SURFACE COVER AND SOIL TEXTURE INTERACTIONS ON ENRICHMENT OF ORGANIC CARBON CONTENT IN SEDIMENT

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Abstract
Soil texture and water stability of aggregates are by themselves, important factors to predict soil erodability, and interactions with surface cover should also be taken into account to determine the control of organic carbon (C) content in the sediment. The objectives of this work were; to analyze the interaction effect of surface cover and soil texture on selectivity of splash and wash, and to establish if the changes in the selectivity of soil erosion influence the enrichment rate of C in sediment. Soil samples of silty loam typic Argiudoll, clay loam typic Argiudoll, and sandy loam typic Camborthid were used in order to analyze the detachment rate with different cover degrees; in simulated rain of 55 mm h^{-1} (1340 J m^{-2}). The particles from splash and wash were sieved, dried and weighted. The enrichment rate (ER) in particles and in C content (EROC) were estimated. We was found that surface cover has produced a decrease in total detachment rate of splash and wash in all the cases, but important interactions were observed between soil texture and water stability. Observed data suggest that surface cover was more important than soil texture in modifying ER in particles of splash and wash, but cannot controlled the EROC.

Additional Keywords: enrichment rate, selectivity, splash, wash, interrill erosion

Introduction
Interrill erosion has two relevant mechanisms: detachment and transport due splash and wash which seem to be processes extremely selective in removing fine particles. Moreover, it was found that wash is more selective than splash (Wan and El Swaify, 1998a). 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 environmental pollution (Parsons *et al*., 1991; Wan and El Swaify, 1998b). Surface cover can modify both, splash and wash detachment, but could modify the selectivity of soil erosion increasing the delivery of particles with a high potential of pollution due to their colloidal nature (Bradford and Huang, 1994; Rienzi and Sanzano, 2002). In addition, soil texture and water stability of aggregates are important factors to predict the soil erodability, and the interactions with surface cover should also be taken into account to controlling release of organic carbon (C) content of the sediment (Shiettecatte *et al*., 2002; Rienzi and Grattone, 2002). The objectives of this work were; to analyze the interaction effect of surface cover and soil texture on selectivity of splash and wash, and to establish if the changes in the selectivity of soil erosion modify enrichment of C in sediment.

Materials and Methods
Soil samples of silty loam typic Argiudoll, clay loam typic Argiudoll, and sandy loam typic Camborthid were used in order to analyze the detachment rate with different cover degrees; a laboratory rainfall 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 the partitioned splash and wash detachment and measured the 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 at 1 mm; 0,5 mm; 0,25 mm; 0,05 mm and < 0,005 mm; wet sieved aggregates were oven dried at 60 ºC and weighed. The enrichment rate was estimated by means of ER= (Wet sieved aggregate fraction (%) of sediment) x (wet sieved aggregate fraction (%) of in situ soil)$^{-1}$. The organic C content of in situ samples and from each particles size of splash and wash were measured, and the enrichment rate in C content (EROC) by means of EROC = (Organic C content (%) in aggregate fraction of sediment) x (Organic C content (%) of in situ soil)$^{-1}$ were also determined.

Results and Discussion
Figure 1 shows the effect of cover on enrichment rate in particles from splash and wash in Conventional Tillage plot; we observed that no significant changes occur for any diameter, in spite of cover surface degree was changing from no-cover to 60 percent of cover.

Figure 2 shows the effect of cover surface when pasture plot was evaluated; we can observed in this case that an important interaction was produced on enrichment rate in particles from wash process with 60% of cover, but had not any effect on splash process. This could imply that the energy of drop impact is not responsible for enrichment rate in particles; other factors as soil microtopographic, aggregate size or aggregate stability should are involved at this level.

