Soil carbon under environmental plantings: the role of nutrient ratios

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Mixed environmental plantings (EPs) of native trees and shrubs are widespread in temperate agricultural regions of Australia, yet the influence of these plantings on soil carbon sequestration (SCS) has not been fully explored. This research focuses on the impacts of EPs upon agricultural soils and the role of nutrient dynamics in regulating SCS.

Soils were sampled within paired plots in established EPs and adjacent agricultural land (AL), at 15 sites spanning a climatic gradient in central New South Wales. Soil nutrient analyses included total carbon, soil organic carbon (SOC), total nitrogen (TN), total phosphorus (TP), and total sulphur (TS), as stoichiometric relationships between C, N, P and S influence soil C stability. The effects of soil properties and site variables upon plant growth and nutrient cycling were also investigated.

Climate was found to be the primary influence on SOC, TN and TS, with greater concentrations of these nutrients present at sites characterised by cooler, wetter conditions. In contrast, concentrations of TP were driven by soil type and geology. Mean C:N:P:S ratios in the EP soils were found to be 1000:79:10:11. In comparison with fundamental ratios required for the formation of stable soil organic matter (SOM), results showed that in the majority of EPs studied, TN levels were adequate, while TP and TS appeared to be constraining the rate of SCS. Total P and TS also appeared to be limiting SCS in the AL, but to a lesser degree than the in the EP soils.

These results indicate that though EPs provide significant carbon benefits, the majority of SOC gained exists within labile rather than stable forms due to limitations imposed by other nutrients. This conclusion was supported by analysis of SOC fractions, which indicated that increased C beneath plantings was likely due to ongoing replenishment of labile C rather than substantial accumulation of stable SOM.

Overall, results indicate that the extent of SCS under EPs is highly dependent upon climate, soil fertility and nutrient dynamics.