# • PRESS RELEASE •

**Consultative Group on International Agricultural Research**
1818 H St., NW, Washington, DC

**Contacts:** Marshall Hoffman
O: 703-820-2244
H: 703-533-8482

Sarwat Hussain
Tel: 202-473-5690
Fax: 202-473-3112

**Embargoed until 4:00 p.m. EDT, Thursday, October 9, 1997**
**Released from Washington, DC**

## Bioengineering of Crops Could Help Feed the World

### Crop Increases of 10-25 Percent Possible

*Interviews are available with Ismail Serageldin, World Bank Vice President for Environmentally and Socially Sustainable Development, and scientists on the World Bank panel on biotechnology. Please call 703-820-2244 to schedule a time.*

Bioengineered crops -- changing the nature of plants by adding or removing DNA -- could improve food yields by up to 25 percent in the developing world and help feed the 3 billion people to be born over the next 30 years, says a report by a top-flight scientific panel convened by the World Bank and the Consultative Group on International Agricultural Research (CGIAR).

Genes can be inserted into the major food crops, including rice, corn, wheat, potatoes, cassava and others to make them resistant to pests and diseases without the need for chemicals, or make them resistant to drought, cold, heat and other hostile conditions. Genes can also be inserted to increase the food content of crops -- increasing the amount of starch in potatoes and protein in rice, for example, says **Bioengineering of Crops**, a report prepared for the World Bank and CGIAR.

"The challenge of feeding an additional 3 billion human beings, 95 percent of them in the poor developing countries, on the same amount of land and water currently available, requires a dramatic transformation of rural economies and intensified agriculture," says Ismail Serageldin, Chairman of CGIAR and World Bank Vice President for Environmentally and Socially

Sustainable Development, who commissioned the panel that wrote the report. "All possible tools that can help promote sustainable agriculture for food security must be marshaled, and biotechnology, safely deployed, could be a tremendous help in that fight."

By far the greatest proportion of current research in crop biotechnology is being conducted in industrial countries on the crops of economic interest in those countries. In the European Union, almost 2,000 biotechnology research projects are underway, at least 1,300 of them using plants.

About 40 percent of field trials being conducted in **developing countries** are for virus resistance. Twenty-five percent of the trials are for crops modified for herbicide resistance, and another 25 percent are for insect resistance, with the balance for product quality, fungal resistance or agronomic traits.

Agricultural bioengineering has been made possible by the swiftly increasing abilities of scientists to extract and manipulate DNA (deoxyribonucleic acid) which makes up the genes of all living things. The transfer process involves cutting the desired gene out of a chromosome (string of genes) of a particular plant, animal or bacteria, and putting that gene into a plant cell; the genetically modified cell is then regenerated to produce a 'transgenic', or genetically modified plant. The modified plant passes the new gene onto its progeny.

"Biotechnology raises many ethical, safety and patenting issues," says Nobel Prize winner Henry W. Kendall, chairman of the panel, as well as chair of the Union of Concerned Scientists. "This conference is bringing the best scientific and intellectual talent to address the issues of safety, and confront all perceived and real risks with a view of devising a sensible, scientifically based strategy for the safe use of biotechnology."

Top scientists in the field, international organizations and concerned citizen groups will discuss the latest developments in bioengineering and to assess risks of the process, in a conference, **Biotechnology and Biosafety**, to be held in Washington Oct. 9-10. Other scientists attending, besides Kendall, will be Werner Arber of the International Council of Scientific Unions, Nobel Prize winner in medicine and physiology; Christopher Somerville, of the Carnegie Institute of Washington; Rita Colwell, President of the Biotechnology Institute, University of Maryland; and Po Tien, Director of the Molecular Virology and Bioengineering Department, Chinese Academy of Sciences.

The conference is sponsored by the World Bank, CGIAR, the U.S. National Academy of Sciences, the American Association for the Advancement of Science, the Smithsonian Institution, the International Council of Scientific Unions, the Third World Academy of

Sciences, the Food and Agriculture Organization, the United Nations Educational, Scientific and Cultural Organization, the United Nations Industrial Development Organization, the United Nations Development Programme, the United Nations Environment Programme.

