Understanding coexistence

Science, Principles and Practical Experiences

A fact file about the coexistence of GM and non-GM crops

"I am convinced that co-existence can be achieved by using appropriate measures that are well adapted to the different local conditions in the different regions. There is a need for feasible and pragmatic solutions."

Commissioner Fisher Boel,
(Speech, Committee of the Regions, 27 June 2005)

"…the report finds that coexistence in crop production at the 0.9% threshold is feasible with few or no changes in agricultural practices."

European Commission
(Press release (24/02/06) accompanying EC Joint Research Centre Report, "New case studies on the coexistence of GM and non-GM crops…")

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EXECUTIVE SUMMARY

The successful co-existence of genetically-modified (GM) and non-GM crops in Europe is not just possible in theory, it is a practical reality. Since 1998, growing numbers of European farmers have chosen to plant approved GM varieties on their farms, and have demonstrated that they are fully capable of managing the farm-level practices that allow them to do so in harmony with their neighbours and with their own non-GM crops. The key to this success is a regulatory and political environment which provides European farmers the freedom to choose their agricultural practices and which is based on principles of proportionality and non-discrimination. This fact file on co-existence summarises the scientific, technical, legal and regulatory facts on which a system of practical co-existence must be built. In short, discussion of co-existence must take note of the following points.

- EU laws ensure that GM products which, following extensive safety evaluation, have been approved for cultivation in the EU may not subsequently be arbitrarily banned. EU farmers must have a practical choice to plant crops that have been approved under EU legislation.

- Regulation (EC) no. 1829/2003 defines a GM labelling threshold of 0.9% for Europe. In some cases, the requirement to label products may have economic consequences for farmers wishing to market their products as non-GM. The European Commission confirms that the goal of co-existence measures is to allow non-GM crops to be marketed without economic loss that could potentially result from the adventitious presence of GM material above the labelling threshold of 0.9%. GM grower responsibilities are not involved in cases where no economic loss occurs, or where the non-GM grower applies a different purity standard than the EU 0.9% threshold.

- 100% purity in agricultural production is not possible, nor is it an appropriate policy objective as regards safe, approved products. Farmers have practiced effective co-existence among themselves for generations and should be able to choose the measures that best fit their local farming conditions, while still meeting the legitimate goals of co-existence.

- Thousands of Spanish farmers have planted over a quarter of a million hectares of GM maize since 1998 without significant problems of co-existence because they have been given freedom to develop their own co-existence practices and have worked closely with all players in the food and feed production chains. This experience is largely reflected in other countries in Europe and around the world that also grow GM crops without disruption to non-GM production.

INTRODUCTION

This document is intended to help inform people interested in the science, the principles and the practical experience of the co-existence of genetically-modified (GM) and non-GM crops. Its emphasis is on the scientific, technical, legal and regulatory facts which influence the issue of co-existence, and extensive reference will be made to this factual background.

The paper:

- addresses the main facts and principles (p 3) of co-existence from a European perspective.
- provides several examples of practical experiences (p 8), with an emphasis on successful co-existence as practiced in Spain since 1998.
- reviews several of the most relevant scientific studies on co-existence in Europe (p 10).
- provides information that is specific to individual crops of particular interest (p 11) to European farmers: maize, oilseed rape, sugar beet, and potato.

This document can be downloaded from www.europabio.org.

FACTS AND PRINCIPLES

What is coexistence?
Coexistence is about how crops intended for different markets can be grown in the same vicinity without becoming commingled and thereby possibly compromising the economic value of each other. Coexistence is based on the premise that farmers should be free to cultivate the crops of their choice using the production system they prefer, whether they are GM, conventional or organic.

"Co-existence refers to the ability of farmers to make a practical choice between conventional, organic and GM crop production, in compliance with the legal obligations for labelling and/or purity standards."
(European Commission recommendation on guidelines for the development of national strategies and best practices to ensure the co-existence..", 23 July 2003)

Coexistence – a common practice in agriculture

Coexistence of two or more crops of the same species is not a new concept. Within a farming community, growing similar crops for different markets in the same farming region is not a new challenge. For many years, what might be considered as incompatible crops – for example speciality maize grown for human consumption and waxy maize grown for the starch industry – have been grown in the same areas or even on the same farm. Different types of wheat, barley and rice are similarly grown in close proximity and channelled to different uses (e.g. bread wheat vs. feed wheat; malting barley for the production of beer vs. animal feed barley). Farmers follow simple but effective procedures to achieve agreed standards of quality and purity in their harvested product.

