ANNEX 1

QUESTIONNAIRE about the socio-economic implications of the placing on the market of GMOs for cultivation

16 July 2009

A – Introduction note

Article 31.7 (d) of Directive 2001/18/EC[1] provides that the Commission should send to the European Parliament and the Council a specific report on the operation of the Directive including inter alia an assessment of the socio-economic implications of deliberate releases and placing on the market of GMOs. These implications are defined in Recital (62) of the Directive as the socio-economic advantages and disadvantages of each category of GMOs authorised for placing on the market, which take due account of the interest of farmers and consumers. In its 2004 report, the Commission noted that there was no sufficient experience to make such an assessment (the Directive became fully applicable as of 17 October 2002 and several Member States had not transposed yet so only little experience of its implementation was available).

Moreover Regulation (EC) No 1829/2003, its articles 7 and 19, asks the Commission to submit a draft of the authorisation decision taking into account, together with the opinion of the Authority in charge of the scientific assessment, "other legitimate factors relevant to the matter under consideration".

At its meeting on 4 December 2008, the Environment Council adopted conclusions on GMOs mentioning among other things the appraisal of socio-economic benefits and risks of placing GMOs on the European market for cultivation. In particular the Council conclusions indicated the following:

"The Council:

7. Points out that under Regulation 1829/2003 it is possible, under certain conditions and as part of a case by case examination, for legitimate factors specific to the GMO assessed to be taken into account in the risk management process which follows the risk assessment. The risk assessment takes account of the environment and human and animal health. Points out that under Directive 2001/18/EC, the Commission is to submit a specific report on the implementation of the Directive, including an assessment, inter alia, of socio-economic implications of deliberate releases and placing on the market of GMO.

   Invites the Member States to collect and exchange relevant information on socio-economic implications of the placing on the market of GMOs including socio-economic benefits and risks and agronomic sustainability, by January 2010. INVITES the Commission to submit to the European Parliament and to the Council the report based information provided by the Member States by June 2010 for due consideration and further discussions.

[1] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC

This possible consideration of socio-economic factors in the authorisation of GMOs for cultivation has also been raised by several Member States in the Environment and Agriculture Councils of the last months[2].

In order to respond to the invitation of the Council conclusions of 4 December 2008 and to the requirements of the legislation, the Commission invites Member States to submit all information they would consider relevant by January 2010 at the very latest.

In order to help Member States in structuring their responses, the Commission drafted a non exhaustive list of areas and stakeholders which could be concerned. In addition, for each of these categories, we have introduced in the annex a list of leading questions which could be used where considered appropriate.

When preparing their contribution Member States are invited to report *ex post* on the socio-economic impact of GMOs that have been approved in the EU and cultivated in their territory. Additionally, Member States are also invited to assess *ex ante* the possible implications of GMOs of currently pending approvals as well as those which are under development according to the best of their knowledge. One possible source of information in that respect is that recent report produced by the Joint Research Centre titled "The global pipeline of new GM crops" (available at http://ipts.jrc.ec.europa.eu**).**
The submissions must be as explicit and informative as possible and supported by evidence and data. When feasible, the socio-economic analysis – be it *ex post* or *ex ante* – should be quantified. In case documents are attached, they should be accompanied by a summary of the relevant part and a specification about the argument or topic that is being defended.

Where stakeholders are consulted at national level (e.g. farmers and consumers), we would appreciate it if their responses would be incorporated in your submission in an aggregated fashion. The list of stakeholders consulted, as well as any other pertinent information, may indeed be attached to the questionnaire.

Please note that the contributions must only deal with "socio-economic implications of the placing on the market of GMOs including socio-economic benefits and risks and agronomic sustainability" for each category of GMOs. These contributions should cover cultivation of GMOs and placing on the market of GM seeds.

If you choose to fill in the annexed questionnaire, please consider that answers should be broken down by the purpose of the genetic modification (herbicide tolerant, insect resistance, etc) if this affects the content of the responses.

DEADLINE FOR CONTRIBUTIONS: January 2010

[2] Environment Council of 2 March 2009, Agriculture Council of 23 March 2009 and Environment Council of 25 June 2009

B - Contact Details

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C – Areas and stakeholders on which Member States are invited to comment

1 - Economic and social implications: influence on concerned economic operators

Introductory notes

The Spanish Administration appreciates the efforts of the Commission for redacting this questionnaire that intends to know the socio economic implications of the releasing into the market GMOs following the application of the European legislation in this matter.

Nevertheless, we think that the information that can be obtained from the answers of the questionnaire is only partially useful because it is limited to the implications of the cultivation of GMO and in the EU we have a limited experience with cultivation of only one insect resistant crop. Only five countries grow GM corn at the moment and there is no experience at all in cultivation of herbicide resistant crops.

We would like to mention as well, that the Joint Research Centre has published a study called "Adoption and performace of the first GM crop introduced in EU agriculture: Bt maize in Spain" that has very broad and useful information for the Commission.

Upstream

1.1. Farmers

For each question, answers can be broken down by the range of stakeholders:

- *farmers cultivating GM crop;*
- *and/or conventional crops;*
- *and/or organic crops;*
- *beekeepers;*
- *seed producers producing GM seeds;*
- *seed producers producing conventional seeds;*
- *seed producers producing organic seeds;*

…

1.2. Seed industry

For each question, answers can be broken down by the range of relevant stakeholders, including:

- *plant breeders;*
- *multiplying companies;*
- *seed producing farmers;*
- *seed distributors;*

…

Downstream

Consumers;
Cooperatives and grain handling companies;
Food and feed industry;
Transport companies;
Insurance companies;
Laboratories;
Public Administration
Reasearch Institutions
-CSIC (High Council of Scientific Research)
-INIA (National Institute of Agricultural Research)

Innovation and Research
-ASEBIO (Spanish Association of Bioenterprises)
-ANOVE (The National Plant Breeders Association)

Farmer´s Unions
-ASAJA

Farmers, consumers and ecologists
-Amigos de la Tierra
-Greenpeace
-COAG
-CECU
-Ecologistas en Acción

Economic context

Internal market;
Specific regions and sectors.

2 - Agronomic sustainability

Biodiversity, flora, fauna and landscapes
Renewable or non renewable resources
Climate
Transport / use of energy

3 - Other Implications

ANNEX

Lead questions per area and stakeholder

For each question, answers should be broken down:
- by the purpose of the genetic modification if this affects the content of the responses,
- between ex ante and ex post considerations.

<u>1. - Economic and social implications</u>

Upstream

1.1. Farmers

For each question, answers can be broken down by the range of relevant agricultural stakeholders farmers
- farmers cultivating GM crops;
- and/or conventional crops;
- and/or organic crops;
- beekeepers;
- seed producers producing GM seeds;
- seed producers producing conventional seeds;
- seed producers producing organic seeds;
…

Has GMO cultivation an impact regarding the following topics? If so, which one?

- farmers' revenues (output prices and agricultural yields);

PUBLIC ADMINISTRATION

1.1.1. Aunque España es el país de la UE que dedica más superficie al cultivo de variedades modificadas genéticamente, solo supone un 20 % aproximado del cultivo de maíz, por lo que podemos indicar que el impacto del cultivo actual de los OMG en los ingresos de los agricultores en general es reducido. Si puede tener importancia en determinadas comarcas en las que la superficie del cultivo de maíz MG es elevado, como Aragón y Cataluña. La producción ecológica de maíz en España también es muy reducida, por lo que no hay grandes implicaciones por el cultivo de OMG. Lo que si hay que destacar es que si no se pudiera importar maíz MG para la producción de piensos para la alimentación animal, no podría competir el ganadero español en el mercado mundial, con graves daños en sus ingresos, e incluso podría suponer la desaparición de muchos de ellos.

RESEARCH INSTITUTIONS

1.1.1. Many data recorded since the very beginning of the GM crops demonstrate the economic advantage for farmers. It depends, of course, of the adequate use of the GM crop; for example: to use GM maize resistant to the stem borer is positive, both from the yield and the economic revenue, if the farm is situated in a region infested by the pest, the higher the infestation level, the better the revenues. But if the farm is pest-free, it would be a silly business to plant the GM crop.

INNOVATION AND RESEARCH

ASEBIO**:**

insect resistant (IR) crops:

- The effects on yields of IR-maize depend on the pest level in each area, and for this reason adoption of Bt-maize is high in Aragón and Catalonia and very low if any in Castilla y León[3].
- The first IR-maize grown in Spain was Compa CB variety derived from Bt176 event, whose welfare gain in the six years from 1998 to 2003 have been estimated to reach 15,5 million € (Demont and Tollens, 2004).
- An *ex ante* study under Spanish conditions proved that IR-cotton saved 15,8 l/ha of insecticide and yielded 12% more than conventional cotton under 1998 conditions (Novillo *et al*., 1999).
- The positive effect of MON810 IR-maize on crop yields when corn borer attack is important, has been 11% (1.500 kg/ha) in *ex ante* studies (Novillo *et al*., 2003), confirmed in 2004-2006 independent studies by 5,6% (717 kg/ha) average gain in three year study (GENVCE, 2007a).
- An *ex post* survey financed by the EC measured that the use of Bt-maize seeds in Spain resulted in gross margin increases from 3,17 to 135 € per hectare depending on the year and areas of cultivation (Gómez-Barbero *et al*, 2008).
- The growing surface planted in Spain –from 22.000 ha in 1998 to 76.000 ha in 2009[4]- after 12 years of local experience is a strong *ex post* indicator of higher farmer revenues.
- The % of yield increase with IR crops ranges from 0%-37% in cotton and 5%-34% in maize; this results in gross margin increase of 23-470 $US/ha for IR cotton and 12-53 $US/ha for IR-maize (Qaim, 2009).

herbicide resistant (HT) crops:

- Official data by US Department of Agriculture[5] have confirmed the growing adoption by US farmers of HT varieties of soybean (reaching 91% of adoption after 14 years of experience), cotton, maize, canola and sugar beets, suggesting better farmer revenues through lower costs and increased flexibility.
- Global data have confirmed growing acceptance of HT varieties in the countries where they have become available to the farmers (James, 2009).
- An *ex ante* survey of 100 farmers financed by the EC indicated than 36,5% of Spanish farmers are likely to adopt HT maize (vs. 38,5% unlikely) and 48,3 % of Spanish farmers are likely to adopt IR/HT maize (vs. 35% unlikely) when the new varieties are available (Rodríguez-Cerezo, 2009).

ANOVE:

Impact on revenue, yields and profitability

The information provided below summarises the main 'first round' socio-economic global impacts of genetically modified (GM) crop technology since it was first adopted on a broad

[3] http://www.mapa.es/agricultura/pags/semillas/estadisticas/serie_maizgm98_06.pdf
[4] http://www.mapa.es/agricultura/pags/semillas/estadisticas/serie_maizgm98_06.pdf
[5] http://www.ers.usda.gov/Data/BiotechCrops/#2008-7-2

commercial scale in 1996. As such, the data presented is ex post analysis. The material presented largely draws on the findings presented in the latest (4th) annual update report on the global socio-economic and environmental impacts of biotech crops by Brookes G & Barfoot P (2009)[6]. This information follows the same methodology used for the previous three annual reports, all of which have been published in the peer review scientific journal AgBioforum[7]. This latest report (4th edition) has also recently received acceptance for publication in the next edition of AgBioforum. It should also be noted that the Brookes & Barfoot analysis is based on an extensive review of existing farm level impact data for biotech crops (over 50 references on direct/first round socio-economic impacts, many of which are in peer reviewed journals).

Insect resistant (IR) corn/maize

Two biotech insect resistant traits have been commercially used targeting the common corn boring pests (*Ostrinia nubilalis* (European corn borer or ECB) and *Sesamia nonagroides* (Mediterranean stem borer or MSB) and Corn Rootworm pests – *Diabrotica).* These are major pests of corn crops in many parts of the world and significantly reduce yield and crop quality, unless crop protection practices are employed.

The two biotech IR corn traits have delivered positive yield impacts in all user countries when compared to average yields derived from crops using conventional technology (mostly application of insecticides and seed treatments) for control of corn boring and rootworm pests.

The positive yield impact varies from an average of about +5% in North America to +24% in the Philippines

Figure 1). In terms of additional production, on an area basis, this is in a range of +0.25 tonnes/ha to +0.88 tonnes/ha.

Average positive yield and production impact across the total area planted to biotech IR corn traits over the cumulative time period of adoption (a maximum of twelve years) has been + 6.17%. This has added 62.4 million tonnes to total corn production in the countries using the technology. In 2007, the technology delivered an extra 15 million tonnes of corn production (Table 1).

In the EU, in maize growing regions affected by corn boring pests, the primary impact of the adoption of GM IR maize has been higher yields compared to conventional maize. Average yield benefits have often been +10% and sometimes higher, although impacts vary by region and year according to pest pressure (Table 1).

Figure 1: Corn: yield and production impact of biotechnology 1996-2007 by country

[1] Available at www.pgeconomics.co.uk

[2] AgbioForum 8 (2&3) 187-196, 9 (3) 1-13 and 11 (1), 21-38. www.agbioforum.org

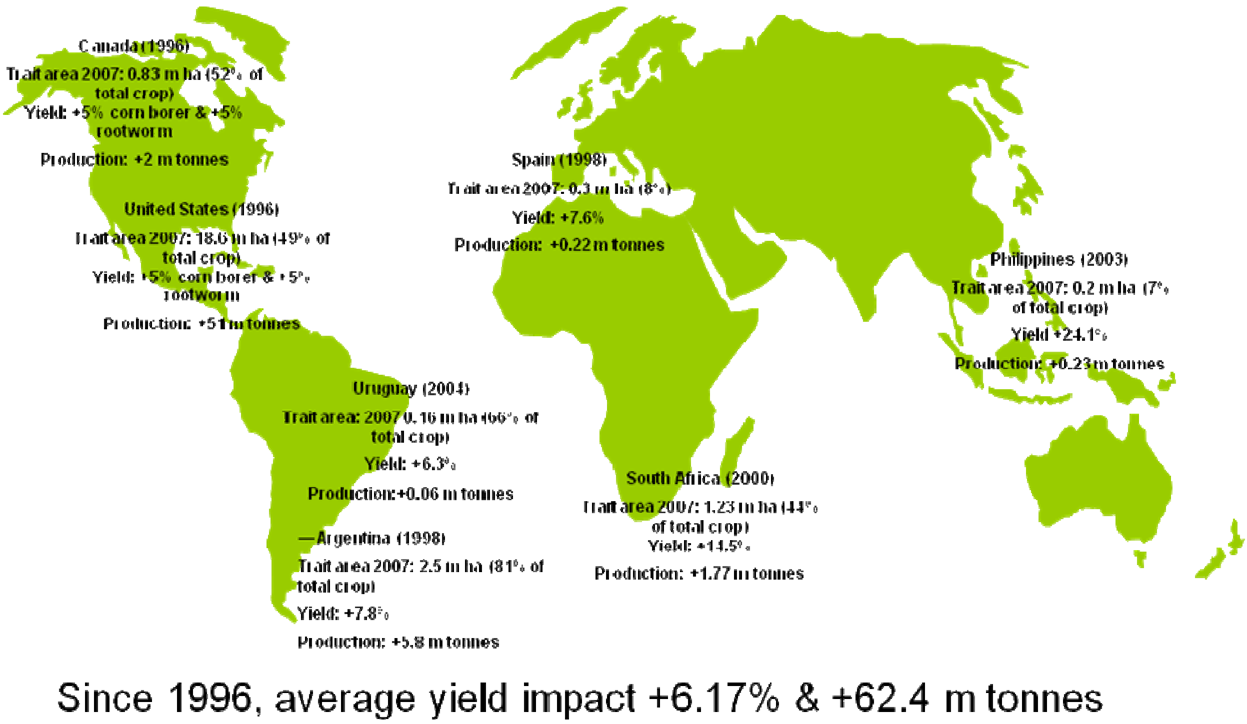

Table 1: Corn: yield and production impact of biotechnology 1996-2007

	Year of first adoption	GM trait area 2007	% of crop to trait[8]	Average trait impact on yield %[9]	Average yield impact (tonnes/ha)	Additional production from trait (tonnes): 2007	Additional production from trait (tonnes): cumulative
US Corn borer resistant	1996	18,560,907	49	5	0.43	8,584,419	44,662,867
US Corn Rootworm resistant	2003	8,417,645	22	5	0.43	3,893,161	7,023,290
Canada Corn borer resistant	1996	831,000	52	5	0.38	344,450	1,972,525
Canada Corn Rootworm resistant	2004	39,255	2.5	5	0.38	16,271	30,591
Argentina corn borer resistant	1997	2,509,000	81	7.8	0.48	938,366	5,801,153
Philippines corn borer resistant	2003	193,890	7	24.15	0.52	117,998	233,281
S Africa Corn borer resistant	2000	1,234,000	44	15.3	0.46	740,400	1,775,135
Uruguay Corn borer resistant	2004	105,000	62	6.3	0.32	32,398	62,957
Spain Corn borer resistant	1998	75,148	21	7.4	0.7	70,188	288,320
France Corn borer resistant	2005	22,135	1.5	10	0.88	20,807	25,540
Germany Corn borer resistant	2005	2,685	0.7	4	0.35	976	1,374

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[3] From year of first commercial planting to 2006

[4] Average of impact over years of use, as estimated by Brookes & Barfoot (2009)

Portugal corn borer resistant	2005	4,263	3.6	12.5	0.65	2,936	4,203
Czech Republic Corn borer resistant	2005	5,000	4.7	10	0.66	2,875	3,939
Slovakia Corn borer resistant	2005	948	0.6	12.3	0.68	499	519
Poland Corn borer resistant	2006	327	0.1	12.5	0.59	216	231
Romania Corn borer resistant	2007	360	0.02	7.1	0.25	89	89
Cumulative totals		**32,001,563**				**14,766,049**	**61,886,014**

Insect resistant (IR) cotton

Insect resistant traits have been commercially used targeting various *Heliothis* pests (eg, budworm and bollworm). These are major pests of cotton crops in all cotton growing regions of the world and can devastate crops, causing substantial reductions in yield, unless crop protection practices are employed.

The biotech IR cotton traits used have delivered positive yield impacts in all user countries (except Australia[10]) when compared to average yields derived from crops using conventional technology (mainly the intensive use of insecticides) for control of *heliothis* pests.

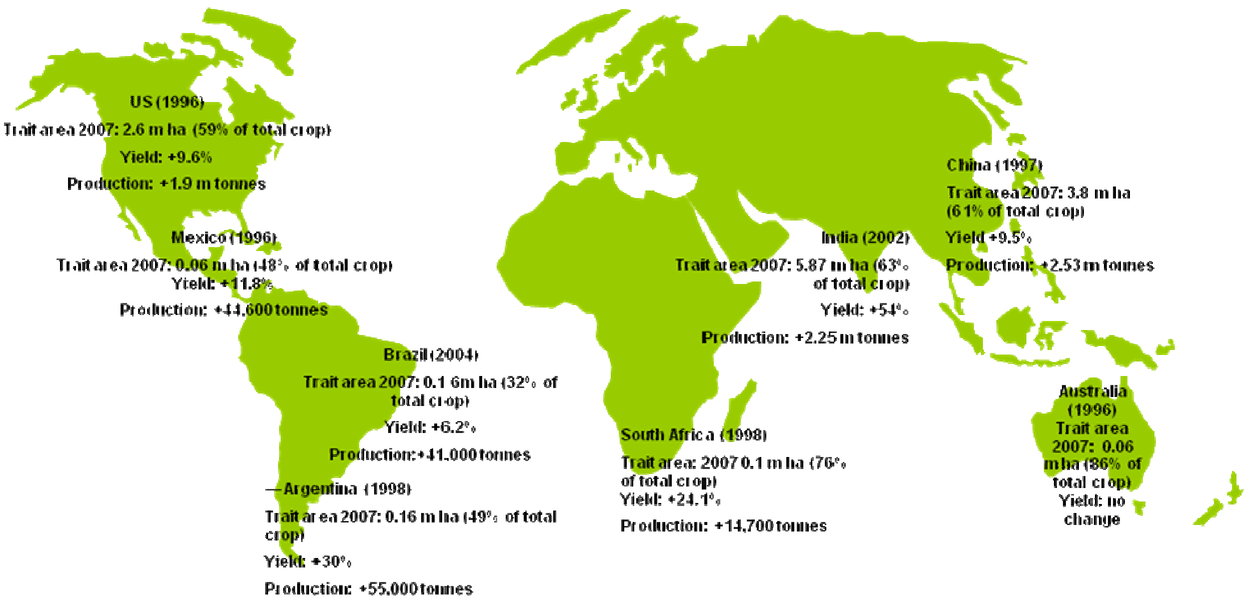
> The positive yield impact varies from an average of about +6% in South America to +54% in India

Figure 2). In terms of additional production, on an area basis, this is in a range of +0.05 tonnes/ha to +0.17 tonnes/ha (of cotton lint).

The average positive yield and production impact across the area planted to insect resistant cotton over the eleven year period has been + 13.3%. This has added 6.85 million tonnes to total cotton lint production in the countries using the technology. In 2007, the technology delivered an extra 2.01 million tonnes of cotton lint production (
Table 2).

Figure 2: Cotton: yield and production impact of biotechnology 1996-2007 by country

[5] This reflects the levels of *Heliothis* pest control previously obtained with intensive insecticide use. The main benefit and reason for adoption of this technology in Australia has arisen from significant cost savings (on insecticides) and the associated environmental gains from reduced insecticide use



Since 1996, average yield impact +13.3% & +6.85 m tonnes

Table 2: Cotton: yield and production impact of biotechnology 1996-2007

	Year of first adoption	GM trait area 2007	% of crop to trait[11]	Average trait impact on yield %[12]	Average yield impact (tonnes/ha)	Additional production from trait (tonnes): 2007	Additional production from trait (tonnes): cumulative
US	1996	2,585,160	59	9.6	0.07	240,420	1,900,796
China	1997	3,800,000	61	9.5	0.1	449,920	2,533,336
South Africa	1998	9,900	76	24.3	0.11	1,644	14,734
Australia	1996	55,328	86	Nil	-	-	-
Mexico	1996	60,000	48	11.8	0.12	6,570	44,628
Argentina	1998	162,300	49	30	0.12	20,352	55,349
India	2002	5,868,000	63	54.8	0.17	1,261,620	2,255,826
Columbia	2002	20,000	43	8.1	0.06	1,763	5,360
Brazil	2006	358,000	32	6.2	0.08	29,440	40,627
Cumulative totals		**12,918,688**				**2,011,730**	**6,850,656**

Herbicide tolerant soybeans

Weeds have traditionally been a significant problem for soybean farmers, causing important yield losses (from weed competition for light, nutrients and water). Most weeds in soybean crops have been reasonably controlled, based on application of a mix of herbicides.

Although the primary impact of biotech herbicide tolerant (HT) technology has been to *provide more cost effective* (less expensive) and *easier* weed control versus improving yields from *better* weed control (relative to weed control obtained from conventional technology), improved weed control has,

[6] From year of first commercial planting to 2006

[7] Average of impact over years of use, as estimated by Brookes & Barfoot (2009)

nevertheless occurred - delivering higher yields. Specifically, the main country in which HT soybeans has delivered higher yields has been in Romania, where the average yield increased by over 30 per cent (
Figure 3)[13].
Biotech HT soybeans have also facilitated the adoption of no tillage production systems, shortening the production cycle. This advantage enables many farmers in South America to plant a crop of soybeans immediately after a wheat crop in the same growing season. This second crop, additional to traditional soybean production, has added 67.6 million tonnes to soybean production in Argentina and Paraguay between 1996 and 2007. In 2007, the second crop soybean production in these countries was 14.5 million tonnes (
Table 3).

Table 3: Second crop soybean production facilitated by biotech HT technology in South America 1996-2007 (million tonnes)

Country	**Year first commercial use of HT soybean technology**	**Second crop soybean production 2007**	**Second crop soybean production cumulative**
Argentina	1996	13,987,114	64,870,614
Paraguay	1999	472,358	2,689,280
Total		**14,459,472**	**67,559,894**

Herbicide tolerant canola

Weeds represent a significant problem for canola growers contributing to reduced yield and impairing quality by contamination (eg, with wild mustard seeds). Conventional canola weed control is based on a mix of herbicides which has provided reasonable levels of control although some resistant weeds have developed (eg, to the herbicide trifluralin). Canola is also sensitive to herbicide carryover from (herbicide) treatments in preceding crops which can affect yield.
The main impact of biotech HT canola technology, used widely by canola farmers in Canada and the US, has been to provide more cost effective (less expensive) and easier weed control, coupled with higher yields. The higher yields have arisen mainly from more effective levels of weed control than was previously possible using conventional technology. Some farmers have also obtained yield gains from biotech derived improvements in the yield potential of some HT canola seed.
The average annual yield gains (average over all years of adoption) have been about +3.5% in the US and +9% in Canada (
Figure 3).
Over the 1996-2007 period, the additional North American canola production arising from the use of biotech HT technology was +4.44 million tonnes (
Figure 3).

Herbicide tolerant corn & cotton

Weeds have also been a significant problem for corn and cotton farmers, causing important yield losses. Most weeds in these crops have been reasonably controlled based on application of a mix of herbicides.

