

# SCIENCE & EDUCATION Impact

Benefits from USDA/Land-Grant Partnership

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## Biotechnology Comes of Age

Engineering possibilities.

*2003 marks the 50<sup>th</sup> anniversary of Watson and Crick's discovery of DNA, a crucial first step in the creation of modern genetic science. It was 20 years ago that the first biotech product was approved for producing human insulin. Biotechnology is no longer a novelty for Americans or American agriculture. Crops that ward off insects and disease, gene-based medical treatments and DNA detective stories are commonplace, and there seem to be no bounds to how the technology can be employed.*

### Payoff

- **A nitrogen fix.** Some plants can find their own fertilizer, but corn isn't one of them. It can cost farmers \$40 per acre to fertilize a cornfield. **Wisconsin** scientists went looking for bacteria that live in corn and can capture nitrogen from the air. Greenhouse experiments narrowed the field to seven strains, and field tests showed the bacteria improved corn yields up to 10 percent. Several companies are interested in licensing the technology, which could result in seed corn coated with growth-promoting bacteria and reduced nitrogen runoff into streams and rivers. **Florida** researchers found a gene in pond algae that helps the microscopic plants compete better for nitrogen. They then worked with a biotech company to create a transgenic wheat plant that produced significantly more grain than conventional wheat for the same amount of fertilizer.
- **Booster shots.** Despite some natural resistance, barley is a pushover for stem rust. **Minnesota** scientists genetically enhanced that resistance, the first time a gene for rust resistance has been isolated from a small-grain cereal crop. Not only is this genetically engineered resistance better than the original barley plant, scientists think it also may work in wheat. Fire blight, a bacterial disease in apple trees, annually costs growers more than \$100 million. It can be treated only with the antibiotic streptomycin, but not for long - some bacteria already are resistant. **Cornell** researchers are using biotechnology to enhance the tree's existing genes to help it fight fire blight, greatly reducing tree death.
- **Health benefits.** Breast cancer-fighting taxol once was available only from slow-growing Pacific yew trees, and efforts to manufacture the compound have been

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problem-ridden. **Washington State** scientists have tracked the biological pathway the tree follows to produce the drug and have identified about half the genes involved. Once the work is complete they hope to be able to produce more taxol at lower cost and investigate new taxol derivatives with greater potency and fewer side effects. **Georgia** researchers used enzyme biotechnology to attach beneficial fatty acids to conventional fats and oils, the least recommended part of the food pyramid. Laboratory trials with mice showed the designer fats lowered cholesterol and bolstered immune system cells, an encouraging outcome for people with AIDS and for other immuno-suppressed people.

- **Hot chocolate.** Chocolate manufacturers in Pennsylvania have the milk they need to support their \$5 billion retail industry, but imported cocoa is hard to come by, with 40 percent of the crop lost to insects and disease each year. Pesticides help but they're expensive and nobody wants them near the rain forests where most cocoa is grown. Traditional plant breeding for resistance is slow and uncertain. Starting with plants endowed with superior flowers and pest resistance, **Penn State** researchers cloned individual cells and grew them into full-size cocoa plants. It's now possible to clone as many as 4,000 plants from just one flower, and the university has worked with scientists in seven cocoa-producing countries to make sure they're comfortable with the technology.
- **Triple play.** The \$45 million Texas citrus industry is at risk from two highly infectious plant diseases that have caused widespread damage around the world. **Texas A&M** scientists have moved genes into Red Rio grapefruit that helps protect the trees against citrus tristeza virus, brown aphids and citrus canker, a bacterial disease. The genetic protection comes from a vaccine derived from the original virus, an insect-destroying protein from a lily commonly found in the northeastern United States and a milk gene that battles bacteria.
- **Oh, behave.** Advancing animal well-being may get some help from research that identifies the genetic basis for aggressive behavior. **Purdue** researchers showed that breeding swine and poultry to cooperate rather than compete can improve productivity and decrease mortality. An experimental line of quail bred to

behave had 25 percent better feed efficiency. In pigs, 20 percent more growth for the same amount of feed could increase net incomes by \$2 billion.

- **Animal health.** Veterinary medicine and animal disease diagnosis have improved thanks to new genetic technologies that speed vaccine and diagnostic tool development. **Tennessee** researchers devised several antibodies that detect a substance called antigen 85 in cows infected with Johnes's disease, one of the top three diseases in beef and dairy cattle and responsible for \$250 million annual economic losses. They hope Ag85 helps them develop a vaccine and a better diagnostic kit. Scientists at the **Virginia-Maryland** Regional College of Veterinary Medicine developed a livestock vaccine against brucellosis, a disease that affects both animals and humans. The U.S. Army has asked researchers to develop a human vaccine as well. These tools would become even more critical in the event of a bioterrorism incident.
- **Calf crisis.** Basic genetic research helped **Nevada** animal scientists develop a vaccine for *Tritrichomonas foetus*, a parasite that causes a reproductive disease in cattle. The vaccine is the only pretreatment available for the disease and may save Nevada cattle ranchers \$950,000 per year. Western U.S. cattle producers also are looking forward to another Nevada project that will detect epizootic bovine abortion, a tick-borne disease that causes cows to lose their unborn calves at six to nine months. The test is quicker, better and cheaper and may lead to new treatments. Officials estimate this disease may kill up to 90,000 calves annually in California alone.



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