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Enrichment Rate In Organic Carbon In Interrill Erosion: Effect Of Soil Cover

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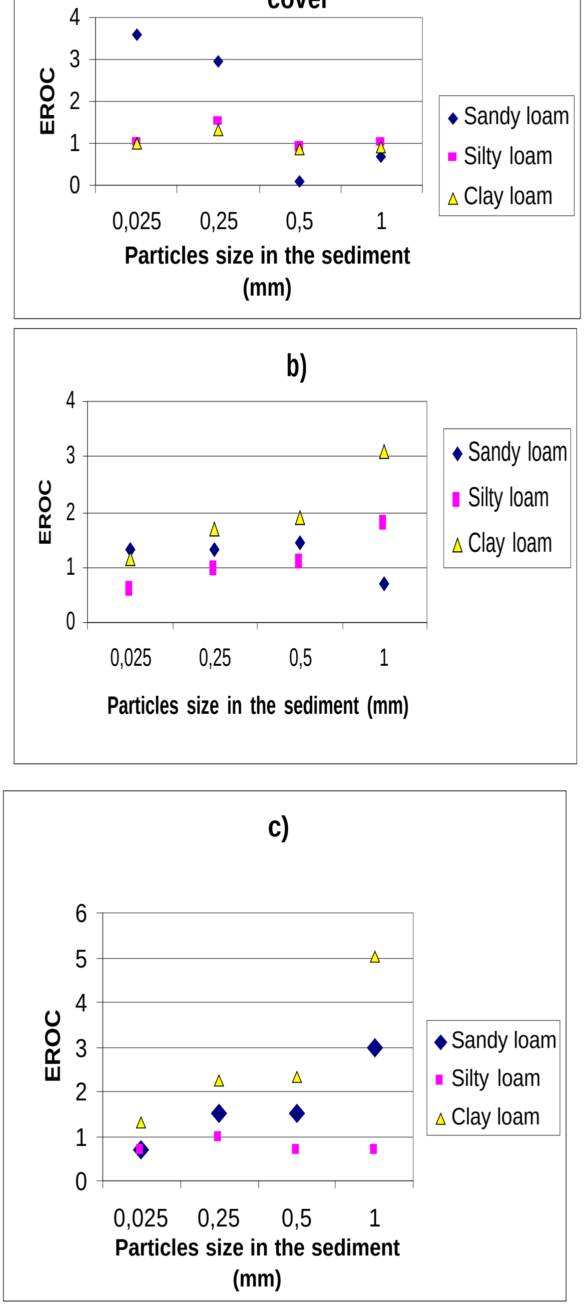
Résumé
Les échantillons de sols de différente texture ont été exposés au simulateur de pluie avec trois degrés de couverture de sol pour déterminer si le changement dans la couverture de sol avait l'effet sur le taux d'enrichissement dans le contenu organique de carbone. Les données ont montré que quand l'augmentation de couverture de sol, le taux d'enrichissement dans le carbone organique a diminué dans les particules plus petites que 0,25mm, mais a augmenté dans la grandeur de particule plus haut que 0,5 millimètres; la raison n'est pas comprise encore. En plus a été remarqué que 60 % de sol couvrent son pas assez pour diminuer le taux d'enrichissement dans le carbone organique parce que la valeur était plus haute que 1; cela pourrait représenter une édition très importante dans la condition aride et semi-aride où obtenir le haut pourcentage de couverture de sol ce n'est pas possible.
Mot clé: Taux d'enrichissement dans le Carbone Organique; Couverture de Sol; Sélectivité; érosion d'Interruisselet

Abstract
Soils samples of different texture were exposed to rain simulator with three soil cover degrees in order to determine if the change in soil cover had effect on enrichment rate in organic carbon content. Data showed that when the soil cover increase, the enrichment rate in organic carbon decreased in particles smaller than 0,25mm, but increased in particle size higher than 0,5 mm; the reason is not understood yet. In addition was observed that 60 % of soil cover its not enough to decrease the enrichment rate in organic carbon, because the value was higher than 1; this could represent a very important issue in arid and semiarid condition where to obtain high percentage of soil cover it is not possible.
Keywords: Enrichment rate in Organic Carbon; Soil Cover; Selectivity; Interrill erosion