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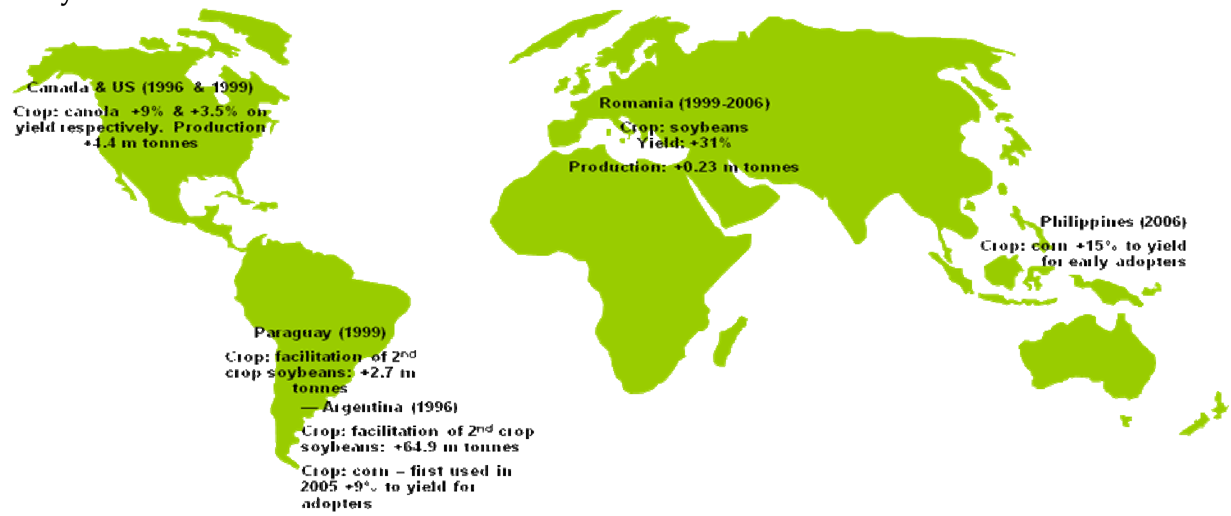
[8] Weed infestation levels, particularly of difficult to control weeds such as Johnson grass have been very high in Romania. This is largely a legacy of the economic transition during the 1990s which resulted in very low levels of farm income, abandonment of land and very low levels of weed control. As a result, the weed bank developed substantially and has been subsequently very difficult to control, until the GM HT soybean system became available (glyphosate has been the key to controlling difficult weeds like Johnson grass)

The HT technology used in these crops has mainly provided more cost effective (less expensive) and easier weed control rather than improving yields from better weed control (relative to weed control levels obtained from conventional technology).

Improved weed control from use of the HT technology has, nevertheless, delivered higher yields in some regions and crops (

Figure 3). For example, in Argentina, where HT corn was first used commercially in 2005, the average yield effect has been +9%, adding +0.45 million tonnes to national production (2005-2007). Similarly in the Philippines, (first used commercially in 2006), early adopters are finding an average of +15% to yields (this has delivered an extra 83,000 tonnes on the small area using the technology in the first two years of adoption).

Figure 3: Herbicide tolerant crops: yield and production impact of biotechnology 1996-2007 by country



Production impacts: summary

Drawing on the impacts presented above, Table 4 summaries the impact that adoption of biotech traits has had on production levels of the four main crops in which the technology has been used (soybeans, corn, cotton and canola) over the 1996-2007 period. Key points to note are:

- The biotech IR traits, used in the corn and cotton sectors, have accounted for 99% of the additional corn/maize production and all of the additional cotton production;
- In 2007, at the global level, world production levels of soybeans, corn, cotton lint and canola were respectively +6.5%, +1.9%, +7.7% and +1.1% higher than levels would have otherwise been if biotech traits had not been used by farmers;
- In area equivalent terms, if the biotech traits used by farmers in 2007 had not been available, maintaining global production levels at the 2007 levels would have required additional (conventional crop) plantings of 5.89 million ha of soybeans, 3 million ha of corn, 2.54 million ha of cotton and 0.32 million ha of canola. This total area requirement is equivalent to about 6% of the arable land in the US, or 23% of the arable land in Brazil.

Table 4: Additional crop production arising from positive yield effects of biotech crops

	1996-2007 additional production (million tonnes)	**2007 additional production (million tonnes)**
Soybeans	67.80	14.46
Corn	62.42	15.08
Cotton	6.85	2.01

Canola	4.44	0.54

Farm income and cost of production effects

Over the twelve year period 1996-2007, biotechnology has had a significant positive impact on global farm income derived from a combination of enhanced productivity and efficiency gains (
Table 5):

- In 2007, the direct global farm income benefit from biotech crops was $10.1 billion. This is equivalent to having added 4.4% to the value of global production of the four main crops of soybeans, maize, canola and cotton;
- Since 1996, farm incomes have increased by $44.1 billion;
- The largest gains in farm income have arisen in the soybean sector, largely from cost savings. The $3.9 billion additional income generated by GM herbicide tolerant (GM HT) soybeans in 2007 has been equivalent to adding 7.2% to the value of the crop in the biotech growing countries, or adding the equivalent of 6.4% to the $60 billion value of the global soybean crop in 2007. These economic benefits should, however be placed within the context of a significant increase in the level of soybean production in the main biotech adopting countries. Since 1996, the soybean area in the leading soybean producing countries of the US, Brazil and Argentina increased by 58%. Of the total cumulative income gains from biotech HT soybeans ($21.81 billion 1996-2007), 78.5% has been due to cost savings and the balance due to yield increases (from improved weed control mainly in Romania and Mexico) and facilitation of 2nd crop soybeans in South America (by shortening the production cycle for soybeans, the technology has enabled many South American farmers to plant a crops of soybeans immediately after a wheat crop 'in the same season'). The average farm income gain over the 1996-2007 period across the total biotech HT soybean area was $42/ha and for 2nd crop soybeans the average gain was $167/ha;
- Substantial gains have also arisen in the cotton sector through a combination of higher yields and lower costs associated with the use of GM IR technology. In 2007, cotton farm income levels in the biotech adopting countries increased by $3.2 billion and since 1996, the sector has benefited from an additional $12.6 billion. Within this, 65% of the farm income gain has derived from yield gains (less pest damage) and the balance (35%) from reduced expenditure on crop protection (spraying of insecticides). The 2007 income gains are equivalent to adding 16.5% to the value of the cotton crop in these countries, or 10.2% to the $27.5 billion value of total global cotton production. Biotech IR cotton has provided the largest gains per hectare, with an average farm income gain across the total biotech IR cotton area, over the 1996-2007 period, of $150/ha. Income gains have been largest in developing countries, notably China and India, where the average income gain has respectively been +$286/ha and +$275/ha;
- Significant increases to farm incomes have also resulted in the maize and canola sectors. The combination of GM insect resistant (GM IR) and GM HT technology in maize has boosted farm incomes by $7.2 billion since 1996. In the North American canola sector an additional $1.44 billion has been generated;
- Of the total cumulative farm income benefit, $20.5 billion (46.5%) has been due to yield gains (and second crop facilitation), with the balance arising from reductions in the cost of production. Within this yield gain component, 68% derives from the GM IR technology and the balance to GM HT crops.

Table 5: Global farm income benefits from growing biotech crops 1996-2007: million US $

Trait	Increase in farm income 2007	Increase in farm income 1996-2007	Farm income benefit in 2007 as % of total value of production of these crops in biotech adopting countries	Farm income benefit in 2007 as % of total value of global production of crop

GM herbicide tolerant soybeans	3,935	21,814	7.2	6.4
GM herbicide tolerant maize	442	1,508	0.7	0.4
GM herbicide tolerant cotton	25	848	0.1	0.1
GM herbicide tolerant canola	346	1,439	7.65	1.4
GM insect resistant maize	2,075	5,674	3.2	1.9
GM insect resistant cotton	3,204	12,576	16.5	10.2
Others	54	209	Not applicable	Not applicable
Totals	**10,081**	**44,068**	**6.9**	**4.4**

Notes: All values are nominal. Others = Virus resistant papaya and squash. Totals for the value shares exclude 'other crops' (ie, relate to the 4 main crops of soybeans, maize, canola and cotton). Farm income calculations are net farm income changes after inclusion of impacts on yield, crop quality and key variable costs of production (eg, payment of seed premia, impact on crop protection expenditure)

Table 6 summarises farm income impacts in key biotech adopting countries. This highlights the important farm income benefit arising from GM HT soybeans in South America (Argentina, Brazil, Paraguay and Uruguay), GM IR cotton in China and India and a range of GM cultivars in the US. It also illustrates the growing level of farm income benefits being obtained in South Africa, the Philippines and Mexico.

Table 6: GM crop farm income benefits 1996-2007 selected countries: million US $

	GM HT soybeans	**GM HT maize**	**GM HT cotton**	**GM HT canola**	**GM IR maize**	**GM IR cotton**	**Total**
US	10,422	1,402.9	804	149.2	4,778.8	2,232.7	***19,789.6***
Argentina	7,815	46	28.6	N/a	226.8	67.9	***8,184.3***
Brazil	2,868	N/a	N/a	N/a	N/a	65.5	***2,933.5***
Paraguay	459	N/a	N/a	N/a	N/a	N/a	***459***
Canada	103.5	42	N/a	1,289	208.5	N/a	***1,643***
South Africa	3.8	5.2	0.2	N/a	354.9	19.3	***383.4***
China	N/a	N/a	N/a	N/a	N/a	6,740.8	***6,740.8***
India	N/a	N/a	N/a	N/a	N/a	3,181	***3,181***
Australia	N/a	N/a	5.2	N/a	N/a	190.6	***195.8***
Mexico	8.8	N/a	10.3	N/a	N/a	65.9	***85***
Philippines	N/a	11.4	N/a	N/a	33.2	N/a	***44.6***
Romania	92.7	N/a	N/a	N/a	N/a	N/a	***92.7***
Uruguay	42.4	N/a	N/a	N/a	2.7	N/a	***45.1***
Spain	N/a	N/a	N/a	N/a	60.0	N/a	***60***
Other EU	N/a	N/a	N/a	N/a	12.6	N/a	***12.6***
Columbia	N/a	N/a	N/a	N/a	N/a	10.4	***10.4***

Notes: All values are nominal. Farm income calculations are net farm income changes after inclusion of impacts on yield, crop quality and key variable costs of production (eg, payment of seed premia, impact on crop protection expenditure). N/a = not applicable

In terms of the division of the economic benefits obtained by farmers in developing countries relative to farmers in developed countries.

Table 7 shows that in 2007, 58% of the farm income benefits have been earned by developing country farmers. The vast majority of these income gains for developing country farmers have been from GM IR cotton and GM HT soybeans[14]. Over the twelve years, 1996-2007, the cumulative farm income gain derived by developing country farmers was $22.1 billion (50.1% of the total).

Table 7: GM crop farm income benefits 2007: developing versus developed countries: million US $

	Developed	Developing
GM HT soybeans	1,375	2,560
GM IR maize	1,773	302
GM HT maize	402	41
GM IR cotton	286	2,918
GM HT cotton	16	8
GM HT canola	346	0
GM virus resistant papaya and squash	54	0
Total	**4,252**	**5,829**

Developing countries = all countries in South America, Mexico, India, China, the Philippines and South Africa

It is important to recognise that the analysis presented above is largely based on estimates of average impact in all years. Recognising that pest and weed pressure varies by region and year, additional sensitivity analysis is presented below for the crop/trait combinations where yield impacts were identified in the literature. This sensitivity analysis was undertaken for two levels of impact assumption; one in which all yield effects in all years were assumed to be 'lower than average' (levels of impact that reflected yield impacts in years of low pest/weed pressure) and one in which all yield effects in all years were assumed to be 'higher than average' (levels of impact that reflected yield impacts in years of high pest/weed pressure). The results of this analysis suggests a range of positive direct farm income gains in 2007 of +$8.5 billion to +$12.9 billion and over the 1996-2007 period, a range of +$38.2 billion to +$52.2 billion (
Table **8**). This range is broadly within 85% to 120% of the main estimates of farm income presented above.

Table 8: Direct farm income benefits 1996-2007 under different impact assumptions (million $)

Crop	Consistent below average pest/weed pressure	Average pest/weed pressure (main study analysis)	Consistent above average pest/weed pressure
Soybeans	21.796.0	21,814.1	21,829.0
Corn	4,571.0	7,181.2	12,152.0
Cotton	10,920	13,424.4	15,962.0
Canola	818.7	1,438.6	2.013.0
Others	101.4	208.8	224.3
Total	**38,207.1**	**44,067.1**	**52,180.3**

Note: No significant change to soybean production under all three scenarios as almost all gains due to cost savings and second crop facilitation

EU focus

GM IR maize: Spain

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[9] The classification of different countries into developing or developed country status affects the distribution of benefits between these two categories of country. The definition used is consistent with the definition used by James (2007)

Spain has been commercially growing GM IR maize since 1998 and in 2007, 21% (75,150 ha) of the country's maize crop was planted to varieties containing a GM IR trait.

As in the other countries planting GM IR maize, the main impact on farm profitability has been increased yields (an average increase in yield of 6.3% across farms using the technology in the early years of adoption). With the availability and widespread adoption of the Mon 810 trait from 2003, the reported average positive yield impact is about +10%[15]. There has also been a net annual average saving on cost of production (from lower insecticide use) of between $37/ha and $57/ha[16] (Table 9). At the national level, these yield gains and cost savings have resulted in farm income being boosted, in 2007 by $20.6 million and cumulatively since 1998 the increase in farm income (in nominal terms) has been $60 million.

Relative to national maize production, the yield increases derived from GM IR maize were equivalent to a 2% increase in national production (2007). The value of the additional income generated from Bt maize was also equivalent to an annual increase in production of 1.94%.

Table 9: Farm level income impact of using GM IR maize in Spain 1998-2007

Year	Cost savings ($/ha)	Net cost savings inclusive of cost of technology ($/ha)	Net increase in gross margin ($/ha)	Impact on farm income at a national level ($ millions)
1998	37.40	3.71	95.16	2.14
1999	44.81	12.80	102.20	2.56
2000	38.81	12.94	89.47	2.24
2001	37.63	21.05	95.63	1.10
2002	39.64	22.18	100.65	2.10
2003	47.50	26.58	121.68	3.93
2004	51.45	28.79	111.93	6.52
2005	52.33	8.72	144.74	7.70
2006	52.70	8.78	204.5	10.97
2007	57.30	9.55	274.59	20.63

Sources and notes:

1. Impact data (based on Brookes (2002 & Brookes (2008)). Yield impact +6.3% to 2004 and 10% used thereafter (originally Bt 176, latterly Mon 810). Cost of technology based on €18.5/ha to 2004 and €35/ha from 2005
2. All values for prices and costs denominated in Euros have been converted to US dollars at the annual average exchange rate in each year

GM IR maize: Other EU countries

A summary of the impact of GM IR technology in other countries of the EU is presented in Table 10. This shows that in 2007, the additional farm income derived from using GM IR technology in these seven countries was +$7.4 million. Cumulatively over the 2005-2007 period, the total income gain was $8.6 million.

Table 10: Farm level income impact of using GM IR maize in other EU countries 2005-2007

	Year first planted GM IR maize	Area 2007 (hectares)	Yield impact (%)	Cost of technology 2007 ($/ha)	Cost savings 2007 (before deduction of cost of technology: $/ha)	Net increase in gross margin 2007 ($/ha)	Impact on farm income at a national level 2007 (million $)

[10]The cost of using this trait has been higher than the pre 2003 trait (Bt 176) – rising from about €20/ha to €35/ha

[11]Source: Brookes (2002) and Alcade (1999)

France	2005	22,135	+10	54.57	68.21	254.73	5.64
Germany	2005	2,685	+4	54.57	68.21	117.32	0.32
Portugal	2005	4,263	+12.5	47.75	0	143.94	0.61
Czech Republic	2005	5,000	+10	47.75	24.56	146.25	0.73
Slovakia	2005	948	+12.3	47.75	0	102.35	0.09
Poland	2006	327	+12.5	47.75	0	123.33	0.04
Romania	2007	360	+7.1	43.66	0	34.66	0.01
Total other EU (excluding Spain)		**35,670**					**7.44**

Source and notes:

1. Source: based on Brookes (2008)
2. All values for prices and costs denominated in Euros have been converted to US dollars at the annual average exchange rate in each year

FARMER´S UNIONS

Los OGMs muestran una clara tendencia en mejora de rendimientos y no incide en absoluto sobre el precio unitario del producto.

FARMERS, CONSUMERS AND ECOLOGISTS

Pérdida del mercado de maíz ecológico por contaminación MG y venta a menor precio en mercado convencional; así como el sobrecoste de producir maíz no transgénico, y por ende la paulatina desaparición del sector del maíz ecológico por una parte y la enorme dificultad de producir en convencional en determinadas zonas por otra;

- farmers' production costs;

PUBLIC ADMINISTRATION

1.1.2. Los costos para los agricultores que cultivan maíz MG con el evento MON 810 no se incrementan sensiblemente, e incluso a veces se reducen, por no tener que realizar tratamientos químicos y poder efectuar la recolección más tarde, con el grano de maíz ya seco. Si les puede suponer un costo añadido a los productores de semillas convencionales y ecológicos, por mayores controles, análisis, etc. Y para la administración, por las mismas razones.

RESEARCH INSTITUTIONS

1.1.2. In the case of resistance to insects, the cost is very much reduced (there is a lot of data on this point); in the case of herbicide tolerance, the experience has demonstrated that there is a significant reduction in both the amount of a.i. and the number of treatments, with reduction in the energy and handwork costs.

INNOVATION AND RESEARCH

ASEBIO:

-insect resistant (IR) crops:

- An *ex ante* study under Spanish conditions proved that use of insecticides was no longer needed for control of corn borers in IR maize (MON810) (Novillo *et al*, 2003).

- Another *ex ante* study under Spanish conditions in 1998 proved that IR-cotton saved 5,6 insecticide applications involving 15,8 l/ha of insecticides (Novillo *et al*., 1999).
- The lower use of insecticides with IR maize –an average reduction of 0,53 treatments/ha- has been confirmed in an *ex post* survey financed by the EC (Gómez-Barbero *et al*, 2008).
- In the previous study, the number of insecticide treatments to control corn borers used by conventional maize farmers ranged from 0 to 4 treatments (Rodríguez-Cerezo, 2009), which highlights the variability in the decisions taken by individual farmers.

herbicide resistant (HT) crops:

- No data on HTseed + herbicide costs are available as the trait has not been approved yet for cultivation by the EC, but from the wide experience in other areas (James, 2009), it can be expected to be competitive with other options, offering additional tools to interested farmers.
- Data from *ex ante* studies under european conditions indicate that the efficiency of approved herbicides in conventional varieties of maize varies according to location and weed spectrum, and the conventional approach is to use a combination of pre- and post-emergent products with residual and/or foliar activity (Dewar, 2009).
- In the EC sponsored *ex ante* study under European conditions, the average cost of herbicides for conventional maize was 47,77 €/ha, but with a high variability (standard deviation= 31,98) and individual range from 10 to 150 €/ha (Rodríguez-Cerezo, 2009), which highlights the variability in the decisions taken by individual farmers.

FARMER´S UNIONS

Los OGMs producen una clara reducción en los costes de cultivo fundamentalmente por la reducción en el empleo de fitosanitarios.

FARMERS, CONSUMERS AND ECOLOGISTS

El coste promedio de la semilla MON810 es mayor que el coste de la semilla no MG. Este hecho se confirma con información aportada por otros autores: en el Estado Español, el incremento de precio de las semillas de maíz Bt se ha estimado en más de un 20%, hasta 30€ por hectárea (Brookes, 2002), aunque otros autores sitúan ese incremento de precio en casi 38 € por hectárea (Gómez-Barbero, 2006).

· El número de agricultores que deja una franja de cultivo convencional en sus siembras transgénicas no llega ni al 10%

· No se cobra más para la cosecha transgénica, no tiene ventaja en el mercado. De hecho, se destina principalmente para alimentación ganadera .

·Los costes de producción son mayores en los cultivos MG:

-las semillas MG son más caras que las convencionales

-los productos químicos son más caros y se emplean más por hectárea de cultivo transgénico que en la agricultura convencional

·Los rendimientos promedios de los cultivos MG no son mayores que los convencionales

· Los precios de las cosechas MG son menores que para las cosechas convencionales

- labour flexibility;

PUBLIC ADMINISTRATION

1.1.3. El cultivo de variedades modificadas si que flexibiliza el trabajo a los agricultores, por diversas razones, entre las que se destacan: La posibilidad de ampliar el cultivo, con siembras más tardías e incluso con segundas cosechas, al no ser atacadas por el taladro. También existe la posibilidad de realizar una recolección más retrasada, al no encamarse las cosechas.

RESEARCH INSTITUTIONS

1.1.3. See last point: reduction in worked hours means more flexibility in the labour design in the farm

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- The built-in protection under Spanish conditions avoids the operations of scouting and applying insecticides at the right moment for the control of corn borers in IR maize (MON810), facilitating the integrated management of other pests. Additionally, the burial of dry stems after harvest for cultural control of corn borer larvae is no longer needed (Novillo *et al*, 2003).

herbicide resistant (HT) crops:

- It is well known that in the countries where cultivation is allowed, the availability of HT crops facilitates the adoption of reduced tillage and conservation tillage practices, saving the time and fuel needed for tillage operations before planting of the crop (Service, 2007, James, 2009, Brookes, 2009).

ANOVE:

GM herbicide tolerant crops have been shown in a number of ex-post studies to have increased management flexibility. This comes from a combination of the ease of use associated with broad-spectrum, post-emergent herbicides like glyphosate and the increased/longer time window for spraying (see for example Brookes & Barfoot (2009), American Soybean Association (2001), Carpenter & Gianessi (1999) and Fernandez-Cornejo J & McBride W (2002)).

GM insect resistant crops have also provided a convenience/flexibility benefit from less time being spent on crop walking and/or applying insecticides (see for example, Brookes (2002)).

Relevant references in full

American Soybean Association Conservation Tillage Study (2001). http://www.soygrowers.com/ctstudy/ctstudy_files/frame.htm

Brookes G (2002) The farm level impact of using Bt maize in Spain, ICABR conference paper 2003, Ravello, Italy. Also on www.pgeconomics.co.uk

Brookes G & Barfoot P (2009) GM crops: global socio-economic and environmental impacts 1996-2007. PG Economics. www.pgeconomics.co.uk Also Global impact of biotech crops: income and production effects 1996-2007, Agbioforum (2009) forthcoming

Carpenter J & Gianessi L (1999) Herbicide tolerant soybeans: Why growers are adopting Roundup Ready varieties, Ag Bioforum, Vol 2 1999, 65-72

Fernandez-Cornejo J & McBride W (2002) Adoption of bio-engineered crops, USDA, ERS Agricultural Economics Report No 810

FARMER´S UNIONS

Los OGMs permiten al agricultor una mayor flexibilidad en las diferentes labores.

- quality of the harvest (e.g.mycotoxines);

PUBLIC ADMINISTRATION

1.1.4. De acuerdo con la experiencia existente, las cosechas españolas de maíz modificado genéticamente resistente a insectos presentan un contenido en micotoxinas (fumonisinas) muy inferior al de las cosechas convencionales y ecológicas de la misma zona de producción.

RESEARCH INSTITUTIONS

1.1.4. There are a lot of scientific reports in the case of GM maize resistant to stem borer that clearly indicates a minor amount of mycotoxines in the case of transgenic maize in comparison with the conventional one.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- It has been well documented in data from the USA that -in areas with high corn borer attacks- the reduction of damages to the maize grains by using IR maize varieties results in lower presence of mycotoxines (Munkwold, 1997).
- The same benefit of mycotoxin reduction has been found in trials completed under Spanish and Mediterranean conditions (Cahagnier and Melcion, 2000; Serra *et al*., 2008; GENVCE, 2007 b; GENVCE, 2008; Ariño, 2009).
- According to the Rapid Alert System for Food and Feed (RASFF) from 2003 to 2008, 62 batches of maize products had to be removed from the market (or rejected in case of imports) because of too high content of mycotoxins (mainly fumonisins). The details published by RASFF[17] indicated that no batches coming from IR-maize were involved, 43 cases were related to conventional maize and in 19 cases the origin of the product was organic maize (Escobar and Quintana, 2008).
- We must remember that, according to the European Food Safety Authority (EFSA)[18], fumonisin B_1 is carcinogenic in rodents, so that EC Regulation nº 1881/2006 was published on December 19th, 2006, establishing a **tolerance of 2.000 micrograms/kg** for the presence of fumonisins in raw maize. But as in several EU countries the IR varieties are not allowed for cultivation, the European Commission recognized on September 28th, 2007 that under certain conditions it was not possible to reach the desired target levels and published the EC Regulation nº 1126/2007, setting a tolerance of **4.000 micrograms/kg** for the presence of fumonisins in raw maize.

herbicide resistant (HT) crops:

[17] http://ec.europa.eu/food/food/rapidalert/archive_en.htm

[18] http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1178620762453.htm

- No changes in maize quality are expected as the tolerance for glyphosate traces in HT-maize tolerant to glyphosate (1 mg/kg) is one tenth of the safe tolerance established for conventional wheat (10 mg/kg).

ANOVE*:*

There is a growing body of ex-post analysis evidence to show that the adoption of GM IR maize has delivered important improvements in grain quality from significant reductions in the levels of mycotoxins found in the grain. Several papers quantifying and measuring this, in the EU, are summarised in Brookes G (2008). In terms of revenue from sales of corn, however, no premia for delivering product with lower levels of mycotoxins have, to date, been reported although where the adoption of the technology has resulted in reduced frequency of crops failing to meet maximum permissible fumonisin levels in grain maize (eg, in Spain), this delivers an important economic gain to farmers if they sell their grain to the food using sector. GM IR corn farmers in the Philippines have also obtained price premia of 10% (see Yorobe J (2004) relative to conventional corn because of better quality, less damage to cobs and lower levels of impurities.

