

**D**ISSOLVED IN A TEST TUBE, THE essence of life is a clear liquid. To the naked eye it looks just like water. But when it is stirred, the "water" turns out to be as sticky as molasses, clinging to a glass rod and forming long, hair-thin threads. "You get the feeling this is really different stuff," says Dr. Francis Collins in his molecular-biology laboratory at the National Institutes of Health. Collins heads a mammoth effort to catalog the library of biological data locked in these threads, a challenge he compares, not inaccurately, with splitting the atom or going to the moon.

In his laboratory at the University of Southern California, Dr. W. French Anderson looks at the same clear liquid and sees

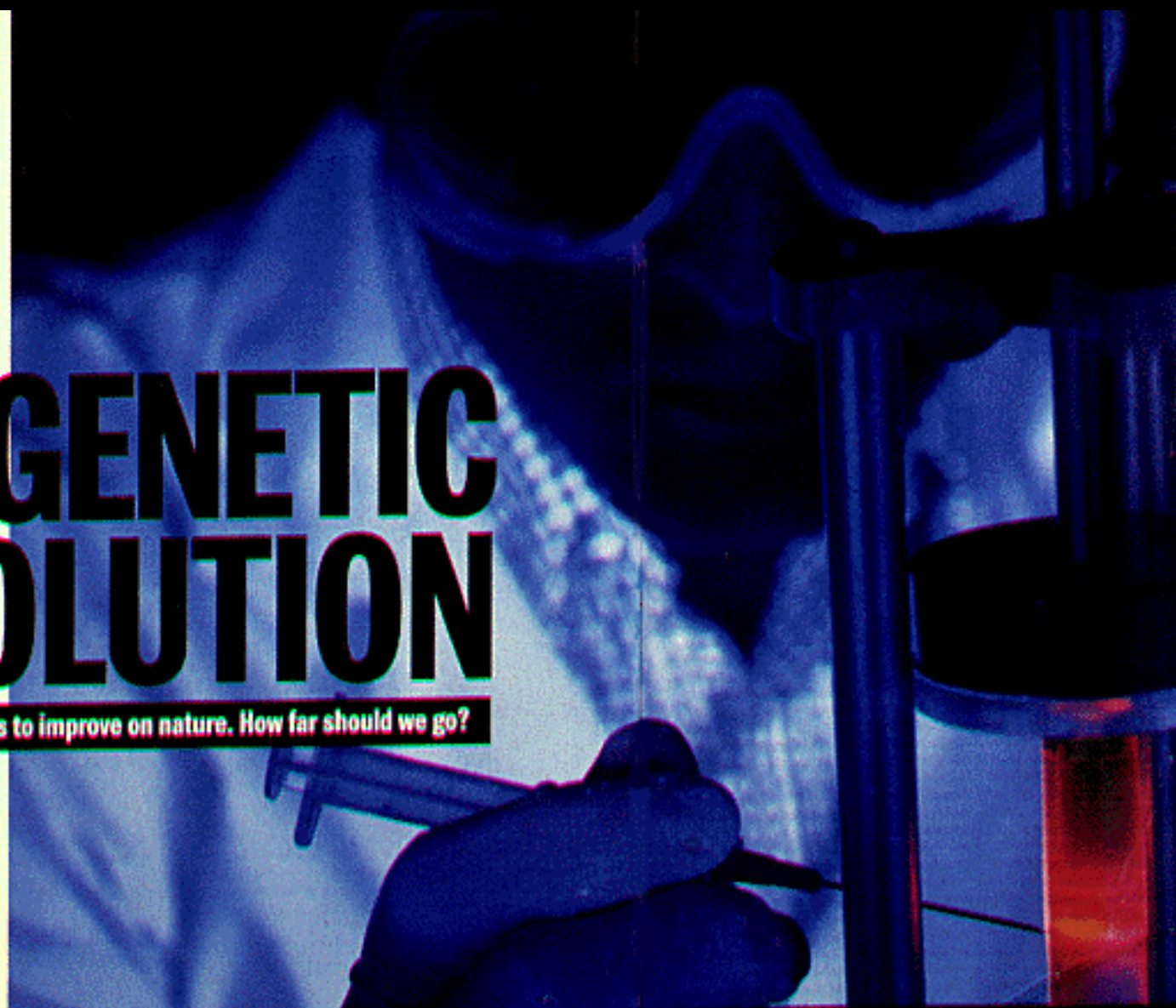
■ SCIENCE

# THE GENETIC REVOLUTION

**New technology enables us to improve on nature. How far should we go?**

not a library but a pharmacy. Anderson's goal, his obsession, is to find the wonder drugs hidden in that test tube. Someday, he says, doctors will simply diagnose their patients' illnesses, give them the proper snippets of molecular thread and send them home cured.

This thread of life, of course, is deoxyribonucleic acid, the spiral-staircase-shaped molecule found in the nucleus of cells. Scientists have known since 1952 that DNA is the basic stuff of heredity. They've known its chemical structure since 1953. They know that human DNA acts like a biological



# Biotechnology...

## Narrow Sense

---

