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ISAAA Briefs

PREVIEW

Global Review of Commercialized Transgenic Crops: 1999

by

Clive James
Chair, ISAAA Board of Directors

Global Area of Transgenic Crops, 1996 to 1999
(millions of hectares/acres)

	Hectares (million)	Acres (million)
1996	1.7	4.3
1997	11.0	27.5
1998	27.8	69.5
1999	**39.9**	**98.6**

Increase of 44%, 12.1 million hectares or 29.1 million acres, between 1998 and 1999

Source: Clive James, 1999

No. 12-1999

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Published by: The International Service for the Acquisition of Agri-biotech Applications (ISAAA).

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Citation: James, C. 1999. Global Status of Commercialized Transgenic Crops: 1999. *ISAAA Briefs* No.12: Preview. ISAAA: Ithaca, NY.

ISBN: 1-892456-16-8

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Introduction

Between 1996 and 1999, twelve countries, 8 industrial and 4 developing, have contributed to more than a twenty fold (23.5) increase in the global area of transgenic crops (Table 1). Adoption rates for transgenic crops are unprecedented and are the highest for any new technologies by agricultural industry standards. High adoption rates reflect grower satisfaction with the products that offer significant benefits ranging from more convenient and flexible crop management, higher productivity or net returns/hectare and a safer environment through decreased use of conventional pesticides, which collectively contribute to a more sustainable agriculture. In 1999, the global area of transgenic crops increased by 44 %, or 12.1 million hectares, to 39.9 million hectares, from 27.8 million hectares in 1998 (Table 1). Seven transgenic crops were grown commercially in twelve countries in 1999, three of which, Portugal, Rumania and Ukraine, grew transgenic crops for the first time.

Distribution by Country

The countries listed in descending order of transgenic crop area on a global basis in 1999 (Table 2) are: USA 28.7 million hectares, representing 72 % of the global area; Argentina with 6.7 million hectares equivalent to 17 % of global area; Canada 4.0 million hectares representing 10 %; China with approximately 0.3 million hectares equivalent to 1 %; Australia and South Africa each grew 0.1 million hectares of transgenic crops in 1999. The balance of <1 % was grown in Mexico, Spain, France, Portugal, Rumania and Ukraine, each with <0.1 million hectares. The proportion of transgenic crops grown in industrial countries was 82 % (Table 3), less than 1998 (84 %), with 18 % grown in the developing countries, with most of that area in Argentina, and the balance in China, South Africa and Mexico.

As in 1998, the largest increase in transgenic crops in 1999 occurred in the USA (8.2 million hectares) where there was a 0.4 fold increase, followed by Argentina (2.4 million hectares) with a 0.6 fold increase, and Canada (1.2 million hectares) with a 0.4 fold increase. USA continued to be the principal grower of transgenic crops in 1999 although its share of global area was slightly lower (72 %) in 1999

than in 1998 (74%). China's transgenic crop area increase was the largest relative change, increasing 3.0 fold from less than 0.1 million hectares of *Bt* cotton in 1998 to approximately 0.3 million hectares in 1999, equivalent to 1% of global share; Argentina's global share of transgenic crop area increased from 15 % of global area in 1998 to 17 % in 1999. Canada's share of global transgenic crop area remained the same, 10 % of global area in 1998 and 1999.

Distribution by Crop

The seven transgenic crops grown in 1999 were, in descending order of area, soybean, corn/maize, cotton, canola/rapeseed, potato, squash and papaya (Table 4). Transgenic soybean and corn continued to be ranked first and second in 1999, accounting for 54 % and 28 % of global transgenic crop area, respectively. Cotton (3.7 million hectares) and canola (3.4million hectares) shared third ranking position in 1999 each occupying approximately 9 % of global area. Potato, squash and papaya occupied less than 1% of the global area of transgenic crops in 1999.

