

BIOTECHNOLOGY PATENTS

The following was extracted from the OECD (2005), *Compendium of Patent Statistics*. The report is available on line at: www.oecd.org/sti/ipr-statistics

- Biotechnology patents have grown more rapidly than overall patent applications at the European Patent Office (EPO). Between 1991 and 2002, they grew by 8.3% a year, while total EPO patent applications grew by 5.7%. The rate of increase in biotechnology patents accelerated from 1994 onwards. The latest available data show a slight decline in biotechnology patent filings at the EPO. This could be related to the adoption by the EPO of more restrictive policies for examining biotechnology patents in recent years. This trend is also observed for countries with a large biotechnology patent portfolio.
- The latest available data show that around 5.3% of all EPO patent applications are in the biotechnology field (see methodological box for definition). However, the ratio of biotechnology patents to all EPO patents varies substantially across countries. New Zealand, Denmark and Australia have a very high ratio of biotechnology patents to all EPO patents (more than 10%). In contrast, only around 2% of all EPO patents originating from Finland and Italy are biotechnology patents.
- For the majority of countries, the ratio of biotechnology patents to all EPO patents increased between 1991 and 2002. However, notable exceptions are Denmark and Belgium as well as countries with a low ratio of biotechnology patents to all EPO patents.
- In 2002, more than 5,800 biotechnology patents were filed at the European Patent Office (EPO), most of which originated from the United States (39.9%) and the European Union (34.5%). Around 14% of the EPO biotechnology patents originate from Japan. Since 1997, the shares of the European Union and Japan in biotechnology patents have increased, while those of the United States have continuously decreased.
- To measure a country's level of specialisation in biotechnology patents, country shares can be expressed in terms of a specialisation index (see methodological box). By this measure, the United States is highly specialised in biotechnology patents, while the European Union and Japan are not.
- Denmark, Canada, New Zealand and Australia are the most specialised countries in biotechnology patents. Italy, Turkey and Luxembourg are the least specialised. Three non-OECD countries (Israel, China and India) are also relatively specialised in biotechnology patents.

Definition of biotechnology patents

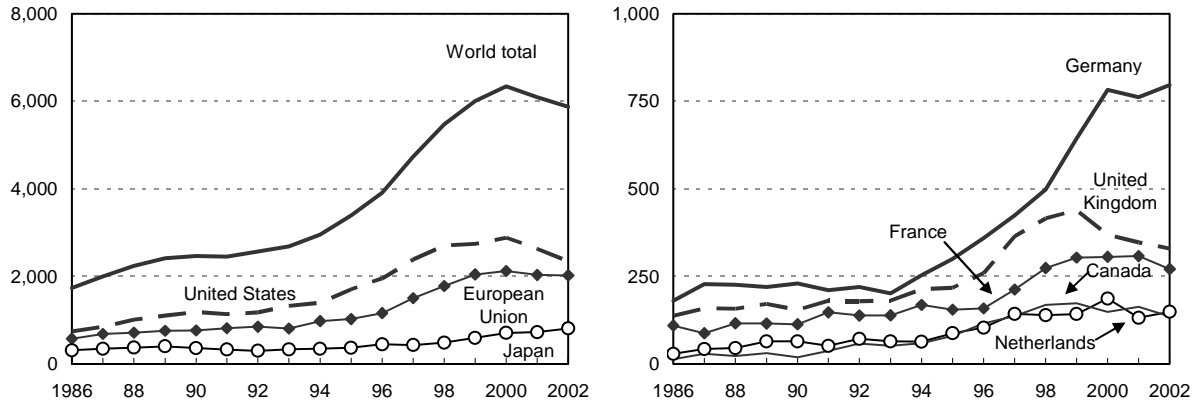
The definition of biotechnology patents covers the following IPC classes: A01H1/00, A01H4/00, A61K38/00, A61K39/00, A61K48/00, C02F3/34, C07G(11/00, 13/00, 15/00), C07K(4/00, 14/00, 16/00, 17/00, 19/00), C12M, C12N, C12P, C12Q, C12S, G01N27/327, G01N33/(53*, 54*, 55*, 57*, 68, 74, 76, 78, 88, 92).

For further details on the IPC classes, see www.wipo.int/classifications/fulltext/new_ipc/index.htm.

