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# Soil Loss-Rainfall Duration Relations as Affected by Peat Content, Soil Type and Compaction Effort

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## 1. Introduction

Soil erosion, and its associated impacts, is a big environmental problem, globally. The resulting costs of this phenomenon are tremendous and originate from both on-site and of-site effects of erosion (Morgan, 2005). On-site effects are particularly important on agricultural lands. The outcome includes loss of soil fertility and productivity, breakdown in soil structure, and at times loss of life and property. This decline in fertility leads to increased costly fertilizer use, affects food production and food security and substantial declines in land values. Off-site problems generally result in downstream or downwind sedimentation. There is also the issue of pollution transfer from place to place.

It is thus very important that new methods and practices for reducing and/or controlling erosion be developed and existing ones improved so as to combat this very important problem. There is also the need to encourage the use of existing agri-environmental management methods like the use of geotextiles and soil conditioners. Basically, all strategies for soil conservation include the following: providing a barrier against raindrop impact, increasing soil aggregate stability, increasing infiltration capacity of the soil to reduce runoff and/or increasing surface roughness to reduce velocity of runoff and wind (Morgan, 2005).

Peat is sometimes used as a source of organic matter for the soil. In Trinidad, peat is particularly used in nurseries, because unlike other organic materials like FYM, its incorporation is not accompanied by weeds infestation. Peat increases soil fertility and improves physical properties like saturated hydraulic conductivity (Ohu et al., 1985) and available water and reduces bulk density (Lebeau et al., 2003; Ekwue and Harrilal, 2010).

Soil erosion by water consists of two basic processes: splash detachment and transport by raindrops and runoff. Splash erosion is the first step in the soil erosion process and control measures are best targeted at reducing it. Ekwue (1990, 1992) found that splash detachment by raindrops declined with increasing peat content of soils and noted that the relationship was negatively exponential over a range of organic matter content (1.50 – 18.23%). Peat was found to act as mulch and thereby protecting the soil surface from the direct impact of raindrops. Ekwue et al. (2009) further found that peat decreased soil transport by runoff or overland flow (wash erosion). However, it was not clear why peat reduced soil transport since it is known to reduce inter-aggregate stability and soil strength which affects the soil erosion process. Ekwue and Harrilal (2010) followed it up by studying the effect of peat on wash erosion by raindrop impact and observed that peat decreased wash erosion by reducing soil bulk density, increasing infiltration rates and decreasing runoff. The effect of peat incorporation on the overall soil erosion process is therefore now clearly understood. Soil erosion by raindrops is also known to be affected by rainfall duration but it is not clear how this relationship is affected by other parameters that affect the soil erosion process including peat content, soil compaction and soil type. This paper reports the results of an interaction experiment set up to examine the relative effects of peat content, soil type, rainfall duration and compaction efforts on raindrop erosion. The aim is to further increase the general understanding of how peat affects the soil erosion process.

## 2. Materials and methods

Three soils, Piarco sandy loam, Maracas clay loam and Talparo clay (Table 1) were used for the study. They were the same soils used in the earlier studies by Ekwue et al. (2009) and Ekwue and Harrilal (2010). Air-dry soil samples were ground to pass a 5 mm sieve. Particle size distribution (Table 1) was performed using the hydrometer method (Lambe, 1951). Organic matter content in the samples was measured using the Walkley and Black (1934) method. Organic matter content in the samples was increased by adding air-dry sphagnum peat moss (with 0.15 t $m^{-3}$ air-dry density) at rates of 5%, and 10%, air-dry mass basis.

| Soil Series | Classification* | Organic Matter Content (%) | Sand (0.06-0.002) mm | Silt (0.06-0.002) mm | Clay (<0.002) mm |
|---|---|---|---|---|---|
| Piarco | Aquoxic Tropudults | 1.7** | 64.9 | 17.0 | 18.1 |
| Maracas | Orthoxic Tropudults | 4.7 | 44.7 | 24.7 | 30.6 |
| Talparo | Aquentic Chromuderts | 2.7 | 25.4 | 28.3 | 46.3 |

* Classification according to the Soil Taxonomy System (Soil Survey Staff, 1999).

** All values are means of three replicates

Table 1. Classification, organic matter, and the particle size distribution (%) of the soils

Raindrop erosion was measured with a soil erosion assessment facility whose soil test bed (Figure 1) was fully described by Ekwue et al. (2009). The difference is that this has now been added a rainfall simulator (Figure 2) designed using the original design of Tossel et al. (1990). The simulator utilized three continuous spray full jet nozzles (6.35 mm diameter) placed along the length of a 2 m high, ½ inch diameter P.V.C. frame mounted onto the frame of the test bed. The intensity of the simulated rainfall from each nozzle was 90 mm $hr^{-1}$ with a Christiansen (1942) coefficient of uniformity of 89%, median drop size of 2.03 mm and a kinetic energy of 29.38 J $m^{-2}$ $mm^{-1}$. The rainfall intensity was chosen as a compromise between what is expected in temperate and tropical climates. During the erosion test period, the simulator frame was covered with a transparent material to limit the effect of wind on the raindrops falling to the test bed.

