Tamil Nadu Agricultural University aims to eliminate a virus plaguing India's papaya crops.

Courtesy P. Balasubramanian

Ringspot Virus Infected

Will a Genetically Modified Papaya Seed Help Indian Farmers?

In the face of soaring global food prices, more and more countries are looking to genetically modified, or GM, crops as the solution to feeding their people. India itself took another step forward in the cultivation of these crops in October 2007: the Missouri-based global seed giant, Monsanto, donated technology to Tamil Nadu Agricultural University, Coimbatore, for developing a papaya resistant to the ringspot virus, which causes India's farmers heavy losses.

The project's aim is to increase papaya production in India by 750 million kilograms.

The new papaya, resistant to the ringspot virus, was introduced in Hawaii in the 1990s, and is now successfully cultivated there. Scientists at the Centre for Plant Molecular Biology at Tamil Nadu Agricultural University are working to develop a new papaya variety specifically to resist the virus under Indian conditions.

"Hopefully, the GM papaya will be made available to papaya farmers in about four to five years," says P. Balasubramanian, director of the center. The Government of India has approved the technology transfer.

Since the early 1980s, some agricultural scientists and research institutions have seen GM plants as the answer to food shortages and malnutrition. In their view of the coming "Evergreen Revolution," high-yielding, pest-resistant plants will boost the agricultural production of devel-

Courtesy ISAAA

Far left: A ripe papaya infected with papaya ringspot virus.

Left: Davao Solo Papaya, resistant to the virus, being grown inside a confined trial screen house in the Philippines.

How GM Crops Work

Under millennia-old conventional plant breeding methods, closely related plants are cross-bred to produce new varieties that are stronger or tastier or yield larger quantities. Genetic engineering provides a more precise way of obtaining the desired traits in a plant, but it goes beyond simple recombination, introducing genes from an entirely different species, usually a bacterium, yeast or virus. This alters a plant's genetic material, or DNA, in a way that is not possible in the wild or by using conventional techniques. In a successful experiment, the desirable new trait reliably appears in the plant generation after generation. Researchers usually work on improving a plant's shelf-life, salt tolerance, drought resistance, nutrient content, pest resistance or disease resistance. To protect a papaya, a gene coding for the coat protein (the outer layer) of papaya ringspot virus is fired into the papaya's own DNA. The virus may attack the plant but cannot multiply further because its own coat protein gene is locked up by the gene introduced in the plant. The plant is thus resistant to the virus.

Courtesy P. Balasubramanian

Dr. Rajinimala (left), Nafisa Banu and Dr. K. Angappan at Tamil Nadu Agricultural University.

oping countries. What Monsanto donated is a 10-year, "royalty-free, non-exclusive license to use the technology to develop, identify, characterize and commercialize" the virus-resistant papaya in India, according to Bhagirath Choudhary, national coordinator of the International Service for the Acquisition of Agri-biotech Applications (ISAAA). It is a U.S.-based nonprofit organization that helps transfer biotechnologies to developing countries so poor farmers can produce more crops. ISAAA's work is funded by charitable institutions and government agencies, with technology and training donated by corporations. According to Choudhary, "This is an important contribution toward alleviation of poverty of small, resource-poor farmers, as papaya ringspot virus is the most devastating disease of papaya."

Clive James, a Canadian who chairs the ISAAA Board of Directors and has visited India twice in the past year to promote the development and use of biotechnology, goes even further when describing the benefits. "Our philosophy is that the aim should be to increase

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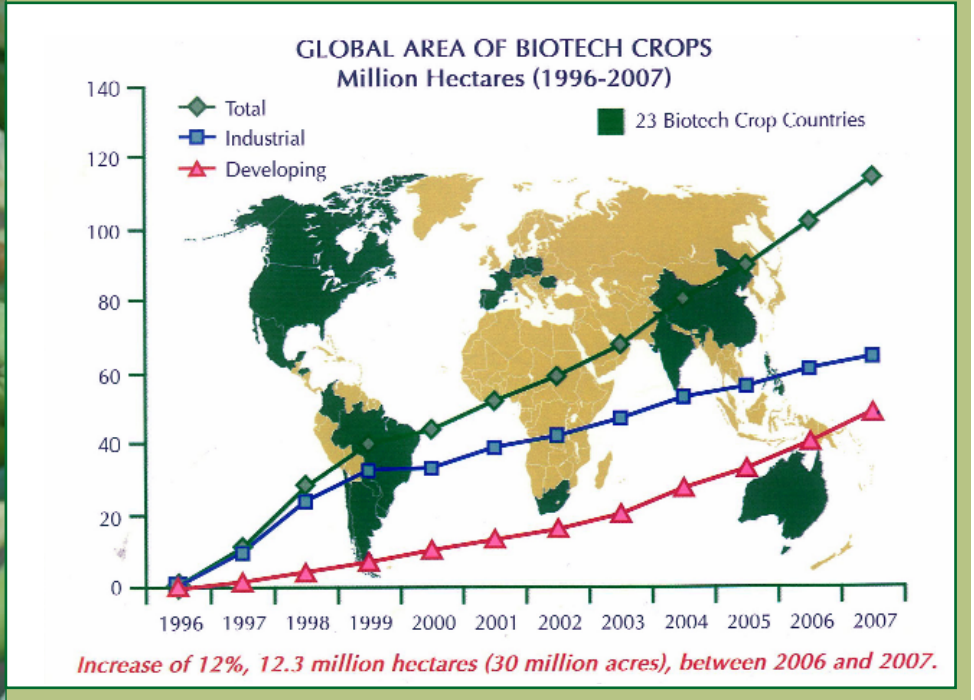
Biotech Crops Around the World

According to ISAAA, India is one of 23 countries growing GM crops. In fact, the number of developing countries planting GM crops (12) is slightly higher than the number of industrialized countries planting them (11). Twelve million farmers grow GM crops on 114 million hectares worldwide. Eleven million of those farmers are resource-poor. The United States is the top grower of GM crops, with 23.32 million hectares of GM soybeans and 26.96 million hectares of GM corn, or 73 percent of all U.S. corn grown. Hawaii has long served as the world's largest outdoor biotechnology laboratory, and farmers like Albert Kung (above) are growing genetically modified papayas. At Kamiya Farm in Laie, Hawaii, Kung checks the leaves on a genetically engineered papaya tree.



