

# The Genus Bacillus and Genus Trichoderma for Agricultural Bio-Augmentation

Recent studies have focused on the benefits of individual bacteria and individual fungi in farming of many different crops, especially rice. A large percentage of these studies have focused on the genus Trichoderma and the genus Bacillus.

Although Trichoderma species and Bacillus species are naturally present at low levels in most cultivated soils, soils treated with high levels of herbicides, insecticides, fertilizers, and pesticides over several seasons have been shown to have severely reduced populations of the natural beneficial bacteria and fungi. Basically, the harsh chemical treatments are working to kill the bad bacteria and bad fungi. Unfortunately, these chemicals are killing the good, beneficial microorganisms as well. As a result, in these soils, the plants are usually smaller, produce diminished yields, and have many more disease problems.

Fortunately, these organisms can be replaced through agricultural bio-augmentation, which is defined as the addition of laboratory cultivated organisms, grown in very large numbers, to the soil in order to replace or increase populations of beneficial bacteria and/or fungi.

EmTec has carefully selected agriculturally important beneficial microorganisms in the following products:

**EmTec-GP** contains five species from the bacterial genus Bacillus, one species from the bacterial genus Paenibacillus, and four species from the fungal genus Trichoderma.

The organisms in these products have been tested individually for safety and efficacy in studies around the world. The EmTec blend of both beneficial fungi and beneficial bacteria have been demonstrated in field trials and have proven especially effective in rice farming resulting in larger taller plants with more chlorophyll, greater root mass, yield increases, better grain quality and less fragmentation of grain.

## Trichoderma

Trichoderma are ubiquitous fungi naturally present in the soil and are among the most common saprophytic microorganisms that can be isolated. The Trichoderma are especially well known as early colonizers of root systems and directly promote plant growth by increasing the beneficial microbial activity in the rhizosphere, which is the intense zone of stimulated microbial activity around the roots.

Currently many individual species of Trichoderma are widely used in Bio-Augmentation programs for numerous crops as growth stimulating agents as the artificially added organisms quickly occupy an ecological niche on the roots and greatly increase the root mass and plant health for a season long effect. In published studies, colonization of roots by Trichoderma has been shown to increase corn root and shoot growth by 66%. Root growth was shown to be markedly enhanced by colonization with Trichoderma and this increase has been attributed to the elimination of stressors that hamper growth. As a result of this study, it was proposed that the Trichoderma directly reverses the injurious oxidation of membrane lipids and proteins by acting as an antioxidant.

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Growth stimulation by Trichoderma is quite complex and is effected by a variety of interactions with several biochemical factors from the production of enzymes and beneficial compounds, including:

1. Processing essential inorganic and organic nutrients for the plant such as nitrogen, phosphorus, calcium, copper, molybdenum, magnesium, zinc, iron, in ways that are absorbable by plant roots and mobile within the plant system,
2. Helping to balance water absorption,
3. Breakdown and transfer of organic nutrients left over by primary soil productivity,
4. Competition with pathogenic organisms for water and nutrients,
5. The bioremediation of toxic organic chemicals such as hydrocarbons, fungicides and pesticides.

A recently proposed more specific contributing factor to increased growth is that trichoderma have been shown to have the ability to solubilize Manganese contained in MnO<sub>2</sub>. Manganese is a microelement required for several physiological functions of plants including photosynthesis and is thought to play a major role in both growth and disease resistance. Plants can only take in the chemically reduced form (Mn<sup>+2</sup>) whereas the oxidized form (Mn<sup>+4</sup>), found in fertilizer, is essentially insoluble. The solubilization of Mn<sup>+4</sup> by Trichoderma was shown to occur without being correlated to pH changes and did not require a deficiency of Mn<sup>+2</sup>.

Also, Trichoderma are efficient in the production of the enzyme cellulase. In most cases, Trichoderma are used in the commercial manufacturing process for cellulase. This capability and the production of many other extracellular enzymes, such as those that degrade many other complex substrates including hemicellulose and chitin, makes the Trichoderma very valuable in increasing the rate of crop residue decomposition. Trichoderma are used world wide for rice straw degradation.

## Bacillus

**EmTec-GP** is contains five different Bacillus species, packaged in spore form. Each of these organisms has shown to increase plant growth and health when used individually. The addition of the bacteria at the recommended levels immediately increases the population of these microorganisms to that of a fertile soil. A benefit found with the augmented microbial population is an increased rate of crop residue decomposition due to the production of extracellular enzymes that degrade complex organic substrates including cellulose, hemicellulose, chitin, and fungicides.

The effects of the beneficial bacteria in **EmTec-GP**, directly and indirectly on plant growth, are many and varied. Plants taken from bio-augmented soils are larger, have denser greener leaves containing more chlorophyll and have greater root mass. Some of the growth stimulating factors produced by these beneficial microorganisms include:

1. Supplying biologically utilizable nitrogen compounds;
2. Production of phytohormones (plant growth regulators) including auxins, cytokinin, ethylene, gibberellin, and abscisic acid;

3. Processing inorganic and organic nutrients, such as nitrogen, phosphorus, calcium, copper, molybdenum, magnesium, zinc, iron, and very importantly, a source of water in ways that are absorbable by plant roots and mobile within the plant system.

**EmTec-GP** is unique in the global market place because it combines five of the most agriculturally important bacilli in one product.

## Results

**EmTec-GP** has been field tested in the USA, South America and South East Asia for 3 years. Multiple field trials have documented increased yields of 10-20%.

Highly stressed fields, and fields that have been treated aggressively with harsh chemicals are showing the largest increase in yield. It is very easy to visually inspect the effects of the product throughout the test period in a demonstration area. You will observe a physical difference in the size of seedlings, and, upon inspection, you will notice increased an increase in the size of the major roots as well as a significant in quantity of root hairs.

In addition, most farmers have provided testimonials stating the visual effects of the product, including richer, darker green color (from increased chlorophyll), less empty grain and less grain fragmentation.

In addition to rice, the following crops have been shown to benefit from treatment with **EmTec-GP**: cotton, soybeans, field and sweet corn, potatoes, tomatoes, beans, cabbage, cucumbers, peanuts, turf, trees, shrubs, ornamental crops, strawberries, tomato, cabbage, grapes, rice, wheat, barley, peas, grapes, hops, pome fruit, and stone fruit.

EmTec also has the ability to produce most agriculturally beneficial bacteria and/or fungi for use as agriculture soil amendments in large or small quantity.

This information sheet was downloaded from:

<http://www.emtec.co.th/agricultural-bio-augmentation.html>

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