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The European Coexistence Bureau: Five Years' Experience

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The European Coexistence Bureau (ECoB) was established in 2008 to help European Union member states identify best practices for technical segregation measures between GM and non-GM crops and, on these bases, develop guidelines for crop-specific measures for coexistence. The ECoB works with EU member states' experts, managed by the European Commission's Joint Research Centre staff; the ECoB works in consultation with stakeholders. The ECoB deals with best practices of coexistence at the technical and agronomic level, excluding related administrative or legal issues. Since its establishment, the ECoB has focused on coexistence in GM maize production, since this remains the only GM crop cultivated in EU countries. The ECoB has produced Best Practice Documents (BPDs) for (i) coexistence of GM maize crop production with conventional and organic farming, (ii) monitoring efficiency of coexistence measures in maize crop production, and (iii) coexistence of GM maize and honey production. An overview on similar efforts and expert groups, which are beginning to appear outside the European Union (United States, Canada, and Brazil) for development of coexistence guidelines, is also presented.

Key words: adventitious mixture, best agricultural practice, coexistence, genetically modified (GM) crops, segregation measures, tolerance threshold.

Introduction

The coexistence approach adopted in the European Union (EU) promotes the ability of farmers to choose between the cultivation of genetically modified (GM), non-GM, and organic crops with respect to market demand and consumer preferences. The coexistence rules should support market forces to operate freely in compliance with community legislation (European Commission, 2009) and provide opportunities for different agricultural systems to coexist side by side in a sustainable manner.

The European Union has adopted a subsidiarity principle for the detailed regulation of coexistence between GM and non-GM crops due to the heterogeneity in agricultural practices, landscapes, and legal environments among the EU Member States (MS; European Commission, 2010). In practice, this means that the development of specific coexistence regulations is a responsibility of the individual Member State and, in some cases, is a regional competence. However, the European Commission (EC) retains several roles when it comes to coexistence as strategy. First, the EC publishes general guidelines framing the coexistence policy by explaining the background and rationale behind coexistence and the different coexistence measures. Second, the EC mediates the information exchange among MS about coexistence legislation and experience through the network group for the exchange and coordination of information concerning coexistence (COEX-NET). Finally, the EC's Joint Research Centre (JRC) is in charge of providing specific technical advice to MS on how to develop coexistence measures; this is done through the European Coexistence Bureau (ECoB). The activities of the ECoB are explained in this article.

The European Coexistence Bureau

The ECoB was established in 2008 as a result of the conclusions of the Agriculture Council of May 2006. Its role is to identify technical segregation measures and to develop crop-specific best practice guidelines for coexistence. The ECoB coordinates crop-specific Technical Working Groups (TWGs) composed of MS experts and managed by JRC staff; duties also include assisting the consultation with stakeholders. The ECoB deals with the best practice of coexistence at technical and agronomic levels, excluding related administrative or legal issues. Documents produced by ECoB are public and can be found on the ECoB's website.[1]

1. *http://ecob.jrc.ec.europa.eu/*

The ECoB's work since its inception has been dedicated to coexistence in maize crop production, since Bt maize is the only GM crop commercially grown in the EU territory. The TWG for maize (TWG Maize) was established in 2008 and comprises experts nominated by 20 MS. Since then, the group has developed three Best Practice Documents (BPDs) for

- coexistence of GM maize crop production with conventional and organic farming;
- monitoring efficiency of coexistence measures in maize crop production; and
- coexistence of GM maize and honey production.

All proposed agricultural management practices in these BPDs are consensually agreed upon among the TWG members to ensure coexistence while maintaining the economic and agronomic efficiency of the farm. For the management of the economic risk to non-GM farmers, the recommended coexistence measures ensure that any adventitious presence of GM material complies with the established tolerance threshold. The margins for adventitious presence of genetically modified organisms (GMOs) in non-GMO products are in line with market demands. Furthermore, these BPDs consider that MS are free to decide which level of admixture will be pursued in their national coexistence measures in order to avoid the potential loss of income for conventional and organic producers (European Commission, 2010). The comprehensive analysis of a large body of literature and sets of empirical data is the basis for consensus within the TWG Maize of ECoB and is presented in the aforementioned BPDs.

