Geophysical Research Abstracts,
Vol. 11, EGU2009-12908, 2009
EGU General Assembly 2009
© Author(s) 2009

The Effects of Different Tillage Systems on Soil Hydrology and Erosion in Southeastern Brazil

A.V.F.A. Bertolino (1), N.F. Fernandes (2), A.P. Souza (2), J.P. Miranda (2), and M.L. Rocha (2)

(1) Dept. of Geography, State University of Rio de Janeiro, Rio de Janeiro, Brazil, (2) Dept. of Geography, Federal University of Rio de Janeiro Rio de Janeiro, Brazil (nelsonff@acd.ufrj.br)

Conventional tillage usually imposes a variety of modifications on soil properties that can lead to important changes in the type and magnitude of the hydrological processes that take place at the upper portion of the soil profile. Plough pan formation, for example, is considered to be an important consequence of conventional tillage practices in southeastern Brazil, decreasing infiltration rates and contributing to soil erosion, especially in steep slopes. In order to characterize the changes in soil properties and soil hydrology due to the plough pan formation we carried out detailed investigations in two experimental plots in Paty do Alferes region, located in the hilly landscape of Serra do Mar in southeastern Brazil, close to Rio de Janeiro city. Farming activities are very important in this area, in particular the ones related to the tomato production. The local hilly topography with short and steep hillslopes, as well as an average annual rainfall of almost 2000 mm, favor surface runoff and the evolution of rill and gully erosion. The two runoff plots are 22m long by 4m wide and were installed side by side along a representative hillslope, both in terms of soil (Oxisol) and steepness. At the lower portion of each plot there is a collecting trough connected by a PVC pipe to a 500 and 1000 liters sediment storage boxes. Soil tillage treatments used in the two plots were: Conventional Tillage (CT), with one plowing using disc-type plow (about 18 cm depth) and one downhill tractor leveling, in addition to burning residues from previous planting; and Minimum Tillage (MT), which did not allow burning residues from previous planting and preserved a vegetative cover between plantation lines. Runoff and soil erosion measurements were carried out in both plots immediately after each rainfall event. In order to characterize soil water movements under the two tillage systems (CT and MT), 06 nests of tensiometers and 04 nests of Watermark sensors were installed in each plot. Based on previous studies in this area, suggesting that the plough pan develop at about 20cm depth, the soil water potential (SWP) sensors were installed, in each nest, at 15, 30 and 80 cm depths. Continuously readings in the 30 SWP sensors were made both at a daily and event basis (during some rainfall events) for 25 months. Rainfall was continuously measured in the area by an automatic rain-gauge (tipping bucket) installed close to the plots. In order to characterize changes is soil porosity, both total pore space and pore inter-connections, undisturbed soil blocks were collected for micromorphological analyses (0-10cm, 12-22cm and 25-35cm depths) at small trenches located at the upper parts of each plot. The results attested that soil under CT developed a plough pan layer at about 20 cm depth, showing a 44% decrease in total pore space from 0-10cm to 12-22cm depths, with a predominant network of isolated pores. In the MT plot, soil porosity is more homogeneous with depth, with a predominant network of larger and better connected pores. The results related to soil hydrology show that in many moments, both CT and MT, stay very close to saturation, both at 15 and 30 cm depth. Above the plough pan under CT, soils tend to saturate faster and to have a slower drainage rate than the ones under MT. Detailed SWP analyses made during rain events suggest that CT may favors lateral flows while soils under MT are draining. Soil erosion rates measured for individual events at CT are about four times greater than the ones observed at MT. The results observed in this study attest that conventional tillage (CT) in this area imposed important changes in soil structure, pore-size distribution and connectivity, as well as in soil infiltration, drainage and erosion.