

Researchers study organic matter processes in rice fields

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A soil scientist from RUDN University reports that plant root secretions affect microorganisms and biochemical processes in paddy soils such as rice fields. Rice field soils play a very important role in the agriculture of Southeast Asia, since they cover > 160 Mio ha and are used to produce food for a quarter of world population. The results of the study were published in the *European Journal of Soil Biology*.

Soil fertility depends very much on the quantity and quality of carbon, the [organic matter](#) in soil. Both quantity and quality are regulated by plants growing on the soil and the quantity of plant residues remaining after harvesting. This defines the amount of organic matter and, consequently, the [soil fertility](#), the productivity, stability and quality of the crops. These questions are relatively well studied for upland soils. However, the biochemical processes in rice paddies are under-studied. They are flooded for at least several months each year, and play an important role in the economy of China and other Southeast Asia countries. The rate of carbon input and transformation in paddy soils is different than in the soils investigated in Europe and North America.

"People breathe with lungs and fish breathe with gills. This is the simplest analogy showing the difference between upland and paddy soils. There are very few studies devoted to the processes taking place in paddy soils," says the co-author of the paper Yakov Kuzyakov (RUDN University).

During growth, plant roots release organic substances into the soil that

are easily accessible for [microorganisms](#). These [root secretions](#) become a substrate or food for microorganisms, which, in turn, mineralize organic substances released by roots and present in soil, turning these organic inputs into nutrients, nitrogen, phosphorus and sulfur, which are accessible to plants. Due to microbial processes, rice fields emit a lot of methane (CH_4) and nitrous oxide (N_2O), well-known greenhouse gases.

In order to study the effects that root secretions have on microorganisms, scientists from China, Russia and Germany added three groups of substances into soils: glucose, oxalic acid and acetic acid. These are secreted by the roots of most plants in significant quantities. The researchers studied the decomposition rate for these analogues of root secretions in upland and in paddy soils, and the ways these compounds stimulate the microbial activities.

The researchers found that there are more microorganisms in paddy soils than in [upland soils](#). However, the amount of the three tested substances (analogous to root exudates) in both soil types is approximately the same. This means that microorganisms in the rice fields use plant root secretions more slowly. Consequently, root-released carbon remains for longer in paddy soils, and this affects long-term carbon accumulation and soil fertility. Due to the input of [root](#) secretions, the activity of microorganisms and the organic matter decomposition rate increases. This, in turn, accelerates the mineralization of nutrients—nitrogen, phosphorus and sulfur—which become available to plants.

"Roots do not simply give out [organic substances](#) into [soil](#) and lose these energy rich compounds. Roots stimulate the activity of microorganisms, which consequently benefit plants by producing more nutrients in an accessible form," Kuzyakov said.

More information: Husen Qiu et al, Weaker priming and mineralisation of low molecular weight organic substances in paddy than

in upland soil, *European Journal of Soil Biology* (2017). [DOI: 10.1016/j.ejsobi.2017.09.008](https://doi.org/10.1016/j.ejsobi.2017.09.008)

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