Introduction
Detachment and transport due to splash and wash in interrill erosion are extremely selective processes (Wan, El Swaify, 1998a). The particle distribution in sediment depend on the nature of those processes and its mechanisms. When particle size distribution changes, the quality of sediment produced in interrill erosion should depend on the relative participation of splash and wash in the soil erosion processes, with important consequences for the environmental pollution (Parsons et al., 1991; Wan, El Swaify, 1998b).
Surface cover can modify the splash detachment through the decrease of the energy of falling drop, but could redirect the selectivity of soil erosion increasing the delivery of colloidal particles, which are responsible of carry out pollutant substances (Bradford and Huang, 1994; Rienzi and Sanzano 2002) . In addition, soil texture should be taken into account to control the release of organic carbon content in the sediment (Shiettecatte et al., 2002; Rienzi and Grattone, 2002). The objective of this work was to analyze the interaction effect of surface cover and soil texture to establish if the changes in soil cover can modify the enrichment rate in carbon content of sediment.

Materials and Methods
Soil samples of silty loam typic Argiudoll, clay loam tipic Argiudoll, and sandy loam tipic Camborthid were used in order to analyze the detachment rate with three different cover degrees using patches of vegetal sponges (no cover, 30% and 60% soil cover); in laboratory a

Figure 1: Enrichment rate in organic carbon (EROC) in Splash process a) no cover; b) 30% soil cover; c) 60% soil cover



rain simulator (55 mm. h^{-1} ; 1340 $J.m^{-2}$) was used with special trays (Rienzi, 1994). Soils were dry-sieved, gently packed in the containers and wetting over night from the bottom before expose to simulate rain.

Special trays were used in order to collect splash and wash detachment and to measure total soil losses (Rienzi, 1994). Trays have a 4 lateral splash collector, one wash collector and a drained outlet in the bottom. Sediment was collected each 5 minutes per hour, sieved in battery of sieves with sizes from 1 mm; 0,5 mm; 0,25 mm at 0,025 mm; wet sieved aggregates were oven dried at 60 ºC and weighted.

Organic carbon content of in situ samples and for each particles size of splash and wash were measured; then, enrichment rate in carbon content (EROC) was calculated by means of the following equation:

EROC = (Organic C content (%) in aggregate fraction of sediment) x (Organic C content (%) of in situ soil)$^{-1}$.

Results and Discussion:

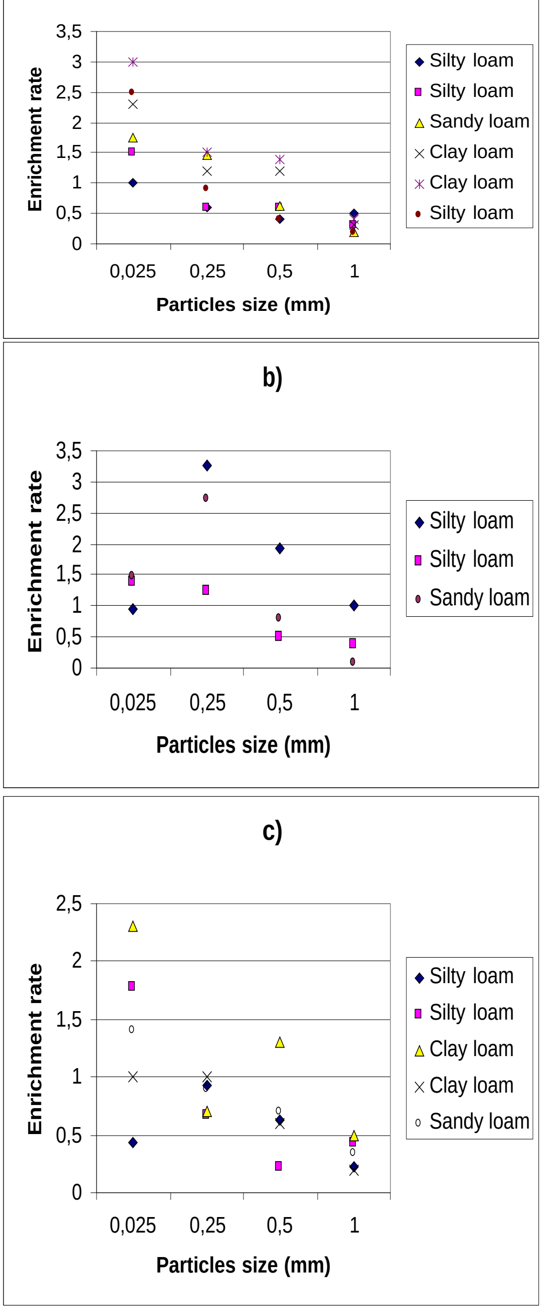
Figure 1 shows the enrichment rate in organic carbon measured in the sediment produced by splash in different soil textures, when the soil cover were increasing from 0 % to 60 %. In spite of the soil texture variability, the enrichment rate in soil organic carbon with no cover (Figure 1 a) trends to decrease when the particles size are increasing,showed an inverse relationships with the size of particles in the sediment. However, with 30% of soil cover, it was observed a significant effect on enrichment in small particles (0,025 mm) which was reduced in silty loam and clay loam soils, but not in sandy loam soils; no significant changes were observed in the other particles, specially in particles from 0.5 mm at 1 mm. When the soil cover was increased to 60% (Figure 1 c), the trend was not similar than no cover condition, and the enrichment rate in organic carbon increased when the particles size in the sediment increased. The soil cover showed a limited efficiency in order to decrease the enrichment rate in organic carbon in the sediment, in spite of it was expected that the splash should be controlled by the soil cover, due to the kinetic energy-dependent of this process. This suggest that probably the enrichment rate in organic carbon in the sediment not depend on this energy or the aggregate size can modify the dispersion forces of the impact. Lal