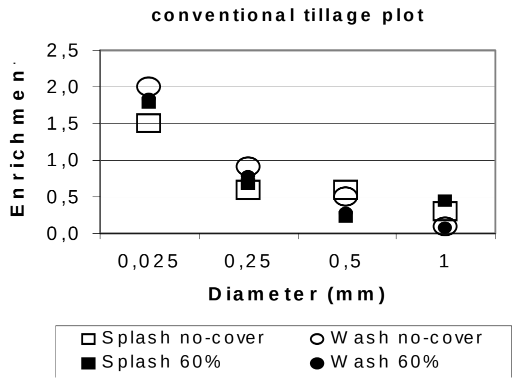

Figure 1. Cover effect on enrichment in particles (ER) from splash and wash in conventional tillage plot

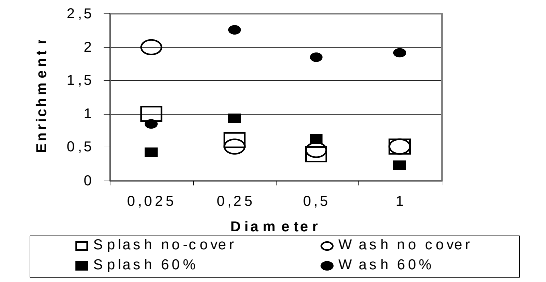

Figure 2. Cover Effect on enrichment rate of particles (ER) from splash and wash in pasture plot

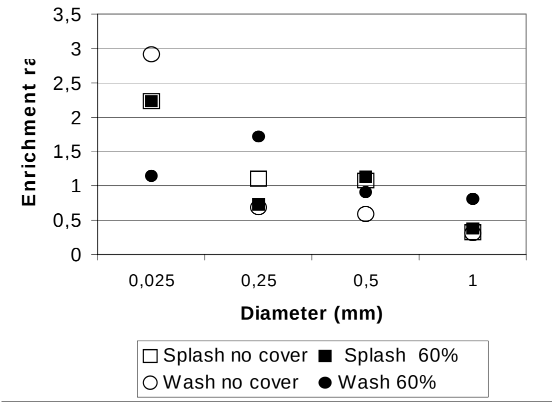

Figure 3. Cover Effect on enrichmentrate in particles (ER) from splash and wash in conventional tillage plot (clay loam soil)

Although Figure 3 shows the behavior of different soil, with silty clay loam texture, cover surface had not produced any effect in enrichment rate, like Figure 1; both plots had been under Conventional tillage for at least 5 years; if same behavior was observed with a different soil texture, this supports the previous statement about existence of strong interaction among drop energy, soil surface condition, aggregate stability and aggregate size. According to this, cover surface cannot modify the quality of sediment. Results from a pasture plot on silty clay loam soil suggest that aggregate stability has controlled enrichment rate of sediment, probably due to the strongest binding produced in this special environment.

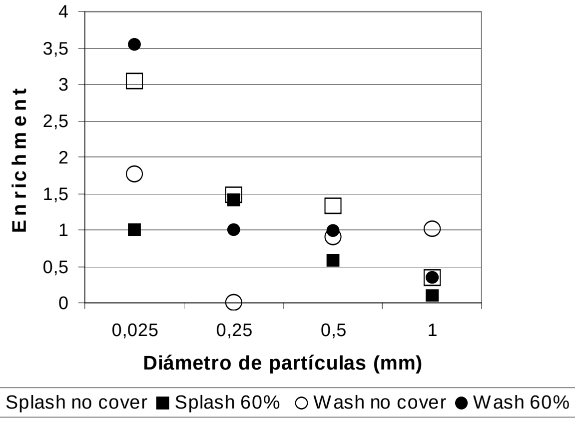

Figure 4. Cover effect on enrichment rate in particles from splash and wash in pasture plot (clay loam soil)

If surface cover cannot control enrichment rate of particles when high aggregate stability are present in soil surface, as occurred in pasture plots (Figure 2 and 4), we can expect that in degraded soil, as in the conventional tillage plot (Figure 1 and 3), sealing surface could modify the results of detachment in interrill erosion, as was mentioned by Agassi y Bradford (1999); because seal is the most common feature in interrill erosion, specially when transport limit conditions prevail. Bradford and Huang (1994) observed that detachment on particles can changed during the event , because strong seal surface can prevent the release of particles thus increasing selectivity of small particles However, the low effect of cover surface found it in all cases could had been produced by a close texture class between this soils.