"It is striking that so many distinguished organizations have agreed to cosponsor this conference," says Prof. Kendall. "The results of this conference should carry weight both by the quality and eminence of the participants as well as the scope and breadth of the co-sponsors."

CGIAR, a consortium of 16 international research centers, has traditionally functioned by promoting free access to genetic materials and research results. CGIAR will be challenged in this new era of patented proprietary research to find ways of intensifying its work for promoting, through research, sustainable agriculture for food security in the developing countries.

**Current and Potential Contributions of Bioengineered Crops**

Bioengineered crops are being introduced into the United States and other industrialized countries -- for example the Flavr Savr tomato is one of the first genetically engineered plants to receive approval from the U.S. Food and Drug Administration. The fruit ripening characteristics of this variety were modified to provide a longer shelf life.

Genetically engineered crops with improved pest and disease resistance, such as cotton, are also close to the U.S. market. Rice varieties with enhanced virus tolerance should be available to American farmers within a few years.

By the year 2000, annual farm sales of biotechnology-derived products are likely to total some $10 billion, with 70 percent based on seeds and 30 percent on veterinary and other products. Some $1 billion a year is spent on global research and development in agricultural biotechnology.

Most of the bioengineering research carried out for developing countries to date has been to lay the groundwork for future crop transformation, but improvements in crop yields could come rapidly. The crops being researched include:

**Rice**: The Rockefeller Foundation's support for rice biotechnology should begin to pay off in two to five years in the form of new varieties available to some Asian farmers, the report says. In China, rice varieties produced through another form of biotechnology are now being grown on thousands of acres by farmers in rural areas near Shanghai.

"It is likely that efforts to improve the rice yield in Asia through biotechnology will result in a production increase of 10 to 25 percent over the next 10 years," the report says. "The increase will come from improved hybrid rice systems in China; from rice varieties transformed with genes for resistance to pests and diseases in other countries, which will increase average yields by preventing crop damage, not by increasing yield potential."

**Corn (or Maize)**: Corn yields in developing countries may also be increased by biotechnology if genes useful in tropical countries are discovered in the course of corn research underway in the United States, the report says. Developing world scientists would be most interested in improving the protein quality and oil content of corn.

**Potatoes**: Some success has been demonstrated in increasing the starch content of the potato through genetic manipulation, which holds the hope of a significant increase in production potential from the same amount of potato plants in a field of the same size.

Potatoes are basically water and starch, but the starch content, which carries most of the food value, is less than 20 percent, versus more than 60 percent for corn. Scientists believe that if the process can be perfected, it can also be applied to other root and tuber crops crucial to the developing world, such as cassava, yams and sweet potatoes.

**Pest and Disease Resistance**: Prospects for incorporating pest and disease resistance into developing country crops are more favorable than prospects for increasing yields. Insect and disease problems are much simpler to address, and much of the effort in biotechnology is focused on these problems.

Agricultural intensification, through improving the productivity and income of the millions of small holder farmers in the developing world, is central to reducing poverty, protecting the environment and increasing food security. Without intensification, the forests will be chopped down, the hillsides will be colonized, the soils will be eroded and the waters will be dissipated. How to intensify is the question. Biotechnology is only a small part of the answer, but a potentially important part.

The U.S.-based company Monsanto has given Mexico without cost the genes that confer resistance to important potato viruses, and trained Mexican scientists in plant transformation and other skills needed to make use of the genes. The transformed potatoes are now being field-tested in Mexico.

Monsanto has also worked with the U.S. Agency for International Development (USAID) and the Kenya Agricultural Research Institute to develop and donate a similar virus control technology to Kenya and Indonesia for virus control in the sweet potato.

"These cases, however, are fairly few," says Mr. Serageldin. "We have to seek more ways of cooperation between researchers in industrialized countries and farmers in the developing world."

**Herbicide Resistance**: Scientists are trying to make crops that are resistant to herbicides, which kill weeds. Weeds are one of the main constraints to crop yield increases in developing countries. If herbicide-resistant crops are developed and planted, environmentally-safe herbicides could be used to kill weeds threatening the fields but would not harm the crops. A major value would be much less use of environmentally-unsafe herbicides.

