CURRENT PLANT SCIENCE AND BIOTECHNOLOGY IN AGRICULTURE

Nitrogen Fixation: Fundamentals and Applications

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NEW SYNTHETIC AND MULTI-SPECIES BACTERIAL INOCULANTS FOR PLANT GROWTH-PROMOTING RHIZOBACTERIA

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Peat formulations are the carrier of choice for most bacterial inoculants. Although these inoculants have proven abilities, they also have some practical deficiencies which are difficult to overcome; therefore, new formulations are slowly being introduced using unconventional synthetic polymers like alginate which offer substantial advantages over peat. In the field of inoculation technology, the encapsulation of microorganisms is only experimental. These formulations encapsulate the living cells, protect the microorganisms against many environmental stresses and release them to the soil gradually when the polymers are degraded by soil microorganisms. They can be dry stored at ambient temperatures for prolonged periods, offer a consistent batch quality, a better defined environment for the bacteria, and can be manipulated easily according to the needs of specific bacteria. These inoculants can be amended with nutrients to improve the short-term survival of the bacteria upon inoculation. However, they are rather expensive relative to peat-based inoculants and require more bio-technical handling by the industry.

Alginate is the most common material for encapsulation. The preparation of macro-beads (1-3 mm in diameter) and microbeads (100-200 µm) containing bacteria is relatively easy and involves multi-step procedures.

Several Plant Growth-promoting Rhizobacteria, like *Azospirillum*, have erratic and unpredictable behavior under field conditions making them unlikely candidates for commercialization. For a better exploitation of their potential, we are proposing a new concept: mixed inoculation of more than one microorganism in a single carrier, inoculated simultaneously. The beneficial effect on plants is the synergistic effect of both (or several) microorganisms. In this inoculation type, *Azospirillum*, for example, may take the role of a "helper" bacteria or be "helped" by other bacteria to overcome its own unpredictability. In this regard, several synergistic combinations of *Azospirillum* and other microorganisms are known. Cellulose breakdown by *Cellulomonas* and pectin degradation by *Bacillus* were enhanced when co-cultured with *Azospirillum*. Synergism in nitrogen fixation occurred when cultures of *Azospirillum* were mixed with *Arthrobacter* or *Staphyloccocus*. Nodulation of legumes or infections with VAN fungi were increased when mixed or co-inoculated with *Azospirillum*. However, thus far, mixed inoculation is at the far end of contemporary inoculation research and development.