

HOW COVER CROP MIXTURES ACTIVATE THE MICROBIOME

Cover crops have been proven to improve soil fertility and support higher yield – this is now widely recognised. However, the true mechanisms and reasons behind their effects only become apparent when we take a closer look at the soil. Bacteria, fungi and many other microorganisms are active here. Collectively, they are described as the soil microbiome. DSV consultants Mario Reinhold (Central Uplands region, Germany) and Andreas Krallinger (Northern Germany) describe below the effect that biodiverse cover crop mixtures have on soil life and how they can help to stabilise yields.

THE CENTRAL UPLANDS REGION – MORE SPECIES, MORE SOIL LIFE

Site: North Thuringia and southern Saxony-Anhalt: Contrasting water conditions

Mario Reinhold has been working as a DSV consultant for five years, supporting farmers in North Thuringia and southern Saxony-Anhalt. His area of operation includes a wide variety of soil and water conditions. The spectrum ranges from the water-rich Eichsfeld region, with around 700 mm of annual rainfall on medium-textured soils, to very dry locations in the Kyffhäuser district and parts of southern Saxony-Anhalt, where rainfall is sometimes less than 400 mm. The challenges faced in farming are correspondingly varied.

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Cover crops as a driver of the microbiome

A key finding of the multi-year, scientifically monitored CATCHY project, which investigated the effects of cover crops, is also supported by Mario Reinhold's practical experience: "As the diversity of the cover crop mixture increases, so does the diversity of the soil microbiome. Each plant species releases specific exudates via its roots. And each exudate attracts different microorganisms. The more species, the broader the network," explains Reinhold. He deliberately draws a comparison with the human gut, because an unbalanced diet leads to an unbalanced microbiome – in the soil as well as in the body.

Another eye-opening moment for him came when he looked at the soil in the Eichsfeld district. TerraLife®-MaizePro sown early showed



"If you can detect the typical scent of damp earth in your soil, then you know – the microbiome is at work here."

by autumn, extensive root penetration, stable soil structure and a soil that "smelled of life", as Reinhold describes it. "When you take a soil sample and that typical earthy smell comes up, then you know the microbiome is at work here." Among other things, this is caused by soil bacteria called actinomycetes, which form geosmines (organic molecules) that produce this characteristic scent of damp earth.

Adaptation rather than extinction

It was particularly during dry periods that Reinhold realised just how much of influence the microbiome has on water management in the soil. Cover crops go into a dormant state when they are under drought stress and

» **Especially in extreme conditions, the microbiome determines whether the soil can act as a buffer during periods of stress. Cover crop mixtures are a key tool in this regard. «**

Mario Reinhold

The **cover crop projekt CATCHY** was launched by the Federal Ministry of Education and Research (BMBF) in 2015. Several universities and institutions have jointly investigated how cover crops can be used as part of innovative cropping systems to maintain and improve in the long term.



Fig. 2: A cover crop stand that appears to have died off (left) springs back to life after rainfall (right). Prof. Dr Christel Baum explains the link to the enriched soil microbiome in another article.

spring back to life after rain. 'It's not dying off, it's adaptation,' emphasises Reinhold.

This became clear to him from a cover crop stand shown in Fig. 2. During the dry periods, the stand appeared almost dead (see Fig.

2; left). However, as soon as the rain fell, it began to develop further (see Fig. 2; right). He identifies another, often underestimated effect associated with the use of cover crop mixtures in the breakdown of herbicide residues. In Reinhold's region, there is an in-

creasing incidence of sulphonylurea-related damage. "I am convinced that an active microbiome is key to increasing degradation rates. Cover crop mixtures are an important tool for this purpose."

THE NORTH – A NETWORK BELOW THE SURFACE

Andreas Krallinger's most impressive and lasting CATCHY 'aha' moment comes from farms reporting up to 15 tonnes per hectare higher fresh matter yield in maize following the application of TerraLife®-MaizePro, compared to simple crop mixtures or fallow land. "This confirms what CATCHY describes, but also the philosophy behind TerraLife® mixtures: soil chemistry, soil structure and the microbiome are positively influenced by diverse cover crop mixtures." An impressive image that Krallinger also likes to share with farmers is the perfect spider's web that becomes visible through a pocket microscope when directed at the soil beneath a diverse cover crop mixture. "Fine roots, fungal hyphae, connections in every direction," enthuses Krallinger.



Diversity adapts – and takes time

The positive results of the CATCHY project were also confirmed in practical cultivation trials in the north. It is not the individual species that is decisive, but the interaction between species and how they adapt to the conditions. On poorer soils prone to compaction, robust, stress-tolerant species in the mixture – such as oil radish, which is a deep-rooted plant, or linseed and phacelia – succeed. Sorghum, for example, also grows well on heavy soils and is very drought tolerant. In more favourable locations, however, other species, such as legumes (field beans, lupins or clovers), or

cruciferous plants such as yellow mustard, are more established.

The abundance of the individual components in the cover crop mixtures can therefore provide information about the condition of the soil and indicate where action may be needed. "For this reason, the all-round mixtures from the TerraLife® programme are always a good choice," notes the DSV consultant.

Krallinger adds that patience is rewarded when integrating diverse cover crops into the crop rotation. "Anyone who gives the system time will quickly realise that diversity is not a risk – but rather a form of insurance." Patience pays off particularly on sites with an unreliable water supply. In waterlogged conditions, cover crop areas often only become accessible up to four days later than on fallow land.

"Because the water that prevents you from driving over the area at that moment will be available to you as a reliable water reservoir during the summer months! At the same time, you get a softer, more yielding, well-tilled soil," says Krallinger.

Conclusion

Whether dry or wet, light or heavy – cover crop mixtures activate the microbiome, regu-

Schleswig-Holstein site: diversity between marshland, sand and the sea

Andreas Krallinger has been working at DSV for over 24 years. His advisory area covers large parts of Schleswig-Holstein – from Hamburg to the Kiel Canal and from the North Sea to the Baltic Sea. Soil conditions range from heavy marsh soils along the coast to sandy loams inland, and from light sands to moorland sites. The requirements for the cropping system vary accordingly. Whilst the south of the state receives around 630 mm of annual rainfall, figures on the west coast can exceed 1,000 mm in some areas. At the same time, average temperatures have risen significantly in recent years. For Krallinger, one thing is certain: under these conditions, soil life is increasingly decisive in determining whether soils remain productive, structurally stable and high-performing.

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late nutrient dynamics and make soils more resilient. CATCHY provides the scientific basis; practice confirms it. Diversity in the crop is not an end in itself – it is the key to stable yields under increasingly extreme conditions.

This interview was conducted by Jan Hendrik Schulz and Anna-Lena Bräucker.