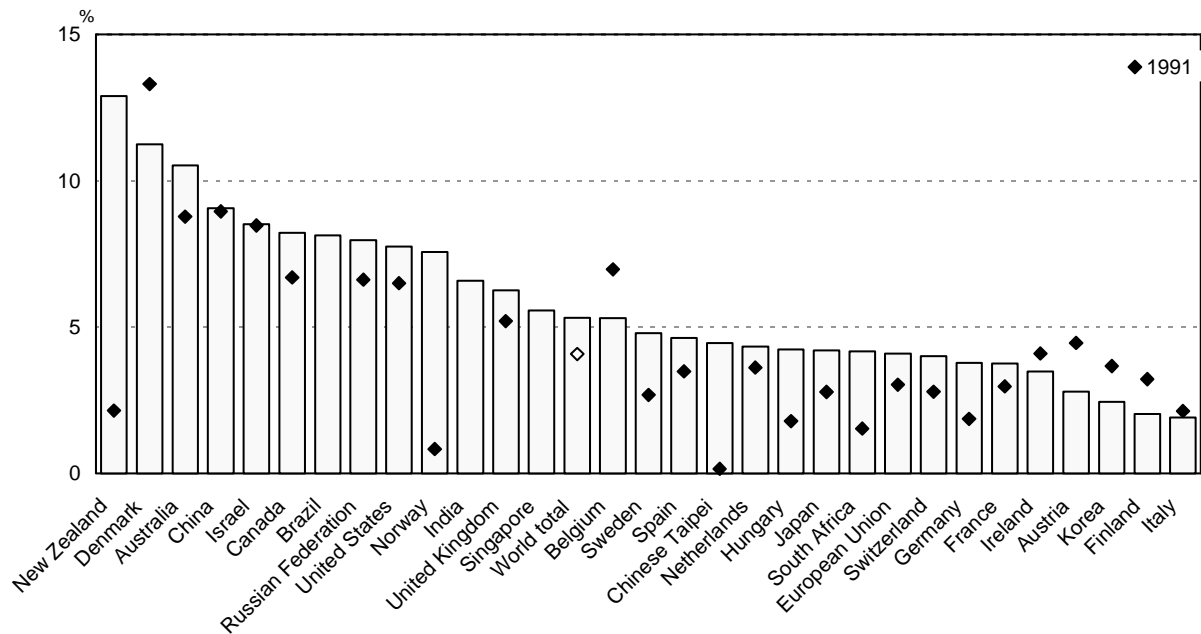
The specialisation index (SI) is calculated as the share of country A in a specific technology area (*i.e.* biotechnology patents) divided by the share of country A in all technology areas (total EPO patents of country A). When the SI of biotechnology patents is greater than 1, the country has a higher share in biotechnology patents relative to its share in all technology areas. Conversely, when the SI of biotechnology patents is below 1, the country has a lower share in biotechnology patents than in all technology areas combined.

Biotechnology patents

Trends in biotechnology patents¹ filed at the EPO
Total number, major regions and leading countries



Biotech patents¹ as a percentage of the national total (EPO): selected countries/economies,² 2002



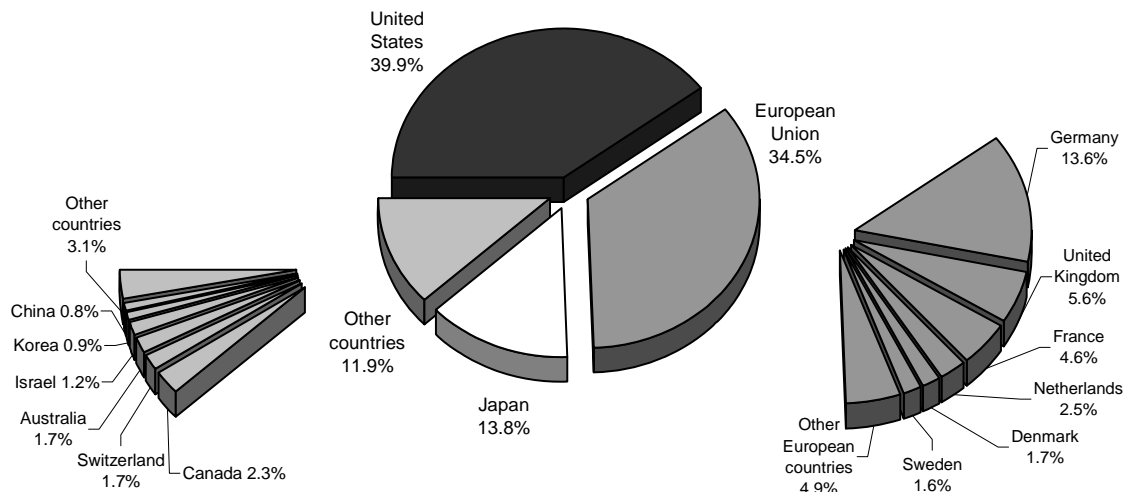
Patent counts are based on the inventor's country of residence, the priority date and fractional counts.

1. The provisional definition of biotechnology patents is presented in the methodological box.
2. The graph only covers countries with more than 100 EPO applications in 2002.

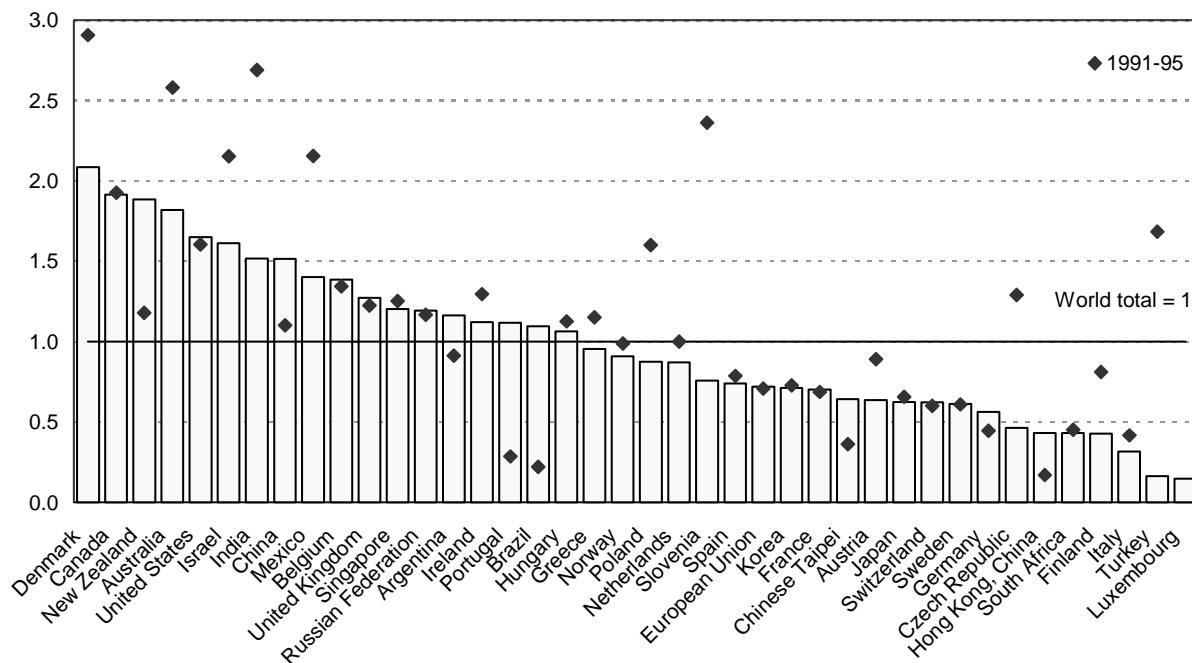
Source: OECD (2005), *Compendium of Patent Statistics*, January 2006.

