

Long-term green manuring strengthens core microbiomes in driving multiple functions across vertical soil profiles: Study

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The experiment consisted of a typical high-yield cropping system, with a 150 cm wide strip of both wheat and maize in the intercropping system. For green manure treatment, hairy vetch was sown annually and plowed in situ into the soil as green manure in mid-October. Credit: Science China Press

A study [published](#) in the journal *Science China Life Sciences* was led by Prof. Weidong Cao (Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences) and Prof. Zongxian Che (Institute of Soil and Fertilizer and Water-saving Agriculture, Gansu Academy of Agriculture Sciences).

The fertilization experiment was established in 1988 in a wheat maize cropping system in Wuwei County, Gansu Province, China, which includes the typical fertilization system (chemical N, [cow manure](#), straw, and green manure) in China. "Fully understanding the advantages and disadvantages of typical fertilization is of great significance to guide farmland management in China," Zongxian Che says.

Weidong Cao together with his student Guopeng Zhou, sought to determine whether each fertilizer differs in its ability to change certain [soil](#) C and N processes, such as organic C mineralization, N fixation, and N₂O release. The team performed microcosmic experiments on the basis of long-term typical fertilization experiments to determine the potential functions of soil, and analyzed the driving mechanism of soil functions.

The team found that the long-term application of green manure or cow manure produced wheat yields equivalent to those obtained with chemical N, with the former providing higher soil functions and allowing the functionality of N cycling (especially soil N mineralization and biological N fixation) to control wheat production.

The keystone phylotypes within the [global network](#) rather than the overall microbial community dominated the soil multifunctionality and functionality of C, N, and P cycling across the soil profile (0–100 cm).

The researchers also confirmed that these keystone phylotypes consisted

of many metabolic pathways of nutrient cycling and essential microbes involved in organic C mineralization, N₂O release, and biological N fixation.

For instance, the chemical N, green manure, and cow manure resulted in the highest abundances of amoB, nifH, and GH48 genes and Nitrosomonadaceae, Azospirillaceae, and Sphingomonadaceae within the keystone phylotypes, and these microbes were significantly and positively correlated with N₂O release, N fixation, and organic C mineralization, respectively.

Amazingly, the team demonstrated that organic fertilization increased the effects of the network size and keystone phylotypes on the subsoil functions by facilitating the migration of soil microorganisms across the soil profiles and green manure with the highest migration rates.

"These new exciting results add to growing evidence the unique role of green manure in keeping and improving soil health. They suggest green [manure](#) can facilitate the migration of soil microorganisms across the soil profiles and promote soil biological N fixation, we hope that this study will provide selectable strategies for controlling soil functions and productivity by mediating soil microbial keystone taxa in agricultural ecosystems," Weidong Cao says.

More information: Guopeng Zhou et al, Green manuring relocates microbiomes in driving the soil functionality of nitrogen cycling to obtain preferable grain yields in thirty years, *Science China Life Sciences* (2023). [DOI: 10.1007/s11427-023-2432-9](https://doi.org/10.1007/s11427-023-2432-9)

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