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PLANT GROWTH-PROMOTING BACTERIA

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Annotation: Some beneficial indigenous soil bacteria and fungi act directly by providing a plant growth-enhancing product, and others act indirectly. The latter organisms inhibit the growth of pathogenic soil microorganisms, thereby preventing them from hindering plant growth.

Key words: Plants, bacteria, mechanisms, organisms, biocontrol strains.

Under and development and high crop yields depend on the genetic con- stitution of the crop species, suitable weather conditions, and soil natural environmental conditions, successful plant growth components, including the availability of nutrients; the absence of growthinhibitory substances, such as salt; the presence of certain beneficial microorganisms; and the absence of pathogenic ones (called phytopathogens, from *phyto,* meaning plant). The direct promotion of plant growth usually entails providing the plant with a compound that is synthesized by the bacterium, such as fixed nitrogen or a plant hormone. Also, these bacteria can facilitate the uptake by the plant of certain nutrients from the environment. The indirect promotion of plant growth occurs when plant growth-promoting bacteria lessen or prevent the deleterious effects of phytopathogenic organisms, either fungi or bacteria, i.e., they act as biocontrol agents. This activity is called antibiosis, and it either depletes a scarce resource required by the pathogen or produces a compound that impedes the growth of the phytopathogenic organism.

Direct stimulation of plant growth and development by plant growthpromoting bacteria can occur in several different ways. The bacteria can (1) fix atmospheric nitrogen to ammonia that is used by the plant; (2) synthesize siderophores that solubilize and sequester iron from the soil and provide it to plant cells; (3) synthesize phytohormones, such as auxin, cytokinin, or gibberellin, that enhance various stages of plant growth; (4) solubilize minerals, such as phosphorus, that are used by the plant; and (5) synthesize an enzyme that can modulate the level of the plant hormone ethylene. Any particular plant growth-promoting bacterium may utilize one or more of these mechanisms.

Much of the recent genetic research directed at creating microbial strains with augmented plant growth-promoting activity has focused on a few areas of study.

• Engineering of better biocontrol strains of bacteria to decrease the damage to plants from a variety of pathogens. This work is aimed at replacing some of the chemical pesticides that may become environmental pollutants.

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•The use of bacteria to lower ethylene levels in plants. These studies are directed toward preventing high levels of ethylene from accumulating in plants and thereby decreasing the damage to the plant from a variety of environmental stresses, including drought, flooding, salt stress, and the presence of pathogens.

• The molecular basis of nitrogen fixation. This topic has been investigated thoroughly to determine whether it is possible to increase the level of microbial nitrogen fixation and consequently lessen the current dependency on chemical fertilizers for crop plants.

• Root nodule formation by symbiotic bacteria. This process has been studied with the aim of producing genetically engineered bacteria that can outcompete naturally occurring symbiotic bacteria.

• Microbial synthesis of iron-sequestering compounds (siderophores). These reactions are being characterized in the hope that it might be possible to produce beneficial strains that prevent the growth of phytopathogenic microorganisms.

• Manipulation of plant growth-promoting bacteria to facilitate phytoremediation (the use of plants to remediate contaminated environments). Current research in this area mainly deals with plant growth-promoting bacteria rather than fungi. This is at least partly due to the fact that scientists have found it difficult or even impossible to grow many beneficial fungi in culture, so not only is it difficult to manipulate them in the laboratory, it is also extremely difficult to obtain large enough amounts of these organisms for inoculation of crops. In the past, bacterial fertilization had a dubious reputation. During the 1950s in the Soviet Union, more than 10 million hectares (about 39,000 square miles) of farmland were treated with diazotrophic (nitrogen-fixing) bacterial mixtures that consisted primarily of *Azotobacter chroococcum* and *Bacillus megaterium*. In these experiments,about 60% of the time, yields of various crops were increased by 10 to 20%.However, these field trials were poorly designed and not replicable, so many researchers were skeptical about the validity of the work and tended to discount the use of bacterial inoculants as fertilizing agents on a large scale. In recent years, considerable progress has been made toward understanding many of the mechanisms employed by plant growth-promoting bacteria. Thus, there is a much greater likelihood than in the past that results will be predictable and reproducible

Growth Promotion by Free-Living Bacteria

Plant growth-promoting bacteria include a wide range of bacteria that are free-living or that form a symbiotic relationship with plants, such as *Rhizobium* and *Frankia*. While numerous free-living soil bacteria are considered to be plant growth-promoting bacteria (Table1), not all bacterial

