The Effect of Sedum Plant Cover on Acid Soil and Clay Soil Erosions under Rainfall Simulation

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1. Introduction

Soil erosion is the removal and subsequent loss of soil by the action of water, ice, wind and gravity. Soil erosion is a process that occurs naturally at a slow rate. The average natural geologic rate of soil erosion is approximately 0.2 tons per acre per year. This is approximately equal to the average rate at which soil is being produced from parent rock and organic materials (Gangaware et al., 1997). The most ubiquitous form of erosion is that done by water. This soil erosion occurs in three phases: (1) particle detachment; (2) sediment transport; and (3) sedimentation. In other word, climatological; soil structure; topographical and vegetation are the main factors contributing to soil erosion. Soil cover is the most significant factor in controlling the erosion process.

The accelerated soil erosion has been seriously endangered agricultural production and the existence of human beings, and is one of the environmental disasters all over the world. It's not only the main cause of deterioration of land productivity, but also the important aspect of non-point resources pollution of water. This situation in developing countries is more serious, due to the poor land-water management, prevailing of slash-and-burn agriculture activities and cattle ranching.

Regarding the characteristics of the sedum plant; high tolerant water stress and low management requirements, and in the other hand, the actual situation in developing countries, we tried to use this plant and to evaluate its effectiveness as soil cover on slope area and under high rainfall intensity.

2. Material and methods

Clay soil and acid soil (from Tohaku and Yamaguchi, respectively) were used during this experiment, which consisted of three components: (1) analysis with no cover; (2) analysis with 25% cover; and (3) analysis with 75% cover. The mean rainfall intensity and the slope gradient conditions are 60 mmh^{-1} and 10°, respectively. Air-dry and saturated soils were prepared in order to determine the actual state conditions of the soils, the effect of using used in the experiment and the effectiveness of the sedum plant as soil cover along the down slope. Disturbed soils of clay and acid types were packed on different boxes, 30 cm by 50 cm by 5 cm, above gravel filter with 2 cm thickness. The precaution is taken to evaluate the soil infiltration rate. We saturated the soils from the bottom of the soil box, and it was done after 24 h. The straws of sedum were spread on the saturated soil surface, and left for 4 days before subjecting to rainfall simulation. The surface runoff and soil infiltration were taken every 5 min or 10 min interval times with J-bottle (2000 ml) and weighted. The sediment load was obtained after drying the runoff samples at 105°C.

Table 1 The characteristics mean values with standard deviation of the soils.

Soil type	pH_{-H20}	bulk density [g/cm^3]	OM [%]	Clay[%]	Silt [%]	Sand [%]	Ks at 20°C
Acid soil	3.48 ±0.001	1.38 ±0.12	4 ±0.06	19 ±2	40.2 ±1	36.8 ±1	2.79 E-05 ±3 E-06
Tohaku soil	5.69 ±0.01	1.06 ±0.09	8 ±0.13	43.2 ±3.5	22.9 ±1.1	25.9 ±0.3	3.39 E-05 ±3 E-05

OM: organic matter; Ks: saturated hydraulic conductivity [$cm\ s^{-1}$]

3. Results and discussion

The acid soil represents the compacted state on the soil surface 20 min after the launching the rainfall simulation, while the clay soil is partially (**Fig.1**). The soil behavior explains the effect of raindrops compression on the soil surface; the clay soil characteristic is more flexible than of the other soil. **Figs.1** and **4** show that there is no considerable difference in the amount of the surface runoff between saturated and used of the same kind of soil. The comparison of the amount of the sediment load explains the effect of soil structure (**Table 1**) on soil erosion; the clay soil is more erodible than acid soil (**Fig.4**). The **fig.1** shows that the soils with covers have much runoff than bare soils, although, the sediment load of the covered soil is less (**Fig.4**), these mean that the plant covers reduce the energy kinetic of raindrops on the soil surface; the outsplash caused by raindrops decreased, and

