Plant Biotechnology in Asia: Current Benefits and Future Opportunities

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Agricultural biotechnology has been rapidly adopted since its introduction in 1996, and Asia is poised to lead the expansion as the technology enters its second decade. In 2006, the 11th year of widespread biotech crop planting, more than 10 million farmers around the world planted more than 100 million hectares in biotech crops. The majority of these farmers were planting these biotech crops in Asia.

India emerged as the leader in Asia, as the country jumped two spots to become the world’s fifth largest producer of biotech crops. India, which planted insect-protected Bt cotton for the first time in 2002, increased the planted area by 192 % last year to total 3.8 million hectares, surpassing China for the first time, according to the International Service for the Acquisition of Agri-biotech Applications (ISAAA).
The area occupied by biotech crops, which increased by 13% during 2006, is projected to be more than 200 million hectares in 2015 and will be grown by over 20 million farmers. This rapid adoption and growth of biotech crops is a clear indicator that farmers and governments around the world recognize the environmental, economic and food security benefits, according to ISAAA.

In China, for example, multiple studies have documented the exceptional yield increases among farmers who planted insect-protected cotton. Not only have their yields increased, there has been a substantial decrease in pesticide-related illnesses as farmers control the most devastating cotton pests with reduced use of chemicals. Dr. Jikun Huang, a scientist with the Chinese Academy of Sciences, recently told the Reuters news service that “biotechnology has helped farmers reduce cost and raise production on limited land.” He said Bt cotton increased income of some 6.8 million farmers as it cut pesticide use by 60%, while raising yields by 10% compared with conventional varieties.

Similar results were reported in India where farmers who planted the Bt cotton reported 13% higher profits than farmers who used non-Bt cotton.

In the Philippines, where corn growers face persistently high infestations of the yield reducing Asian corn borer pest, farmers report yield increases of 20% to 30% by planting insect-protected corn developed using biotechnology.

In North and South America, herbicide tolerant soybeans have enabled farmers to reduce their herbicide usage and convert to soil-saving conservation tillage, which prevents valuable topsoil from washing off into streams.

These benefits have recently been quantified in studies done by EU economists. In a study by Brookes and Barfoot (2006), it was reported that biotech crops generated an incremental US$5.6 billion in 2005. In the period from 1996–2005, farmers have netted a cumulative increase in returns of US$27 billion. Surprisingly, the majority of this extra value (55%) was generated in developing countries, largely from Bt cotton and herbicide tolerant soybean. These economists further reported that farmers who planted biotech crops used less overall chemical pesticides to control pests in their crops. Since 1996, biotech crops have contributed to a cumulative reduction of more than 220 million kilograms of pesticide active ingredient, which represents a decrease of more than 15% in the environmental impact of chemicals used in agriculture. Once again, the majority of these environmental benefits were reported in developing countries where biotech cotton and soybeans are grown, including China and India.

These benefits are driving widespread growth of biotech crops. In 2006, 22 countries planted biotech crops and an additional 29 countries have approved biotech crops for import for food/feed use.

“More than half of the global population of 6.5 billion people now live in countries where biotech crops are grown, allowing 3.6 billion people to benefit from the economic, societal and environmental advantages generated through biotech crops,” said Clive James, author of ISAAA’s annual survey of biotech usage. “With 51 countries in total gaining experience with biotech crops, acceptance will continue to grow.”

The first decade of plant biotechnology began in 1996 with the first plantings of biotech crops in the US, Canada, China, Argentina, Australia and Mexico. That year, a total of 4.2 million acres (1.75 million hectares) of biotech crops were planted. Herbicide tolerance was followed by insect-protected and disease-protected crops. Today, farmers
are able to plant biotech crops “stacked” with multiple beneficial traits, enabling them to control a variety of insects and improve their weed control.

Plant biotechnology is a continuation and refinement of plant breeding, which has been ongoing for centuries. Throughout history, farmers identified the most productive plants in their fields and cross-bred them, thereby combining the best traits. However, this process often transferred undesirable traits to the new plant along with the desired traits. Through biotechnology, scientists are able to isolate a single gene and insert it into the DNA of a plant, imparting only the desirable trait. And unlike conventional cross-breeding, biotechnology is able to use beneficial genes from other species. For example, the Bt gene that controls various types of insects in corn, cotton and other crops is derived from a ubiquitous, soil bacterium.

