The Global Status of Commercialised Genetically Modified Plants

1 July 2008 - 31 December 2009

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BIOSECURITY NEW ZEALAND

Megan Dymond and Kathryn Hurr, Plant Imports, MAF Biosecurity New Zealand.

CONTENTS

Executive Summary 4
Background to this report 5
1. GM Crops Commercialised Worldwide 6
2. The Global Pipeline of new GM Crops 9
2.1 GM Crops in the Commercial Pipeline 10
2.2 GM Crops in the Regulatory Pipeline 11
2.3 GM Crops in the Advanced R&D Pipeline 12
GM maize 13
GM soybean 14
GM oilseed rape (*Brassica napus* var. *oleifera*) 15
GM rice (Oryza sativa) 15
2.4 Field Testing 17
Australia – Limited and controlled releases (Field tests) 18
Canada and USA – Field tests/trials 19
Europe – Field trials 20
Malaysia-Asia – Field trials 21
India – Field trials 22
3. References and other Sources of Information 23
International Field Test Sources 24

List of Appendices: 25
Appendix 1. GM Varieties of Zea mays (maize and sweet corn) 26
Appendix 2. GM Varieties of Brassica napus var. oleifera (oilseed rape) 30
Appendix 3. GM Varieties of Glycine max (Soybean) 31
Appendix 4. GM Varieties of Gossypium hirsutum (cotton) 32
Appendix 5. Other GM Crop Varieties 34

Executive Summary

This report updates the global status of commercialised genetically modified (GM) crops, and provides a summary of the GM crops currently in commercial, regulatory and research and development pipelines. The report is part of an ongoing series, enabling MAF to maintain up-to-date testing protocols at the border and to forecast the crops most likely to be commercialised over the next five years.

Thirteen new GM events were approved for commercial cultivation in the reporting period, 1 July 2008 to 31 December 2009. Twelve of these events are in crops with existing commercialised varieties: cotton, corn, soybean and papaya. The thirteenth event is an insect-resistant eggplant (brinjal) – the first GM variety of this crop, which was approved by India's biotechnology regulator the Genetic Engineering Approval Committee (GEAC) in November 2009. It still requires permission from the Indian government before it can be cultivated.

There were around forty different GM events growing in commercial crops by the end of 2009. A recent report by the Institute of Prospective Technical Studies (IPTS) estimates that **by the end of the year 2015, there will be around 120 commercialised events**. This is an increase of eighty events within the next five years. There are at least twenty-one new GM crop events currently in the regulatory pipeline which might be approved for commercialisation within the next reporting period (1 January 2010 – 30 June 2011). This leaves the remainder (approximately fifty-nine events) to come from crops which are currently in advanced research and development pipelines at present.

Most of the events in development are for herbicide tolerant and/or insect resistant traits. More than half are varieties of the four major crops: maize, soybean, oilseed rape, and cotton. New crops and traits are also being targeted. **Fourteen new species** are well advanced in regulatory and R&D pipelines, including rice, eucalypt, blue rose, potato, eggplant, tomato, sorghum, sugarcane, and beans. GM wheat is in early-phase field trials, with commercialisation expected in 2017, and GM forage species such as clover, ryegrasses, and tall fescues, may also be expected by then.

Emerging trends

- New traits: Crops able to tolerate greater extremes of climate and/or using fewer agricultural inputs (such as drought tolerance, nitrogen-use efficiency).
- New crops new countries: By 2015, half the new commercialised transgenic events will have been developed by national technology providers in Asia and Latin America, in crops designed for domestic agricultural markets.
- GM rice as a crop and drought tolerance as a trait are expected to drive continued global adoption of GM over the next five years.
- Stacked traits: crops with more than one GM trait are progressively replacing single-trait crops. A quadruple-stacked maize was approved last year (Genuity SmartStax ™) and an octet hybrid is expected in the next few years.

Background to this report

In New Zealand, genetically modified seeds are considered “new” organisms under the Hazardous Substances and New Organisms (HSNO) Act 1996. They require approval from the Environmental Risk Management Authority before they can be grown.

MAF implements four protocols at the border to test seed lots imported for sowing for the presence of unapproved GM seeds. Such GM seeds may be unintentionally part of the imported seed consignment, through accidental mixing from cross-pollination during field production, or admixture during seed cleaning and processing. The seed testing protocols do not guarantee the complete absence of GM seeds, but help to mitigate the risk that unapproved GM seeds will be released in the environment.

This report covers the period from 1 July 2008 to 31 December 2009. It is part of a series of reports to maintain an up-to-date list of GM crops approved for commercial cultivation around the globe, and provides a snap-shot of the GM crops in regulatory and research and development (R&D) pipelines to forecast what might be commercialised in the near future. This information enables MAF and importers to assess the likelihood that future imported consignments might contain unapproved GM seeds, and to plan and allocate resources as required.

While every effort has been made to present accurate information, some details differ according to the source of information used and the situation will obviously change over time. Therefore the figures quoted in this report should be treated as indicative rather than predictive.

The first section lists the GM crops currently commercialised and their global coverage. The following section provides a summary of crops currently in the global pipeline, which may be commercialised in the near future. A list of information sources used to prepare this report is given in Section 3. Appended to this report are a series of lists summarising the GM crops which are currently commercialised.

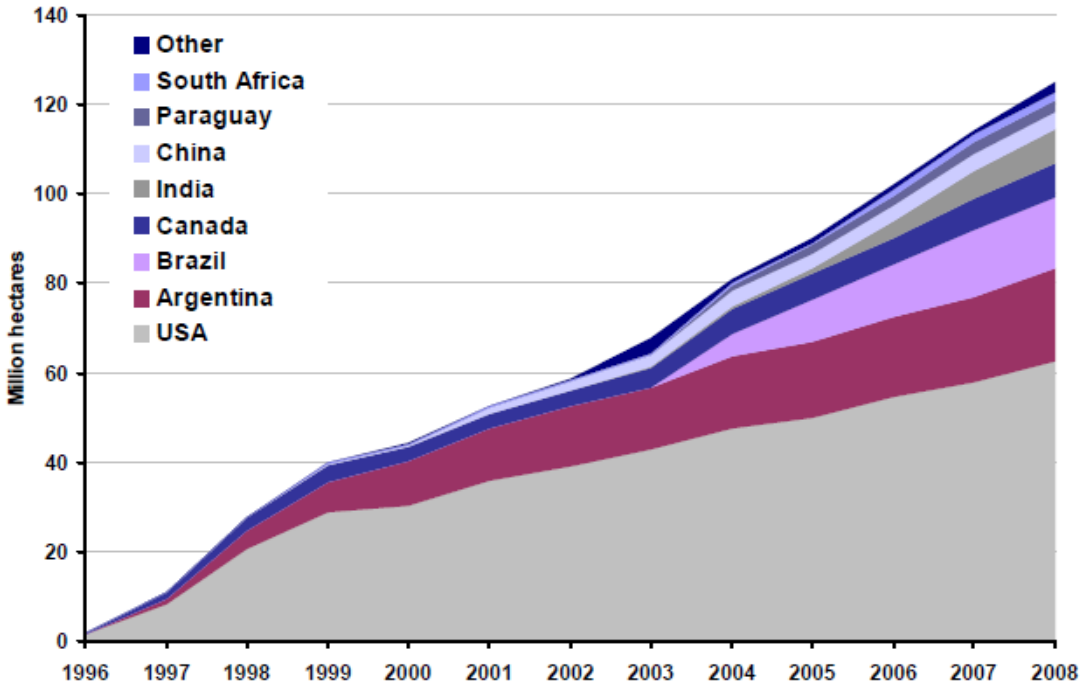
GM Crops Commercialised Worldwide

Large-scale cultivation of genetically modified (GM) crops began in 1996 and has continued to expand in both industrialised and developing countries. GM crops are now planted on a global area of 125 million hectares in 25 countries (James 2008).

In the first decade of GM crops, technology providers were largely private companies in the USA, Canada and Europe. The second decade is seeing an increased number of GM crops which have been developed by national technology providers in Asia and Latin America, principally designed for domestic agricultural markets. It is anticipated that by 2015, half the new transgenic events brought to market will have been developed by players in Asia (33 in India, 20 in China, 5 in the rest of Asia) and in Latin America, with the other half coming from companies in the United States and the European Union.

Five principal developing countries: China, India, Argentina, Brazil and South Africa, with a combined population of 2.6 billion, are driving the increases in global adoption. Rice as a crop and drought tolerance as a trait are expected to be pivotal for future growth in global GM crop adoption.

Figure 1: Country evolution of area cultivated in GM crops



Source: JRC-IPTS report. The global pipeline of new GM crops. Stein & Rodriguez- Cerezo, 2009. Data from Clive James, 2008.

Four main crops account for most of the GM crop varieties in commercial cultivation: soybean, maize, cotton, and canola. The most common traits in commercial production are herbicide tolerance and insect resistance (75 million hectares and 12 million hectares in 2008, respectively). In 2008, there were around 30 different transgenic events commercialised worldwide, increasing to around 40 events by mid-2009 (Stein & Rodríguez-Cerezo, 2009).

Stacked[1] traits (combined herbicide tolerance and insect resistance) were planted more widely in 2008 than single Bt insect resistant traits, occupying nearly 25 million hectares (James, 2008).