Improved weed control arising from the adoption of GM HT crops has also reduced harvesting costs for many farmers. Cleaner crops have resulted in reduced times for harvesting. It has also improved harvest quality and led to higher levels of quality price bonuses in some regions. Examples where this arisen include in Romania (GM HT soybeans: see Brookes (2005)), in Canada (GM HT canola: see Canola Council (2001) and in Argentina (GM HT soybeans: see Qaim & Traxler (2002)).

Relevant references in full

Brookes G (2005) The farm level impact of using Roundup Ready soybeans in Romania. Agbioforum Vol 8, No 4. Also available on www.pgeconomics.co.uk

Brookes G (2008) The benefits of adopting GM insect resistant (Bt) maize in the EU: first results from 1998-2006,International Journal of Biotechnology (2008) vol 10, 2/3, pages 148-166

Canola Council of Canada (2001) An agronomic & economic assessment of transgenic canola, Canola Council, Canada. www.canola-council.org

Qaim M & Traxler G (2002) Roundup Ready soybeans in Argentina: farm level, environmental and welfare effects, 6th ICABR conference, Ravello, Italy

Yorobe J (2004) Economics impact of Bt corn in the Philippines. Paper presented to the 45th PAEDA Convention, Querzon City

FARMER´S UNIONS

Según el tipo de evento, los OGMs mejoran distintos aspectos relacionados con la sanidad del cultivo y de las producciones.

- cost of alternative pest and/or weed control programmes;

PUBLIC ADMINISTRATION

1.1.5. La no utilización de maíz MG en regiones con ataques importantes de taladro, obliga a realizar tratamientos insecticidas, limitados a los primeros estadíos del cultivo, con muy limitados efectos. En el caso del algodón, en el que no se ha autorizado hasta el momento ningún evento resistente a insectos en la UE, es obligatorio realizar una larga serie de tratamientos para controlar las plagas del cultivo, cada día menos efectivos, por lo que la producción se ha reducido en los últimos años, siendo en la actualidad un cultivo sin futuro en España.

RESEARCH INSTITUTIONS

1.1.5. Many data are available on published studies. Both pest and weed control programmes can be very expensive; in heavily infested zones, they are indeed not only expensive (amount of a.i and human labour) but dangerous for the labourers applying the products and the contamination of surface and ground waters, sometimes for long term. These facts need to be considered in future statements.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- Without considering the cost of scouting for monitoring the appearance of corn borer generations, and product application, the average cost of insecticide estimated in the *ex post* study sponsored by the EC ranged in three different Spanish provinces from 4,43 to 32,07 €/ha (Gómez-Barbero *et al*., 2008), but the relatively low level of use is because of poor efficacy on the corn borer once the insects have penetrated the stems of the crop.

herbicide resistant (HT) crops:

- Modern production of maize in the EU often requires programs with more than one herbicide (Dewar, 2009). Without considering application or the cost of a thorough soil preparation to facilitate control of problem weeds, the cost of a herbicide program for conventional maize was estimated as an average of 47,77 €/ha but with individual values ranging from 10 to 150 €/ha (Rodriguez-Cerezo, 2009). The high variability shows that weed pressure can change from farmer to farmer or even from plot to plot.

FARMER´S UNIONS

Una gran mayoría de los OGMs provocan una reducción en aplicaciones herbicidas y/o insecticidas y/o fungicidas, con su consiguiente efecto de mejora ambiental.

FARMERS, CONSUMERS AND ECOLOGISTS

El fuerte incremento en el empleo de los herbicidas observado en los cultivos transgénicos se debe fundamentalmente a la aparición de plantas silvestres no cultivadas ("malas hierbas") resistentes a los productos herbicidas.Teniendo en cuenta que hay solicitudes para poder cultivar variedades MG tolerantes a herbicidas, concretamente al glifosato, a corto plazo en Europa, subrayamos la importancia de indicar qué está sucediendo en otros países dónde ya los han introducido

· Durante los primeros tres años de cultivo transgénico en los EEUU se aplicaba menos producto químico por hectárea de variedades MG pero desde el año 2000 en adelante su empleo ha ido en aumento. En el caso concreto del herbicida glifosato, a lo cual están tolerantes las variedades empleadas en la mayor parte de la superficie cultivada con transgénicos en los EEUU, ya hay nueve especies de "malas hierbas" resistentes a este producto químico.

· La reacción del agricultor o agricultora es:

o añadir ingredientes activos adicionales

o incrementar el grado de principio activo que se aplica

o aumentar el número de veces en que se aplican herbicidas

o depender más en la preparación (arado etc) del suelo

o eliminar manualmente las malas hierbas

Todas estas opciones suponen mayores costes de producción y algunas, mayor presencia nociva de residuos en los suelos, las aguas y la cosecha final.

Concretamente en cuanto a lo que se refiere al empleo del glifosato, se calcula que la introducción de la soja transgénica ha supuesto que el uso de éste agro tóxico se multiplique por tres entre 1999 y 2006. Pero es de subrayar que, en el mismo periodo, el uso de otros herbicidas como el 2,4-D ha crecido de forma espectacular, lo que muestra que el incremento del uso de glifosato no está sustituyendo otros herbicidas (Benbrook, 2005). El Servicio Nacional de Agricultura, Alimentación y Salud y Calidad (SENASA) de Argentina calculó en 2007 que 120.000 hectáreas estaban infestadas con malezas resistentes al glifosato (Amigos de la Tierra, 2008).

- price discrimination between GM and non-GM harvest;

PUBLIC ADMINISTRATION

1.1.6. En España no hay una importante discriminación del precio en las cosechas de maíz MG frente al no MG, como consecuencia de que ambas se dedican fundamentalmente a la alimentación animal y compiten en precio con el maíz importado, en su mayoría MG. Solo en el caso del maíz destinado al consumo humano, que normalmente se demanda el no MG, es cuando existe una cierta diferencia en precio, estimado en aproximadamente un 10 % como máximo.

RESEARCH INSTITUTIONS

1.1.6. Spanish experience with GM maize resistant to stem borer indicates that the product is sold to the animal feed industry because of the negative of main food industries to use it.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- Because of the EU traceability and labelling requirements and the little communication by authorities that GM labelling is not a risk warning, IR-maize is practically not used for Spanish food (15% of the harvest), but it is **accepted without price discrimination for feed** uses (85% of the harvest). As the area planted with IR-maize in Spain in 2009 was around 22%, practically all the IR-maize harvest is being used to produce GM-feed (containing GM maize and soybeans).

herbicide resistant (HT) crops:

- HT-maize can be imported since 2004 -but not yet grown in Spain- and is used for feed production. When cultivation of the new HT-varieties is approved, the price discrimination is expected to be the same as for IR-maize.

FARMER´S UNIONS

En absoluto existe diferenciación de precios según OGM o no OGM puesto que las referencias de precios son internacionales y en estos mercados no se comercializan de forma independiente producciones OGM y no OGM.

FARMERS, CONSUMERS AND ECOLOGISTS

Todo indica que existen una serie de graves implicaciones económicas para los propios agricultores y agricultoras que cultivan maíz MG en el Estado español. Básicamente, hay muchos casos en que agricultores y agricultoras compran una tecnología que no necesitan, con un sobre coste en semillas, un rendimiento igual o menor que las variedades no MG, con un precio igual (o inferior según el destino final del maíz) en el mercado y una gradual pérdida de acceso a semillas no transgénicas.

- availability of seeds and seed prices;

PUBLIC ADMINISTRATION

1.1.7. No existen problemas en España de disponibilidad de semilla, por existir en el mercado una amplia oferta de variedades de maíz, tanto convencionales como modificadas genéticamente. A veces los productores ecológicos tienen problemas para conseguir semillas ecológicas y necesitan utilizar semillas convencionales sin tratamiento químico.

RESEARCH INSTITUTIONS

1.1.7. In Spain, in the stem borer area the seeds are available at a reasonable price.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- In 2009 there were around 123 varieties of IR-maize, included in the Spanish or European Catalogs, approved for commercialization in Spain. However, only around 25-40 varieties best adapted, –distributed by 10 seed companies-, anre used in the areas with usual corn borer problems. Therefore, it can be concluded that this is a very competitive market, with prices of 125-238 €/ha for conventional maize seed and 165-283 €/ha for comparable IR-maize seed.

herbicide resistant (HT) crops:

- No indication on prices can be given as cultivation of HT-varieties is not approved, but it is expected that the price with be competitive with current system with conventional varieties and herbicides.

ANOVE:

Seed prices

Brookes G & Barfoot P (2009) examined this issue in terms of the cost farmers pay for accessing GM technology relative to the total trait benefit (measured in terms of the farm income gain plus the cost of accessing the technology at the farm level).

Table 11 summarises their ex-post analysis across the four main biotech crops for 2007, and identified that the total cost was equal to 24% of the total technology gains (inclusive of farm income gains plus cost of the technology payable to the seed supply chain[19]).

For farmers in developing countries the total cost was equal to 14% of total technology gains, whilst for farmers in developed countries the cost was 34% of the total technology gains. Whilst circumstances vary between countries, the higher share of total technology gains accounted for by farm income gains in developing countries relative to the farm income share in developed countries

[12]The cost of the technology accrues to the seed supply chain including sellers of seed to farmers, seed multipliers, plant breeders, distributors and the GM technology providers

reflects factors such as weaker provision and enforcement of intellectual property rights in developing countries and the higher average level of farm income gain on a per hectare basis derived by developing country farmers relative to developed country farmers.

Table 11: Cost of accessing GM technology (million $) relative to the total farm income benefits 2007

	Cost of technology : all farmers	Farm income gain: all farmers	Total benefit of technology to farmers and seed supply chain	Cost of technology : developing countries	Farm income gain: developing countries	Total benefit of technology to farmers and seed supply chain: developing countries
GM HT soybeans	931	3,935	4,866	326	2,560	2,886
GM IR maize	714	2,075	2,789	79	302	381
GM HT maize	531	442	973	20	41	61
GM IR cotton	670	3,204	3,874	535	2,918	3,453
GM HT cotton	226	25	251	8	8	16
GM HT canola	102	346	448	N/a	N/a	N/a
Total	**3,174**	**10,081**	**13,255**	**968**	**5,829**	**6,797**

1. N/a = not applicable. Cost of accessing the technology is based on the seed premia paid by farmers for using GM technology relative to its conventional equivalents. Total farm income gain excludes £26 million associated with virus resistant crops in the US

Qaim & Traxler (2005) identified that, in terms of aggregate welfare, the economic surplus associated with GM HT soybeans in Argentina in 2001 was $335 million, of which farmers were able to capture 90% of the benefit. In contrast, they estimated that in the US, the share of the total trait benefit (of GM HT soybeans) was, the supply chain and farmers captured 57% and 43% respectively of the benefit. This greater share of the supply chain in the US relative to Argentina reflected the more effective Intellectual Property Rights (IPR) protection available in the US.

Pray et al (2002) examined these issues relating to the adoption of GM IR cotton in China but extended their analysis to consider consumer level impacts. They concluded that because the Chinese government bought all of the cotton at a fixed price, no benefits were passed on down the supply chain to consumers. Also because of weak intellectual property rights the major share of benefits was retained by farmers, with little accruing to the technology providers (public and private sector).

Traxler et al (2001) and Traxler and Godoy-Avila (2004) similarly found in Mexico (adoption of GM IR cotton) that 85% of the total benefits from adoption went to farmers with only 15% earned by the seed suppliers and technology providers.

Trigo and CAP (2006) estimated the distribution of accumulated benefits generated by GM HT soybeans in Argentina in the period 1996 to 2005, to be farmers 78%, the supply chain 9% and the government (from export taxes), 13%.

Demont M et al (2007) estimated the annual (ex-post) share split of global benefits from the first generation of GM crops to have been two-thirds 'downstream' (farmers and consumers) to one third 'upstream' (the input suppliers including biotechnology companies, plant breeders, seed suppliers, seed producers and wholesalers). This analysis also examined the potential (ex ante) share of these benefits if first generation GM crops were widely used in the EU (Insect resistant maize and herbicide tolerant maize, sugar beet and oilseed rape). This part of the analysis suggested a similar likely breakdown of benefits with 62% going to farmers/consumers and 38% to the supply chain (based on a total estimated annual benefit of €668 million).

Overall, all of the papers that have examined this issue have consistent findings, namely that a significant majority of the benefit has accrued to farmers (relative to the supply chain, including the providers of the technology).

Relevant references in full

Brookes G & Barfoot P (2009) GM crops: global socio-economic and environmental impacts 1996-2007. PG Economics. www.pgeconomics.co.uk Also Global impact of biotech crops: income and production effects 1996-2007, Agbioforum (2009) forthcoming

Demont et al (2007) GM crops in Europe: how much value and for whom? EuroChoices 6 (3), Agricultural Economics Society/European Association of Agricultural Economists

Pray C et al (2002) Five years of Bt cotton in China – the benefits continue, The Plant Journal 2002, 31 (4) 423-430. Also, Pray et al (2001) Impact of Bt cotton in China, World Development 29 (5), 813-825

Qaim M & Traxler G (2005) Roundup Ready soybeans in Argentina: farm level & aggregate welfare effects, Agricultural Economics 32 (1) 73-86

Traxler G et al (2001) Transgenic cotton in Mexico: economic and environmental impacts, ICABR conference, Ravello, Italy

Traxler and Godoy-Avila (2004): Transgenic cotton in Mexico, Agbioforum 7, (1-2), 57-62, www.agbioforum.org

Trigo E & Cap E (2006) Ten years of GM crops in Argentine agriculture, ArgenBio, Argentina

Impact on seed variety availability/biodiversity

This issue has been examined in a limited number of ex-post studies. Zilberman et al (2007) examined whether the introduction of biotech traits may lead to a loss of seed (bio) diversity and a reduction in the number of varieties grown. They identified that the introduction of biotech traits may actually increase the number of distinct varieties when the technological, economic and regulatory conditions facilitate the adoption of biotech traits in a large number of local varieties. However, limited capacity to modify local varieties may adversely affect seed (bio)diversity, as it may result in a small number of varieties containing biotech traits (sometimes imported) being planted on land where a larger number of local varieties had formerly grown. In the seed markets of most countries, the decisions about adoption of different varieties by farmers and the availability of different seed varieties containing various traits/attributes by the local seed sector are made on economic grounds. It is therefore in the interests of biotech trait 'holders' to facilitate access to their traits by companies that breed and supply local varieties, best suited to local conditions, if they wish to maximise uptake of their technology at the farm level. However, when there are a large number of local varieties grown with small shares of the total market, supplied by a large number of seed companies, it may prove unattractive (from an economic perspective) to licence biotech traits to many (small) local seed companies. Therefore, if it is considered to be desirable from a public policy perspective to maintain/preserve local varieties, Zilberman et al argue it may be appropriate for the public sector to address this 'market failure' through a) operating policies and regulations that provide favourable conditions to introduce biotech traits into local varieties (ie, an efficient, transparent and low cost regulatory approval process so as to maximise the market incentives for trait availability in local seed), and b) providing incentives for farmers to continue to use local varieties without a biotech trait. In this way, partial adoption of biotech traits will occur, allowing farmers to gain access to new technology and helping to preserve seed (bio)diversity.

Pehu F & Ragasa C (2007) concluded that the quick and extensive adoption of GM IR cotton in China owed much to publicly developed GM IR cotton varieties and to a decentralised breeding system, which transferred quickly the GM trait to local varieties that could then be sold at relatively low prices. Similarly, in Mexico good availability of seed and credit facilitated a high adoption rate for

GM IR cotton. In contrast, lack of credit and access to credit in South Africa was considered as an important factor hindered adoption.

Relevant references in full

Pehu F & Ragusa C (2007) Agricultural Biotechnology: transgenics in agriculture and their implications for developing countries, World Bank, Background Paper for the World Development Report of 2008

Zilberman D et al (2007) The impact of agricultural biotechnology on yields, risks and biodiversity in low income countries, Journal of Development Studies, vol 43, 1, 63-78, Jan 2007

FARMER´S UNIONS

La disponibilidad de las semillas corresponde a las empresas semillistas como en cualquier cultivo. Los precios varían según especies y eventos y la generalización en el empleo provocaría una adecuación de los precios.

FARMERS, CONSUMERS AND ECOLOGISTS

Los y las agricultores que siembran transgénicos tienen prohibido guardar semillas de la cosecha para la siguiente siembra. Todos los años tienen que comprar semillas a las empresas con las enormes tasas tecnológicas que implican. Paralelamente, hay que tener en cuenta que, al dejar de guardar y sembrar semilla, ésta pierde poder germinativo, a la vez que es cada vez más difícil conseguir semilla no transgénica en el mercado, por lo que se complica y mucho cualquier retorno a la agricultura no transgénica con semillas no transgénicas guardadas de campañas anteriores o buscando semilla en el mercado.

- dependence on the seed industry;

PUBLIC ADMINISTRATION

1.1.8. Siempre existe una cierta dependencia de la industria de la semilla, ya que tanto las variedades convencionales como las MG son híbridas y no se pueden reutilizar. En España la mayoría de la semilla procede de importación, tanto en el caso de variedades convencionales como MG.

RESEARCH INSTITUTIONS

1.1.8. As in the case of traditional hybrid cultivars there is a total dependence. The farmers have to buy the seeds every year . It is important to point out that this is not a problem for them because the benefits in productivity compensate the investment in seeds.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- No change at all from conventional system, as hybrid seed of conventional maize is also being acquired every year by the farmers in the regions where IR-maize is being grown. Farmers know that the investment in hybrid seed is well compensated by much higher yields.

herbicide resistant (HT) crops:

- No change from conventional system is expected, as seed from conventional maize hybrids is also being bought by the farmers every year in the regions where HR-maize is being proposed. Farmers know that the investment in hybrid seed is well compensated by much higher yields.

FARMER´S UNIONS

En cualquier híbrido la dependencia de empresas semillistas es una realidad, independientemente de que este sea OGM o no.

- farmers' privilege (as established by Article 14 of Regulation (EC) No 2100/94 on Community plant variety rights) to use farm-saved seeds;

PUBLIC ADMINISTRATION

1.1.9. No existe privilegio de los agricultores para el caso de las semillas híbridas, por lo que no se puede aplicar para el maíz MG.

RESEARCH INSTITUTIONS

1.1.9. As most of the farmers consuming GM maize indicates this is not a big problem (see comment above).

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- This is not relevant for IR-seeds of maize, soybean, cotton or sugar beet, which according to point 2 of Article 14 of EC Regulation nº 2100/94, are excluded from the farmer's privilege.

herbicide resistant (HT) crops:

This is not relevant for seeds of maize, soybean, cotton or sugar beet, which according to point 2 of Article 14 of EC Regulation nº 2100/94, are excluded from the farmer's privilege.

FARMERS, CONSUMERS AND ECOLOGISTS

La agricultura transgénica no cambia en absoluto la dependencia de los y las agricultores en las subvenciones para hacer su trabajo **"**rentable" (en términos del contexto de rentabilidad que exige la Unión Europea), más o menos el 30% de sus ingresos.

- the use of agriculture inputs: plant protection products, fertilisers, water and energy resources;

PUBLIC ADMINISTRATION

1.1.10. En los cultivos españoles de maíz MG, todos ellos de regadío, los imputs utilizados varían poco de los no MG. Solo variará el consumo de insecticidas que será inferior en los MG resistentes a insectos.

RESEARCH INSTITUTIONS

1.1.10. See answer 5 above: they allow for less chemicals and energy; concerning water and fertilisers, they will depend of the crop variety (i.e., the rest of the genotype: a GM has only 1-4 transgenes, all the other genes belong to the original genotype), as the crop system traditional or conservation labour.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) maize:

- As explained before, there is a clear reduction in the amounts for insecticides applied to control target species (Novillo *et* al., 2003; Gómez-Barbero *et* al., 2008; Brookes and Barfoot, 2009).
- The yield increase often measured with IR-maize means an indirect **reduction** on the amounts of soil, water, energy and fertilizer **per unit of crop produced**.

herbicide resistant (HT) crops:

- The use of herbicides in HT-crops can be smaller or similar to the use in conventional crops, depending if the weed pressure expected by each farmer is high or low. As the HT-seeds will be somewhat more expensive than the conventional ones, they will not be used significantly unless the cost (and often the amount) of the post emergence herbicides is lower than the conventional ones.
- It has been proved with HT-soybeans and other HT-crops, that this trait facilitates the adoption of reduced tillage and conservation tillage practices, which reduce soil erosion, damage to wildlife, energy use, and CO_2 emissions (Trigo and Cap, 2006; Service, 2007; Roucan-Kane and Grey, 2009).

ANOVE:

Use of inputs

See 2. Agronomic sustainability.

FARMER´S UNIONS

Los eventos disponibles en materia de OGM producen un claro ahorro de fitosanitarios, la aparición de variedades resistentes a sequía podría implicar ahorros de agua.

FARMERS, CONSUMERS AND ECOLOGISTS

Estudios realizados por el Joint Research Center de la Unión Europea (Gómez-Barbero,M., 2008) no han demostrado que el maíz transgénico MON810 garantice una mayor productividad en las zonas donde se cultiva en territorio español. A partir de entrevistas con agricultores, lo que hace que los datos requieren de un proceso de contraste, encuentran que en dos de las tres provincias estudiadas el maíz transgénico no demuestra ser más productivo que el convencional. Este estudio destaca además que la aceptación de estas semillas por los y las agricultores se verá seriamente comprometida al adoptarse medidas para garantizar la coexistencia con los cultivos no transgénicos. Los investigadores piden más investigación sobre la aceptación que tendrían estos cultivos una vez incorporados los costes de la coexistencia. En resumen, las semillas transgénicas se están extendiendo por el Estado Español debido en gran parte a la presión de las multinacionales semilleras, y porque, debido a la falta de legislación, no incluyen el coste de garantizar la protección de los cultivos convencionales y ecológicos.

Por último, el estudio afirma que la ventaja económica de los y las agricultores que cultivan maíz transgénico es un ahorro en insecticidas. Sin embargo, previamente a la introducción del maíz Bt en España el uso de insecticidas contra el taladro europeo del maíz se limitaba tan solo a un 5% de la zona cultivada con maíz. (Brookes, 2007). Sin embargo, el empleo de pesticidas en los cultivos estadounidenses ha aumentado significativamente, no se ha reducido. En el caso de los herbicidas, su empleo en cultivos transgénicos ha aumentado en

144.4 millones de kilos desde el inicio de éstos en 1996. Concretamente en 2008 se empleaba un 26% más de pesticidas por hectárea de cultivo MG que por hectárea de cultivo no transgénico.

Se comprueba que los riesgos derivados del cultivo de OMG pueden clasificarse en riesgos económicos y ambientales, y estos últimos entre aquellos que están dentro y fuera de la Directiva 2004/35/CE. Siguiendo el ejemplo del maíz OMG puede decirse que, respecto a los riesgos ambientales dentro de la Directiva 2004/35/CE, hay estudios científicos que demuestran que las esporas Bt afectan a insectos beneficiosos (mariposas y abejas) y a los microorganismos del suelo, y que el abuso en la utilización de glifosato puede llegar a contaminar las aguas subterráneas.Respecto a los riesgos ambientales fuera de la Directiva 2004/35/CE hay que destacar la creación de resistencia en malezas por el abuso de la utilización de un único herbicida, es decir, el glifosato; y las afectaciones a insectos beneficiosos que no se encuentren ligados a un área Natura 2000. Finalmente los riesgos de tipo económico o de la coexistencia pueden incluir el riesgo de impurezas de las semillas, los riesgos de polinización cruzada; los riesgos de mezcla durante las operaciones de siembra, cosecha y almacenamiento; y una última categoría de riesgos que podemos llamar “jurídicos” que se intenta remediar mediante normas especiales de responsabilidad.

- health of labour (possible changes in the use of plant protection products);

PUBLIC ADMINISTRATION

1.1.11. Existe una sensible mejora en el caso del maíz MG resistente a insectos, por el menor uso de insecticidas.

RESEARCH INSTITUTIONS

1.1.11. It could be a little beat more healthy according to the resistance to pest , but also they will allow probably more herbicide to be used, and probably less toxic products by better targeting. .

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- The lower number of insecticide applications, means lower exposure of farm labour to the effects of insecticides, which are often classified as harmful or toxic. In *ex-ante* studies, the number of insecticide applications avoided under Spanish conditions ranged from 5,6 in IR-cotton to 2 in IR-maize (Novillo *et al*., 1999; Novillo *et al*., 2003)

herbicide resistant (HT) crops:

- In the case of herbicides, the use of HT-varieties allows the change of most conventional herbicides (often classified as irritant or harmful) to glyphosate formulations which have been approved without the need of risk pictograms for operators or the environment[20] [21].
- A review for Europe of the possibilities with glyphosate-tolerant maize concluded that the new programs will offer a more environmentally friendly alternative to conventional growing systems (Dewar, 2009).

[20] http://www.mapa.es/es/agricultura/pags/fitos/registro/productos/proexi.asp?e=0&cod=16948&nom=

[21] http://www.mapa.es/es/agricultura/pags/fitos/registro/productos/proexi.asp?e=0&cod=22959&nom=

- Current recommendations by Aragón Government in Spain rank conventional maize herbicides as having impacts from “low” to “medium” or “high”, while the impact of glyphosate applications is classified as “low”[22].

ANOVE:

Improved health and safety for farmers and farm workers (from reduced handling and use of insecticides) is also a feature highlighted in several papers examining the ex-post impact of GM IR cotton in developing countries. Huang et al (2002 & 2003) and Pray et al (2001 & 2002) identified benefits from reduced exposure to insecticides and associated incidences of pesticide poisonings being reported in China as a result of the adoption of GM IR cotton.

