Pocket K No. 51

# Coexistence of Biotech and Non-biotech Crops

In 2015, the world accommodates 7.3 billion people. By 2050, world population is expected to reach 9.8 billion.[1] With the exponentially growing population, decreasing resources, and intensifying climate change, it is compelling to adopt various production systems to attain food security. Thus, coexistence of different production systems has become a viable option for some countries.

The United States Department of Agriculture has defined coexistence as simultaneous planting of conventional, organic, identity preserved, and genetically engineered (GE) or biotech crops in contiguous location, in line with consumer preferences and farmer choices. Conventional crops are produced from non-GE crop varieties and do not follow the standards for cultivation of organic produce. Organic crops are planted based on national organic regulations. Identity preserved (IP) crops has assured quality that is the same with the breeding stock. GE crops are produced using seeds developed through modern biotechnology techniques.[2] Thus, coexistence gives the farmers freedom to choose the best production system and get the most value out of these choices.

## Case Studies

GE crops have been planted since 1996 and by 2014, there were already 181.5 million hectares planted in 28 countries.[3] Continuous cultivation of GE crops in these countries together with non-GE crops confirms that coexistence is achievable.[4]

Several studies have been conducted to test the feasibility of coexistence between GE and non-GE crops under real-life large-scale farming conditions. Overlapping flowering periods in GE maize and non-GE maize was found not to increase labeling threshold of 0.9% in a 2004 study in Germany. The study conducted in 30 sites was the basis for the 20 m planting distance between GE and non-GE maize, which can be separated by plants for pollen barrier.[5]

In another study conducted in Spain, cross-fertilization between Bt and conventional maize in two regions was found to be determined by synchronicity of flowering time and the distances between the donor and receptor fields. The researchers plotted a map indicating the Bt and non-Bt maize fields, together with their respective flowering time. They used these data for sampling and analysis using real-time quantification system-polymerase chain reaction (RTQ-PCR). Results showed that cross-fertilization was higher in the borders, and decreased towards the center of the field. Nine out of 12 fields had values of GM DNA much lower than 0.9%. Thus, the researchers also recommended a 20 m security distance between transgenic and conventional fields to maintain pollen flow of below 0.9% threshold.[6]

Farm-scale experimental fields in Po valley, Italy showed that 0.9% cross-fertilization threshold in the EU can be achieved with proper positioning of recipient and donor

fields and scheduling of flowering time. The scientists designed three types of experimental fields: (1) a block of pollen source was planted in the middle of a recipient field (2) a block of pollen source was separated from the recipient maize by fallow soil and/or maize buffer zones of different shape and dimension; and (3) the pollen source was planted within a recipient field of maize hybrids with different growing cycle lengths and flowering time. The findings of the study exhibited that the 0.9% cross-fertilization threshold was achieved within, on average, 10 m in the type 1 experiment. The wind was not a significant factor in the cross-fertilization.
Buffer maize plants that shed non source pollen, were the most efficient barrier against cross-fertilization.[7]

These studies suggest that coexistence is possible following proper guidelines such as planning of flowering time and setting buffer distance between GE and non-GE crops. For instance, in the UK, the Supply Chain Initiative on Modified Agricultural Crops (SCIMAC) released some guidelines for separation distances between GE and non-GE crop fields to meet the 0.9% labeling threshold.[8]

## Current Experience

Farms in North America illustrate the successful GE and non-GE crops coexistence, since this is the region with the highest GE crop planting.[3] Figure 1 shows the share of biotech, conventional, and organic production systems in soybean, maize, and canola in North America in 2002.[8]

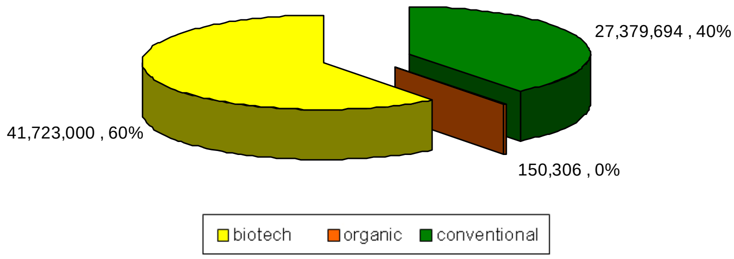


Figure 1. Percentage of biotech, conventional, and organic production systems in soybean, maize, and canola in North America (2002)
Sources: USDA, ISAAA, and University of Manitoba

The North American experience in coexistence has shown that even if the greatest share (60%) was devoted to GE crops, majority (96% of those surveyed) of organic farmers have not incurred economic losses due to the presence of biotech crops. The remaining (4%) farmers experience losses or downgrading of produce because of the marketing decision taken by their certifying body or customer rather than any requirement under national organic regulations.[8]