Figure 5 shows the results of a sandy soil with and without cover; and we can observed that effect on enrichment rate in the sediment are very similar to observed in the other soils, meanly a poor control of soil cover on particle size distribution, despite the difference in soil texture. This implies that we only should expect a reduction in total amount of soil erosion by using cover surface.

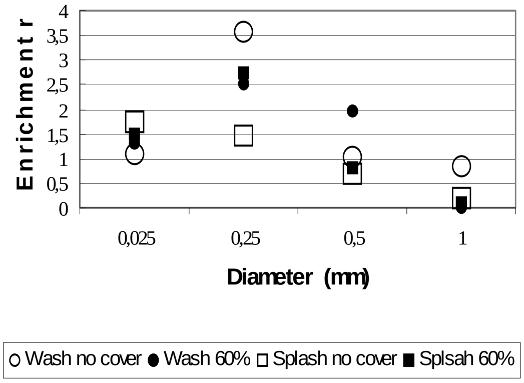

Figure 5. Cover effect on enrichment rate of particles from splash and wash on sandy loam soil

Effect of enrichment rate in organic carbon content (EROC) in sediment produced by interrill soil erosion

As a consequence of a low effect of cover surface on size distribution in sediment, we could expect also a low effect on enrichment rate in organic C produced by cover surface on interrill erosion. However, in the conventional tillage plot under 60% cover, EROC trended to increase with the diameter size. Only in pasture plot not any changes with or without cover was observed in EROC , in spite of those soil has a highest organic C content.

Sandy loam soils (Figure 7) shows that interrill erosion can make this soil release a higher content of organic C than others soils, especially in small diameter of aggregates, probably due to a very weak structure. In this condition, cover surface can control the release of organic C and EROC was decreasing. Results suggest that enrichment rate in particles and enrichment rate in organic C has not the same way when soils were exposed to rainfall; in fact, size distribution in sediment seems to be related with detachment process, and depend on either soil microtopography, aggregate size and its stability or type and degree of cover surface. Organic C release, however, seems depend on either the degree of weak structure or the degree of protection of organic C inner of aggregates.

This could be the reason for observed differences between ER of particles and ER in organic C, and interrill erosion could produce that the higher ER in particles, the higher ER in organic C or the lower ER in particles, the higher ER in organic C, including all combination as possible.

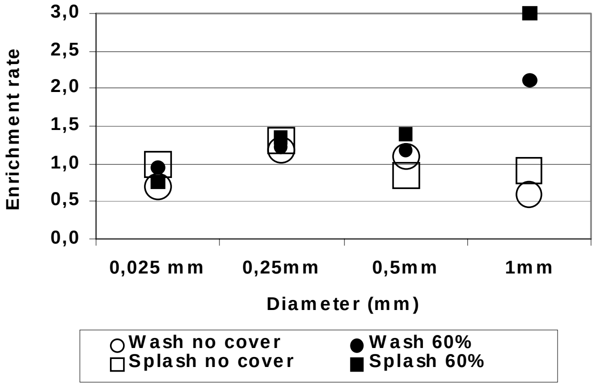

Figure 6. Enrichment rate of carbon content in conventional tillage plot with two cover degrees

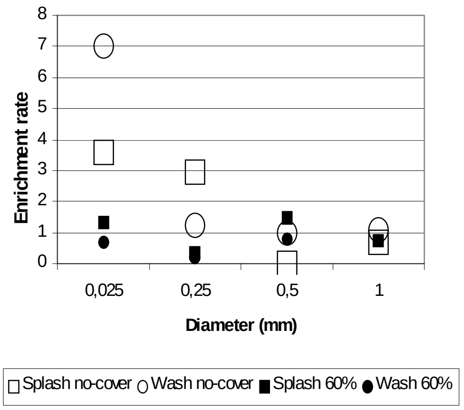

Figure 7. Enrichment rate in organic carbon content in sandy loam soil with and without cover

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