

Organic carbon storage in the biomass and soils of hedgerows

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Introduction

- The implementation of agroforestry is a well-recognized option to promote carbon sinks for climate change mitigation.
- Hedgerows as a traditional form of agroforestry are also considered to store and sequester carbon. However, a comprehensive and quantitative overview comprising soil and biomass carbon is lacking.
- We therefore performed a literature review and meta-analysis to derive for the first time comprehensive estimates for the carbon storage in the soils and biomass of hedgerows in the temperate climate zone.



Material & Methods

- Hedgerows were defined as linear structures composed of shrubs and trees or solely shrubs established on agricultural field borders and managed in various ways.



- We compiled data from 9 studies with 83 sites on soil organic carbon (SOC) storage under hedgerows in comparison to adjacent croplands and grasslands.
- The difference in SOC between the hedgerow soils and the soils of adjacent agricultural fields was studied through meta-analysis of response ratios.



- Hedgerow biomass carbon stocks were compiled from 72 sampled hedgerows (4 studies plus own data).
- Descriptive statistics were applied to describe the obtained biomass data set.
- We did not include modelling studies or remote sensing data.

Effect of hedgerows on soil organic carbon

- SOC was 32.0%, [95%CI , 15.0%, 51.4%] higher under hedgerows compared to adjacent cropland.
- No significant difference was found between SOC storage of hedgerow soils and the soils of grassland.

