

New Tools for the State's Industries

Travel anywhere in North Carolina, and chances are good that you can find biotechnology at work.

Living organisms are now being used in virtually every industry to make products or processes with economic value. And that, in a nutshell, is biotechnology. It's not an industry, per se, but an array of tools. Since the late 1970s, biotechnology has been increasingly doing, simplifying or replacing jobs that were once done by machines, chemicals or not done at all.

Thirty years ago, when the first biotechnology companies took wing, Research Triangle Park was already becoming a global model for attracting organizations committed to outstanding scientific and social achievement.

In 1984 the State established the North Carolina Biotechnology Center in RTP as the world's first non-profit government-funded biotechnology support organization. The Biotechnology Center has since guided and nurtured biotechnology development statewide, seeding it with tens of millions of dollars in grants and loans.

As a result, North Carolina is the envy of the world, with the third-largest population of biotechnology companies in the United States — about 320 bioscience companies employing about 48,000 people. Another 400 firms employing more than 28,000 people provide service and support to those companies.

Here are some examples of biotechnology at work in traditional industries throughout the Old North State:

AGRICULTURE: Biotechnology is now a routine part of farming, helping to create value-added crops such as nicotine-free tobacco, drought-tolerant corn and Roundup-resistant cotton. It also helps improve livestock health and breeding, feed efficiency and waste remediation.

AQUATIC LIFE: Those who harvest commercial quantities of food from the ocean and from freshwater sources are similarly using biotechnology for some of the same kinds of outcomes. Many vaccines, for example, are now developed with varying degrees of biotechnology involvement, conferring protection to fin fish and shellfish from more than 50 kinds of diseases and parasites. Marine scientists working with biotechnology skills are addressing nutritional and aesthetic quality, feed conversion and other concerns.

BIOFUELS: Geopolitical uncertainties over petroleum have increased interest in renewable, clean-burning biofuels such as ethanol and biodiesel. Because these fuels are made from organic matter, farmers across

the state may have new opportunities to grow the corn, soybeans, sorghum or even switchgrass, algae or kudzu to feed the biofuel refineries. Enzymes made through biotechnology are used to break down the sugars in starchy vegetation to make biofuels, and to convert cellulose from woody plants into ethanol.

DEFENSE: Biotechnology techniques are being used in developing vaccines against biological weapons such as anthrax and smallpox. A recent study showed that one acre of transgenic tobacco plants could produce enough anthrax vaccine to inoculate the entire U.S. population. Biotechnologists are developing monoclonal antibodies to detect infectious agents and to kill harmful bacteria and viruses used in bio-warfare. They're also developing artificial skin, blood and portable detection devices for use on battlefields.

ENVIRONMENT: Tools of biotechnology — antibodies, enzymes, microbes and some algae — can be used as environmental monitoring tools to detect and measure harmful pollutants in soil and water. Organisms such as bacteria and algae can be used to clean up toxic waste,

Just as information technology is ubiquitous throughout the culture, biotechnology is now infused into almost every aspect of North Carolinians' life and commerce.

Creative entrepreneurs continue to reach deeper into the ever-expanding tool box of biotechnologies, finding new ways to solve problems that affect virtually every business and industry in the state.

radioactive waste, chemical spills and other pollution in soil, air, and water, breaking down contaminants into harmless byproducts.

Paints and cements can be made to include beneficial bacteria or enzymes to prevent the corrosion and contamination that comes from bacterial slimes, fungi or algae. This is particularly useful for outdoor surfaces of buildings, boats, and transportation infrastructure. Biotechnology can improve and accelerate recycling of a variety of materials. For example, enzymes can be used to de-ink recycled paper and can decrease the disintegration time of recycled pulp.

Harmful and invasive organisms such as kudzu and red algae may be better controlled through biotechnology, and even used for beneficial purposes. Biotechnology is also providing tools such as environmentally friendly pesticides to control populations of insect pests, including gypsy moths.

FOOD PROCESSING: Using biotechnology to modify the structure of starches from crops such as corn and potatoes improves freezing stability and nutritional content.

FORENSICS: Using the unique DNA sequence of each individual, scientists are tapping the fundamentals of biotechnology to identify sources of tissues to help solve crimes and determine biological ancestry. Forensic pathologists study historically relevant organisms such as the 1918 Spanish flu virus to predict and prevent future outbreaks.

FORESTRY: Biotechnology tools are being used to rescue and restore threatened and endangered species, such as the American chestnut, virtually wiped out by blight. Rapid propagation of trees through tissue culture techniques provides speed and accuracy to the tree-breeding process. Biotechnology can help speed nature's own repair and re-

newal schedules, selecting trees able to grow faster and healthier with built-in resistance to pests, diseases and climatic stress. Biotechnologists can also use certain fungi and bacteria to protect living trees from disease and put beneficial fungi on felled trees to protect the wood from decay until it's ready to be used.

HEALTH CARE: Vaccines are being developed against cancer, rabies, malaria and many other diseases, with the help of biotechnology tools. Biotechnology techniques are used to develop and manufacture therapeutic proteins, insulin and blood-clotting factors and improved diagnostic tests.

Meanwhile, physician researchers in North Carolina, with grant help from the North Carolina Biotechnology Center, are reporting major advances in using biotechnology capabilities in adapting animal organs for human use and even growing organs from donors' own cells.

In other cutting-edge science, researchers have been exploring ways to engineer plants so they incorporate human proteins for efficient use in medical therapies.

HOUSEHOLD PRODUCTS: Enzymes discovered and produced through biotechnology methods are used as detergents and detergent additives. Proteases, amylases and lipases are used to dissolve protein, starch, and fatty stains on clothing, while other enzymes are used to prevent dye leaching and fraying of fabric.

INDUSTRIAL PROCESSING: In addition to its use in biofuel production, another way biotechnology may help reduce American dependence on foreign oil is through increased development of biodegradable vegetable-based coatings, plastics, cosmetics, lubricants and inks.

NATURAL PRODUCTS: Biotechnology tools can be used to identify and characterize active compounds in

herbs and other plants used in alternative medicines. The use of tissue culture techniques may save some threatened or endangered species that grow exclusively in the North Carolina mountains.

TEXTILES: The state's textile producers use biotechnology tools to quickly make large quantities of strong and flexible natural and synthetic fibers in factories requiring 20 to 50 percent less water than that used in older mills. Biotechnology is also being used to help improve dye uptake and retention in textiles and to enhance moisture absorbency and wrinkle and shrink resistance.

In 2004 the Biotechnology Center published *New Jobs Across North Carolina: A Strategic Plan for Growing the Economy Statewide through Biotechnology*. The plan, developed at the request of Gov. Mike Easley and guided by a blue-ribbon committee chaired by former governors Jim Hunt and Jim Martin, offers 54 strategic recommendations for growing the state's biotechnology industry, creating jobs and training the people to fill them.

Most of those workers won't even have to stray from traditional North Carolina industries. As demonstrated above, they'll merely need to adapt to some new ways of doing business.

New Tools for the State's Industries, the document from which this "BioBrief" was excerpted, and other information about biotechnology in North Carolina are on the Biotechnology Center's Web site at www.ncbiotech.org.

CONTACT: Jim Shamp, News & Publications Editor, (919) 541-9366 or jim_shamp@ncbiotech.org