

An Assessment of Bt Corn – Focusing on A case study in Italy, from the perspective of an Environmental Ethicist.

Abstract

Recently, there has been a lot of research carried out about GMO crops and their effects (Domingo and Gin\’e Bordonaba, 2011). This report outlines the environmental ethics of growing Bt genetically modified corn based on the effects on non-target organisms, cross-contamination, effects on other ecosystems and the ethics of GMOs in general was also discussed. The results of this research were that, according to literature, Bt crops do not pose any significant risk to the environment. It was discussed that the group of farmers led by Giorgio Fidenato in Italy should be reimbursed after their land was seized and destroyed by the authority because of a national law against the growing of GMOs law (Scienza in Rete, 2014). A decision about changing current framework was made due to these findings.

Introduction

This report was compiled to discuss the viability of MON 810 Bt corn from an environmental ethics perspective and assess whether Giorgio Fidenato and his farmers in a particular case study in Italy should be allowed to grow Bt corn. It will be discussed whether they should be reimbursed for the land that was destroyed by the authority in July 2014 on the basis that the farmers broke the national law, which in turn did not comply with the EU law (Scienza in Rete, 2014). Bt maize was approved for cultivation in 1995 and first grown in 1996 (Yu, Li and Wu, 2011) so it is not a new advance in biotechnology. Many studies have been carried out using animal feeds to determine the effects of GE crops and as stated by Domingo and Gin\’e Bordonaba (2011), it is very rare that a scientific paper is produced highlighting the negative effects of these crops. Selective plant breeding has been carried out for over 100 years to establish sound traits in plants, but only in recent years has it become a large concern due to the nature of the crop engineering (Robinson, 1999). This has caused an uproar in relation to ethical concerns for the environment, religion and in industry (Bennett et al., 2013). It is a concern that it is not ethical to alter living organisms, especially for the benefits of the producers as opposed to the human race (Bennett, 2013).

Segregation of roles for this study was broken down evenly between the six group members. XX is representing a regulatory body (EFSA), XX is a plant scientist from an industrial consulting firm, XX is an insect biologist specializing in biodiversity, XX plays the role of a corn market expert, XX represents a professor of Agronomy from a local university and I am speaking on behalf of an environmental ethicist.

As the environmental ethicist, it was my role to completely analyse the effects Bt crops have on the surrounding environment and determine whether it is ethically sound to grow these crops depending on their effects. The GMO research must be honest, open, objective and must give clear access to sound science to all in order to be classed as ethical (Resnik, 2014).

What is Bt-Corn?

Bt corn is a genetically modified strain of the maize plant that has had a foreign gene added, in order to increase its resistance to pests without having to spray on chemical pesticides (Yu, Li and Wu, 2011). *Bacillus thuringiensis* (Bt) is a bacterium that naturally survives in soil. It produces proteins (Cry1Ab and Cry1F) that are effective against the larvae of selective insects including the European corn borer, corn earworm and southwest corn borer (Mendelsohn et al., 2003; Viltorov, 2011). These proteins act as a neurological toxicant towards insects acting as an effective pesticide (Viktorov, 2011). It has been claimed that Bt corn poses less of a risk to humans and to soil compared to the commercial chemicals that are usually used as pesticides (Mendelsohn et al., 2003; Velkov et al, 2005). Modern agriculture has been explained as 'inefficient and environmentally and ethically unsound, due to its reliance on agrochemicals to control pests (Robinson, 1999) replacing modern agriculture with genetic engineering is a more ethically sound option.

Case-Study in Italy

This report discusses a case-study in Italy of a group of farmers led by Giorgio Fidenato that grew Bt-resistant corn in fields in order to increase their production rates and therefore their revenue (Scienza in Rete, 2014). Unfortunately, local authorities seized their fields due to local laws forbidding 'open-field use of GMO'. The team of consultants (outlined above) discussed whether seizing the land was the justified and whether growing this strain of maize should be allowed in Italy. The growth of this particular strain of corn with Bt proteins inserted was critically analysed and discussed to determine the exact effects. This report discusses whether the farmers should receive a refund for the loss of their land, and secondly, a recommendation will be made whether to alter the current legal framework to allow growth of GMOs in the future.

Main environmental concerns

The environmental concerns associated with GM crop use include effects on biodiversity, soil, other ecosystems, and cross-contamination with other plants. Currently, intensive agriculture relies on the use of chemical aids for successful crop yield (Robinson, 1999).

