

# Farmers Adopt ARS-Improved Soybean Bacterium

**A** lowly bacterium first cultured 2 decades ago by ARS researchers is now enjoying celebrity status as a commercial soybean inoculant.

Behind that success is Urbana Laboratories, a St. Joseph, Missouri, company that has sold nearly 14 million acres' worth of the inoculant since obtaining a license from ARS to market the bacterium in 1994.

A *Bradyrhizobium* species, the bacterium converts (fixes) gaseous nitrogen into forms that soybean plants can use for optimal growth and higher yield. In return, the plant shelters and nourishes the bacterium inside root nodules, where nitrogen fixation occurs.

ARS microbiologists L. David Kuykendall and William J. (Jim) Hunter originally developed, tested, and in 1991 patented the bacterium as an improvement over *Bradyrhizobium* strains being used by soybean farmers.

In the laboratory, they used nitrous acid to trigger gene mutations in a liquid culture of *B. japonicum* strain I-110. Through a similar process called direct selection with one of the resulting mutant strains, they settled on a strain called TA11Nod+ (or Nod+) as their final choice.

Interestingly, use of this bacterial genetics approach—rather than a recombinant one—may have contributed to the mutant strain's acceptance among farmers, notes Hunter, with ARS' Plant, Soil and Nutrient Research Unit, Fort Collins, Colorado.

Nod+, also called the USDA Patented Strain, "is derived through nonrecombinant means, so you don't have to worry

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**Soybean yields are higher after seed inoculation with the Nod+ nitrogen-fixing strain of bacteria. Developed by ARS, this inoculant has been rapidly growing in popularity.**

about foreign genes in the bacterium's DNA," adds Kuykendall, with ARS' Molecular Plant Pathology Laboratory in Beltsville, Maryland.

Promising results from field studies also boosted acceptance by growers. For example, against *B. japonicum* I-110—a top soybean inoculant itself—the Nod+ strain formed 44 percent more nodules and fixed 50 percent more nitrogen. Generally speaking, a well-nodulated crop helps save on synthetic fertilizer costs and nourishes soils at rates less likely to affect groundwater, Hunter notes.

Large-scale testing of the Nod+ strain began shortly after Urbana began selling it in 1995. Based on those field trials, conducted by extension scientists at 377 sites in 18 states, the inoculant's use increased soybean yields by 2 to 3 bushels per acre.

In 1995, the first year of sales, Urbana inoculants containing the Nod+ strain were used on 220,000 acres of soybeans. Over 4 million acres' worth of inoculant was produced for 2001—a 20-fold increase. Since its introduction, Hunter estimates, the new inoculant has raised yields by nearly 30 million bushels. At \$5 per bushel, this means an additional \$150 million gross income for farmers.

In February, Hunter and Kuykendall received an ARS award for "superior effort" in transferring the inoculant technology to market.

Noting the 100-year history of soybean inoculants, Kuykendall comments that "the new strain's impact has been strong enough to show that we improved on an old, sustainable process and that what's good for the environment can actually make good economic sense as well."—By **Jan Suszkiw**, ARS.

*This research is part of Plant Biological and Molecular Processes, an ARS National Program (#302) described on the World Wide Web at <http://www.nps.ars.usda.gov>.*

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