Cottoning onto how plants make cellulose

One of the most abundant materials on Earth also happens to be one of the most enigmatic. Cellulose, a large polymer consisting of numerous sugar molecules linked together, is found in all plant cell walls. It makes trees stand tall, puts the fiber in fruits and vegetables, and gives cotton its puffy boll. Yet the steps plants use to make cellulose have eluded researchers for years, prompting many to turn their attention to other questions.

Now, a new finding may revive interest in this ubiquitous molecule.

Scientists at Calgene in Davis, Calif., and the Hebrew University in Jerusalem have identified three plant genes—one in rice and two in cotton—each of which may code for cellulose synthase, an enzyme that assembles sugar molecules into cellulose.

No plant cellulose synthase has yet been isolated, so the researchers sought plant genes that resemble genes known to code for that enzyme in bacteria, says David M. Stalker of Calgene. The group reports its findings in the Oct. 29 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Identification of the genes may enable scientists to genetically alter plants to produce cellulose with more desirable properties. Textile manufacturers have told Calgene, which runs a large cottonseed business, that "they'd like fibers to be more uniform, stronger, and longer," Stalker says. One day, perhaps, cotton fibers could be made without plants at all, says R. Malcolm Brown Jr. of the University of Texas at Austin, who studies cellulose synthesis in bacteria.

Brown and his colleagues first isolated cellulose synthase from bacteria in 1989 and a year later identified the gene that encodes it. Even now, scientists do not fully understand the structure and action of the bacterial enzyme.

To look for matches to parts of the bacterial gene, the Calgene and Hebrew University researchers scanned approximately 400 randomly chosen sequences of DNA from cotton. "We figured that if we screened randomly, we should eventually run across something that looks like synthase," Stalker says. "Some skill was involved and some luck."

A computer program, usually helpful in finding matches between long stretches of DNA, didn't yield many clues in this case. The plant genes contained two extra DNA regions, which made them dissimilar enough from the bacteria to fool the computer. Instead, the researchers had to just "eyeball" the data, Stalker says. "It was necessary to throw away the computer and let the brain do the work."

A group at the Australian National University in Canberra has found cellulose-deficient mutants of *Arabidopsis thaliana*, a simple mustard plant. Stalker expects that these mutant genes will correspond to the genes his group has identified.

The researchers' immediate plans are to determine whether the genes actually code for cellulose synthase by seeing what they produce when moved into another biological system, such as yeast. Only then might they begin to modify cellulose. *— C. Wu*

National Cotton Council of America

A cotton plant's fuzzy boll is 98 percent cellulose.

New data challenge personality gene

In a pair of reports released earlier this year, scientists asserted that the presence of a particular gene increases the likelihood that someone will have an excitable, adventurous personality. Closer scrutiny raises questions about whether researchers have cornered this so-called personality gene, according to two new studies.

A version of the D4 dopamine receptor gene, or *D4DR*, cited as a key factor in producing novelty-seeking behavior (SN: 1/6/96, p. 4) shows no sign of eliciting this personality characteristic in Finnish men, contend psychiatrist Anil K. Malhotra of the National Institute of Mental Health in Bethesda, Md., and his coworkers.

Moreover, the same *D4DR* variation occurs frequently in some parts of the world and rarely in others, making it an unlikely candidate for regulating such a widespread trait, asserts a team directed by geneticist Kenneth K. Kidd of Yale University School of Medicine.

"It's unacceptably speculative to claim that large, heterogeneous populations would have an average difference in novelty-seeking behavior just because they differ dramatically in the frequencies of [this gene]," Kidd argues.

The *D4DR* gene regulates a protein involved in the transmission between brain cells of messages carried by dopamine. The gene contains a region that is repeated from 2 to 11 times in different individuals. Earlier data suggested that a 7-repeat form of the gene occurs mainly in avid novelty seekers, identified by their answers to a questionnaire.

Malhotra's investigation, published in the November MOLECULAR PSYCHIATRY, yields no association between the 7-repeat version of *D4DR* and novelty seeking in a group of 193 Finnish men. None of the volunteers suffered from psychiatric disorders.

In an additional examination of 138 alcoholic Finnish men, many of whom displayed high levels of novelty seeking, the *D4DR* variation appeared slightly more often among those with the lowest scores on that personality trait, the researchers hold.

Kidd's team, which presented its findings this week at the American Society of Human Genetics annual meeting in San Francisco, assessed *D4DR* variations in 14 populations from Africa, Europe, the Middle East, East Asia, North America, and South America.

The 7-repeat form appeared far more often in some regions, such as the Middle East, than in others, such as East Asia, the researchers note. Studies that discerned a link between this *D4DR* form and novelty seeking took place in Israel and the United States, where the gene is relatively frequent, they state.

Preliminary data gathered by Kidd's team indicate that chimpanzees, gorillas, and orangutans exhibit other DNA variations in a region that corresponds to the part of the human *D4DR* gene where repeated sequences are found. This suggests that natural selection has not preserved stable, functional variations of *D4DR* in primates, in his view.

The 7-repeat form of *D4DR* may still affect personality, argues geneticist Dean H. Hamer of the National Cancer Institute in Bethesda, who directed one of the studies linking it to novelty seeking. In that analysis, the gene showed an even stronger association with a measure of general happiness, Hamer contends. A dopamine-mediated reward system in the brain may strongly influence a happy outlook on life and have a weaker effect on novelty seeking, he theorizes. *— B. Bower*