"The co-existence of different production types is not a new issue in agriculture. Seed producers, for example, have a great deal of experience of implementing farm management practices to ensure seed purity standards." (European Commission recommendation, 23 July 2003)

Product purity and adventitious presence

Because farming is practiced in the "open" environment, it has always been understood that some unwanted "mixing" of similar harvested crop produce intended for different markets may occur. This unavoidable mixing has been minimised by establishing realistic and achievable thresholds for the co-mingling ("adventitious presence") of one material in another and by putting in place good agricultural growing, harvesting and storage practices. There are a number of examples of this, and one of the best

know is the establishment of thresholds for the "adventitious presence" of non-organic product in organic farm produce. In this case, production rules clearly lay down procedures to be followed and also thresholds for the presence of materials of non-organic origin. This enables the coexistence of the two farming practices in the same farming communities.

There are several ways in which an agricultural crop product may co-mingle with that from another crop of the same species:

1. different varieties of the same crop can cross-pollinate to a lesser or greater extent. This will be dependent on the biology of the crop in question: some plants (e.g., wheat and soybean) pollinate themselves, whereas others (e.g., maize and oilseed rape) may also be pollinated by neighbouring plants of the same crop;

2. the mechanical mixing of one crop with another during seeding, harvesting and storage; and, through the product distribution chain that may share common transport, handling and storage facilities.

Thus, in the farming environment, harvested produce from these crops can never be completely pure (i.e. absolute purity of 100% can not be guaranteed). For example, growers producing certified seed have to meet strict purity standards (these depending on the biological characteristics of the each crop species) and do this by following good growing practices, even when neighbours are growing similar crops in the same regions. The seed growers are coexisting with their commodity-producing neighbours.

Tolerances for the presence of unwanted materials in food and feed are set because of the impossibility, in any practical agricultural crop product and food processing/handling chain, of ensuring absolute purity. In simple terms, if 100% purity were possible, then why would the organic industry allow for up to 5% non-organic material in organic produce?

"In the production of food, feed and seed, it is practically impossible to achieve products that are 100% pure."

(Commissioner David Byrne, "New technologies in agriculture", Informal Agriculture Council, 18 September 2001)

"Legislation on seeds has always recognised that a 100% purity is not possible, which is why thresholds have been set which take into account the fact that plants are grown in an open field, that cross-pollination is a natural phenomenon and that one cannot control wind and insects which contribute to this.

(Network of Concerned Farmers, Website statement, September 2003)

Coexistence is not a safety issue - GM crops are rigorously tested

GM crops undergo a rigorous safety assessment before being placed on the market and offered to European farmers. They should be treated in the same manner as conventional crops in order to provide food manufacturers, retailers and consumers with a choice of ingredients. Farmers should also continue to have the choice of what crops to grow and how to cultivate them. High crop purity levels are achievable using existing, well developed management practices. For all crops, accepted practices for harvesting, cleaning, transportation etc have been developed to achieve the desired standards of quality. These standards ensure a balance between the desire for high quality and the incremental cost incurred to achieve such quality. Increasing purity levels beyond those met by these practices has a significant effect on costs (and hence on food, feed or even seed prices) for no real benefit to the consumer. This holds true whether crops have been bred "conventionally" or with the aid of biotechnology.

"…when we talk about co-existence we should be clear that we are not dealing with a safety concern. GM crops that pose a risk to human health or the environment will not be authorised for cultivation in the EU.."

