Pea plants may manipulate soil microbes to facilitate nutrient uptake & combat stress

Researchers at National Centre for Cell Science (DBT-NCCS), Pune, an autonomous institute of the Department of Biotechnology (DBT), studied long-term exposure to various agricultural practices, such as tillage and residue management on bacterial community in the soil. They also investigated how the rhizosphere microbiome is influenced by the use of the pea plant as a rotation crop. They found that soil and residue management practices affect the structure of the bacterial community in the bulk soil, as well as the pea rhizosphere.

Pea plants were found to be a dominating selection factor that influenced the soil microbiome under different tillage and residue management treatments. Interestingly, these studies revealed that the pea plant rhizosphere had higher numbers of bacteria that can produce plant growth-promoting substances, and those which have the ability to remove toxic elements from the soil. This led to the inference that the pea plants likely shape the microbial community around their roots in a way that may help them with nutrient uptake, and enable them to combat stress and grow in unfavourable soil conditions, which would be advantageous when growing in the acidic and iron-rich soils of this region. These findings were published in the journal, Frontiers in Microbiology. The insights gained from these studies could prove valuable in designing long-term conservation agriculture strategies for the improvement of soil quality and crop yield in the north-eastern regions of India.

Legumes, such as peas, beans and chickpea, have a symbiotic association with nitrogen-fixing bacteria, which are necessary for the plants' growth. These plants have specialized structures on their roots, called nodules, inside which these bacteria reside and fix nitrogen, which also helps increase the fertility of the soil. In addition to the bacteria in these nodules, other microbes present in the soil also affect plant growth, especially those present in the rhizosphere, the region immediately surrounding the roots. The different types of microbes present in the soil collectively constitute the soil microbiome, and those close to the roots constitute the rhizosphere microbiome. Since soil microbial communities, especially the rhizosphere microbiome, significantly influence the growth and productivity of plants, they are vital indicators of soil quality.

The soil microbiome is highly sensitive to agricultural soil management practices. Therefore, a sustainable system of agriculture that promotes optimal crop productivity with minimal impact on the environment, including the soil, is preferable. Approaches like conservation agriculture (CA) are considered as better alternatives for improving crop productivity since they help preserve and enrich the agroecosystem concomitantly. CA involves the use of various strategies, including crop rotations and diversification of cropping systems, and minimal soil disturbance. In long-term conservation agriculture experiments conducted in the acidic soils of northeastern India, various strategies are being tested on experimental farms. This includes the use of legume crops like pea in rotation with rice cultivation.

To be able to modify agricultural methods optimally, it is important to understand how the various practices used influence the soil microbiome in the short- and long-term, and what their consequent effects on the growth, health and productivity of the crops are. Studies done in North Eastern India have shown the impact that reduced tillage can have on soil quality and crop productivity, for example. However, the influence on soil microbial communities had not been investigated.

Contact details:
Scientist, Dr. Praveen Rahi
(praveen@nccs.res.in, praveen_rahi22@yahoo.co.in)
Communication coordinator,
Jyoti Rao (jyoti@nccs.res.in)