The apparatus measures erosion on surfaces with slopes varying from 0% to 30%. The soil tray has a flexible drainage hose added to the bottom end throughout the length of it. Gravel was placed at the bottom of the soil tray to a depth of 8 cm before putting the soil to be tested, such that water that infiltrated through the soil first passed through the layer of gravel, which acted as a filter, and ensured that clean water flowed down the drain preventing the siltation of the drain pipes. During testing, the eroded soil and overflow water (runoff) flowed into the soil collection pan. Here soil settled under its own weight. From this compartment, the water flowed through a drainpipe and into a drain where the runoff was measured. Sediments were collected from the collection tray after the tests and oven dried to determine the mass of soil eroded.

For each test, soil was added to the soil tray to a depth of 2 cm. This is the depth of soil that is normally involved in the soil erosion process. Soil was then compacted at three levels (100 kPa, 150 kPa and 185 kPa). The three compaction levels were obtained using a 3.6 kg roller 2, 3, and 4 times each followed by a 5.8 kg roller 3, 4 and 5 times respectively. The aim was to produce a compacted soil similar to field conditions and to determine the effect of these levels of compaction on soil erosion. Bulk density and penetration resistance achieved after soil preparation were measured using a hand pushed spring-type Proctor penetrometer (ASTM, 1985). Erosion by simulated rainfall was assessed using a factorial experiment involving the three soils with the three peat contents, and exposed to four rainfall durations (5, 10, 20 and 30 min) with two replications giving a total of 216 tests. The slope gradient was fixed at 9% which is prevalent in agricultural soils in Trinidad (Gumbs, 1987). Analysis of variance of soil erosion values was performed using the MINITAB computer software.