Herbicide tolerant **GM soybean** is the most extensively planted GM crop globally and was planted on approximately 65.8 million hectares in 2008, representing 53% of the global biotech crop area (125 million hectares for all crops – James, 2008). Approximately 80% of the soybean area in South Africa and 90% of the USA soybeans was GM in 2008 (230,000 hectares and 28.6 million hectares, repsectively). GM soybeans are also grown extensively in nine Latin American countries, including Argentina, Paraguay, and Bolivia.

GM maize is the second most dominant biotech crop, planted on around 37.3 million hectares globally, equivalent to 26% of the global biotech area (James, 2008). In the US, 85% of the national maize crop was biotech in 2008. Just over a fifth of this area was occupied by hybrids with a single trait, the rest was planted with hybrids with either double or triple stacked traits. Insect resistant Bt maize is grown in seven countries in Europe on over 107,000 hectares, and also in South Africa on 1.6 million hectares (approximately 62% of the land area cultivated in maize). Burkina Faso and Egypt grew Bt maize for the first time in 2008.

Table 1. Global Area of Biotech Crops in 2008: by Country (Million Hectares)

Rank	Country	Area (million hectares)	Biotech Crops
1*	USA*	62.5	Soybean, maize, cotton, canola, squash, papaya, alfalfa, sugarbeet
2*	Argentina*	21.0	Soybean, maize, cotton
3*	Brazil*	15.8	Soybean, maize, cotton
4*	India*	7.6	Cotton
5*	Canada*	7.6	Canola, maize, soybean, sugarbeet
6*	China*	3.8	Cotton, tomato, poplar, petunia, papaya, sweet pepper
7*	Paraguay*	2.7	Soybean
8*	South Africa*	1.8	Maize, soybean, cotton
9*	Uruguay*	0.7	Soybean, maize
10*	Bolivia*	0.6	Soybean
11*	Philippines*	0.4	Maize
12*	Australia*	0.2	Cotton, canola, carnation
13*	Mexico *	0.1	Cotton, soybean
14*	Spain *	0.1	Maize
15	Chile	<0.1	Maize, soybean, canola
16	Colombia	<0.1	Cotton, carnation
17	Honduras	<0.1	Maize
18	Burkina Faso	<0.1	Cotton
19	Czech Republic	<0.1	Maize
20	Romania	<0.1	Maize
21	Portugal	<0.1	Maize
22	Germany	<0.1	Maize
23	Poland	<0.1	Maize
24	Slovakia	<0.1	Maize
25	Egypt	<0.1	Maize

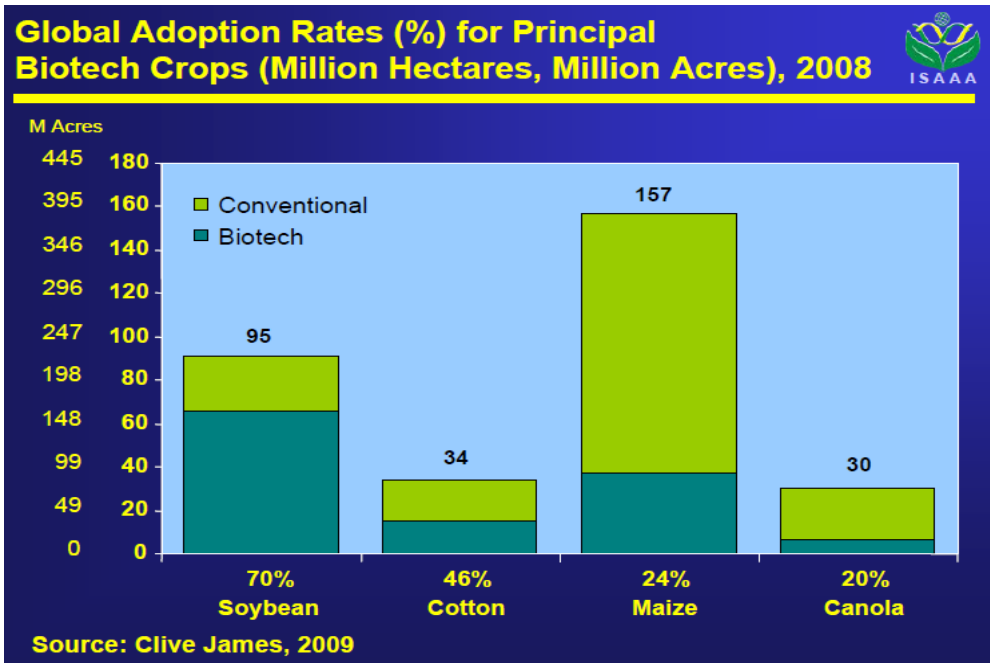
* 14 biotech mega-countries growing 50,000 hectares, or more, of biotech crops
Source: Clive James, 2008.

GM cotton is the third most dominant crop, occupying 15.5 million hectares – or nearly half the global area under cotton cultivation. It is commercially grown in 15 countries (James, 2008). It occupies more than 90% of the national area in the USA (44 million

[1] Stacked events are GM varieties cross-bred together through traditional plant breeding to confer multiple traits providing a broader spectrum of insect control, multiple options for weed control with herbicides, or to provide a combination of insect and weed control.

hectares), nearly 69% of the 22 million hectares of cotton planted in China[2], and nearly 81% of the 15 million hectares of cotton planted in India.[3] Australia and South Africa grow approximately 1 million hectares of GM cotton. The African country, Burkina Faso grew 8,500 hectares of Bt cotton for the first time in 2008. Double-stacked traits occupy 75% of all GM cotton acreage in the USA, 81% in Australia and 19% in South Africa.

GM oilseed rape was grown on approximately 5.9 million hectares in 2008, predominantly in Canada, the USA and Australia (James, 2008).



GM alfalfa is currently grown on approximately 102,000 hectares in the USA. A court injunction in 2007 suspended further plantings of Roundup Ready RR® alfalfa until a new dossier of information could be submitted to the regulators for consideration. This decision is still pending.

GM sugar beet (RR ®) was grown commercially for the first time in the USA in 2008 on approximately 258,000 hectares. It was adopted very rapidly by sugar producers, and by the end of the 2009 season nearly 95% of the sugar beet crop produced in the USA was Roundup Ready.

Small areas of GM virus-resistant crook-neck squash (2,000 hectares) and virus-resistant papaya (2,000 hectares in Hawai'i) are also grown in the US. China grows virus-resistant papaya on approximately 4,500 hectares, and 400 hectares of Bt poplars. A delayed ripening tomato and virus resistant sweet pepper are commercially approved in China, but are currently not being grown.

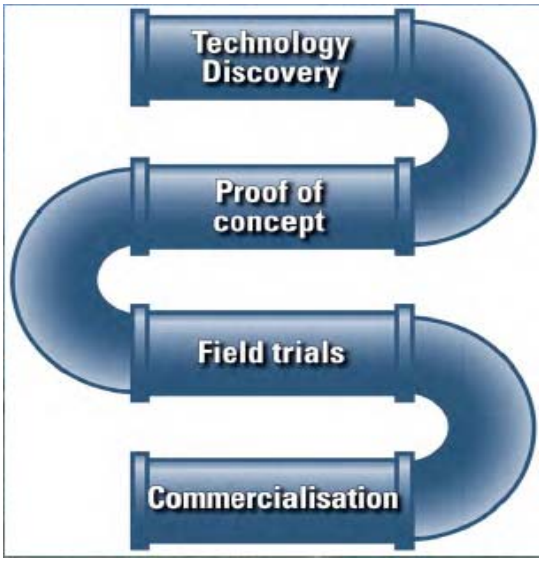
[2] USDA Foreign Agricultural Service report, March 2009.
http://gain.fas.usda.gov/Recent%20GAIN%20Publications/AGRICULTURAL%20BIOTECHNOLOGY%20ANNUAL_Beijing_China%20-%20Peoples%20Republic%20of_8-3-2009.pdf Accessed 13/1/10

[3] Bt-cotton-in India - a status report 2nd-edition (Accessed 21/1/2010).
http://www.apaari.org/wp-content/uploads/2009/10/bt-cotton-2nd-edition.pdf

1. The Global Pipeline of new GM Crops

There is an extensive pipeline of crops and traits currently under development around the world. Typically the development pipeline has several stages, as depicted by the following diagram.

Typical Development "Pipeline"



Source: J. Glover – Bureau Rural Sciences (BRS), DAFF, Australia.

The pipeline can also be classified according to their proximity to market, which helps to see which crops may be commercialised in the short term, and which are longer term prospects.

Crops in the pipeline can be classified based on their proximity to market:

- **Commercial pipeline –** GM events authorised for marketing but not yet commercialised.
- **Regulatory pipeline –** involving regulatory submissions, seed bulk-up and pre-marketing (the final pre-launch phase).
- **Advanced R&D pipeline** – advanced development, involving trait integration, field testing and generation of regulatory data.
- **Early R&D** – includes trait development, large-scale transformation, and proof-of-concept.

Based on Stein & Rodriguez-Cerezo, 2009.

In 2008, the Joint Research Centre's Institute of Prospective Technical Studies (JRC-IPTS) surveyed GM companies to find out what crops they had in their research and development (R&D) pipelines. Based on what is in the advanced R&D pipeline, they estimate that **by 2015 there will be over 120 commercialised events**[4,5]. This is compared to the 40 or so events currently available in commercial crops in 2009.

2.1 GM Crops in the Commercial Pipeline

The four major crops which currently dominate the GM landscape (soybeans, maize, cotton and canola) are also the most common crops in the development: more than half of the GM crop varieties in the R&D pipeline are varieties of these four crops. Insect resistance and herbicide tolerance continue to be the most common traits in the pipeline. New GM events and new crops are increasingly being developed, and will emerge during the second decade.