Bennett, Morse and Ismael (2006) suggested that the number of accidental pesticide poisonings cases associated with growing cotton in South Africa had fallen following the adoption of GM IR cotton.

Relevant references in full

Bennett R, Morse S & Ismael Y (2006) The economic impact of genetically modified cotton on South African smallholders: yields, profit and health effects, Journal of Development Studies, 42 (4): 662-677

Huang J et al (2002) Transgenic varieties and productivity of smallholder cotton farmers in China, Australian Journal of Agricultural and Resource Economics 46 (3): 367-387

Huang J et al (2003) Biotechnology as an alternative to chemical pesticides: a case study of Bt cotton in China, Agricultural Economics 29 (1), 55-67

Pray C et al (2002) Five years of Bt cotton in China – the benefits continue, The Plant Journal 2002, 31 (4) 423-430. Also, Pray et al (2001) Impact of Bt cotton in China, World Development 29 (5), 813-825

Impact on labour use

Ex-post analysis by Qaim M et al (2006) identified in India, associated with the adoption of GM IR cotton, that reduced insecticide sprayings resulted in a lower requirement for labour to undertake pest scouting and spraying (this mostly affected male family members) but this was counterbalanced by additional labour requirements for harvesting (higher yields), with the latter labour change mainly affecting casual, usually female labour. Overall, they concluded that the net effect on labour use was neither, positive or negative.

These impacts were also identified by Dev S & Rao N (2007), albeit in an ex-post study focusing on the Andra Pradesh region of India only. Their work identified that the net impact on labour use of using GM IR cotton was positive (ie, the extra harvest labour requirement was greater than the loss of pest scouting and spraying labour requirement).

Subramanian A & Qaim M (2008) looked at this issue further through research into a small cotton growing community in India, via monitoring of household expenditure patterns and activities. Whilst this was only a small piece of research it provided a useful insight into wider economic impacts and was representative of semi arid tropical regions in central and southern India. Its key findings were that GM IR cotton had delivered a net creation of rural employment, with the additional harvest labour requirements being greater than the reductions associated with pest scouting and spraying. This did have gender implications given that it has been mostly females who gained, relative to males who lost out. Their analysis, however shows that on average, the saved male family labour has been/can be re-employed efficiently in alternative agricultural and non agricultural activities so that, the overall returns to male labour increase.

The returns to management time saved for famers/farm workers and their re-deployment also tended to be greater for larger farmers than smaller ones. This was largely explained by the fact that large farmers are often better educated and have better access to financial resources which help them gain alternative employment or set up self employment activities.

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[22] Boletín Fitosanitario de Avisos e Informaciones from March 7th, 2009 in: http://portal.aragon.es/portal/page/portal/AGR/AGRICULTURA/CPV/publiCPV/FITOSANITARIO

Fernanez-Cornejo J & Caswell M (2006) showed that the adoption of GM HT soybeans in the US, by reducing management time associated with the crop, allowed additional time for off-farm income earning opportunities.

Gouse M et al (2006) found that the use of GM IR technology in maize (in the Kwazulu-Natal region of South Africa, in 2003/04 was neutral in respect of labour use (a year of low pest pressure). They perceive that in years of higher pest pressure the labour requirement would likely fall, as less insecticide granules would be applied by farmers/workers.

Trigo E & Cap E (2006), looking at the social changes associated with the expansion of soybean production, using GM HT technology and its facilitation of no tillage production practices, cite statistics on farm employment trends between 1993 and 2005, which show that the total number of jobs in the sector has been consistent (1.2-1.3 million) during a period in which the country's unemployment rate reached its highest historic level.

Relevant references in full

Dev S & Rao N (2007) Socio economic impact of Bt cotton, Centre for Economic and Social Studies, Hyderabad, Monograph, Nov 2007

Fernandez-Cornejo J & Caswell M (2006) The first decade of genetically engineered crops in the US. Economic Information Bulletin 11. Washington DC, Economic Research Service, USDA

Gouse M et al (2006) Output & labour effect of GM maize and minimum tillage in a communal area of Kwazulu-Natal, Journal of Development Perspectives 2:2

Qaim M et al (2006) Adoption of Bt cotton and impact variability: insights from India, Review of Agricultural Economics, vol 28, No 1, 48-58

Subramanian A & Qaim M (2008) Village-wide effects of agricultural biotechnology: the case of Bt cotton in India, World Development, vol 37, N0 1, 256-262

Trigo E & Cap E (2006) Ten years of GM crops in Argentine agriculture, ArgenBio, Argentina

FARMER´S UNIONS

La reducción en el empleo de fitosanitarios supone una clara ventaja ambiental para los fitosanitarios.

- farming practices, such as coexistence measures and clustering of GMO and/or non-GMO production;

PUBLIC ADMINISTRATION

1.1.12. Las prácticas agrícolas que se recomiendan en España, al no existir unas medidas de coexistencia obligatorias, son sencillas de realizar para los agricultores que cultivan maíz MG: Una distancia mínima con respecto a los agricultores vecinos no MG y una zona tampón alrededor de su cultivo, que sirva como zona refugio. Además hay que tener determinadas precauciones en siembra y cosecha, si no se desea comercializar en la zona ambas cosechas juntas, como ocurre en las regiones con mayor cultivo de maíz MG. No se han producidos problemas de coexistencia, que se hayan podido confirmar por las administraciones públicas, a pesar de la demanda de algunas ONG. Los ensayos realizados por diferentes instituciones públicas españolas han demostrado que 50 metros de distancia entre cultivos y 4 líneas de borde, que hace de zona refugio, son suficientes para que las cosechas de los vecinos contengan menos del 0,9 % de OMG. Existe un problema en la producción ecológica. Los agricultores que realizan esta producción, a diferencia de los ambientalistas que dirigen las ONG, no quieren que a las producciones ecológicas se les exija que tengan que estar libres de OMG (como desean las ONG, para exigir en el fondo que se prohíba el cultivo de variedades MG). Desean que sus cosechas tengan que cumplir con los mismos requisitos que las convencionales: inferior al 0,9 % de OMG autorizados para consumo, para no tener que etiquetar y poder comercializarlos como ecológicos

RESEARCH INSTITUTIONS

1.1.12. GM cultivars are cultivated in the same way that the traditional ones. Coexistence, so far, has not produced any incidence in Spain.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- No problem as most of maize in Spain (85%) is used to produce feed, which is labelled as containing GM-soybeans and GM-maize, and the use of the crop is similar in each locality. Within 12 years of cultivation in Spain this has not been an issue as no suits between farmers because of coexistence problems have been registered (updated report from Novillo *et al*., 2007).
- Building up on the thorough coexistence studies under real coexistence conditions (Melé *et al*., 2006; Messeguer *et al*., 2006; Palaudelmàs *et al*., 2007; Palaudelmàs *et al*., 2008), a brochure on Good Agricultural Practices for cultivation of Bt-maize has been agreed by the seed industry and is being yearly updated since 2004 and widely communicated to Spanish farmers (ANOVE, 2009).

herbicide resistant (HT) crops:

- We can expect the same degree of positive coexistence, following the Guide of Good Agricultural Practices such as the one jointly developed by the seed industry for Bt-maize[23].

ANOVE:

Co-existence and GM IR maize production in Europe

Research

The possibility of GM adventitious presence occurring in a non GM crop because of cross-pollination in maize crops is well researched. It draws on practical (commercial) ex-post experience of growing specialty maize crops (eg, waxy maize), GM crops, and specific research studies. Maize pollination essentially relies on wind dispersal of pollen. As such, levels of cross-pollination are generally closely related to distance of a receptor plant from a pollen donating plant, with the level of cross-pollination falling rapidly the further away the recipient plant is from the pollen source (as maize pollen is fairly heavy, the vast majority is deposited within a short distance of any emitter plant). On average, almost all maize pollen travels no further than 100 metres and nearly all potential cross-pollination between fields of non GM maize occurs within 18-20 metres of an emitter crop. In respect of GM maize containing a single trait such as insect (Bt) resistance, the presence of the GM trait in only 50% of pollen means that almost all cross pollination (of pollen with the GM trait) will occur at a reduced distance from the GM emitter crop.

Not surprisingly, it is possible to find examples of research that identified rates of cross-pollination (and hence levels of adventitious presence) at variance with these rates, because of the influence of a number of other factors. These include:

- *Timing of planting (and flowering) of different maize crops*: the greater the difference between planting times of crops of the same variety, the lower the levels of cross-pollination;
- *Varietal differences*: recommendations for planting times and the time each variety takes to flower (and produce/be receptive to pollen) usually varies by variety. Consequently, varietal

[23] http://www.anove.es/docs/maizbt_2009.pdf

differences can contribute differences in the timing of flowering and hence to the chances of cross-pollination occurring (see above);

- *Buffer crops*: the planting of (non GM) buffer crops affects cross-pollination levels. This is because a non GM buffer crop (of maize) can act as a interceptor to a large proportion of GM pollen and can provide additional non GM pollen that 'crowds out' the GM pollen (further reducing the chances of the GM pollen introgressing with the non GM crop in which adventitious presence is to be minimised). One row of buffer crop is considered to be roughly equal to 10 metres equivalent of separation distance;
- *Temperature and humidity levels*: the drier and hotter conditions are at time of flowering the lower the levels of cross-pollination and vice versa;
- *The strength and direction of wind:* levels of cross-pollination are highest in receptor crops that are typically downwind of donor crops. Not surprisingly, the stronger the wind at time of pollen dispersal, the greater the likelihood of cross-pollination being recorded at greater distances;
- *Barriers*: objects such as hedges and woods, as well as topography can affect levels of cross-pollination by interrupting and diverting airborne pollen flow. These barriers can cause pollen to be diverted upwards (and hence could travel further than otherwise would be the case) and sometimes this can result in pollen being deposited in 'hot spots';
- *Length of border/shape of fields*: the longer the border between a GM and non GM crop, the greater the chances of cross-pollination occurring and vice versa;
- *Volunteers*. The presence of volunteer maize plants from an earlier crop may increase the level of adventitious presence in a crop. Whilst this possible source of adventitious presence is potentially highest in regions which do not have low enough average winter temperatures to kill volunteer plants, farm level experience (eg, in Spain) shows that this is a very minor source of adventitious presence.

In terms of achieving the EU labelling threshold of 0.9% for grain maize, research findings in Spain, France, Portugal, Italy, Switzerland, Germany and the UK have produced consistent results; this threshold is achievable through the application of measures such as isolation distances and the use of buffer rows. For (non GM or organic) plots/fields with a size of over 5 ha, no isolation distance is required. Where the non GM/organic plot is within 1-5 ha in size an isolation distance of 20 metres will be sufficient to ensure purity levels within the 0.9% labelling threshold (or if an isolation distance is not possible, the application of four buffer rows of non GM maize between a GM crop (on the GM growing farm) and a non GM crop as a single measure will deliver effective co-existence). For non GM plots under 1 ha in size an isolation distance of up to 50 metres may be required, for example if a non GM plot is located downwind of GM emitter crops.

Commercial experience

These factors of influence are known to growers of specialty maize crops (eg, waxy maize) and to the organisations that typically supply seed to farmers and/or buy (specialty) maize from farmers. As a result, the application of a variety of measures (such as separation distances, the use of buffer crops, varying the time of planting or varieties used), and taking into consideration the dilution effect on adventitious presence levels of normal harvesting practices[24], usually delivers required levels of purity. More recently, the same principles and practices have been successfully applied in respect of commercial GM maize crops where a non GM maize market has developed in a number of countries including Spain. Adventitious presence levels in excess of required purity levels (eg, set at the EU

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[13] The key point being that it is normal practice to test crops for adventitious presence of all unwanted material (eg, the presence of GM material in non GM crops that are required to be certified as non GM, weed material, dirt, seed off types etc) after harvest. As a result, levels of adventitious presence of any unwanted material tend to be lower in harvested crops than might be the case if testing was undertaken in the field before harvest

labelling threshold and in some cases to more stringent, market-driven thresholds) are rare[25]. This is because the measures taken are based on years of experience and usually operate to 'worst case' scenarios. Also in commercial crops, the rate of GM adventitious presence from cross pollination tends to be less than observed in research tests/trials due to factors such as differences in flowering time of crops and the dilution effect.

Overall, evidence from both commercial practice, and research shows that GM, conventional and organic growers[26] of maize have co-existed, and can co-exist and maintain the integrity of their crops without problems through the application of good farming and co-existence practices. Where GM maize growers are located near non GM maize growers who sell their crops into markets with a requirement for certified non GM maize, a separation distance of up to 25 metres (possibly extended to 50 metres in some, limited circumstances[27]) or the planting of 4-6 buffer rows should be sufficient to allow effective co-existence.

The summary provided above draws on the following references:

APROSE (2004) Evaluation of cross pollination between commercial GM (Mon 810) maize and neighbouring conventional maize fields. Analytical survey of 14 commercial Bt fields in 2003 by Monsanto, Nickersons and Pioneer Hi-Bred International, presented to the Spanish Bio-Vigilance Commission, unpublished

Bénétrix F & Bloc D (2003) Mais OGM et non OGM possible coexistence. Perspectives Agricoles No 294

Brookes G and Barfoot P (2003) Co-existence of GM and non GM crops: case study of maize grown in Spain, paper presented to the 1st European conference on the coexistence of GM crops with conventional and organic crops, GMCC-O3, Denmark, November 2003

Brookes G et al (2004) GM maize: pollen movement and crop co-existence. www.pgeconomics.co.uk/pdf/maizepollennov2004final.pdf

Devos Y et al (2005) The co-existence between transgenic and non-transgenic maize in the European Union: a focus on pollen flow and cross-fertilisation, Environ. Biosafety Res. 4 71-87

Foueilassar X & Fabie A (2003) Waxy maize production, an experiment evaluating coexistence of GM and conventional maize, ARVALIS, France

Joint Research Centre (2006) New case studies on the coexistence of GM and non GM crops in European agriculture, Eur 22102, JRC, IPTS Technical Report Series. www.

Loubet, B and Foueillassar, X. et al., (2003) INRA Thiverval-Grignon Etude mécaniste du transport et du dépôt de pollen de maïs dans un paysage hétérogène.Rapport de fin de projet Convention INSU N° 01 CV 081

Ma B et al (2004) Crop ecology, management & quality: extent of cross-fertilisation in maize by pollen from neighbouring transgenic hybrids, Crop Science 44, 1273-1284, Crop Science Society of America, USA

Melé E et al (2004) First results of co-existence study: European Biotechnology Science & Industry News No 4, vol 3

Meir-Bethke & Schiemann J (2003) Effect of varying distances and intervening maize fields on outcrossing rates of transgenic maize, Proceedings of the 1st European conference on the co-existence of GM crops with conventional and organic crops, Denmark, November 2003

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[14]Instances of GM adventitious presence in non GM/organic maize crops have occasionally been reported. These have been rare and usually caused by failure to apply good farming and co-existence practices rather than any failure of co-existence measures per se

[15]In respect of organic growers this assumes application of the EU legal (labelling) threshold of 0.9%. It does not consider the threshold applied by some organic certifying bodies of zero detectible presence because it is not possible to meet such a threshold in any form of agricultural production system

[16]For example, if the non GM crop is in a plot size under 1 ha and located downwind of a GM crop

Ortega Molina J (2006) The Spanish experience with co-existence after 8 years of cultivation of GM maize, paper presented to the Co-existence of GM, conventional and organic crops, Freedom of Choice Conference, Vienna, April 2006
Porta G et al (2006) Indagine sulle dinamiche di diffusione del polline tra coltivazioni contigue di mais nel contesto padano, CRA-Instituao Sperimentale per la Cerealicoltura
Rodriguez-Cerezo E (2006). Segregation up to the farmgate: agronomic measures to ensure co-existence. JRC IPTS paper presented to the Co-existence of GM, conventional and organic crops, Freedom of Choice Conference, Vienna, April 2006
Sears, M. K. & Stanley-Horn, D. (2000) Impact of Bt corn pollen on monarch butterfly populations. In: Fairbairn, C., Scoles, G. & McHughen, A. (Eds.) Proceedings of the 6th International Symposium on The Biosafety of Genetically Modified Organisms. University Extension Press, Canada.
Weber W et al (2005) Koexistenz von gentechnisch verandertem und konventionellem mais. Mais ½, 1-6

FARMER´S UNIONS

La coexistencia no ha supuesto un problema en países como España donde llevamos con una coexistencia práctica y real a pie de campo de más de 12 años.

FARMERS, CONSUMERS AND ECOLOGISTS

En 2006 Greenpeace presentaba, junto a las organizaciones Assemblea Pagesa de Catalunya y Plataforma Transgènics Fora, el documento “La Imposible Coexistencia”*1*, en el cual se mostraba, a través de una amplia investigación, la verdadera situación de los cultivos transgénicos en España. Basándose esencialmente en las realidades de Cataluña y Aragón, el texto constituyó un testimonio real sobre la inviabilidad de la “coexistencia” de la agricultura transgénica con los modelos sin transgénicos. Se recogieron decenas de testimonios de agricultores/as, ganaderos/as y gerentes de cooperativas, así como los resultados de análisis de muestras de campos de maíz, constatándose la falta total de medidas de separación, segregación y control por parte de la Administración y se ofrecían datos sobre la opacidad en el mundo de la investigación, el nulo seguimiento y control de los cultivos por parte de la administración, la presencia de variedades ilegales y de campos experimentales no autorizados, o la ausencia de registros públicos con la situación de los campos.

Hay una marcada tendencia a dejar de cultivar maíz ecológico en las zonas del Estado español en las que se cultiva maíz transgénico. Así, en Aragón ha pasado de ser el primer productor de maíz ecológico del Estado español en 2003 a reducir la superficie de este cultivo en un 75%,debido al elevado número de casos de contaminación de maíz ecológico por transgénicos.Esta tendencia se debe a tres hechos interrelacionados:

(i) en primer lugar, una falta de información adecuada que permita a los y las agricultores conocer con detalle exactamente dónde se ubican los campos de cultivo de maíz MG, bien por que aunque recientemente se ha sabido en que municipios se cultivan no se conoce en qué predios exactamente, bien por que escasean los casos de personas que quieren cultivar maíz MG que hayan advertido el hecho a su vecino o vecina agricultor;
(ii) en segundo lugar, no se ha podido tomar ninguna medida eficaz hasta la fecha que evite la contaminación MG, a la vez que todos los documentos teóricos y prácticos sobre el particular indican que es imposible una coexistencia entre cultivo de maíz MG y no MG sin contaminación (ver Assemblea Pagesa, Plataforma Transgénics Fora! & Greenpeace, 2006, Greenpeace 2008; EHNE 2005, 2007, COAG 2009.....); por lo que, los y las agricultores han preferido simplemente desistir en los intentos de cultivar maíz ecológico que lo sea verdaderamente, sin contaminación transgénica alguna.

(iii) En tercer lugar, no hay un modo adecuado y eficaz de poder reclamar compensación por las pérdidas económicas sufridas. En definitiva no existe la base jurídica para garantizar que los y las responsables de las contaminaciones sean quienes paguen sus consecuencias.

No hay evidencias claras de la posibilidad de crear un producto seguro ni siquiera para riesgos exclusivamente económicos. La ausencia de criterios uniformes en materia de normas de coexistencia puede alterar los resultados de los modelos científicos de cuantificación del riesgo, exigiendo trabajosos estudios individualizados de adaptación. Además, unos costos desorbitados de estudio y preparación de cada póliza harían económicamente inviable la comercialización de este tipo de contrato.

Finalmente el establecimiento de Fondos Públicos de Compensación que cubran los riesgos económicos de la coexistencia, harían que los seguros privados sobre los mismos riesgos no tuviesen cabida en el mercado.

- cost of coexistence measures;

PUBLIC ADMINISTRATION

1.1.13. El coste de las medidas de coexistencia en España es reducido, al no existir unas medidas muy extremas. En el caso de que se reglamentaran unas medidas más exigentes, podría llevar a que muchos agricultores de determinadas zonas no puedan cultivar maíz MG, al no poder cumplirlas.

RESEARCH INSTITUTIONS

1.1.13. Due to the lack of a normative dealing with coexistence, no cost until now.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- The cost of the Good Agricultural Practices for Bt-maize is affordable for the Spanish farmers, judging by the growing surface up to 76.057 ha in 2009[28].

herbicide resistant (HT) crops:

- We can expect the same degree of positive coexistence as with Bt-maize.

FARMER´S UNIONS

Medidas drásticas de coexistencia pueden suponer un coste inasumible para el agricultor y un freno al desarrollo de estas tecnologías.

FARMERS, CONSUMERS AND ECOLOGISTS

En el caso del cultivo del maíz, los flujos genéticos o caminos de contaminación entre variedades convencionales y variedades MG son, principalmente, la polinización cruzada en el campo y el empleo de maquinaria compartida (sembradoras, cosechadoras y secadoras...) en el cultivo y gestión posterior de la cosecha (EHNE, 2007). La presencia de semilla MG en lotes de semilla convencional también es una posibilidad ya que el Estado español es permisivo ante la presencia de hasta un 0.5% de semilla de maíz MG en semilla convencional no MG (Hugo, S. et tal., 2007: ver apartado 2.7), sin advertir dicha presencia

[28] http://www.mapa.es/agricultura/pags/semillas/estadisticas/serie_maizgm98_06.pdf

en la etiqueta del lote de semilla, iniciando un proceso de contaminación contra el que es imposible actuar (a no ser que cada agricultor/a invierte dinero en analizar privadamente cada lote de semillas, algo que es, de hecho prohibitivo.

Algunos agricultores del Estado español han sufrido las consecuencias agronómicas y económicas de la contaminación de sus cultivos no transgénicos por elementos MG. Es de subrayar que estos informes se han tenido que realizar con dinero de organizaciones sociales ante la falta de acción de las instituciones españolas pertinentes.

- conflicts between neighbouring farmers or between farmers and other neighbours

PUBLIC ADMINISTRATION

1.1.14. No existen conflictos importantes, que se sepa.

RESEARCH INSTITUTIONS

1.1.14. Some minor conflicts between ecoactivists and some farmers, but not between neighbours.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- No legal conflicts are known in Spain after local cultivation of Bt-maize for 12 consecutive seasons, involving a total of more than 535.000 ha of GM crop planted (updated report from Novillo *et al*., 2007).

herbicide resistant (HT) crops:

- We can expect the same degree of positive coexistence as with Bt-maize.

FARMER´S UNIONS

No se han detectado en España después de más de 12 años.

FARMERS, CONSUMERS AND ECOLOGISTS

No se informa debidamente a los y las agricultores acerca de la gestión apropiada de los sembrados con transgénicos, lo cual supone que son ellas mismas las personas que se identifican como las que generan problemas de convivencia con vecinos y vecinas en caso de producirse contaminaciones.

A lo largo de la última década hemos constatado que la introducción de la agricultura transgénica acentúa la división y el enfrentamiento entre los y las agricultores, obligándoles a cargar con los riesgos y los problemas derivados de los transgénicos, mientras las empresas responsables de la introducción de los OMG se lavan las manos. La realidad que se percibe en el campo es un cierto miedo y una fuerte inquietud. Consecuentemente, muchos y muchas agricultores y ganaderos, gerentes o técnicos de cooperativas prefieren no pronunciarse acerca de sus opiniones y experiencias con los OMG, lo cual es utilizado por las empresas biotecnológicas y aquella fracción de la clase política afín a ellas para afirmar que no existen implicaciones sociales del empleo de transgénicos.
Esta situación está documentada en trabajos científicos, por ejemplo, de la Universidad Autónoma de Barcelona (Binimelis, 2005; Binimelis, 2008), que determinan varias fuentes de conflicto en el medio rural generadas por los transgénicos.

En primer lugar, el hecho de que cuando un o una agricultor se ve contaminado, es prácticamente imposible establecer quien es el/la responsable de la contaminación. Al no haber un registro ni ser públicos los datos de la declaración de la PAC por parte de los y las agricultores, los y las afectados no pueden conocer el origen de la contaminación.

Por otro lado, al sufrir una contaminación y cuando el cultivo transgénico está extendido por el territorio, estos trabajos demuestran que es muy complicado establecer causalidad directa con el campo del / de la agricultor cultivador de variedades transgénicas que es responsable de la contaminación.

- labour allocation- insurance obligations;

PUBLIC ADMINISTRATION
1.1.15. No existen en España en estos momentos.

RESEARCH INSTITUTIONS
1.1.15. so far unknown, at least to my knowledge.

INNOVATION AND RESEARCH
ASEBIO:
insect resistant (IR) crops:

- Not necessary under Spanish conditions.

herbicide resistant (HT) crops:

- Not expected under Spanish conditions.

FARMER´S UNIONS
No existe ni debe existir diferenciación de ningún tipo.

FARMERS, CONSUMERS AND ECOLOGISTS
Confirmando los estudios realizados por Munich RE, Swiss RE y el Comité Europeo de Seguros se concluye que no es posible actualmente plantearse la elaboración de un seguro que cubra los riesgos derivados del cultivo de OMG, ya sean medioambientales o económicos. En el primero de los casos el gran escollo es la ausencia de información científica revelante con la cual calcular el riesgo a cubrir, que a su vez debido a la novedad de la materia, tampoco se puede suplir aplicando la estadística. En el segundo, si bien se cuenta con información científica suficiente, y los daños a cubrir serían abordables, la ausencia de una regulación clara en materia de coexistencia impide realizar cálculos generales que demuestren la viabilidad económica del proyecto. Las implicaciones socio-económicas son evidentes.

- opportunities to sell the harvest due to labelling;

PUBLIC ADMINISTRATION
1.1.16. No existen problemas en cuanto a la venta de las cosechas o problemas de etiquetado.