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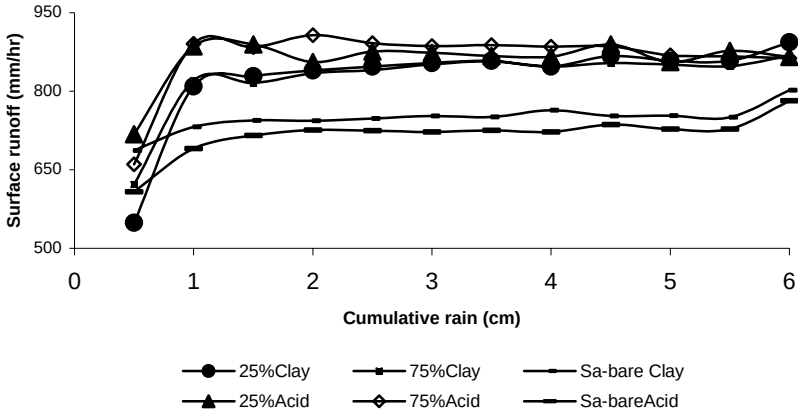
due to the using disturbed soil (no infiltration occurred) as effect the runoff increases. The plant ramification has an important role in trapping the sediment; as results there is no considerable difference in sediment load between 25% and 75% of plant cover in the same kind of soil (**Fig.2**, **Fig.3**).



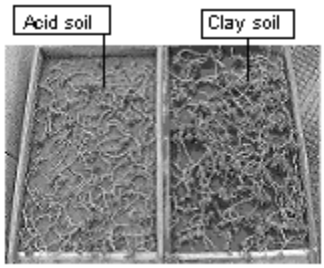
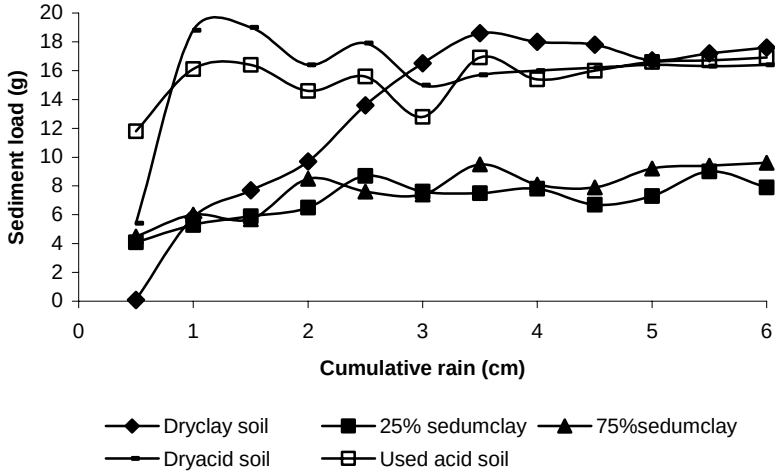


Fig 2 Plots covered with 25% of sedum

Fig 1 Surface runoff of saturated clay and acid soils with bare and plant covers conditions.



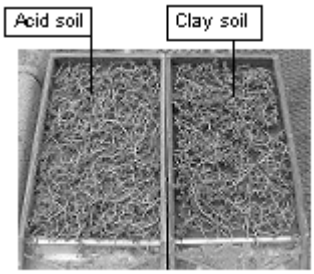


Fig 3 Plots covered with 75% of sedum

Fig 4 Sediment load taken from the surface runoff of clay and acid soil.

4. Conclusion

The acid soil responds quickly to the effect of raindrops compression on the soil surface, however this soil has a less soil erodibility than the clay soil. Although, the soil surface of the used soil is compacted, there is no considerable difference in the amount of surface runoff between this soil and the saturated soil due to the soil particle-size. Sedum plant reduce the energy kinetic of the raindrops, as results, the outsplash decrease considerably. Hence, the entrainment of sediment transportation decreases to 45% due to the plant ramification. In the other word, the increasing surface runoff means that the surface roughness increases; despite of the soil packing effect on the box the soil infiltration does not occur during the whole simulation. The sedum plant is effective on lightening the soil erosion, however, the acidity affects on its growth, it delays the plant growing.

Acknowledgements

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Reference

Fen-li Zheng, Chi-hua Huang, Darrell Norton (2000) Vertical Hydraulic Gradient and Run-on Water and Sediment Effects on Erosion Processes and Sediment Regimes.