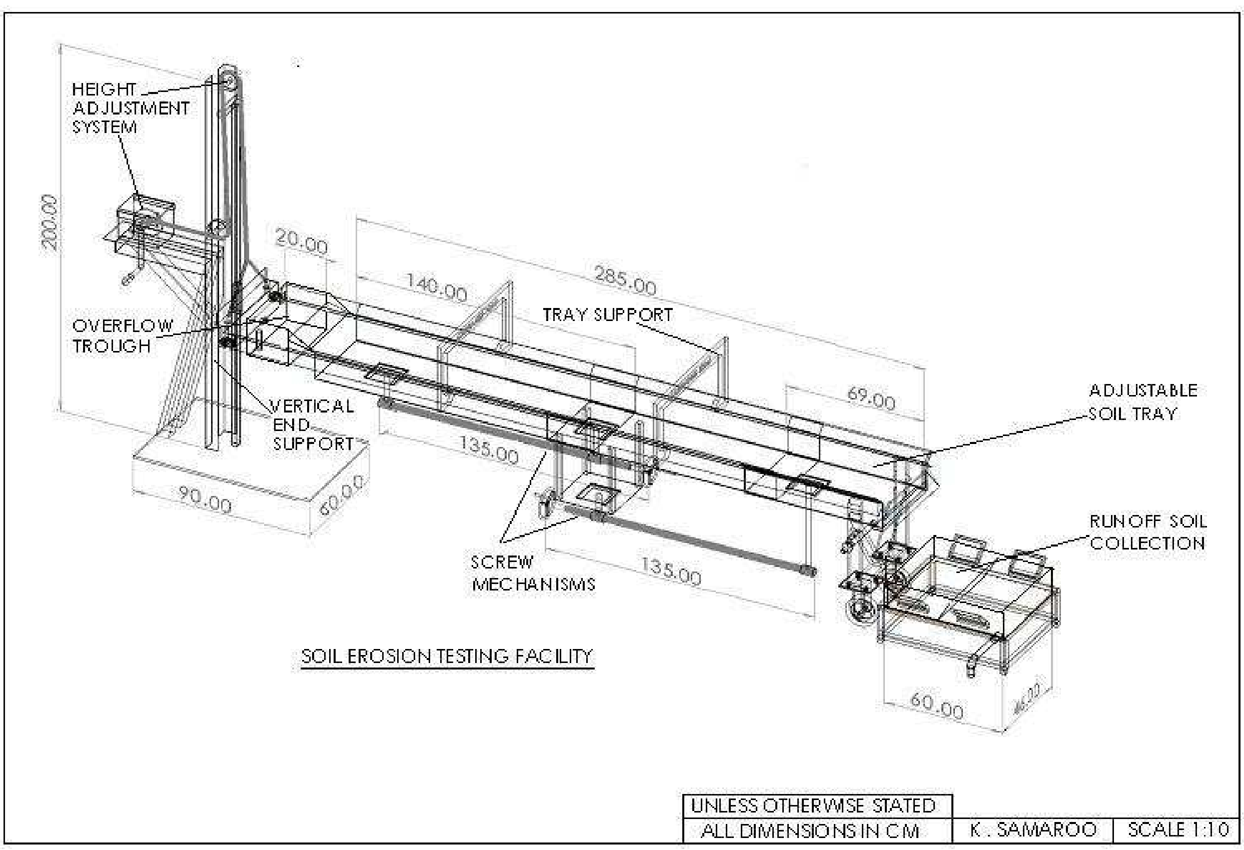



Fig. 1. The soil bed of the erosion facility

Fig. 2. The rainfall simulator with the soil bed

## 3. Results and discussion

### 3.1 Factors affecting runoff and soil loss

Table 2 shows the value of soil loss for the three soils. Soil loss decreased with increasing peat contents for all combinations of soil type, rainfall duration and compaction effort. Soil loss also decreased with increasing compaction effort and increased with increasing rainfall duration. Soil loss was consistently highest in the sandy soil, intermediate in the clay soil and lowest in the clay loam soil. Table 3 shows that cumulative runoff increased with increasing rainfall duration and compaction levels but decreased with increasing peat content. Runoff was highest in the clay, followed by clay loam and lowest in the sandy loam soil.

| Soil | Peat content (%) | Compaction effort, 100 kPa Rainfall duration (min) | | | | Compaction effort, 150 kPa Rainfall duration (min) | | | | Compaction effort, 185 kPa Rainfall duration(min) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 20 | 30 | 5 | 10 | 20 | 30 | 5 | 10 | 20 | 30 |
| Piarco sandy | 0 | 0.48 | 0.85 | 2.10 | 3.39 | 0.49 | 0.82 | 1.85 | 3.30 | 0.42 | 0.85 | 1.66 | 2.39 |
| loam | 5 | 0.45 | 0.81 | 1.84 | 2.95 | 0.45 | 0.79 | 1.66 | 2.76 | 0.38 | 0.75 | 1.51 | 2.03 |
| | 10 | 0.42 | 0.79 | 1.60 | 2.74 | 0.42 | 0.75 | 1.44 | 2.53 | 0.34 | 0.68 | 1.30 | 1.78 |
| Maracas | 0 | 0.40 | 0.81 | 1.47 | 2.51 | 0.40 | 0.72 | 1.16 | 2.01 | 0.31 | 0.63 | 1.19 | 1.62 |
| clay loam | 5 | 0.36 | 0.68 | 1.30 | 2.11 | 0.32 | 0.66 | 1.10 | 1.88 | 0.25 | 0.49 | 1.02 | 1.37 |
| | 10 | 0.28 | 0.563 | 1.17 | 1.87 | 0.24 | 0.50 | 0.851 | 1.43 | 0.17 | 0.39 | 0.81 | 1.21 |
| Talparo | 0 | 0.46 | 0.81 | 1.97 | 2.86 | 0.46 | 0.78 | 1.88 | 2.81 | 0.39 | 0.74 | 1.49 | 2.29 |
| clay | 5 | 0.42 | 0.78 | 1.77 | 2.67 | 0.40 | 0.71 | 1.54 | 2.64 | 0.35 | 0.69 | 1.39 | 1.91 |
| | 10 | 0.39 | 0.76 | 1.52 | 2.43 | 0.36 | 0.66 | 1.21 | 2.21 | 0.28 | 0.58 | 1.16 | 1.67 |

[a]Values are means of two replicates.

Table 2. Soil loss[a] (kg) for three soils with and without peat compacted and exposed to four rainfall durations

Table 4 summarizes the mean values of cumulative runoff and soil loss for the different experimental factors. Mean runoff increased with increasing clay content, compaction effort and rainfall duration but decreased with increasing peat content. For soil loss, mean values of soil loss varied from 1.36 kg in the sandy soil to 0.95 kg in the clay loam soil. The analysis of variance (Table 5) showed that the main effects of soil type, peat content, compaction effort and rainfall duration were all significant (P = 0.001) for the two parameters as depicted by the 'F' values. Rainfall duration was the most important factor that affected the two parameters. In addition, the most significant interaction that affected the two parameters was that between soil type and rainfall duration which was significant at 0.1% level. This was followed by the interactions between compaction effort and rainfall duration and between peat content and rainfall duration in that order for the two parameters. These interactions and the main effects will be described below.