**Use of recombinant DNA methods to genetically alter or genetically characterize a living organism;**  
**genetic engineering.**

# Examples of Biotechnology in the *Narrow* Sense...

---

- recombinant DNA methodology
- addition of genes to an organism
- regulating genes already in an organism
- using DNA profiles to identify an organism
- using DNA profiles to augment conventional breeding techniques

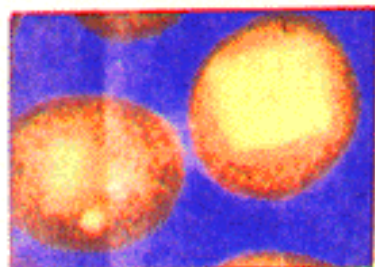
# Applications in Crop Improvement...

---

- **FlavrSavr® tomatoes**
- **Engineered virus resistance (squash, cucumbers)**
- **Bt production in plants (tomatoes, cotton)**
- **Inhibited ripening (tomatoes)**
- **Altered flower color (petunia, roses, tobacco)**
- **Herbicide resistance (many)**

# Ag biotech beginnings

By Larry Waterfield  
Washington, D.C. editor



Researchers,  
firms urge on  
the future,  
poised for a  
genetic revolution



Photos courtesy Monsanto Co., St. Louis, and Mycogen Corp., San Diego

*The healthy tomato plant (above) was genetically engineered with a gene from the *Bacillus thuringiensis* bacterium, which prevents insect feeding. The ordinary plant was damaged when exposed to a particular type of caterpillar; the bioengineered plant thrived.*

*Encapsulated in the cell wall of *Pseudomonas* bacteria (far left photo), the Bt toxin protein is thought to be more effective than ordinary Bt, which has been used as a biopesticide for more than 50 years.*

