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Can Conservation Agriculture Enhance Soil Organic Carbon Sequestration In Mediterranean And Humid Subtropical Climates? A Meta-Analysis

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Mediterranean and humid subtropical climate is characterized by hot summer and cold to mild winter with a medium-low soil organic carbon (SOC) content and high risk of land desertification. Recent EU policies pointed out the need to preserve the SOC stock and to enhance its accumulation by promoting the adoption of conservation agriculture (CA) as an efficient action for climate change adaptation and mitigation. The meta-analysis is a powerful data analysis tool, which can be useful to evaluate the effectiveness of CA in increase SOC in comparison with conventional agriculture. In fact, this topic has been addressed by several published articles even though the methodology shortcomings make sometimes difficult to draw reliable conclusions about the contribution of CA. In our work, we applied a robust methodology to comply with the meta-analytic assumptions, such as an independence of effect sizes and weighting, as well as the requirement to use no predictive functions like pedotransfer. Therefore, the present meta-analysis defines a conservative and replicable approach to deal with soil carbon data, explaining the differences between conventional (control) and CA management (treatment) in terms of SOC stock accumulation in the first 0-0.3 m layer. A defined methodology was developed to summarize carbon data within a unique soil layer taking into account the real variance and correlation between different initial soil carbon layers. A final database of 49 studies has been used to summarize the effect and to explain the heterogeneity across studies, including also several pedoclimatic moderators in the analysis. An overall positive effect of about 13 % change in SOC accumulation was found due to CA practices compared to control. To better explain the data variability, we created two different groups of studies ("low carbon in control, LC" and "high carbon in control", HC) base on the amount of SOC in control (with 40 Mg ha^{-1} as a threshold). This method leads to more reliable conclusions that it is more likely to find a response to CA management in soil with low carbon content rather than in soil that have more than 40 t C stock ha^{-1} . A positive correlation was also found between clay soils with high carbon content in control and carbon sequestration event though the texture classification did not explain data variability. Agronomic management plays an essential role in inducing C accumulation under CA in both LC and HC groups, especially with high residue retention during long-term experiments (0.21 Mg C ha^{-1} yr^{-1} for the whole database). We also found that climatic and geographical moderators can

explain the variability among the effect sizes, like the absolute value of latitude or the precipitation during the year, even though the different continent or climate Köppen classification did not give significant results.