### 3.1.1 Peat content

Soil loss decreased with increasing levels of peat in the three soils. This was true irrespective of the compaction effort, and the rainfall duration that the three soils were exposed to. The decrease in soil loss by peat content confirms the earlier findings in the previous papers by Ekwue et al. (2009) and Ekwue and Harrilal (2010) that peat decreases soil erosion by water. This can be attributed to its reduction of soil bulk density (Table 6).

| Soil Type | Peat Content (%) | Compaction Effort, 100 kPa Rainfall duration (min) | | | | Compaction Effort, 150 kPa Rainfall duration (min) | | | | Compaction Effort, 185 kPa Rainfall duration (min) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 20 | 30 | 5 | 10 | 20 | 30 | 5 | 10 | 20 | 30 |
| Piarco | 0 | 12.6 | 24.3 | 50.2 | 75.8 | 13.7 | 25.1 | 52.8 | 77.8 | 15.1 | 28.0 | 54.3 | 82.2 |
| sandy | 5 | 10.3 | 21.4 | 45.8 | 68.3 | 11.5 | 23.0 | 46.9 | 70.6 | 13.4 | 25.0 | 48.7 | 76.1 |
| loam | 10 | 7.1 | 17.2 | 38.3 | 58.1 | 8.3 | 18.3 | 38.1 | 63.3 | 10.5 | 20.1 | 44.0 | 70.5 |
| Maracas | 0 | 14.1 | 26.7 | 53.2 | 80.0 | 15.2 | 28.7 | 55.1 | 82.3 | 16.2 | 30.1 | 61.7 | 84.2 |
| clay | 5 | 12.3 | 23.8 | 48.2 | 73.7 | 13.1 | 26.0 | 51.3 | 76.8 | 14.0 | 27.3 | 55.1 | 78.3 |
| loam | 10 | 9.8 | 19.3 | 42.1 | 65.2 | 11.3 | 23.8 | 47.9 | 70.3 | 12.1 | 24.9 | 49.0 | 74.1 |
| Talparo | 0 | 16.9 | 28.3 | 55.2 | 84.2 | 16.4 | 31.9 | 59.4 | 87.7 | 17.1 | 31.4 | 63.0 | 90.1 |
| clay | 5 | 15.0 | 25.1 | 51.1 | 79.0 | 14.3 | 27.1 | 54.8 | 82.0 | 15.2 | 28.1 | 58.1 | 84.0 |
| | 10 | 12.3 | 23.8 | 47.8 | 72.7 | 12.6 | 25.0 | 50.7 | 75.7 | 14.1 | 26.3 | 53.1 | 79.9 |

Table 3. Surface runoff (mm) of soils at varying peat, compaction levels and rainfall durations

This is in line with the findings of Ekwue and Stone (1995) and Ekwue et al. (2009) which showed that peat reduces bulk density of soils by diluting the soil matrix with its own less dense material. This reduction in soil bulk density ensured that peat increased the infiltration capacity of the soils, and therefore reduced runoff and soil loss as was further confirmed in this study (Tables 2, 3, and 4). Ekwue (1987, 1992) reported increases in infiltration rates as a result of peat incorporation to the soil. Table 6 shows that penetration resistance decreased with increasing peat contents in all the soils. This result is in agreement with the findings of Ekwue (1990) and Zhang et al. (2005) which showed that peat reduces soil strength. Peat reduces soil strength by just adding to the soil bulk, reducing its inter-aggregate stability and making the soil aggregates to fall apart (Ekwue, 1987). Although soil strength is known to increase the resistance of soils to erosion (Rachman et al., 2003; Wuddivira, 2008), the present results further confirm that peat reduces soil loss by increasing infiltration and decreasing runoff during rainfall rather than by strengthening the soil as was obtained for other organic materials like farmyard manure by Wuddivira et al. (2009) and Ekwue et al. (2009). Runoff and soil erosion are important not only for soil and water conservation, but also to reduce nutrient discharge with runoff (Bjorneberg et al., 2000). This means that the reduction of surface runoff and soil erosion by peat will not only aid soil conservation, but also reduce loss of plant nutrients in the soil. The interaction between peat content and rainfall duration (Fig. 3) shows that the effect of peat on soil loss increases with rainfall duration. A similar interaction was reported for soil detachment by Ekwue (1991) in connection to organic matter originating from grass.

### 3.1.2 Soil type

The main effect of soil type was the second most important of all the experimental factors on soil loss and runoff (Table 5). This was almost like the previous paper by Ekwue and Harrilal (2010) where it was the most important factor. This may be as a result of the same process involved in the raindrop erosion measured in the two studies. In a previous study by Ekwue et al. (2009), soil type was the least important factor and this may be because this study measured wash erosion by surface runoff, while the present and the Ekwue and Harrilal (2009) examined the total erosion process of transport of soil particles detached by raindrop which is commonly referred as interrill erosion (Levy et al., 2001). Piarco sandy loam had the largest quantity of mean soil loss and this has been consistent in the with these two recent studies. Although this soil had the least runoff as the rainfall duration increased (Tables 3 and 4), its low percentage clay content (18.1%, Table 1) decreased the soil strength (Table 6), thus decreasing the soil's ability to increase the cohesiveness of the particles. The larger size of the sandy loam soil led to greater presence of large pores which enhanced infiltration. Results show that this led to lower surface runoff. However, decreased soil cohesiveness, the presence of more loose detached sand particles ensured that the soil had greater soil loss than the other soils despite its maintenance of high infiltration and low runoff rates.