Coexistence in GM Maize Crop Production

In 2010, the ECoB released the BPD for coexistence of GM maize crop production with conventional and organic farming (Czarnak-Kłos & Rodríguez-Cerezo, 2010). The document outlines best practices for coexistence in maize crop production, be it grain or silage. Maize seed production is not addressed. The BPD starts with a comprehensive review of the available data (coming from field experiments and commercial cultivation) on managing the adventitious presence of GM maize in non-GM harvests. The best practice to limit outcrossing included recommendations on isolation distances to ensure different thresholds of adventitious presence.

The scientific and statistical basis for the consensus reached by the TWG Maize of ECoB on the appropriate isolation distances for maize production was the analysis of a large body of literature on gene flow in maize in experimental and commercial conditions. In particular, one important piece of evidence was the statistical meta-analysis research conducted at the JRC of more than 1,400 observations of maize gene flow reported in the literature (Riesgo, Areal, Sanvido, & Rodríguez-Cerezo, 2010). The ECoB also confirmed the technical possibility to have the isolation distance reduced through the use of buffer zones of non-GM maize around the GM field. These buffer zones are easy to implement and can act as a refuge to delay resistance development at the same time. Similar to the recommendations regarding isolation distances, ECoB also provided consensus guidelines for temporal isolation, such as differences in sowing dates or in maturity class. Further issues documented include volunteer control and cleaning of machinery.

Although the scope of the best practices for maize coexistence is mainly on measures that could be taken by individual farmers, the fact is that in the European landscape, situations exist where coexistence is difficult to achieve. This is mainly the case in situations where agricultural plots are fragmented (Sanvido et al., 2008). The ECoB consensus is that voluntary field clustering is an appropriate solution in specific cases.

Monitoring the Efficiency of Coexistence Practices in GM Maize Crop Production

The second BPD produced by the ECoB (Rizov & Rodríguez-Cerezo, 2014) provides recommendations on how to monitor the efficiency of coexistence practices between GM and non-GM maize crop production proposed in the previous document.

Monitoring effectiveness and efficiency of coexistence measures requires taking into account all possible admixtures, such as cross-pollination, contamination by sowing, harvesting, transportation, storage, etc. The TWG Maize performed an extensive analysis of the results of three European Framework of Research projects: SIGMEA (Sustainable Introduction of GMOs into European Agriculture),[2] CO-Extra (GM and Non-GM Supply Chains: Their CO-EXistence and TRAceability),[3] PRICE (PRactical Implemation of Coexistence in Europe),[4] and the available practical experience in the EU MS.

2. *http://www7.inra.fr/sigmea*
3. *http://www.coextra.eu*
4. *http://price-coexistence.com*

It was agreed that monitoring the potential for adventitious presence of GM maize at the field level is appropriate. To optimize cost efficiency, this monitoring could be combined and/or substituted with monitoring during harvesting of the particular field on site or afterwards from the trailers.

The TWG Maize of ECoB concluded that the selection of sampled fields should be done in a rational manner, and only the most exposed fields should be tested. If the coexistence measures are efficient in this case, there is no need to assess adventitious presence in less risky situations. To evaluate the potential for adventitious presence of GM maize in a particular field, these factors need to be considered.

- Location of the monitored fields in relation to the GM maize area and their size in respect of their outcrossing potential
- Envisaged efficiency of applied coexistence measures
- Regional specificities, relevant for pollen-mediated gene flow

For the non-GM field location to be monitored, information from registers of GM maize fields is quite useful. Depending on the particular data about the GM fields' location in these registers, additional information may be needed. Further refinement of monitored areas could be achieved with the utilization of the monitoring-aid tools.

The currently available monitoring-aid tools need to be validated for a large-scale variation of regional and environmental conditions for the assessment of coexistence between GM and non-GM maize. They should meet multiple user-friendly requirements for farmers, regulators, and other stakeholders in guiding coexistence measures. In this respect, the developments of the European-funded research project FP7 PRICE are quite promising; the FP7 PRICE project is a continuation of the achievements of previous projects (FP6 SIGMEA and FP6 CO-EXTRA). A monitoring-aid tool should combine the structure of cost of coexistence with the compliance rate to assess the effectiveness of coexistence measures. Those measures that effectively reduce the GM content in non-GM crops to the requested level should be ranked by their cost.

