Global review of commercialized transgenic crops

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THE unprecedented rapid adoption of transgenic crops during the initial five-year period (1996 to 2000) when genetically modified (GM) crops were first adopted, reflects the significant multiple benefits realized by large and small farmers in industrial and developing countries that have grown transgenic crops commercially. Between 1996 and 2000, a total of fifteen countries – 10 industrial and 5 developing – contributed to more than a twenty-five fold increase in the global area of transgenic crops from 1.7 million hectares in 1996 to 44.2 million hectares in 2000. The accumulated area of transgenic crops planted in the five-year period 1996 to 2000 total 125 million hectares, equivalent to more than 300 million acres.

Adoption rates for transgenic crops are unprecedented and are the highest for any new technology by agricultural industry standards. High adoption rates reflect grower satisfaction with products that offer significant benefits ranging from more convenient and flexible crop management, higher productivity and/or net returns per hectare, health benefits and a safer environment through decreased use of conventional pesticides, which collectively contribute to not only improved weed and insect pest control (attainable with transgenic herbicide-tolerant and insect-resistant *Bt* crops) but also benefits of lower input and production costs; genetically modified crops offer significant economic advantages to farmers compared with corresponding conventional crops. The severity of weed and insect pests varies from year to year and hence this will have a direct impact on pest control costs and the consequent economic advantage.

Despite the on-going debate on GM crops, particularly in countries of the European Union, millions of large and small farmers in both industrial and developing countries continue to increase their plantings of GM crops because of the significant multiple benefits they offer. This high adoption rate is a strong vote of confidence in GM crops, reflecting grower satisfaction. Many recent studies have confirmed that farmers planting herbicide-tolerant and insect-resistant *Bt* crops are more efficient in managing their weed and insect pests. An estimated 3.5 million farmers grew transgenic crops to health and economic advantages. In coming years, the number of farmers planting GM crops is expected to grow substantially and the global area of GM crops is expected to continue to grow. Global population would exceed 6 billion by 2050, when approximately 90% of the global population will reside in Asia, Africa and Latin America. Today, 815 million people in the developing countries suffer from malnutrition and 1.3 billion are afflicted by poverty. Transgenic crops, often referred to as GM crops, represent promising technologies that can make a vital contribution to global food, feed and fibre security.

Global reviews of transgenic crops have been published as ISAAA Briefs annually since 1996. This publication provides the latest information on the global status of commercialized transgenic crops. A detailed global data set on the adoption of commercialized transgenic crops is presented for the year 2001 and the changes that have occurred between 2000 to 2001 are highlighted. The global adoption trends during the last six years from 1996 to 2001 are also illustrated. Given the continuing debate on transgenic crops, particularly the issues relating to public acceptance, there has been much speculation as to whether the global area of transgenic crops would continue to increase in 2001. This publication documents the global database on the adoption and distribution of GM crops in 2001.

Note that the words transgenic crops and genetically modified crops, maize and corn, as well as rapeseed and canola are used synonymously in the text, reflecting the usage of these words in different regions of the world. Global figures and hectares planted commercially with transgenic crops have been rounded off to the nearest 100,000 hectares. In some cases this leads to insignificant approximations and there may be slight variances in some figures, totals and percentage estimates. It is also important to note that countries in the Southern Hemisphere plant their crops in the last quarter of the calendar year; the transgenic crop areas reported in this publication are planted, not harvested, hectarage in the year stated. Thus, the 2001 information for Argentina, Australia, South Africa and Uruguay is hectares planted in the last quarter of 2001.

Global area of transgenic crops in 2001

The estimated global area of transgenic crops for 2001 is 52.6 million hectares or 130.0 million acres (Table 1). It is noteworthy that 2001 is the first year when the global

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area of transgenic crops has exceeded the important historical milestone of 50 million hectares. To put this global area of transgenic crops into context, 52.6 million hectares is equivalent to more than 5% of the total land area of China (956 million hectares) or the US (981 million hectares) and more than twice the land area of the United Kingdom (24.4 million hectares). The global increase in area of transgenic crops between 2000 and 2001 is 19%, equivalent to 8.4 million hectares or 20.8 million acres. This increase of 8.4 million hectares between 2000 and 2001 is almost twice the corresponding increase of 4.3 million hectares between 1999 and 2000 which was equivalent to 11% growth.

