Detachment Rate in Cropland and Pasture Soils

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Abstract: Soils samples of different texture (silty loam, silty clay loam and clay loam) and land use ranking from pasture to Conventional Tillage (CT) and No tillage (NT) were exposed to rain of 55 mm • h^{-1} (1,350 J • m^{-2}) with a rain simulator in order to analyze the relationship between soil parameters and detachment rate (Di). It was observed that the use of some equations could have unbiass to predict soil erosion because the relationship between selected parameter are no linear. The interaction between drop impact and soil stability should be considerate because could modify the detachment rate a despite of soil texture.
Keywords: Interrill erosion, detachment rate, aggregates stabilty, clay content, silt content

1 Introduction

The detachment rate (Di) is a more important measure in order to predict the interrill erosion processes; it was used to characterize the susceptibility of soils to water erosion, and was found that it have relationship with soils characteristics like the texture, organic matter content, and other. (Sharma *et al*.,1995, Liebenow *et al*., 1990).

However, many factors like soil tillage or soil degradation can to modify the relationship between Di and soil characteristics inducing unbias in model responses.

In this work we tested the relationships between Di and some soil characteristics in order to understand the soil behavior to interrill erosion and to determine relationships between different soil parameters.

2 Materials and Methods

In laboratory, 36 soil of different texture (silty loam, silty clay loam and clay loam) and land use ranking from pasture to Conventional Tillage (CT) and No tillage (NT) were exposed to rain of 55 mm • h^{-1} (1,350 J • m^{-2}) with a rain simulator (Rienzi, 1994) during 1 h. In order to avoid no desiderable interferences, NT samples were exposed without cover.

Three replicate samples were used in all cases; splash, wash and infiltration rate were separated and measured in specials trays (Rienzi, 1994). Splash and wash detachment were sieved at 0, 0.05 mm, 0.125 mm, 0.5 mm, 0.75 mm to 1 mm diameter size, dryied to 105℃ and weighed; geometric mean diameter (GMD) (Mazurak, 1950) of splash and wash were recorded too.

Silt and clay content (Day, 1965), organic carbon content (Walkley, Black, 1965) and mean weight diameter (MWD) (Kemper, Rosenau, 1986) of different treatment were measured in soil samples before the experience.

3 Results and Discus sion

It was found that the detachment rate have different values in pasture soil samples in comparing with agricultural soil samples; Di ranking of 8.61×10^{-6} to 4.12×10^{-4} kg • m^{-2} • seg^{-1}. The observed lowest Di values corresponded to pasture in all cases probably due to expected higher aggregate stability, a despite of different soil texture.

No difference were observed between CT and NT samples, without cover. This could be due to NT can increase organic and biologic soil parameters faster than soil physics parameter.

Table 1 Correlation analysis between measured variables. Di (detachment rate); O.C. (organic carbon content); MWD: (mean weight diameter)

	SILT	CLAY	O.C.	MWD
Di	– 2.4680 (NS)	– 1.7700 (NS)	– 0.010 (NS)	– 1.420 (NS)
O.C.	– 0.8164 (****)	+ 0.4009 (***)		+ 2.638 (NS)
MWD	– 0.7460 (NS)	+ 0.768 (NS)	+ 2.638 (NS)	

References: NS: no significant; *** = very significant p<0.01; ****= higher significant p<0.001

Table 1 shows the correlation analysis in order to stablish possible relationship between Di and soil parameters; the lack of significance should be interpreted like a consequence of the tillage practices and no linear relationships between parameters. The splash dependence of interrill processes, produce large variations in aggregate breakdowns which could explain this result. The soil characteristic selected here perhaps have been no sensitive to show differences in soil behavior under water erosion.

Figure 1 shows this situation; just only the clay vs Di were presented here, because clay content could modify the soil strenght and aggregate stability (Sharma *et al*., 1995).

Soils samples under pasture present lower variability than soil samples under tillage sistem, but the same no linear relationships.

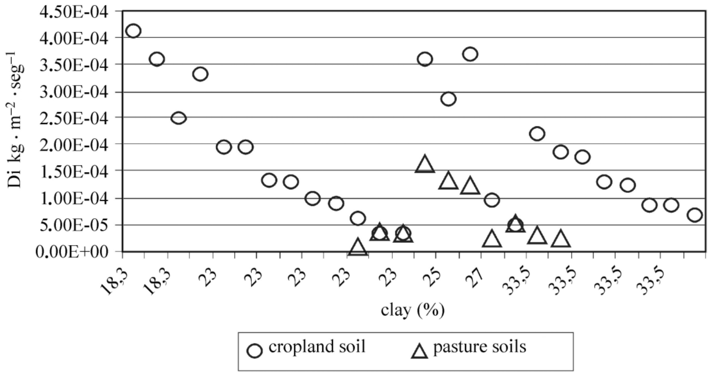

Fig.1 Relationship between detachment rate and clay content in soils with diferent land use

Sharma *et al*., (1995) ajusted an equation to predict Ki using data of clay content; their equation was used here to compare the results of estimated K values and our data, transforming it using equation $Ki = Di \cdot I^{-1} \cdot St^{-1}$; where St result negigible due low slope experiment; the results are shown in Figure 2 and we can observe that only a few cases could be predicted by the clay content, and large differences were observed in all others, because that it has not been fulfilled the assumption of linear relationship.

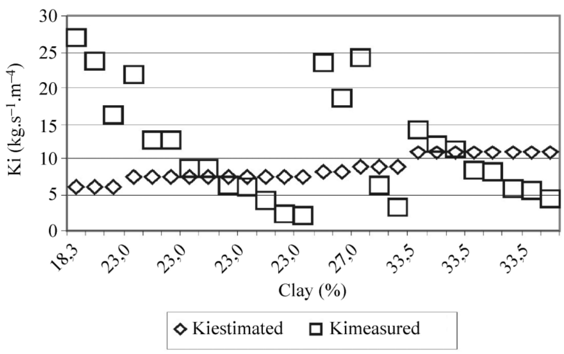

Fig.2 Comparison between predicted (Sharma equation) and measured Kidata

A despite of soil texture, Ki could be modified by the soil stability, but the sense of change is not clear.

However, the relationship between detachment rate and soil texture can be more complicated. By apply a simple regression with Splash and Wash GMD as dependence variable vs clay and silt content in soil, it were found the following relationships:

GMD splash = 1.78 +0.018 Clay % r^2 14% SSE 0.21

GMD wash = 0.925 + 0.044 Clay % r^2 81 % SSE 0.10

GMD splash =3.47 + (– 0.018 Silt %) r^2 13.6 % SSE 0.21

GMD wash = 5.16 + (– 0.045 Silt %) r^2 80 % SSE 0.09

In this equation, the GMD of splash detachment cannot be explained from clay or silt content, however the GMD of wash had a good agreement, but the different coefficient sign should be noticed; the silt content show a inverse relationship with the GMD from both, splash and wash.

Because the energy involved in this processes, the lower relationships observed between splash and clay and silt content could be explained, but not is claire the relationships between wash processes and silt content.

This situation should be considered and more attention should be addressed to clarify underlying mechanisms of detachment rate and their relationship with soil aggregate stability, in order to include a specific parameter that provide a better equation to predict soil detachment.

4 Conclusions

It was observed that due to no linear relationship between simple soil parameters and detachment rate, the use of some equations could have unbias in model response; no linear relationship could be due to lower sensibility of some soil characteristics to represent the mechanisms and interactions between drop impact and aggregate stability. Those interaction should be considerate because could modify the detachment rate a despite of soil texture.

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