A rigorous regulatory regimen determines the safety of biotech crops. Extensive studies compare the biotech crop with its conventionally produced counterpart to ensure that adding a gene did not alter the plant in any unexpected way and there are no new safety issues. Extensive studies also assess the impact of the new crop on the environment and wildlife, including insects, mammals, birds and other living things. These studies are reviewed by regulatory agencies in the specific countries where crops are to be grown, and no crop can be planted or imported until regulatory agencies give their approval. Nearly every scientific body around the world, including the World Health Organization and the combined National Science Academies from all regions of the globe, has endorsed the regulatory process for determining the safety of biotechnology and agree that these new crops are not different from conventional plants with regard to safety.

Biotechnology is providing benefits today for all types of farmers, whether they operate large farms in the US, Spain and Brazil or very small holdings in developing countries like India, China and the Philippines. “More than 90 % (of) farmers growing biotech crops last year were small, resource-poor farmers from the developing world, allowing biotechnology to make a modest contribution to the alleviation of their poverty,” ISAAA’s James said in a recent press release.

ISAAA predicts that the adoption in the developing world will outstrip adoption in industrialized nations in the coming decade. “Millions of small, resource-poor farmers will turn to the potential biotech crops offer in the next decade.” Developing countries now account for 40 % of the global biotech crop area.

ISAAA, which receives funding from public and private sources, exists to alleviate hunger by bringing technologies to developing regions of the world. The group’s annual reports assess the adoption of biotechnology. ISAAA predicts that the second decade of biotechnology will feature strong growth in Asia led by China, India and countries such as Pakistan and Vietnam, which have not currently grown any biotech crops.

The Philippines, the first Asian nation to commercially introduce Bt corn in 2003, is planning to continue its expansion of biotechnology. This year, biotech corn acreage increased to 120,000 hectares from the previous year’s 70,000. In addition, the country is developing many of its own biotech products. For instance, the Institute of Plant Breeding at the University of the Philippines expects to field test a genetically modified papaya resistant to ringspot virus and a delayed ripening papaya which would extend the fruit’s shelf-life. The agency is also developing an eggplant that would be resistant to insects such as the whitefly.
Researchers around the world are developing a number of biotech products that will bring agronomic and consumer benefits to Asians and others. Here are a few of the products now in the biotech pipeline:

- **Rice** – Cornell University and the University of California–Riverside, in the United States are developing drought- and flood- resistant rice. “Golden rice,” which increases vitamin A levels to prevent blindness, continues to make progress.

- **Papaya** – The same type of virus-resistant papaya that is credited with saving the papaya industry in Hawaii is being developed for Indonesia, Malaysia, the Philippines, Thailand and Vietnam.

- **Lettuce** – The National Institute of Education in Singapore has used plant biotechnology to develop a new type of lettuce that is fortified with resveratrol, the ingredient in red grapes and red wine that is believed to help prevent heart disease and cancer.

- **Mustard** – As part of a global partnership to combat vitamin A deficiency in many areas of the developing world, researchers at Michigan State University, US Agency for International Development (USAID), the Tata Energy Research Institute in India and the Monsanto Company, are working to boost levels of beta-carotene, which stimulates the production of vitamin A, in mustard seed.

- **Coffee** – Researchers in Japan are developing a caffeine-free variety that preserves taste, which is lost when chemicals are used to remove caffeine.

In addition to these products with strong Asian interest, many other products are being developed to introduce vitamins and important nutrients into the global food supply. These products include more healthy oils, such as low-linolenic soybeans with no trans-fats and new oils high in omega-3. As Asian diets change there is increasing demand for such heart healthy food products across the region.

Biotechnology is also helping nations produce biofuels to reduce reliance on petroleum-based energy. Not only does biotechnology increase yields for crops used to make ethanol, it promises to yield new types of enzymes that can convert more abundant cellulose sources, such as grasses and wood chips, into ethanol. Countries like India, China and Indonesia, to name a few, are all currently assessing the potential of biotechnology to facilitate a productive source of biofuels to address energy demands.

Throughout human history, new technologies have been met with resistance, and the history of biotechnology is no different. A decade of proven safety and demonstrated benefits is removing the doubts of many who initially were skeptical. Already in the European Union, where adoption has been most resisted, 25 % of the member nations have approved the planting of biotech crops.

The challenge of food security remains a key priority for most nations, and is especially critical in Asia where the greatest population growth is expected. Producing nutritious, safe and affordable food becomes increasingly more challenging each year, as cities take more arable land and pest problems reduce crop yields. New technologies will continue to be an important part of successful food production systems globally,
and biotechnology is one of these technologies that is already contributing to the food security challenge. The 22 nations that have been planting biotech crops have benefited from the significant economic and environmental benefits. Additionally the 29 countries that import biotech crops for food and feed use already realize the value of a consistent supply of nutritious and affordable food. As new crops are developed that have more direct consumer and societal benefits, consumer interest and support in biotechnology is expected to grow.

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