RESEARCH INSTITUTIONS
1.1.16. See answer 6.

INNOVATION AND RESEARCH
ASEBIO:
insect resistant (IR) crops:

- IR-maize is normally channelled to produce feed while conventional maize is used for the starch industry or other food uses.

herbicide resistant (HT) crops:

- No changes from current conditions for IR crops.

FARMER´S UNIONS
No existen diferencias.

- communication or organisation between the farmers;

PUBLIC ADMINISTRATION
1.1.17. Las diferentes asociaciones de agricultores existentes en España tienen una opinión distinta ante los cultivos MG. Por ejemplo en el caso del algodón, todas las asociaciones excepto una (COAG) están de acuerdo en que se aprueben los algodones resistentes a insectos y así lo han comunicado a la administración española.

RESEARCH INSTITUTIONS
1.1.17. In Spain there are no specific farmer organizations concerning GM crops.

INNOVATION AND RESEARCH
ASEBIO:
insect resistant (IR) crops:

- No problem under Spanish conditions.

herbicide resistant (HT) crops:
No problem expected under Spanish conditions

FARMER´S UNIONS
Sin problemas sobre el terreno.

FARMERS, CONSUMERS AND ECOLOGISTS
Existe una falta de información adecuada que permita a los y las agricultores conocer con detalle exactamente dónde se ubican los campos de cultivo de maíz MG, bien por que aunque recientemente se ha sabido en que municipios se cultivan no se conoce en qué predios exactamente, bien por que escasean los casos de personas que quieren cultivar maíz MG que hayan advertido el hecho a su vecino o vecina agricultor.

- farmer training;

PUBLIC ADMINISTRATION
1.1.18. No se han producido problemas especiales entre los agricultores para el uso de este tipo de semillas MG.

RESEARCH INSTITUTIONS

1.1.18. No specific problem; farmers sowing GM maize know the cgaracreirstics of the new materials.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- Mostly done by the seed industry, through conferences, demonstrations, brochures, and distribution of leaflets on Good Agricultural Practices for cultivation of Bt-maize in each bag of seeds.

herbicide resistant (HT) crops:

- Same approach as above is expected under Spanish conditions.

FARMERS, CONSUMERS AND ECOLOGISTS

Los problemas que los agricultores han experimentado han influido en el contenido del documento "Comentarios al primer borrador del documento "Mejores prácticas para la coexistencia en maíz" que la organización agraria COAG ha remitido a la Oficina Europea de la Coexistencia (COAG, 2009), por ejemplo, las dificultades de pretender depender de épocas diferentes de floración de distintas variedades de maíz para evitar la contaminación MG.
Hay una marcada tendencia a dejar de cultivar maíz ecológico en las zonas del Estado español en las que se cultiva maíz transgénico

- beekeeping industry.

PUBLIC ADMINISTRATION

1.1.19. Que se conozca, no se han detectado problemas en las abejas por el cultivo del maíz MG.

RESEARCH INSTITUTIONS

1.1.19. No problem caused by GM maize (the only GM crop cultivated in Spain). There are several scientific reports dealing with the lack of Bt protein effect on bees.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- Not affected because a) MON810 is safe for bees; b) maize is not a very lasting pollen source; and c) dryland honey producing areas are usually away from the irrigated areas cultivated with maize.

herbicide resistant (HT) crops:

- No effect is expected under Spanish conditions.

Any other impacts you would like to mention:

PUBLIC ADMINISTRATION

1.1.20. Habría que indicar que la información que se traslada a los consumidores, al exigir que se etiquetan las cosechas MG, es que estas cosechas son de inferior calidad o no son suficientemente seguras, cuando en realidad no existen diferencias entre ambos tipos de cosechas, y en algunos casos son incluso de mayor calidad sanitaria las MG.

RESEARCH INSTITUTIONS

1.1.20. No.

INNOVATION AND RESEARCH

ASEBIO:

- An economic analysis published in Spain has confirmed more economic benefits with GM crops –particularly short term- and identified others such as; a) more time available for farmers to initiate other activities, b) lower risk from more consistent crop yields, c) benefits for farmers not using GM seeds as they are able to find pesticides and conventional seeds at more affordable prices, d) more competitive prices for consumers and e) better health for farmers thanks to lower exposure to pesticides (Sanz-Magallón and Teruel, 2006).
- For early adopting countries, such as Argentina, the benefits of cultivation of HT (10 years) and IR (8 years) varieties have been estimated in 20.000 million and 500 million $US, respectively, including the generation of near one million jobs and enabling price reductions in the produced soybeans (Trigo and Cap, 2006).
- The main Spanish farmer association ASAJA and the Spanish association of maize-growing farmers (AGPME[29]) have repeatedly complained by the fact they are not allowed to grow different GM-varieties whose crops can be legally imported and consumed in the European Union (Barato, 2009).

1.2. Seed industry

For each question, answers can be broken down by the range of relevant stakeholders, including:

- *plant breeders;*
- *multiplying companies;*
- *seed producing farmers;*
- *seed distributors;*

And/or:

- *GM seeds;*
- *conventional seeds;*
- *organic seeds;*

And/or:

- *industrial / arable crops;*
- *vegetable crops…*

Has GMO cultivation an impact regarding the following topics? If so, which one?

- employment, turn over, profits;

[29] http://www.agrodigital.com/PlArtStd.asp?CodArt=64085

PUBLIC ADMINISTRATION

1.2.1. Véanse las respuestas anteriores.

RESEARCH INSTITUTIONS

1.2.1. More qualificated level of employments.

INNOVATION AND RESEARCH

ANOVE:

The development of GM crops is a proven reality in the countries where it has been allowed, with 14 years of growing adoption worldwide (James, 2009). Data from the USA indicate private investments in GMO development for maize, cotton and soybean are contributing to faster improvements on production efficiency than in other crops such as wheat (Roucan-Kane and Gray, 2009). The new technology has added value to seeds, with a total estimated in an accumulated figure of 50.000 million $ US (James, 2009) and benefits shared among seed producers, farmers and consumers (FAO, 2004). Although plant biotechnology was initiated in Europe (García Olmedo, 1998), the peculiar EU regulations have allowed little room for employment and profits from this technology in the European Union.

For analysis of the shares of total benefits derived by the seed sector from GM crops, see section 1.1 d) above.

- the production of seeds (easiness/difficulty to find seed producers, easiness/difficulty to find areas to produce these seeds…);

PUBLIC ADMINISTRATION

1.2.2. Aunque ya se ha comentado anteriormente, la producción de semillas de maíz en España es muy reducida. Existen amplias zonas sin maíz MG y por ello se puede elegir sin problemas a los agricultores-colaboradores para producir semillas no MG. Los costos de producción pueden ser ligeramente superiores, por la necesidad de realizar análisis en las semillas, pero no por necesidad de ampliar las distancias de aislamiento exigidos en este tipo de cultivos, que son suficientes para evitar un contenido de OMG mínimo.

RESEARCH INSTITUTIONS

1.2.2. Similar to the production of conventional seeds.

INNOVATION AND RESEARCH

ASEBIO:

No major difficulties exist if tolerances for adventitious presence of non expected GM events in seed are established in the range of 0,5-0,9%, but if tolerances are lowered, the cost for the European seed industry could be increased and much less competitive (EuropaBio, 2009)

- marketing of seeds;

PUBLIC ADMINISTRATION

1.2.3. Ningún problema para la comercialización de las semillas. La administración española asume el costo de los análisis de contendido de OMG en semillas, si previamente no los han realizado las entidades productoras o importadoras de las semillas.

RESEARCH INSTITUTIONS

1.2.3. It is more difficult due to the attitude against GM crops of some organizations. Nevertheless, in areas where the maize stem borer is endemic it is not necessary a marketing of the product.

INNOVATION AND RESEARCH

ASEBIO:

The impact is positive, as only one seed company was selling Bt-maize in Spain from 1998 to 2002, and in 2009 ten seed companies are offering 123 varieties of maize with MON 810[30].

FARMERS, CONSUMERS AND ECOLOGISTS

Es evidente que las propias prácticas comerciales de las empresas que venden semillas de variedades MG tienen implicaciones socio-económicas, sin mencionar su dudoso carácter ético:

· Se ha vendido y se sigue vendiendo una tecnología a agricultores y agricultoras que no la necesitan: así, se ha vendido y se vende semilla de maíz Bt para, teóricamente, luchar contra el taladro del maíz, en zonas del Estado español que no sufren ataques del taladro, o lo sufren esporádicamente y en muy baja intensidad.

· Se ha vendido y se sigue vendiendo maíz MG a agricultores y agricultoras sin indicar claramente su carácter transgénico. Se puede discutir sobre qué parte de la culpa lo tienen o no dichos agricultores y agricultoras, pero lo que no se puede discutir es que, evidentemente, esto también supone que no se tome medida alguna de prevención de contaminación por parte de dichas personas agrarias con impactos económicos para sus socios/as.

- the protection of plant breeders rights; - the protection of plant genetic resources.

PUBLIC ADMINISTRATION

1.2.4. En el caso de los OMG se han patentado los eventos, por lo que los obtentores que quieran utilizar su derecho, para la obtención de nuevas variedades, deben de pagar un precio por utilizar las patentes. En el caso de los maíces normalmente no se utiliza este derecho del obtentor, por utilizarse variedades híbridas, pero en algodón, colza no híbrida, etc, si que podrían utilizar este derecho, pero deberán siempre llegar a una acuerdo con el que ha patentado el evento que quieran utilizar.

RESEARCH INSTITUTIONS

1.2.4. Yes, a strong impact, especially because of the patent rights of the molecular constructs (“events”). The impact on the second item (GR) will be a problem under the Treaty of Rome given the different interpretations of the article 13 (I think, I have nor the text before me) by developed and underdeveloped countries

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[30] See “Cuadro – Variedades autorizadas para comercio en España” in: http://fundacion-antama.org/los-transgenicos-en-el-mund/

***INIA** answered NO (No impact regarding protection of plant breeders rights and not either regarding protection of plant genetic resources).

INNOVATION AND RESEARCH

ASEBIO:

- the protection of plant breeders rights;

In the case of Spain, plant breeders' rights have not been affected by the eventual integration of patented genes, as the trait integration, development and commercialization of the GM variety has been made by the owner of the conventional germplasm. This is proven by the 10 companies which are distributing or licensed the access to MON810 protection for maize varieties in Spain in 2009.

- the protection of plant genetic resources.

Although this is a "case by case" issue discussed and verified by EFSA in the long approval process, it is agreed plant genetic resources are not directly affected by current traits commercialized or developed in **maize** because this species can not transfer genes to native European species. Furthermore, if the GM crops increase their production efficiency, an indirect protection for plant genetic resources in their native habitats can be gained (Ammann, 2009).

Does the marketing of GM seeds have an impact on the seed industry and its structure in the EU (size of companies, business concentration, competition policy)? Please specify per sector.

- for plant breeders;

PUBLIC ADMINISTRATION

1.2.5a. Cualquier avance de la técnica produce un impacto sobre la industria. Las nuevas tecnologías necesitan más medios para su investigación y desarrollo, y en el caso de los OMG no ocurre de manera diferente. El costo de todos los trabajos que hay que realizar para conseguir que un evento se autorice por la UE para consumo es muy alto, y mucho mayor para su cultivo. Por ello, solo las multinacionales de cierta importancia pueden asumir unos costos tan grandes, sin saber además si se van a aprobar o no los eventos.

RESEARCH INSTITUTIONS

1.2.5a. Yes. Other regions in the planet (East Asia, Latinoamerica, USA) are putting a lot of effort on GM crops. EU seed companies need to consider the lack of competitivity for the future.

- for seed multiplication;

PUBLIC ADMINISTRATION

1.2.5b.Ya se ha comentado anteriormente este tema.

RESEARCH INSTITUTIONS

1.2.5b. Not very much. Seed multiplication industry will manage GM crops as usual, taking care of the characteristics of the new materials as it already did when hybrid cultivars were introduced in the farming practice

- for seed producers;

PUBLIC ADMINISTRATION

1.2.5c. La comercialización de semillas de variedades no MG tiene un problema añadido: No existen umbrales de OMG en semillas y por eso existen dificultades para saber si una semilla con unas cantidades mínimas de OMG autorizados podrán ser comercializadas o no en determinados países de la UE. Algunos de ellos exigen el "cero" de OMG, sin distinguir entre autorizados o no autorizados.

Convendría que la Comisión Europea que es la competente para establecer estos umbrales máximos en semillas, los establezca cuanto antes y que además debe fijar unos máximos que puedan ser asumidos por los productores de semillas sin encarecer demasiado el precio de las mismas.

RESEARCH INSTITUTIONS

1.2.5c. same answer.

FARMERS, CONSUMERS AND ECOLOGISTS

Como se ha ido documentando, el principal impacto económico del cultivo de los transgénicos tiene que ver con la contaminación de cultivos, cosechas, piensos y demás de la producción no MG. Una de las vías más fáciles de generar dicha contaminación es mediante la presencia de semillas transgénicas en lotes de semillas no transgénicas (convencionales y ecológicas), particularmente cuando no hay control sobre dichos lotes o no se indica en la etiqueta del lote cuando hay una presencia de semilla MG. Esto ocurre bien por error o bien intencionadamente por parte de la empresa de semillas.

La evidencia que los movimientos sociales han podido reunir, sugiere que el Estado español tiene una actitud muy permisiva hacia la contaminación (mal llamada "presencia fortuita") de semillas convencionales por semillas MG, con evidentes implicaciones socio-económicas para la agricultura y la alimentación libre de OMG, como exponemos a continuación.

No existe legislación alguna referente a la presencia de semillas MG en lotes de semillas no MG, aunque la Comisión Europea lleva desde la introducción de los OMG proponiendo aplicar la misma práctica a las semillas que a los alimentos transgénicos: consideraría "libres" de OMG lotes de semillas convencionales y ecológicas aunque tuviesen una presencia determinada de semillas MG. Así, para desarrollar el capítulo C de la Directiva 90/220/CE (de liberación intencional al medio ambiente de OMG) vigente en ese momento, la Comisión Europea introdujo la propuesta de permitir "la presencia fortuita de semillas MG" hasta un 0.3% para especies de cultivos caracterizadas por la polinización cruzada y hasta un 0.5% para cultivos de especies auto-polinizantes o de propagación vegetal (propuesta plasmada en papel en SANCO 1542/02 Julio 2002).

Las implicaciones agronómicas pero también socio-económicas de esta propuesta son graves. En términos prácticos, eso supondría sembrar con semilla que podría ser MG de 30 a 50 metros cuadrados en cada hectárea de cultivo supuestamente no MG y sin ni siquiera saberlo, ya que no se indicaría en su etiquetado. Las implicaciones para el amparo legal de las semillas 100% libres de elementos MG son enormes, pero también para el amparo legal del cultivo, cosechas y nuevas semillas de la parcela cultivada. Las implicaciones prácticas negativas para semillas libres de OMG de las propuestas iniciales de la Comisión Europea ya habían sido señaladas por el Comité Científico de Plantas de la propia Comisión Europea (Comité Científico de Plantas, 2001), sin que la Comisión cambiara su estrategia.

No se ha llegado a legislar sobre este particular en la UE, por lo que existe, en estos momentos, una situación “alegal” y hay disparidad en los criterios y medidas adoptados por los Estados Miembros. En el caso concreto del Estado español, el criterio tiene fuertes implicaciones socio-económicas. Así, y cómo se ha comentado con anterioridad, en 2007 se realizó un estudio sobre la llamada “presencia adventicia”, o sea, contaminación, de transgénicos en semillas convencionales (Hugo et al., 2007). De entrada, la política aplicada del Estado español en esta materia indica que la contaminación existe y que no se toman las medidas correctoras necesarias para garantizar la práctica de la agricultura 100% libre de OMG.

- for the availability of conventional and organic seeds;

PUBLIC ADMINISTRATION

1.2.5d. No hay un impacto importante. Se pueden comercializar todas, aunque lógicamente la oferta de variedades de las empresas no puede ser tan amplia como en el caso de que solo existiera un tipo de cultivo. Lo mismo sucede con la investigación, hay que repartirla en varios frentes.

RESEARCH INSTITUTIONS

1.2.5d. No if a coexistence normative is mandatory.

FARMERS, CONSUMERS AND ECOLOGISTS

La pérdida de piensos ecológicos al estar contaminados por elementos MG y el coste de reemplazarlos por piensos no contaminados
Ha habido numerosos casos de contaminación de piensos ecológicos por MG con la consiguiente pérdida económica derivada de tener que reemplazar los piensos y deshacerse de los piensos contaminados

- creation/suppression of barriers for new suppliers;

PUBLIC ADMINISTRATION

1.2.5e. No hay barreras para la comercialización en España de variedades ofertadas por nuevos productores.

RESEARCH INSTITUTIONS

1.2.5e. No.

- market segmentation.

PUBLIC ADMINISTRATION

1.2.5f. Aunque podría existir una mayor segmentación del mercado, ya era muy importante en el caso del maíz: consumo animal, humano, maíz dulce, maíz blanco, palomitas, producción de almidón, semillas, etc. Antes de los cultivos MG, cualquier agricultor o industrial que deseara realizar un cultivo especial, diferente del convencional para la alimentación animal, debía de adoptar las medidas necesarias para evitar la transferencia de polen o la mezcla de cosechas, ya que podría mermar el valor de la suya. Es decir, el agricultor que deseara obtener una cosecha de mayor precio, tenía que adoptar medidas para conseguir que su cosecha no se viera afectada por la de los vecinos. Ahora con los cultivos

MG, que son de menor precio, se exige lo contrario que sean estos los que adopten medidas que eviten las mezclas.

RESEARCH INSTITUTIONS

1.2.5f. It is possible if the confrontation between organic and transgenic agriculture is manintained at the EU.

INNOVATION AND RESEARCH

ASEBIO:

As explained before on the Spanish experience, plant breeders' rights have not been affected by the eventual integration of patented genes, as the trait integration, development and commercialization of the GM variety is being made by the owners of the conventional germplasm. This is proven by around 10 companies which are distributing or licensed the access to MON810 protection for maize varieties in Spain in 2009.

The availability of conventional seeds and organic seeds has not been affected, as conventional seeds are used to plant around 77% of the Spanish maize surface. Despite a much higher subsidy for organic maize production (162,27 €/ha vs 93,16€/ha for integrated maize[31]), we are not aware of seed production according to organic rules; farmers growing organic maize are likely to choose conventionally produced maize seeds, before any treatment to protect the seeds with synthetic pesticides.

Any other impact you would like to mention:

PUBLIC ADMINISTRATION

1.2.6. Ninguna otra mención

RESEARCH INSTITUTIONS

1.2.6. No.

Downstream

1.3. Consumers

Has GMO cultivation any impact regarding the following topics? If so, which one?

- consumer choice (regarding quality and diversity of products);
- the price of the goods;
- consumer information and protection;

PUBLIC ADMINISTRATION

1.3.1. El cultivo de los OMG en el mundo ha conseguido abaratar el costo de los productos. Por ejemplo el precio del algodón se ha reducido sensiblemente porque las cosechas de algunos países se han duplicado. Los consumidores pueden elegir libremente entre productos convencionales, ecológicos y MG, en razón a que existen normas claras de etiquetado.

[31] Real Decreto 172/2004 sobre medidas complementarias al Programa de Desarrollo Rural (BOE 12/02/2004).

Hay un grupo de productos que contienen OMG, de los cuales algunos de ellos serán considerados por el público como seguros y eficaces, como, por ejemplo, vacunas que contienen trazas de maíz. El consumidor será influenciado por los anuncios de la TV o por los periódicos. Últimamente, los nuevos productos desarrollados, como algunos antibióticos que contienen maíz u otros productos para el sector sanitario, han llamado la atención y tendrán un gran impacto socio-económico. El consumidor tendrá una mayor gama de productos para elegir pero tendrá que estar bien informado para hacer una buena elección. El desarrollo de productos OMG que contienen una o varias características nuevas, determinará una disminución del precio de la suma total de sus características individuales.

RESEARCH INSTITUTIONS

1.3.1. No in my opinion. In fact, in a recent study performed in 10 European countries, it seems that Europeans buy GM products when they have the opportunity.

INNOVATION AND RESEARCH

ASEBIO:

- consumer choice (regarding quality and diversity of products);

- According to the 2005 Eurobarometer, the acceptance/tolerance of Spanish consumers for GM food is the highest in the EU, reaching 74% of those surveyed in 2002 and 2005 (Europeans and Biotechnology in 2005: Patterns and Trends, 2006[32]). However, because of the little effort by the European Authorities to explain to consumers that GM labels are not a risk indication, and the aggressive and misleading campaigns of Greenpeace[33] and other NGOs, only a small number of food products include fractions coming from GM plants. At the same time, most feed products are labelled with indications of GM content (maize and/or soybeans, mainly). Therefore, the consumer choice is very limited.
- Spanish scientists have identified lack of knowledge from reliable source as the main barrier for better acceptance (Cámara, 2006; ACSA, 2009).

- the price of the goods;

- In Argentina, the reduction in the cost of production has enabled a much faster increase in the growth of the area planted with soybeans, with similar or lower prices for the crop (Trigo and Cap, 2006). We recall that the expansion in the cultivation of HT soybeans happened at a time when animal proteins were not allowed in feed.
- The benefits of GM crops have also been analyzed by a Spanish expert, who indicated that the important benefits for technology providers and farmers in the short term, are later on increasingly shared with downstream consumers (Sanz-Magallón, 2001).
- As most of the feed producers indicate GM content (maize and/or soybeans, mainly) in their products, and being the cost of grains a very high proportion of the cost of the feed (and therefore, the cost for livestock producers), we can assume that GM grains are more affordable than the comparable conventional grains. Price difference for non GM material is often quoted as 10-20% more expensive, depending on the origin and crop involved. However, as Spanish consumers can hardly find foods with GM labels, the benefit for them is only indirect through an increased crop production.

[32] http://www.ec.europa.eu/research/press/2006/pdf/pr1906_eb_64_3_final_report-may2006_en.pdf

[33] http://www.greenpeace.org/espana/campaigns/transgenicos/consumo/gu-a-roja-y-verde

- Although food prices may not be an issue for some privileged consumers in developed countries, FAO is reminding that "The high food price situation continues to give rise to concern for the food security of vulnerable populations in both urban and rural areas, as these groups spend a large share of their incomes on food."[34]

- consumer information and protection;

- As at this moment the main consumers of GMOs in Spain are the livestock sector, the different associations have issued declarations in favour of approval of GMOs with a positive Scientific evaluation (ANPROGAPOR *et al.*, 2008).
- The Spanish Food Safety Agency has included information on the meaning of the GM labels at their web site (see section "Preguntas Frecuentes" at http://www.aesa.msc.es/aesa/web/AESA.jsp) but OCU, the main consumer association, stated they are not interested in broadcasting this information because the small proportion of products with GM labels at market shelves.

ANOVE:

Impact on prices

Assessing the impact of the biotech agronomic, cost saving technology such as herbicide tolerance and insect resistance on the prices of soybeans, maize, cotton and canola (and derivatives) is difficult. Current and past prices reflect a multitude of factors of which the introduction and adoption of new, cost saving technologies is one. This means that disaggregating the effect of different variables on prices is far from easy.

In general terms, it is also important to recognise that the real price of food and feed products has fallen consistently over the last 50 years. This has not come about 'out of the blue' but from enormous improvements in productivity by producers. These productivity improvements have arisen from the adoption of new technologies and techniques.

Against this background, Brookes & Barfoot (2009) point out the extent of use of biotech adoption globally shows that:

- For soybeans the majority of both global production and trade is accounted for by biotech production;
- For maize, cotton and canola, whilst the majority of global production is still conventional, the majority of globally traded produce contains materials derived from biotech production.

This means for a crop such as soybeans, that biotech production now effectively influences and sets the baseline price for commodity traded soybeans and derivatives on a global basis. Given that biotech soybean varieties have provided significant cost savings and farm income gains (eg, $2.76 billion in 2007) to growers, it is likely that some of the benefits of the cost saving will have been passed on down the supply chain in the form of lower real prices for commodity traded soybeans. Thus, the current baseline price for all soybeans, including conventional soy is probably at a lower real level than it would otherwise (in the absence of adoption of the technology) have been. A similar process of 'transfer' of some of the farm income benefits of using biotechnology in the other three crops has also probably occurred, although to a lesser extent because of the lower biotech penetration of global production and trade in these crops.

Building on this theme, some (limited) economic analysis has been undertaken to estimate the impact of biotechnology on global prices of soybeans.

Moschini et al (2000) estimated that by 2000 the influence of biotech soybean technology on world prices of soybeans had been between -0.5% and -1%, and that as adoption levels increased this could increase up to -6% (if all global production was biotech).

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[34] http://www.fao.org/news/story/en/item/28797/icode/

Qaim & Traxler (2002 & 2005) estimated the impact of GM HT soybean technology adoption on global soybean prices to have been -1.9% by 2001. Based on this analysis, they estimated that by 2005 it was likely that the world price of soybeans may have been lower by between 2% and 6% than it might otherwise have been in the absence of biotechnology. This benefit will have been dissipated through the post farm gate supply chain, with some of the gains having been passed onto consumers in the form of lower real prices.

