Can Beneficial Bacteria from Auburn Boost Tomato Growth and Yield?

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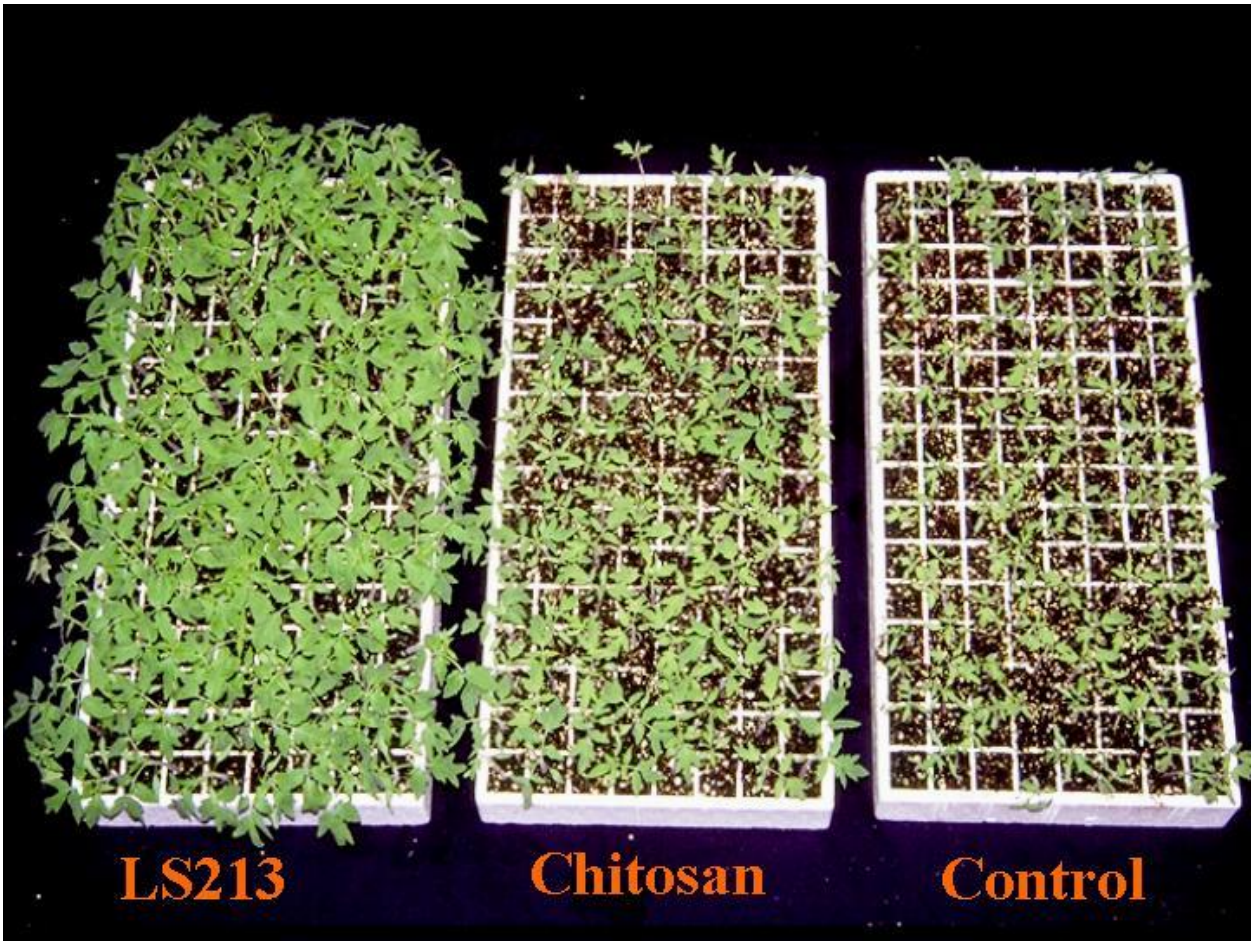
In recent years, commercial production of tomato in the U.S. has grown to depend on the use of transplants, which has generated a transplant plug industry. The advantages of using transplant plugs over seeds is the uniformity of plant size, ease or precision planting, and the increased fruit production in commercial greenhouse facilities. Given the widespread adoption of transplants for field production of tomato, it is essential to have an adequate supply of robust and disease-free transplants.

Growth Promotiong of Tomato Seedling Transplants by PGPR



Effect of PGPR on Root-Knot Nematode of Tomato Seedlings

After transplanting in the field, the young tomato plants are immediately exposed to disease pressure. Tomato is susceptible to a large number of fungal, bacterial, nematode, and viral pathogens that cause diverse diseases. Major tomato diseases include those that attack the root system (*Fusarium* wilt, *Verticillium* wilt, bacterial wilt, nematodes, *Rhizoctonia*), aboveground stems and foliage (early blight, septoria leaf spot, bacterial canker, late blight), and fruit (bacterial spot, bacterial speck, anthracnose). Thus, successful tomato production is dependent upon disease management programs throughout the life of the tomato plant.

