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Tillage and liming effects on aggregate distribution and associated carbon and nitrogen in acid soils of SW Spain

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Beneficial effects of conservation tillage are well known on a wide variety of environmental aspects. The lack of ploughing in no till systems conserves soil structure, enhances the accumulation of organic carbon in the surface layer and promotes the development of soil microorganisms. On the other hand, liming is a common practice in acid soils. Lime raises the pH, reduces Al toxicity enhancing root development, but controversial results have been found about the effects of liming on soil structure. Ultisols from SW of Spain present severe chemical constraints as poor nutrient availability and high Al contents in the exchange complex. On the other hand, traditional practices as conventional tillage led to a dramatic decrease on soil organic carbon and a degraded soil structure. No till plus liming might be recommendable to achieve a sustainable and productive agriculture in these particular soils, but little is known about the effect of these practices on soil structure when applied together. The aim of this study was to evaluate the effect of traditional tillage (TT) versus no tillage (NT), and liming versus no liming on aggregate size distribution and associated carbon and nitrogen. The study was conducted on a Plinthic Palexerult (Soil Survey Staff, 1999) in the Cañamero's Raña (SW Spain) under Mediterranean climate (mean annual temperature: 15.0º C; mean annual precipitation: 869 mm). The experimental design was a split-plot with four replications. The main factor was tillage (no till versus traditional till) while the second was the inclusion or not of Ca-amendment (sugar foam plus red gypsum). Samples were collected in 2011 after six years of treatment at a 0-5, 5-10 and 10-25 cm depths. The aggregate distribution was determined by wet sieving method to separate four aggregate size classes: (i) >2000 μm (large macroaggregates), (ii) 250-2000 μm (small macroaggregates), (iii) 53-250 μm (microaggregates), (iv) <53 μm (silt and clay fraction). Soil organic carbon and nitrogen were measured by dry combustion in each aggregate fraction. Our preliminary results showed that aggregate distribution was dominated by microaggregates (42%) followed by small macroaggregates (31%) at surface layer. The mean weight diameter (MWD) was 60% and 40% greater under NT compared with TT at 0-5 cm and 5-10 cm layers respectively. C and N concentrations as well as C:N ratio decreased in the order large and small macroaggregates > microaggregates > silt and clay fraction. No tillage increased C and N concentrations and decreased C:N ratio at 0-5 cm layer. The limed plots showed a lower C:N ratio when compared to the non-limed ones, but liming had no effect on the aggregate size or the C and N concentration.