Examples of successful agricultural plant growth stimulation by free-living plant growth-promoting bacteria

№	*Bacterium*	*Plant(s)*
1	*Azospirillum brasilense*	*Guinea grass, millet, sorghum, bean, wheat, barley, fountain grass, Sudan grass, corn, chickpea, fava bean, oat, rice*
2	*Azospirillum irakense*	*Winter wheat, corn*
3	*Azospirillum lipoferum*	*Millet, sunflower, corn*
4	*Azospirillum sp.*	*Wheat, corn, millet, mustard, rice, sorghum*
5	*Azotobacter chroococcum*	*Barley*
6	*Bacillus amyloliquefaciens*	*Tomato, pepper*
7	*Bacillus cereus*	*Tomato, pepper*
8	*Bacillus polymyxa*	*Wheat, sugar beet*
9	*Bacillus pumilis*	*Tomato, pepper*
10	*Bacillus subtilis*	*Tomato, pepper, peanut, onion*
11	*Bacillus sp.*	*Sorghum, wheat*
12	*Burkholderia vietnamiensis*	*Rice*
13	*Enterobacter cloacae*	*Tomato, pepper, mung bean*
14	*Pseudomonas cepacia*	*Winter wheat*
15	*Pseudomonas chlororaphis*	*Spring wheat*
16	*Pseudomonas fluorescens*	*Winter wheat, potato, tomato, cucumber, blueberry*
17	*Pseudomonas putida*	*Winter wheat, potato, canola, cucumber, lettuce, tomato, barley, oat*
18	*Pseudomonas sp.*	*Canola, potato, rice, lettuce, cucumber, tomato, corn*

strains of a particular genus and species have identical metabolic capabilities. Thus, for example, some *Pseudomonas putida* strains actively promote plant growth, while others have no measurable effect on plants.

The major applications of bacteria for improving plant growth include agriculture, horticulture, forestry, and environmental restoration (phytoremediation). In the past 20 years or so, based on a better understanding of the mechanisms employed by these bacteria and following a large number of successful laboratory and field studies, an increasing number of plant growth-promoting bacteria have been commercialized.

The mechanism most commonly invoked to explain the various effects of plant growth-promoting bacteria on plants is the production of phytohormones. Research in this area has focused on the role of a class of phytohormones called auxins. The most common and best-characterized auxin is indole-3-acetic acid (IAA), which stimulates in plants both rapid responses, such as increases in cell elongation, and long-term effects, such as increases in cell division and differentiation. Since both plants and plant growthpromoting bacteria can synthesize auxin, it is difficult for researchers to distinguish between plant responses that result from bacterial auxin synthesis and those that result from plant auxin synthesis. This uncertainty notwithstanding, there is considerable evidence to suggest that many plant growth-promoting bacteria facilitate plant growth by altering the hormonal balance within a plant.

References

1.Lim, H.-K., S.-G. Kim, K.-H. Jung and J.-H. Seo. 2004. Production of the kringle fragments of human apolipoprotein(a) by continuous lactose induction strategy.*J.Biotechnol.*108:271–278.

2.March, J. C., M. A. Eiteman, and E. Altman. 2002. Expression of an anaplerotic enzyme, pyruvate carboxylase, improves recombinant protein production in *Escherichia coli. Appl. Environ. Microbiol.* 68:5620–5624.

3.McKillip, E. R., A. S. Giles, M. H. Levner, P. P. Hung, and R. N. Hjorth. 1991.Bioreactors for large-scalet-PAproduction. *Bio/Technology*9:805–812.

4.Mendoza-Vega, O., C. Hebert, and S. W. Brown. 1994. Production of recombinant hirudin by high cell density fed-batch cultivations of a *Saccharomyces cerevisiae* strain: physiological considerations during the bioprocess design. *J. Biotechnol*. 32:249–259.

5.Merchuk, J. C. 1990. Why use airlift bioreactors? *Trends Biotechnol*. 8:66–71.

6.Mukherjee, K. J., D. C. D. Rowe, N. A. Watkins, and D. K. Summers. 2004. Studies of single-chain antibody expression in quiescent *Escherichia coli. Appl. Environ.Microbiol*.70:3005–3012.

7.Park, T. H., J.-H. Seo, and H. C. Lim. 1991. Two-stage fermentation with bacteriophage λ as an expression vector in *Escherichia coli*. *Biotechnol. Bioeng*. 37:297–302.