In relation to the global cotton market, analysis by Frisvold G et al (2007) estimated that as a result of higher yields and production of cotton associated with the use of GM IR cotton in the US and China (in 2001), the world price of cotton lint was 0.014$/pound lower (-3.4%) than it would have otherwise have been (based on an indicative world farm level price in 2001 for cotton lint of about $900/tonne, this is equal to a $30.87/tonne of lint). Important impacts arising from this (and which are equally applicable to the impact of all GM and other (non GM) cost reducing/productivity enhancing technology) are:

- Purchasers of cotton on global markets benefit from the lower prices, as do end consumers;
- Non adopting cotton farmers, both in the countries where the new (GM IR) technology is used, and in other countries where the technology is not available, lose out because they experience the lower world prices, yet get no cost savings/productivity gains that might be derived from using the new technology.

Anderson K et al (2006) examined the impact of the adoption of GM IR cotton up to 2001 (also simulated impacts of adoption/non adoption of the technology in a number of (then) non adopting countries) on the international cotton market. At that time (2001) they estimated that global cotton production had not been significantly affected, although the world price of cotton was estimated to be about 2.5% lower than it would otherwise have been if the technology had not been adopted in the US, China, Australia and South Africa.

Relevant references in full

Anderson K et al (2006) Recent and prospective adoption of GM cotton: a global CGE analysis of economic impacts, World Bank Policy Research Working Paper 3917, World Bank, http://econ.worldbank.org

Brookes G & Barfoot P (2009) GM crops: global socio-economic and environmental impacts 1996-2007. PG Economics. www.pgeconomics.co.uk Also Global impact of biotech crops: income and production effects 1996-2007, Agbioforum (2009) forthcoming

Frisvold G et al (2007) Bt cotton adoption in the US and China: international trade and welfare effects, Agbioforum, vol 9, 2, 1-17

Moshini G et al (2000) Roundup Ready soybeans and welfare effects in the soybean complex, Agribusiness 16, (1): 33-55

Qaim M & Traxler G (2002) Roundup Ready soybeans in Argentina: farm level, environmental and welfare effects, 6th ICABR conference, Ravello, Italy

Qaim M & Traxler G (2005) Roundup Ready soybeans in Argentina: farm level & aggregate welfare effects, Agricultural Economics 32 (1) 73-86

FARMERS, CONSUMERS AND ECOLOGISTS

Las implicaciones socio-económicas para la población consumidora son evidentes si se tiene en cuenta la legislación actual de etiquetado de alimentos transgénicos:
en la actualidad no hay obligación alguna de etiquetar los alimentos ganaderos en función de haber consumido pienso o forraje transgénico o no, por lo que es imposible crear un mercado diferenciado de productos ganaderos en función de su alimentación, a no ser que se contempla un etiquetado "libre de OMG", sin apoyo institucional alguno en la actualidad en el Estado español y que, de todos modos, carga una vez más la responsabilidad de la certificación sobre la economía de los y las ganaderos que no quieren usar transgénicos y no

sobre las espaldas de los intereses generando el problema mediante la comercialización de semillas MG. Evidentemente esta situación se cambiaría, aunque también se complicará si las instituciones europeas hacen caso a la Resolución del Parlamento Europeo de marzo de 2009 en que exige el etiquetado de los productos animales (carne, leche, queso...) en función de su alimentación con o sin transgénicos, algo que todas las organizaciones firmantes del presente documento llevan años reivindicando.

Los propios cultivos transgénicos y el contexto legal en que éstos se hayan introducido tienen implicaciones socio-económicas claras para la población consumidora, resumidas en la pérdida del derecho de la población consumidora a alimentarse sin transgénicos. Este hecho está expuesto en el documento "Exposición acerca del desamparo ante la ley de la alimentación y agricultura libre de organismos modificados genéticamente" redactado por movimientos sociales del Estado español y entregado a su Defensor del Pueblo (Amigos de la Tierra, et al., 2009). Más allá de los tremendos riesgos ambientales y sanitarios, los OMG corresponden a un
ataque sin precedentes contra la libertad de elección de la ciudadanía. Corresponden a una imposición tecnológica como nunca antes en la historia de la humanidad. A una materialización del déficit democrático general en nuestras sociedades, donde la alianza del capital con la tecnociencia intenta desmontar toda resistencia social

Esta situación, que se repite en numerosas ocasiones a lo largo y ancho del Estado español, se debe en gran parte a la legislación europea que no permite que los y las consumidores ejerzan su derecho a consumir alimentos totalmente libres de transgénicos. Además de la falta de etiquetado de los productos derivados de animales alimentados con transgénicos (carne, leche o huevos), se permite una contaminación de hasta un 0,9% por ingrediente sin que esta presencia figure en la etiqueta. Esta presencia, que solo debería ser posible en caso de la que empresa pueda demostrar que es "accidental" es generalizada en los alimentos que incluyen tanto maíz como soja (sobre el concepto inadecuado de presencia "accidental" y el desamparo legal de la población consumidora que quiere consumir alimentos sin OMG, ver Amigos de la Tierra *et al.*, 2009).

Any other impact you would like to mention:

PUBLIC ADMINISTRATION

1.3.2. Impacto de la información que sobre los OMG llega al consumidor, fundamentalmente sobre la calidad de los productos MG, que a veces no se ajusta a la realidad. Las informaciones sesgadas de algunas ONG no hacen ningún favor a los consumidores y por supuesto a ninguno de los productores de estos cultivos.

RESEARCH INSTITUTIONS

1.3.2. No.

INNOVATION AND RESEARCH

ASEBIO:

The slow speed of approval in the EU, coupled with a labelling system which is being identified as risk warning for humans, has been related with the rejection by poor African countries with hunger problems, of aid including GM crops safely consumed in the USA or other countries[35,36]. In this context, the misleading comments about approved GM foods, could have irreversible damages for human lives and a serious ethical responsibility.

FARMERS, CONSUMERS AND ECOLOGISTS

El creciente control que ejercen las empresas de la ingeniería genética sobre un extremo de la cadena agro-alimentaría, las semillas, supone a la larga un decreciente margen de maniobra de la población consumidora de elegir el modo de producción de las comidas que compra, siendo la alimentación el otro extremo de la cadena agro-alimentaria.

Por último, es denunciable la falta de seguimiento sobre riesgos sobre la salud de los transgénicos. Cabe señalar que en los Planes de Seguimiento de los cultivos transgénicos en el Estado español no figura obligación alguna de realizar estudios sobre los posibles impactos de los cultivos Bt sobre la salud, por lo que es de suponer que este tipo de vigilancia no se está llevando a cabo, contraviniendo la normativa comunitaria sobre liberación de organismos modificados genéticamente que exige este tipo de seguimiento, y poniendo en riesgo la salud humana y del ganado. Esta falta de seguimiento de los efectos sobre la salud resulta grave, sobre todo teniendo en cuenta que la autorización del evento MON 810 cultivado actualmente en el Estado español ha prescrito y está actualmente en proceso de evaluación, y que un estudio de 2008 ha demostrado que probablemente la toxina Bt producida en el campo por el MON 810 sea diferente de la utilizada en la evaluación de impacto de este maíz transgénico.17 Esto invalidaría la mayor parte de las pruebas de "seguridad" realizadas para el MON810, si no todas.

De la misma manera, ante la posible introducción de cultivos tolerantes al glifosato, urgen mayores estudios independientes acerca de los impactos de dicho producto en la salud humana, como agro-tóxico tal cual y como agrotóxico en el contexto de relación con variedades concretas de transgénicos. (Somos conscientes del empleo actual del glisosato en la agricultura convencional, dato que también entendemos requiere mucho mayor estudio tanto desde el punto de vista de la salud como de la contaminación ambiental).

1.4. Cooperatives and grain handling companies

Has GMO cultivation any impact regarding the following topics? If so, which one?

- work organisation; 1.4.1.
- handling and storage; 1.4.2.
- transport; 1.4.3.
- administrative requirements on business or administrative complexity. 1.4.4.

PUBLIC ADMINISTRATION

Se supone que el impacto sobre las cooperativas de agricultores no difiere mucho del que se produce sobre los agricultores individualmente. Si la misma cooperativa almacena cosechas convencionales y modificadas genéticamente el coste de la segregación de ambos tipos de cosechas puede tener una cierta importancia.

RESEARCH INSTITUTIONS

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35 http://www.libertaddigital.com/opinion/henry-i-miller/politicas-que-matan-12879/

36 http://africanagriculture.blogspot.com/2007/08/zambian-government-rejects-fresh-calls.html

- work organisation; 1.4.1. Field plot and seed storage distribution.
- handling and storage; 1.4.2. As above.
- transport; 1.4.3. Seed distribution.
- administrative requirements on business or administrative complexity. 1.4.4. Up to now, the administrative requeriments are too much, as well as the complexity. It is a handicap for some SME companies.

INNOVATION AND RESEARCH

ASEBIO:

In order to comply with the traceability and labelling obligations, the Cooperatives and grain handling companies have to choose if they allow in their products some proportion of GM grains (with proper GM labelling) or no GM grains at all (for non GM labelled batches). Although in some cases of large cooperatives both sources can coexist, generally the decision is taken before planting time. Before planting time, depending on the pricing prospects for conventional and GM maize crop, the Cooperatives take the decision to allow their member farmers the choice for use of GM maize seed or not.

FARMERS, CONSUMERS AND ECOLOGISTS

El coste añadido de averiguar si los piensos (convencionales o ecológicos) están o no contaminados. El o la ganadera que quiere evitar el empleo de transgénicos en su alimentación ganadera puede elegir dos caminos:

(a) Sustituir la soja y el maíz en la alimentación ganadera por otros componentes (ver sección anterior para una aproximación de costes, ya que éstos no se diferenciarían mucho si la intención es evitar el empleo de la soja. Otro camino sería buscar soja certificada libre de OMG, que también tiene un sobre coste ampliamente documentado en Internet.)

(b) Analizar la soja y maíz que emplea para averiguar el carácter transgénico o no de la alimentación y actuar en consecuencia.

Si se optara por este segundo camino, tomando como base la situación de gran parte de la ganadería intensiva o semi-intensiva europea, en que se emplea sustanciales cuantías de maíz y soja y sabiendo que las importaciones de soja son mezclas deliberadas de soja transgénica y convencional, para evitar concentrados GM, el/la titular de la explotación ganadera tendría que analizar cada lote de concentrado con maíz y/o soja para determinar su pureza.

Any other impact you would like to mention:

RESEARCH INSTITUTIONS

No

1.5. Food and feed industry

Has GMO cultivation any impact regarding the following topics? If so, which one?

- range of products on offer;

PUBLIC ADMINISTRATION

1.5.1. Por supuesto que el cultivo de OMG aumenta, en general, la gama de productos en oferta, aunque con características semejantes. Pero, dado que el único evento autorizado para cultivo en la UE es el maíz MON 810, destinado íntegramente en España a la alimentación animal, y que no existen cultivos OMG destinados a la alimentación humana, no puede evaluarse su incidencia en la industria alimentaria.

RESEARCH INSTITUTIONS

1.5.1. Positive.

- employment, turn over, profits;

PUBLIC ADMINISTRATION

1.5.2. Comentado anteriormente

RESEARCH INSTITUTIONS

1.5.2. See above 1.1.1 to 1.1.3 and 1.2.1.

- work organisation;

PUBLIC ADMINISTRATION

1.5.3. La cuestión es que se priorizan las cosechas no MG sobre las MG, por motivos puramente “políticos” y en determinadas industrias no quieren saber nada de productos MG u obtenidos a partir de cultivos MG, por las presiones de determinadas ONG.

RESEARCH INSTITUTIONS

1.5.3. See answers to 1.4.

- crop handling (drying, storage, transport, processing, etc...);

PUBLIC ADMINISTRATION

1.5.4. No hay diferencias en comparación con los cultivos no OGM.

RESEARCH INSTITUTIONS

1.5.4. see answer 1.4.1.

- administrative requirements on business or administrative complexity;

PUBLIC ADMINISTRATION

1.5.5. La complejidad administrativa aumenta al segregar las cosechas y tener que esperar a tener los análisis de presencia de OMG en los productos que se adquieren, además de los costos añadidos de estos análisis de no contenido de OMG, en la recepción de los productos.

RESEARCH INSTITUTIONS

1.5.5. As in 1.4.4

INNOVATION AND RESEARCH
ASEBIO:

- GMO cultivation has not affected much the range of food products on offer, because only a small number of food products include fractions coming from GM plants. At the same time, most feed products are labelled with indications of GM content (maize and/or soybeans, mainly). This is not likely to have affected employment, turnover and profits in the short term, as all the companies in the food sectors tend to behave in similar way.
- Long term, the reduced access for imports of maize gluten feed or soybeans from the USA –because of the issue of low level presence of non approved GMOs-is likely to increase the cost of feeds and put at risk some jobs in the feed industry and their consumers (pork, chicken, cattle and other livestock jobs). The importance of affordable GM grains for the Spanish feed industry has been highlighted by Spanish experts, and the benefits from its availability extend to downstream users (Sanz-Magallón, 2001).
- The policy of slow approval of new GM products is already influencing the lower competitiveness of the European livestock industry, because of a 53% disadvantage in the cost of feed per ton of pig meat and 75% higher price of feed for beef; as a result, the EU is no longer self sufficient in beef production and European pork production is also at risk (Pazos, 2008). For this reason, the European association of farmers and cooperatives COPA-COGECA has requested "an improvement in the European authorisation procedure for GMOs used in feed" (COPA-COGECA, 2008). This is interpreted as quicker approval for GM products with positive EFSA Scientific Opinion.

Any other impact you would like to mention:

RESEARCH INSTITUTIONS
1.5.6. No.

INNOVATION AND RESEARCH
ASEBIO:
The full acceptance of GM crops by the value chain starting with farmers, coops, feed industry and livestock producers must be preserved under the strict EU labelling system.

FARMERS, CONSUMERS AND ECOLOGISTS
La subida de precios de los piensos para ganadería ecológica debido tanto al sobre coste de adquirir maíz ecológico no contaminado como a la subida del precio de elementos alternativos.

1.6. Transport companies

Has GMO cultivation any impact regarding carriers (insurance, cleaning, separate lines...)? If so, which one?

PUBLIC ADMINISTRATION

1.6.1. No en particular.

RESEARCH INSTITUTIONS

1.6.1. Yes because contamination of carriers is a risk. Due to the strict EU legislation on trazability separate lines are absolutely necessary and, of course, that implies an extra cost.

INNOVATION AND RESEARCH

ASEBIO:

As commented before GMO cultivation in Spain has not affected much the impact on carriers, because only a small number of food products include fractions coming from GM plants. At the same time, most feed products are labelled with indications of GM content (maize and/or soybeans, mainly).

Long term, and not related with cultivation, the soybeans importation problems–because of the issue of low level presence of non approved GMOs-is likely to increase the cost of insurance and cleaning, leading to higher prices for soybean imports.

1.7. Insurance companies

Does the GMO cultivation have any impact regarding insurance companies (e.g. in terms of developing new products)? If so, which one?

PUBLIC ADMINISTRATION

1.7.1. Podría tener su impacto si se exigiera que los agricultores de variedades MG deban responder ante posibles efectos en otros cultivos vecinos mediante la contratación de un seguro que los cubriera.

RESEARCH INSTITUTIONS

1.7.1. No.

INNOVATION AND RESEARCH

ASEBIO:

Local cultivation of GMOs has not affected insurance companies because the risk of these crops is not higher than the one from conventional varieties, and because Spain is a net importer of GM-maize and GM-soybeans grains or products.

ANOVE:

Various studies (summarised, for example in Brookes & Barfoot (2009)) highlight the importance of GM IR technology in improving production risk management. Essentially, the technology takes away much of the worry of significant pest damage occurring and is, therefore, highly valued by farmers who use the technology. This 'insurance' benefit of the technology has also recently been recognised by the insurance sector in the US, which began in 2008 to offer US maize farmers insurance discounts (for crop losses) if they used stacked maize traits (containing insect resistance and herbicide tolerant traits). The level of discount on crop insurance premiums is equal to about $7.41/hectare (about €5.3/ha).

1.8. Laboratories

Has GMO cultivation any impact regarding the following topics? If so, which one?

- employment, turn over, profits;

PUBLIC ADMINISTRATION

El cultivo de OMG no afecta al empleo directamente pero se necesitarían más análisis de tipo técnico, por lo que se necesitaría mayor cantidad de personal. Es uno de los aspectos que surgen como consecuencia del cultivo de OMG, además de los ya comentados.

RESEARCH INSTITUTIONS

1.8.1. The impact will be even more important than stated in previous sections. The amount of scientists will increase both in the public and the private sector.

- feasibility of analyses;

PUBLIC ADMINISTRATION

1.8.2. Ha costado un tiempo para que los laboratorios se actualizaran y dieran unos resultados fiables y repetitivos.

RESEARCH INSTITUTIONS

1.8.2. More and more feasible and accurate.

- time necessary to provide the results;

PUBLIC ADMINISTRATION

1.8.3. Se ha reducido mucho el tiempo, a la vez que los resultados son más precisos, pero todavía es un proceso largo, ya que hay que llevar las muestras a un laboratorio específico y no se pueden analizar directamente en la recepción de las empresas.

RESEARCH INSTITUTIONS

1.8.3. Each year shorter and more precise

- prices of the analyses.

PUBLIC ADMINISTRATION

1.8.4. Aunque van reduciéndose los precios, siguen siendo unos análisis costosos.

RESEARCH INSTITUTIONS

1.8.4. Each year cheaper.

INNOVATION AND RESEARCH

ASEBIO:

Local cultivation and import of GMOs has influenced the creation of laboratories with capability to analyze GMOs (by PCR methods) whose results are used to validate the quality and traceability of soybean and maize sources. At this moment, we estimate in 15-20 the number of laboratories performing routine PCR analysis in 2-3 days for a unit cost around 40-80 €.

Any other impact you would like to mention:

RESEARCH INSTITUTIONS

No.

INNOVATION AND RESEARCH

ASEBIO:

The cost of analysis is higher to comply with 0,9% threshold than for lower thresholds, without any impact on the safety of the product.

1.9. Innovation and research

Do GMO cultivation and the technology spill over have an impact on the following topics? If so, which one?

-investment in plant research, number of patents held by European organisations (public or private bodies); 1.9.1

PUBLIC ADMINISTRATION

Es necesario realizar una inversión en investigación agrícola con el fin de obtener patentes para la industria en la UE, pues, tal y como se ha comentado anteriormente, el único OMG que contiene un evento aprobado por la UE, no procede de un estado miembro.

La tecnología desarrollada tendrá un impacto positivo, ya que se podrá utilizar también para el cultivo tradicional.

RESEARCH INSTITUTIONS

1.9.1 The investment in I+D will increase dramatically, as in privates as well in public institutions; there are hundreds and thousands challenges related to agricultural (as commodities) productions and sustainability to be solved through the GMOs technology.

- investment in research in minor crops; 1.9.2..

PUBLIC ADMINISTRATION

Se produce un impacto local en el caso de cosechas de menor importancia económica; en este caso habrá una menor inversión por parte de la industria, ya que los beneficios no suelen ser muy elevados.

RESEARCH INSTITUTIONS

1.9.2. Depending on the Brussels will. This type of research will never will carried out by strong multinational companies.

- employment in the R&D centres in the EU; 1.9.3

PUBLIC ADMINISTRATION

Actualmente se necesitan científicos en este campo de investigación.
Las empresas y organizaciones europeas disponen de una pequeña cantidad de patentes y es necesario aumentar esa cantidad por razones económicas, y por la posición de la UE en el mercado; en este caso, influirá en el empleo en la UE, concentrado en el desarrollo de patentes.

RESEARCH INSTITUTIONS

1.9.3 As in 1.9.1 it would increase dramatically.

- use of non-GM modern breeding techniques (e.g. identification of molecular markers); 1.9.4.

PUBLIC ADMINISTRATION

El hecho de añadir nuevas técnicas a las ya existentes, favorecerá el cultivo tradicional, lo que puede traducirse en una mejora de la calidad, de los beneficios económicos y de la producción. Además, tiene una aceptación mayor que el cultivo de OGM.

RESEARCH INSTITUTIONS

1.9.4. The use of molecular technique is more attractive for young Ph. D. students, for example, because of the greater possibility of publishing in scientific journals, but it should have to be reminded that a new method has to be grafted onto the older one in order to be effective.

- access to genetic resources; 1.9.5.

PUBLIC ADMINISTRATION

Habría un acceso restringido a las patentes y los mecanismos implicados durante el tiempo que ha sido establecido por las directivas de la UE. Una vez que hayan expirado los derechos de la patente, se podrá tener acceso al conocimiento de nuevas variedades, mecanismos de acción, diseños de cría, etc…

RESEARCH INSTITUTIONS

1.9.5. See answer 1.2.4: It will be a problem under the Treaty of Rome given the different interpretations of the article 13 by developed and underdeveloped countries

- access to new knowledge (molecular markers, use of new varieties in breeding programmes, etc.). 1.9.6

RESEARCH INSTITUTIONS

1.9.6 It should be facilitated, because a large opportunity will be open for small technology-based companies (spin-off) which will increase in number and develop a knowledge net. Also these companies will increase employments of high-medium level. Even this increase in knowledge will reach the rural areas of the EU countries and from hence to the rest of the world.

INNOVATION AND RESEARCH

ASEBIO:

Although there are several Spanish institutions with very competent scientists, the complexity and lack of predictability of the EU Regulations for cultivation of GM crops is discouraging investments in commercial development of new traits by local institutions, particularly in minor crops with lower potential to get an appropriate return on the investment.

Other breeding methods which are not stigmatized by the GM labelling, such as the molecular markers, are used with increasing frequency by local and multinational companies.

1.10. Public administration

Has GMO cultivation any impact regarding the actions of the national public administrations and the necessary budget (national and local level) for example policing and enforcement costs.

PUBLIC ADMINISTRATION

1.10.1. Los costos que recaen en la administración española por el control y seguimiento de los cultivos modificados son bastante más importantes de lo que se cree. Es posible que en la actualidad los beneficios que aportan los cultivos MG de maíz en España, sean muy inferiores al costo de las inspecciones, muestreos, análisis de semillas, reuniones en Bruselas, etc. Si en el futuro estos cultivos se amplían a otras especies y se incrementan las Has. es lógico suponer que los beneficios sean mucho mayores.

El cumplimiento de la legislación española y de la UE en cuanto al cultivo de OMG requiere la puesta en práctica de actividades de seguimiento, control e inspección. Este aumento de los costes administrativos tiene, de hecho, impacto en el presupuesto público.

1) En relación a las actividades de supervisión del cultivo de maíz MON810, durante los últimos diez años se han desarrollado varios estudios independientes, llevados a cabo por instituciones públicas científicas y financiadas por el Gobierno español, para complementar el plan de seguimiento del maíz MON810 establecido a nivel europeo.

2) Además, existen otras actividades de control e inspección, llevadas a cabo en España por Autoridades Central y Regionales competentes, en relación al aumento de los costes administrativos de la Administración Pública por el uso de OMG (como por ejemplo, los análisis de pureza de las semillas).

Todos los países deben destinar parte de su presupuesto al trabajo de grupos de expertos para continuar con el estudio de OMG en el mercado; y estos grupos deben coordinar su trabajo con las Autoridades Locales, considerando también las cosechas de menor importancia comercial y la posibilidad de dañar el cultivo tradicional o dichas cosechas. Se necesita un mayor número de Autoridades que inspeccionen específicamente la producción, crecimiento y transporte de OMG y esto debe ser incluido en el grupo de impactos que afectan a la Administración Pública.

RESEARCH INSTITUTIONS

1.10.1. As we mentioned previosuly, several big countries in Latinoamerica, East Asia and North America are strongly supporting GM crops. It is an economical risk to obviate the development of this kind of products. .

INNOVATION AND RESEARCH

ASEBIO:

The GMO cultivation has been accompanied by research projects to monitor effects of the new varieties (additionally to the Monitoring Plans undertaken by the seed companies) plus attention to adventitious presence of GMOs in seed lots of conventional maize and cotton varieties (Esteban, 2009).

Any other impact you would like to mention:

Economic context

1.11. Internal market

Does the placing on the market of GMO seeds have an impact on the functioning of the EU internal market on seeds? If so, which one?

PUBLIC ADMINISTRATION

1.11.1. En algunos países de la UE no se pueden introducir semillas MG, aunque la Comisión Europea las haya autorizado. También se exige en algunos países contenido cero de OMG en semillas convencionales, que tampoco lo exige la CE.

RESEARCH INSTITUTIONS

1.11.1. No if there is a reasonable strategy .

INNOVATION AND RESEARCH

ASEBIO:

The trade of seeds in the internal EU market is being affected by country specific very low tolerances such as those required in Italy or Greece

Does it have an impact on the internal markets for services (if so which impact and which services), for agriculture products and on workers' mobility? If so, which one?

PUBLIC ADMINISTRATION

1.11.2. No de manera apreciable

RESEARCH INSTITUTIONS

1.11.2. Not probably.

INNOVATION AND RESEARCH
ASEBIO:
Not affected so far.

Does GMO cultivation have an impact on monopolies? If so, which ones (emergence/disappearance)?

PUBLIC ADMINISTRATION
1.11.3. Ya hemos hablado del problema de las patentes de eventos MG y la posible creación de monopolios.

RESEARCH INSTITUTIONS
1.11.3. Yes, because of the transgen patent. There will be "crop monopolies2 unless clear regulations on the breeder's rights.

INNOVATION AND RESEARCH
ASEBIO:
Not affected, as shown by the 10 seed companies offering in Spain several varieties of maize seeds with the option of MON810 protection against corn borers.
Although at this moment the main seed companies offering GMOs are the same as offering conventional varieties, some scientists have alerted that the complexity and very strict requirements for GMO approvals is a barrier which can only be overcome by multinational companies.

Does it provoke cross-border investment flows (including relocation of economic activity)?

