FARMING PRACTICE
ORGANIC FARMING SYSTEMS

IMPACT: CARBON SEQUESTRATION

Reference 21

Aguilera, E; Lassaletta, L; Gattinger, A; Gimeno, BS. 2013 Managing soil carbon for climate change mitigation and adaptation in Mediterranean cropping systems: A meta-analysis AGRICULTURE ECOSYSTEMS & ENVIRONMENT 168, 25-36. 10.1016/j.agee.2013.02.003

Background and objective

Comprehensive data on sequestration potential by most reccomanded management practices have been compiled at a global level and under a number of climates, but no integrated data is available in the specific context of Mediterranean cropping systems. 1)Estimate the mean change in SOC content and SOC sequestration rate associated to the adoption of RMPs and to the application of different C input rates; 2)Analyze the effect of different organic farming systems and practices on C sequestration; 3)Identify the main sources of uncertainty in the available information.

Search strategy and selection criteria

It was collected the available peer-reviewed literature reporting comparisons between RMP and conventional management under Mediterranean climatic conditions. Studies were selected after searching simultaneously the keywords "Mediterranean", "conventional" and "Soil" in the ISI Web of Knowledge electronic database. 1)Pair-wise comparisons of the performance of RMPs and conventional management, performed under similar pedo-climatic conditions, and after at least 3 or more years of management. 2)Analysis was also restricted to croplands, including arable crops, orchards and horticulture, but excluding permanent grassland and forests. 3)Only studies performed in field conditions excluding laboratory and experimental greenhouse studies

Data and analysis

Variables and categories studied in organic management meta-analysis: Management intensity, Organic input, Crop type, Experiment type. Paired data comparing SOC concentration (% SOC in soil) and C sequestration rate (Mg C ha−1 yr−1) under RMP and conventional management were collected or estimated. When more than one RMP or conventional (control) treatment existed within the same independent study, effect sizes for all possible combinations between RMPs and conventional were calculated. Afterwards, one composite effect size was computed for all combinations of each RMP by computing their mean value, in order to avoid redundancy of the data. Weighted mean effect sizes of each category were calculated, with bias-corrected 95% confidence intervals (CIs) generated by a bootstrapping procedure (10,000 iterations), using MetaWin software.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
79	Field studies (i.e. excluding laboratory and experimental greenhouse studies) conducted under Mediterranean climatic conditions in croplands (including arable crops, orchards and horticulture, but excluding permanent grassland and forests) assessing the performance of organic systems in comparison to conventional systems. In study organic croplands organic practices were applied for at least three consecutive years prior to sampling.	Organic cropping systems	Conventional systems	Metric: SOC content and C sequestration rate.; Effect size: Natural log of response ratio (RR) was choosen as the effect size unit for SOC content comparisons between organic and conventional systems. Raw difference in means was chosen as the effect size for sequestration rate comparisons.	75

Results

- The application of organic amendments at agronomic rates (OA) increased SOC by 23.5% and C sequestration rate by 1.31 Mg C ha−1 yr−1.
- In cover crop category, where the organic matter input is always produced within the system, the average increases in SOC were reduced to 10% and C sequestration averaged 0.27 Mg C ha−1 yr−1.
- NT showed an average increase of 11.4% in SOC resulting in a C sequestration rate of 0.44 Mg C ha−1 yr−1, whereas under RT, SOC content increased by 15% and C sequestration rate by 0.32 Mg C ha−1 yr−1.
- SOC concentration was increased by 19.2% and C sequestration rate by 0.97 Mg C ha−1 yr−1 in organic treatments. SOC increment in organic systems was greater under irrigation than under rainfed conditions (25% vs. 13% increase over conventional, respectively).
- The increase in SOC concentration and sequestration rate in organic plots was much more pronounced in plots of controlled experiments (51.6% and 1.28 Mg ha−1 yr−1) than in real farms (11.4% and 0.31 Mg ha−1 yr−1, being the latter non-significant).

Factors influencing effect sizes

- C input : NA
- Soil disturbance : NA

Conclusion

Carbon sequestration is effectively promoted by organic farming practices in Mediterranean cropped soils. This relative increase of SOC sequestration over conventional practices is more marked in intensive cropping systems, where the difference in carbon inputs are higher.