ecogrowth

TECHNICAL ARTICLE

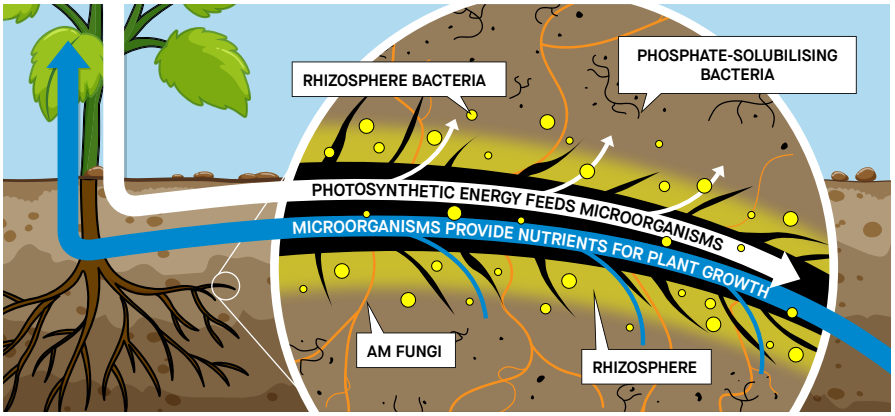
Plant phosphorus uptake via soil biology

Promoting productive growth and development

Phosphorus (P) is an essential plant macronutrient because it makes up part of important biological molecules in the cell. For productive growth and development, plants must have a source of P, which they primarily take up from the soil. Here, we will dig into how plants acquire P from the soil and the role soil biology plays in this.

Plants primarily absorb soil P in the form of orthophosphate (Pi), which can be taken up through either direct or indirect mechanisms. Direct uptake is when plant roots absorb Pi from soil in the rhizosphere immediately surrounding the plant root. However, direct uptake has its limitations, as P-depletion zones are quickly formed around existing plant roots. To access further soil P, additional root growth is necessary, which is a resource-intensive investment for the plant. On the other hand, indirect uptake is when the plant forms a symbiotic relationship with arbuscular mycorrhiza (AM) fungi that source Pi from the soil surrounding its hyphae (the hyphosphere) and brings this back to the plant root.

The extensive growth of AM mycelium throughout the soil means that P is mined from a much greater soil volume. Successful symbiosis between the plant and AM fungi causes the plant to downregulate direct P uptake and invest more in indirect P uptake. There is a complex, interconnected web between plant roots, AM fungi and phosphate-solubilising bacteria (PSB) whereby carbon (products of photosynthesis) is given by the plant in exchange for nutrients (i.e., P) mined from the soil (Etesami, Jeong, and Glick 2021). The organisms involved in these exchanges influence each other's growth and metabolism through various signalling molecules, such as phytohormones, flavonoids, and sugars.



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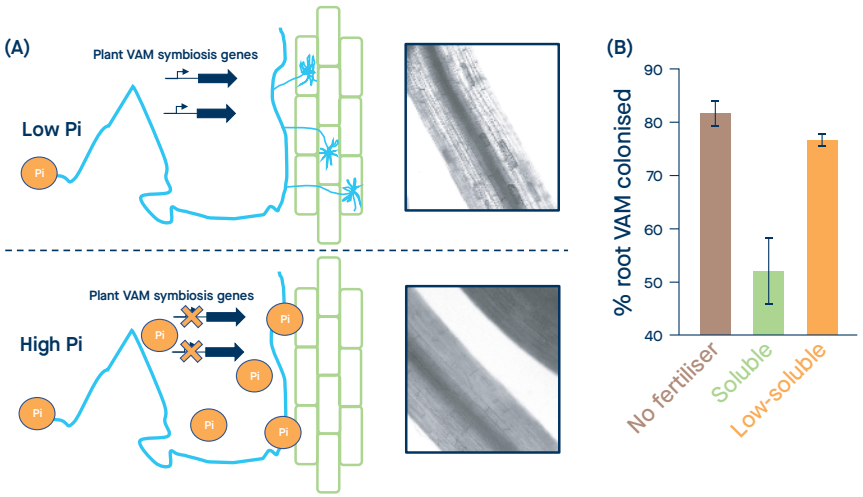
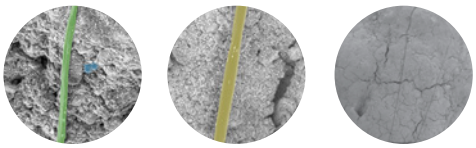
The connection between AM fungi growth, successful root colonisation and the Pi status of the plant has been known since the 1980s. Recently, a direct molecular link was established (Paries and Gutjahr 2023). When the plant senses that P supply is low, it induces a Pi starvation response (PSR) leading to an increase in compounds involved in plant–AM fungi symbiosis. Conversely, when the plant is oversupplied with P, PSR is deactivated and plant–AM fungi symbiosis is suppressed. This disconnect between plant roots and soil microbiology can have negative effects, including soil carbon loss and poor soil health.

PSR and the symbiosis between plant¬s and AM fungi are still being actively researched, with more details continuing to emerge. However, a clear fundamental principle is that the connections between plant roots and soil microbiology can be disrupted by an excess of soluble P nutrition. Ecogrowth granular fertiliser is designed around rock phosphate activated by EcoAdvance® biology. Ecogrowth granular fertiliser supplies P in a low-soluble, bioavailable form that promotes root connections with soil biology, thereby building soil health and enhancing plant nutrient uptake.



eco advance PREMIUM BIOLOGY®



High magnification images of rock phosphate granules with phosphorus solubilising EcoAdvance® micro organisms growing across the surface.

Biology for life

EcoAdvance® premium biology brings soil to life with beneficial microbes that activate the rhizosphere surrounding plant roots.

Biologically active soil has better structure, moisture retention, enhanced nutrient cycling and improved mineral availability for quality, healthy plants.

Etesami, Hassan, Byoung Ryong Jeong, and Bernard R. Glick. 2021. 'Contribution of Arbuscular Mycorrhizal Fungi, Phosphate–Solubilizing Bacteria, and Silicon to P Uptake by Plant', *Frontiers in Plant Science*, 12.

Paries, M., and C. Gutjahr. 2023. 'The good, the bad, and the phosphate: regulation of beneficial and detrimental plant-microbe interactions by the plant phosphate status', *New Phytologist*, 239: 29-46.

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