During the six-year period 1996 to 2001, the global area of transgenic crops increased by more than 30-fold, from 1.7 million hectares in 1996 to 52.6 million hectares in 2001 (Figure 1). This high rate of adoption reflects the growing acceptance of transgenic crops by farmers using GM technology in both industrial and developing countries. During the six-year period 1996–2001 the number of countries growing transgenic crops more than doubled, increasing from 6 in 1996 to 9 in 1998, to 12 countries in 1999 and 13 in 2000 and 2001.

Distribution of transgenic crops in industrial and developing countries

Figure 2 shows the relative hectarage of transgenic crops in industrial and developing countries during the period 1996 to 2001. It clearly illustrates that the area under GM crops has grown substantially in industrial countries. Significant increase has also been observed in the developing countries. In 2001 more than one quarter (Table 2) of the global transgenic crop area of 52.6 million hectares, equivalent to 13.5 million hectares, was grown in developing countries. Whereas the absolute growth in GM crop area between 2000 and 2001 was twice as high in industrial countries (5.6 million hectares) compared with developing countries (2.8 million hectares), the percentage growth was higher in the developing countries of the South (26%) than in the industrial countries of the North (17%).

Table 1. Global area of transgenic crops, 1996 to 2001

	Hectares (million)	Acres (million)
1996	1.7	4.3
1997	11.0	27.5
1998	27.8	69.5
1999	39.9	98.6
2000	44.2	109.2
2001	52.6	130.0

Increase of 19%, 8.4 million hectares or 20.8 million acres between 2000 and 2001.

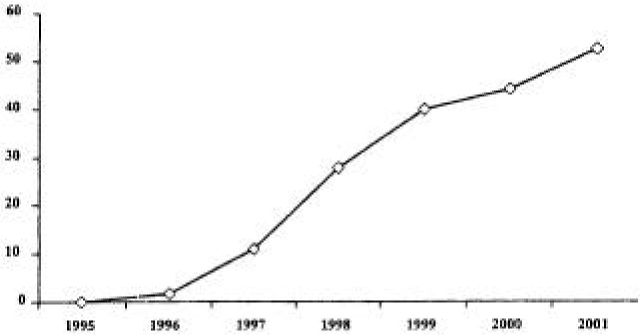

Figure 1. Global area of transgenic crops, 1996 to 2001 (million hectares).

Distribution of transgenic crops, by country

In 2001, four countries grew 99% of the global transgenic crop area (Table 3) and all four countries reported growth of GM crops between 2000 and 2001 (Figure 3). It is noteworthy that the top four countries include two industrial countries, USA and Canada, and two developing countries, Argentina and China. Consistent with the pattern since 1996, the USA grew the largest transgenic crop hectarage (68%) in 2001. The USA grew 35.7 million hectares (6%) and China 1.5 million hectares (3%); China had the highest percentage year-on-year growth by tripling its GM crop area of *Bt* cotton between 2000 and 2001. Year-on-year growth was the same (18%) for the USA and Argentina and lower for Canada (6%). In 2001, transgenic crop hectarage also increased in South Africa and Australia where the growth rates were 33% and 37% respectively.

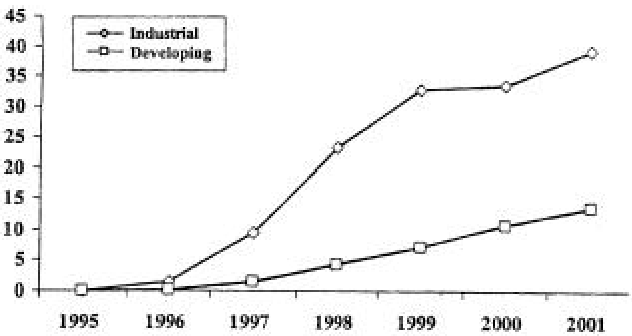

Figure 2. Global area of transgenic crops, 1996 to 2001: industrial and developing countries (million hectares).