In the reporting period, from 1 July 2008 to 31 December 2009, **thirteen** new crop events were approved for commercial cultivation. Twelve of these were in crops with existing GM varieties (cotton, corn, soybean, and papaya), and approved in Canada, the US, China, and India. These crops may now be grown commercially, but whether or not this occurs depends on the technology developer.

A thirteenth crop, Bt eggplant or brinjal, was recently given regulatory approval by the Indian biotechnology regulator, the Genetic Engineering Approval Committee (GEAC)[6]. The crop is yet to be permitted for cultivation by the Indian government, with a decision expected in the first quarter of 2010. If permitted, this would make Bt brinjal India's first genetically modified food crop.

Table 1. GM crops approved for commercial cultivation June 2008 – December 2009

Crop	Common name	Company	Altered Traits	Date of Approval
Glycine max DP305423	Soy	Pioneer Hi-Bred International Inc.	Modified seed fatty acid content (specifically high oleic and low linoleic acid)	Canada – 20 April 2009
Glycine max DP356043	Soy	Pioneer Hi-Bred	Herbicide tolerant	USA – 24 July 2008
Glycine max BPS-CV127-9	Soy	BASF	Herbicide tolerant	Brazil – 10 December 2009
Zea mays MON89034 x TC1507 x MON88017 x DAS-59122-7 *"Genuity SmartStax*	Maize	Monsanto and Dow AgroSciences	Stacked herbicide and insect resistant	USA - 2009 Canada - 2009 Japan - 2009

[4] Stein, A. and Rodriquez-Cerezo, E. 2009. The global pipeline of new GM crops - Implications of asynchronous approval for international trade. JRC report, EUR 23486 EN.

[5] Stein, A. and Rodriquez-Cerezo, E. 2010. International trade and the global pipeline of new GM crops. Nature Biotechnology 28 (1): 23-25.

[6] Jan 2009, ISAAA Brief 38 "The Development and Regulation of Bt Brinjal in India (Eggplant/Aubergine)". http://www.isaaa.org/kc/inforesources/publications/pocketk/default.html#Pocket_K_No._35.htm

Zea mays DP098140-6 Optimum GAT	Maize	Pioneer	Glyphosate and Imaidazolinone herbicide tolerant	USA – 9 December 2009
Zea mays *MIR162*	Maize	Syngenta	Insect resistance	Brazil – 17 September 2009
Zea mays	Maize	Origin Agritech	Phytase maize	China – 23 November 2009
Gossypium hirsutum GHB614	Cotton	Bayer CropScience	Glyphosate tolerance	USA – 18 June 2009
Gossypium hirsutum Dharwad Event	Cotton	UAS, Dharwad	Insect resistance	India, GEAC, 2008
Gossypium hirsutum 9124	Cotton	Metahelix, India	Insect resistance	India, GEAC, 2009
Carica papaya X17-2	Papaya	University of Florida	Papaya Ringspot Virus resistant	USA - 2 Sep 2009
Solanum melogena	Eggplant (brinjal)	India	Insect resistance	India, GEAC, 2009

2.2 GM Crops in the Regulatory Pipeline

GM crops which have been submitted to regulatory authorities for assessment and approval for environmental release are included in this section. If successful, these crops could be given commercial approval within the next reporting period, 1 January 2010 – 30 June 2011.

During the reporting period, **twenty-one GM crop events** were submitted into various regulatory pipelines: mostly these are soybean, maize and cotton crops. China recently announced plans to commercialise GM maize and rice, expected in the next two years. Four GM rice lines are in the regulatory pipeline in China.

Table 2. GM crops in the Regulatory Pipeline (pending approval)

Crop	Common name	Company	Altered Traits	Status
Zea mays DAS-40278-9	Maize	Dow	Herbicide tolerant	Submitted to USDA 21 Aug 09
Zea mays HCEM485	Maize	Stine Seed	Glyphosate tolerant	Submitted to USDA 4 Mar 09
Zea mays MON87460	Maize	Monsanto	Drought tolerant	Submitted to USDA 25 Feb 09
Zea mays *DP32138*	Maize	Pioneer	Male Sterile, Fertility restored, Visual marker	Submitted to USDA 3 Dec 08
Zea mays 3272	Maize	Syngenta	Thermostable alpha-amylase	Submitted to USDA 11 Jan 07
Glycine max MON87705	Soybean	Monsanto	Low saturated fatty acid, high oleic acid, and herbicide tolerance	Submitted to USDA 20 July 09

Glycine max MON87769	Soybean	Monsanto	Improved Omega-3 fatty acid production	Submitted to USDA 2 July 09
Glycine max MON87701	Soybean	Monsanto	Lepidoperan resistant	Submitted to USDA 23 Mar 09
Glycine max FG72	Soybean	Bayer CropScience	n/a	Submitted to USDA 24 Nov 09
Eucalyptis grandis ARB-FTE1-08	Eucalyptus	ArborGen	Freeze tolerant, fertility altered	Submitted to USDA 31 Dec 08
Gossypium hirsutum T304-40XGHB119	Cotton	Bayer	Glufosinate tolerant, insect resistant	Submitted to USDA 5 Dec 08
Gossypium hirsutum	Cotton	Dow AgroSciences Australia Ltd	Insect Resistance	Submitted to OGTR 25 Nov 09
Gossypium hirsutum Event 9124	Cotton	Metahelix	Insect Resistance	India
Gossypium hirsutum Event 24	Cotton	JK Agri Genetics Seeds	Insect Resistance	India
Gossypium hirsutum COT67B	Cotton	Syngenta	Insect Resistance	n/a
Rosa IFD52401 and IFD52901	Rose	Florigene, Australia Pty.	Altered flower colour	Submitted to USDA 10 Nov 08
Rosa X hybrida	Rose	Florigene, Australia Pty.	Altered flower colour	Submitted to OGTR 19 June 09
Oryza sativa Bt163	Rice	Huazhong Agricultural University	Insect resistant	China
Oryza sativa Xa21	Rice	Biotech Research Center, Chinese Academy of AgScience	Disease resistant	China
Oryza sativa KMD1	Rice	n/a	Insect resistance	China
Oryza sativa B827	Rice	n/a	Insect resistance	China
Medicago sativa J101, J163	alfalfa	Monsanto	Herbicide tolerance	USDA, awaiting EIS

n/a = no further information available

2.3 GM Crops in the Advanced R&D Pipeline

GM crops in the advanced R&D pipeline are often still in field trials, in order to generate agronomic and regulatory data for assessment purposes. Here we use information gathered from a number of different sources to build a picture of what we could expect to be commercialised over the next 5-8 years. It may not be a true prediction of what will be available in future, but it indicates emerging crops, traits and trends.

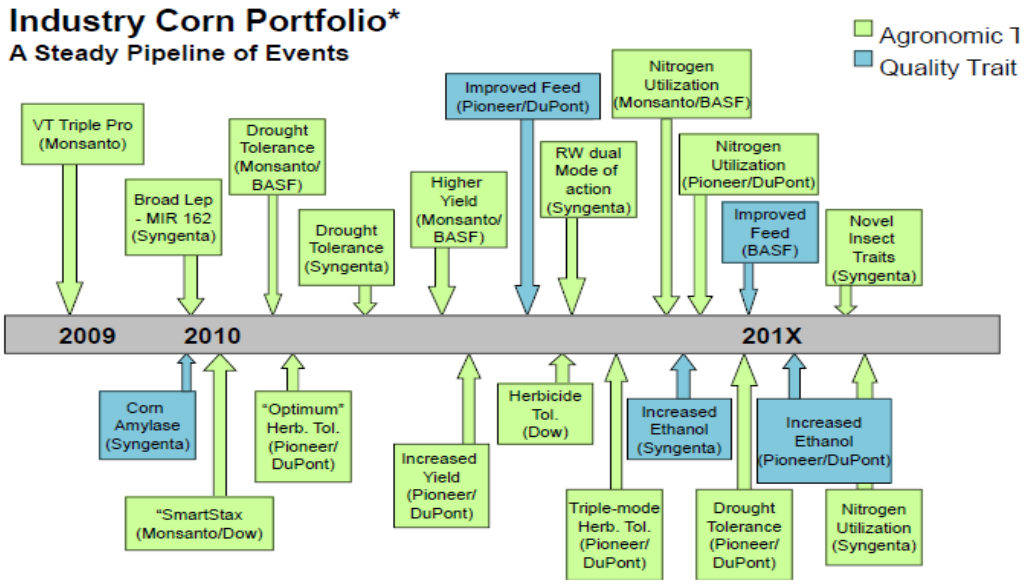
The IPTS report released last year anticipates that by 2015, half the new transgenic events brought to market will have been developed by players in Asia (33 in India, 20 in China, 5 in the rest of Asia) and in Latin America, with the other half coming from companies (mostly private) in the United States and the European Union. Many of the crops and traits developed by these emerging countries will be crops important for domestic food production and security, such as rice.

GM maize

Approximately twenty new transgenic maize events are in the pipeline to be commercialised in the next five years. SmartStax™ maize was commercially approved in December 2009, and is expected to be cultivated in the USA in 2010. Drought tolerance maize is a new trait, and is expected to be commercialized first in the USA, followed by Sub Saharan Africa in 2017.

