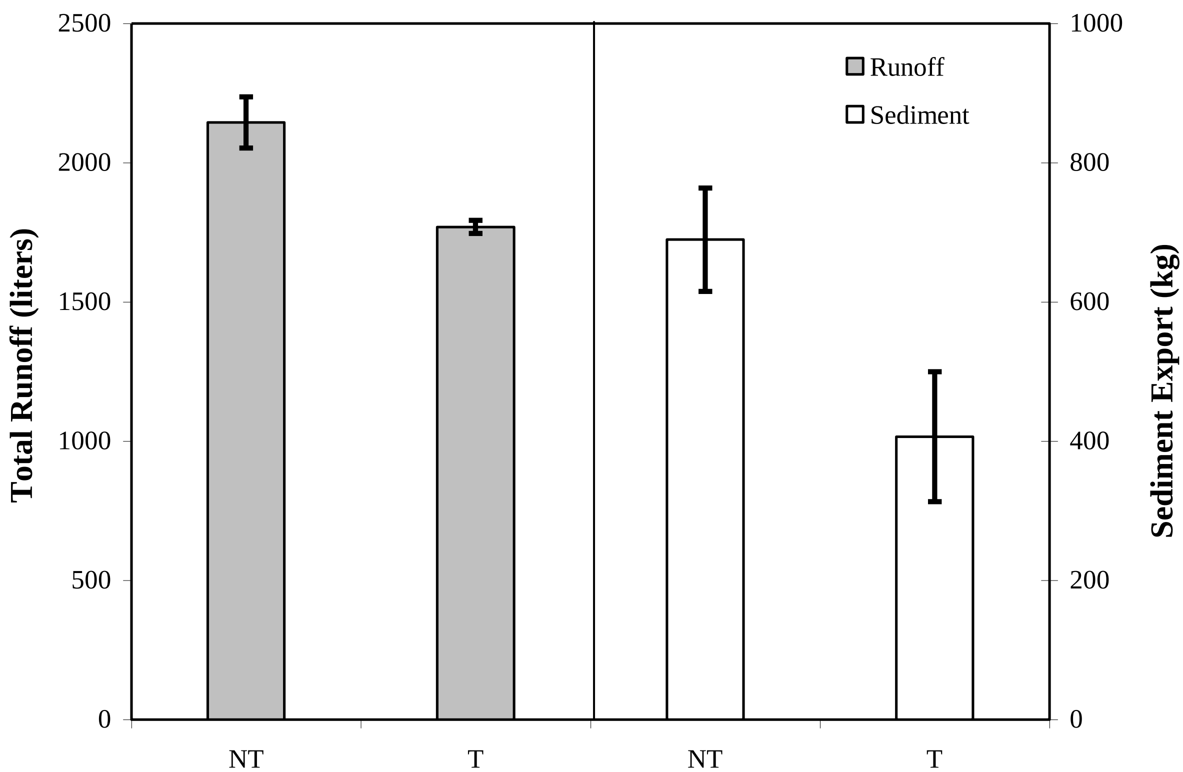

Figure 11: Mean total runoff volume and sediment export from the No Treatment (NT) and Treatment (T) experiments, with simulation variability shown as error bars.