Biotechnology patents

Share of countries in biotechnology patents¹ filed at the EPO, 2002



Specialisation index of biotechnology patents¹ filed at the EPO,² 1996-2002



Patent counts are based on the inventor's country of residence, the priority date and fractional counts.

1. The provisional definition of biotechnology patents is presented in the methodological box.
2. The graph only covers countries/economies with more than 200 EPO applications for the period 1996-2002.

Source: OECD (2005), *Compendium of Patent Statistics*, January 2006.

BIOTECHNOLOGY IN AGRICULTURE

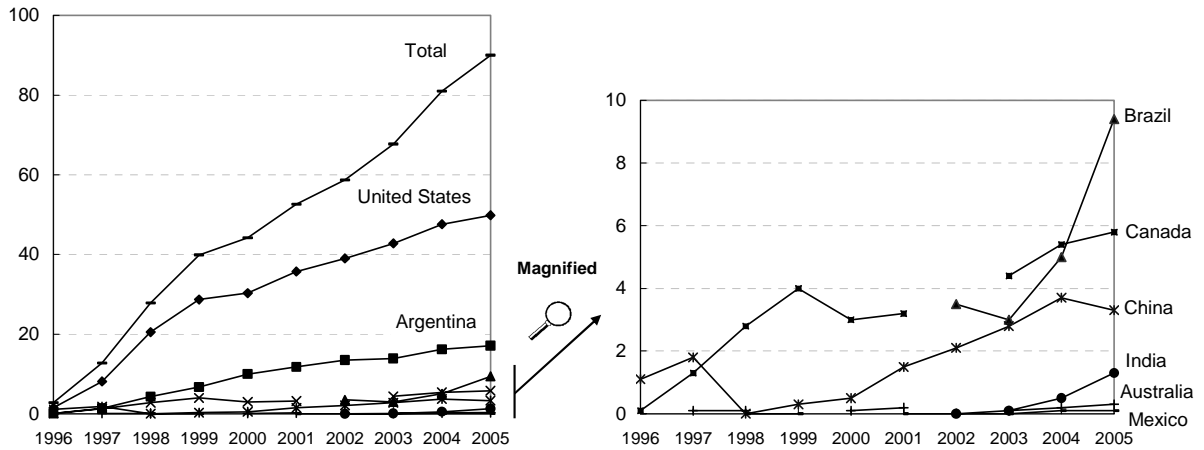
- Biotechnology has many applications in agriculture, including diagnostics, vaccines and therapeutics for animal health; DNA fingerprinting for managing animal stocks and identifying specific plant varieties, animal and plant propagation, marker-assisted selection for plant and animal breeding programmes, and genetic modification (GM) of plant and animal varieties using rDNA technology. Animal health applications are combined in this report with human health applications, due to the similarity in the underlying biotechnologies.
- Internationally comparable data for biotechnology applications in agriculture are limited to GM plant varieties. Two types of data are available: hectares planted with GM crops and field tests of new GM varieties.