Table 3. *Zea mays* (corn, maize) new events

Possible commercialisation	Country	Company	Trait
2010	US	Pioneer Hi-Bred	Insect resistance
	US	Pioneer Hi-Bred	Stalk Rot resistance
	US	Pioneer Hi-Bred	Drought tolerance I
	US	Pioneer Hi-Bred	Seed Production Technology
	US	Monsanto	MON87754 – high oleic content
2011	US	Syngenta	Refuge-reduction corn – herbicide tolerance
2012	US	Monsanto	Roundup® Hybridization System (RHS)
	US	Monsanto	Drought tolerance
	n/a	Dow AgroSciences	Herbicide tolerance
	US	Pioneer Hi-Bred	Drought tolerance II
	US	Pioneer Hi-Bred	Nitrogen-use efficiency
	US	Pioneer Hi-Bred	Ethanol & Feed Value II
	US	Pioneer Hi-Bred	Ethanol & Feed Value III
	US	Pioneer Hi-Bred	Increased yield
2014	India	n/a	Insect resistance
2015 +	US	Syngenta	Nitrogen-use efficiency
	US	Syngenta	Novel insect traits
	US	Syngenta	Drought tolerance
	n/a	BASF PlantScience	Crop composition
	US	Advanta/ Arcadia BioSciences	Insect resistance
	n/a	Pioneer/DuPont	Drought tolerance



*Estimated commercialization pipeline of corn biotech events prepared by the **U.S. Grains Council**
Commercialization dependent on many factors, including successful conclusion of regulatory process

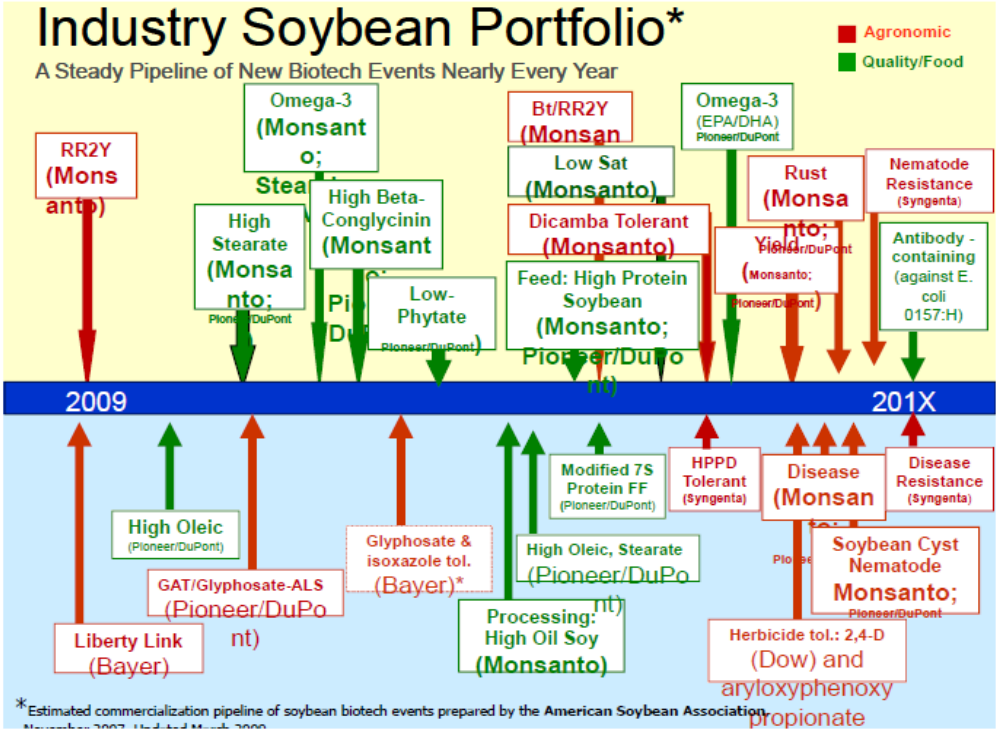
Source: Dr William Wilson – North Dakota State University
www.ndwheat.com/uploads%5Cresources%5C748%5Cgm-wheat-strategies.pdf

GM soybean

For soybeans, there is currently only one GM event commercially available (RR® soybean). IPTS predict this will increase to around 17 different events by 2015. New traits will also be available, including disease resistance and altered oil composition, such as increased omega-3 oils.

Table 4. *Glycine max* (soybean) new events

Possible commercialisation	Country	Company	Trait
2010	US	Monsanto	Genuity™ Roundup Ready 2 Yield
	US	Syngenta	Aphid resistance
	US	Syngenta	Second gen. herbicide tolerant
2011	US	Monsanto	Omega-3 oils
	Brazil	Monsanto	Roundup Ready 2 Yield soybeans
	US	Monsanto	Vistive® Gold, altered oil properties
	US	Syngenta	Rust tolerance
	US	Syngenta	nematode resistance
	US	Pioneer	Rust resistance
2013	US	Syngenta	HPPD tolerance
	US	Pioneer	Disease resistance
	US	Pioneer	Improved feed
	US	Pioneer	Improved oil content
	US	Pioneer	Nematode resistant
2015	US	Syngenta	Disease/nematode resistance



Source: Dr William Wilson – North Dakota State University (Image has not rendered well).
www.ndwheat.com/uploads%5Cresources%5C748%5Cgm-wheat-strategies.pdf

GM oilseed rape (*Brassica napus* var. *oleifera*)

The number of GM oilseed rape events is predicted to increase from 4 currently to at least 8 events by 2015. One event is currently in the regulatory pipeline, with another five in the R&D pipeline.

Table 5. *Brassica napus* var. *oleifera* (oilseed rape, rapeseed)

Possible Commercialisation	Country	Company	Trait
2011	**n/a**	Bayer CropScience	Herbicide tolerance
	n/a	Bayer CropScience	Disease resistance
	US	Pioneer/DuPont	Herbicide tolerance
2013	**n/a**	BASF Plant Science	Fatty acid content
2014	**n/a**	Bayer CropScience	Oil content
2015	US	Monsanto	Roundup Ready 2nd gen.
	n/a	BASF Plant Science	Oil content
	US	Pioneer/DuPont	Increased yield

GM rice (Oryza sativa)

Currently there are no commercially approved events of rice being cultivated. IPTS predict that by 2015, as many as 15 GM events could be grown. Five events are currently in the commercial and regulatory pipelines worldwide.

Ninety percent of rice grown around the globe is consumed domestically. Publicly funded institutions in Asia, India and China[7] are focusing on developing GM traits in locally adapted varieties. India is developing several GM rice lines and intends to cultivate these away from their basmati-growing areas, as basmati is heavily exported.

***Table 6. Oryza sativa* (rice)**

Possible Commercialisation	Country	Company	Trait
2011	China	n/a	Bt63 insect resistance
	Phillipines	IRRI	Golden Rice 1 Beta-carotene
2012	Phillipines	IRRI	Golden Rice 2 Beta-carotene
	China	n/a	herbicide tolerant
	India	n/a	Virus resistant
	India	n/a	Virus resistant
	US	Pioneer/DuPont	Herbicide tolerant
	US	Pioneer/DuPont	Insect resistance
2013	India	Mahyco	Bt insect resistance
	India	n/a	Disease resistant
	n/a	Bayer CropScience	Herbicide tolerance
	n/a	Bayer CropScience	Insect resistance
2014	Bangladesh	IRRI	Golden Rice - Beta carotene
	India	IRRI	Golden Rice - Beta carotene
2015	India	n/a	Salinity tolerance
	India	n/a	Drought tolerance
	Indonesia	n/a	Insect resistance
	Pakistan	n/a	Insect resistance

[7] China plans to commercialise GM rice and maize - http://www.gmo compass.org/eng/news/477.docu.html

Other GM Crops

The IPTS predicts that **GM cotton** events will increase from 12 today to 27 by the year 2015, and that there will be **8 GM potato events** commercially available by 2015. Three potato events are already in the regulatory pipeline worldwide, one for assessment exclusively in the EU, while the other two are being assessed in Argentina. A cisgenic[8] potato is expected to be commercialised in Belgium in 2014.

Minor crops are predicted to grow from 7 events currently marketed today (papaya - 2, squash, sugar beet, tomato - 2, sweet pepper) to around 23 events by 2015.

Possible Commercialisation	Crop	Country	Company	Trait
2011	Potato	India	n/a	Disease tolerant
2012	Cotton		Bayer CropScience	Insect & herbicide resistance
	Cotton	US	Monsanto	Stacked herbicide tolerance – 3 way
	Potato	India	n/a	Reduced cold-induced sweetening
	Potato	India	n/a	Dwarfness
	Bean	Brazil	Embrapa	Virus resistance
2013	Cotton (8 varieties)	India		Insect tolerance
	Cotton		Dow AgroSciences	Herbicide tolerant
2014	Potato	Belgium	AVEBE	Cisgenic, starch content
	Potato	China	n/a	n/a
	Eggplant	India	n/a	Stress tolerance
	Eggplant	India	n/a	Fungal resistance
	Tomato	India	n/a	Stress tolerance
	Tomato	India	n/a	Extended shelf life
≥ 2015	Sugarcane	US	Monsanto	Insect resistant & Roundup Ready
	Sorghum	US	Advanta/ Arcadia BioSciences	Salt-tolerance
≥ 2015	Sorghum	US	Advanta/ Arcadia BioSciences	Nitrogen-Use Efficiency
	Sweet sorghum	US	Advanta/ Arcadia BioSciences	Biofuels
	Cabbage, cauliflower	India	n/a	Insect resistance
	Okra	India	n/a	Insect resistance
	Mustard	India	n/a	Male sterility
	Peanuts	China	n/a	n/a
	Cabbage	China	n/a	n/a
	Wheat	China	n/a	n/a
	Chilli	China	n/a	n/a

n/a = further information not available

[8] Cisgenic crops are produced using the techniques of genetic modification, but utilising only the plant's own DNA, i.e. there is no foreign DNA. This is in contrast to transgenic crops, where genes may be selected from any other living organism.

