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How 23 Years of Different Soil Managements Affect a Tropical Acrisol? Lessons from a No-Tillage Experiment

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Abstract

No-tillage (NT) plays an important role in soil conservation, and is usually accredited to improve many soil parameters. The objective of this work is to verify the effect of 23 years of different soil management systems on chemical and physical soil parameters of an Acrisol in Coimbra, Brazil. The experiment uses four different soil management systems, namely no tillage (NT), one operation with disk plow (DP), one operation with disk harrow followed by disk plow (DH+DP) and two operations with disk harrow (DH). Soil samples were collected at different depths (0–5, 5–10, 10–20 and 20–40 cm, respectively) for the following analyses: pH, levels of available P, K⁺, Ca²⁺, Mg²⁺, exchangeable Al³⁺, total organic carbon (TOC), texture, bulk density (BD), among others. The results were submitted to an analysis of variance and the means were compared by Tukey HSD test ($p < 0,05$). The results indicate that soil management influenced several soil parameters, while others remained unaffected. Differences are mostly observed at the surface. As predictable, the TOC is significantly higher in the NT, but only at the superficial level. Regarding pH, and taking into account the soil in the region, NT was able to increase the pH level only superficially. This is explained by the deposition of lime applied when planting. The use of lime also influenced Ca, Mg and Al levels. For those parameters, NT presented at the more superficial depth better values (more suitable for agricultural production), while at other depths a turn-over is observed, especially in Al³⁺. Regarding physical parameters, and as for the chemical parameters, differences between NT and other soil managements were more pronounced at superficial depths. As expected, BD in NT is significantly higher at the surface and it keeps the tendency to maintain the value at other depths. In opposition, other soil management systems present a lower BD at the surface, but rapidly increasing the values according the depth. With exception of BD at the most superficial depth, NT presented similar or better values for physical parameters. Overall, the results indicate that in long term NT is more suitable for agronomic purposes.

Keywords: Agricultural soils, no-tillage, organic matter, soil changes, tropical soils