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The Gallecs trial, a mid-term experiment on reduced tillage, fertilisation and green manure in Mediterranean dryland arable cropping systems

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Conservation agriculture and organic farming are two alternative strategies aimed at improving soil fertility in arable cropping systems through reducing tillage intensity, maintaining year-round soil cover and increasing nutrient recycling, using farmyard and green manures. However, the reduction of tillage intensity can increase weed infestation and decrease nutrient availability. The mid-term "Gallecs" trial (Catalonia) was established in autumn 2011 at Gallecs, a periurban agricultural area near Barcelona. The effects of tillage (mouldboard versus chisel ploughing), fertilisation by farmyard manure (without versus with) and green manure (without versus with) on soil fertility indicators, weed abundance and grain crop yields were studied in a 4-years cereal-legume rotation for human consumption under organic farming conditions in the Mediterranean region (Catalonia, Spain).

Fertilisation was the most important factor, increasing the cereal yields, SOC, N, microbial biomass (C_{mic} and N_{mic}) content of the soil, and density and biomass of earthworms. However, fertilisation did not favour legume crops, probably owing to competition with weeds. Overall, there was a loss of SOC and a reduction of soil carbon stocks over the four years, irrespective of the ploughing intensity, while the nitrogen content increased. However, SOC losses were lower in plots fertilised with farmyard manure, even an increase in SOC occurred in the upper soil layer (0-10cm) of plots with chisel ploughing. The tillage system does not have a consistent negative effect on yields both in cereal and legume crops. Summing up, fertilisation was the most effective way to build up soil organic matter reserve, through stimulation of microbial community functioning. Reduced tillage had also positive effects on microbial biomass and SOC contents, whereas the positive effect of green manures was very low. Improving soil management is necessary to increase SOC sequestration in the Mediterranean dryland arable fields, and thus mitigate climate change and sustain crop production.