(Commissioner Fisher Boel, Speech, Committee of the Regions, 27 June 2005)

"We also have strict legislation on labelling and traceability, which ensures that European consumers have a choice with respect to the food they prefer." (Commissioner Fisher Boel, Committee of the Regions, 27 June 2005)

"It is important to make a clear distinction between the economic aspects of coexistence and the environmental and health aspects dealt with under Directive 2001/18/EC on the deliberate release of GMOs into the environment." (European Commission recommendation, 23 July 2003)

"Since only authorised GMOs can be cultivated in the EU, and the environmental and health aspects are already covered by Directive 2001/18/EC, the pending issues still to be addressed in the context of coexistence concern the economic aspects associated with the admixture of GM and non-GM crops." (European Commission recommendation, 23 July 2003)

The co-existence of GM and non-GM-crops

The use of GM crop varieties alongside non-GM crops does not fundamentally change the current situation regarding coexistence. As GM crops further become a part of commercial agriculture in more Member States, they will be found at low levels when harvesting other varieties. Equally, small amounts of other varieties will be found in GM crops. This is a fact of life in agriculture, and GM crops are no different from others in this regard. Coexistence between any crops or forms of agriculture is possible – as it has always been – by recognising that absolute purity is not achievable, but that high purity is.

Some important basic concepts relevant to understanding coexistence are:

- Of the major European crops – wheat, maize, barley, oilseed rape, sugar beet, potatoes, etc – only GM varieties of maize, oilseed rape, potato and sugar beet will be available for commercial planting in the near term;
- With respect to maize and oilseed rape, crops will only pollinate other varieties of the same crop. Thus, for example, GM oilseed rape would have no influence on a farmer's ability to grow organic maize in adjacent fields;
- Cross-pollination will only occur to a significant degree if the crops are sufficiently close, the flowering periods are the same and the receiving crop has not already self-pollinated;
- Scientific studies show that for all crops, the majority of cross pollination occurs at the edge of the fields with a rapid decrease as the distance from the pollen source increases;
- The potential for cross-pollination is only present in certain well defined cases. Good communication between nearby farmers and other codes of conduct can ensure problem-free coexistence through agreement to separate crops of the same type.

Despite the long experience we have with coexistence, even before the existence of GM crops, the EU has treated GM crops differently. Regulations mandate a low labelling threshold level (0.9%) for GM presence in conventional harvested produce and processed products (so-called "adventitious presence[1]"). This labelling threshold is imposed even though GM crops and products derived from them are subjected to more extensive and stringent safety testing than their conventional counterparts. The 0.9% labelling threshold is stricter than those for foods produced according to organic standards, which have a 5% threshold for non-organic content. Therefore, under current legislation it is acceptable that organic products contain up to 5% non-organic material whilst conventional products must contain less than 0.9% approved GM material.

Some people are calling for a lower threshold than 0.9% of GM material in organic crops. This would be directly contradictory to both the aims and intent of both European policy regarding the freedom to use GMOs, as well as fundamental concepts of EU law.

European coexistence guidelines

The European Commission published a set of guidelines in July 2003 about the coexistence of GM and non-GM crops. The guidelines are based on the principle that coexistence is about providing farmers and consumers with a practical choice between conventional, organic or GM food and feed production. These guidelines for Member States suggest best agricultural practices to follow when growing GM and non-GM crops[2] so as to enable the farming community to continue growing non-GM crops without exceeding the labelling threshold. Since the publication of the Commission guidelines, a number of Member States (e.g., Denmark, Netherlands, and Spain) have developed country-specific guidelines and/or legislation that provide rules for the growing of GM crops.

As with the coexistence of other crops and farming systems, it should remain the responsibility of individual farmers to assure the quality of their crops, choosing quality assurance practices that are most suited to their farming systems and regions. Applying these established principles – based on common sense, forethought, neighbourliness and good communication – can ensure that those who choose not to cultivate GM varieties will be able to grow their crops alongside those who do.

Regulatory policy

GM crop cultivation in the EU is regulated by several legal acts, the most relevant of which are:

- Directive 2001/18: the legal basis for the authorisation to place GMOs or GM-derived products on the EU market, and to conduct field trials of GMOs.
- Regulation 1829/2003: the legal basis for the approval to use GMOs and derived products in food and feed.
- Regulation 1830/2003: sets out requirements for traceability and labelling of GMOs and derived products.
- EU and national seed legislation also regulates the marketing of seed varieties that incorporate GM traits (required for cultivation).