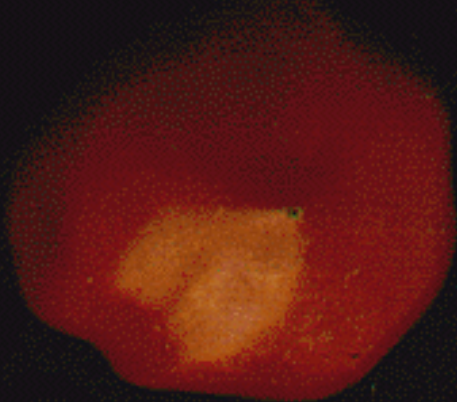
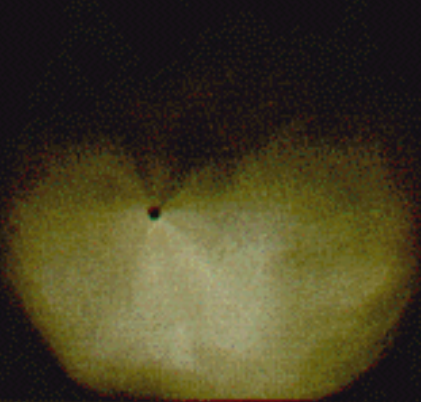
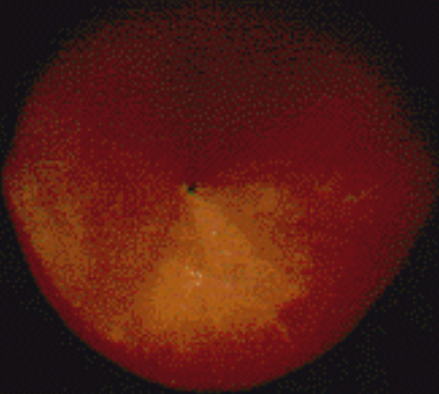
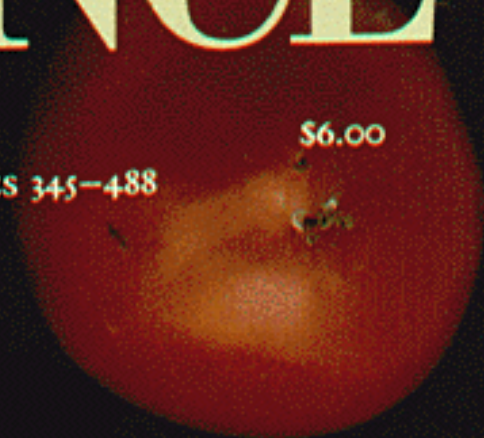
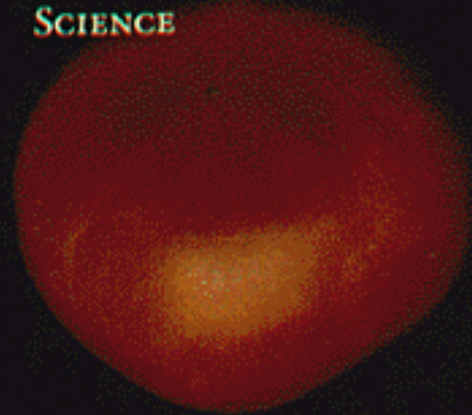
AMERICAN  
ASSOCIATION FOR THE  
ADVANCEMENT OF  
SCIENCE

# SCIENCE

18 OCTOBER 1991

VOL. 254 ■ PAGES 345-488

\$6.00



“Using the tools of genetic modification and tissue culture, the scientists of DWP Plant Technology Corporation have been able to produce new breeding lines with higher yields, greater disease resistance, increased color, and improved flavor. This represents the most advanced biotechnology program of its kind today.”

Dr. Wilson Sharp, Executive Vice President and Scientific Director, DWP Plant Technology Corporation, Former Director of Pioneer Research, Corning Glass Company

Commercial tomato plants growing in culture bottles prior to undergoing greenhouse and field trials. These are the first step in developing new DWP varieties.

DWP scientists evaluate experimental tomatoes for disease resistance. New breeding lines have been selected and are currently being tested in the Company's variety improvement program.

Several tomato breeding lines with increased natural color have been developed by DWP scientists. This is part of the Company's mission to provide the consumer with all-natural, premium tomatoes.

Commercial automatic tomato harvesting. This technology, along with DWP's labor-saving thinning systems, will insure the continuing supply of low-cost, high-quality processing tomatoes.

Commercial tomatoes at the processing line of Corning Glass Company to be used for the production of tomato-based products.