2.4 Field Testing

Where information is available on the GM crops and plants currently in field testing around the globe, these are reproduced in following tables. While field test information cannot predict which crops will be commercialised, as it is not possible to know whether the trait is successful in the field and will be progressed towards the regulatory and commercial pipelines, it is useful in that it presents a snap-shot of the current research and development (R&D) effort going on in different crops around the globe.

European field trials are predominantly maize evaluations for regulatory data and assessment, or registration purposes. Also there are several starch-altered potatoes in field trial.

In **Malaysian-Asia** countries, **c**otton, rice and sorghum are important crops in field trials.

Australia has a number of different crops in field testing. Field testing of virus-resistant white clover commenced in 1998, and it is expected to be commercialised within the next 5 years. Other forages in field testing include GM ryegrass and tall fescues. Drought-tolerant wheat and barley are also in field trials.

In **South America,** Colombia is trialling moth-resistant potatoes, Mexico has approved two maize trials, and Argentina is trialling stacked maize hybrids.

GM Wheat
In May 2009, United States, Canadian, and Australian Wheat industry organisations issued a Trilateral Statement giving strong support to the research and development of GM wheat. All three countries plan to commercialise at the same time – expected to be in 2017.

Australia is currently field-testing drought-tolerant wheat, while Canada and the US are field testing a number of other traits including disease-resistance and herbicide tolerance.
http://www.afaa.com.au/news/news_pdf_057_FINAL_Trilateral_Biotech_Statement.pdf

Australia – Limited and controlled releases (Field tests)

Plant species	Company	Trait	Limited and controlled release - license issue date
Sugarcane *Saccharum spp.*	BSES Limited	Herbicide tolerance	11 Nov 2009
	BSES Limited	Altered plant growth, enhanced drought tolerance, enhanced nitrogen use efficiency, altered sucrose accumulation, and improved cellulosic ethanol production from sugarcane biomass	24 July 2009
	The University of Queensland	Altered sugar production	29 August 2008
Wheat and Barley *Triticum aestivum* and *Hordeum vulgare*	CSIRO	Enhanced nutrient utilisation efficiency	10 July 2009
	CSIRO	Altered grain starch composition	5 June 2009
	The University of Adelaide	Enhanced tolerance to abiotic stressors, including soil boron and drought, and increased beta glucan levels	6 June 2008
Wheat *Triticum aestivum*	CSIRO	Altered grain composition	28 May 2009
	Victorian Department of Primary Industries	Drought tolerance	30 June 2008
White Clover *Trifolium repens*	Victorian Department of Primary Industries	Viral disease resistance, Antibiotic resistance	7 January 2009
Cotton *Gossypium hirsutum*	Bayer CropScience Pty Ltd	Insect resistance, herbicide tolerance	8 December 2008
	CSIRO	Altered fatty acid composition of the cottonseed oil	28 October 2008
	CSIRO	Waterlogging tolerance	1 August 2008
	Monsanto	Water use efficiency	16 September 2008
Maize (corn) *Zea mays*	CSIRO	Genetically modified to investigate gene function	3 December 2008
Torenia *Torenia x hybrid*a	Florigene Pty Ltd	Enhanced Phosphate uptake	4 September 2008
Perennial ryegrass and tall fescue *Lolium perenne* and *Lolium arundinaceum*) (Schreb.)	Victorian Department of Primary Industries	Altered lignin and fructan metabolism	29 July 2008
Banana *Musa. acuminata* cv. Grande Naine	Queensland University of Technology	Enhanced disease resistance, reporter gene expression	11 July 2008

Office of the Gene Technology Regulator OGTR - http://www.ogtr.gov.au/internet/ogtr/publishing.nsf/Content/ir-1

Canada and USA – Field tests/trials

Country	Plant /Species	Number of Field test Permits	Country	Plant/Species	Number of Field test Permits
Canada	Alfalfa	1	USA	Cowpea	1
Canada	Artemisia	1	USA	Eucalyptus hybrid	4
Canada	Brown Mustard	40	USA	False flax	1
Canada	Canola	162	USA	Grape rootstocks	1
Canada	Corn	220	USA	Mouse ear cress	1
Canada	Camelina	16	USA	Nicotiana spp.	3
Canada	Poplar	1	USA	Onion	1
Canada	Safflower	2	USA	Papaya	1
Canada	Soybean	74	USA	Peanut	2
USA	Alfalfa	14	USA	Loblolly pine	3
USA	Apple	1	USA	Plum	1
USA	Arabidopsis thaliana	1	USA	Poplar	1
USA	Barley	4	USA	Grey poplar	1
USA	Burley	1	USA	Hybrid poplar	1
USA	OSR- canola	4	USA	Potato	11
USA	Corn	282	USA	Rapeseed	18
USA	Corn or maize	1	USA	Rice	6
USA	Camelina	1	USA	Perennial ryegrass	1
USA	Cassava	1	USA	Safflower	5
USA	Cotton	31	USA	Sorghum	2
USA	Black cottonwood	1	USA	Soybean	130
USA	Eastern cottonwood	2	USA	Sugarbeet	8
USA	Sugarcane	2	USA	Thale cress	1
USA	Sweet potato	1	USA	Tobacco	16
USA	Switchgrass	2	USA	Tomato	9
USA	Wheat	5	USA	Spring wheat	1

Europe – Field trials

EU Country	Crop	Notification Numbers
Spain	Maize – Pioneer Hi-Bred variety evaluations	B/ES/09/52, B/ES/09/53 B/ES/09/54-CON B/ES/09/55-CON B/ES/09/56-CON B/ES/09/25, B/ES/09/26 B/ES/09/17, B/ES/09/18 B/ES/09/19, B/ES/09/20 B/ES/09/21, B/ES/09/22 B/ES/09/23, B/ES/09/24 B/ES/08/22 B/ES/08/23-CON B/ES/08/24-CON B/ES/08/25-CON
	Maize – Monsanto varieties evaluation	B/ES/09/12, B/ES/09/13 B/ES/09/14, B/ES/09/16 B/ES/09/02, B/ES/09/03 B/ES/09/04, B/ES/09/05 B/ES/09/06, B/ES/09/07 B/ES/09/08, B/ES/09/09 B/ES/09/10, B/ES/09/11
	Maize – agronomic/ID trials for registration	B/ES/09/47, B/ES/09/48 B/ES/09/29, B/ES/08/43, B/ES/08/44, B/ES/08/26
	Potatoes - altered starch -- increased starch -- heat stress tolerance	B/ES/09/50, B/ES/09/51 B/ES/09/49, B/ES/08/45 B/ES/09/57
	Sugar beet – herbicide tolerant HT & Rhizomania resistnt	B/ES/10/01, B/ES/09/45, B/ES/09/28, B/ES/08/35 B/ES/09/46
Hungary	Potatoes – drought tolerant	B/HU/07/06
	Barley - pharma	B/HU/08/1, B/HU/08/2
	Wheat – rust resistance	B/HU/08/3
Denmark	Maize – Monsanto varieties evaluation	B/DK/09/02, B/DK/09/03 B/DK/09/04
	Maize – Syngenta varieties evaluation	B/DK/09/01

Country	Crop	Notification Numbers
Spain	Maize – Syngenta varieties evaluation	B/ES/09/57, B/ES/09/58 B/ES/09/59, B/ES/09/60 B/ES/09/61, B/ES/09/38 B/ES/09/39, B/ES/09/40 B/ES/09/41, B/ES/09/42 B/ES/09/43, B/ES/09/44 B/ES/08/33, B/ES/09/34 B/ES/08/28, B/ES/09/29 B/ES/08/32, B/ES/08/30, B/ES/08/31
	Maize – herbicide appl. -- insect resistance	B/ES/09/27, B/ES/09/01 B/ES/09/15
	Cotton – agronomic/ID trials for registration	B/ES/09/30, B/ES/09/31-CON B/ES/09/32-CON, B/ES/09/34
	Cotton – insect resistance	B/ES/08/41-CON B/ES/08/39-CON B/ES/08/40-CON
	Cotton – herbicide tolerant	B/ES/08/42-CON B/ES/08/38 B/ES/08/27
	Cotton – insect resistant & herbicide tolerant	B/ES/08/36-CON B/ES/08/37-CON
Finland	Potatoes – altered starch	B/FI/09/1MB
	Birch - sterile	B/FI/08/1MB
Iceland	Barley	B/IS/09/01
Portugal	Maize – Monsanto varieties evaluation	B/PT/09/01

EU Country	Crop	Notification Numbers
France	Maize – cropping system	B/FR/02/03/04
Czech Republic	Maize – Monsanto varieties evaluation -- Syngenta varieties	B/CZ/09/03, B/CZ/08/03 B/CZ/09/01
	Potatoes – late blight res. --altered starch	B/CZ/09/02 B/CZ/08/04
Sweden	Hybrid aspens	B/SE/09/12395
	Populus deltoides – ecosystem processes	B/SE/08/379
	Arabidopsis – genome evaluation	B/SE/09/2058

