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Fallow Effects on Improving Soil Properties and Decreasing Erosion: Atlantic Forest, Southeastern Brazil

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Soil tillage plays a major role in changing physical and hydrological properties of soils through time, and in consequence, in the dynamics of infiltration, soil water and erosion. In the hilly landscape of southeastern Brazil, many areas originally occupied by the Atlantic Forest (one the most threatened biomes on the planet) have been continuously transformed in the last decades into agricultural systems, usually associated with small farming properties. Traditionally, the agricultural activities in these areas incorporate rotational systems which include a fallow period, where previously farmed areas repose for at least five years. In some areas, vegetation grows so fast that after 7 or 8 years these sites may be considered by regulator agencies as forests, impeding their use again for farming. As a consequence, farmers tend to decrease the amount of time used fallow impeding the recovery of original soil properties, reducing in consequence the infiltration rate, and increasing the runoff and erosion. Currently, the Brazilian laws allow that the farmers use the fallow system for 10 years in areas where this technique has been used traditionally. So, a major issue here is for how long the farming plots should be left reposing. Therefore, this study aims both to characterize the effects of continuous farming on soil physical and hydrological properties, as well as to define the impacts of different fallow periods on the improvement of soil properties and in the reduction of runoff and erosion.

The experiments were carried out in a cultivation site located at Bom Jardim city, close to Rio de Janeiro city. The area is situated at about 800m of elevation in the hilly steep topography of the Serra do Mar, a coast range in southeastern Brazil, with an average total annual rainfall of 2000 mm. In this study, carried out in a typical farm of the area, we compared the effects of 5 different soil usages on soil properties: banana, coffee, F2 (2-year fallow), F5 (5-year fallow) and forest. For each case, 12 soil samples were collected at 4 depths: 0-5, 5-10, 10-20 and 20-30cm, with 3 repetitions, leading to a total of 60 soil samples, where the following properties were characterized: porosity (micro, macro and total), bulk density and aggregate stability. Besides, in situ measurements of saturated hydraulic conductivity were conducted with a Guelph permeameter.

The results obtained in this study attested that all the soil properties analyzed were affected by soil usage, especially at shallow depths, in particular macroporosity and total porosity, which have major influences on infiltration rates, runoff and soil erosion. Besides, the results suggested that the 5-year fallow (F5) was able to recover from 72% to 100% of total porosity for the 0-10cm depth layer (considering forest values as reference), while in the 2-year fallow (F2) this recovery was lower, ranging from 66 to 80%. A similar trend was observed for macroporosity, showing recovering values from 60% to 90% and from 50% to 76%, for F5 and F2, respectively. However, aggregate stability values did not show significant variations between the two fallows. Saturated hydraulic conductivity, on the other hand, presented the lowest recovering values for all the studied properties: between 13% and 58% for F5 and between 6% and 33% for F2. Comparing to the natural forest (reference value), the coffee plantations presented the worst soil conditions in terms of soil hydrology and erosion. The results presented here attested important improvements in soil physical and hydrological properties after a 5-year fallow, leading to decrease in surface runoff and soil erosion in the area.