Modern plant disease control techniques are largely based on several applications of chemical fungicides. However, the availability of chemical pesticides is declining and therefore the need for an alternative control strategies, including those, which would allow growers to use an organic label for fruit, are growing. Work has been on-going at Auburn University on the use of beneficial bacteria (called PGPR for "plant-growth-promoting rhizobacteria) as components in a biologically based integrated pest management strategy.

PGPR have been shown to increase plant growth of a number of agronomically important crops, and some PGPR strains activate plant defenses, a phenomenon known as "induced resistance". Induced resistance using PGPR has been noted against multiple pathogens, including fungi, bacteria, viruses, and, in a very few cases, nematodes. An alternative approach for control of nematodes is the use of specific organic amendments, such as chitin and chitosan, which were previously found by Auburn nematologist Dr. Rodríguez-Kábana to control nematodes when mixed into field soils. We have been investigating the combination of PGPR, which induce resistance with chitosan amendment of peat-based plant growth media for production of vegetable transplants. The combination of PGPR with chitosan is designed to enhance seedling growth and develop disease-suppressive transplant plugs.

The purposes of this study were to increase the rate of seedling growth thereby decreasing the time required to produce transplants in commercial greenhouse prior to transplanting into fields and to develop disease suppressive transplant plugs, which are protected for a time from multiple diseases.

The effects of several mixtures of PGPR and chitosan on plant growth-promotion, and induced resistance against various foliar pathogens were evaluated under greenhouse conditions. Each biological preparation contained industrially formulated spores of two PGPR strains and flaked chitosan. Field experiments were conducted during 1999 at Sand Mountain Research Station, Crossville, AL to evaluate several of these LS preparations as potting mix amendments at seeding application for control of root-knot nematode and bacterial spot of tomato. Further, the effects of biological treatments on growth and yield of tomato were evaluated in the field naturally infested with root-knot nematode and foliar pathogens. Seedling growth parameters were measured at 0, 30 and 60 days after transplanting. Fruit was harvested and weighed at several times during the growing season.

Research by Auburn scientists showed that most of the LS series, particularly LS213, significantly increased seedling growth of all crops (measured by height, caliper, root and shoot fresh weight) compared to a non-treated control (Figs. 1 & 2). Most of the LS series, including

LS213, provided significant levels of disease suppression for all diseases evaluated (data not shown here).

Mixtures of two PGPR strains plus a formulation carrier chitosan, particularly LS213 exhibited a more consistent and significant level of growth promotion on tomato seedlings. The transplant mix delivery system for biological preparations has demonstrated potential to enhance transplant vigor, provide protection against root-knot nematodes and other foliar diseases in the field and enhance yield. These results indicate a synergy in plant growth-promotion and induced resistance by the combination of chitosan and the mixtures of two bacterial strains. Gustafson, LLC. has developed the biological preparation (LS213) developed at Auburn University into a commercial product under the trade name of **BioYield^{TM}**. This research has been conducted in collaboration with our Alabama Agricultural Experiment Station outlying unit near Crossville, AL. Studies are in progress to test **BioYield^{TM}** as a component for integrated pest management systems in many other vegetable transplant systems and also in row crops in Alabama.