Country	Crop	Notification Numbers
Romania	Maize – Monsanto varieties evaluation	B/RO/09/05, B/RO/09/06 B/RO/09/07 B/RO/09/16, B/RO/09/17 B/RO/09/18, B/RO/09/19
	Maize – Pioneer Hi-Bred varieties evaluation	B/RO/09/20, B/RO/09/20 B/RO/09/01, B/RO/09/02
	Maize – herbicide tolerant	B/RO/09/09, B/RO/09/10 B/RO/09/08
	Maize – Syngenta varieties evaluation	B/RO/09/03, B/RO/09/04 B/RO/09/11, B/RO/09/12 B/RO/09/13, B/RO/09/14 B/RO/09/15,
Slovakia	Maize -	B/SK/09/01, B/SK/09/02 B/SK/09/03, B/SK/08/04
Poland	Sugar beet – herbicide tolerant	B/PL/09/02-06
	Maize – agronomic comparison	B/PL/09/02-05

Joint Research Centre: http://gmoinfo.jrc.ec.europa.eu/gmp_browse.aspx

Malaysia-Asia – Field trials

Country	Plant /Species	Number of Field test Permits
China	Cabbage	1
	Canola	1
	Chilli Pepper	1
	Cotton	10?
	Maize (corn)	3
	Peanut	1
	Potato	1
	Rice	1
	Soybean	1
	Wheat	1
Indonesia	Rice	1

Country	Plant/Species	Number of Field test Permits
Japan	Canola	1
	Carnation	1
	Eucalyptus	3
	Maize (corn)	3
	Rice	3
	Rose	2
	Soybean	4
	Cotton	1
Pakistan	Rice	1
Philippines	Rice	2

India – Field trials

Crop	Company Name	Trait	Gene/Event
Brinjal	Bejo Sheetal Seeds Pvt. Ltd.	Insect resistance	*cry1Fa1* (Event 142)
Cabbage and Cauliflower	Nunhems India Pvt. Ltd.	Insect resistance	*cry1Ba, cry1Ca* and *bar*
Potato	Central Potato Research Institute	Transgenic dwarf potato	*GA20 Oxidase1* (Events HP-600, HP-608, HP-609, HP-502, HP-504, HP-508, HP-401, HP-425, HP-431and HP-433)
		Disease resistance (late blight)	RB gene for conferring resistance to late blight disease
		Reduction in cold-induced sweetening and chip colour improvement	vacuolar acid and invertase RNAi-transgenic events
Cotton	JK Agrigenetics Ltd	Insect resistance	*cry1Ac* (Event-1) and *cry1EC* (Event-24)
	Dow Agrosciences	Insect resistance	*cry1 Ac & cry1F* (Widestrike=Event 3006-210-23 and Event 281-24-236)
RRF cotton	Maharashtra Hybrid Seeds Co. Ltd.	Insect resistance &Herbicide tolerance	Stacked *cry1Ac & cry2Ab* (MON 15985) and *CP4EPSPS* (MON 88913)
Corn	Monsanto India Ltd.	Insect resistance & Herbicide tolerance	Stacked *cry2Ab2* and cryA.105 (MON 89034) & *CP4EPSPS* (NK603)
	Pioneer Overseas Corporation	Insect resistance & Herbicide tolerance	Stacked *cry1F and CP4EPSPS* (stacked event of TC1507XNK603)
	Dow Agrosciences India Pvt. Ltd.	Insect resistance	*cry1F* (event TC1507)
Rice	Bayer Bioscience Pvt. Ltd.	Insect resistance	*cry 1Ab, cry 1Ca & bar*
	Maharashtra Hybrid Seeds Co. Ltd.		20 Bt Rice events namely 2Bt-1 to 2Bt-20 containing *cry2Ab*
Groundnut	ICRISAT	Virus resistance	Coat protein gene (cp) of tobacco streak virus against peanut stem Necrosis Disease and Rchit gene for resistance against *Aspergillus*
Sorghum	National Research Centre for Sorghum	Insect Resistance	*cry1B gene NRCSCRY1B event 4 and NRCSCRY 1B event 19*

Source: http://www.igmoris.nic.in/field_trials.asp

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Pioneer:
http://www.pioneer.com/web/site/portal/menuitem.8e36377986a91418bc0c0a03d10093a0/

International Field Test Sources

Argentina:	http://translate.google.com/translate?hl=en&sl=es&u=http://www.sagpya.mecon.gov.ar/new/0-0/programas/conabia/index.php&sa=X&oi=translate&resnum=1&ct=result&prev=/search%3Fq%3Dcona
Australia:	http://www.ogtr.gov.au/internet/ogtr/publishing.nsf/Content/gmorec-index-1
Brazil:	http://translate.google.com/translate?hl=en&sl=pt&u=http://www.ctnbio.gov.br/&sa=X&oi=translate&resnum=1&ct=result&prev=/search%3Fq%3Dctnbio%26hl%3Den%26lr%3D
Canada:	http://active.inspection.gc.ca/eng/plaveg/bio/pntvcne.asp
	http://www.inspection.gc.ca/english/plaveg/bio/confine.shtml#sum
China	http://www.biosafety.gov.cn/
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EU:	http://gmoinfo.jrc.ec.europa.eu/ http://www.gmo-compass.org/eng/home/
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Mexico	http://translate.google.co.nz/translate?hl=en&sl=es&u=http://www.prodiversitas.bioetica.org/des4.htm&ei=82vWSq7ZJ4vstAOg64DKBQ&sa=X&oi=translate&resnum=3&ct=result&ved=0CBYQ7gEwAg&prev=/search%3Fq%3Dhttp://www.senasica.sagarpa.gob.mx/pagconasag/svtransgen.htm%2523ensayo%26hl%3Den%26sa%3DG
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South Africa:	http://www.daff.gov.za/
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United States:	http://www.isb.vt.edu/cfdocs/fieldtests1.cfm

List of Appendices:

Appendix 1: GM Varieties of *Zea mays* (maize and sweet corn) commercially available

Appendix 2: GM Varieties of *Brassica napus* var. *oleifera* (oilseed rape)

Appendix 3: GM Varieties of *Glycine max* (soybean)

Appendix 4: GM Varieties of *Gossypium hirsutum* (cotton)

Appendix 5: Other GM Crop Varieties

Appendix 1. GM Varieties of Zea mays *(maize and sweet corn)*

Event	Company	Date of Environmental Approval (Country)	Description	Promoter/ Terminator	Genetic Components/Markers
MON810 Yieldgard®	Monsanto	1995(US), 1996(Japan), 1997(Canada, South Africa), 1998(Argentina, EU), 2002(Philippines), 2003(Uruguay), 2007(Brazil)	Resistance to certain Lepidopteran pests	enhanced CaMV35S	*cry1Ab*
NK603 Roundup Ready®	Monsanto	2000(US), 2001(Canada, Japan), 2004(Argentina), 2005(Philippines), **2008(Brazil)**	Glyphosate herbicide tolerance	enhanced CaMV 35S, *nos*	CP4 *epsps*
MON863	Monsanto Yieldgard	2003(US, Canada), 2006(EU)	Resistance to certain Coleopteran pests	CaMV35S, *nos*	*nptII, cry3Bb1*
MON88017	Monsanto	2005(US), 2006(Canada, Japan)	Glyphosate herbicide tolerance, and resistance to certain Coleopteran pests	CaMV35S, *nos*	CP4 *epsps*, *cry3Bb1*
TC1507 Herculex® I	Mycogen (now Dow AgroSciences)	2001(US), 2002(Canada, Japan), 2005(Argentina), **2008(Brazil)**	Glufosinate herbicide tolerance, and resistance to certain Lepidopteran pests (	CaMV35S	*pat, cry1Fa2,*
GA21[1]	Syngenta Roundup Ready	1997(US), 1998(Argentina, Canada, Japan), **2008(Brazil)**	Glyphosate herbicide tolerance	*nos*	*epsps*
BT11 (X4334CBR,X4734 CBR)	Syngenta Seeds, Inc.	1996(US, Canada, Japan, UK), 2001(Argentina), 2003(South Africa), 2004(Uruguay), 2005(Philippines), 2007(Brazil), 2008 (Colombia)	Glufosinate herbicide tolerance, and resistance to certain Lepidopteran pests	CaMV35S, *nos*	*pat, cry1Ab*,
MIR604	Syngenta Seeds, Inc.	2007(US, Canada, Japan)	Resistance to certain Coleopteran pests	*nos*	*pmi, mcry3A*
DAS-59122-7	DOW AgroSciences LLC and Pioneer Hi-Bred International Inc.	2005(US, Canada), 2006(Japan)	Glufosinate herbicide tolerance, and resistance to certain Coleopteran pests	CaMV 35S	*pat, cry34Ab1, cry35Ab1*

Maize events authorised in at least one country but not yet commercialised or no longer available

