

Science for Environment Policy

Soil biodiversity reduces nitrogen pollution and improves crops' nutrient uptake

Increased soil biodiversity can reduce nitrogen pollution, improve nutrient uptake by plants and even increase crop yields, new research suggests. The two-year study found that levels of nitrogen leaching from soil with an abundant soil life were nearly 25% lower than for soil with a reduced level of soil life. Practices which enhance soil biodiversity such as reduced tilling, crop rotation and organic farming may therefore help reduce the environmental impacts of fertilisers and improve agricultural sustainability, the researchers say.

Fertilisers boost crop growth by providing important nutrients. However, the amount applied in modern [agriculture](#) is often far in excess of that taken up by crops. For instance, it is estimated that only half of all nitrogen applications are used by plants; the rest can be leached from fields, or lost to the atmosphere as gas, causing environmental problems.

Intensive agriculture also threatens [soil](#) organisms, such as fungi, earthworms and others; in fact, studies have shown that [soil biodiversity is under threat in 56% of EU territory](#). These organisms are known to be important for nutrient cycling and there has been some suggestion that their decline may increase the need for artificial fertilisers.

In this study, part-funded by the EU project [BRIO](#)¹, the researchers investigated whether the abundance and [biodiversity](#) of soil organisms could affect plant growth and nutrient use, as well as nutrient leaching. They filled 16 containers, each with a volume of 230 litres, with sterilised soil that was then treated with either a reduced or a high level of soil life and placed them outdoors. The containers were monitored for two years, and rotated with maize, grass and wheat crops. Fertiliser was applied twice during the study.

In the first year, nitrogen leaching was 51.5% lower in containers with higher soil life compared with reduced soil life containers: the equivalent of 150.6 kilograms per hectare of nitrogen (kg/ha) leached from the low soil-life containers, but just 74.4 kg/ha from the biodiverse containers. This was reflected in the improved nutrient uptake of the crops: plants in the biodiverse containers contained 28.9% more nitrogen and 110% more phosphorus than those in the reduced soil-life containers.

Crop yields and plant biomass were also significantly higher in the biodiverse containers. For example, maize in the reduced soil-life containers showed yields of 33.2 tonnes per hectare (t/ha), but this increased by 22.3% to 40.3 t/ha in the biodiverse containers.

In the second year the differences were not as pronounced and the only statistically significant differences were a greater biomass of wheat and higher plant phosphorus levels in the biodiverse containers. However, this does not imply that biodiversity is not important in the long term, the researchers say. They point out that, in the second year, the reduced soil-life containers were invaded by a variety of soil organisms including arbuscular mycorrhizal fungi (which are particularly important for plants and nutrient cycling).

The researchers note that phosphorus leaching was higher in the more biodiverse containers. However, this reflects increased mobilisation of this element by soil organisms, they say, which also makes the phosphorus easier for the plants to take up. As a result, relative phosphorus losses, defined as the number of grams of phosphorus leached per kilogram of phosphorus taken up by the plants, was actually 25% lower for biodiverse containers, compared with the reduced soil-life containers.

In conclusion, increased soil biodiversity could be an important step on the road to sustainable agriculture. Management practices known to enhance soil biodiversity, such as reduced tilling, crop rotation and organic farming, could provide real improvements in nitrogen and phosphorus use efficiency.



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1. Banking Rhizosphere Micro-Organisms project (BRIO) was supported by the European Commission under the Seventh Framework Programme. See: http://ec.europa.eu/research/bio_economy/agriculture/projects/brio_en.htm