



Molecular biologists at Bayer CropScience develop high-quality natural fibers

Cotton with less thirst

Water is gradually becoming a scarce resource the world over. Cotton farmers in the United States are among those experiencing increasing difficulty. Fortunately, researchers at Bayer CropScience have responded: biotech scientists and breeders are developing new varieties of cotton that need less of this precious liquid to produce high yields with high fiber quality.

It's quality you can feel: the stronger, longer, and finer the cotton fibers, the better they can be processed into thread and high-quality fabric. Linda Trolinder has a sure sense of this natural product. A molecular biologist at Bayer CropScience, she grew up in Lubbock, Texas, "the heart of cotton country." There, in the South Plains, lies the world's largest continuous cotton-growing area responsible for one half of the total U.S. cotton production.

Cotton is used mainly for textiles, but only slightly more than one-third of the global production ends up as sweaters,

underwear or fashionable clothing. The fibers also play a role in the paper industry and the manufacture of packaging materials. The versatile cotton fiber is a key material in the automotive industry as well, where it serves as a component of the natural fiber-reinforced plastics used to make high-quality interior trim. The seed of the cotton plant is also important to the economy: when extracted from the seed by pressing, the oil is suitable for both cooking and technical applications.

Trolinder is currently focusing on both fibers and seed. At Bayer

CropScience, the Texan and her team are responsible for researching and developing new traits in cotton. She spends half her time at BioScience research headquarters in Ghent, Belgium, and the other half in the laboratories at Lubbock. But her goal is always the same: to discover, develop and introduce new technologies and traits that will improve profitability and sustainability for cotton farmers all over the world. "We're working on numerous projects that provide methods for the improvement of cotton," she says. "We are developing new



Cotton experts: a farmer checks the quality of his fiber plants (photo left). Together with a team of research and development scientists, Linda Trolinder (above) is developing new traits to enhance yield.

It's fiber length that counts

As with every natural product, the quality of cotton is determined by numerous factors: depending on variety and weather conditions, the shrubs produce fibers that are short or long, thick or thin, durable or weak. The most important quality trait is length.

Profile:

- *Shrub*
- *Harvest: 150 to 225 days after sowing*
- *Up to 20,000 fibers per seed*
- *Crop plant for more than 2,000 years*
- *Areas of cultivation: tropics and subtropics*



Success: the coveted cotton fiber grows from seeds like these. Using biochemical analysis and genetic engineering methods, biotechnologists can elucidate the molecular mechanisms of fiber development.

biotechnology-based traits and working with our breeders to develop advanced breeding methods which will improve the productivity of the crop."

Trolinder's team is pursuing three main objectives: "We want to enhance yield, improve the quality of the cotton seed and fiber, and make the plant less susceptible to stress." Stress factors include not only pests and weeds, but also unfavorable environmental conditions, such as drought and extreme temperatures. One of the most significant problems in the near future will be water shortage. "We have to help farmers soon," the Texan explains. "If we succeed in developing water-saving varieties, cotton production will continue to be profitable and help contribute to the conservation of natural resources and the environment." At present, a pair of jeans consumes 11,000 liters of water on its way from the field to the sale rack, according to the UNESCO-IHE Institute for Water Education in the Netherlands. Most of it goes into watering the crop; another big portion is used to clean and dye the fibers. The biotech scientists in Ghent and Lubbock are developing alternatives to reduce water consumption in both phases.

The goal is to develop genetically improved plants that require less water yet produce higher yields. The researchers have already achieved some successes and are currently verifying these results in extensive field trials.

"We're working as fast as we can," Trolinder reveals, "because we know that cotton-growing regions of the world will be particularly hard hit by climate change and water will be scarce. We need better plants." Her team is finding them these days using biotechnology-based engineering and molecular-assisted breeding methods. The researchers start by looking for typical DNA sequences or molecular markers that are associated with a specific trait such as enhanced yield or low water consumption.

Putting new traits into cotton varieties twice as fast

Today, thousands of these markers have been identified (see also "Food for the world", page 10). "With their help, we can more accurately predict the phenotype or agronomic characteristics of the plant based on the genotype or DNA sequence. The method allows breeders to identify with much greater efficiency and accuracy those few plants containing the maximum number of desired traits which allows them to increase productivity at a faster pace," Trolinder explains.

As a result, breeders can analyze plants more efficiently than they could just a few years ago, greatly enhancing their ability to develop superior performing varieties. What's more, in the past, if they wanted to breed or introgress a new trait into a plant by back-crossing into an elite variety, they needed at least four generations to do so. Thanks to the power of molecular marker analysis, they now need only two.

In one of the projects, biotechnology is being used to help the cotton industry be more environmentally friendly. Trolinder's team is working to develop cotton with fibers whose electric charge differs from that of common cotton, meaning the fibers can be dyed more easily and effectively. "Hopefully the garments of tomorrow will be more readily dyed and resist fading." In addition, it is anticipated that textile manufacturers will require much less water and salt to manufacture them. To ensure that all these new cotton varieties are indeed a success, Bayer researchers are testing them all over the world under various conditions. "We need data for all conceivable climate regions so that we end up with products that truly benefit farmers," says Trolinder.

 www.icac.org
The International Cotton Advisory Committee website provides statistics and technical information on cotton.