Event	Company	Date of Environmental Approval (Country)	Description	Promoter/ Terminator	Genetic Components/Markers
MON80100	Monsanto	1995 (US)	Resistance to certain Lepidopteran pests	CaMV35S, *nos*	*nptII*, CP4 *epsps, gox247,cry1Ab*
MON802 Yieldgard®	Monsanto	1997 (Canada, Japan, US)	Glyphosate herbicide tolerance, and resistance to certain Lepidopteran pests	enhanced CaMV 35S, *nos*	*nptII,* CP4 *epsps, gox247,cry1Ab*
MON809	Monsanto	1996 (Canada, US), 1997 (Japan)	Glyphosate herbicide tolerance, and resistance to European corn borer	enhanced CaMV35S, *nos*	CP4 *epsps, gox247,cry1Ab*
B16 (DLL25)	Dekalb Genetics Corporation	1995 (US), 1996 (Canada), 1999(Japan)	Glufosinate herbicide tolerance	CaMV 35S	*bla*, *bar*
T14, T25	Bayer Cropscience	1995(US), 1996(Canada), 1997(Japan), 1998(EU, Argentina), 2007(Brazil)	Glufosinate herbicide tolerance	CaMV 35S	*pat, bla*
676, 678, 680	Pioneer Hi-Bred International Inc.	1998(US)	Glufosinate herbicide tolerance and male sterility	CaMV 35S	*pat,* dam
MS3 InVigor™	Bayer Cropscience	1996(US, Canada)	Glufosinate herbicide tolerance, and male sterility	CaMV 35S, *nos*	*bla, bar, barnase*
MS6 InVigor™	Bayer Cropscience	1999 (US)	Glufosinate herbicide tolerance, and male sterility	CaMV 35S, *nos*	*bla, bar, barnase*
176	Syngenta Seeds, Inc.	1995(US), 1996(Japan, Canada, Argentina), 1997(EU)	Glufosinate herbicide tolerance, and resistance to certain Lepidopteran pests	CaMV 35S	*bla, bar, cry1Ab*
BT11 x MIR162	Syngenta Seeds, Inc.	**2009 (US)**	Stacked[9] - Glufosinate herbicide tolerance, and resistance to a range of Lepidopteran pests	CaMV35S, *nos*	*pmi, pat, cry1Ab, vip3Aa20*

[9] Stacked hybrids are those produced from multiple different GM events which have been conventionally bred together into one new variety. Certain jurisdictions may request notification in advance of the release of a stacked hybrid, or may request information to conduct an environmental and food safety assessment.

Event	Company	Date of Environmental Approval (Country)	Description	Promoter/ Terminator	Genetic Components/Markers
CBH-351 StarLink™	Bayer CropScience	1998(US)	Glufosinate herbicide tolerance, and resistance to certain Lepidopteran pests	CaMV35S, *nos*	*bla, bar, cry9c*
DBT418	Dekalb Genetics Corporation	1997(US, Canada), 1998(Argentina), 1999(Japan)	Glufosinate herbicide tolerance, and resistance to European corn borer	CaMV35S	*bar, cry1Ac, pinII, bla*
DAS-06275-8	Dow AgroSciences	2004(US), 2006(Canada), **2008(Japan)**	Resistance to Lepidopteran pests	CaMV35S	*bar, mocry1F*
MON863 x MON810	Monsanto	2004(Japan)	Stacked - Resistance to certain Colepteran pests and certain Lepidopteran pests	CaMV35S, *nos*	*nptII*, cry3Bb1, cry1Ab
MON89034	Monsanto	**2008 (US, Canada, Japan)**	Resistance to Lepidopteran pests	CaMV 35S, FMV35S, *nos*	*cry1A.105, cry2Ab*
BT11 x GA21	Syngenta Seeds Inc.	2007(Japan)	Stacked - Glyphosate and glufosinate herbicide tolerance, and resistance to Lepidopteran pests	CaMV 35S, *nos*	*pmi, pat, epsps*
DAS-59122-7 x NK603	DOW AgroSciences LLC + Pioneer Hi-Bred International Inc.	2006(Japan)	Stacked - Glyphosate herbicide tolerance, and resistance to Coleopteran pests	CaMV 35S, *nos*	CP4 *epsps, pat, cry34Ab1, cry35Ab1*
MIR604 x GA21	Syngenta Seeds Inc.	2007(Japan)	Stacked - Glyphosate herbicide tolerance, and resistance to Coleopteran pests	*nos*	*pmi, epsps, mcry3A*
MON863 x MON810 x NK603	Monsanto	2004(Japan)	Stacked - Glyphosate herbicide tolerance, and resistance to Coleopteran and Lepidopteran pests	CaMV 35S, *nos*	*nptII,* CP4 *epsps*, *cry3Bb1, cry1Abs*
MON863 x NK603	Monsanto	2004(Japan)	Stacked - Glyphosate herbicide tolerance, and resistance to Coleopteran pests	CaMV 35S, *nos*	*nptII*, CP4 *epsps*, *cry3Bb1*

Event	Company	Date of Environmental Approval (Country)	Description	Promoter/ Terminator	Genetic Components/Markers
NK603 x MON810	Monsanto	2004(Japan, EU), 2005(Philippines), 2007(Argentina, South Africa)	Stacked - Glyphosate herbicide tolerance, and resistance to Lepidopteran pests	enhanced CaMV 35S, *nos*	CP4 *epsps*, *cry1Ab*
TC1507 x NK603	DOW AgroSciences LLC	2005(Japan), **2008(Argentina)**	Stacked - Glyphosate and glufosinate herbicide tolerance, and resistance to Lepidopteran pests	enhanced CaMV 35S, *nos*	*pat*, CP4 *epsps, cry1Fa2*
DAS-59122-7 x TC1507 x NK603	DOW AgroSciences LLC + Pioneer Hi-Bred International Inc.	2006(Japan)	Stacked - Glyphosate and glufosinate herbicide tolerance, and resistance to Coleopteran and Lepidopteran pests	CaMV 35S, *nos*	*pat*, CP4 *epsps*, *cry34Ab1, cry35Ab1, cry1Fa2*
TC1507 x DAS-59122-7	DOW AgroSciences LLC + Pioneer Hi-Bred International Inc.	2006(Japan)	Stacked - Glufosinate herbicide tolerance, and resistance to Coleopteran and Lepidopteran pests	CaMV 35S	*pat, cry34Ab1, cry35Ab1, cry1Fa2*
Event 3272	Syngenta Seed Inc.	2008(Canada)	Modified amylase for ethanol production	*nos*	*amy797E, pmi*
LY038	Monsanto	2006(US, Canada), 2007(Japan)	Enhanced lysine level (cDHDPS)		*cordapA*
MON810 x LY083	Monsanto	2007(Japan)	Stacked - Enhanced lysine level and resistance to European corn borer	CaMV35S	*cordapA, cry1Ab*

[1]Discontinued in 2001 in Canada, Demeke et al – Adventitious presence of GMOs, Canadian Grain Commission. 16 August 2005.

BOLD type – indicates field release in 2008-April 2009

Appendix 2. GM Varieties of Brassica napus var. oleifera (oilseed rape)

Event	Company	Date of Environmental Approval (Country)	Description	Promoter/ Terminator	Genetic components/Markers
HCN10 Liberty-Link™ Independence	Bayer Cropscience	1995(US),1995(Canada), 1997(Japan), 2003(Australia)	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium	CaMV 35S	*pat*
HCN92 Liberty-Link™ Innovator	Bayer CropScience	1995(Canada), 1996(Japan), 2002(US), 2003(Australia)	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium	CaMV 35S, *nos*	*nptII, pat*
T45 (HCN28)	Bayer Cropscience, Excel, Liberty Link	1996(Canada), 1997(Japan), 1998(US), 2003(Australia), 2004(EU)	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium	CaMV 35S	*pat*
GT200 Roundup Ready®	Monsanto	1996(Canada), 2003(US), 2006(Japan)	Glyphosate herbicide tolerance	chloroplast transit peptide	CP4 *epsps, goxv247*
GT73, RT73 Westar Roundup Ready®	Monsanto	1995(Canada), 1996(Japan), 1999(US), 2003(Australia)	Glyphosate herbicide tolerance	FMV35S	CP4 *epsps, goxv247*
MS1, RF1 =>PGS1	Aventis CropScience	1995(Canada), 1996(Japan), 2002(US), 2003(Australia)	Glufosinate ammonium herbicide tolerance and fertility restored	PSsuAra, pTa 29, anther-specific promoter, *nos*	*nptII, bar, barnase, barstar*
MS8, Rf3, MS8 x RF3	Bayer CropScience	1996(Canada), 1998(Japan), 1999(US), 2003(Australia)	Glufosinate ammonium herbicide tolerance and fertility restored	PSsuAra, pTa 29, anther-specific promoter	*bar, barnase, barstar*
23-18-17, 23-198	Monsanto	1994(US), 1996(Canada)	Modified seed fatty acid content, specifically high laurate levels and myristic acid production	CaMV 35S, seed-specific promoter, tml3'	BayTE, *nptII*
Oxy-235 Westar	Aventis CropScience	1997(Canada), 1998(Japan)	Oxynil herbicide tolerance, including bromoxynil and ioxynil	enhanced CaMV 35S, *nos*	*bxn*

Bayer CropScience Oxy 235 - last seed sales in 2001,

Bayer CropScience Topas 19/2, MS1/Rf1, and MS1/RF2 - last seed sales in 2003

Bayer CropScience HCN92 Liberty Link - last seed sales in 2003

Appendix 3. GM Varieties of Glycine max (Soybean)

Event	Company	Date of Environmental Approval (Country)	Description	Promoters/ Terminators	Genetic Components/Markers
MON04032-6 Roundup Ready	Monsanto	1994(US), 1995(Canada), 1996(Argentina, Japan), 1997(Uruguay), 1998(Mexico, Brazil), 2001(South Africa), 2004(Paraguay)	Glyphosate herbicide tolerance	enhanced CaMV 35S, *nos*	nptII, CP4 *epsps*

