

Genetically Modified Corn Analysis and Recommendations by Professor of Agronomy

Abstract

As a result of a local law in Northern Italy, which bans the use of genetically modified organisms in open-fields, a group of farmers who wanted to demonstrate the benefits of using GM crops had their fields seized and crops destroyed. The local government was not the only party involved in the damage, since local environmental groups were involved as well. These farmers have now sued for economic damage and a panel was constructed to guide the local court of justice. The farmers' claims that MON810 has been proven safe and reliable are fact based and have accurate. Through analysis, it has been supported that MON810 maize does not pose any allergenic risks, no consequences for livestock, and no observable consequences from human consumption. Also, antibiotic-resistance marker genes do not pose a threat in this instance, since they are no longer used in MON810 maize. Also many benefits such as the reduction of pesticide usage, reduction of mycotoxins, and the possibility for better yields during tough harvests have all been displayed. The panel has concluded that the farmers should be refunded for the damages.

Introduction

The work of our group was aimed towards developing recommendations concerning the potential reimbursement of the farmers whose crops and fields sustained substantial damage in Northern Italy, due to their illegal seeding of GM crops. I represent the Professor of Agronomy from a local University in Italy. It's my task to study and present the factual science behind plant genetics and physiology along with the science behind producing and using plants for food, as well as many other industries. I will specifically look into the factual science behind creating, producing and using BT corn. This can then be used to dissolve misconceptions and generate recommendations. In addition to my role, the panel is comprised of:

- Environmental Ethicist
- Plant Scientist
- Insect Biologist
- Corn Market Expert

- Scientific Expert on the Genetically Modified Panel for the European Food Safety Authority

Introduction to GM Crops

A genetically modified organism (GMO) is a plant or animal that has been modified genetically by the transfer and insertion of genetic material from another organism. A specific desirable gene is identified and separated from the rest of the genome of the donor organism and is then inserted using molecular techniques into the genome of the newly modified organism (Bessin 2004). The focus of this study is on genetically modified corn and therefore the donor organism could be a bacterium, fungus, or another plant. In the case being studied, the specific type of corn is genetically modified to contain the same properties as an insecticide and the donor organism is a naturally occurring soil bacterium, *Bacillus thuringiensis* (Bt). The particular strain that is being discussed by the panel is MON810 maize. The desired gene that Bt contains is known to produce a protein that is toxic to Lepidoptera larvae, particularly the European corn borer (Bessin 2004). These types of toxic proteins are known as Crystal or Cry proteins. The specific protein, Bt delta endotoxin (*Cry1Ab*), is very selective and generally only harms insects within the Lepidoptera order, this causes it to be desirable for biological control programs because it does much less damage to insect predators and parasitoids than broad-spectrum insecticides (Bessin 2004). Commercial microbial insecticides utilizing Bt have been available since the 1960s and these products have an exemplary safety record and are used on a variety of crops (Gewin 2003).

The corn that we have today was domesticated around 10,000 years ago when humans learned the technique of cross-pollination. “A simple grass known as ‘teosinte’ was bred with another type of grass, in order to produce husks of modern corn (Gewin 2003)”, so in a sense, corn was the result of human manipulation from the very beginning. Genetically modified crops are known to have the fastest adoption rate of any new technology in global agriculture. Bt corn could represent huge advantages in the reduction of pesticide use, which would have ecological and environmental benefits. A great example of how beneficial this technology could be is that with the adoption of Bt cotton, the spraying of around 2 million pounds of pesticides- roughly 50% of previous usage- has been spared (Gewin 2003). With the use of Bt corn, the amount of pesticide usage would be decreased to a similar extent. Also, it has been shown through many

studies, that farmers who adopt GM crops tend to do better than those who do not, during tough harvests (Gewin 2003).

Analysis of the Safety of GM Crops

Bt microbial products have been used for around 40 years and have managed to maintain a very good track record. There have only been two reports containing possible adverse human effects and both of these reports were issued prior to 1995 and neither dealt with exposure to Cry proteins (University of California Biotechnology Workgroup 2012). Many studies have been conducted and show no adverse effects of humans and other animals consuming GM crops. For example, back in 2008, there was a study conducted to evaluate the effects of transgenic corn on rats that were fed either GM corn or conventional corn over three generations; no significantly negative effects were observed (Kiliç and Akay 2008). No substantial differences have been observed between consuming conventional corn and its conventional counterpart, it can therefore be deemed safe for use.

There are many citizens who are concerned with the impacts that feeding livestock with GM crops may have on humans who consume products produced from these animals. However, there are a large number of studies that have shown no harmful effects produced in animals that are given feed, which contains GM crops. For example, in 2010 a study was conducted to analyze the effects of feeding lactating dairy cows genetically modified crops over 25 months. They looked at milk composition and at the actual effects on the cows themselves and no changes were observed (Steinke et al. 2010).

According to a review of GM crops that was completed by the International Council for Science (ICSU), genetically modified corn crops have been found to contain lower levels of mycotoxins, which are compounds that are potentially carcinogenic for humans. These mycotoxins are a result of fungal activity in insect-infested corn crops, and due to lower levels of holes in genetically modified plant tissue, these fungi are not able to enter and emit toxins (Gewin 2003). This shows yet another potential benefit of using genetically modified crops.

