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REGULAR ARTICLE

Soil properties following reforestation or afforestation of marginal cropland

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Abstract
Aims Reforestation or afforestation of marginal agricultural lands offers opportunities to sequester soil organic carbon (SOC), improve the quality of degraded soils, and provide ecosystem services. The objectives of this study were to identify the extent and distribution of marginally productive cropland in the state of Iowa and to quantify the changes in SOC and relevant soil properties following tree planting.
Methods A geographic information system (GIS) analysis was used to identify 1.05 million ha of marginal cropland within the state. Soil samples were collected from four locations with (<51 yr-old) forest plantations and adjacent crop fields. Soil samples were analyzed for SOC, total nitrogen (TN), pH, cation exchange capacity (CEC), ammonium acetate-extractable K, Ca, Mg, and Na, and particle size.
Results The forested soils had 30.0±5.1 % (mean ±standard error) more SOC than the tilled cropland. The average annual change in SOC following tree planting was estimated to be 0.56±0.05 Mg C ha^{-1} yr^{-1}. Differences were observed in several soil properties but strong correlations with SOC content were only observed for bulk density and extractable Ca.
Conclusions These results indicate that within 5 decades of tree planting on former cropland or pasture there was consistently and significantly greater SOC in soil beneath the trees.

Keywords Soil organic carbon · Carbon sequestration · Soil quality · Climate change mitigation · Ecosystem services

Abbreviations

C	Carbon
CEC	Cation exchange capacity
CSR	Corn suitability rating
GIS	Geographic information system
HEL	Highly erodible land
ISPAID	Iowa Soil Properties and Interpretations Database
NT	No-till
SOC	Soil organic carbon
TN	Total nitrogen

Introduction

Reforestation and afforestation are often considered foremost practices for sequestering carbon (C) as a

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