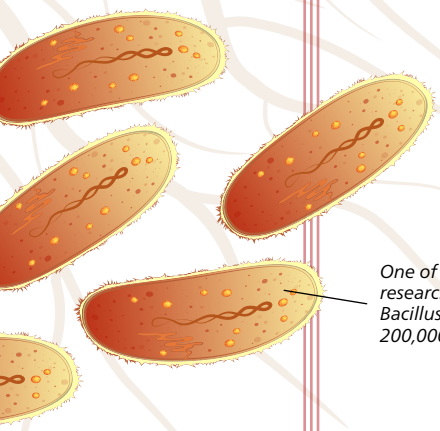
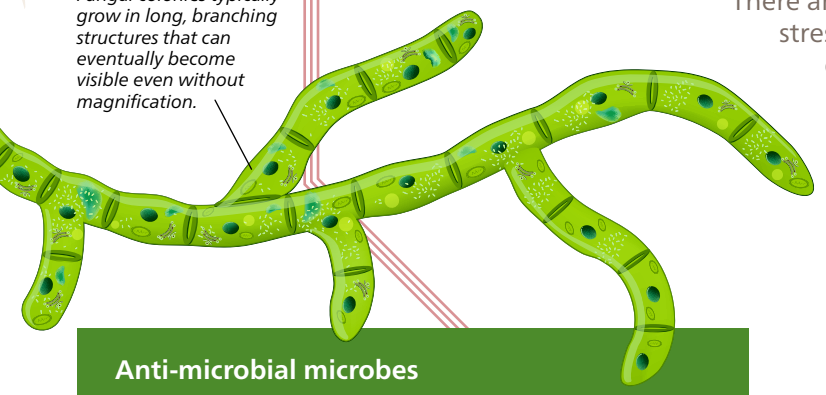
INVISIBLE ALLIES

THE SCIENCE BEHIND MICROBIAL INOCULANTS



One of the most heavily researched bacteria, Bacillus subtilis has over 200,000 identified strains.



Fungal colonies typically grow in long, branching structures that can eventually become visible even without magnification.

Anti-microbial microbes

Research in peanuts indicates that the fungus *Trichoderma* can be exploited as an antimicrobial agent against pathogenic molds and the aflatoxins they subsequently produce.[9]

Soils can feed the world

Excessive chemical and pesticide use can destroy soil's complex and delicate bacterial activity. Sustainable modern agriculture seeks to work alongside these natural partners for crop health and productivity.[1]

Inoculation of plants with beneficial bacteria can be traced back for centuries.

Farmers noticed that mixing soil taken from a previous legume crop with soil in which non-legumes were to be grown, yields often improved.[4] Today, these silent partners in the soil can form the basis for maximizing plant health.

What are microbial inoculants?

Microbial inoculants primarily consist of living microorganisms that are applied to seeds, plant surfaces, or the soil. They can form beneficial relationships with plants and aid in plant development.[17]

What benefits do they provide?

The effects of these inoculants are almost as varied as the microbes themselves. Some facilitate nitrogen fixation, while others enhance nutrient uptake, reducing the demand for fertilizers.[4]

Some microbes suppress pathogens by competing with them for the same resources. Others produce compounds that act directly to inhibit or kill pathogens. Some networks of fungi can even pass immune activation signals from a stressed plant to neighboring plants.[11]

There are microbes that can help plants survive environmental stresses such as drought, salinity, flooding, temperature extremes—or reduce the negative effects of pollution.

"An inoculum of 0.1–10% of a suppressive soil introduced into a conducive soil can establish disease suppression."

—Dieter Haas & Geneviève Défago, University of Lausanne

Hormone production

Research has uncovered microbial production of auxins, hormones that promote various aspects of plant growth such as cell elongation and root growth. Studies show that inoculation with these microorganisms is linked to improved growth in the host plant.[14]

Common Microbial Inoculants

Bacillus lichenoformis

Common soil bacteria that can break down resilient proteins in plant residues. Also associated with nematode suppression.[10]

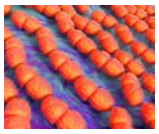
Bacillus subtilis

Acts as an antagonist against a wide variety of pathogens, including *Fusarium*, *Pythium*, *Rhizoctonia*, *Sclerotinia*, and even nematodes.[10]

Bradyrhizobium japonicum

Forms a symbiotic relationship with roots of legumes, making nitrogen available to the plant. Benefits pass on to crops in rotation with legumes.

Enterococcus faecium



Commonly found in animal digestive tracts and useful for breaking down plant residues. Suppresses pathogens by reducing oxygen and raising pH.

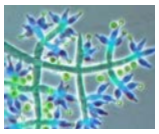
Lactobacillus plantarum

Produces lactic acid and hydrogen peroxide to suppress competing microorganisms in its environment.

Pseudomonas fluorescens

Plays a major role in plant growth promotion, induced resistance and biological control of pathogens, including nematodes.

Trichoderma harzianum



Fungus that creates a symbiotic relationship with plant roots. Acts antagonistically toward pathogenic soil fungi such as *Botrytis* and *Fusarium*.

Extremophiles

Microbes can help plants thrive in environments that would otherwise be too hostile.

Plants with symbiotic fungi growing in Yellowstone National Park have been found to survive temperatures of 160° F, while those plants without the fungi could only survive up to 105° F.[12]

Elsewhere, grapes inoculated with the rhizobacterium *Burkholderia* were found to have increased photosynthesis and reduced cell damage from cold temperatures when compared to the plants that were not inoculated.[3]

"Optimization of soil microbial communities could allow farmers to apply less chemical fertilizer, thus saving money."

—American Academy of Microbiology

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