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Editorial

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Symbiotic Nitrogen Fixation

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Editorial

As part of the nitrogen cycle, the chemical processes by which atmospheric nitrogen is assimilated into organic compounds, particularly by certain microorganisms. The supply of fixed or usable sources of nitrogen restricts crop plant productivity and, as a result, food production. In the developing world, nitrogen fertiliser production is currently a major cost for the efficient growth of various crops. The mechanism is only present in bacteria and archaea, and not in eukaryotes.

Plants provide a niche and fixed carbon to bacteria in exchange for fixed nitrogen in a mutualistic relationship known as symbiotic nitrogen fixation. This process is mostly confined to legumes in agricultural systems, but there is a lot of curiosity about whether similar symbioses can be produced in nonlegumes, which provide the majority of human food. In agricultural systems, symbiotic nitrogen fixation is largely confined to legumes, but there are a variety of microorganisms that live in the rhizosphere of other crop plants, including some diazotrophs, and some of which have been shown to boost plant development.. Symbiotic nitrogen fixation takes place in specialised organs called nodules, which are caused on leguminous host plants by bacteria from the Rhizobiaceae family. The formation of nodules is a multistep process that necessitates ongoing contact between the two partners, as well as the exchange of various signals and metabolites. A specialised community of prokaryotes conducts biological nitrogen fixation (BNF), which was discovered by Beijerinck in 1901 (Beijerinck 1901). The enzyme nitrogenase catalyses the conversion of atmospheric nitrogen (N2) to ammonia in these species (NH3). Plants can easily assimilate NH3 to generate the nitrogenous biomolecules described earlier. Plants provide a niche and fixed carbon to bacteria in exchange for fixed nitrogen in a mutualistic relationship known as symbiotic nitrogen fixation. Symbiotic nitrogen fixation by rhizobia in root nodules of crop and forage legumes provides substantial economic and environmental benefits. Nitrogen fixation could be increased in various ways, but most of these would cause a proportional increase in photosynthate costs. It is essential to life because fixed inorganic nitrogen compounds are required for the biosynthesis of all nitrogen-containing organic compounds, such as amino acids and proteins, nucleoside triphosphates and nucleic acids. As part of the nitrogen cycle, it is essential for agriculture and the manufacture of fertilizer.

The simplest type of nitrogen-fixing symbiosis is between plants and associative nitrogen-fixing bacteria, which are a subset of plant growth-promoting rhizobacteria (PGPR). Endosymbiosis is the most complex form of nitrogen-fixing plant-microbe interaction. Bacterial endosymbionts are normally collected from the atmosphere and housed within plant cells inside membranes extracted from plants. Nitrogen-fixing cyanobacteria interact with certain plants. Seedlings in the symbiosis between Gunnera plants and Nostoc cyanobacteria recruit the endosymbiont through the secretion of carbohydrate-rich mucilage. Nostoc then reaches the inner cortex via specialised glands and is accommodated within cells.

Nitrogen-fixing bacteria are microorganisms that can turn nitrogen from the environment into fixed nitrogen (inorganic compounds usable by plants). These species are responsible for more than 90% of all nitrogen fixation, and thus play a significant role in the nitrogen cycle. The symbiotic nitrogen-fixing bacteria enter the root hairs of host plants, multiplying and stimulating the development of root nodules, plant cell enlargements, and bacteria in near proximity. The symbiotic nitrogen-fixing bacteria enter the root hairs of host plants, multiplying and stimulating the development of root nodules, plant cell enlargements, and bacteria in near proximity.

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