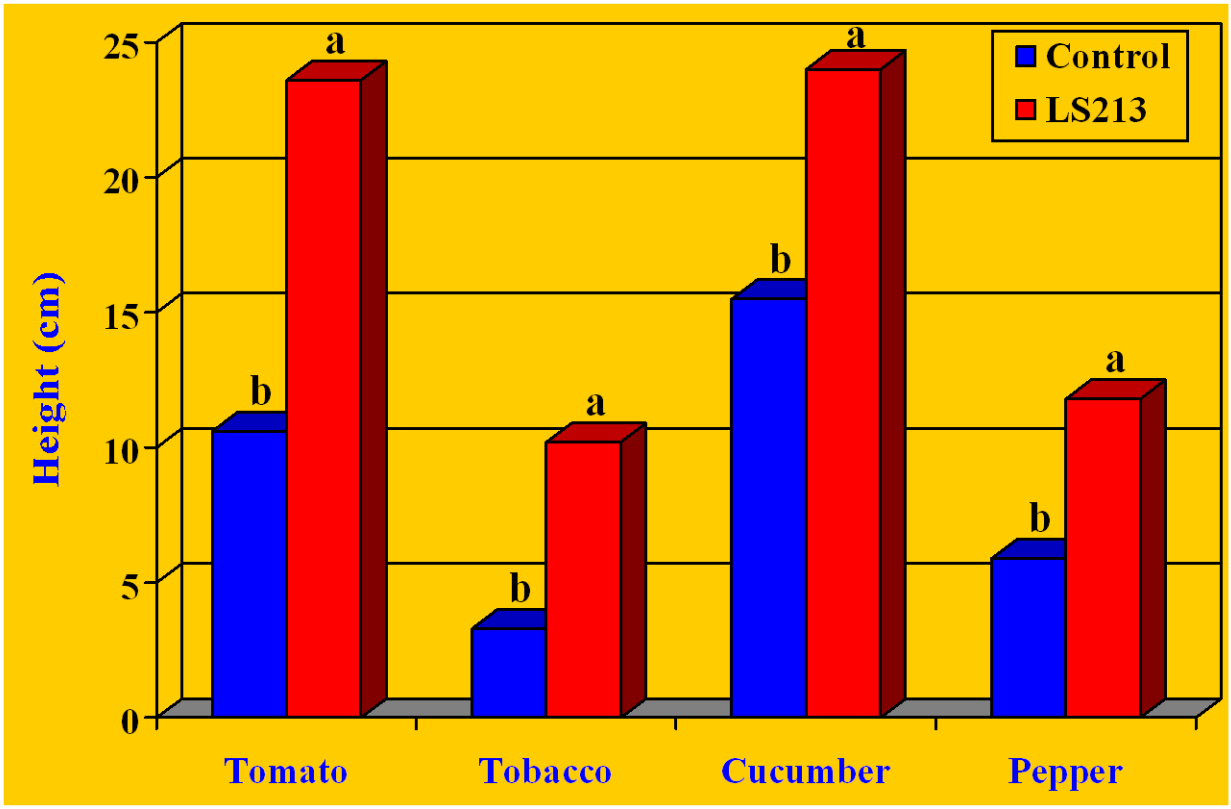


Fig. 1. Effect of a biological preparation (LS213) on seedlings shoot height of various vegetable transplant plugs 4 weeks after seeding. Mean values with different letters are significantly different (95% confidence).