With the 46.3% clay content of the Talparo clay soil (Table 1), the soil cohesiveness and soil strength (Table 6) was the greatest as was measured by the soil penetration test. However, due to the low infiltration and high runoff rates recorded for this soil, the Talparo soil still had more soil loss than the Maracas clay loam soil. Although there was little raindrop detachment, due to the quantity of clay in the soils composition, the Talparo clay experienced the lowest infiltration and greatest amount of surface runoff of the three soils (Tables 3 and 4). This quantity of surface runoff was able to produce soil erosion, and as the rainfall duration increased, so too did the runoff and also the quantity of erosion. However, its high clay composition and high soil strength ensured that there was less erosion than the Piarco sandy loam. The Maracas clay loam had the least soil loss. This was mainly its evenly balanced composition of sand, silt and clay (Table 1). The Maracas clay loam had 30.6% clay content which was enough to produce good cohesive nature and soil strength for the particles so as to minimize splash erosion and easy detachment. The sand and silt composition allowed the soil to have steady infiltration throughout the testing period and leading to runoff which was closer to that recorded for the sandy loam soil (Table 4). These characteristics of low soil detachment and medium runoff made the Maracas clay soil to have the least soil loss of the three soils.

| Factor level | Mean runoff (mm) | Mean soil loss (kg) |
|---|---|---|
| Soil type | | |
| Piarco sandy loam | 37.1 a | 1.36 c |
| Maracas clay loam | 41.6 b | 0.95 a |
| Talparo clay | 44.7 c | 1.27 b |
| LSD (P = 0.001) | 2.0 | 0.06 |
| Peat content, % | | |
| 0 | 44.7 c | 1.34 c |
| 5 | 41.5 b | 1.20 b |
| 10 | 37.1 a | 1.04 a |
| LSD (P = 0.001) | 2.0 | 0.06 |
| Compaction effort, kPa | | |
| 100 | 38.2 a | 1.34 c |
| 150 | 41.3 b | 1.23 b |
| 185 | 43.8 c | 1.01 a |
| LSD (P = 0.001) | 2.0 | 0.06 |
| Rainfall duration (mins) | | |
| 5 | 13.1 a | 0.38 a |
| 10 | 25.1 b | 0.71 b |
| 20 | 51.0 c | 1.42 c |
| 30 | 75.3 d | 2.27 d |
| LSD (P = 0.001) | 2.5 | 0.08 |

[a] Mean values for each factor were obtained by averaging the measured values over the levels of the other three experimental factors. Values followed by different letters in each column are significantly different at the 0.1% level. Number of experimental points is 216 representing a factorial experiment with 3 soil types, 3 levels of added peat, 3 compaction levels, and 4 rainfall durations with 2 replications.

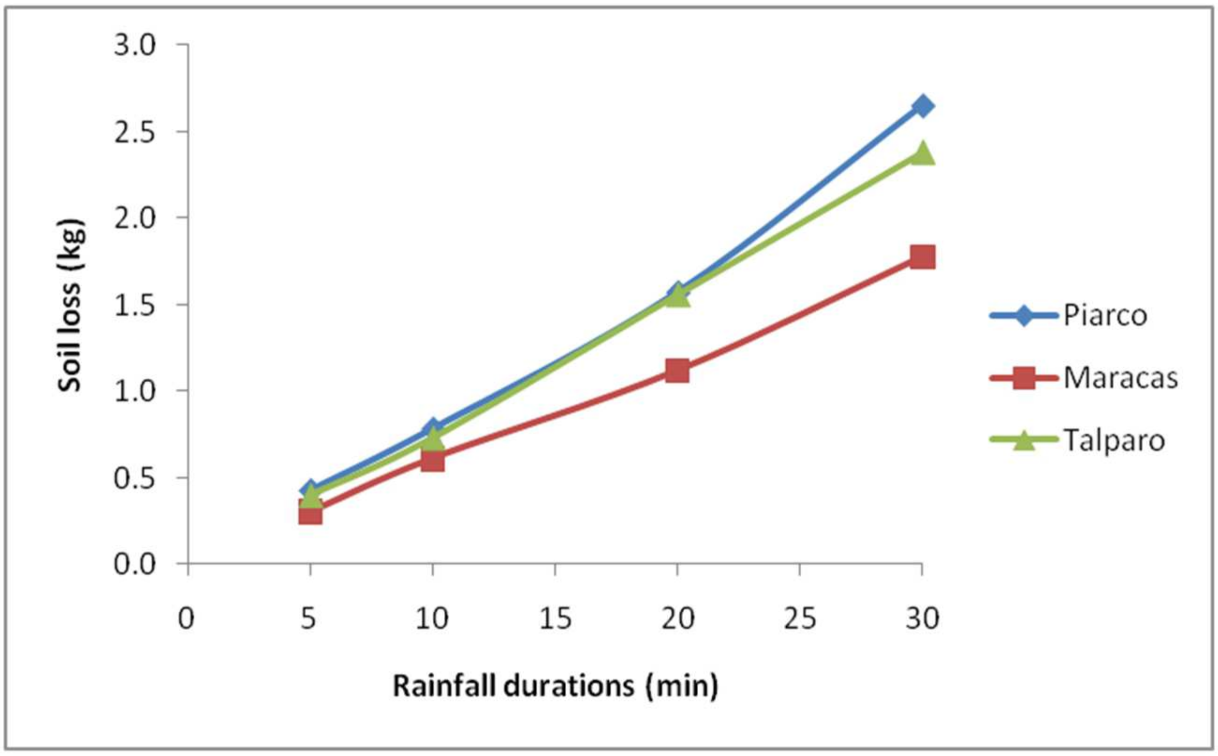
Table 4. Mean values of cumulative runoff and soil loss for different experimental factors[a]