Increase of 12%, 12.3 million hectares (30 million acres), between 2006 and 2007.

Courtesy ISAAA

productivity on the cropland that we have today, that is 1.5 million hectares. If you can double the production on the land that is already in agriculture, then you will not have to chop down forests and encroach on sanctuaries of biodiversity."

Some 2.5 billion kilograms of papaya are produced annually in India, in Andhra Pradesh, Assam, Bihar, Gujarat, Karnataka, Maharashtra, Manipur, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal. It is eaten fresh and cooked and processed into pickles, jams, candies, fruit drinks and juices. Papain, an enzyme purified from papaya latex, is extracted for export. The enzyme is used in the medicine and textile industries, breweries, leather processing and meat tenderizing. In light of the significance of papaya to the Indian economy, the introduction of a GM variety is likely to have a huge impact. Choudhary estimates that the technology promises a potential benefit of Rs. 112.5 million for India's papaya industry.

What are the conditions of the Monsanto donation? According to ISAAA's James, it is true that corporations donate a new technology or product to potential customers to build a market, but that is not the case here. The 10-year, royalty-free period for Tamil Nadu Agricultural University "is just a project timeframe. The donation will continue. Monsanto will not come back and say, 'You owe us some royalties now that the 10 years is over.'"

James feels that fears about allergic reactions from GM foods can be addressed. He cites a case, often pointed out by opponents of GM foods as an example of what can go wrong with biotechnology, in which a gene from Brazil nut inserted in a variety of corn was found to cause an allergic reaction. James

For more information:

Monsanto in India

http://www.monsantoindia.com/

ISAAA

http://www.isaaa.org/

Genetically modified crops:The controversy

http://encarta.msn.com/guide_gmomain/genetically_modified_crops_the_controversy.html

says the case actually shows that the system works, that a gene found to cause an allergy can be identified and removed.

While hopes are high that the new papaya will solve one problem related to papaya cultivation, it's important to point out that GM seeds aren't meant to solve all the problems a farmer faces. Plants designed to resist one pest may still be damaged by others. Insects and viruses can evolve to overcome the resistance engineered into the plant. In such cases, farmers growing GM crops still need to spray pesticides.

Laws and regulatory committees in India are still grappling with advances in genetic engineering. The Indian Council of Medical Research recently drafted guidelines on the nutritional and safety assessment of GM foods (www.icmr.nic.in). The draft guidelines specify how GM foods should be tested and emphasize that they must be shown to be as non-toxic and non-allergenic as their traditional counterparts, and nutritionally superior to their non-GM equivalents if they are to be approved for commercial production in India.

James suggests that the involvement of private companies, philanthropic organizations and government agencies working together to improve crop yields can enhance sustainability. "I think in many developing countries there is often the view that the private sector is a negative force, rather than a positive one," says James. He argues that government monopolies are no different than corporate ones, and are sometimes worse. "So a better working relationship between the two is…get the best of the private sector, best of the public sector together and build new programs where they have roles that reflect their comparative advantages." This is ISAAA's role, he says. "The best contribution that they [the private sector] can make is technology, which has cost millions to develop, that can be used for the alleviation of poverty and hunger."

Meanwhile, papaya continues to rank high in research objectives. Choudhary says, "Papaya technology is listed as a priority technology under the Agricultural Knowledge Initiative between the United States and India. The ISAAA is already implementing the ringspot virus-resistant papaya technology donated by Monsanto and improving the shelf life of papaya using a delayed ripening technology donated by Syngenta through the Papaya Biotechnology Network of Southeast Asia."

Because of the economic significance of the crop in India, the development of GM papaya is sure to be closely watched by all stakeholders.

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Courtesy P. Balasubramanian

Sekhar Natarajan, chairman of Monsanto India (left); Clive James, chairman and founder of ISAAA, and P. Balasubramanian, director of the Centre for Plant Molecular Biology at Tamil Nadu Agricultural University, celebrate the virus-resistant papaya technology transfer in October 2007.

Partnerships in Agricultural Research

An agricultural biotechnology conference, co-sponsored by the Indian Council of Agricultural Research and the U.S. Department of Agriculture, was held in New Delhi in March 2008, bringing together eminent Indian and American scientists and researchers in the field of agricultural biotechnology.

The conference on "Harnessing the Benefits of Biotechnology" provided a platform for experts from both countries to discuss their strategies for increased research collaboration and public-private partnerships that will result in the improvement of agricultural crops to benefit farmers and consumers.

Many Indian and American institutions participated in the workshop, including the Indian Institute of Technology, Kanpur, the National Research Centre on Plant Biotechnology, the Indian Agricultural Research Institute, Punjab Agricultural University, the Donald Danforth Plant Science Center, Virginia Polytechnic Institute and State University, Washington University and the University of Missouri.

For more information:
http://www.icar.org.in/
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