



Agriculturization in the Argentinean Northern Humid Pampas: the Impact on Soil Structure and Runoff

M. C. Sasal (1), J. Léonard (2), A. Andriulo (3), and M. G. Wilson (1)

(1) INTA EEA Paraná, Ruta 11, km 12.5, 3101, Oro Verde, Entre Rios, Argentina, (2) INRA, US 1158 Agro-Impact, site de Laon, Pôle du Griffon, 180 rue Pierre-Gilles de Gennes F-02000, Barenton-Bugny, France, (3) INTA EEA Pergamino, Ruta 32, km 5.5, 2700, Buenos Aires, Argentina.

Argentina is among the countries with the largest cropped area under no-tillage (NT). No tillage was adopted in the northern Humid Pampas to reduce the widespread soil degradation by water erosion. With the advent of genetically modified soybean varieties, NT has developed exponentially. This evolution, combined with the influence of the international market trend, has resulted in large changes in crop sequence composition toward the disappearance of pastures and the expansion of soybean monoculture. The aim of this work was to evaluate the long-term consequences of these changes on the topsoil structure and the way in which the evolution of soil structure relates to the simplification of the crop sequence and to runoff at a regional scale. We analyzed the topsoil structure of 25 sites with Argiudolls having 4 to 29 consecutive years of NT using the cultural profile approach. An intensification sequence index (ISI) was calculated as the ratio between the length of the growth period and the length of the year. Fifteen natural-rainfall runoff plots (100 m²) with 3.5% slope were used to analyze the relationship between soil structural state, crop sequence and runoff for four years. Four types of soil structures were identified and a general pattern of vertical soil structure organization was revealed. The top centimeters of 72% of the sites were dominated by a granular structure. Platy soil structure development was omnipresent: all sites exhibited a horizontal platy structure (<10 cm thick) developing either directly from the soil surface or from below the granular structure. Below the platy structure layer, a gamma soil structure (with visible structural porosity) was observed in all sites (30-75% of the A horizon), while compacted delta soil structure was detected in localized zones. A significant parabolic relationship ($R^2=0.60$) was found between the number of consecutive years under NT and the proportion of platy structure in the A horizon. The proportion of platy structure increased during the first 15 years of NT, and then the extension of platy structure tended to stabilize and even to decrease after 20 to 25 years. The development of platy soil structure was negatively related to the ISI ($R^2=0.57$) and runoff increased as the proportion of platy structure increased and the proportion of granular structure decreased ($R^2=0.85$). We concluded that high soybean frequency in cropping systems under NT favors the extension of platy soil structure and increases runoff. More than 70% of the agricultural area of the northern Humid Pampas region is currently covered by soybean cultivation, mostly as a single annual crop (ISI=0.38). Our results thus suggest that promoting management practices such as the expansion of wheat/soybean double crop (ISI=0.83) could limit soil structure degradation and reduce runoff and the associated environmental risks.