| Sources of variation | Degrees of freedom | Runoff | Soil loss |
|---|---|---|---|
| Soil type | 2 | 50.3* | 166.7* |
| Peat content | 2 | 50.5* | 79.1* |
| Compaction effort | 2 | 27.1* | 99.5* |
| Rainfall duration | 3 | 2002.2* | 1915.7* |
| Soil type x peat content | 4 | 0.6 | 0.2 |
| Soil type x compaction effort | 4 | 0.8 | 1.9 |
| Soil type x duration | 6 | 4.5* | 29.4* |
| Peat content x compaction effort | 4 | 0.8 | 0.8 |
| Peat content x duration | 6 | 1.9 | 11.8 |
| Compaction effort x duration | 6 | 3.1* | 27.2* |
| *Significant at 0.1% level | | | |

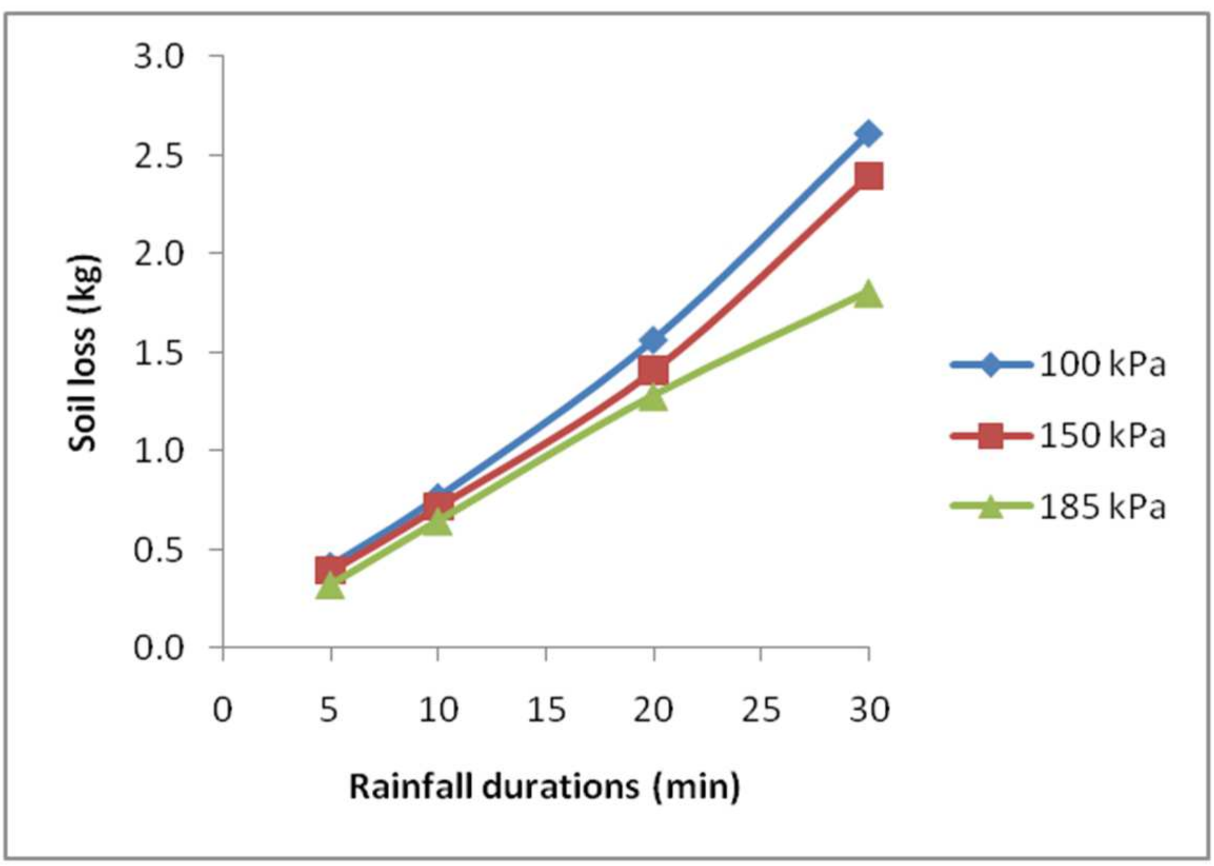
Table 5. 'F' values in the analysis of variance for cumulative runoff and soil loss