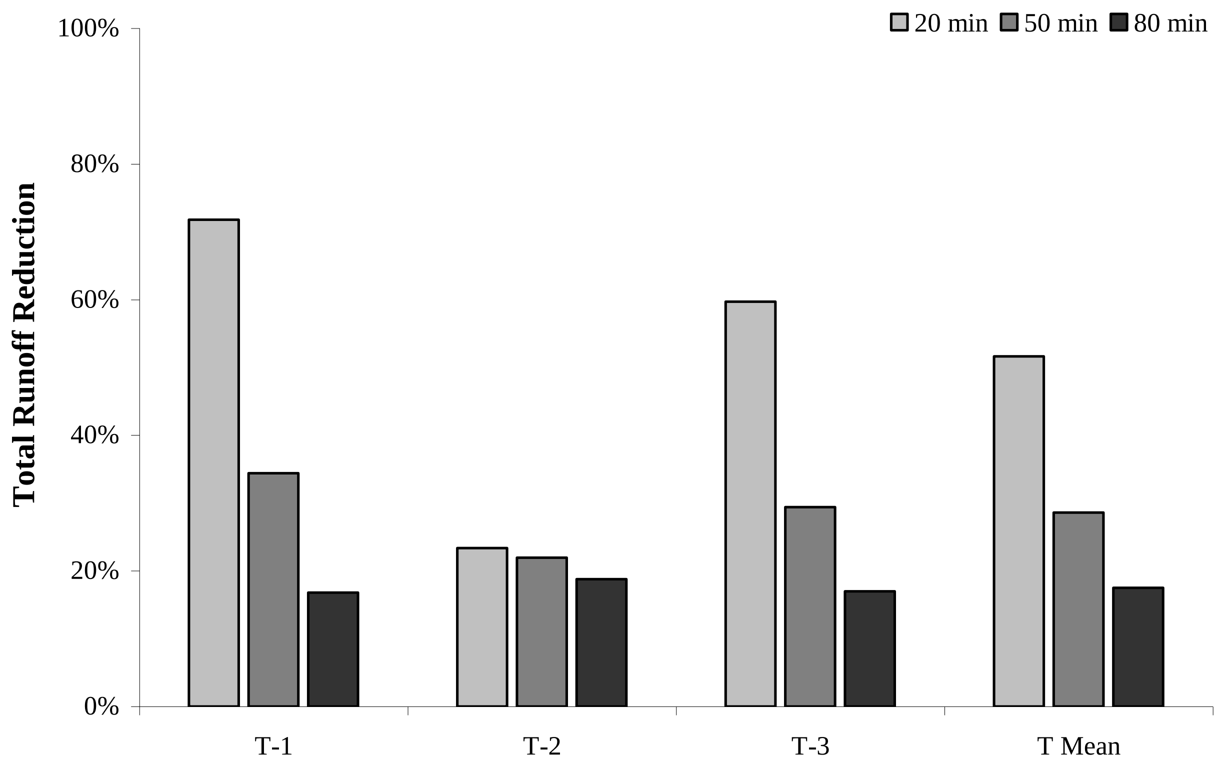

Figure 12: Reduction in total runoff volume using the Treatment product.