Article 22 of Directive 2001/18 states: *"Member States may not prohibit, restrict or impede the placing on the market of GMOs, as or in products, which comply with the requirements of this directive."* At the same time, Article 26a says *"Member States may take appropriate measures to avoid the unintended presence of GMOs in other products."*

In order to meet the requirement of being "appropriate", any co-existence measures taken by Member States must be:

- Aimed at avoiding economic loss to other farmers
- Proportionate to the legitimate objective (0.9% labelling threshold)
- Compatible with basic principles of EU law (especially free movement of goods)

"*Regulations must not be so hard that the producers of GM crops have no chance to come to market*."
(Commissioner Fischer Boel, Arable Farming, Feb 13, 2006)

"No form of agriculture, be it conventional, organic or agriculture using GMOs, should be excluded in the EU"
(European Commission recommendation, 23 July 2003)

"A general prohibition of all types of GMOs in a region could therefore not be justified."
(Commissioner Fisher Boel, Speech, Committee of the Regions, 27 June 2005)

The European Commission has provided useful guidance to determine if proposed co-existence measures are appropriate or not. In brief, this guidance confirms that co-existence measures should:

1. Be restricted to economic aspects of growing approved crops
    - Co-existence measures are not about protecting the environment or human/animal health:
        → This has been fully addressed in the scientific risk assessments prior to approval
        → Directive 2001/18 and Regulation 1829/2003 have safeguard clauses to handle any new safety concerns which may arise
        → Approval conditions specify any special measures to be taken with the GMO

2. Allow growing of GM crops, and allow consumer choice.

3. Aim toward attaining the EU labelling threshold - 0.9% - which applies to non-GM food and feed, including organic.
    - Producers who wish to maintain stricter thresholds than 0.9% are responsible for the incremental measures this requires. This is already the case with many forms of high value-added agricultural production (planting seed, high oleic maize, high erucic acid oilseed rape, etc.)

4. Target practices that can be implemented at farm level.

5. Avoid regional bans (unless by voluntary agreement of the effected growers).

6. Apply existing national liability rules in cases where economic damage to a non-GM grower may occur.

7. Be consistent with Community law:
    - proportionate to legitimate goals (0.9% labelling threshold)
    - must not otherwise restrict an approved product

"National strategies for co-existence should ensure an equitable balance between the interests of farmers of all production types. Cooperation between farmers should be encouraged.
(European Commission recommendation, 23 July 2003)

"We live in the real world," …"*We need to recognise that farmers grow a variety of crops throughout the EU and that it would be wrong to penalise anyone for unavoidable 'contamination'*."
(Spokesman Commissioner Fischer Boel, Just-Food, 25 January 2006)

PRACTICAL EXPERIENCES FROM EUROPE AND BEYOND

Spain

Spanish farmers have grown ¼ million hectares of insect-resistant Bt maize over the last 8 years. There have been no confirmed instances of co-existence-related problems, despite an absence of formal co-existence measures. The economic, environmental, grain quality and farming practice benefits have been scale-neutral.

What practical measures do Spanish farmers employ?

- Isolation (distance, barrier rows)
- Planting near other crops
- Different flowering dates
- Cleaning of planting and harvesting equipment
- Ensure full traceability and labelling, record keeping, testing, etc.
- Extensive cooperation with the agricultural production chain

The experiences in Spain shows that GM crops coexisting with non-GM crops has not been a problem.

Other European countries

In addition to Spain, commercial cultivation of GM maize has begun in the Czech Republic, France, Germany and Portugal. Although the area under GM cultivation has been constrained by temporary limited selection of locally-adapted varieties and by more or less restrictive national and regional regulatory practices, farmers continue to test these crops and to expand their cultivation. As is the case in Spain, farmers and other observers in these countries have reported no significant co-existence problems with non-GM crops so far. Furthermore, the large-scale multi-year trials researching the effect of GM crops on farmland wildlife in the UK (Farm-Scale Evaluations) also monitored potential co-existence problems on neighbouring farms; the lack of problems from the more than 200 commercial-sized fields of GM maize, oilseed rape, and beets provide additional proof that farmers can manage co-existence issues. Finally, GM soybeans have been grown on tens of thousands of hectares in Romania for several years, again without problems related to co-existence.

"Freedom of choice will only be possible when all technologies are available". (Giuseppe Elias, Italian Farmer)

"We support the EC recommendation that measures for coexistence should build on existing segregation methods/practices, and be science-based, cost effective, proportionate, and avoid any unnecessary burden for farmers, seed producers, co-operatives and other actors associated with any production type."

