Impact of leaf litter of different tree species on soil chemistry and biodiversity

Removing carbon (C) from the atmosphere to mitigate global climate change effects will be a major challenge for humanity in the 21st century. Scientists have studied how microorganisms found in soil from leaf litter of different tree species affect soil C processes.

As soils provide a larger C pool than the vegetation and atmosphere combined, an important strategy to combat climate change could be to sequester even more C in soils. Plant-soil interactions play an important role in ecosystem services such as C sequestration and nitrogen (N) retention in soil.

The AFOREST project focused on the effect of tree species on the composition, structure and functioning of soil biota involved in C cycling and N cycling. The research was undertaken with the support of the Marie Skłodowska-Curie Actions programme. “Our main goal was to investigate how individual tree species can influence soil biota and their effect on the physico-chemical properties of soil,” states MSCA research...
fellow Petr Heděnec.

Scientists explored the effects of leaf litter from common European tree species on the community structure and composition of soil biota species and their metabolic diversity and role in C and N turnover in soils. The research was carried out in a tree species experiment with monoculture stands of six common European tree species – broadleaves beech, pedunculate oak, lime, sycamore, ash, and the conifer Norway spruce.

**Effects of tree species**

According to Heděnec, the selected tree species differ widely in the type of leaf litter they produce, which in turn affect soil biota. “For example, Norway spruce, oak and beech produce slowly decomposable leaf litter with high C:N ratio, low nutrient contents and high lignin content. However, ash, sycamore and lime produce easily decomposable leaf litter with low C:N ratio, high nutrient contents and low lignin content.”

An important aspect of AFOREST was the specific taxonomic groups of soil bacteria, fungi or small creatures living in the soil, regarding their contribution to soil processes related to C and N cycling. “Our results revealed very clear cases of the links between functional groups of soil biota and tree species,” Heděnec explains.

“For example, we found higher relative abundance of copiotrophs (fast growing bacteria with high nutrient turnover) in soils beneath trees producing low C:N ratio leaf litter. However, oligotrophs (slow growing bacteria with slow nutrient turnover) were dominant in soils under trees producing low quality leaf litter with high C:N ratio.”

**Help for foresters**

Results also showed the strong impact of tree species on trophic interactions in soils. “We found a high abundance of bacterial feeding nematodes in soils under ash, sycamore and lime (where bacteria were found to dominate) while fungal feeding nematodes were dominant in soils under Norway spruce, oak and beech where fungi were dominant,” notes Heděnec.

In contrast to the general hypothesis that trees with high C:N ratio litter play a positive role in stabilising soil organic C, project results indicated that trees with low C:N ratio litter support high diversity of soil organisms. This, in turn, may promote microbial processes and in particular bacterial activities that help the stabilisation of soil organic C that remains in the soil after partial decomposition of any material produced by living organisms.
“AFOREST results will help forest management and policymakers to select suitable tree species to increase the diversity of soil organisms which in turn affect C and N fluxes in soils,” Heděnec concludes.

Keywords

AFOREST, tree species, leaf litter, C:N ratio, soil biota, C sequestration, carbon, nitrogen

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