Table 2. Global area of transgenic crops in 2000 and 2001: industrial and developing countries (million hectares)

	2000	%	2001	%	+/–	%
Industrial countries	33.5	76	39.1	74	+ 5.6	+ 17
Developing countries	10.7	24	13.5	26	+ 2.8	+ 26
Total	44.2	100	52.6	100	+ 8.4	+ 19

Table 3. Global area of transgenic crops in 2000 and 2001: by country (million hectares)

	2000	%	2001	%	+/–	%
USA	30.3	68	35.7	68	+ 5.4	+ 18
Argentina	10.0	23	11.8	22	+ 1.8	+ 18
Canada	3.0	7	3.2	6	+ 0.2	+ 6
China	0.5	1	1.5	3	+ 1.0	+ 200
South Africa	0.2	< 1	0.2	< 1	< 0.1	+ 33
Australia	0.2	< 1	0.2	< 1	< 0.1	+ 37
Mexico	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Bulgaria	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Uruguay	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Romania	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Spain	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Indonesia	–	–	< 0.1	< 1	< 0.1	–
Germany	< 0.1	< 1	< 0.1	< 1	< 0.1	–
France	< 0.1	< 1	–	–	–	–
Total	44.2	100	52.6	100	+ 8.4	+ 19%

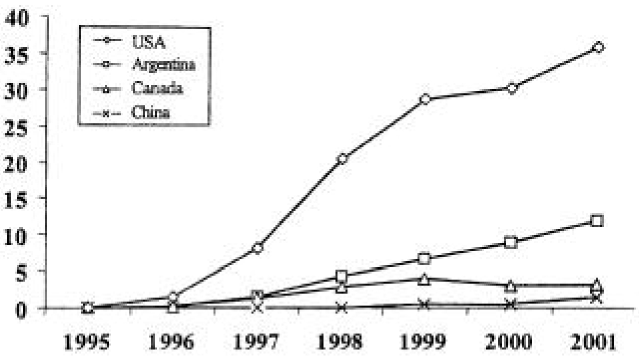

Figure 3. Global area of transgenic crops, 1996 to 2001: by country (million hectares).

The 13 countries that grew transgenic crops in 2001 are listed in descending order of their transgenic crop areas (Table 3). There are three industrial countries and six developing countries. In 2001, transgenic crops were grown commercially in all six continents of the world – North America, Asia, Oceania, Europe (Eastern and Western) and Africa. Of the top four countries that grew 99% of the global transgenic crop area, the USA grew 68%, Argentina 22%, Canada 6% and China 3%. The other 1% was grown in the remaining nine countries, with South Africa and Australia being the only countries in that group growing more than 1,00,000 hectares or a quarter million acres of transgenic crops.

In USA there was an estimated net gain of 5.4 million hectares of transgenic crops in 2001. This came about as a result of significant increases in the area of transgenic soybean and cotton, a modest increase in canola, and a small decrease in the area of transgenic corn. In Argentina, a gain of 1.8 million hectares was reported for 2001 because of significant growth in transgenic soybean and a modest increase in corn.

For Canada, a net gain of 0.2 million hectares was estimated with gains in both GM corn and soybean with a slight decrease in GM canola associated with the general decrease of 856,000 hectares in the national area planted to canola in 2001 compared with 2000. For China, the area planted to *Bt* cotton increased by a significant 1.0 million hectares from 0.5 million hectares in 2000 to 1.5 million hectares in 2001.

A significant increase of *Bt* corn was reported for South Africa, where the combined area of transgenic corn, cotton and soybean is expected to be approximately 25,000 hectares. In Australia, over 200,000 hectares of transgenic cotton was planted in 2001 compared with 150,000 hectares in 2000, with Mexico reporting a modest area of transgenic cotton and soybean. The countries growing transgenic crops in 2001 include two Eastern European countries – Romania growing herbicide-tolerant soybean and Bulgaria growing herbicide-tolerant corn. The two European Union countries – Spain and Germany – which grew small areas of *Bt* corn in 2000, continued to grow *Bt* corn in 2001; Spain grew about 12,000 hectares and Germany less than a hundred hectares in 2001. France, which grew a token area of *Bt* corn in 2000, did not report *Bt* corn for 2001. One new country, Indonesia, reported the commercialization of transgenic crops for the first time in 2001, growing a small area (4000 hectares) of *Bt* cotton.

The country portfolios of deployed GM crops continued to diversify in 2001 with several crop/trait introductions reported for the first time. These included herbicide-tolerant corn in Argentina, herbicide-tolerant cotton as well as the stacked *Bt*/herbicide-tolerant cotton in Australia, herbicide-tolerant soybean, *Bt* white corn and herbicide-tolerant cotton in South Africa and *Bt* cotton in Indonesia.