Distribution by Trait

The relative ranking of the principal transgenic traits were the same in 1998 and 1999 (Table 5), with herbicide tolerance being by far the highest, at 71 % in both 1998 and 1999. Insect resistant crops decreased from 28 % in 1998 to 22 % in 1999. However, stacked genes for insect resistance and herbicide tolerance increased significantly in the US in both maize and cotton from 1 % in 1998 (0.3 million hectares) to 7 % or 2.9 million hectares in 1999, equivalent to an 8.7 fold increase; virus resistance traits in potatoes, squash and papaya occupied less than 1 % and <0.1 million hectares in both 1998 and 1999

Highlights 1998-99

The major changes in area and global share of transgenic crops for the respective countries, crops and traits, between 1998 and 1999 were related to the following factors.

- In 1999, the global area of transgenic crops increased by 44 %, or 12.1 million hectares, to 39.9 million hectares, from 27.8 million hectares in 1998. Seven transgenic crops were grown commercially in twelve countries in 1999, three of which, Portugal, Rumania and Ukraine, grew transgenic crops for the first time.
- The four principal countries that grew the majority of transgenic crops in 1999 were USA 28.7 million hectares (72 % of the global area); Argentina, 6.7 million hectares (17 %), Canada 4.0 million hectares (10 %); China 0.3 million hectares (1 %); The balance was grown in Australia, South Africa, Mexico, Spain, France, Portugal, Rumania and Ukraine.

- Growth in area of transgenic crops between 1998 and 1999 in the industrial countries continued to be significant and 3.5 times greater than in developing countries (9.4 million hectares versus 2.7 million hectares).

- In terms of crops, soybean contributed the most (59 %) to global growth of transgenic crops, equivalent to 7.1 million hectares between 1998 and 1999, followed by corn at 23 % (2.8 million hectares), cotton at 10 % (1.2 million hectares) and canola at 8 % (1.0 million hectares).

- There were three noteworthy developments in terms of traits; herbicide tolerance contributed the most (69 % or 8.3 million hectares) to global growth between 1998 and 1999; the stacked genes of insect resistance and herbicide tolerance in both corn and cotton contributed 21 % equivalent to 2.6 million hectares; and insect resistance increased by 1.2 million hectares in 1999 representing 10 % of global area growth.

- Of the 4 major transgenic crops grown in 12 countries in 1999, the two principal crops of soybean and corn represented 54% and 28% respectively for a total of 82 % of the global transgenic area, with the remaining 18% shared equally between cotton (9 %) and canola (9 %).

- In 1999, herbicide tolerant soybean was the most dominant transgenic crop (54 % of global transgenic area, compared with 52% in 1998), see Table 6, followed by insect resistant corn (19 % compared with 24% in 1998), herbicide tolerant canola (9 %), *Bt*/herbicide tolerant corn at 5 % herbicide tolerant cotton at 4 %, herbicide tolerant corn at 4%, *Bt* cotton at 3% and *Bt*/Herbicide tolerant cotton at 2 %.

- The four major factors that influenced the change in absolute area of transgenic crops between 1998 and 1999 and the relative global share of different countries, crops and traits were:

    - firstly, the substantial increase of 4.8 million hectares in herbicide tolerant soybean in the USA (from 10.2 million hectares in 1998 to 15.0 million hectares in 1999, equivalent to 50 % of the 30.0 million hectares US national soybean crop in 1999), coupled with an increase of 2.1 million hectares in herbicide tolerant soybean in Argentina (from 4.3 million hectares in 1998 to an estimated 6.4 million hectares in 1999, equivalent to approximately 90 % of the 7.0 million hectares of Argentinean national soybean crop in 1999);.

