Haim Time

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Soil Inoculation with Beneficial Microbes – Does it work?

Microorganisms require adequate soil moisture, a near neutral soil pH, sufficient nutrients, proper soil temperature and most importantly, readily available organic material to thrive in the soil ecosystem. The amount of organic carbon will directly influence the increase of microorganisms in the soil and a carbon to nitrogen ratio of 24:1 is required to ensure sufficient mineralization of organic matter and release of inorganic nutrients. Additionally, soil texture may also play a role. For example, in clay soils with smaller pores, there are more protective sites for introduced bacteria against protozoan predation than sandy soils with larger pore spaces.

With all of these ecological requirements, how do you assure the establishment and efficacy of microbial inoculants in soil? In general, the goal is to maximize the number of cells that remain viable subsequent to inoculation. This can be accomplished by inundating the soil with concentrated (>10^6 cfu/ml) inoculum that consist of multiple complimentary and compatible microbes. Supplying a variety of food sources, i.e., sugars, mono-, di- and oligosaccharides as well as organic carbon can further enhance a microorganism's ability to overcome the introduction into a potentially hostile environment.

The method of delivery can also influence inoculum success. Using carriers such as peat, clay or humic acid can provide some protection by acting as eco-stations until population levels increase. For example, encapsulation of *P. fluorescence* cells in alganite beads supplemented with bentonite clay and skim milk provided excellent survival in the soil. The practice of coating seeds is now extensively studied and can further contribute to inoculum success through root affiliation and rhizosphere presence. In a number of areas, soil microbial inoculation has already become an accepted and successful agricultural practice. Biofertilizers such as nitrogen fixing and phosphate solubilizing bacteria and yeast, phyto-stimulators, such as *Azospirillum*, that produce plant growth promoting hormones, and biological control agents such as Trichoderma, Pseudomonas and Bacillus that protect plants against plant pathogens are just a few examples of how microbes can be used in crop production.

So, can it be concluded that inoculation with beneficial microbes actually works?

The answer is yes; however, as mentioned above, the degree of efficacy will depend on the inoculum's ability to deal with the "hostility of the soil environment". To assure consistent and stable efficacy of introduced organisms, we need to continue characterizing target soils and rhizospheres as habitats for introduced microorganisms and monitor the responses of inoculants to the stresses (such as antagonism and predation) faced in their new environment. What remains clear is that biological interventions, such as microbial soil introductions, remain increasingly urgent at every level of crop production.

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