(Policy statement by the UK National Farmers Union, "Coexistence of GM crops with conventional and organic production", October 2003)

"Ce programme démontre que les agriculteurs qui veulent lutter contre la pyrale avec des OGM autorisés peuvent le faire dans le respect des autres cultures." (Christophe Terrain, President, AGPM, French Corn Growers Association)

"It would therefore be disproportionate to allow the entire responsibility for implementing management measures for coexistence to fall on the grower of a GM crop that has ..approval".

(Policy statement by the UK National Farmers Union, "Coexistence of GM crops with conventional and organic production", October 2003)

"Il n'y a pas de problème de coexistence avec les non-OGM si on respecte des distances de sécurité avec les espèces conventionnelles".

(Claude Ménara, French farmer who grows GM and non-GM maize in 2005, Agence France Presse, 6 February, 2006)

Rest of the world

In the United States, the market has developed practical, proportionate and workable co-existence practices based on a case by case situation. Furthermore, it has done this and subsequently ensured successful co-existence of all forms of agriculture during a period in which plantings of organic soybeans and maize increased rapidly. Organic areas of soybeans and maize have increased by 270% and 187% respectively between 1995 and 2001, while GM crops reached shares of 68% and 36% of total plantings of soybeans and maize respectively by 2001. The lack of significant problems demonstrates that wide-scale plantings of GM and non-GM and organic cultivation can co-exist in the same regions.

"Survey evidence amongst US organic farmers (2003) shows that the vast majority (96%) have not experienced any loss of organic sales or downgrading of produce as a result of GM adventitious presence having been found in their crops. Where a small number (4%) report some losses/downgrading this has been due to a marketing decision taken by their certifying body or customer rather than any requirement under national (USDA) organic regulations."

(Graham Brookes, "Coexistence of GM and non-GM crops: current experience and key principles, Oct 2004)

In Canada, a decade of growing GM crops in co-existence with non-GM and organic crops provides extensive evidence that the different systems of production are mutually compatible. For example, producers of conventional and organic oilseed rape and soybeans have continued their activity without disruption following the introduction of GM crops in Canada. The practical rules regarding product labeling and organic production practices established by the Canadian General Standards Board have facilitated successful co-existence by effectively balancing the rights and obligations of farmers and by providing for consumer interests regarding labeling. Among other things, these rules:

- set tolerance standards in organic production for the AP of non-organic ingredients,
- establish workable rules for the labeling of non-GM products,
- are based on practical thresholds, as it is recognized that "absolute zero" is not practical in agricultural production.

To help ensure these standards, industry groups in Canada have developed guidelines of good agricultural practice that help facilitate coexistence between GM, conventional and organic agriculture. These include using pedigreed seed, knowledge of market specifications or tolerances to meet target markets, understanding the regulations, choosing appropriately located fields to avoid certain problems (e.g. pollen outcrossing) and consulting/coordinating planting decisions with neighbors (http://www.croplife.ca).

SCIENTIFIC STUDIES ABOUT COEXISTENCE

Can GM and non-GM coexistence be realised in the EU? The answer is clearly "yes." There is a large body of scientific research that shows this coexistence is achievable. One of the clearest indications of this is a recent study by researchers at FAL Rekenholz in Switzerland[3] who surveyed available literature on gene flow in maize and oilseed rape, considered farming practices and field sizes in Switzerland, and determined that coexistence (maintaining a GM adventitious presence of less than 0.5% at the edge of a neighbouring non-GM field) is feasible in Switzerland providing farming communities cooperate and farmers inform one and other of their intentions.

The Catalan Research Institute for Agriculture & Food (Institut de Recerca I Technologia Agroalimentàries – IRTA) conducted a "worst case scenario" study of maize cross pollination in 2003 with both GM and non-GM maize. There were no pollen barriers or separation of the fields. The average cross-pollination across the whole conventional fields was 0.2%. This study confirms to good agricultural practices applied in Spain. Identical guidelines established by the seed industry in Spain have been published and are attached to each bag of Bt maize seed sold.