**Drought Resistance**: Drought is a major problem for nearly all crop plants in the developing world, and the prospect of a "drought resistance gene" has excited many scientists. However, plant scientists recognize that many traits, and therefore many genes, contribute to drought tolerance or resistance: long, thick roots; thick, waxy leaves; the ability to produce viable pollen when under drought stress; the ability to recover from a dry period. Some of these traits can undoubtedly be controlled genetically, but little progress has been made thus far in identifying the genes that control them.

**Oils**: Biotechnology has also been used to change the proportion of fatty acids in soybeans, and to modify the composition of canola oil.

**The Need for Bioengineering -- Increased Food Production**

Currently, some 1 billion people around the world go hungry each day, half of them suffering from severe malnutrition.

Population in the developing world is 4.6 billion and is expanding at 1.9 percent a year, a rate that has been decreasing somewhat in the past decade. The least developed nations are growing at 2.8 percent a year. If they continue to grow at this rate, their population will double in 24 years. Currently, about 87 million people are added to the world's population each year.

In 1961 the amount of cultivated land supporting food production was 0.44 hectares per capita. Today it is about 0.26 hectares per capita, and based on population projections, it will be in the vicinity of 0.15 hectares per capita by 2050.

The rate of expansion of arable land is now below 0.2 percent a year and continues to fall. The bulk of the land best suited to rainfed agriculture is already under cultivation, and the land that is being brought into cultivation generally has lower productivity.

Erosion has made a billion hectares, or nearly 2.5 billion acres, of soil unusable for agriculture in recent decades. Asia has the highest percentage of eroded land, nearly 30 percent, but in all major regions the percentage exceeds 12 percent. It is estimated that 17 percent of all land under cultivation was degraded by human activity between 1945 and 1990.

"There are just two ways to increase food production -- put more land under cultivation, or increase yields," says Mr. Serageldin. "Clearly, the only realistic alternative humanity now has is to boost yields on available land. This will require many things other than biotechnology, but biotechnology will be a crucial part of expanding agricultural productivity in the 21st century."

**Risks of Bioengineering**

The major risks and objections to bioengineering include:

**Inadvertent Consequences:** Some critics have said that plants could be changed in unforeseen ways that would not be known until it was too late to reverse the process. Global research, however, has already worked to protect people, as when a company wanted to use a desired gene from the Brazil nut to put into the soybean, to increase the value of soybean protein for chicken feed. However, research demonstrated that this gene was the same gene that triggers allergic reactions to Brazil nuts in many people. Even though the company believed that the chickens would not be allergic and that humans would not have been affected by the chicken products, there was concern that the altered soybeans might accidentally get into the food chain. Because of that fear, the company voluntarily dropped the project.

**Ethics**: Private companies in the United States and other countries can patent genes that they manipulate in the test tube, but many non-government organizations, some international organizations and some governments object, arguing that no forms of life should be "owned."

"While patent protection is necessary to get the private sector involved in this research and development, we must find ways to handle public goods and the needs of the poor around the world," says Mr. Serageldin. "New modes of partnership will have to be worked out."

**Herbicide tolerance**: Some critics of bioengineering have raised the possibility that, for example, herbicide-tolerant squash could cross with its wild relative in southern climates, a

weed, and produce a herbicide resistant weed that could not be killed and would therefore grow without any form of control.

**Loss of biodiversity**: Said to be a consequence of growing genetically uniform plants [developed through genetic engineering]. This is also an issue raised with modern crop varieties developed through conventional means.

**Food Safety**: Many people are concerned that if they eat fruits or vegetables that are resistant to bacteria, it could kill all bacteria in their stomach, harming the digestive process. No scientific evidence supports such fears.

**Cutting choices for vegetarians**: Some vegetarians have said they do not want to eat vegetables that contain animal genes, because the food would not be a purely plant product.

"We must not dismiss the fears and concerns of people about the possible risks of the new technologies," says Mr. Serageldin. "But we must not allow diatribes to shackle progress either. We need processes of consultation and scientific evidence to guide our actions. This conference is one effort at generating a consensus approach to a difficult subject."

