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Overview of biostimulants and plant growth-promoting bacteria

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Agricultural biostimulants have become common inputs into crop production with a projected world-wide market of \$2.2 trillion in 2018. The European Biostimulant Industries Council (EBIC) defined biostimulant as “a material that, when applied to a plant, seed, soil or growing media - in conjunction with established fertilization plans, enhances the plant's nutrient use efficiency, or provides other direct or indirect benefits to plant development or stress response.” This definition emphasizes that biostimulants do not have direct effects on crop pests and diseases, and hence, they are distinct from biopesticides or biological control agents.

Biostimulants increase crop growth and development by diverse mechanisms including enhancing nutrient availability in soil, increasing root biomass or root surface area, increasing the plant's nutrient uptake capacity, and activating tolerance to abiotic stresses such as drought, salinity, and heavy metals.

In the U.S., the Biostimulant Coalition, a non-profit group of interested parties cooperating to address regulatory and legislative issues, considers biostimulants to include “biological or naturally-derived additives and / or similar products, including but not limited to i. bacterial or microbial inoculants, ii. biochemical materials, iii. amino acids, iv. humic acids, v. fulvic acid, vi. seaweed extracts and vii. other similar materials.” The category of microbial inoculants includes free-living fungi, arbuscular mycorrhizal fungi, and beneficial bacteria termed plant growth-promoting rhizobacteria (PGPR). PGPR survive inoculation onto seeds or into soil, catabolize seed and root exudates, colonize plant roots ectophytically and sometimes endophytically, and produce several biologically active compounds that result in enhanced plant growth. Currently available PGPR-based biostimulants include products with single strains, mixtures of 2-3 strains, and complex mixtures of many strains, sometimes together with microbial metabolites formed in the bioreactor broth.