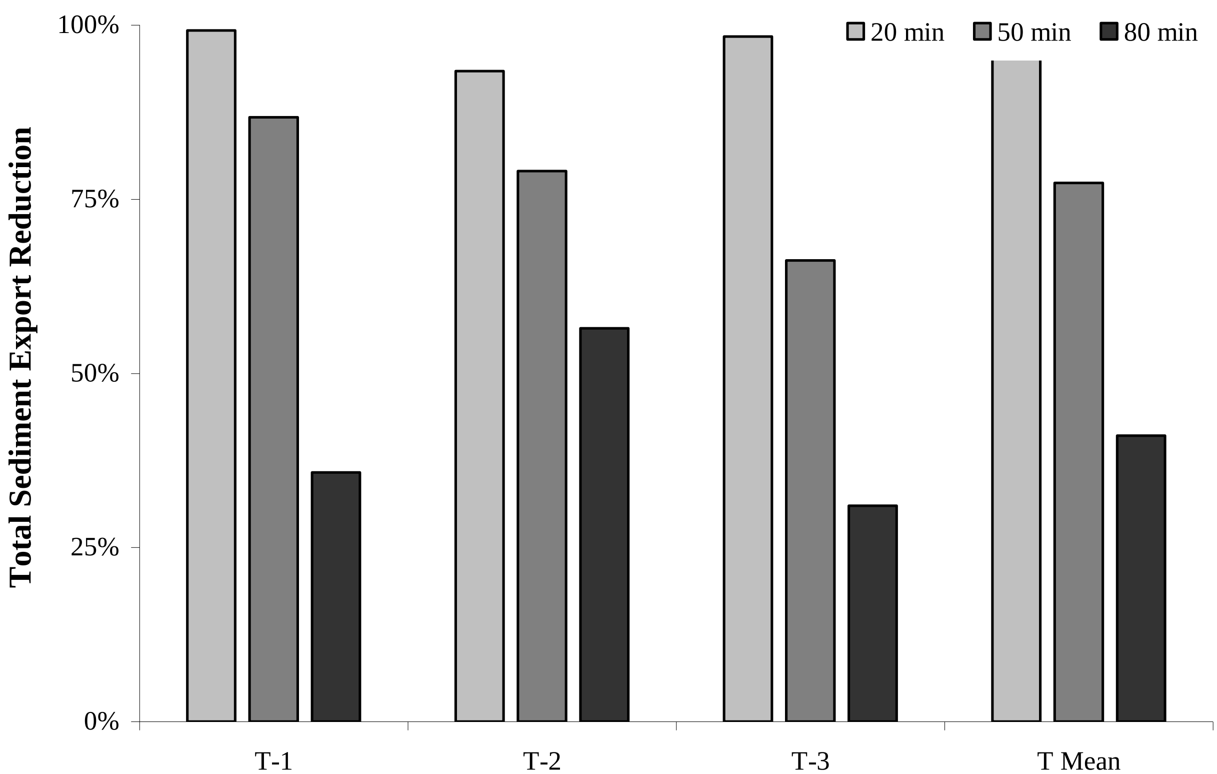

Figure 13: Reduction in total sediment export using the Treatment product.

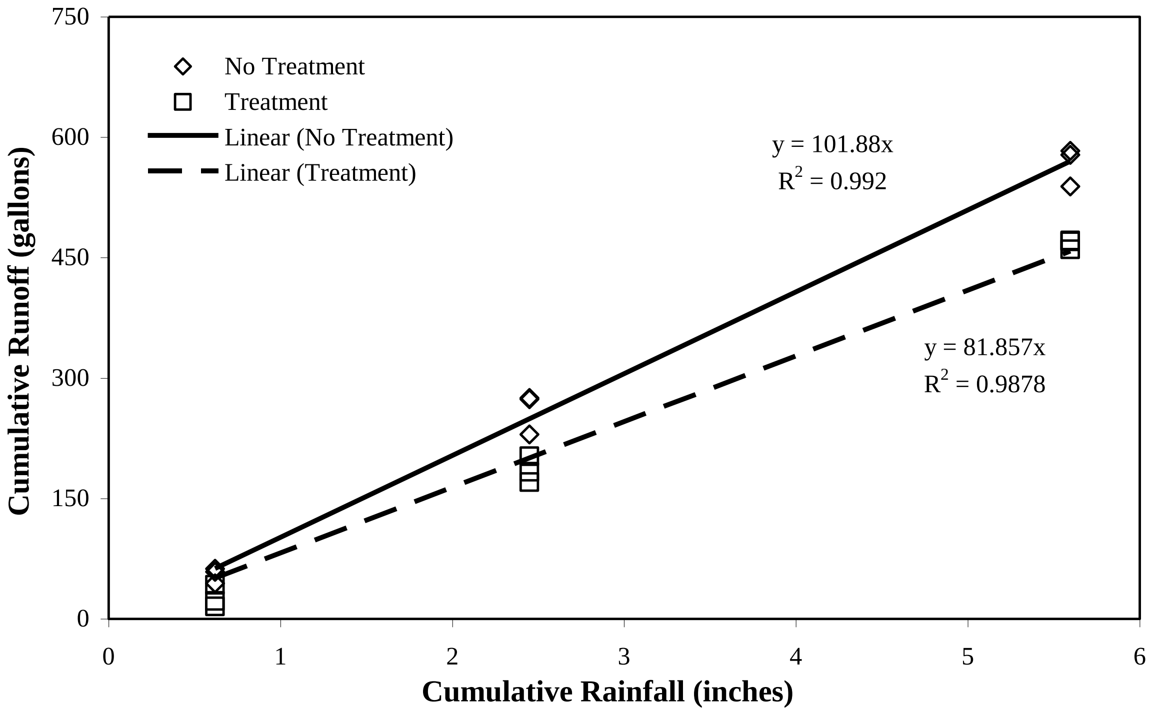

Figure 14: Cumulative runoff as a function of cumulative rainfall for each period of constant rainfall for No Treatment (NT) and Treatment (T) Experiments.

