



Minor Stimulation of Soil Carbon Storage by Nitrogen Addition

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Anthropogenic nitrogen (N) fertilization and deposition adds 292 Tg N each year, largely to terrestrial ecosystems. N addition usually stimulates biomass growth and results in increases in plant carbon (C) pool sizes. Whether this stimulated biomass growth would lead to increased C storage in soils – the largest pool in the land – is a critical issue for the mitigation of climate change. Fossil fuel burning and deforestation emit about 10 Gt C per year to the atmosphere. Global analysis has shown that terrestrial ecosystems absorb a substantial portion of emitted C. If N addition is one key mechanism underlying contemporary terrestrial C sequestration, the land C sink would be likely to be enhanced as N deposition and fertilization are anticipated to increase in the future. However, impacts of C addition on soil C sequestration remain highly controversial. To reveal a central tendency, we synthesized results from nearly 300 studies. Our analysis showed that N addition did not significantly stimulate soil C storage in nonagricultural ecosystems (e.g., forests and grasslands) but significantly in agricultural ecosystems. Averaged effects of N addition on soil C storage were minor across all ecosystems. N-induced changes in soil C stocks were significantly regulated by soil C:N. Nitrogen addition tends to stimulate C storage in low C:N soil but increase C loss in high C:N soil. Our results indicate that N stimulation of C storage primarily occurs in plant pools but is highly limited in soil pools.