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Reimagining Crop Nutrition

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While synthetic fertilizers have accelerated crops yields worldwide, most of the synthetic nitrogen that farmers apply is never absorbed by the crops they produce; instead, the nitrogen evaporates into the atmosphere and is washed into nearby waterway that become polluted or becomes the greenhouse gas nitrous oxide, which is 300 times more potent than CO^2.
Biological nitrogen fixation (BNF) by plant-associated bacteria has the potential to provide a sustainable and efficient source of nitrogen to crop roots. However, the abundance of fertilizer and residual nitrogen in agricultural soils has repressed BNF in natural rhizosphere microbes. To address this problem, we have restored BNF in the rhizosphere of cereal crops by creating a platform to identify, characterize and fine-tune plant-associated microbes. Fine-tuning the genetic regulation of BNF resulted in strains able to fix nitrogen in fertilized conditions and release scaled amounts of nitrogen to cereal crop roots. As measured by ^{15}N abundance studies in field conditions, these microbes supply up to 25 kg N/ha directly to corn plants. These first-generation nitrogen-producing microbes are the first commercially-viable example of BNF as a nitrogen management solution.