

Microbial inoculants for sustainable agriculture in a changing climate

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Although plant breeders continue to increase crop yield potential, historical time series of national yield statistics demonstrate yield stagnation of many crops in western Europe. As the climate changes, year-to-year variability in national yields is increasing as droughts, heatwaves and floods restrict yields by directly affecting plant growth and reproduction, or curtailing the cropping calendar. Multiple stresses impacting the crop in a typical season is becoming more commonplace.

Plants sense their rootzone and aerial environments, with plant hormones co-ordinating growth and regulating crop water use. Many of these climatic stresses perturb plant hormone status, by increasing stress ethylene production. Furthermore, soil and leaf water deficits increase ABA concentrations. Although these hormonal changes are adaptive, plant breeders and biotechnologists have enhanced or attenuated the production of, or sensitivity to, these hormones. However, agronomic successes of these genetically altered plants depends largely on the stress environment.

An alternative is to supply microbial inoculants: soilborne microbes that produce or metabolise these plant hormones. While rhizobial technologies to enhance legume nodulation have attracted considerable historical attention, this process is intricately regulated by plant hormones and highly stress-sensitive. Utilising other soilborne microbes as „helper bacteria” can enhance legume nodulation and stress tolerance, and may also boost the climatic resilience of cereals, oilseeds and tubers. Many researchers have highlighted the potential of ACC deaminase-containing rhizobacteria (that break down the ethylene precursor ACC) in boosting crop stress tolerance by enhancing root growth (as ethylene often inhibits root growth). Despite intense academic interest in these ACC deaminase-containing rhizobacteria, there have been few attempts to use them in mainstream agriculture. Biological challenges and commercial opportunities are considered.

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