Excessive phosphate fertilizer use can reduce microbial functions critical to crop health

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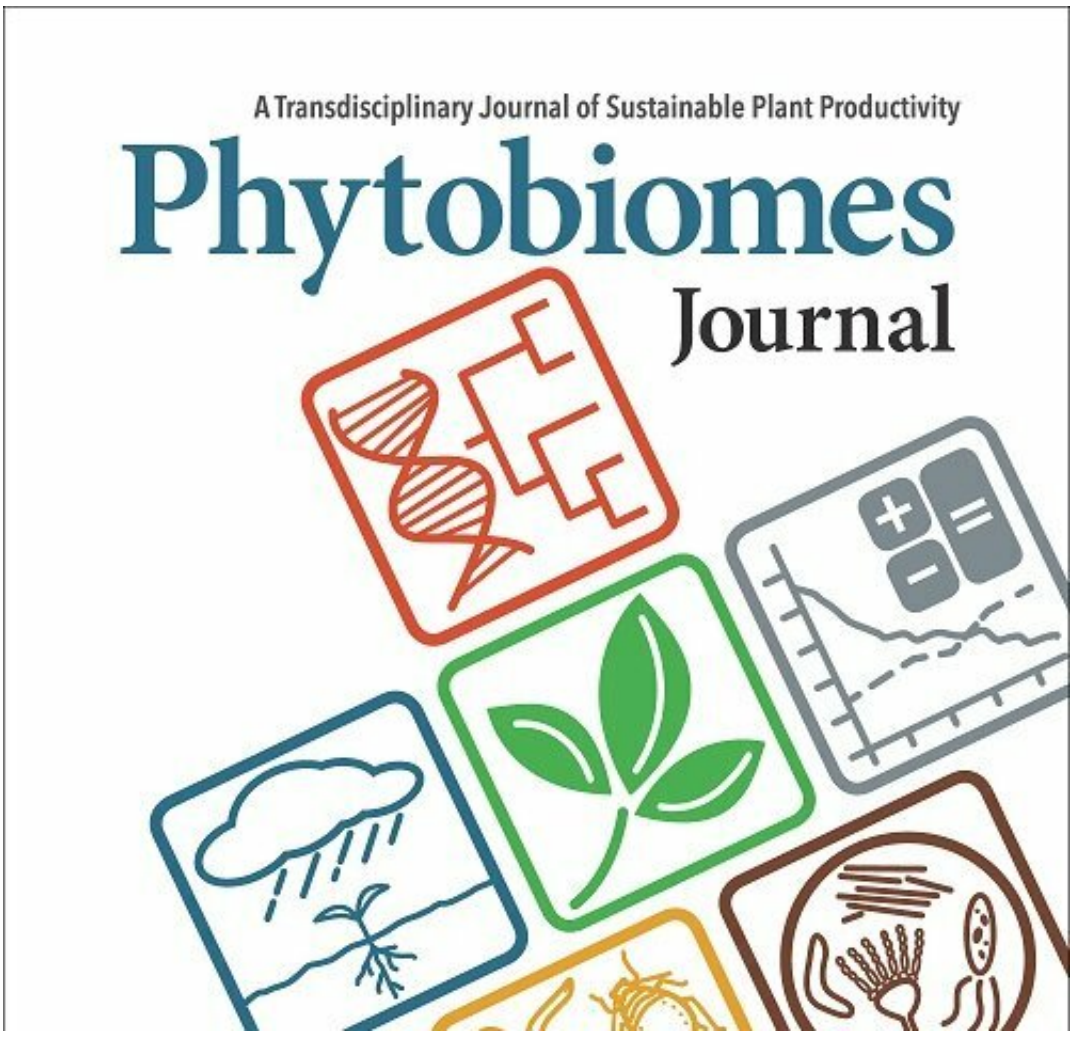

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Phosphorus is crucial for plant growth—with it, plants can acquire, transfer, and store the energy that helps them flourish in full health. Without it, plants flounder: they're stunted, discolored, and produce low yields. For this reason, farmers and gardeners often apply phosphate fertilizers (P-fertilizer) to increase the amount of phosphorous in their soil. However, a recent study finds that excessive P-fertilizer may actually hurt the plants it is trying to help by altering the composition and function of the microbes in the soil.

In a study published in the open access *Phytobiomes Journal*, a team of scientists led by Drs Terrence Bell and Jenny Kao-Kniffin at Penn State University set out to determine if nutrient history changed the function of soil microorganisms—that is, could multiple generations of nutrient application and microbial transfer separate the impacts of nutrients and soil microorganisms on crop health. The answer seems to be yes, and that soil treated with high amounts of phosphate can result in poorer plant performance, but even more intriguing, it appears that the soil microorganisms from this conditioned soil can negatively impact plant yield.

To arrive at this conclusion, the team grew four generations of alfalfa (*Medicago sativa*) in soil with different concentrations of P-fertilizer (low to high), and after each generation, a small amount of soil, including soil-borne microorganisms, from pots containing the top-growing plants was transferred to the next generation. They then applied the microorganisms selected under each nutrient condition to all other nutrient conditions to determine whether nutrient history changed the function of soil microorganisms, even when a particular nutrient amendment (e.g. high inorganic P-fertilizer) was no longer applied.

The team found that alfalfa plants grown in soil treated with high levels of inorganic P-fertilizer, or with the microbes from this treatment but in low P-fertilizer, performed worse than alfalfa plants grown in soil

treated with lower or no levels of P-fertilizer. Using high-throughput DNA sequencing, they saw that the composition of microorganisms grown under high inorganic P was distinct from other treatments.

These findings require additional study, but for now they suggest that excessive P-fertilizer could have lasting negative effects on crop productivity by reducing the microorganisms (or how they function) that are critical to crop health.

More information: Laura M. Kaminsky et al, Medicago sativa has Reduced Biomass and Nodulation When Grown with Soil Microbiomes Conditioned to High Phosphorus Inputs, *Phytobiomes Journal* (2018). DOI: 10.1094/PBIOMES-06-18-0025-R

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