Distribution of transgenic crops, by crop

The distribution of the global transgenic crop area for four major crops is illustrated in Figure 4 for the period 1996 to 2001. It clearly shows the dominance of transgenic soybean occupying 63% of the global area of transgenic crops in 2001; the entire transgenic soybean is herbicide-tolerant. Transgenic soybean retained its position in 2001 as the transgenic crop occupying the largest area. Globally, transgenic soybean occupied 33.3 million hectares in 2001, with transgenic corn in second place at 9.8 million hectares, transgenic cotton in third place at 6.8 million hectares and canola at 2.7 million hectares (Table 4).

In 2001, the global hectarage of the herbicide-tolerant soybean is estimated to have increased by 7.5 million hectares, equivalent to a 20% increase. Gains of approximately 5.7 million hectares of transgenic soybean were reported for the USA in 2001, with 71% of the national soybean area of 30.1 million hectares planted to transgenics. Argentina reported a gain of 1.8 million hectares of GM soybean with adoption rates estimated at 98% of the 11.2 million hectares of soybean grown in 2001.

Transgenic corn area in 2001 is estimated to have decreased globally by about 500,000 hectares (Table 4) with all the reduction in the USA. Some observers have attributed the reason for the decrease in transgenic corn in the USA in 2001 to some farmers concluding that the historically low infestations of European Corn Borer in 1999 and 2000 did not merit the use of *Bt* corn in 2001 on the basis that infestation may continue to be low; however ECB levels in 2001 proved much higher than expected and this may result in increased plantings in future. Others have suggested that farmer-uncertainty about markets for transgenic corn as well as low prices may have contributed to decreased plantings of *Bt* corn in 2001 by a small proportion of farmers. Decreases in transgenic corn in the USA were offset by significant increases in transgenic corn in Canada, Argentina and South Africa where adoption rates increased.

The small decrease of 100,000 hectares in the area planted globally with transgenic canola in 2001 all occurred in Canada and was associated with the general decrease of 856,000 hectares in the national area planted to canola in Canada in 2001 compared with 2000; the decrease in canola area is attributed to low prices. However, the percentage of the canola crop in Canada planted to transgenics increased from 55% in 2000 to 61% in 2001. The decrease in Canada in 2001 was offset by a modest increase in transgenic canola in USA, which increased by more than 10% in 2001.

The global area of transgenic cotton in 2001 is estimated to have increased by 1.5 million hectares, from 5.3 million hectares in 2000 to an estimated 6.8 million hectares in 2001 – this is equivalent to a year-over-year increase of 28% in the global area of transgenic cotton. The most significant increase was reported for China which tripled its *Bt* cotton area from 0.5 million hectares in 2000 to 1.5 million hectares in 2001. In the USA the percentage of transgenic cotton increased from 72% in 2000 to 77% in 2001. Australia also increased its transgenic cotton area by 33% from 150,000 hectares to 200,000 hectares with plantings at approximately the same levels in Mexico, Argentina and South Africa.

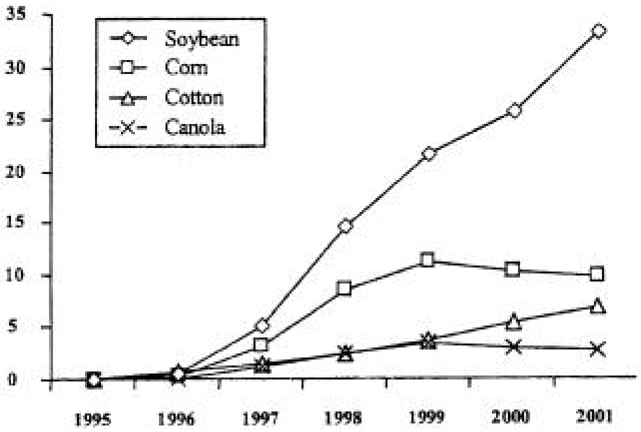

Figure 4. Global area of transgenic crops, 1996 to 2001: by crop (million hectares).

