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How heat, nitrogen, and leaf litter influence soil carbon storage

Original title: *The susceptibility of soils to priming: the impact of litter addition, nitrogen fertilisation, and heat-shock*

Forests do more than just grow trees – they play a vital role in capturing and storing carbon from the atmosphere, helping to slow climate change. A lot of this carbon is locked away underground in the soil, but as the climate warms changes in temperature and nutrient availability could disrupt this balance, potentially causing soils to release more carbon, as carbon dioxide, back into the atmosphere.

This project explored how certain climate-related changes – more leaf litter from increased plant growth, extra nitrogen in the soil due to more active microbes, and sudden heatwaves – affect the soil's "priming" behaviour. This refers to how microbes in the soil respond to 'fresh food sources' (like sugars from plant roots), and whether this encourages them to break down older, stored carbon in the soil, potentially releasing it as carbon dioxide.

To investigate this, soil was collected from a beech forest in southern Sweden and exposed in the lab to three different treatments: added leaf litter, added nitrogen, or a short-term heatwave. After one week, sugar was added to the treated soils to mimic the 'fresh food sources' from plant roots. Over the following week, how active the microbes became, how much they grew (an indicator of carbon storage), and how much carbon they released as gas was measured.

The results showed that these climate-related changes do affect how much carbon is stored in the soils. More leaf litter led to more microbial growth and a greater release of stored soil carbon to the air (as carbon dioxide). Extra nitrogen made microbes use carbon more efficiently, but still led to more carbon being released to the atmosphere, while heatwaves reduced microbial growth overall, and led to less stored carbon being lost. Interestingly, the addition of sugar generally reduced how well carbon was stored in the soil. This suggests that, as climate change boosts plant root growth, beech forest soils may become less effective at storing carbon.

In short, not all climate changes affect soil in the same way. Some make soils more likely to lose stored carbon, while others may actually reduce this risk, at least for a while. These findings help us better understand how future climate conditions could influence the ability of beech forest soils to store carbon, and ultimately their role in regulating the Earth's climate.

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