**Conclusions and Recommendations**

The panel's recommendations: very high priority must be assigned to the expansion of agriculture and to increased production of food in the developing world. It is critically important that increases in food production outpace population growth. Damaging agricultural practices must be replaced with lower impact, sustainable activities so that global capacity to produce food does not decline.

Because DNA technology is so powerful, it has the ability to make significant positive or negative changes in agriculture. Bioengineered crops are not in principle more injurious to the environment than traditionally bred crops. The panel recommends:

*1. The World Bank should direct attention to the need for liaison with and support of the developing world's agricultural science community. A specific and urgent need is the training of developing world scientists in biotechnology methods so that each nation will have a cadre of scientists to assist it in setting and implementing its own policies on biotechnology research and biosafety.*

*2. The World Bank should identify and support high-quality research programs whose aim is to exploit the favorable potential of genetic engineering for improving the lot of the developing world.*

*3. The World Bank should support the implementation of formal, national regulatory structures in its client nations by seeing to it that these structures retain their vigor and effectiveness through the years and by providing scientific and technical support to the client nations as requested.*

*4. The World Bank should support, in each developing country, the deployment of an early warning system to identify any troubles that may arise and to introduce improvements in adapting new strains.*

*5. The World Bank should increase its support of research in biotechnology and related areas at international agricultural research centers because these centers are currently in the best position to ensure that high-quality, environmentally sustainable agricultural products and processes are developed and transferred to developing countries.*

*6. The World Bank should continue to give high priority to all aspects of increasing productivity in developing world agriculture while encouraging the necessary transition to sustainable methods.*

Besides DNA agriculture, the panel says that the developing world needs:

o Increasing priority on conventional plant breeding and farming practices;
o Ensuring that adequate energy and water become available and that procedures for their efficient use are made known and adopted;
o Ensuring the introduction of modern means of controlling pests, including the use of integrated pest management systems, safe chemicals and resistant crops.
o Supporting the transition to sustainable activities and the reduction of waste and loss in all elements of the agriculture enterprise;
o Ensuring that the changes in agriculture will provide the employment opportunities that will be needed in the developing world.

"Because we do not want to proceed in this controversial area without the best scientific advice, we were grateful to Prof. Kendall and his colleagues to have reviewed the evidence and given us the advice they have," says Mr. Serageldin. "Together with the results of this conference, their

advice will inform the Bank's work on supporting the development and safe use of biotechnology in developing countries, for the benefit of the poor and the environment."

* * *

**The World Bank/CGIAR Panel and authors of the report:**

**Roger Beachy**: Scripps Family Chair, Scripps Research Institute; co-director, International Laboratory of Tropical Agricultural Biotechnologies. Received 1991 Commonwealth Award for Science and Invention.

**Thomas Eisner**: Schurman Professor of Chemical Ecology and director, Cornell Institute for Research in Chemical Ecology, Cornell University. Awarded 1994 National Medal of Science.

**Fred Gould**: Reynolds Professor of Entomology, North Carolina State University. Received U.S. Award for Excellence in Integrated Pest Management.

**Robert Herdt**: Director, agricultural sciences, Rockefeller Foundation. Fellow, American Association for the Advancement of Science.

**Henry W. Kendall**: J.S. Stratton Professor of Physics, Massachusetts Institute of Technology. Chair, Union of Concerned Scientists. Awarded 1990 Nobel Prize in Physics.

**Peter H. Raven**: Director, Missouri Botanical Garden. Professor of botany, Washington University. Home secretary, National Academy of Sciences. Many awards, including the Japan International Prize for Biology, and jointly received the Sasakawa Prize, the Volvo Prize and the Prize of the Institute de la Vie.

**Jozef S. Schell**: Director, Department of Genetic Principles of Plant Breeding, Max Planck Institut für Züchtungsforschung. Professor, plant molecular biology, Collège de France. Winner of numerous awards, including the Wolf Prize, the Sir Hans Krebs medal, and the Australia Prize.

**M. S. Swaminathan**: UNESCO Professor in Ecotechnology and chair, M.S. Swaminathan Research Foundation, Madras, India. Fellow, Royal Society of London. Awarded numerous awards, including the World Food Prize.