Hectares planted with GM crops

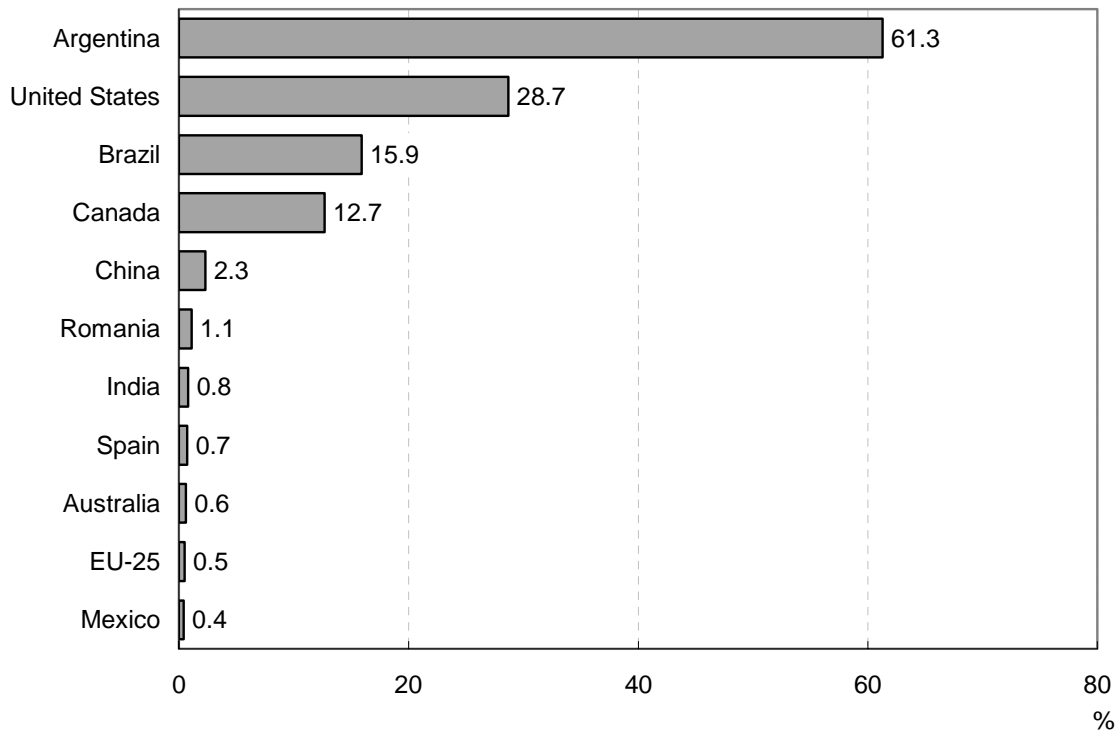
- GM crops were first extensively commercialised in 1996. Data on GM crop hectares are available for four OECD countries outside the European Union members, plus for India, China, Argentina and Brazil. The number of hectares planted with GM crops is negligible in most European Union countries, although some commercial GM crops are reported in 2005 for Spain, Germany, Portugal, France and the Czech Republic.
- In 2005, the United States accounted for 89% of GM crop hectares within the OECD. The United States' share of global GM crop hectares declined from 68% in 2000 to 55% in 2005, as the number of hectares planted with GM crops increased rapidly in other countries.
- In the three years between 2002 and 2005, the number of hectares planted with GM crops increased 27% in Argentina, 28% in the United States, 53% in Canada, 57% in China, and 169% in Brazil.
- The maximum area that can be planted with GM crops partly depends on the total arable land under cultivation. Argentina has the highest percentage of arable land planted with GM crops in 2005, at 61%, followed by the United States (29%), Brazil (16%) and Canada (13%). The estimate of 0.5% of arable land in the EU-25 under GM crops is likely to substantially overestimate the actual value.
- Two other main factors that determine the area planted with GM crops are regulations and the types of crops grown in each country. GM use is highest for countries with suitable growing conditions for the main GM crops to date: soybeans, maize, cotton, and canola.

Biotechnology in agriculture

Million hectares planted with GM crops, 1996 to 2005



Percent of all arable land^{1,2} planted with GM crops, 2005



1. Data for arable land is for 2003. The amount of error in the estimated percentage of land planted with GM crops is likely to be low because the total area of arable land is relatively stable. For example, between 2001 and 2003 total arable land decreased by 0.5% in the United States and increased by 0.4% in Canada. A larger change was observed in Australia, with a decrease of 1%.

2. Arable land is defined as land under annual crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for "Arable land" does not measure the amount of land that is potentially cultivable.

Sources: Clive James, 1997, 1999 'Global Review of Transgenic Crops', ISAAA Briefs, The International Service for the Acquisition of Agri-biotech applications (ISAAA), Ithaca New York; Clive James (2004, 2005), 'Global Status of Commercialized Biotech/GM Crops', ISAAA, Ithaca, New York; Data on arable land from FAOSTAT, 2006. <http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=agriculture>