In 2003, the U.S. Department of Agriculture formed the Advisory Committee on Biotechnology and 21st Century Agriculture (AC21) to examine long-term effects of biotechnology on U.S. food and agriculture system. The committee is composed of experts coming from a wide range of fields and interests, and developed recommendations and activities to strengthen coexistence among different production systems. The recommendations aimed to educate farmers on coexistence; conduct more research on current state of coexistence; provide farmers with tools and incentives to promote coexistence; increase assurance about the quality and diversity of U.S. seed germplasm resources; and present a framework of establishing a system of compensation for actual economic losses for farmers intending to grow IP products.[2] To date, the recommendations are followed and implemented by concerned federal agencies.[9]

The European Commission developed general guidelines on coexistence in 2003. The guidelines, together with current GE regulations, were formulated to address the concerns of some Member States about the introduction of GE food and feed in the EU. The ex ante regulations cover prohibition and approval procedures for biotech crops, registration and information duties, technical segmentation measures, insurance measures, legal liability for damages, proving damage, and penalties.[10]

The European coexistence system for biotech, conventional, and organic maize crops has been successfully practiced particularly in Spain. In 2014, Spain planted 131,538 hectares of Bt maize, which is 92% of the EU hectarage of Bt maize.3 With this wide hectarage of biotech crops, neighboring fields have either been planted with Bt maize or non-Bt maize variety which are both sold as feed. Some reports of unintended contamination of GE DNA in organic maize were attributed to poor implementation of proper coexistence practices. In the U.K., farm-scale trials of biotech crops have co-existed successfully with conventional and organic crops. No organic or conventional crops planted close to the trial sites have reported unintended contamination of GE DNA that led to economic losses or loss of organic status on nearby farms.[8]

## Conclusion

Biotech crops have been planted since 1996, and since then, production systems have evolved in countries adopting biotech crops. Farm-scale studies and actual experiences confirm that coexistence of different production systems is achievable. Coexistence will continue to be successful as long as farmers with different preferences would also continue to be flexible and exhibit mutual respect of each others' practices and needs.

The gap between farmers can be eliminated through dialogue and pursuit of a common goal of having ecologically balanced, biologically based system of farming. The government also plays a role in ensuring food security by implementing sound policies supporting such system of farming. Consumers influence what kinds of plants are developed and what tools are used. Agriculture demands collective help and all suitable tools to feed the growing population in an ecological manner.[11]

## References

[1] Population Reference Bureau. 2015. 2015 World Population Data Sheet. http://www.prb.org/pdf15/2015-worldpopulation-data-sheet_eng.pdf.
[2] USDA Advisory Committee on Biotechnology and 21st Century Agriculture (AC21). 2012. Enhancing Coexistence: A Report of the AC21 to the Secretary of Agriculture. http://www.usda.gov/documents/ac21_report-enhancing-coexistence.pdf.
[3] James, C. 2014. Global Status of Commercialized Biotech/GM Crops: 2014. ISAAA: Ithaca, New York.

[4] Supply Chain Initiative on Modified Agricultural Crops (SCIMAC). 2006. GM Crop Co-existence in Perspective. http://www.scimac.org.uk/files/GM_crop_%20coexistence_perspective.pdf.
[5] Weber, W.E., T. Bringezu, I. Broer, J. Eder, and F. Holz. 2007. Coexistence between GM and Non-GM Maize Crops-Tested in 2004 at the Field Scale Level (Erprobungsanbau 2004). Journal of Agronomy and Crop Science 193:79-92.
[6] Messeguer, J., G. Peñas, J. Ballester, M. Bas, J. Serra, J. Salvia, M. Palaudelmas, and E. Mele. 2006. Pollen-mediated Gene Flow in Maize in Real Situations of Coexistence. Plant Biotechnology Journal 4:633-645.
[7] Della Porta, G., D. Ederle, L. Bucchini, M. Prandi, A. Verderio, and C. Pozzi. 2008. Maize Pollen Mediated Gene Flow in the Po Valley (Italy): Source-Recipient Distance and Effect of Flowering Time. European Journal of Agronomy 28(3):255-265.
[8] Brookes, G. 2004. Co-existence of GM and Non-GM Crops: Current Experience and Key Principles. http://www.pgeconomics.co.uk/pdf/Coexistencekeyprinciplesdocument.pdf.
[9] USDA. 2013. Fact Sheet: Summary of USDA Efforts to Address Final Recommendations by the Advisory Committee on Biotechnology & 21st Century Agriculture (AC21). http://www.usda.gov/documents/usda-factsheet-ac21-final-recommendations.
pdf.
[10] Beckmann, V, C. Soregaroli, and J. Wesseler. 2006. Coexistence Rules and Regualtions in the European Union. American Journal of Agricultural Economics 8(5):1193-1199.
[11] Ronald, P.C. and R.W. Adamchak. 2008. Tomorrow's Table: Organic Farming, Genetics, and the Future of Food. Oxford University Press: New York, New York.

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