Table 4. Global area of transgenic crops in 2000 and 2001: by crop (million hectares)

Crop	2000	%	2001	%	+/–	%
Soybean	25.8	58	33.3	63	+ 7.5	+ 29
Maize	10.3	23	9.8	19	– 0.5	– 5
Cotton	5.3	12	6.8	13	+ 1.5	+ 28
Canola	2.8	7	2.7	5	– 0.1	– 4
Potato	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Squash	< 0.1	< 1	< 0.1	< 1	(–)	–
Papaya	< 0.1	< 1	< 0.1	< 1	(–)	–
Total	44.4	< 1	< 0.1	< 1	(–)	–

Distribution of transgenic crops, by trait

During the six-year period 1996 to 2001, herbicide tolerance has consistently been the dominant trait followed by insect resistance (Figure 5). In 2001, herbicide tolerance, deployed in soybean, corn and cotton, occupied 77% of the 52.6 million hectares (Table 5), with 7.8 million hectares planted to *Bt* crops equivalent to 15% and stacked genes for herbicide-tolerance and insect resistance deployed in both cotton and corn occupying 8% of the global transgenic area in 2001. It is noteworthy that the area of herbicide-tolerant crops has increased significantly by 24% or 7.9 million hectares between 2000 and 2001 (32.7 million hectares to 40.6 million hectares). Crops with stacked genes for herbicide tolerance and *Bt* also increased from 3.2 million hectares in 2000 to 4.2 million hectares in 2001, whereas the global area of insect-resistant crops has decreased from 8.3 million hectares in 2000 to 7.8 million hectares in 2001 (Table 5 and Figure 5). The trend for stacked genes to gain an increasing share of the global transgenic crop market is expected to continue.

Dominant transgenic crops in 2001

Herbicide-tolerant soybean was the dominant transgenic crop grown commercially in seven countries in 2001 – USA, Argentina, Canada, Mexico, Romania, Uruguay and South Africa (Table 6). Globally, herbicide-tolerant soybean occupied 33.3 million hectares, representing 63% of the global transgenic crop area of 52.6 million hectares for all crops. The second most dominant crop was *Bt* maize, which occupied 5.9 million hectares, equivalent to 11% of global transgenic area and planted in six countries – USA, Canada, Argentina, South Africa, Spain and Germany. The other six crops listed in Table 6 all occupy 5% or less of global transgenic crop area and include, in descending order of area, herbicide-tolerant canola, occupying 2.7 million hectares (5%); *Bt*/herbicide-tolerant cotton on 2.4 million hectares (5%); herbicide-tolerant maize on 2.1 million hectares (4%); *Bt* cotton on 1.9 million hectares (4%); *Bt*/herbicide-tolerant maize on 1.8 million hectares (3%).

Global adoption of transgenic soybean, corn, cotton and canola

One useful way to portray a global perspective of the status of transgenic crops is to characterize the global adoption rates of the four principal crops – soybean, cotton, canola and corn – in which transgenic technology is utilized (Table 7 and Figure 6). The data indicate that in 2001, 46% of the 72 million hectares of soybean planted globally were transgenic, up from 36% in 2000. Similarly, 20% of the 34 million hectares of cotton, up from 16% in 2000, were planted to transgenic cotton. The areas planted to transgenic canola and maize, expressed on percentage basis, were unchanged at 11% of the 25 million hectares of canola, and 7% of the 140 million hectares of maize respectively. If the global areas (conventional and transgenic) of these four crops are aggregated, the total area is 271 million hectares, of which 19% is under transgenics, up from 16% in 2000. It is noteworthy that two-thirds of these 271 million hectares are in the developing countries where yields are lower, constraints are greater and the need for improved production of food, feed and fibre crops is the greatest.

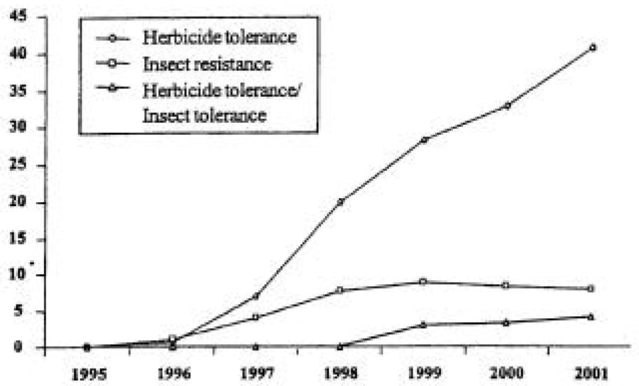

Figure 5. Global area of transgenic crops, 1996 to 2001: by trait (million hectares).