In 2004, large scale co-existence trials of GM and conventional maize were conducted in 30 locations in seven federal states in Germany. The trials were overseen by Institute for Plant Breeding and Plant Protection of the Martin Luther University in Halle-Wittenberg and included participation by both private farmers as well as the institutes for agriculture of the German Federal States Bavara and Saxony-Anhalt. The main conclusions of the report were:

- Farmers cultivating GMO maize directly alongside non-GMO maize should ensure a separating strip of conventional maize of no more than 20 metres to ensure non-GM crop falls within EU threshold for AP of 0.9%.
- In the case of larger conventional fields – following consultation between the neighbours – GMO maize can even be cultivated directly adjacent without the separating strip, without the labelling threshold value of the affected harvest both being exceeded.

During three planting seasons (2002-2004) a multi-partner study was carried out in France on various aspects of co-existence of GM and non-GM maize. The study known as Programme Opérationnel d'Evaluation des Cultures issues des Biotechnologies (POECB) was carried out by AGPM with assistance from INRA, IRTAC, FNPSMS, and SEPROMA. The study demonstrated the feasibility of co-existence in maize under actual filed condition.

"The results of the pre-commercial plantings show that, as for silage maize, workable solutions can be found for grain maize that allow the coexistence of GM and conventional systems."

("The coexistence of genetically modified and conventional maize",
Prof. W E. Weber et al, in Mais, Die Fachweitschrift Fur den MaisanBauer, 2005)

"What is an effective and cost effective best practice is specific to national or local conditions. This makes an EU-wide "one-size-fits-all" approach unworkable." (Commissioner Fischler, July 2003)

"The provisional results from the test crop have shown that co-existence in the cultivation of genetically modified and conventional corn is feasible in Germany. With this conclusion, the scientific information already available from Spain, France and Germany was confirmed in commercial terms."

(Inno Planta Nordharz/Börde, "Insights gained from the 2004 test
Crop Coexistence of Genetically Modified and Conventional Corn", November 2004)

"Les trois années d'expérimentation ont montré que une parcelled de maïs conventionnel equivalent en surface à la parcelled de maïs OGM, et située à proximité immediate de celle-ci, présente un taux de fecundation criosée inférieur à 0.9%."

(POECB, 2002-2004, Synthèse des résultats

SPECIFIC CROPS

There is a large body of research data developed over decades that provides information about the cross pollination that occurs between crops of the same type. Much of this research has been conducted in the past so as to establish growing practices that enable seed growers to produce seed of registered crop varieties, though it must be noted that a purity of 100% is not attainable and is not required under EU seed laws. See also the OECD where the experience of plant breeders is published in "Traditional Crop Breeding Practices" in 1993, OECD – a publication that focused on field crops species by species. Additional OECD work has resulted in a series of 16 consensus documents on the biologies of different crop plants that includes maize, oilseed rape, sugar beet and potato.[4]

Maize

Maize is an out-crossing cereal originating in Mexico. It has female flowers on the main stem of the plant; when pollinated by pollen from the same or neighbouring plants, these flowers form the well know "corn cob", with hundreds of seeds on it. Decades of plant breeding experience and the production of modern maize hybrid varieties (both non-GM and GM) show that the EU labelling threshold of 0.9% can be achieved by using appropriate isolation distance, AND that this can be reduced by using border rows (in the case of a GM crop, by having rows of non-GM maize surrounding the main crop) or separation distances. In the EU farmers do not save maize seed from one year to the next, rather, every year they buy certified seed of varieties that meet their and their customers' specific needs. For both GM and non-GM varieties, this is "hybrid" seed that provides the grower with high yields because of "hybrid vigour."

Research into out-crossing in maize indicates that an isolation distance between GM and non-GM crops of 25m will be sufficient to achieve out-crossing into the non-GM crops of less than 0.9%. The research indicates also that this distance may be reduced if the GM crop is surrounded by non-GM border rows of maize plants.

