

# Agriculture study on cover crops mixtures delivers unexpected results

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Soil profile of a test field: Samples the size of a brick were taken from the soil at different depths and the roots were then isolated, scanned and measured. Credit: Johannes Siebigteroth/University of Bonn

Farmers usually plant cover crops after harvesting their main crop. This

prevents erosion of the soil and nutrient leaching. The roots of these crops also stabilize the structure of the soil. It had been assumed that a mixture of different cover crops would result in particularly intensive rooting.

However, a recent study carried out by the Universities of Bonn, Kassel and Göttingen found only limited evidence that this is the case. Instead, mixed [cover crops](#) grow thinner roots than when just one single type of cover crop is planted. This result was unexpected. It documents how little is understood about the interactions between [plant roots](#). The study was published in *Plant and Soil*.

In agriculture, crops are usually differentiated into main crops and cover crops. The first category includes crops with which farms mainly earn their money such as cereals, potato or maize. Once these crops have been harvested, it is time for the cover crops: They are sown to maintain or improve the quality of the soil. Cover crops suppress weeds, prevent nitrate leaching and reduce erosion by rain and wind.

"These crops are not usually harvested but simply die away during the first frosty days," explains Roman Kemper, who received his doctorate in the research group headed by Prof. Dr. Thomas Döring at the Institute of Crop Science and Resource Conservation (INRES) at the University of Bonn. "Nevertheless, they are hugely important for economic farming."

## **Comparing mixed cover crops with pure stands**

Many of these positive effects are hugely dependent on how well the roots of the cover crops penetrate the soil. It had been widely assumed up to now that mixed cover crops penetrate the soil more intensively than pure stands of cover crops comprising one single plant species.

The reasoning behind this idea is that if roots from several species sown at the same time are competing, the result will be so-called niche differentiation. This means the roots of some cover crops will mainly penetrate upper layers of soil, while others will seek out lower layers of soil.

"Overall, this should mean that a mixture of crops will result in greater rooting of the entire soil profile," says Kemper. "In agroforestry systems in which trees are also planted next to typical agricultural crops, this effect is actually observed. However, we were not able to find any evidence for this effect in the cover crops in our fields."

The researchers tested cover crops of oil radish, winter rye and crimson clover in their study. The plants were either sown as single or mixed cover crops. The scientists then investigated how the roots had penetrated the soil at different depths in late Fall.

"We were surprised by the results," emphasizes Kemper. "Particularly positive effects were observed in the fields where oil radish and winter rye had been sown on their own. The roots of the winter rye favored the upper layers, while the roots of the oil radish penetrated significantly deeper."

But what happened when oil radish was planted together with winter rye? Surprisingly, the root mass did not increase in all of the soil layers taken together as a result. The roots of the deeper rooting oil radish did penetrate more intensively into lower levels of the soil in the mixed crop than was the case with pure stands. However, the roots of the mixed cover crops were significantly thinner and thus the root mass did not increase overall.

## **Cleaning and closely examining every root**

The results document how little is currently known about the root growth of crop mixtures. This may also be due to the fact that their research involved extremely painstaking work.

Hundreds of [soil samples](#)—each as big as a brick—had to be taken for the study. The samples were washed, sieved and then cleaned using a pair of tweezers to remove even the tiniest pieces of dirt or contamination from the roots that were sometimes just a few tenths of a millimeter thick. Every root was then scanned, dried and weighed.

However, this painstaking work was worth the effort. "There has so far only been rudimentary research carried out into the rooting performance of our arable crops," says Kemper. "This means that there is still a lot of new things to discover."

**More information:** Roman Kemper et al, Oil radish, winter rye and crimson clover: root and shoot performance in cover crop mixtures, *Plant and Soil* (2023). [DOI: 10.1007/s11104-023-06240-y](https://doi.org/10.1007/s11104-023-06240-y)

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