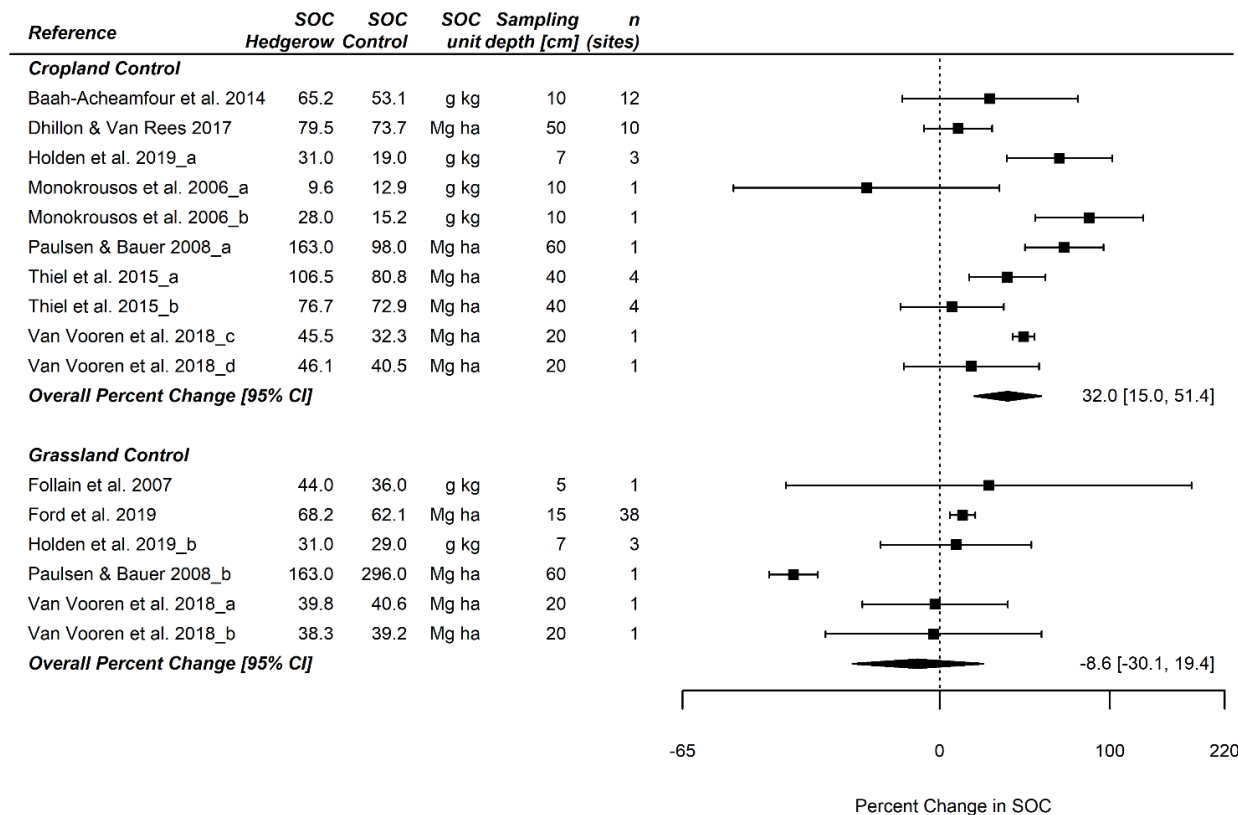


Fig. 1: Effect of hedgerows on soil organic carbon (SOC) storage. Shown are individual mean effect sizes and 95% confidence intervals in percent change (back-transformed log response ratio) for all studies or paired-plot comparisons (marked by lowercase letters). The diamond shows the overall estimated percent change using a random-effects model for the subgroups 'Cropland Control' and 'Grassland Control'.

Carbon storage in the biomass of hedgerows

- The analysed hedgerows stored on average $48 \pm 29 \text{ Mg C ha}^{-1}$ in the above-ground biomass. Above-ground biomass C stocks showed increasing trends with years since the last coppicing and hedgerow height.
- Below-ground biomass C stock was estimated to be on average $45 \pm 28 \text{ Mg C ha}^{-1}$ based on the only study which measured below-ground biomass with a root:shoot ratio of 0.94 ± 0.26 ([Axe et al. 2017](#)).

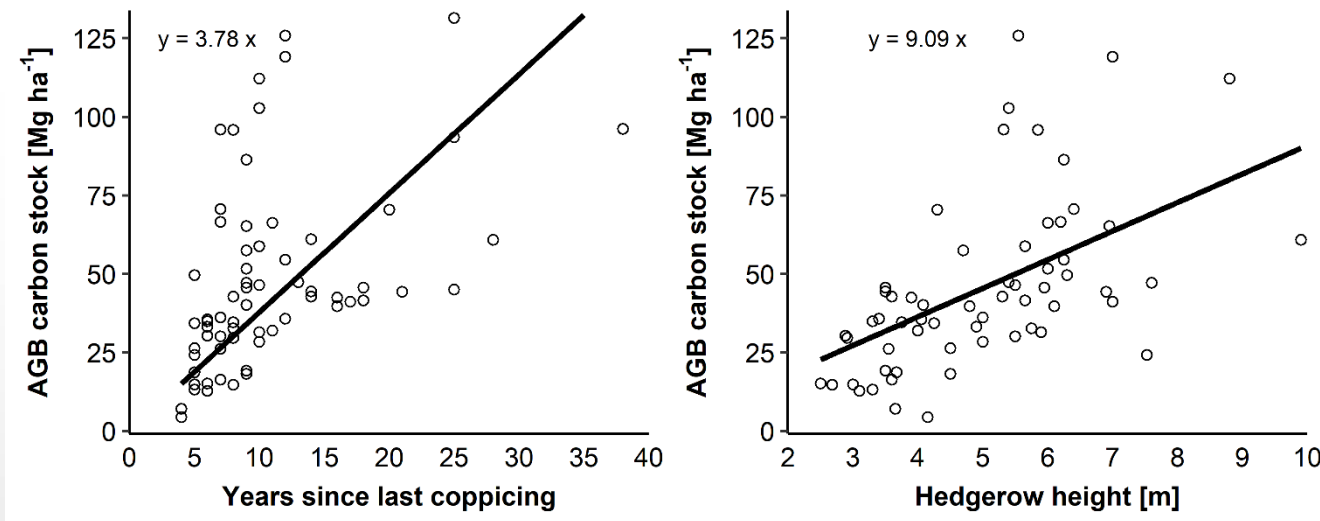


Fig. 2: Above-ground biomass (AGB) carbon stocks of analysed hedgerows in dependence of years since the last coppicing and hedgerow height.

Conclusions

- Our results indicate that organic carbon stored in hedgerows is similar high as in forests.
- Hedgerows stored $106 \pm 41 \text{ Mg C ha}^{-1}$ more carbon in the soil and in the biomass than croplands.
- The establishment of hedgerows, especially on cropland, can thus be an effective option for carbon sequestration in agricultural landscapes.
- The establishment of hedgerows is particularly promising as the problem of reversibility of carbon that is sequestered as SOC in croplands or grasslands is solved since hedgerows are permanent parts of the landscape, and at the same time ecosystems service, e.g. enhancement of biodiversity and soil protection, are provided.



Thank you for your attention and your comments!

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