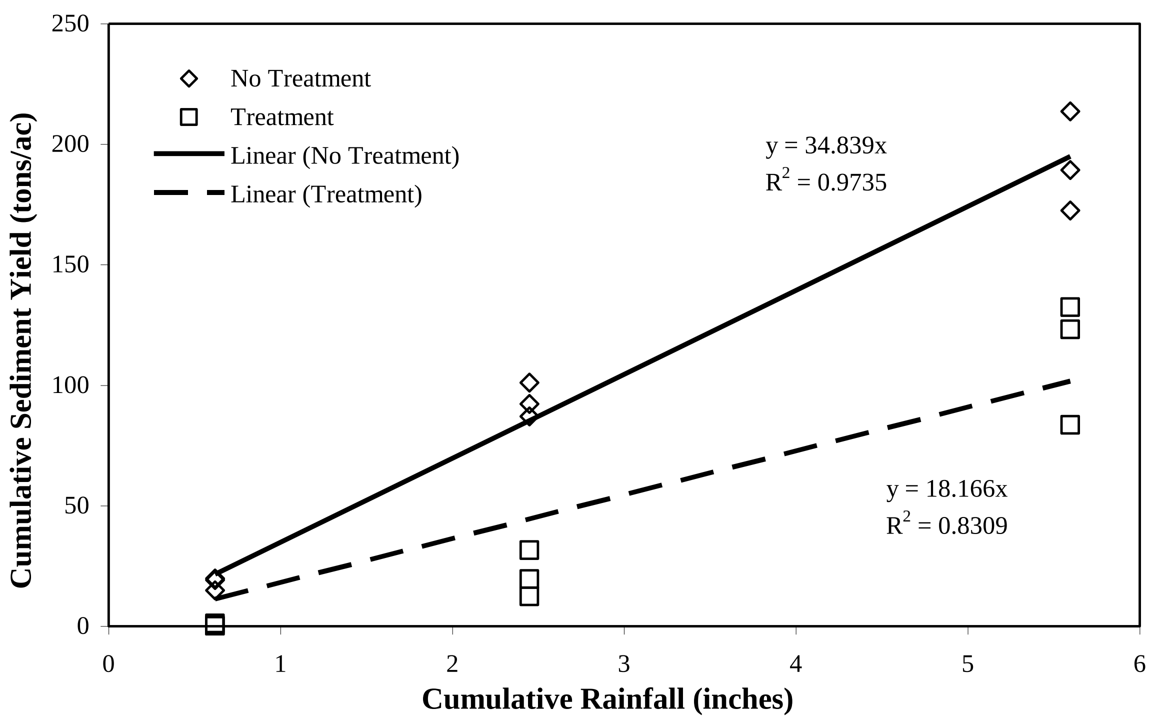

Figure 15: Cumulative sediment yield as a function of cumulative rainfall for each period of constant rainfall for No Treatment (NT) and Treatment (T) Experiments.

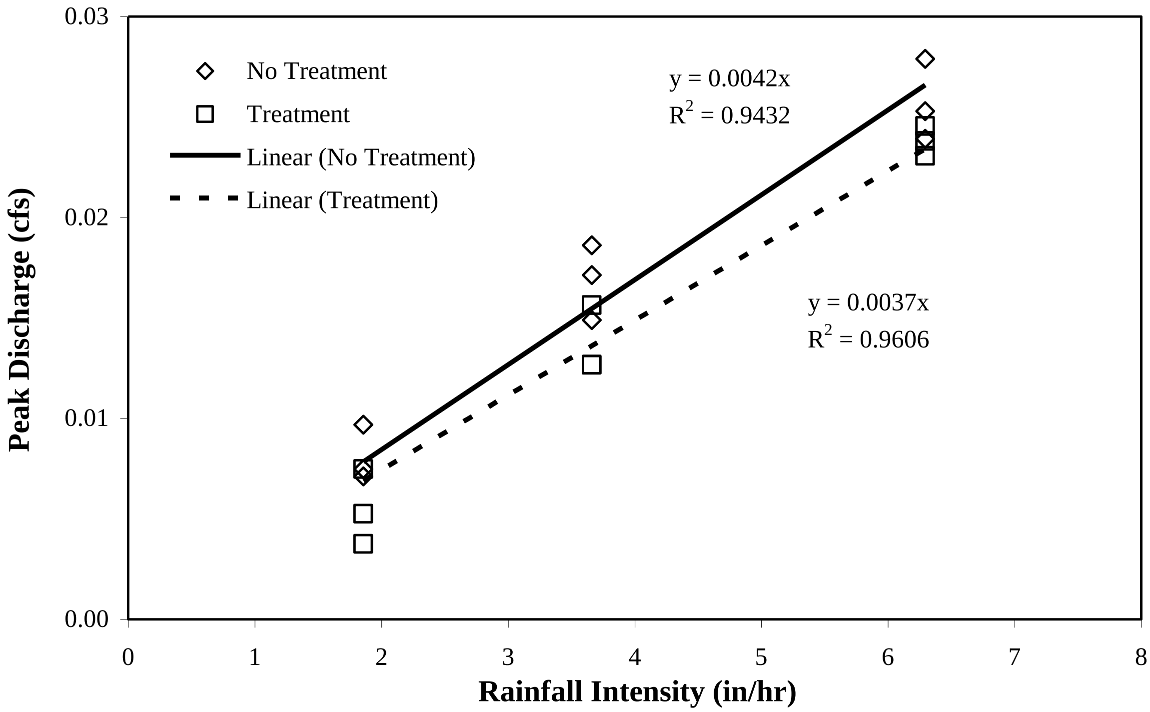

Figure 16: Peak discharge as a function of rainfall intensity for No Treatment (NT) and Treatment (T) Experiments.