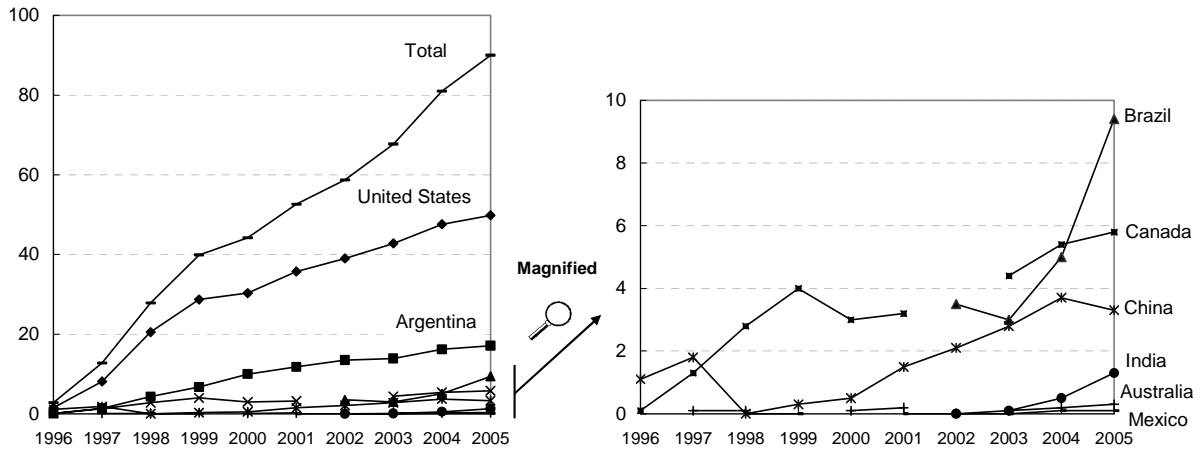
BIOTECHNOLOGY IN AGRICULTURE

Field trials of GM varieties

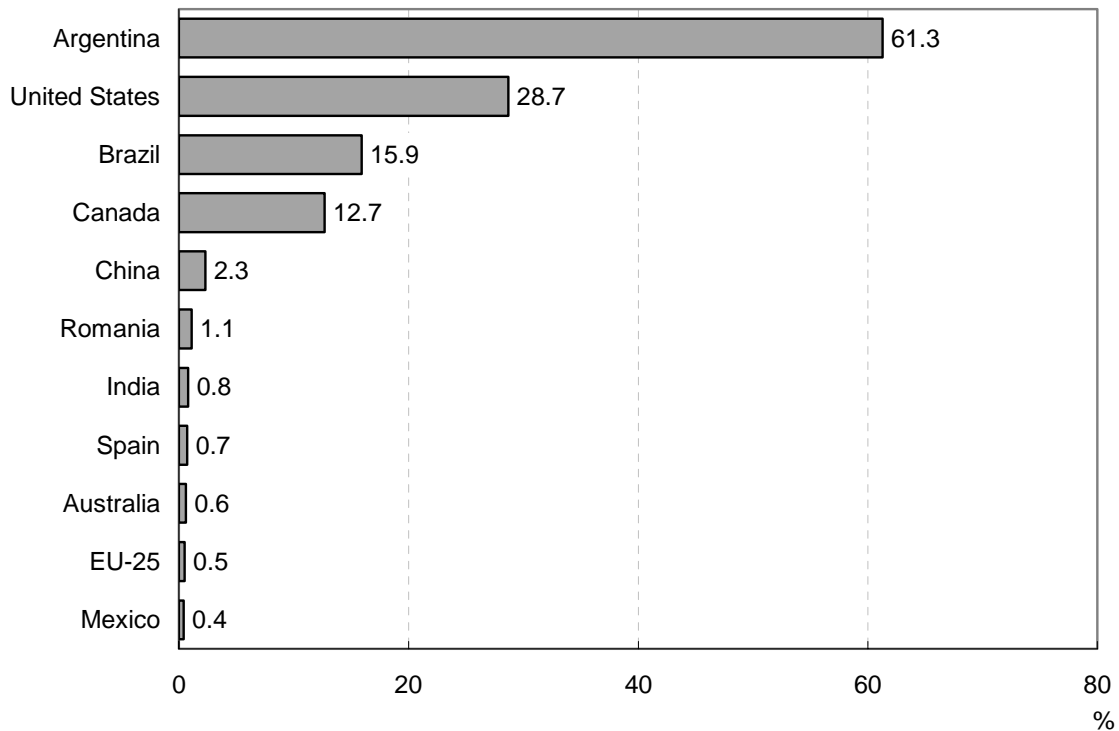
- For regulatory reasons, Australia, Canada, the European Union, Japan and the United States maintain publicly available databases of field trials of GM plant varieties. The field test data provide information on both the amount of development work to produce new GM plant varieties and the types of GM traits under development (see the methodological note).
- Field trials can be undertaken for one genetic trait or for two or more traits simultaneously (stacked traits). The results presented here count each trait, rather than each field trial.
- Field trial data are not available for Japan after 2001, and are therefore not included here. The most comparable recent time period for the remaining countries is between 2002 and 2004. The field trials are aggregated over these three years because of the low number of trials in the European Union and Australia.
- Between 2002 and 2004 inclusive, 4,970 traits were field tested in the United States, Canada, the European Union, and Australia combined. The United States accounted for 70.5% of the total, Canada for 23.1%, Europe for 4.8% and Australia for 1.5%.
- Canada has the highest intensity for field trials of specific traits, with 35.1 traits field tested per billion PPP\$ of agricultural output at producer prices and 36.2 traits field tested per million population. The United States is second, with 18.2 traits field tested per billion PPP\$ of output and 12.0 traits field tested per million population.
- The field trials cover five major categories of genetic traits: tolerance to commercial herbicides, pest resistance to viruses, bacteria, insects, nematodes and fungi; improvements to product quality such as the type of oils, starches, sugars or cellulose in the plant, and improvements to agronomic characteristics such as yield or salt and cold tolerance. A fifth type of field trial covers technical traits, such as marker genes, genetic containment or other traits that are unclassifiable.
- A large percentage of the field trials in the 1990s concerned herbicide tolerance. Other types of GM technology offer potential environmental advantages by reducing pesticide use and improving agronomic characteristics (which could reduce fertilizer use). In addition, 'second generation' traits for improved product quality, such as low phytase animal feeds or improved oil seeds, could increase the value added of crop production, replace non renewable industrial feed stocks with renewable agricultural feed stocks, and provide a range of environmental benefits.
- An increase over time in the share of product quality traits out of all traits is a marker for increasing interest in the commercial possibilities of second generation traits, which could reach the market within two to six years after the field trials. Trend data are available for the United States, Canada, and the EU-15.
- Over time, the share of domestic field tests for product quality fell in the United States from 24% in 1995 to 12% in 2000, but increased after 2004, reaching 24% of American trials in 2005. The percentage of trials for product quality traits in the European Union reached 28% in 2003, but this is based on a total of only 111 traits that were field tested, compared to 814 traits tested in field trials in the United States in 2003. There is no consistent trend for Canada in the share of product quality traits.
- The share of all domestic field trials for agronomic traits has increased the most in Canada, from 4% of all Canadian field trials of traits in 1998 to 24% of Canadian trials in 2004, followed by a slight decline to 22% in 2005. There is also a moderate upward trend in the United States since 2000, increasing from 7% to 17% of American field trials for agronomic traits in 2005.
- The United States accounted for over 50% of all field trials for each trait category between 2002 and 2004 inclusive. The United States conducted 81.4% of the 795 tests for product quality traits between 2002 and 2004 in the United States, Canada, the European Union, and Australia combined. The United States also conducted 86.3% of all trials during these three years for pest resistance traits and 54.9% of all trials for agronomic traits.