- in France, researchers using waxy maize and feed maize showed that to reach a cross pollination of less that 0.9% (the EU's mandatory labelling threshold) growers should have a distance of between 10 – 25 metres[5] between the two different crop types. Another study [6] showed that in plots of maize separated by 25m, in the first 5m the cross pollination level was 0.67% and that in the total harvest the level was 0.11%.
- in Germany, studies of gene flow between commercial sized GM and non-GM maize fields showed that when planted next to each other, the non-GM maize plants at a distance of 20 – 30m from the GM maize had cross pollination levels of 0.24%[7]
- in northern Italy (Padana Plain), the gene flow of maize fell below the critical threshold of 0.9% at a distance of 17.5 metres from pollen sources, and to below 0.5% at a distance of 30 metres. Amongst the measures that can be used to limit gene flow, the use of buffer zones and the use of varieties that have different blossoming times has proved to be particularly effective. The use of open spaces between the different crops is less efficient and is able to reduce gene flow only in the absence of wind or when more than thirty metres of empty space separates the crops. These are some of the results collected by researchers in 2005 in Lombardy within the most extensive cooperative experiment ever conducted in Italy, and one of the largest in Europe[8].
- in Spain, surrounding a plot of 1.900 m2 GM maize with 2.1 ha of non-GM maize showed that at 9m from the GM source cross pollination of the non-GM was 0.58%, 11m 0.38%, 13m 0.3% and 17m 0.24%[9].
- For a recent review of maize out-crossing studies see Devos, 2005[10].

Oilseed rape

Oilseed rape is grown for its seeds that are high in oil (different profiles of fatty acids making up the seed oil provide oils with a variety of high quality food and industrial uses) and protein that is used as animal feed. It is grown in the EU as a winter annual and is mainly self-pollinating although it may outcross with its immediate neighbouring plants through physical contact at rates between 12-47%[11]. Oilseed rape, unlike maize, can disperse seeds into the soil, especially during harvesting. The management of these seeds that

may germinate to form “volunteer” plants in the following seasons is very important in order to achieve coexistence of GM and non-GM oilseed rape crops. The plant breeding and research community has over several decades developed a large body of research into out-crossing within the species *B. napus* in order to develop practical procedures for the production of high quality certified seed of oilseed rape varieties.

Research shows that for normal open pollinated varieties cross pollination from one field to another is very low and that the community threshold of 0.9% can be achieved with minimal isolation distances. Border rows on non GM oilseed rape around the GM crop provide an additional measure to prevent gene flow.

- In a large study in Australia in 2002 researchers looked at cross pollination from a new herbicide tolerant variety to conventional crops[12]. Seeds collected from fields next to the new variety revealed less than 0.5% cross pollination, while results from the whole field surveys of conventional oilseed rape showed outcrossing rate of a maximum 0.07% with an average amongst all 63 fields surveyed of less than 0.03%.
- In a recent two year study in Germany, Funk *et al*[13] reported that for out-crossing from a GM plot into surrounding non-GM plots showed a rapid decay as the distance from the GM pollen donor increased. This study suggested that at a distance of less that 2m from the GM pollen source the level of out-crossing in the non-GM crop would be less than 0.9%, and at 30m it would not be reliably detected (i.e. less than 0.1%). The authors suggested that the EU labelling threshold of 0.9% in food and feed could be achieved with no isolation distances between the non-GM and GM fields.
- Oilseed rape growers do sometimes save seed from their harvest to grow as a crop the following year. Farmers doing this will need to assure themselves of the quality of their saved seed with respect to the adventitious presence of GM.

Sugar beet

This crop is grown as a biennial, seeded one year and harvested the next. The harvested part of the plant is a swollen root, not seeds. The sugar-rich swollen root is harvested before the plant flowers, although there are some plants that “bolt” (generally less than 1%[14]) and produce flowers before harvest. For this reason, sugar beet seed production is always strictly controlled to ensure a very high level of purity of the seed that is certified and sold to farmers. Sugar beet farmers purchase this certified seed for every crop they grow. The major route for adventitious presence of GM sugar beet in non-GM sugar beet would be through mechanical mixing of the harvested beets.

Potato

This crop, a native of South America, is a perennial that is grown annually from vegetative tubers (known as seed tubers) that are not true seeds. These seed tubers produce a harvest of additional large tubers that are harvested as the crop. As with sugar beet, the potential for adventitious presence of GM potato in a non GM crop arising through mechanical mixing and isolation distances between the two crop types is very small.

[1] Adventitious Presence
[2] European Commission guidelines on coexistence of GM and Non GM crops
[3] FAL Rekenholz
[4] OECD Biotrack - http://www.oecd.org/document/51/0,2340,en_2649_34385_1889395_1_1_1_1,00.html
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