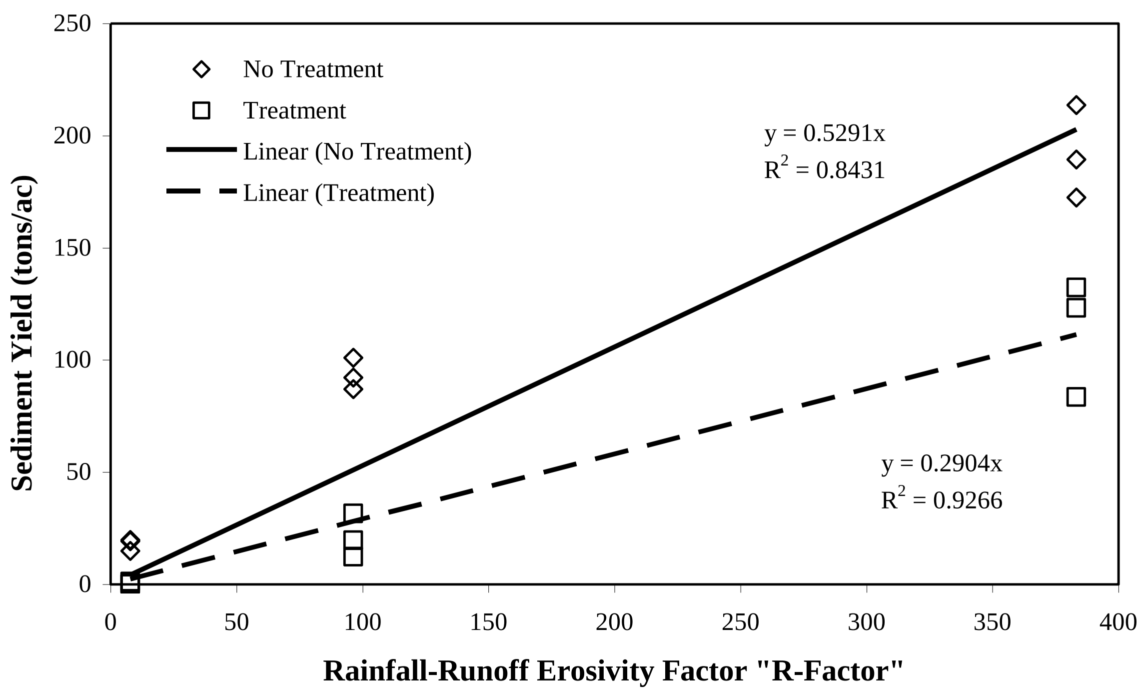

Figure 17: Sediment yield as a function of the rainfall-runoff erosivity factor for each period of constant rainfall for No Treatment (NT) and Treatment (T) Experiments.

Figure 18: SERL Facilities: tilting soil bed with overhead rainfall simulators, water treatment and storage systems.

Appendix A – SERL Experiment Photographs

T-1 (GG-3-B) Performed: January 15, 2008

t = 0 minute

t = 9 minute

t = 18 minute

t = 27 minute

t = 36 minute

t = 45 minute

T-1 (GG-3-B) Performed: January 15, 2008

t = 54 minute

t = 63 minute

t = 72 minute

t = 80 minute

T-2 (GG-3-C) Performed: January 16, 2008

t = 0 minute

t = 9 minute

t = 18 minute

t = 27 minute

t = 36 minute

t = 45 minute

T-2 (GG-3-C) Performed: January 16, 2008

t = 54 minute

t = 63 minute

t = 72 minute

t = 80 minute

T-3 (GG-3-D) Performed: January 17, 2008

t = 0 minute

t = 9 minute

t = 18 minute

t = 27 minute

t = 36 minute

t = 45 minute

T-3 (GG-3-D) Performed: January 17, 2008


t = 54 minute


t = 63 minute


t = 72 minute


t = 80 minute