Concluding remarks

The experience of the first six years, 1996 to 2001, during which a cumulative total of over 175 million hectares (almost 440 million acres) of transgenic crops were planted globally in 16 countries, 10 industrialized and 6 developing, has vindicated the vision of the pioneers of crop biotechnology who have seen their early promises of transgenic crops fulfilled – GM crops have met the expectations of large and small farmers planting transgenic crops in both industrial and developing countries.

The unprecedented rapid adoption of transgenic crops during the first six-year period, 1996 to 2001, reflects the significant multiple benefits realized by large and small

Table 5. Global area of transgenic crops in 2000 and 2001: by trait (million hectares)

Trait	2000	%	2001	%	+/–	%
Herbicide tolerance	32.7	74	40.6	77	+ 7.9	+ 24
Insect resistance (*Bt*)	8.3	19	7.8	15	– 0.5	– 6
Bt/herbicide tolerance	3.2	7	4.2	8	+ 1.0	+ 31
Virus resistance/other	< 0.1	< 1	< 0.1	< 1	< 0.1	–
Global total	44.2	100	52.6	100	+ 8.4	19

Table 6. Dominant transgenic crops 2001

Crop	Million hectares	% of global transgenic crop area
Herbicide-tolerant soybean	33.3	63
Bt maize	5.9	11
Herbicide-tolerant canola	2.7	5
Herbicide-tolerant cotton	2.5	5
Bt/herbicide-tolerant cotton	2.4	5
Herbicide-tolerant maize	2.1	4
Bt cotton	1.9	4
Bt/herbicide maize	1.8	3
Total	52.6	100

Table 7. Transgenic crop area as per cent global area of principal crops, 2001 (million hectares)

Crop	Global area	Transgenic crop area	Transgenic area as per cent of global area
Soybean	72	33.3	46
Cotton	34	6.8	20
Canola	25	2.7	11
Maize	140	9.8	7
Total	271	52.6	19

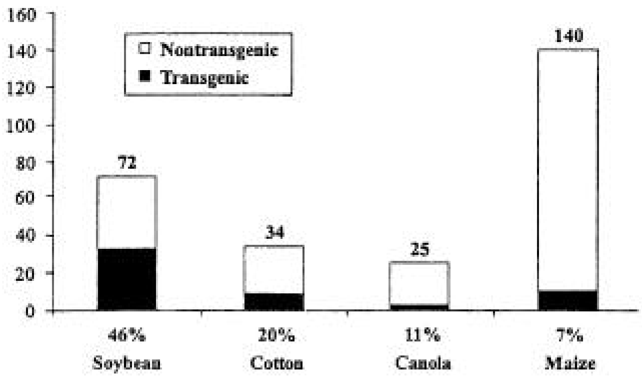

Figure 6. Global area adoption rates (%) for principal transgenic crops, 2001 (million hectares).

farmers. There is a growing body of evidence that clearly demonstrates the improved weed and insect pest control attainable with transgenic herbicide-tolerant and insect-resistant *Bt* crops that also benefit from lower input and production costs. Despite the ongoing debate on GM crops, particularly in countries of the European Union, millions of large and small farmers in both industrial and developing countries continue to increase their plantings of GM crops because of the significant multiple benefits they offer. More specifically, the use of transgenic crops results in:

- More sustainable and resource-efficient crop management practices that require less energy and fuel and conserves natural resources.
- More effective control of insect pests and weeds.
- A reduction in the overall amount of pesticides used in crop production, which impacts positively on biodiversity, protects predators and non-target organisms and contributes to a safer environment.
- Less dependency on conventional pesticides that can be a health hazard to producers and consumers; the potential health benefits associated with fewer pesticide poisonings from *Bt* cotton in China is an important finding, with significant implications for other developing countries where small farmers may be at similar risk from heavy and over-use of conventional pesticides.
- *Bt* maize, which has reduced levels of the fumonisin mycotoxin provides safer and healthier food and feed products.
- Greater operational flexibility in timing of herbicide and insecticide applications.
- Conservation of soil moisture, structure, nutrients and control of soil erosion through no or low-tillage practices as well as improved quality of ground and surface water with less pesticide residues.