| Soil type | Added peat Content, % | Bulk density, t $m^{-3}$ | | | Penetration resistance, kPa | | |
|---|---|---|---|---|---|---|---|
| | | Compaction effort, kPa | | | Compaction effort, kPa | | |
| | | 100 | 150 | 185 | 100 | 150 | 185 |
| Piarco sandy loam | 0 | 1.47 | 1.57 | 1.68 | 150.1 | 157.5 | 165.7 |
| | 5 | 1.37 | 1.47 | 1.56 | 147.2 | 152.8 | 160.5 |
| | 10 | 1.24 | 1.28 | 1.42 | 129.3 | 143.6 | 154.7 |
| Maracas clay loam | 0 | 1.42 | 1.45 | 1.51 | 160.0 | 171.0 | 180.1 |
| | 5 | 1.21 | 1.24 | 1.33 | 153.6 | 165.9 | 172.4 |
| | 10 | 1.04 | 1.07 | 1.12 | 147.8 | 155.6 | 167.4 |
| Talparo clay | 0 | 1.20 | 1.25 | 1.28 | 172.8 | 184.8 | 205.1 |
| | 5 | 1.15 | 1.21 | 1.23 | 163.5 | 170.7 | 189.2 |
| | 10 | 1.12 | 1.17 | 1.20 | 156.7 | 163.0 | 174.1 |

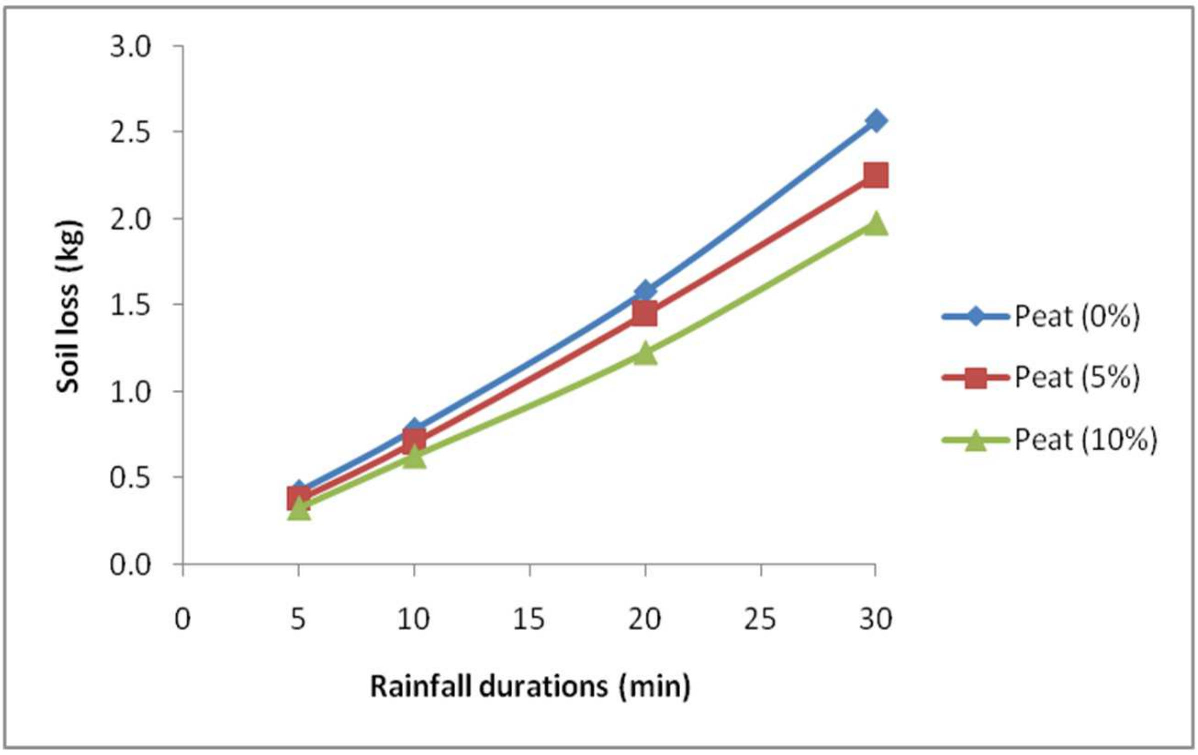
Table 6. Values of bulk density and penetration resistance of soils prior to testing for soil loss


3.0
2.5
2.0
1.5
1.0
0.5
0.0
Soil loss (kg)
0
5
10
15
20
25
30
Rainfall durations (min)
Piarco
Maracas
Talparo

(a)


3.0
2.5
2.0
1.5
1.0
0.5
0.0
Soil loss (kg)
0
5
10
15
20
25
30
Rainfall durations (min)
100 kPa
150 kPa
185 kPa

(b)




(c)

Fig. 3. Effect of the interactions between rainfall duration and (a)soil type, (b) compaction effort and(c) peat content on soil loss.