The ECoB TWG Maize also examined sampling and testing issues, detection methods, and analysis of results and possible follow-up with respect to monitoring efficiency of coexistence measures.

Coexistence between GM Maize Crop Production and Honey Production

The TWG Maize has analyzed in the third BPD the coexistence between GM maize crop production and honey production in the EU (Rizov & Rodríguez-Cerezo, 2013). The TWG Maize assessed whether any further coexistence measures to those recommended in the first BPD are required to limit adventitious presence of GM maize pollen in honey, thus avoiding economic losses for producers.

The ECoB TWG Maize examined the factors determining the presence of pollen in general or maize pollen (more specifically, GM maize pollen) in samples of EU-produced honey. A key piece of evidence for the estimation of the range for total and, particularly, maize pollen content in EU-produced honey was a study providing data from 6,719 honey samples produced in 21 countries of the European geographical area (Persano Oddo et al., 2004); additionally, an exhaustive bibliographic review published by Piazza and Persano Oddo (2004) was considered.

All available empirical data indicate that total pollen presence in EU honey ranges from 0.003% to 0.1% in weight. Considering the share of maize pollen in total pollen within EU-produced honey, the extrapolated figures for maize pollen in honey would be a lower order of magnitude.

Furthermore, the analysis of the limited literature data about the mean flight distances covered by forage honeybees for pollen clearly demonstrated that even though scout honeybees can fly several kilometers searching for pollen and nectar, such flying distances are not a regular foraging behavior of a honeybee colony to cover its daily nutritional needs of pollen. This is particularly valid for maize, which provides only pollen and is not a nectar-producing plant. A rough estimate based on current knowledge of the flying distances covered by honeybees for maize pollen foraging could be in the range of a few hundred meters up to about 1 km. Current knowledge does not allow for establishment of a statistical relationship between maize pollen content in honey and distance of beehives to maize crops.

In addition to biological factors (related to honeybee behavior and maize pollen characteristics), the ECoB TWG Maize also analyzed existing mandatory quality standards by European and international organizations that impact the eventual presence of pollen in commercial honey. An important quality requirement for marketing honey in the EU is the limit of water-insoluble content. The mandatory limit for water-insoluble matter

in honey is fixed at 0.1g/100g, with the exception of "pressed honey," for which the limit is 0.5g/100g. Since this water-insoluble content includes the maize pollen fraction of honey (given the size of maize pollen grains) in addition to pollen of other plant species, debris, and bee parts, the ECoB TWG Maize concludes that the eventual presence of GM maize pollen in honey, if any, will be very low (below 0.1%); this is below mandatory labelling thresholds. The same is true for organically produced honey, as the quality standards are the same. In addition, organic honey has an "obligation of procedure" requirement to locate beehives in areas where—within a 3km radius—nectar and pollen sources consist essentially of organically produced crops.

Finally, the ECoB TWG Maize reviewed the state-of-the-art possibilities for detection and identification of traces of GM maize pollen in honey. These results demonstrate that it is currently possible to determine in honey the amount of GM pollen of a specific crop (e.g., GM maize pollen/total maize pollen) using validated PCR methods. However, at the current state of technology, a practical and robust PCR protocol able to quantify GM pollen relative to total pollen in honey is unavailable. The problem lies in the fact that in all honeys, even if classified as unifloral, the pollen fraction consists of pollen from several species.

In conclusion, the ECoB TWG Maize—based on the analysis of the evidence summarized in this BPD—concludes that no changes in the proposed best practices (Czarnak-Kłos & Rodríguez-Cerezo, 2010) are necessary and that the current practices in honey production and marketing in Europe are sufficient to ensure that adventitious presence of GM maize pollen in honey is far below legal labelling thresholds and is even below 0.1%.

Development of Coexistence Practices in the United States, Canada, and Brazil

In very recent years, the need for developing guidelines for coexistence at the farm level—in consultation with experts and interested parties—has been recognized in countries with a strong production of GM crops (such as the United States and Canada), where coexistence is not based on regulations/legislation but on market arrangements.