There is now considerable evidence that transgenic crops are delivering significant economic benefits. The global economic advantage to farmers deploying herbicide-tolerant (HT) soybean, HT canola and *Bt* corn was estimated to be of the order of \$ 700 million in 1999, equally shared between developing and industrial countries. In addition to these direct economic advantages that farmers derive from transgenic crops, there are also significant additional indirect benefits to others in society. For crops such as herbicide-tolerant soybean, these indirect benefits to consumers globally can be of the same order of magnitude as the direct economic advantages to farmers. Thus, the global direct and indirect economic advantage of GM crop in 1999 was of the order of \$ 1 billion or more.

2001 is the initial year of the second quinquennium (2001–2005) during which GM crops are being commercialized – so what might we expect at the dawn of a new quinquennium in crop biotechnology? In 2001, coincidental with increased political, policy and institutional support for GM crops due to their acknowledged contribution to global food security, the global area of transgenic crops benefited from renewed growth which resulted in a 19% increase in global GM crop area in 2001 – almost twice the growth rate in 2000. The number of farmers that benefited from GM crops increased from 3.5 million farmers in 2000 to an estimated 5.5 million in 2001. More than three-quarters of the GM farmers that benefited from GM crops in 2001 were resource-poor farmers planting *Bt* cotton, mainly in eight provinces in China and also in the Makathini Flats in KwaZulu Natal province in South Africa. The well documented experience of China with *Bt* cotton presents a remarkable case study where 5 million small resource-poor farmers in 2001 are already benefiting from significant agronomic, environmental, health and economic advantages – this is a unique example of how biotechnology can impact on poverty alleviation, as advocated in the 2001 UNDP Human Development Report. The China experience with *Bt* cotton lends itself for introduction and replication to carefully selected developing countries in Asia, Latin America and Africa where resource-poor farmers can learn, share and benefit from the rich experience of China – the majority of the hectarage of global cotton is grown in developing countries. Following a successful launch of *Bt* cotton in 2001, Indonesia is also expected to expand its

Bt cotton in 2002, and India, the largest cotton growing country in the world, has approved commercial cultivation of *Bt* cotton in 2002.

There is cautious optimism that global area and the number of farmers planting GM crops will continue to grow in 2002 in the six principal countries already growing GM crops – USA, Argentina, Canada, China, South Africa and Australia. The other seven countries growing transgenic crops in 2001 are expected to report modest growth in GM crop area in 2002. The commercialization of herbicide-tolerant soybean in Brazil will be dependent on resolving the outstanding regulatory issues between the Ministries of Agriculture, Environment and Justice. The commercialization of GM crops in India and Brazil would represent a watershed for GM crops in developing countries in that the three most populous countries in Asia – China, India and Indonesia with 2.5 billion people, as well as the three major economies of Latin America – Argentina, Brazil and Mexico, plus South Africa would then all be commercializing and benefiting from transgenic crops.

As new and novel products with input and output traits will become available for commercialization in the 2001–2005 quinquennium, it is critical that these products be deployed in an integrated strategy in which both conventional and biotechnology applications are applied to attain the challenging goal of global food security. Adoption of such a strategy will allow society to continue to benefit from the vital contributions that both conventional and modern plant breeding offer. Technology is only one of several elements that can contribute to an integrated global food security strategy where population control and improved food distribution systems are also essential elements. Biotechnology can play its appropriate and essential role in achieving food security in the developing world in countries such as China, which has assigned high priority and a strategic value to biotechnology. The experience of China, Argentina and South Africa, that are already deriving significant benefits from GM crops, should be shared with other developing countries in the three continents of the South which face similar challenges.

This closing paragraph is excerpted from a previous ISAAA Brief. The content is so appropriate at this time that it bears repetition: 'Governments, supported by the global scientific and international development community, must ensure continued safe and effective testing and introduction of transgenic crops and implement regulatory programs that inspire public confidence. Leadership at the international level must be exerted by the international scientific community and development institutions to stimulate discussion and to share knowledge on transgenic crops with society that must be well informed and engaged in a dialogue about the impact of the technology on the environment, food safety, health of producers and consumers, sustainability and global food security. Societies in food-surplus countries must ensure that access to biotechnology is not denied or delayed to developing countries seeking to access the new technologies in their quest for food security, because the most compelling case for biotechnology, more specifically transgenic crops, is their potentially vital contribution to global food security and the alleviation of hunger in the Third World. In short, we must ensure that society will continue to benefit from the vital contribution that plant breeding offers, using both conventional and biotechnology tools, because improved crop varieties are, and will continue to be the most cost effective, environmentally safe and sustainable way to ensure global food security in the future.'