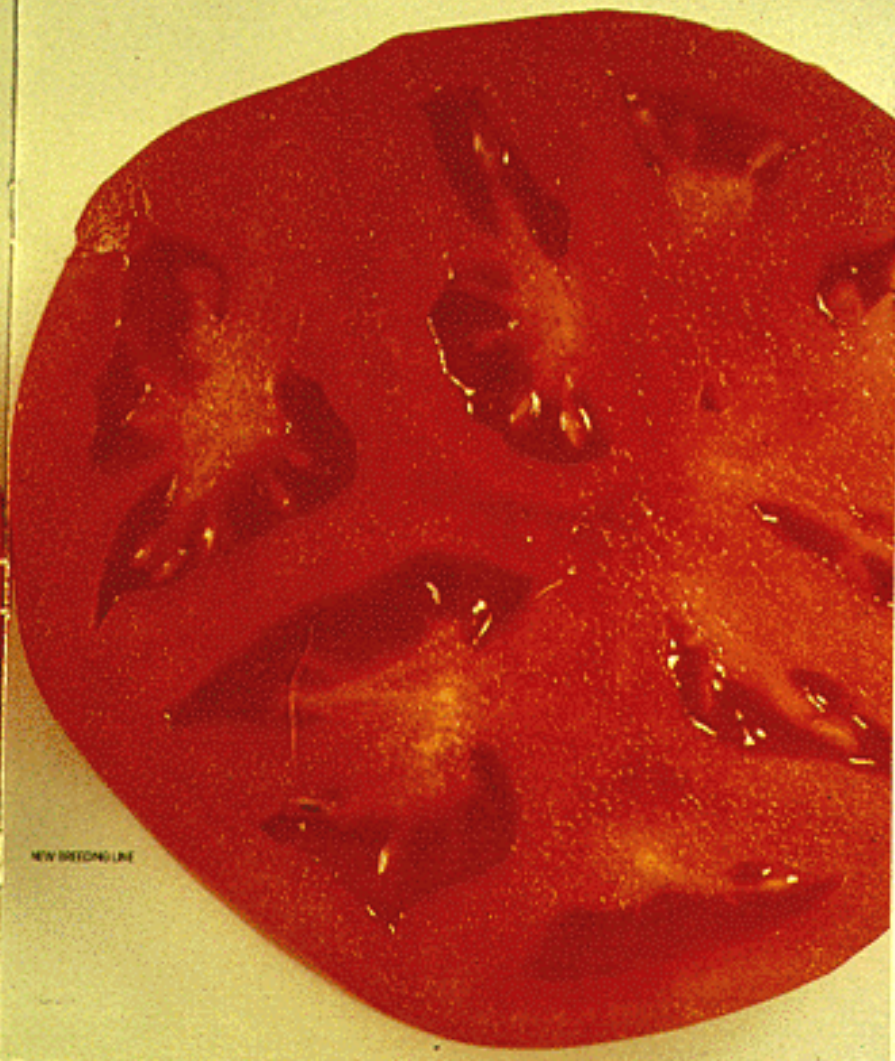


Through the application of proprietary tissue culture technology and plant breeding, DWP Plant Technology Corporation can now produce not a single unique genetic variant from which new breeding lines of economically important crop plants can be selected. This shows DWP is cut the time required for the creation

of new breeding lines in half. From a commercial viewpoint, this represents a major step forward in the improvement of annual crops, and for the first time, makes possible the improvement of perennial and perennial crops within a realistic timeframe.



CONTROL



NEW BREEDING LINE

Comparison between a tomato from a control group and a new DWP-developed variety. New breeding lines have been created which produce tomatoes more than twice the size of those produced by the original breeding lines. This capability allows DWP scientists to interchange characteristics of processing and fresh market tomatoes in the development of superior varieties.