Biotechnology in agriculture

Million hectares planted with GM crops, 1996 to 2005



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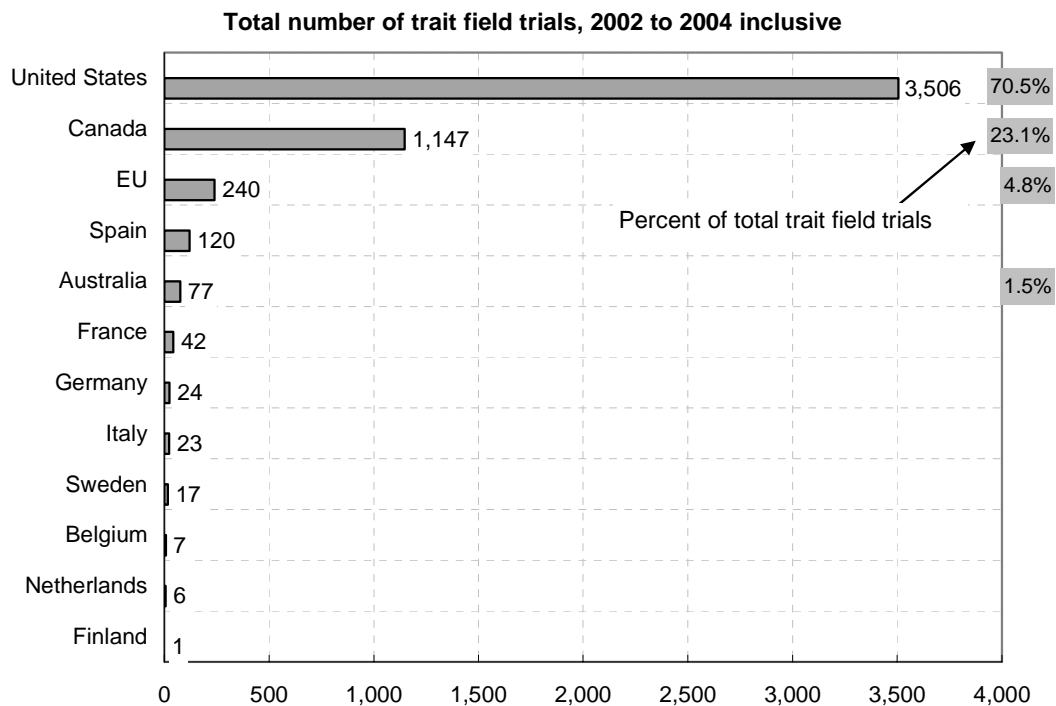
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BIOTECHNOLOGY IN AGRICULTURE

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Source: UNU-MERIT field trials database, March 2006.

Methodology

In the United States, the European Union, Canada and Australia field trials of new GM plant varieties are registered and the data are publicly available. Field trials cover a comparatively late stage of the development of GM varieties, as they do not include greenhouse and laboratory trials. Consequently, field trials provide evidence on relatively late stage research that could be ready for commercialisation within two to six years.

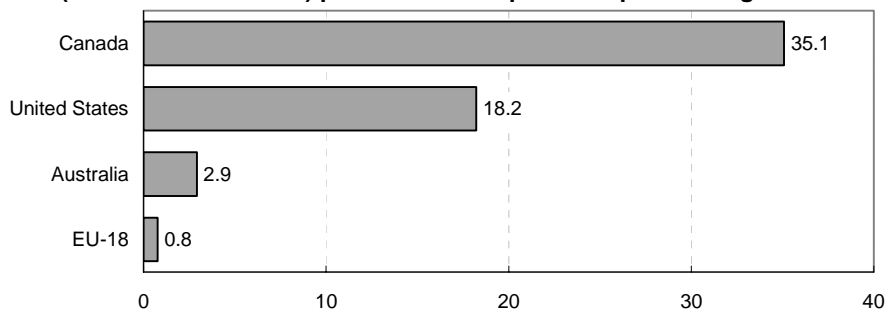
Field trial data have many of the advantages and limitations of patents. Both provide a measure of investment in particular lines of research by firms and public sector institutions to develop new plant varieties (field trials) or inventions (patents), but in both cases there is no direct relationship between the number of trials or patents and the outcome in terms of commercialised GM varieties or inventions. A series of trials can be abandoned, with no commercialisation of the GM variety, and there is a large range in the number of field trials required to develop a GM variety. For example, several hundred field trials were conducted in the United States to alter the ripening characteristics of a tomato variety whereas only 15 trials were required to develop a virus resistant papaya variety.

In the United States, field tests of GM varieties that have already received approval do not need to be registered, which decreases the comparability between Europe and the United States. The UNU-MERIT field trial database used here includes American data for both releases and notifications (an expedited type of release permit). For all countries, the UNU-MERIT database excludes non-plant field tests. The original field test data for Europe are available from <http://biotech.jrc.it/deliberate/gmo.asp>, for the United States from <http://www.aphis.usda.gov>, for Canada from <http://www.inspection.gc.ca>, and for Australia from <http://www.ogtr.gov.au>.