When GM crops are created, the new desired gene is not the only new gene that is introduced into the genome. A marker gene accompanies this new trait, so that the new crops can be identified and distinguished from non-modified counterparts. It has become a large public concern that antibiotic resistance genes are used for some of the marker genes and many worried that the antibiotic resistance would transfer from the transgenic crops to human and animal gut

bacteria (Tuteja et al. 2012). However, MON810 does not contain any antibiotic resistance genes and this concern is therefore not relevant.

It has already been shown through many case studies, that the protein produced by Bt corn, *Cry1Ab*, does not have any homologous allergenic proteins (Reiner et al. 2014). Also, as shown by related studies, rats were found to have no negative immune effects to being fed Bt corn over an extended period of time (Reiner et al. 2014). Therefore it has been displayed that MON810 maize has no negative effects on allergenic responses. Many of the concerns that surround the topic of consuming genetically modified crops, stem from the concept that people want to know exactly what they are putting into their bodies and for many, their excuse is that there isn't enough evidence or data, however as shown here, there are years and years of tests showing no consequences for consumption and that there are plenty of associated benefits.

Labeling and Popular Support

When referring to the packaging and sales of foods containing GM crops, many people are asking for proper labeling. They want to know if a product that they are deciding to purchase contains traces of genetic modification or not, and they want the freedom to make every decision themselves. This is the most ethical approach, however there are many people who are uneducated in the field of biotechnology and are quick to assume the worst. In the field of science, everything is assumed right until it can be proved wrong, and although tests so far have shown Bt corn to be harmless and have shown more environmental benefits than consequences, the fear of the unknown seems to be the deciding factor in the public eye.

In the United States, the Environmental Protection Agency (EPA) regulates any products that are genetically engineered to provide pesticide traits, such as resistance to the corn borer. The Food and Drug Administration (FDA) requires premarket approval for food additives, whether or not they are products of biotechnology (Bessin 2004). The FDA classifies substances added to food products through DNA manipulation as food additives, only if they are significantly different in structure, function, or amount than substances originally occurring in the food (Bessin 2004). Therefore, there are many ways for production companies to go around requirements and use genetically modified products without properly identifying them. If law framework were changed in Northern Italy as a result of this case, the local government would need to be sure to properly enforce screenings and rules so that there is no public misunderstanding or distrust.

Conclusion

After reviewing the case study and relating issues, it is my opinion that genetically modified crops are beneficial to our environment and that these benefits outweigh the risks. Public attitudes play a very large role in shaping legislation that relates to biotechnology issues and therefore they will play a huge role in future decisions regarding Bt corn. Presently, public attitudes are very negative in regards to genetically modified crops, and a lot of this is due to misinformation and lack of education on the subject matter. It is imperative that we make sure that the public is properly informed on this subject, since it has the potential to be very beneficial in the future.

It is my opinion that we should work towards removing the ban on genetically modified crops in the EU and that we should work towards making very structured agencies to regulate and evaluate all things pertaining to these crops. This way, the people will feel safer having access to these crops and to the food produced using them. Also, if this is the case, then Europe will not miss out on the potential to develop better agricultural techniques and technologies.

It may have been wrong of the farmers to originally plant the crops since the law was in place preventing them from planting, however there is significant evidence showing that these plants have benefits and are safe to use and to consume. It would be a loss for the European Union to lose out on the potential profits that could benefit from the use and development of these technologies, so it is suggested that the European Union works towards developing unified approval of GM technologies, particularly MON810. Since there is a gap between the EU regulations and the regulations of the individual countries, it is recommended that discrepancies are eliminated by creating unified regulations across the EU. It is then recommended that the farmers receive compensation for their destroyed crops and fields. These crops and fields could have provided significant amounts of data towards developing better understanding of GM crops, but was destroyed before the Farmers were given a chance to prove their point.

References:

- Bessin 2004. *Bt-corn: What it is and how it works* [Online]. Available from: <http://www2.ca.uky.edu/entomology/entfacts/ef130.asp> [Accessed 14 November 2014].
- Gewin, V. 2003. Genetically Modified Corn – Environmental Benefits and Risks. *PLoS Biology*, 1(1), pp. 15-19.
- Kiliç, A. and Akay, T. 2008. A three generation study with genetically modified Bt corn in rats: Biochemical and histopathological investigation. *Food and Chemical Toxicology*, 46(3), pp.1164-1170.
- Reiner, D., Lee, R., Dekan, G. and Epstein, M. 2014. No Adjuvant Effect of *Bacillus thuringiensis*-Maize on Allergenic Responses in Mice. *PLoS One*, 9(8), pp. 1-9.
- Steinke, K., Guertler, P., Paul, V., Wiedemann, S., Ertle, T., Albrecht, C., Meyer, H. H. D., Spiekens, H., and Schwarz, F. J. 2010. Effects of long-term feeding of genetically modified corn (event MON810) on the performance of lactating dairy cows. *Journal of Animal Physiology & Animal Nutrition*, 94(5), pp. 185-193.
- Tuteja, N., Verma, S., Sahoo, R., Raveendar, S. and Reddy, I. 2012. Recent advances in development of marker-free transgenic plants: Regulation and biosafety concern. *Journal of Biosciences*, 37(1), pp. 167-197.
- University of California Biotechnology Workgroup 2012. *Is the Bt Protein Safe for Human Consumption?* [Online]. Available from: <http://ucbiotech.org/answer.php?question=31> [Accessed 20 November 2014].