IMPACT OF SOIL CARBONATES ON SURFACE SOIL CARBON MINERALISATION IN RESPONSE TO TILLAGE

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No-tillage (NT) cropping systems have many tangible benefits which have enabled easy conversion from conventional tillage (CT) systems in many regions worldwide. Emerging concerns such as developing herbicide resistance in increasing weed populations are putting pressure on the continued adoption of NT. In some cases, growers are using intermittent tillage to manage the challenges. We conducted a field study to clarify the impacts of a short term return to tillage on soil respiration parameters under calcareous soil conditions, to understand the contributions of the dissolution of carbonate material (CaCO3) to CO2 emissions, for accurately estimating the impact of a tillage event on soil organic carbon (SOC).
We evaluated the effect of temperature on the decomposition of soil carbon and determine the decomposition rate of SOC based on kinetic models. This study also evaluates the functional components (hydrophobic and hydrophilic) of soil organic matter (SOM) impacted by the experimental treatments, comprising surface mulch (0 and 5 t/ha) under NT and CT tillage systems. The soil samples were split to assess the impact of an additional 10% (w/w) CaCO3 and incubated for 90 days at 22°C and 37°C.
It was found that the rate of mineralized C was 20.1% and 9.9% greater under CT relative to NT on average, at 22 and 37°C, respectively. CT resulted in 19% lower hydrophobic functional components of SOM. Greater temperature (37°C vs 22°C) significantly increases the mineralization under both CT (2286 and 1965 mg C/kg soil) and NT (2081 and 1636 mg C/kg). The average mineralization was 6.3% higher under mulched conditions. EDXA and morphological analyses of CaCO3 material both showed deterioration of CaCO3 elements under CT. Soil samples amended with 10% CaCO3 significantly increased the potential of readily mineralizable organic fractions. Our study highlights the importance of inorganic carbonates, as a major contributor to CO2 efflux in calcareous soil conditions, which need to be taken into account when aiming to accurately assess the impact of tillage systems on SOC and microbial activity.