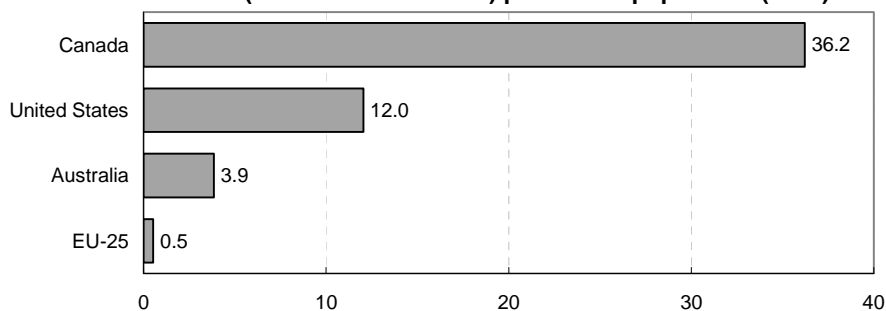
The United States provides ten identifiers for the purpose of each trait. These identifiers were used by UNU-MERIT to identify field trials of specific traits for herbicide tolerance, pest resistance, product quality, agronomic characteristics, and other types of traits. The European Union, Canada, and Australia provide information on the trait but do not include an identifier. UNU-MERIT used the data from the United States and other sources to assign each trait in these countries to one of the five main categories. This classification system contains an unknown but small amount of error because some genetic traits can be used for different purposes. In a small number of trials insufficient detail is provided to accurately determine the purpose of a trial. These are assigned to the 'other' category. All results are based on field tests of specific traits. Approximately 20% of the field tests are for two or more 'stacked' traits. In these cases, each trait is counted separately.

Biotechnology in agriculture

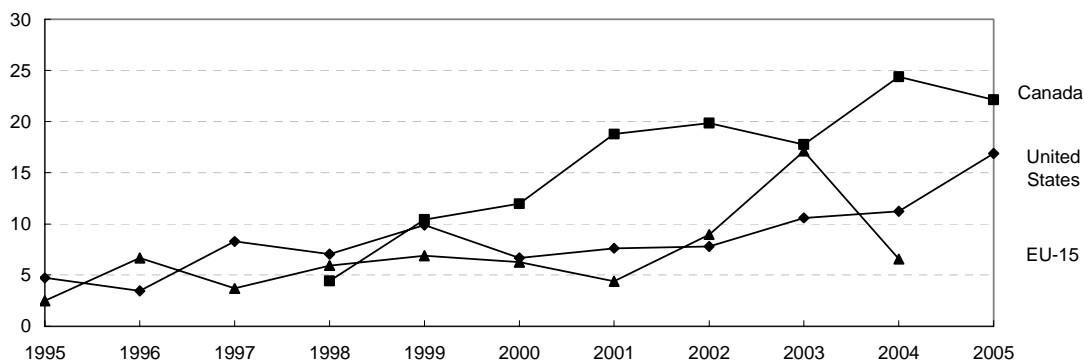
Trait field trials (2002 - 2004 inclusive) per billion PPP\$ producer prices of agricultural output (2003)



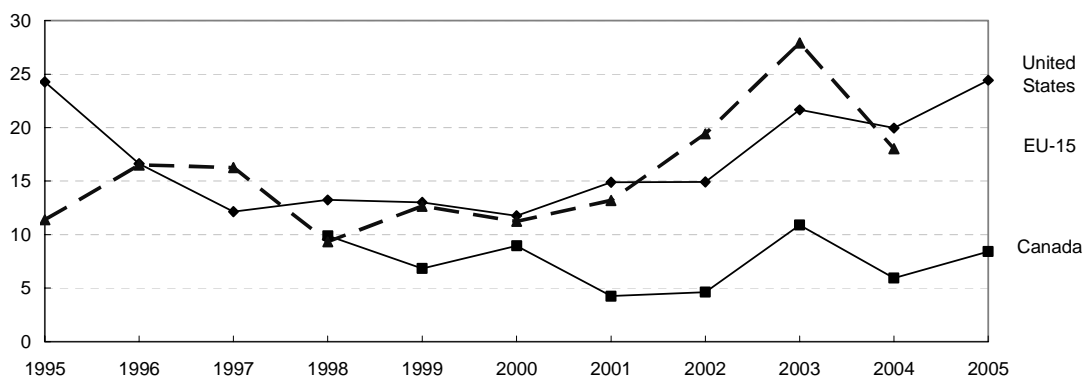
Trait field trials (2002 - 2004 inclusive) per million population (2002)