Authorised in at least one country but not yet commercialised

MON89788 Roundup Ready 2Yield™	Monsanto	2007(US, Canada), 2008(Japan)	Glyphosate herbicide tolerance	P-FMV/TSF1	CP4 epsps
A2704-12, Liberty Link	Bayer CropScience	1996(US), 1999(Canada, Japan)	Glufosinate tolerance	CaMV 35S	PAT
A5547-35 Liberty Link	Bayer CropScience	1996(US), 1999(Canada, Japan)	Glufosinate tolerance	CaMV 35S	PAT
A5547-127	Bayer CropScience	1998(US), 2000(Canada), 2006(Japan)	Glufosinate tolerance	CaMV 35S	*bla,* PAT
GU262	Bayer CropScience	1998(US)	Glufosinate tolerance	CaMV 35S	bla, PAT
W62, W98	Bayer CropScience	1996(US)	Glufosinate tolerance	CaMV 35S	*gus,*BAR
DP356043 Optimum GAT	Pioneer Hi-Bred International Inc.	**2008(US), 2009(Japan)**	Tolerance to Glyphosate and ALS inhibiting herbicides	SCP1, SAMs	*gat4601, gm-hra,*
DP305423	Pioneer Hi-Bred International Inc.	**2009(Canada)**	Modified seed fatty acid content (specifically high oleic and low linoleic)	Kti3, SAMS	*gm-hra*, gm-fad2-1
G94-1, G94-19, G168	DuPont Optimum	1997(US), 1999(Japan), 2000(Canada)	Modified seed fatty acid content	CaMV 35S, *nos*	*gus, bla*, gm-fad2-1

BOLD type – indicates field release in 2008-April 2009

Appendix 4. GM Varieties of Gossypium hirsutum (cotton)

Event	Company	Date of Environmental Approval (Country)	Description	Promoters/ Terminators	Genetic Elements
GHB614	Bayer CropScience	**2009(US)**	Glyphosate herbicide tolerance		*epsps*
LLCotton25 Liberty Link	Bayer CropSceince	2003(US), 2006(Australia), **2008(Brazil)**	Glufosinate herbicide tolerance	CaMV 35S, *nos*	*bar*
MON1445/1698 Roundup Ready	Monsanto	1995(US), 1997(Japan), 1999(Argentina), 2000(South Africa), 2004(EU, Colombia), 2000(Australia), **2008(Brazil)**	Glyphosate herbicide tolerance	modified FMV35S, CaMV 35S, *nos*	*CP4 epsps*, *nptII* & *aad*
MON88913 Roundup Ready Flex	Monsanto	2004(US), 2006(Australia), 2007(South Africa)	Glyphosate Herbicide tolerance	chimeric promoters	CP4 *epsps*
LLCotton25 x MON15985	Bayer CropScience	2007(Japan)	Glufosinate herbicide tolerance, and resistance to Lepidopteran pests	CaMV 35S, *nos*	*bar, cry1Ac, cry2Ab, aad, nptII, uidA*
MON15985 Bollgard II	Monsanto	2002(US, Australia), 2003(South Africa), 2006(India), **2008(Burkina Faso)**	Resistance to Lepidopteran pests	CaMV 35S, *nos*	*cry1Ac, cry2Ab, aad, nptII, uidA*
281-24-236 Widestrike	Dow AgroSciences	2004(US)	Resistance to Lepidopteran pests		*cry1F, pat*
3006-210-23 Widestrike	Dow AgroSciences	2004(US)	Resistance to lepidopteran pests	ubiquitin 1 (Zea mays)	*cry1Ac, pat*
DAS-21023 x DAS-24236 (Wildstrike™)	Dow AgroSciences	2004(US), **2009(Brazil)**	Resistance to Lepidopteran pests	ubiquitin 1 (Zea mays)	*cry1Ac, cry1F, pat*
Event-1	JK Agri Genetics Ltd (India)	2006(India)	Resistance to Lepidopteran pests	CaMV 35S, *nos*	cry1Ac*, aad,nptII*
MON531/757/1076 Bollgard	Monsanto	1995(US), 1996(Australia), 1997(Japan, South Africa, Mexico), 1998(Argentina), 2002(India), 2003(Colombia), 2005(Brazil)	Resistance to certain Lepidopteran pests	enhanced CaMV 35S, *nos*	*cry1Ac, aad, nptII*
MON-15985 x MON-1445	Monsanto	2002(Australia)	Glyphosate herbicide tolerance, and resistance to Lepidopteran pests	enhanced CaMV 35S, *nos*	CP4 epsps, *cry1Ac, cry2Ab, aad, nptII, uidA*

Event	Company	Date of Environmental Approval (Country)	Description	Promoters/ Terminators	Genetic Elements
MON531 x MON-1445	Monsanto	2003(Australia), 2005(South Africa), **2009(Argentina)**	Glyphosate herbicide tolerance, and resistance to Lepidopteran pests	CaMV 35S, *nos*	CP4 epsps, *cry1Ac, nptII, aad*
MON15985 x MON88913	Monsanto	2006(Australia), 2007(South Africa)	Gluphosinate herbicide tolerance & resistance to Lepidopteran pests	enhanced CaMV 35S, *nos*	CP4 epsps, *cry1Ac, cry2Ab, aad, nptII, uidA*
31807/31808	Calgene Inc.	1997(US), 1998(Japan)	Oxynil herbicide tolerance, and resistance to Lepidopteran pests	CaMV 35S	bxn, cry1Ac, nptII
BXN	Calgene Inc.	1994(US), 1997(Japan)	Oxynil herbicide tolerance	*nos*	*bxn, nptII*
n/a	CICR (ICAR) & UAS, Dharwad	**2008(India)**	generally pest resistance		*Cry1Ac*
GFM	Nath Seeds	**India**	Insect resistance		*Cry1A*
GK19	Chinese Academy of Agricultural Sciences	1997(China)	Lepidoperan resistance		*cry1ab, cryaAc*

BOLD type – indicates field release in 2008-April 2009

Appendix 5. Other GM Crop Varieties

(Commercially available)

Crop	Event	Company	Date of Regulatory Approval - Country	Description	Promoters/ Terminators	Genetic Elements
Carnation *Dianthus carophyllus*	66	Florigene Pty Ltd	1995(Australia), 1998(EU)	Delayed ripening (Increased shelf life)	CaMV 35S, *nos*	ACC, surB
Carnation *Dianthus carophyllus*	4,11,15,16	Florigene Pty Ltd	1995(Australia)	Modified flower colour & Sulfonylurea herbicide tolerance	CaMV 35S,	surB, dfr, hfl
Carnation *Dianthus carophyllus*	959A, 988A, 1226A,1351A,1363A, 1400A	Florigene Pty Ltd	1998(EU), 2000(Colombia)	Modified flower colour & Sulfonylurea herbicide tolerance	CaMV 35S, *surB* terminator from *N.tabacum*	surB, dfr, bp40
Papaya *Carica papaya*	55-1/63-1	Cornell University	1996(US)	Resistance to Papaya Ringspot Virus (PRSV)	*nos*, CaMV 35S	*nptII*, gus, *prsv-cp*
Papaya *Carica papaya*		South China Agricultural University	2006(China)	Resistance to Papaya Ringspot Virus (PRSV)		
Petunia *Petunia*	CHS gene	Beijing University	1998(China)	Modified flower colour		
Poplar *Populus nigra*		Research Institute of Forestry, Beijing	2005(China)	Bt - resistance to leaf pests		
Rice *Oryza sativa*	LLRICE06, LLRICE62	Aventis CropScience	1999(US) Not yet grown commercially	Herbicide tolerance - specifically Glufosinate	CaMV 35S	*bar*
Sugar Beet *Beta vulgaris*	T120-7	Bayer CropScience	1998(US), 2001(Canada)	Herbicide tolerance, specifically Glufosinate	CaMV 35S, *nos*	*pat, nptII*
Sugar Beet *Beta vulgaris*	GTSB77	Novartis Seeds, Monsanto	1998(US)	Herbicide tolerance, specifically Glufosinate	FMV 35S, CaMV 35S	CP4 *epsps*, *gox247*, gus
Sugar Beet *Beta vulgaris*	H7-1	Monsanto	2005(US, Canada), 2007(Japan)	Glyphosate Herbicide tolerance	FMV 35S	CP4 *epsps*
Sweet pepper *Capsicum annum*	PK-SP01	Peking University	1998(China)	Cucumber mosaic virus resistant		CMV -CP
Tomato *Lycopersicon*	D2 x A53 (Huafan No. 1)	Huazhong Agricultural University	1997(China)	Delayed ripening /altered shelf life		

Crop	Event	Company	Date of Regulatory Approval - Country	Description	Promoters/ Terminators	Genetic Elements
esculentum						
Tomato *Lycopersicon esculentum*	Da Dong No. 9	Institute of microbiology, CAS	2000(China)	Delayed ripening /altered shelf life		
Tomato *Lycopersicon esculentum*	PK-TM8805R	Beijing University	1998(China)	Virus Resistance		
Yellow Crook Neck Squash *Cucurbita pepo*	CZW-3	Asgrow(USA), Seminis Vegetables Inc.(Canada)	1996(US)	Virus Resistance Cucumber Mosaic Virus (CMV) Watermelon Mosaic Virus (WMV) 2 Zuchinni Yellow Mosaic Virus (ZYMV)	CaMV 35S, *nos*	*nptII*, CP(CMV), CP(WMV 2), CP(ZYMV)
Yellow Crook Neck Squash *Cucurbita pepo*	ZW20	Upjohn(USA), Seminis Vegetable Inc. (Canada)	1994(US)	Virus Resistance Watermelon Mosaic Virus (WMV) 2 Zucchini Yellow Mosaic Virus (ZYMV)	CaMV 35S	CP(ZYMV) CP(WMV 2)

BOLD type – indicates field release in 2008-April 2009