    - secondly, the significant increase of 2.2 million hectares of transgenic corn (insect resistant, *Bt*/herbicide tolerance and herbicide tolerance) in the USA from 8.1 million hectares in 1998 to 10.3 million hectares in 1998, equivalent to 33 % of the 31.4 million hectares US national corn crop in 1999;

- thirdly, the increase of 1.0 million hectares of herbicide tolerant canola in Canada from 2.4 million hectares in 1998 to 3.4 million hectares in 1999, equivalent to 62 % of the 5.5 million hectares Canadian canola crop in 1999;
- and fourth, the 1.0 million hectares increase of transgenic cotton in the USA from 2.2 million hectares in 1998 to 3.2 million hectares in 1999 (equivalent to 55 % of the 5.9 million hectares US national cotton crop in 1999). The 3.2 million hectares of transgenic cotton in 1999 comprised 1.5 million hectares of herbicide tolerant cotton with the balance of 1.7 million hectares equally divided between *Bt* cotton and the stacked gene of *Bt*/herbicide tolerance.

- The combined effect of the above four factors resulted in a global area of transgenic crops in 1999 that was 12.1 million hectares higher and 1.4 fold (44 %) greater than 1998; this is a significant year-on-year increase considering the high percentage of the principal crops planted to transgenics in 1998. Commercialized transgenic crops were grown for the second year in two countries of the European Union (30,000 hectares of *Bt* maize in Spain and 1,000 hectares of *Bt* maize in France) with Portugal growing more than 1,000 hectares of *Bt* maize for the first time in 1999. Two countries in Eastern Europe grew transgenic crops for the first time; Rumania grew introductory areas of herbicide tolerant soybean (>1,000 hectares) and planted <1,000 hectares of *Bt* potatoes, with Ukraine also growing *Bt* potatoes (<1,000 hectares) for the first time. There may also have been a small area of *Bt* maize grown in Germany in 1999 but this could not be verified and thus is not included in the global database.

Value of the Global Market

The global market for transgenic crop products has grown rapidly during the period 1995 to 1999. Global sales from transgenic crops were estimated at $75 million in 1995; sales tripled in 1996 and again in 1997 to reach $235 million and $670 million respectively, more than doubled in 1998 to reach $1.6 billion and increased by more than a third in 1999 to reach an estimated $2.1 to $2.3 billion. Thus, revenues for transgenic crops have increased by approximately thirty fold in the five-year period 1995 to 1999. The global market for transgenic crops is projected to reach approximately $3 billion in 2000, $8 billion in 2005, and $25 billion in 2010.

The Future

The number of countries growing transgenic crops has increased from 1 in 1992, to 6 in 1996, to 9 in 1998, and to 12 in 1999. Area planted to transgenic crops is

expected to continue to grow but will probably start to plateau in the in the year 2000 reflecting the unprecedented high adoption rates to-date and the high percentage of the principal crops already planted to transgenics in the USA, Argentina and Canada.

In the year 2000, countries in Latin America already growing transgenic crops are expected to modestly expand the area of current products and also to introduce new single and multiple trait products, with Brazil, subject to regulatory approval and market demand, possibly growing transgenic crops officially for the first time in 2000. China is expected to expand its transgenic crop area aggressively, with growth and diversification continuing in South Africa, Australia and the Eastern European countries that have already commercialized transgenics. India has transgenic material that is ready for commercialization pending final approval. The major issues that will modulate adoption in the year 2000 will be public acceptance which drives market demand, and regulation. These two issues and labeling of foods derived from genetically modified plants will continue to be dominant factors that will impact on commercial planting of transgenic crops and consumption of genetically modified derived foods in countries of the European Union.

As expansion of transgenic crops continues, a shift will occur from the current generation of "input" agronomic traits to the next generation of "output" quality traits, which will result in improved and specialized nutritional food and feed products that will satisfy a high-value-added market; this will significantly affect the value of the global transgenic crop market and also broaden the beneficiary profile from growers to consumers which could in turn have important implications for public acceptance..

The pace of biotechnology-driven consolidations in industry was slower in 1999 than in the previous 3 years, although there were many alliances in the area of plant genomics that will continue to be of pivotal importance. Most of the large multinationals with investments in seeds, crop biotechnology and crop protection are currently undertaking reviews of their investments and some have already initiated restructuring which has resulted in more focus and downsizing of programs which could lead to new alliances and mergers.