PUBLIC ADMINISTRATION
1.11.4. Como hemos comentado la semilla de maíz MG que se cultiva en España está producida en otros países, por lo que existen flujos de inversión y de deslocalización de la producción de semillas. A mayor tecnificación en la producción de semillas, más deslocalización de la misma a países de bajos costos, bajo la supervisión de multinacionales.

RESEARCH INSTITUTIONS
1.11.4. Very likely. Investments will flow to the new techniques forgetting that traditional techniques will be required to finish even the best of the biotech products.

INNOVATION AND RESEARCH
ASEBIO:
Not for the moment in the trade of seeds, but there is a high risk of the feed industry and the livestock industries (affecting up to an estimated 200.000 jobs) relocating to USA, Brasil, or Argentina because of the higher tolerance for GMO innovations.

Any other impact you would like to mention:

RESEARCH INSTITUTIONS
No.

1.12. Specific regions and sectors

Answers can be broken down on the purpose of the level (national, regional, local) and according to region.

Has GMO cultivation any regional and local impact in those regions regarding the following topics. If so, which one?

- agriculture incomes;

PUBLIC ADMINISTRATION

1.12.1. En las regiones en las que el ataque de taladro en el maíz es muy importante, el cultivo de los MG ha tenido un impacto importante, aunque limitado, en las rentas de los agricultores. Diversos estudios de la Comisión Europea lo avala.

RESEARCH INSTITUTIONS

1.12.1. It would be possible in some cases. For example, a region with an endemic pest and a GM crop resistant cultivar.

INNOVATION AND RESEARCH

ANOVE:

Impact on income distribution

Critics of GM crops sometimes contend that the introduction of GM technology contributes to wider income disparity between richer and poorer farmers because richer farmers are better able to afford the more expensive seed (as well as other inputs such as fertiliser and irrigation) and hence benefit more from the technology than their poorer counterparts. Whilst this issue applies equally to any new (more expensive) technology used in agriculture, it has been specifically examined in very few papers relating to the adoption of GM technology. Morse et al (2007) examined this issue (ex-post analysis) in relation to the adoption of GM IR cotton in India (Maharastra State in 2002 and 2003). Their findings were that income disparities between adopters and non adopters did increase (because of the income benefits from using the technology), however, income disparities between adopters narrowed. Hence, the adoption of the technology both widened some disparities, yet narrowed others. The possible reasons cited for the narrowing of this disparity between adopters include a possible greater uniformity of skills between adopting farmers, and the role of the technology in simplifying pest control management – farmers no longer needed to scout their crops so much for pest levels and were having to, therefore, make fewer decisions on which insecticides to spray, when to apply, how much to use and how to apply. In effect, the GM IR technology contributed to reducing risks of pest damage uniformly for farmers where previously the pest damage levels were more affected by farmer skills in managing pests through the use of insecticides.

Relevant references in full

Morse S et al (2007) Inequality and GM crops: a case study of Bt cotton in India: Agbioforum Vol 10, 1,

FARMERS, CONSUMERS AND ECOLOGISTS

Falta de una estrategia adaptada a las circunstancias regionales: Además falta de información sobre la importancia del mantenimiento de refugios en la comunidad agrícola, y la falta de un seguimiento sistemático en campo para la detección precoz de resistencia

- farms' size;

PUBLIC ADMINISTRATION
1.12.2. La Comisión (JRC) también ha estudiado estos temas.

RESEARCH INSTITUTIONS
1.12.2. It depends on the crop.

INNOVATION AND RESEARCH
ANOVE:
Adoption of biotech traits and size of farm
In relation to the nature and size of biotech crop adopters, there is fairly clear ex-post analysis evidence that size of farm has not been a factor affecting use of the technology. Technology adoption has been by both large and small farmers, with size of operation not having been a barrier to adoption. In 2007, 12 million farmers were using the technology globally, 90% plus of which were resource-poor farmers in developing countries. Specific examples of research that have examined this issue include:

- Fernandez-Cornejo & McBride (2000) examined the effect of size on adoption of biotech crops in the US (using 1998 data). The a priori hypothesis used for the analysis was that the nature of the technology embodied in a variable input like seed (which is completely divisible and not a 'lumpy' input like machinery) should show that adoption of biotech crops is not related to size. The analysis found that mean adoption rates appeared to increase with size of operation for herbicide tolerant crops (soybeans and maize) up to 50 hectares in size and then were fairly stable, whilst for GM IR maize adoption appeared to increase with size. This analysis did, however not take into account other factors affecting adoption such as education, awareness of new technology and willingness to adopt, income, access to credit and whether a farm was full or part time – all these are considered to affect adoption yet are also often correlated to size of farm. Overall, the study suggested that farm size has not been an important factor influencing adoption of biotech crops;
- Brookes (2003) identified in Spain that the average size of farmer adopting GM IR maize was 50 hectares and that many were much smaller than this (under 20 hectares). Size was not therefore considered to be an important factor affecting adoption, with many small farmers (small in the context of average farm size in Spain) using the technology;
- Brookes (2005) also identified in Romania that the size of farm was not an important factor in the adoption of HT soybeans. Both large and smaller farms (within the context of the structure of production in Romania), within a range of 30 hectares to 20,000 hectares in size using the technology;
- Pray et al (2002) and Huang et al (2002). This research into GM IR cotton adoption in China illustrated that adoption has been by mostly small farmers (the average cotton grower in China plants between 0.3 and 0.5 ha of cotton). They also identified that the smallest farmers experienced the largest yield gains;
- Adopters of insect resistant cotton and maize in South Africa have been drawn from both large and small farmers (see Morse et al 2004, Ismael et al 2002, Gouse (2006));
- In 2007, there were 3.8 million farmers growing GM IR cotton in India, with an average size of about 1.6 hectares (Manjunath T (2008);
- GM IR technology (in cotton) is scale neutral, in that both small and larger farms adopt (Qaim et al 2006);
- Penna J & Lema D (2001) indicate that farm size has not affected the adoption of GM HT soybeans in Argentina. In fact, these analysts perceive that the availability of GM HT technology and its facilitating role in the adoption of no tillage production systems has helped small and medium sized in Argentina to improve their competitiveness. Previously these farmers used rotation and mixed farming to maintain/restore soil nutrient levels, soil structure

and levels of organic matter (necessary to maintain crop yields), but the option of using GM HT soybeans in no tillage production systems had allowed these farmers to implement crop after crop production systems (eg, continuous soybeans or a corn-soybean rotation) and allow the wider implementation of second crop soybeans (after a wheat crop in the same season). These options greatly improved profitability levels, keeping them in farming rather than leaving the sector. Bindraban P et al (2009) also concur with this view – in their analysis of the increasing scale of soybean production systems in Brazil and Argentina over the last ten years, they conclude that this trend (of increasing size of farm) was largely driven by the need to benefit from economies of scale required to export in bulk at competitive prices and that the availability of large areas of land, suitable machinery and appropriate farm management techniques facilitated the expansion of large scale soy production systems and farms. GM HT soybean production based on no tillage, fitted with this enlargement in the scale of production but was considered to have not been a major contributor to the changes in the scale/size of soy producing farms (ie, the changes in scale/size would have probably occurred without the availability of GM HT soybeans).

Nevertheless some studies (eg, Thirtle et al (2003) relating to GM IR cotton in South Africa) and Qaim & De Janvry (2003) relating to GM IR cotton in Argentina) have identified cases where small farmers have not adopted biotech traits (notably relating to GM IR cotton in South Africa) and this has been mostly attributed to lack of access to credit to buy (the more expensive) seed. In such cases, this reflects a failure in the credit market, which needs to be addressed through policy mechanisms. This is an issue of relevance for accessing all new (more expensive) technology in agriculture and is not, therefore, a GM trait-specific issue.

Relevant references in full

Brookes G (2003) The farm level impact of using Bt maize in Spain, ICABR conference paper 2003, Ravello, Italy. Also on www.pgeconomics.co.uk

Brookes G (2005) The farm level impact of using Roundup Ready soybeans in Romania. Agbioforum Vol 8, No 4. www.agbioforum.org

Bundrabin P et al (2009) GM-related sustainability: agro-ecological impact, risks and opportunities of soy production in Argentina and Brazil, Plant Research International BV, Wageningen, Netherlands.

Fernandez-Cornejo J & McBride W (2000) Genetically engineered crops for pest management in US agriculture: farm level benefits, USDA, ERS Agricultural Economics Report No 786

Gouse M et al (2006) Output & labour effect of GM maize and minimum tillage in a communal area of Kwazulu-Natal, Journal of Development Perspectives 2:2

Huang et al (2002) Transgenic varieties and productivity of smallholder cotton farmers in China, Australian Journal of Agricultural and Resource Economics 46 (3): 367-387

Ismael Y et al (2002) A case study of smallholder farmers in the Makhathini flats, South Africa, ICABR conference, Ravello Italy 2002

Manjunath T (2008) Bt cotton in India: remarkable adoption and benefits, Foundation for Biotech Awareness and Education, India. www.fbae.org

Morse S et al (2004) Why Bt cotton pays for small-scale producers in South Africa, Nature Biotechnology 22 (4) 379-380

Penna J & Lema D (2001) Adoption of herbicide resistant soybeans in Argentina: an economic analysis, INTA, Argentina

Pray C et al (2002) Five years of Bt cotton in China – the benefits continue, The Plant Journal 2002, 31 (4) 423-430. Also, Pray et al (2001) Impact of Bt cotton in China, World Development 29 (5), 813-825

Qaim M et al (2006) Adoption of Bt cotton and impact variability: insights from India, Review of Agricultural Economics, vol 28, No 1, 48-58

Qaim M & De Janvry A (2003) GM crops, corporate pricing strategies and farmers adoption: the case of Bt cotton in Argentina, American Journal of Agricultural Economics, 85 (4): 814-828

Thirtle C et al (2003) Can GM technologies help the poor? The impact of Bt cotton in Makhathini Flats, KwaZulu-Natal, World Development 31 (4): 717-732

- the farm production practices (e.g. increase or decrease of monoculture);

PUBLIC ADMINISTRATION
1.12.3. Idem

RESEARCH INSTITUTIONS
1.12.3. If any, it will help in crop diversification.

- the reputation regarding other commercial activities of the region/localities.

PUBLIC ADMINISTRATION
1.12.4. Idem

RESEARCH INSTITUTIONS
1.12.4. No clearly.

INNOVATION AND RESEARCH
ASEBIO:
insect resistant (IR) crops:

- Independent research in Catalonia has shown that the yield gains with MON810-maize seeds strongly depends on the intensity of corn borer attack, ranging from 200 to 2.000 kg/ha depending of the year (Salvia *et al*., 2008).
- According to the *ex post* research financed by the IPTS-European Commission, the use of Bt-maize seeds in Spain resulted in gross margin increases from 3,17 to 135 € per hectare depending on the year areas of cultivation, but the adoption of Bt-seeds is not related to farm size, land ownership, age, education, agricultural training or other factors different from their perception about the severity of the problem (Gómez-Barbero *et al*, 2008; Rodríguez-Cerezo, 2009).

herbicide resistant (HT) crops:

- A new *ex ante* survey has shown the willingness of 38%-43% of farmers to adopt maize varieties with tolerance to post emergence herbicides, or herbicide tolerance combined with corn borer resistance, respectively (Rodríguez-Cerezo, 2009).

Any other impact you would like to mention:

RESEARCH INSTITUTIONS
No.

INNOVATION AND RESEARCH
ANOVE:
Wider economy impacts
In Argentina, agricultural exports contribute to government tax revenues (since 2002). Trigo and Cap (2006) estimated, that export taxes on soybean exports between 2002 and 2005 amounted to $6.1

billion, of which $2.6 billion can be attributed to the increase in production linked to the release of GM HT soybean varieties.

Relevant references in full

Trigo E & Cap E (2006) Ten years of GM crops in Argentine agriculture, ArgenBio, Argentina

2. - Agronomic sustainability

2.1 Agricultural inputs

Does the cultivation of EU approved GMOs for cultivation have an impact regarding the use of pesticides against target insect pests (i.e. corn borer)?

PUBLIC ADMINISTRATION
2.1.1 Lógicamente si.

RESEARCH INSTITUTIONS
2.1.1 No more than those of changes of active ingredients.

INNOVATION AND RESEARCH
ASEBIO:
insect resistant (IR) crops:

- The global impact of IR crops from 1996 to 2007 has been a reduction in the use of insecticides reaching 10,2 million kg and 147,6 million kg for IR maize and IR cotton, respectively[37] (Brookes and Barfoot, 2009).
- According to the *ex post* research financed by the IPTS-European Commission, the use of Bt-maize seeds in Spain resulted in a reduction of 0,54 insecticide applications per hectare (Gómez-Barbero *et al*, 2008).

Does the placing on the market of GMOs have an impact, and if so which ones, regarding the use of pesticides or/and on the patterns of use of chemical herbicides?

PUBLIC ADMINISTRATION
2.1.2. La comercialización de OMG, no tiene por qué tener un impacto sobre el uso de pesticidas, pero si que puede incrementarse el uso de herbicidas en determinados casos de ONG resistentes a herbicidas.

RESEARCH INSTITUTIONS
2.1.2. The same that the immediate above (2.1.1)

INNOVATION AND RESEARCH
ASEBIO:

[37] http://www.pgeconomics.co.uk/index.htm

herbicide resistant (HT) crops:

- The global deployment of HT varieties of soybeans, maize, cotton and canola from 1996 to 2007 has been associated to reductions in herbicide use from 4,6% to 13,9%, and a reduction in the environmental impact from 6,8% to 25,8% depending on the crop (Brookes and Barfoot, 2008).
- The expected availability of tolerance to glyphosate for NK603 maize varieties offers more sustainable weed control programs with the alternative of low risk glyphosate approved formulations (Dewar, 2009).

ANOVE:

Use of pesticides and associated environmental impact: worldwide

To examine this impact, the Brookes & Barfoot (2009) analysis analysed both active ingredient use and utilised the indicator known as the Environmental Impact Quotient (EIQ) to assess the broader impact on the environment (plus impact on animal and human health). The EIQ distils the various environmental and health impacts of individual pesticides in different GM and conventional production systems into a single 'field value per hectare' and draws on all of the key toxicity and environmental exposure data related to individual products. It therefore provides a consistent and fairly comprehensive measure to contrast and compare the impact of various pesticides on the environment and human health. In the analysis of GM HT technology it uses the (reasonable) assumption that the conventional alternative delivers the same level of weed control as occurs in the GM HT production system.

Table 12 summarises the environmental impact over the 1996-2007 period identified by Brookes & Barfoot and shows that there have been important environmental gains associated with adoption of biotechnology. More specifically:

- Since 1996, the use of pesticides on the biotech crop area was reduced by 359 million kg of active ingredient (8.8% reduction), and the overall environmental impact associated with herbicide and insecticide use on these crops was reduced by 17.2%;
- In absolute terms, the largest environmental gain has been associated with the adoption of GM HT soybeans and reflects the large share of global soybean plantings accounted for by biotech soybeans. The volume of herbicides used in biotech soybean crops decreased by 73 million kg (1996-2007), a 4.6% reduction, and, the overall environmental impact associated with herbicide use on these crops decreased by 20.9% (relative to the volume that would have probably been used if this cropping area had been planted to conventional soybeans). It should be noted that in some countries, such as in South America, the adoption of GM HT soybeans coincided with increases in the volume of herbicides used relative to historic levels. This largely reflects the facilitating role of the GM HT technology in accelerating and maintaining the switch away from conventional tillage to no/low tillage production systems with their inherent other environmental benefits (notably reductions in greenhouse gas emissions: see below and reduced soil erosion). Despite this net increase in the volume of herbicides used in some countries, the associated environmental impact (as measured by the EIQ methodology) still fell, as farmers switched to herbicides with a more environmentally benign profile;
- Major environmental gains have also been derived from the adoption of GM IR cotton. These gains were the largest of any crop on a per hectare basis. Since 1996, farmers have used 147.6 million kg less insecticide in GM IR cotton crops (a 23% reduction), and this has reduced the associated environmental impact of insecticide use on this crop area by 27.8%;
- Important environmental gains have also arisen in the maize and canola sectors. In the maize sector, herbicide & insecticide use decreased by 92 million kg and the associated environmental impact of pesticide use on this crop area decreased, due to a combination of reduced insecticide use (5.9%) and a switch to more environmentally benign herbicides (6%).

In the canola sector, farmers reduced herbicide use by 9.7 million kg (a 13.9% reduction) and the associated environmental impact of herbicide use on this crop area fell by 25.8% (due to a switch to more environmentally benign herbicides).

Table 12: Impact of changes in the use of herbicides and insecticides from growing biotech crops globally 1996-2007

Trait	Change in volume of active ingredient used (million kg)	Change in field EIQ impact (in terms of million field EIQ/ha units)	% change in ai use on biotech crops	% change in environmental impact associated with herbicide & insecticide use on biotech crops
GM herbicide tolerant soybeans	-73.0	-6,283	-4.6	-20.9
GM herbicide tolerant maize	-81.8	-1,934	-6.0	-6.8
GM herbicide tolerant cotton	-37.0	-748	-15.1	-16.0
GM herbicide tolerant canola	-9.7	-443	-13.9	-25.8
GM insect resistant maize	-10.2	-528	-5.9	-6.0
GM insect resistant cotton	-147.6	-7,133	-23.0	-27.8
Totals	**-359.3**	**-17,069**	**-8.8**	**-17.2**

The impact of changes in insecticide and herbicide use at the country level (for the main biotech adopting countries) is summarised in Table 13.

Table 13: Changes in the 'environmental impact' from changes in pesticide use associated with biotech crop adoption 1996-2007 selected countries: % reduction in field EIQ values

	GM HT soybeans	GM HT maize	GM HT cotton	GM HT canola	GM IR maize	GM IR cotton
US	-29	-7	-16	-42	-6	-33
Argentina	-21	-1	-20	N/a	0	-7
Brazil	-9	N/a	N/a	N/a	N/a	-14
Paraguay	-16	N/a	N/a	N/a	N/a	N/a
Canada	-11	-9	N/a	-25	-61	N/a
South Africa	-9	-3	-8	N/a	-33	NDA
China	N/a	N/a	N/a	N/a	N/a	-35
India	N/a	N/a	N/a	N/a	N/a	-10
Australia	N/a	N/a	-5	N/a	N/a	-24
Mexico	N/a	N/a	N/a	N/a	N/a	-7
Spain	N/a	N/a	N/a	N/a	-37	N/a

Note: N/a = not applicable, NDA = No data available. Zero impact for GM IR maize in Argentina is due to the negligible (historic) use of insecticides on the Argentine maize crop

In terms of the division of the environmental benefits associated with less insecticide and herbicide use for farmers in developing countries relative to farmers in developed countries,

Table 14 shows 52% of the environmental benefits (1996-2007) associated with lower insecticide and herbicide use have been in developing countries. The vast majority of these environmental gains have been from the use of GM IR cotton and GM HT soybeans.

Table 14: Biotech crop environmental benefits from lower insecticide and herbicide use 1996-2007: developing versus developed countries

	Change in field EIQ impact (in	Change in field EIQ impact (in terms of

	terms of million field EIQ/ha units): developed countries	million field EIQ/ha units): developing countries
GM HT soybeans	-3,559	-2,724
GM IR maize	-516	-12
GM HT maize	-1,910	-24
GM IR cotton	-1,053	-6,080
GM HT cotton	-726	-22
GM HT canola	-444	Not applicable
Total	**-8,208**	**-8,862**

Use of pesticides and associated environmental impact: the EU

GM IR maize in the EU

Brookes (2009) examined the impact of the use of GM IR maize in the EU on both actual insecticide use (ex-post analysis) and extrapolated (ex-ante analysis) these impacts to the range of potential adoption areas, if the technology was made available to all EU maize farmers who suffer damage to their maize crops from corn boring pests.

Table 15 summarises the environmental benefits associated with reduced insecticide use that might reasonably be derived from wider adoption of this GM IR technology in the EU maize sector. This suggests that:

- Annual savings of between about 0.41 million kg and 0.7 million kg of insecticide active ingredient could be realised;
- In 2007, only between 14% and 25% of the total annual savings in insecticide active ingredient use and associated environmental impact were realised;
- Most of the potential annual environmental benefits associated with reduced insecticide use have possibly been achieved in Spain. In the Czech Republic, up to about a quarter of the potential savings may have been realised;
- Limited environmental benefits from reduced insecticide use were possibly being achieved in France (7%-11% of potential) and Germany (2%-3% of potential) in 2007. However, with the introduction of the ban on planting of GM IR maize from 2008 in France and 2009 in Germany, these environmental benefits are now no longer being achieved;
- The countries currently foregoing the largest environmental benefits that might reasonably be realised from use of GM IR maize are Italy, France and Germany. This contrasts with Spain, where the potential environmental benefits associated with reduced insecticide use (targeted at corn boring pests) have mostly been achieved.

Table 15: Potential annual EU environmental benefit associated with using less insecticides (for controlling corn boring pests) if GM IR maize technology used

Country	Area typically treated annually with insecticides for corn boring pests ('000 ha)	Potential saving in active ingredient usage ('000 kg)	Potential saving in associated environmental impact ('000 EIQ load units)	Estimated % of potential achieved in 2007
Spain	75-98	72 to 94.1	3,133 to 4,093	77-100
France	200-300	192 to 288	8,354 to 12,531	7-11 (Note zero from 2008)
Germany	80-120	76.8 to 115.2	3,342 to 5,012	2-3 (Note: zero from 2009)
Italy	50-175	48 to 168	2,088 to 7,310	Zero

Czech Republic	20-40	19.2 to 38.4	835 to 1,671	13-25
Others	1-5	1 to 4.8	42 to 209	0
Total	**426-738**	**409 to 708.5**	**17,794 to 30,826**	**14-25**

Notes:

1. Area treated with insecticides: for Spain based on usage in early years of GM IR maize adoption, before widespread use of the technology. For other countries based on a combination of unpublished market research data (source: Kleffmann) and industry estimates

2. Potential (and actual) savings in terms of insecticide active ingredient use and associated environmental load based 0.96 kg/ha and an EIQ load/ha of 41.77/ha – based on Spanish data (Brookes 2003)

Relevant references in full

Brookes G (2003) The farm level impact of using Bt maize in Spain, ICABR conference paper 2003, Ravello, Italy. Also on www.pgeconomics.co.uk

Brookes G (2005) The farm level impact of using Roundup Ready soybeans in Romania. Agbioforum Vol 8, No 4. www.agbioforum.org

Brookes G (2008) The benefits of adopting GM insect resistant (Bt) maize in the EU: first results from 1998-2006,International Journal of Biotechnology (2008) vol 10, 2/3, pages 148-166

Brookes (2009) The existing and potential impact of using GM Insect Resistant (GM IR) maize in the European Union, PG Economics, Dorchester, UK. www.pgeconomics.co.uk

Brookes G & Barfoot P (2009) GM crops: global socio-economic and environmental impacts 1996-2007. PG Economics. www.pgeconomics.co.uk Also, short version in Outlooks on Pest Management, October 2009 (forthcoming)

2.2. Biodiversity, flora, fauna and landscapes (other impacts than the ones considered in the environmental risk assessment carried out under Directive 2001/18 and Regulation (EC) No 1829/2003)

Does the cultivation of EU approved GMOs have an impact regarding the number of non agriculture species/varieties?

PUBLIC ADMINISTRATION

2.2.1. Cuando la Comisión y EFSA han dicho que no hay impacto medioambiental con los eventos autorizados y nadie ha demostrado lo contrario…

RESEARCH INSTITUTIONS

2.2.1. Not at all. EU regulations require this kind of studies previous to the permission.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- The cultivation of MON810 maize varieties resistant to corn borers has no effect on non target organisms, flora, fauna or landscapes, as it has been shown in *ex ante* research (Novillo *et al.*, 2003) and later certified by the June 2009 Scientific opinion by EFSA[38], after considering the Monitoring Reports submitted by its notifier and another 292 relevant scientific references.

- It has also been reported under Spanish real conditions following 9 years of cultivation of IR maize that virus distribution was more linked to the genetic background of the maize varieties rather than the Bt-protection (Achón and Alonso-Dueñas, 2009). This is not surprising as Spanish and Portuguese researchers have found that the transcriptome profiles of MON810 varieties were more similar to their near-isogenic counterparts than are the profiles of other lines produced by conventional breeding (Coll *et al.*, 2008; Batista *et al.*, 2008).

herbicide resistant (HT) crops:

- Research completed under European conditions has shown that impact on biodiversity can be positive when HT crops are managed with herbicides in programs which are more difficult with conventional herbicides (May *et al*., 2005).
- While accepted cultural practices such as tillage severely damage the populations in soils of earthworms (Tebrügge, 2003) and annihilate with irrigation the presence of granivorous harvester ants (Baraibar et al, 2009), it is well recognized that facilitating the adoption of conservation tillage HT-crops will benefit birds, mammals, insects, earthworms and other non target organisms (Fawcett and Towery, 2002).
- When HT crops facilitate conservation tillage, there is an indirect benefit on soil biodiversity because of its stratification is not broken; as an example measured under irrigated maize in Extremadura, the number of million microorganisms per gram of soil went up significantly in three years from 261 under conventional tillage to 437 in direct drilled maize, and to 465 after direct drilling in a cover crop (Muñoz *et al*., 2007).
- The cultivation of NK603 maize tolerant to herbicide has been increasingly adopted in the USA, where it is being widely grown since 2001, with a worldwide adoption of 28 million hectares in 2009[39]. In May 2009, the cultivation of NK603 maize has received a positive Scientific opinion by EFSA after evaluating the data submitted by the notifier and 131 additional scientific references.