# Applications in Tomato Improvement...

---

- **FlavrSavr® tomatoes; slow softening**
- **High lycopene fruit**
- **Delayed/Inhibited ripening**
- **Elevated soluble solids**





# Status of Certain Recombinant

Products

Lab

Field  
Testing

Selling

Public  
Acceptance

	Lab	Field Testing	Selling	Public Acceptance
<b>Humulin®</b>	→	→	→	→
<b>FlavrSavr® Tomatoes</b>	→	→	→	→
<b>Bt crops</b>	→	→		
<b>Virus resistance</b>	→	→	→	→
<b>Delayed ripening crops</b>	→	→	→	→

# Some of the Issues...

---

- **Product Safety**
- **Regulatory Approval**
- **Product Labelling**
- **Ethical Issues**
- **Consumer Acceptance**

# Regulation...

---

"HHS Secretary Louis W. Sullivan, M.D., today announced a policy that will improve the variety of the U. S. food supply by promoting the development through biotechnology of new foods that are safe for consumers."

*HHS News, 26 May 1992*

# Great Expectations...

---

**"Store-bought tomatoes that taste home-grown, fruit trees resistant to the cold, pest-free crops without applying pesticides are just a few of the many improvements consumers will see."**

***HHS News, 26 May 1992***

# Regulation...

---

**"It is anticipated that many substances currently being introduced into plant varieties will not require pre-market approval by FDA."**

***HHS News, 26 May 1992***

# Regulation...

---

**"The questions companies must resolve while developing foods from new plant varieties include:**

- Has concentration of any naturally occurring toxicants been increased?**
- Has an allergen new to the plant been introduced?**
- Have the levels of important nutrients changed?**
- Have new substances been introduced into food that raise safety questions?**
- What are the environmental effects?**
- Have the genetic material and its "expression products" been well characterized?**
- Have accepted, established scientific practices been followed?."**

*HHS News, 26 May 1992*

# Consumer Acceptance???


---

**"Well-known Chefs Boycott Biotech"**

*The Packer, August 1, 1992*

**"Campbell Soup Says No to  
Biotechnology Tomato"**

*Houston Chronicle, January 11, 1993*



# The Great Tomato Debate Is Bioengineered Food Safe?

*By Kathryn V. Sagan*

**D**uring the more than 50 years that Charlie Van Wie has been working Meadow-Brook Farms in Clarksville, New York,

corn that resists pesticides; catfish fortified by trout genes for fast growth; humanized cow's milk, and more.

Others see the new technology as a link in the chain of

# Culinary Currents

NATION'S RESTAURANT NEWS, June 27, 1994

## Seeds of science: Biotech tomatoes

By Pamela Parseghian

**S**ince the controversy over biotechnology first exploded, many in the foodservice industry have been arguing the pros and cons of genetically altered food.

But finally the fruits of labor are on the table, and several who have tasted the future are surprised.

"Whoever says that's not a great flavor is prejudiced," said chef Andre Soltner after taking a bite of a genetically altered tomato in his New York City institution, Lubice.

To find out if the "super" tomato actually lives up to its creators' claims, Nation's Restaurant News asked some influential tasters to participate in a blind taste test of genetically altered tomatoes.

Participating in the test were Andre Soltner, David Burke of Park Avenue Cafe in New York, Howard Drusin, director of purchasing for Restaurant Associates, and Daniel Boukid, chef-owner of Daniel in New York.

To ensure the results were as fair as possible, the tomato was tasted alongside a Vine-Ripened Texas, a Holland import and an ordinary bulk-packed tomato.

MacGregor's brand tomato, the first genetically engineered food to be approved by the U.S. Food and Drug Administration, is grown

"I'm happy," said Burke.

The Flavor Savr tomato "looks terrific," Burke added. "The outer skin is a little firm to the bite, but the flesh is soft." He also found the flavor "a nice balance between sweet and sour."

Soltner, who has cooked professionally for 48 years, described the bio-tech tomato as "nicely ripened, good tasting with a sweetness and texture that a tomato should have."

"It's a good-looking tomato," said Drusin of RA, a New York-based company that manages 140 foodservice operations ranging from the casual Charlie Brown's to the upscale Tropica in Manhattan, which typically purchases more than 11,000 tomatoes weekly.