In 2011, the US Department of Agriculture (USDA) stated as an important priority the need to address any coexistence issues caused by the interaction of different agricultural production systems. Therefore, the Advisory Committee on Biotechnology and 21st Century Agriculture (AC21)[5] was reactivated to focus on a key issue associated with the increasing complexity and diversity of interactions between different forms of agricultural production in US agriculture. The AC21 is composed of 23 members from 16 states and the District of Columbia. The members represent a broad range of interests and expertise: farming communities, the seed industry, the biotechnology industry, the organic food industry, state governments, food manufacturers, consumer and community development groups, the medical profession, and academic researchers.

In 2012 the AC21 submitted a report on enhancing coexistence (USDA AC21, 2012). The report is focused on approaches appropriate to address economic losses by farmers in which the value of their crops is reduced by unintended presence of GMOs. The report discusses possible eligibility standards for a loss and what tools and triggers (e.g., tolerances, testing protocols, etc.) would be needed to verify and measure such losses to determine if claims are compensable; it also discusses what other actions would be appropriate to bolster or facilitate coexistence among different agricultural production systems in the United States. This report stated that the USDA should fund and/or conduct research in a number of areas relevant to the promotion of coexistence in US agriculture, particularly for assessment of the efficacy of existing on-farm and post-farm unintended presence mitigation techniques on a crop-by-crop basis and development of improved techniques as needed. The recommendation also covers seed propagation/multiplication coexistence.

In Canada, the coexistence between GM and non-GM crops is not regulated by the government, but rather the onus is on the producers. CropLife Canada, a trade association representing the manufacturers, developers, and distributors of plant-science technologies, developed the stewardship initiative guide on best management practices for coexistence (CropLife Canada, 2012). In this guide, the leading principles that facilitate a Canadian framework for coexistence of the three main types of production systems—conventional, organic, and GM agriculture—are presented.

The requirements of the Canadian General Standards Board (CGSB)[6] for organic agriculture production and for labelling of foods that are produced or derived from GMO demonstrate how product specifications allow for

5. *http://www.usda.gov/wps/portal/usda/usdahome?contentid=AC21Main.xml*
6. *http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html*

coexistence in the field and in the marketplace. The organic agriculture standard is based on a system that follows a defined process of production that includes methods and inputs and sets tolerance levels for the accidental presence of ingredients outside the standard.

Other professional organizations in Canada, such as the Canadian Seed Trade Association (CSTA), are also involved in development of coexistence practices. The CSTA Board of Directors placed a high priority on the development of broad coexistence plans for organic, conventional, and GM production systems in Canadian crops. The objective of the process is to ensure that Canadian farmers continue to benefit from a diversity of markets and the production systems that are required to participate in those diverse markets, whether organic, conventional, or GM production systems. The CSTA facilitated the establishment of value chain groups, which included academics, forage specialists, alfalfa producers, and their customers. The group reviewed and researched alfalfa hay production systems and the biology of alfalfa in Canada. As a result, a best management practices (BMPs) document for farmers was presented in February 2012. The BMPs for coexistence—including the checklist, along with reports from the development process—can be found on the CSTA website.[7]

The National Technical Commission on Biosafety of Brazil (CTNBio),[8] which provides technical and advisory assistance to the federal government in the formulation, updating and implementation of the national policy for GMOs, is in charge of establishing technical safety standards and technical advice for cultivation of GMOs. With Resolution No. 4[9] of August 16, 2007, CTNBio established the minimum distances between commercial cultivation of GM and non-GM maize in order to assure the coexistence between these production systems. In 2009, CTNBio published a guide for practical implementation of technical segregation measures in maize production.[10]

Conclusion

In summary, in the past five years, the ECoB has completed fundamental work in developing consensus-based best practices of coexistence between GM maize and non-GM maize and honey production in the EU. New, crop-specific, technical working groups (TWG) of ECoB will now be created for crops not yet cultivated in the EU but already assessed by the European Food Safety Authority (EFSA). The soybean TWG of ECoB has been operative since 2013 and a BPD for coexistence in soybean production in the EU is expected for 2014. New TWGs are foreseen for crops such as cotton, sugar-beet, and potato. Activities and guidelines similar to those produced by ECoB are now starting in North and South America.

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7. *http://cdnseed.org/facilitating-choice-through-coexistence/*
8. *http://www.ctnbio.gov.br/ (in Portuguese)*
9. *http://www.ctnbio.gov.br/index.php/content/view/12858.html*
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Authors' Notes

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