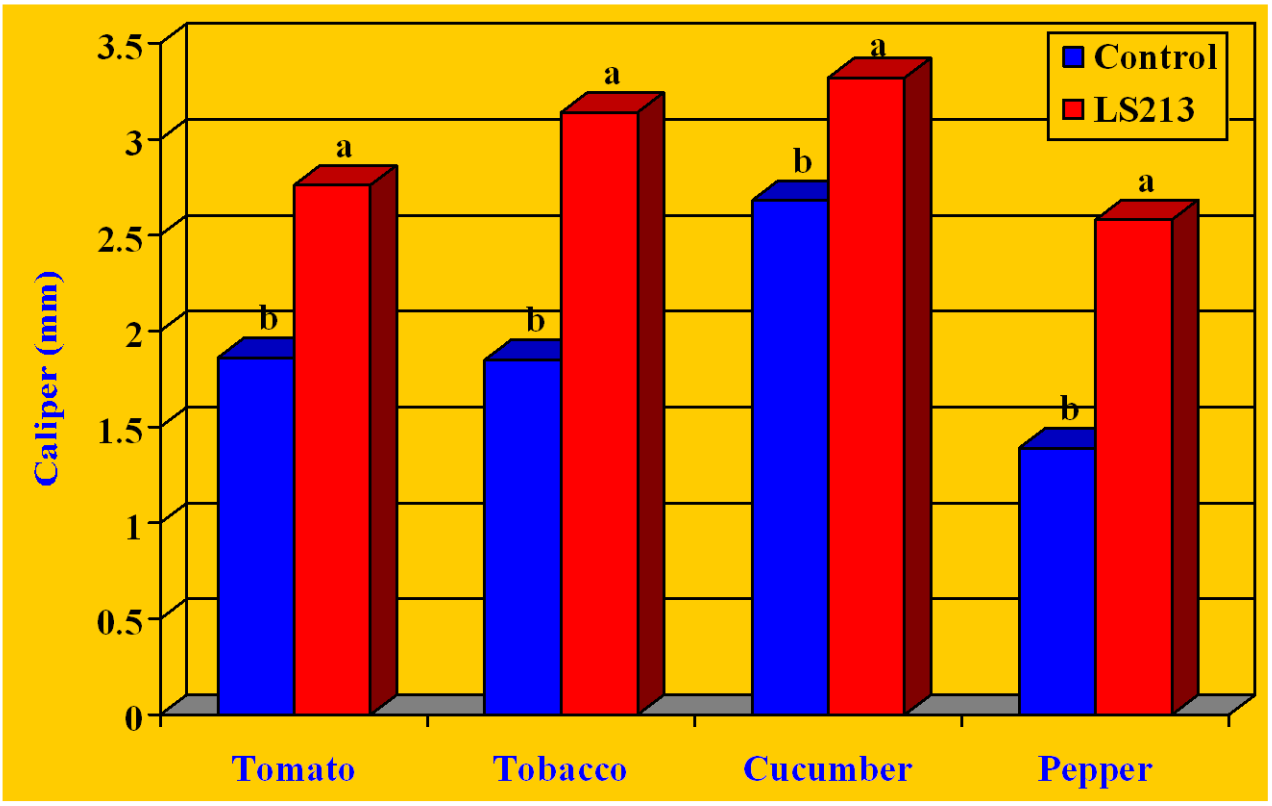


Fig. 2. Effect of a biological preparation (LS213) on stem caliper of various vegetable transplant plugs 4 weeks after seeding. Mean values with different letters are significantly different (95% confidence).

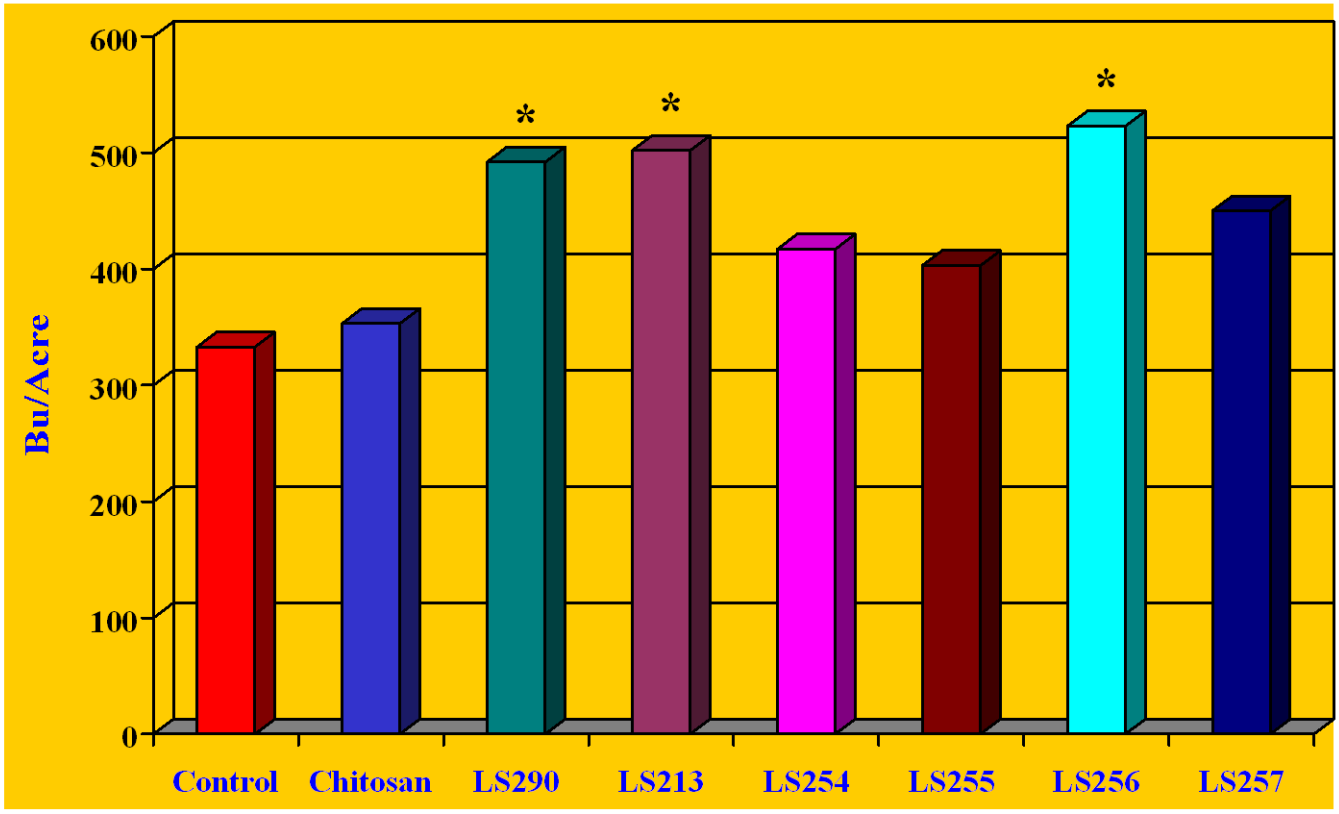


Fig. 3. Effect of biological preparations on tomato yield under field conditions during 1999 at Sand Mountain, Alabama. Asterisk indicates significant difference (95% confidence) from control.

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