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Land use and land management effects on soil organic carbon stock in Mediterranean agricultural areas (Southern Spain)

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INTRODUCTION

Soils play a key role in the carbon geochemical cycle. Agriculture contributes to carbon sequestration through photosynthesis and the incorporation of carbon into carbohydrates. Soil management is one of the best tools for climate change mitigation. Small increases or decreases in soil carbon content due to changes in land use or management practices, may result in a significant net exchange of carbon between the soil carbon pool and the atmosphere. In the last decades arable crops (AC) have been transformed into olive grove cultivations (OG) or vineyards (V) in Mediterranean areas. A field study was conducted to determine long-term effects of land use change (LUC) (AC by OG and V) on soil organic carbon (SOC), total nitrogen (TN), C:N ratio and their stratification in Calcic-Chromic Luvisols (LVcc/cr) in Mediterranean conditions.

MATERIAL AND METHODS

An unirrigated farm in Montilla-Moriles (Córdoba, Spain) cultivated under conventional tillage (animal power with lightweight reversible plows and non-mineral fertilization or pesticides) was selected for study in 1965. In 1966, the farm was divided into three plots with three different uses (AC, OG and V). The preliminary analyses were realized in 1965 for AC (AC1), and the second analyses were realized in 2011 for AC (AC2 - winter crop rotation with annual wheat and barley, receiving mineral fertilization or pesticides), OG (annual passes with disk harrow and cultivator in the spring, followed by a tine harrow in the summer receiving mineral fertilization and weed control with residual herbicides), and V (with three or five chisel passes a year from early spring to early autumn with mineral fertilization or pesticides.). In all cases (AC1, AC2, OG and V) were collected soil entire profiles. Soil properties determined were: soil particle size, bulk density, SOC, TN, C:N ratio, stocks and SRs. The statistical significance of the differences in the variables between land use practices was tested using the Anderson-Darling test at each horizon or a combination of horizons for each soil type.

RESULTS

The LUC had a negative impact in the soil, reducing the SOC and TN stocks. The conversion from AC to V and OG involved the loss of the SOC stock (52.7% and 64.9% to V and OG respectively) and the loss of the TN stock (42.6% and 38.1% to V and OG respectively). The reduction of SOC by LUC, can be explained by a degraded process (due to vegetation losses and unsustainable soil management, which result in progressive impoverishment in the soil organic matter (OM) content, causing low productivity, which derived in unsuitable chemical properties) and by the reduced input of OM in cultivated soils, which reduced physical protection of soil and increased water erosion. However, 46 years of LUC had a positive effect in the soil, increasing the SR (in V and OG) of SOC, TN and C:N ratio (Parras-Alcántara et al., 2013).

REFERENCES

Parras-Alcántara, L., Martín-Carrillo, M., Lozano-García, B. 2013. Impacts of land use change in soil carbon and nitrogen in a Mediterranean agricultural area (Southern Spain). Solid Earth, 4: 167-177.