Table 1: Global Area of Transgenic Crops in 1996, 1997, 1998 and 1999

	Hectares (million)	Acres (million)
1996	1.7	4.3
1997	11.0	27.5
1998	27.8	69.5
1999	39.9	98.6

Increase of 44 %, 12.1 million hectares or 29.1 million acres between 1998 and 1999.

Source: Clive James, 1999.

Table 2: Global Area of Transgenic Crops in 1998 & 1999:
By Country (millions of hectares)

Country	1998	%	1999	%	Increase 1998 to 1999	(Ratio)
USA	20.5	74	28.7	72	8.2	(0.4)
Argentina	4.3	15	6.7	17	2.4	(0.6)
Canada	2.8	10	4.0	10	1.2	(0.4)
China	<0.1	<1	0.3	1	0.2	(3.0)
Australia	0.1	1	0.1	<1	<0.1	(- -)
South Africa	<0.1	<1	0.1	<1	<0.1	(- -)
Mexico	<0.1	<1	<0.1	<1	<0.1	(- -)
Spain	<0.1	<1	<0.1	<1	<0.1	(- -)
France	<0.1	<1	<0.1	<1	<0.1	(- -)
Portugal	0.0	0	<0.1	<1	<0.1	(- -)
Rumania	0.0	0	<0.1	<1	<0.1	(- -)
Ukraine	0.0	0	<0.1	<1	<0.1	(- -)
Total	**27.8**	**100**	**39.9**	**100**	**12.1**	**(0.4)**

Source: Clive James, 1999.

Table 3: Global Area of Transgenic Crops in 1998 & 1999: Industrial & Developing Countries (millions of hectares)

	1998	%	1999	%	Increase (Ratio)
Industrial Countries	23.4	84	32.8	82	9.4 (0.4)
Developing Countries	4.4	16	7.1	18	2.7 (0.6)
Total	**27.8**	**100**	**39.9**	**100**	**12.1 (0.4)**

Source: Clive James, 1999.

Table 4: Global Area of Transgenic Crops in 1998 & 1999: By Crop (millions of hectares)

Crop	1998	%	1999	%	Increase (Ratio)
Soybean	14.5	52	21.6	54	7.1 (0.5)
Corn	8.3	30	11.1	28	2.8 (0.3)
Cotton	2.5	9	3.7	9	1.2 (0.5)
Canola	2.4	9	3.4	9	1.0 (0.4)
Potato	<0.1	<1	<0.1	<1	<0.1 (- -)
Squash	0.0	0	<0.1	<1	(- -) (- -)
Papaya	0.0	0	<0.1	<1	(- -) (- -)
Total	**27.8**	**100**	**39.9**	**100**	**12.1 (0.4)**

Source: Clive James, 1999.

Table 5: Global Area of Transgenic Crops in 1998 & 1999:
By Trait (millions of hectares)

Trait	1998	%	1999	%	Increase (Ratio)
Herbicide tolerance	19.8	71	28.1	71	8.3 (0.4)
Insect resistance (*Bt*)	7.7	28	8.9	22	1.2 (0.2)
Bt/Herbicide Tolerance	0.3	1	2.9	7	2.6 (8.7)
Virus resistance/Other	<0.1	<1	<0.1	<1	< 0.1 (-.-)
Global Totals	**27.8**	**100**	**39.9**	**100**	**12.1 (0.4)**

Source: Clive James, 1999.

Table 6: Dominant Transgenic Crops 1999

Crop	Million Hectares	% Transgenic
Herbicide tolerant Soybean	21.6	54
Bt Maize	7.5	19
Herbicide tolerant Canola	3.5	9
Bt/Herbicide tolerant Corn	2.1	5
Herbicide tolerant Cotton	1.6	4
Herbicide tolerant Corn	1.5	4
Bt Cotton	1.3	3
Bt/Herbicide tolerant Cotton	0.8	2
Total	**39.9**	**100**

Source: Clive James, 1999.