(2005), has mentioned that the kinetic energy of the raindrops can disperses aggregates and to expose the organic carbon physically protected within the aggregates, but this not imply that those aggregates should have the highest amount of organic carbon in the soils.

The other reason for this behaviour could be that the highest cover used in this research (60%) are not enough to protect aggregates from drop impact. Furthermore, the results in Figure 1 suggest that when soil was covered, the consequence was that the detached particles had more organic carbon content than the soil without cover. In other words, the quality of the particles in the sediment was changed.

Figure 2 shows the enrichment rate in particles in splash process, and its was observed that the particles size distribution in the sediment, specially the particles higher than 0.5 mm, had not changed when the soil cover increased. Moreover, the enrichment rate trends to decrease when the particles size increase, showing an inverse relationship between them.

Figure 2: Enrichment rate of particles in the splash process: a) with no cover ; b) with 30% cover; c) with 60% cover



If soil cover can produce those effects on enrichment rate, this suggest that some mechanism was interfered in the soil surface, because this did not occur without cover. It is recognized that seal surface have effect on detachment rate (Kuhn and Bryan, 2004; Slattery and Bryan, 1992; Rienzi, 1994) and Figures 1a) and 2a) show that their effects on ER and EROC are the same. Why the quality of the sediment particles changes when the soil cover increases is not complete understood yet, but probably the uncompleted seal surface formation could be an explanation about this behaviour, due to complex mechanism like time –dependent water content of soil surface (Watung et al., 1996)

Rienzi and Grattone (2002), and Rienzi and Sanzano (2002) observed that the aggregates stability was more important than the soil cover to decrease the EROC and this could be the reason for the behaviour of some soils; soils with weak aggregates could have the highest detachment rate but the lowest EROC. Due to a low organic carbon content , those soils cannot release higher amount of organic carbon in the sediment than others soils with better soil structure (Rasiah et al., 1992). If the soil cover should be more than 60% to obtain ER in particles and/or ER in organic carbon lower than 1, this situation could be very important in sandy loam soils from arid and semiarid condition, because high percentages of soil cover are not often in those environment.

Guérif et al., (2001) had mentioned that in some regions the use of crop residue could be needed for feedling cattles or environmental regulations which had limited the use of herbicides and the weeds should be controlled by tillage. This means that to obtain more than 30% of soil cover are not possible, but this percentage seems not enough to control the enrichment rate of organic carbon in the sediment (Figure 1b), because still was higher than 1.

Conclusions

The preliminary conclusions obtained about effect of soil cover on enrichment rate in organic carbon observed in this work are concerned about the importance to maintain higher level of soil cover, because 60% of soil cover has resulted not enough to obtain enrichment rate values lower than 1. Some data suggested that the seal surface are responsible of increasing the delivery of particles lower than 0,25 mm in the sediment, but whit 60% of soil cover, some unknown mechanism produced the change in the quality of particles higher than 0,5 mm and has limited the decrease in enrichment rate organic carbon lower than 1.

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