European Commission

Science for Environment Policy

Soil nitrogen increased through greater plant biodiversity

11 September 2014
Issue 385

Source: Cong, W-F., van Ruijven, J., Mommer, L. *et al.* (2014). Plant species richness promotes soil carbon and nitrogen stocks in grasslands without legumes. *Journal of Ecology*. DOI: 10.1111/1365-2745.12280

Contact:
jasper.vanruijven@wur.nl

Read more about:
Soil, Biodiversity

Increased plant biodiversity improves grassland soil quality by boosting its nitrogen levels, even in the absence of nitrogen-fixing plants, recent research has found. Previous research has shown that grasslands with higher biodiversity had higher levels of carbon and nitrogen. However, in the case of nitrogen it has been suggested that this was purely a result of increased numbers of nitrogen-fixing legumes, such as clover. This study was the first to show that, even without legumes, increased numbers of grassland species increased both carbon and nitrogen soil stocks.

Levels of nitrogen in soils have been shown to increase with plant diversity. However, mixes of species in grasslands often include legumes (e.g. clover, peas and beans), which are able to 'fix nitrogen' through their roots, i.e. they effectively transfer nitrogen from the air into the soil. It is unclear whether increased nitrogen levels are the result of increased plant diversity generally or whether they are caused by increased numbers of leguminous species. Previous research has also shown that the amount of carbon stored in grassland soil increases as the amount of plant material (biomass) and diversity of species goes up.

In this study, the researchers explored whether increased plant diversity on grasslands increased soil carbon and nitrogen stores even in the absence of legumes. They planted 102 plots in an arable field in the Netherlands with various combinations of eight non-leguminous species: four species of grasses and four species of forbs (flowering plants that are not grasses) and monitored these plots for 11 years.

The researchers measured the above ground and root biomass from plant samples, and assessed the carbon and nitrogen content from soil samples.

The results showed that carbon and nitrogen stocks in the soil increased with the number of plants species grown. Plots containing all eight plant species had 18% higher carbon and 16% higher nitrogen than soil in plots growing only one species. This implies that nitrogen fixation by legumes was not necessary to boost soil nitrogen stocks. Furthermore, the researchers found that a greater diversity of plant species also boosted plant growth, probably due to the higher levels of available nitrogen in the soil.

Carbon decomposes in soil and is released into the atmosphere. The researchers assessed whether the release of carbon varied between plots by calculating the decomposition rate of carbon. They found that decomposition increased when there were more plant species. However, carbon input from above and below ground biomass was higher than carbon losses due to decomposition leading to enhanced soil carbon stocks.

Because the data for the ecosystem effects of each component species in the mixtures were not already available, the researchers tested for differences in ecosystem function and significant relationships between species, using a mixed model. The presence of the forb *Centaurea jacea* enhanced plant biomass and soil carbon stocks, but this was not the only driver of positive effects, as species richness also enhanced such stocks in plots without *C. jacea*, as well as enhancing nitrogen stocks. The researchers conclude, therefore, that the positive effects seen were not due to a single species.

This study is the first to show that nitrogen fixation by legumes is not necessary to enhance soil carbon and nitrogen stocks. Planting a diversity of grassland species was shown to effectively increase plant growth, thus boosting soil carbon, as well as enhancing nitrogen stocks.

To cite this article/service: "Science for Environment Policy": European Commission DG Environment News Alert Service, edited by SCU, The University of the West of England, Bristol.