Percent of all domestic trait field trials for agronomic traits, 1995 to 2005



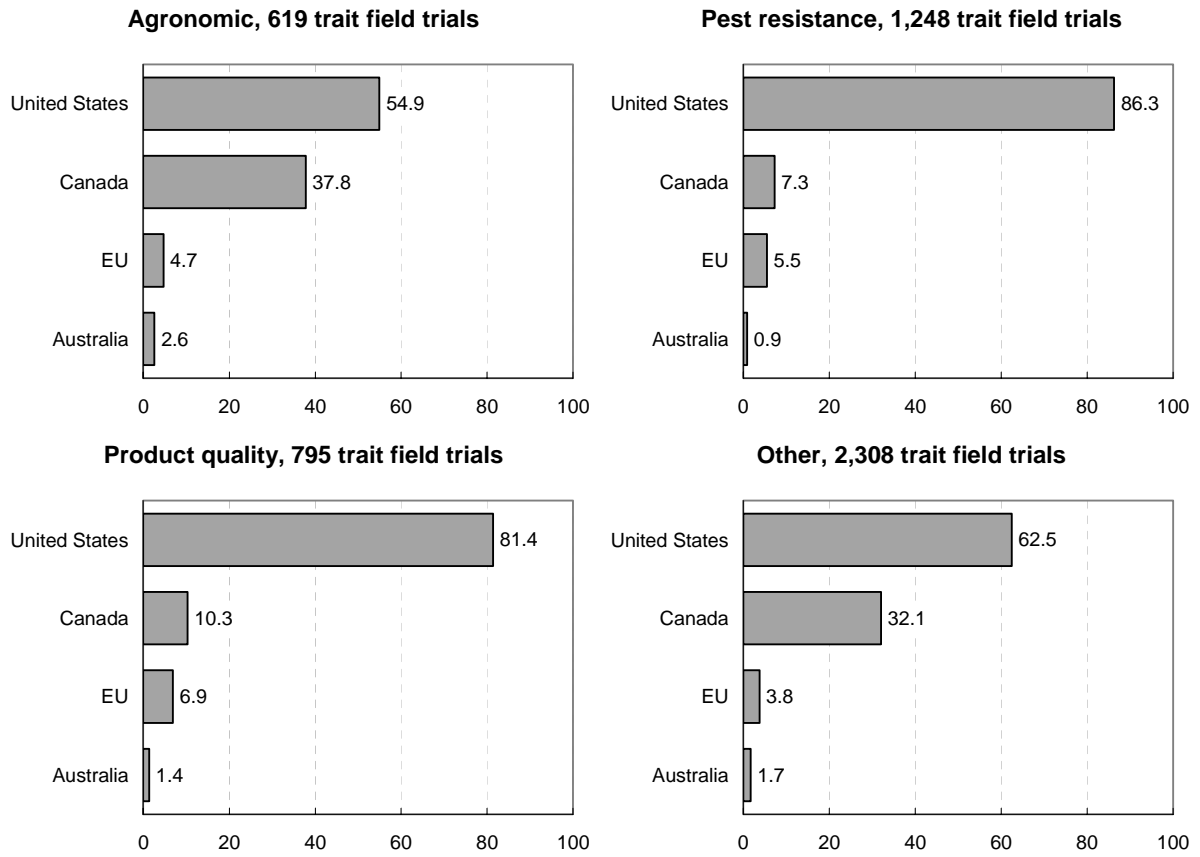
Percent of all domestic trait field trials for product quality traits, 1995 to 2005



Sources: Value at producer prices from OECD, *Economic Accounts for Agriculture 2005*; UNU-MERIT field trials database, March 2006.

Biotechnology in agriculture

Percent of all field trials (2002 – 2004 inclusive) by purpose of the trait



Source: UNU-MERIT field trials database, March 2006.

Biotechnology in agriculture

Table 1. Million hectares planted with GM crops, 1996 to 2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
United States	1.5	8.1	20.5	28.7	30.3	35.7	39	42.8	47.6	49.8
Argentina	0.1	1.4	4.3	6.7	10	11.8	13.5	13.9	16.2	17.1
Brazil	..	..	..	..	..	..	3.5	3	5	9.4
Canada	0.1	1.3	2.8	4	3	3.2	..	4.4	5.4	5.8
China	1.1	1.8	n.a.	0.3	0.5	1.5	2.1	2.8	3.7	3.3
India	..	..	..	..	..	..	<0.1	0.1	0.5	1.3
Australia	..	0.1	0.1	..	0.1	0.2	..	0.1	0.2	0.3
Mexico	..	..	<0.1	<0.1	..	<0.1	<0.1	<0.1	0.1	0.1
Spain	..	..	<0.1	<0.1	..	<0.1	<0.1	<0.1	0.1	0.1
Germany	..	..	..	..	..	<0.1	<0.1	<0.1	<0.1	<0.1
Portugal	..	..	..	<0.1	..	..	..	..	..	<0.1
France	..	..	<0.1	<0.1	..	..	..	..	..	<0.1
Czech Republic	..	..	..	..	..	..	..	..	..	<0.1
Other countries	..	..	..	..	..	..	..	..	..	2.8
Total	2.8	12.7	27.8	39.9	44.2	52.6	58.7	67.7	81	90

Sources: Clive James, 1997, 1999 'Global Review of Transgenic Crops', ISAAA Briefs, The International Service for the Acquisition of Agri-biotech applications (ISAAA), Ithaca New York; Clive James (2004, 2005), 'Global Status of Commercialized Biotech/GM Crops', ISAAA, Ithaca, New York.

Table 2. Number of field tests for specific traits, 1995 to 2005

	Trait	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
United States	Agronomic	40	30	103	151	157	88	113	107	103	130	172	1,194
	Product quality	206	145	151	284	207	155	221	205	211	231	249	2,265
	Herbicide tolerance	209	248	419	657	366	390	352	438	304	360	269	4,012
	Pest resistance	346	387	496	954	732	521	609	529	251	297	194	5,316
	Other	48	61	75	99	126	163	189	95	105	140	135	1,236
	Total traits	849	871	1,244	2,145	1,588	1,317	1,484	1,374	974	1,158	1,019	14,023
Canada	Agronomic	..	..	..	48	67	87	93	86	70	78	87	616
	Product quality	..	..	..	109	44	65	25	20	43	19	33	358
	Herbicide tolerance	..	..	..	229	240	211	119	119	108	82	86	1,194
	Pest resistance	..	..	..	283	72	70	47	47	21	23	27	590
	Other	..	..	..	412	221	294	211	161	152	118	160	1,729
	Total traits	..	..	..	1,081	644	727	495	433	394	320	393	4,487
EU-15	Agronomic	7	21	12	14	18	10	4	6	19	4	..	115
	Product quality	32	52	53	22	33	18	12	13	31	11	..	277
	Herbicide tolerance	140	140	162	105	137	73	40	25	31	22	..	458
	Pest resistance	62	77	63	78	52	33	24	21	27	21	..	875
	Other	40	25	36	17	21	26	11	3	3	3	..	185
Total	Total traits	281	315	326	236	261	160	91	67	111	61	..	1,909

Sources: UNU-MERIT field trial database, March 2006.