The interaction between soil type and rainfall duration (Fig. 3), was significant and shows that as the rainfall duration increased the differences in soil loss between the sandy soil and the clay loam and clay widened. This was similar to the results obtained by Ekwue (1991). Results, therefore, confirm that the effect of soil type on soil erosion depends on the rainfall duration.

### 3.1.3 Rainfall duration

As expected, soil loss increased, in each case with rainfall duration. At higher rainfall duration, there was a greater breakdown in soil aggregates as well as greater cumulative runoff on the soil surface. The magnitude of increase of soil loss with increasing rainfall duration was, however, reduced by increasing peat content, clay content and soil compaction effort as the interactions between rainfall duration and these three parameters showed (Fig. 3). These results are not very explicit in previous studies of soil erosion.

### 3.1.4 Compaction effort

Generally, soil loss decreased with increasing compaction effort in all the soils and this further clarifies the effect of compaction on soil loss. Soil compaction is a process by which soil particles are rearranged into a denser state. This is normally caused by natural forces or human induced mechanical loads such as wheel traffic and tillage. It results in reduction in soil porosity mainly its air-filled fraction, decrease in aeration and water infiltration, and increase in soil strength (Tekeste et al., 2006**).** Although surface runoff increased with increasing compaction effort (Table 3), the greater soil strength which resulted from compaction (Table 6) ensured that soil loss declined with increasing compaction levels. This result is not always certain since it is always feared that greater surface runoff as a result of soil compaction could increase soil erosion.

### 3.2 Derivation of regression equation relating soil loss to experimental factors

The soil loss for the three soils with three levels of peat content compacted at three levels and exposed to four rainfall durations was used to generate a multiple linear regression equation that could be used to predict soil loss. The equation was of the form:

$$SL = 0.767 - 0.00276\ C_t\ 0.0307\ P_t - 0.00386\ P_c + 0.00172\ KE \quad (1)$$

Student 't' (11.34) (-7.62) (- 4.43) (-3.69) (8.70)

(R = 0.878; N = 216)

Where: SL is soil loss (kg); $C_t$ is clay content of the soil (%); Pt is the peat content (%), Pc is compaction effort (kPa) and KE is raindrop kinetic energy (J $m^{-2}$). R is the coefficient of multiple regression and N is the number of experimental data points. The signs of the experimental factors obtained confirm how the factors affected the soil loss. The R is significant at the 0.1% level. The student 't' values for all the experimental factors shown beneath them in the equation were all significant at 0.1% level. The relative 't' values for all the factors also confirm the findings in the analysis of variance which showed that the most important factors that affected soil loss were rainfall duration, soil type, compaction effort and peat content.

## 4. Conclusion

Soil loss by simulated rainfall was measured for three Trinidadian soils in the laboratory using a specially constructed soil erosion apparatus. Soil loss decreased with increasing peat content in all cases and was smallest in the clay loam soil and highest in the sandy loam. Peat decreased soil loss by decreasing runoff during rainfall. Soil loss declined with increasing compaction effort. The interactions involving rainfall duration showed that although soil erosion increases with rainfall duration, these increases will be reduced by increasing clay, and peat contents of the soil as well as the increasing level of soil compaction. A multiple regression equation derived to relate soil loss to the experimental factors was highly significant and confirmed that the most important factors that affected soil loss were rainfall duration, soil type, compaction effort and peat content. The implication of this study is that while land use zoning of soils based on slopes is very essential in soil conservation, the incorporation of organic materials particularly in form of peat in steep arable slopes will greatly minimize soil erosion by water. It will also minimize surface runoff which will decrease the loss of nutrients from farmlands.

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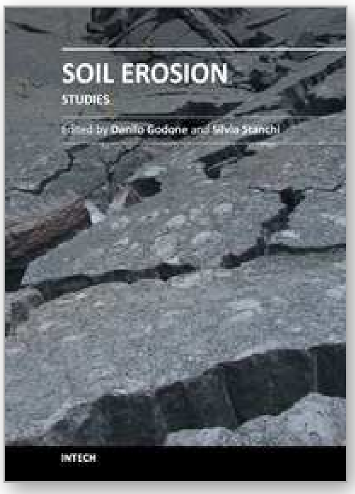


**Soil Erosion Studies**

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Soil erosion affects a large part of the Earth surface, and accelerated soil erosion is recognized as one of the main soil threats, compromising soil productive and protective functions. The land management in areas affected by soil erosion is a relevant issue for landscape and ecosystems preservation. In this book we collected a series of papers on erosion, not focusing on agronomic implications, but on a variety of other relevant aspects of the erosion phenomena. The book is divided into three sections: i) various implications of land management in arid and semiarid ecosystems, ii) erosion modeling and experimental studies; iii) other applications (e.g. geoscience, engineering). The book covers a wide range of erosion-related themes from a variety of points of view (assessment, modeling, mitigation, best practices etc.).



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