Sustainable Technologies for Reducing Phosphorus Leaching Using Plant Growth Promoting Rhizobacteria

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Fertilizers applied to soilless growing substrates in controlled environment agriculture (CEA) often leach nutrients like phosphorus (P), and this leads to environmental pollution. The objective of this research was to evaluate the combination of three novel, sustainable technologies to grow healthy plants while reducing phosphorus leaching. French marigolds and tomatoes were evaluated in a greenhouse experiment with eight treatments and six plant replicates (n=6). Most treatments were grown with no P fertilization so that coconut coir (70% peat: 30% coir substrate) was the only source of P (technology 1), and substrate was amended with iron sulfate to reduce P leaching by creating insoluble iron phosphate that would be held in the containers (technology 2). Plant growth promoting rhizobacteria (PGPRs) (technology 3) including Pseudomonas soli strain C10A8, Bacillus megaterium strain C3F10, Pseudomonas sp. strain C6E7, and Pantoea rwandensis strain C3A8 were evaluated for their ability to make the P in the insoluble iron phosphate available for plant uptake. Leachate was collected to measure P concentrations using a malachite green assay, and plant health and growth were quantified using the Trait Finder digital phenotyping system. Final tissue nutrient content was measured. Iron sulfate amendment reduced phosphorus leaching, and plants were able to grow with coir as the only source of P. The Pseudomonas soli strain C10A8 resulted in plants with greater biomass, greener leaves, and increased P content compared to no bacteria controls. Combining these three novel technologies, the CEA industry can grow quality plants while reducing fertilizer applications and P leaching.

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