ANOVE:

A number of studies have been undertaken examining the impact of biotech traits on various ecological issues. One of the most comprehensive of these is the review conducted by Sanvido O et al (2006). This paper reviewed a considerable body of evidence and literature on issues relating to the environmental impact of GM crops. In its conclusions it says *'The data available so far provides no scientific evidence that the commercial cultivation of GM crops has caused environmental harm'.*

Key points from this report are:

- the environmental impact of GM crops should be considered relative to the environmental impact of the cultivation practices prevailing in modern agricultural systems. These modern production systems have had a profound impact on all environmental resources, including negative impacts on biodiversity;
- *impact of Bt crops on non target organisms*: published long term studies reveal only subtle shifts in the arthropod community. No adverse impacts on non target natural enemies have been observed, in fact there are fewer side effects on non target organisms than under conventional production systems;

[38] http://www.efsa.europa.eu/EFSA/efsa_locale-1178620753812_1211902628240.htm

[39] http://www.monsanto.com/pdf/investors/2009/q4_biotech_acres.pdf

- *impact of bt crops on soil organisms:* no accumulation of bt toxins have been observed after several years of cultivation. There is no evidence of lethal or sub-lethal effects of bt toxins on non target soil organisms like earthworms, collembolan, mites, woodlice or nematodes. Some studies identify differences in numbers of microorganisms but the ecological significance is not clear, given that the natural variation in numbers in production systems has not been measured and, as such, it is not possible to assess whether differences in the bt versus non Bt crops exceed this natural variation. The study reports that the only research that has looked at this issue points to the variation being within the boundaries of this variation (ie, the differences between conventional cultivars is greater than the observed differences of bt crops);
- there is general scientific agreement that gene flow from GM crops to compatible wild relatives will occur. However, rates of spontaneous mating with wild relatives are at rates in the order of what is expected for non transgenic crops. GM HT oilseed rape can form FI hybrids with wild turnip at low frequency under natural conditions. There is a low probability that increased weediness due to gene flow could occur, and where this arises, it is unlikely that GM HT weeds would create greater agricultural problems than conventional weeds – farmers have plenty of options for control of these weeds using other herbicides, through rotation or other means of weed control;
- in natural habitat, no long term introgression of transgenes into wild plant populations leading to the extinction of any wild taxa has been observed to date. Trangenes conferring herbicide tolerance are unlikely to confer a benefit in natural habitats because these genes are selectively neutral in natural environments, whereas insect resistant genes could increase fitness if pests contribute to the control of natural plant populations;
- there is no evidence that the extensive cultivation of GM HT canola in Canada has resulted in a widespread dispersal of volunteer oilseed rape carrying herbicide tolerant traits. Two studies have identified the existence of triple and double HT resistant volunteers, but the general lack of reported multiple-resistant volunteers suggests that these volunteers are being controlled by chemical and other management strategies. This is not an agronomic issue for farmers (as also reported by a survey of canola growers by the Canola Council in 2005). There is also no evidence that GM HT oilseed rape has become feral and invaded natural habitats;
- the impact of GM crops on pest and weed management practices and their potential ecological consequences are usually difficult to assess. They are influenced by many interacting factors and show up only after an extended period of time. Numerous weed species have evolved resistance to herbicides long before the introduction of GM HT traits. The experience of large scale GM HT crop usage confirm that the development of HT resistance in weeds is not primarily a question of genetic modification, but one of crop and herbicide management applied by farmers;
- there is no evidence of weed species having so far developed tolerance to the herbicides glufosinate or glyphosate where the widespread growing of GM HT canola has occurred in Canada;
- in regions where GM HT soybeans and cotton are widely grown, some weeds are showing signs of developing resistance to glyphosate. However, this is managed by farmers using the numerous other herbicides available for weed and volunteer canola control. The net effect of applying small amounts of other herbicides in order to deal with these instances of weed resistance is still delivering a net environmental gain relative to the environmental impact associated with herbicides used on conventional (alternative) crops;
- the results of the UK farm scale evaluations (FSEs) showed that weed biomass and numbers of invertebrate groups were reduced under GMHT management in sugar beet and oilseed rape and increased in maize compared with conventional treatments. These differences were related to the weed management of both conventional and GM HT systems – highly effective weed control practices, as used in GM and non-GM HT crops in the FSEs lead to low numbers

of weed seeds and insects; these might reduce bird numbers that depend on insects and seeds as a food source. The FSEs did, however, assume no other changes in field management, eg, the possible scope for facilitating conservation tillage which results in greater availability of crop residues and weed seeds, and in consequence, improving food supplies for insects, birds and small mammals.

Full reference

Sanvido O et al (2006) Ecological impacts of GM crops: experiences from 10 years of experimental field research and commercial cultivation, ART, Zurich

Impact on number of plant varieties available

An argument sometimes cited relating to seed availability and GMO issues is that farmers may be faced with limited choice and hence 'have limited alternatives to using GM technology'. The argument is based on the view that the main biotechnology companies dominate plant breeding and seed multiplication and therefore have a vested interest in only making new varieties available that contain GM traits and accordingly neglect the provision of non GM seed (and/or non GM seed is only available in older, inferior performing germplasm). In examining this argument, the following points should be noted (taken from Brookes & Barfoot (2003)):

- A trend towards greater concentration into fewer, larger players in agriculture and allied industries is not unique to the plant breeding and seed production sectors. It is a trend that has occurred in most parts of the agricultural and allied sectors. A major driver of this trend has been the increasing costs and financial resources required to develop new products that only ever larger players can afford to stay in the marketplace. This concentration does, however not necessarily mean that farmers are faced with reduced choice of products like seed. For example, in the US, in 2003, there were about 2,000 different soybean varieties available to US growers of which about 1,200 contained GM traits. This means that, even though 75% of the US crop was herbicide tolerant (GM), about 40% of all varieties available were non GM. There were also 122 seed suppliers in the US of which 12 were owned by companies with interests in biotechnology. Also the leading five non GM varieties available had the same yield potential as the leading five GM varieties[40]. This suggests that there is little evidence to suggest that there has been a lack of seed choice for US soybean farmers;
- The leading biotechnology companies do not own all plant breeding and seed production. In most countries, there are a number of plant breeders and seed producers, which are not owned by the biotechnology companies. These companies decide whether to include GM traits in their germplasm according to whether they perceive there may be a reasonable demand for them and hence sufficient scope for earning a return on investments, relative to the level of licence fees or royalties they would have to pay the biotechnology companies. It is likely that some of these companies may choose not to insert GM traits in some varieties, to offer both conventional and GM alternatives or to offer only GM alternatives. The choice will be made on commercial criteria and often without influence from biotechnology companies. In addition, it should not be assumed that the different plant breeders, even if owned by biotechnology companies will necessarily only offer GM traits, especially if a trait available is offered by a rival biotechnology provider;
- In any market economy, where there is reasonable demand for a product (eg, non GM seed), the market usually provides the requirement. The fact that there may be a reasonable demand for non GM seed, this is likely to remain an attractive market for some plant breeders and seed suppliers. If a situation were to arrive where limited new seed became available to serve

[17]If the leading performing varieties were only GM, this would suggest that impact studies should be showing consistent signs of GM varieties out yielding their non GM counterparts. The evidence to date does not show this – there respective yields are broadly the same

a particular market, this might suggest some form of market failure that governments might wish to address. Also if governments perceive that farmers were being provided with limited choice because of the structure of the supply industry and high barriers to entry, this problem is not related to the technology, but to a lack of effective competition policy – here any failure of farmers to benefit from new technology (including non GM) should be laid at the door of policy makers, not the suppliers of the new technology.

In addition, the impact on seed variety availability has been the subject a limited number of specific country studies. These are summarised in section 1.1 e).

Reference in full

Brookes & Barfoot (2003) Consultancy support for the analysis of the impact of GM crops on UK farm profitability, report for The Strategy Unit of the Cabinet Office of the UK government, PG Economics. www.pgeconomics.co.uk

Does GMO cultivation have an impact on agriculture diversity (number of plant varieties available, agriculture species, etc?)

PUBLIC ADMINISTRATION

2.2.2. Lógicamente los cultivos MG posibilitan la existencia de mayor oferta varietal, a disposición de los agricultores.

RESEARCH INSTITUTIONS

2.2.2. No.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

The number of varieties for IR maize in Spain has not been reduced, as the most promising germplasm of 10 different companies are often being offered to the farmers as the conventional or IR-version.

herbicide resistant (HT) crops:

The number of varieties for HT maize in Spain is not expected to be reduced, as the technology is being shared with different companies, who may offer maize varieties to the farmers as the conventional or HT-version.

FARMERS, CONSUMERS AND ECOLOGISTS

"Los cultivos de maíz ecológico están desapareciendo por el temor de los agricultores a que sus cultivos de maíz sean contaminados por maíz transgénico, con las pérdidas que ello acarrea para el agricultor. Cuando las superficies de todos los demás cultivos ecológicos van en aumento, un cultivo como el maíz, imprescindible para las empresas de alimentación y para ganadería ecológica, no cesa de disminuir, teniendo que recurrir a la importación". Este caso remarca el impacto de los cultivos transgénicos para la soberanía alimentaria ya que la contaminación MG está obstaculizando la implantación de la agroecología, los cortos circuitos de comercialización y la especial importancia hacía el empleo de las mujeres en el medio rural.

Does GMO cultivation have an impact, and if so which one, regarding:

- protected or endangered species;
- their habitats;
- ecologically sensitive areas;

PUBLIC ADMINISTRATION

2.2.3. Cuando la Comisión y EFSA dicen que no......

Pueden existir determinadas zonas delicadas, dentro de la Red Natura 2000, y ya está previsto no cultivar OMG en estas zonas.

RESEARCH INSTITUTIONS

2.2.3. In the EU it is necessary to evaluate all these risks before to apply for the commercialization.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- No direct effect has been reported, but considering that yield benefits from IR crops range from 0 to over 50% depending on countries and crops (Brookes and Barfoot, 2009), there is a benefit from the reduced pressure on the habitats of protected/endangered species.
- In the case of Spain, from 2004 to 2007 the yield increase in areas with corn borer attack ranged from 200 to 3.000 kg/ha (Salvia *et al.*, 2008) meaning that the same grain can be produced in a surface 10% lower.

herbicide resistant (HT) crops:

- No direct effect has been reported, and yields are basically the same across countries and crops (Brookes and Barfoot, 2009), but it is well known that the reduced tillage and conservation tillage management facilitated by HT varieties is more respectful for earthworms, ants, birds and other species which live or nest on/in the soil (Fawcett and Towery, 2002; García-Torres *et al.*, 2003; Tebrügge, 2003).

Does GMO cultivation have an impact, and if so which one, regarding:
- migration routes;
- ecological corridors;
- buffer zones.

PUBLIC ADMINISTRATION

2.2.4. Any. Idem anterior

RESEARCH INSTITUTIONS

2.2.4. Same answer than in the previous question

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

No direct effect has been reported, but we can expect some benefit through lower exposure of migrating species to insecticide drift or to preys poisoned by the sprayed insecticide. Since with the IR plants the traces of the very selective insecticide protein are confined in plant tissues, the damage to non target organisms is much lower than after use of conventional insecticides.

herbicide resistant (HT) crops:

No direct effect has been reported, but we can expect some benefit through the adoption of conservation tillage (no or reduced tillage with stubbles on the soil), as it means no disturbance for nesting, more availability of prey, and conditions closer to natural situation before mankind transformed soils and the landscape. The benefits of conservation tillage on the amount and diversity of birds and arthropods have been measured under Spanish conditions (Belmonte, 1993; Castro *el al*., 1996).

Does GMO cultivation have an impact, and if so which one, regarding:

- biodiversity;
- flora;
- fauna;
- landscapes.

PUBLIC ADMINISTRATION

Hasta ahora, no se ha observado ningún impacto negativo debido al cultivo de dos tipos diferentes de eventos GM (Bt176 y maíz MON810), según los resultados de estudios llevados a cabo bajo el plan de seguimiento post-comercialización que se ha realizado en España durante once años. Pueden existir zonas sensibles en la Red Natura 2000, pero el cultivo de OMG en estas zonas no está permitido.

RESEARCH INSTITUTIONS

2.2.5. As in the previous questions

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

No direct effect has been reported, but we can expect some benefit through lower exposure of non target fauna to insecticide drift or to preys poisoned by the sprayed insecticide. Since with the IR plants the traces of the very selective insecticide protein are confined in plant tissues, the damage to non target organisms is much lower than after use of conventional insecticides.

herbicide resistant (HT) crops:

No direct effect different from conventional tillage has been reported, but we can expect some benefit through the adoption of conservation tillage (no or reduced tillage with stubbles on the soil), as it means no disturbance for nesting, more availability of prey, and conditions closer to natural situation before mankind transformed soils and the landscape.

Any other impacts you would like to mention:

RESEARCH INSTITUTIONS

No.

2.3. Renewable or non-renewable resources

Does the placing on the market of GMOs have an impact, if so which ones, regarding the use of renewable resources (water, soil…)?

PUBLIC ADMINISTRATION

2.3.1. Idem 2.2.1

RESEARCH INSTITUTIONS

2.3.1. If any, undoubtly it will beneficious. The genetic tools offers opportunity to design plants with much less needs of water, nutrients, etc…

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

No direct effect has been reported, but where yield increases are obtained, we can expect an indirect reduction in the use of renewable resources such as water or soil **per each unit of crop produced.**

herbicide resistant (HT) crops:

Where HT crops facilitate the adoption of conservation tillage practices, the indirect effects of improved water efficiency and protection of soil against losses due to water or wind erosion can be expected (Fawcett and Towery, 2002; García-Torres *et al.*, 2003; Service, 2007), both on per hectare basis or per each unit of crop produced.

Does the placing on the market of GMOs have an impact, if so which ones, regarding the use of non-renewable resources?

PUBLIC ADMINISTRATION

2.3.2. Idem 2.2.1

RESEARCH INSTITUTIONS

2.3.2 Probably it will open new opportunities and diversity for energetic crops for biofuels, less costly from the point of view of less water and fertilizer consuming. I think this will be an improve of the market opportunities from competence.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- The % of insecticide reduction with IR crops ranges from 33%-77% in cotton and 0-63% in maize (Qaim, 2009). Total reduction in insecticide use thanks to IR crops has been estimated at 10,2 million kg of active ingredient in maize and 147,6 million kg in cotton (Brookes and Barfoot, 2009), important amounts of non-renewable resources have been saved in pesticide manufacture, transport and application. In the case of Spain, an average reduction of 0,54 treatments per ha of IR-maize has been recorded (Gómez-Barbero *et al*., 2008).

- While the protection offered by IR crops does not require any energy (the protection is produced at the same time as the seed), protection by insecticides requires energy for manufacture (up to 452 MJ/kg for carbofuran according to Hernanz, 2009), energy for transport and disposal of byproducts and empty containers (not quantified), and energy needed for each application (3,5 MJ/ha for cereal sprayers, according to Hernanz *et al*., 1995).

herbicide resistant (HT) crops:

- The amount of herbicide saved per ha of HT crops will depend on the degree of infestation by difficult weeds; under small pressure of weeds, the amounts of herbicides applied will be similar to the ones used with conventional varieties, but in farms or plots where weeds are difficult to control, a herbicide reduction may be achieved, such as in the first years of HT deployment in soybeans grown in the USA.
- However, when the farmers adopt conservation tillage techniques because of the increased flexibility offered by HT crops (Fawcett and Towery, 2002; Service, 2007; Roukan-Kane and Gray, 2009), the energy savings in Spanish maize can reach an average of 0,7 GJ/ha for minimum tillage and 3,9 GJ/ha for direct drill (Gil *et al*., 2009) equivalent to 20,6 and 114,7 l/ha of diesel, respectively[41]

Any other impacts you would like to mention:

PUBLIC ADMINISTRATION
Algunos.

RESEARCH INSTITUTIONS
No.

2.4. Climate

Does GMO cultivation have an impact regarding our ability to mitigate (other than by possibly reducing CO2 emissions from fuel combustion – see next section) and adapt to climate change? If so, which ones?

PUBLIC ADMINISTRATION

2.4.1. Dentro de los trabajos de mejora de los OMG está la obtención de variedades que se adapten mejor al cambio climático: Sean más eficientes en el consumo de agua, de abonos; se adapten mejor al incremento de las temperaturas, etc.

RESEARCH INSTITUTIONS

[41] http://bioenergy.ornl.gov/papers/misc/energy_conv.html

2.4.1. Just reducing the amount and applications of agrochemicals (fertilizer, growth regulators, insecticides and herbicides) as well as water, will help a lot. Argentina has interesting data regarding the use of GM soybean and the reduction of CO2 emmissions.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

- While the protection offered by IR crops does not require any energy (the protection is produced at the same time as the seed), protection by insecticides requires energy for manufacture (up to 452 MJ/kg for carbofuran according to Hernanz, 2009), energy for manufacture containers and application equipment, energy for disposal of byproducts and empty containers, and energy needed for each application (3,5 MJ/ha for cereal sprayers, according to Hernanz *et al.*, 1995).
- There is also an indirect benefit when the ploughing under of crop stubbles is no longer needed as a cultural method of control the pest with cultural methods (involving around 25 l/ha of diesel according to Hernanz, 2009).

herbicide resistant (HT) crops:

- In addition to the fuel savings from the reduced tillage, the conservation tillage facilitated by HT crops reduces the speed of oxidation for the stubble of previous crops, increasing the percentage of organic matter on the surface of the soil (SWCS, 1994; Fawcett and Towery, 2002; Reicosky, 2003; Tebrüge, 2003; Ordóñez, 2008). In maize grown under Spanish irrigation conditions, the organic matter in the soil increased when the maize was direct drilled with or without a cover crop (López-Piñeiro *et al.*, 2007), and the increase in organic C in the top 10 cm of soil after 3 years was 0,19% after direct drill of maize, and 0,23% after direct drill of maize in a cover crop (Muñoz *et al.*, 2007). A figure like 0,2% increase in organic matter may look small, but it represents around 26.000 kg of C stored in only one hectare of soil, or the amount of CO_2 released by an efficient car (releasing 130 g CO_2 /km) in more than 733.000 Km.
- The benefits of conservation tillage for mitigation of climate change have been recently recognized by FAO; The proposal is to disturb the soil as little as possible, keep it covered and mix and rotate crops, so that carbon is taken out of the atmosphere and parked in soils and vegetation. Nearly 90 percent of agriculture's potential to reduce or remove emissions from the atmosphere comes from such practices [42].

ANOVE:

Impact on greenhouse gas (GHG) emissions

Brookes & Barfoot (2009) identify that the scope for biotech crops contributing to lower levels of GHG emissions comes from two principle sources:

- Reduced fuel use from less frequent herbicide or insecticide applications and a reduction in the energy use in soil cultivation. The fuel savings associated with making fewer spray runs (relative to conventional crops) and the switch to conservation, reduced and no-till farming systems, have resulted in permanent savings in carbon dioxide emissions. In 2007, this amounted to about 1,144 million kg (arising from reduced fuel use of 416 million litres). Over

[42] http://www.fao.org/news/story/es/item/37941/icode/

the period 1996 to 2007 the cumulative permanent reduction in fuel use is estimated at 7,090 million kg of carbon dioxide (arising from reduced fuel use of 2,578 million litres);

- the use of 'no-till' and 'reduced-till'[43] farming systems. These production systems have increased significantly with the adoption of GM HT crops because the GM HT technology has improved growers ability to control competing weeds, reducing the need to rely on soil cultivation and seed-bed preparation as means to getting good levels of weed control. As a result, tractor fuel use for tillage is reduced, soil quality is enhanced and levels of soil erosion cut. In turn more carbon remains in the soil and this leads to lower GHG emissions. Based on savings arising from the rapid adoption of no till/reduced tillage farming systems in North and South America, an extra 3,570 million kg of soil carbon is estimated to have been sequestered in 2007 (equivalent to 13,103 million tonnes of carbon dioxide that has not been released into the global atmosphere). Cumulatively the amount of carbon sequestered may be higher due to year-on-year benefits to soil quality. However, with only an estimated 15%-25% of the crop area in continuous no-till systems it is currently not possible to confidently estimate cumulative soil sequestration gains.

Placing these carbon sequestration benefits within the context of the carbon emissions from cars, Table 16, shows that:

- In 2007, the permanent carbon dioxide savings from reduced fuel use were the equivalent of removing nearly 0.495 million cars from the road;
- The additional probable soil carbon sequestration gains in 2007 were equivalent to removing nearly 5,823 million cars from the roads;
- In total, the combined biotech crop-related carbon dioxide emission savings from reduced fuel use and additional soil carbon sequestration in 2007 were equal to the removal from the roads of nearly 6.3 million cars, equivalent to about 24% of all registered cars in the UK;
- It is not possible to confidently estimate the soil carbon sequestration gains since 1996 (see above). If the entire biotech crop in reduced or no tillage agriculture during the last eleven years had remained in permanent reduced/no tillage then this would have resulted in a carbon dioxide saving of 83.18 million kg, equivalent to taking 36.97 million cars off the road. This is, however a maximum possibility and the actual levels of carbon dioxide reduction are likely to be lower.

Table 16: Context of carbon sequestration impact 2007: car equivalents

Crop/trait/country	Permanent carbon dioxide savings arising from reduced fuel use (million kg of carbon dioxide)	Average family car equivalents removed from the road for a year from the permanent fuel savings ('000s)	Potential additional soil carbon sequestration savings (million kg of carbon dioxide)	Average family car equivalents removed from the road for a year from the potential additional soil carbon sequestration ('000s)
US: GM HT soybeans	247	110	3,999	1,777
Argentina: GM HT soybeans	609	271	6,136	2,727

[18] No-till farming means that the ground is not ploughed at all, while reduced tillage means that the ground is disturbed less than it would be with traditional tillage systems. For example, under a no-till farming system, soybean seeds are planted through the organic material that is left over from a previous crop such as corn, cotton or wheat

Other countries: GM HT soybeans	91	40	1,341	596
Canada: GM HT canola	131	58	1,627	723
Global GM IR cotton	37	16	0	0
Total	**1,115**	**495**	**13,103**	**5,823**

Notes: Assumption: an average family car produces 150 grams of carbon dioxide of km. A car does an average of 15,000 km/year and therefore produces 2,250 kg of carbon dioxide/year

Full reference

Brookes G & Barfoot P (2009) GM crops: global socio-economic and environmental impacts 1996-2007. PG Economics. www.pgeconomics.co.uk Also, short version in Outlooks on Pest Management, October 2009 (forthcoming)

Any other impacts you would like to mention:

RESEARCH INSTITUTIONS

No.

2.5. Transport / use of energy

Does the cultivation of EU approved GMOs have an impact regarding energy and fuel needs/consumption? If so, which ones?

PUBLIC ADMINISTRATION

2.5.1. Los cultivos MG dedicados a la obtención de biocombustibles reducen la emisión de CO2 a la atmósfera, aunque no de una manera tan importante como al principio se consideraba.

RESEARCH INSTITUTIONS

2.5.1. Please, see several answers above, just 2.4.1 for example, or 1.1.1-1.1.3.

INNOVATION AND RESEARCH

ASEBIO:

insect resistant (IR) crops:

The main effect is derived from the reduction in the use of insecticide production, transport, application and package manufacturing and disposal. The indirect effect is also important; when an 11% yield benefit is achieved, it means a 10% reduction **per unit of crop produced** for all tillage and fertilizer related energy needs, with the only exception for the energy involved in transport of the harvested crop.

herbicide resistant (HT) crops:

The main reduction is expected from the simplification of the tillage operations, with the possibility of further reductions is the organic matter on the top layers of the soil is allowed to return –by adoption of no till/conservation agriculture- to the levels before human disturbance. The benefits of conservation tillage for mitigation of climate change have been recently recognized by FAO[44].

ANOVE:

Use of energy (fuel) impacts (decreased use) associated with the adoption of biotech crops globally are summarised in section 2.4 above – derived from Brookes & Barfoot (2009).

Does the cultivation of EU approved GMOs have an impact regarding the demand for transport in general terms? If so, which ones?

PUBLIC ADMINISTRATION
2.5.2. No creo que exista un impacto a destacar.

RESEARCH INSTITUTIONS
2.5.2. No.

INNOVATION AND RESEARCH
ASEBIO:
No impacts identified.

Any other impacts you would like to mention:

RESEARCH INSTITUTIONS
No.

3 - Other Implications

PUBLIC ADMINISTRATION

El cultivo en el mundo de millones de hectáreas de OMG ha supuesto una gran revolución, de la que los agricultores europeos no se están aprovechando. Los consumidores y los ganaderos europeos si que han podido aprovecharse de que en otras partes del mundo no existan tantas dificultades para autorizar el cultivo de los OMG, ya que gracias a la importación de los mismos y a la oferta existente, los precios de las materias primas no se han disparado y estén controladas en origen. Otro tema son los pecios de los mercados finalistas.

RESEARCH INSTITUTIONS
No.

[44] http://www.fao.org/news/story/es/item/37941/icode/

INNOVATION AND RESEARCH

ASEBIO:

FAO and other personalities have stressed before 2050 the need to produce more food (70% more) and in a cleaner, with a more sustainable way, The best possibilities to achieve this objective is by integrated use of all safe technologies available, and the use of biotechnology has been encouraged by OECD to improve plant varieties and to address global environmental issues (OECD, 2009).

Having said this, the **best choice of tools are more appropriate in each plot or farm should be left to decision of each farmer**, appropriately trained. An example of the current cultivation of MON810 maize varieties in Spain, whose adoption by maize farmers is high in Catalonia and Aragon, where corn borer attacks are more frequent, and nil in Castilla y León, where the pressure of corn borers is negligible

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