These chemicals have adverse effects on the environment, including the soil and possible run-off of these chemicals into nearby water systems. The genetic engineering of Bt corn to reduce the amount of chemical pesticides needed is an example of a crop that can be much less of a burden to the environment (Viktorov, 2011).

How to test the environmental concerns of Bt crops

The European Food Safety Authority (EFSA) run test to establish the environmental effects of Bt corn and other genetically modified crops by comparing the growth of these crops to their non-transgenic counterparts (Waigmann et al., 2012). This method proved to be very effective as it directly related the effects of new transgenic strains of a crop to the non-transgenic version.

Effects on target & non-target organisms (NTOs)

This is one of the biggest concerns associated with this particular type of genetically engineered plant (Robinson, 1999; Romeis et al., 2013). This relates to possible poisoning of species that were not meant to be adversely effected by this crop and also unwanted effects to the targeted organisms. A large worry is that the target organisms can build up resistance over time to the toxic 'cry' genes (Robinson, 1999). As this is also an issue in modern agriculture it will not be considered as an issue specifically particular to transgenic plants.

Many studies have also confirmed that the toxicity of the Bt bacterium will not be passed down the food chain to predators of the corn borer and other organisms that feed on Bt corn (Romeis et al., 2013; Velkov et al, 2005). A review of the literature carried out by Velkov et al (2005) explained that the Bt endotoxin has a toxic effect only on the consumer of the corn, showing no adverse effects were seen in the predators of these insects. It was also shown that Bt bacterium does not bio-accumulate in the soil and cause effects to soil dwelling organisms (Romeis et al., 2013). In conclusion, Vachon, Laprade and Schwartz (2012) and Yu, Li and Wu (2011) both reviewed the available literature and established that problems on NTOs from Bt bacterium were generally backed up by unreliable scientific evidence, but the legitimate evidence that they reviewed showed that Bt maize has no direct effects on NTOs.

Cross contamination

It was discussed by Robinson (1999) that there is some evidence that transgenic genes can escape from their fields, but there is very low risk associated with the fertilisation of the crops with non-GM crops. He explained that it is expected that these GE crops would be "out-

competed” if they travelled to a nearby farm. Viktorov (2011) added that according to many studies, the heavy pollen emitted from the transgenic maize crops for the most part, remained in the same field (“98% of the pollen does not travel farther than 50m from the cornfield”). It is important to note that the dispersal of pollen is dependent on a variety of factors, including wind direction and local climate but these results show that there is a very slim chance of pollen proceeding to fertilise the plants in another field. The highest yield of Cry proteins exist in soil after harvesting (Viktorov, 2011) so containment of the decomposition process of the corn will control the emission of these toxins into other fields/ecosystems.

Effects on other ecosystems

Viktorov (2011) referred to the fact that these GM crops have an adverse effect on stream ecosystems. Studies in the US proved that the contamination of streams by Cry proteins reduced the overall health of the water body. The biodiversity of the ecosystem was heavily effected and this in turn caused algal bloom and a reduction on the water quality overall. This is a negative example of how Bt crops have an effect on surrounding ecosystems but it must be noted that Bt naturally occurs in soil anyway so some samples may not have been representative of the GM crops alone. This effect was not expected initially when the studies begun and it confirms that the risks of transgenic crops can sometimes be unknown and hard to foresee possible impacts prior to scientific testing (Viktorov, 2011).

Ethics of GMOs

The main risk factors associated with GM crops as a whole discusses the risk to the environment and to human health. Robinson (1999) and Bennett et al (2013) both discussed that these risks may be viable if these so-called “Frankenstein Foods” can save world hunger and provide a secure food source. In 2003, in the USA alone, six GE crops produced 2.4 million tonnes of food (Robinson 1999). The basis of much of these ethical concerns is the morality of right and wrong decisions. This directly relates to the issue of having the right to alter nature for our own benefit. Perhaps, not using advances in biotechnology is an ethical concern of its own. If the technology is capable of helping the greater good, it should be taken advantage of. One author described an argument that GE crops are “an inappropriate interference with life itself” (Bennett, 2013) but also discussed that this technology is of great benefits to humans. Another possible problem associated with GM crops is the possibility that only big corporations will benefit from advances in biotechnology, which is not ethically correct (Robinson 1999). The benefits of this technology should be shared equally. For GMO

crops to be considered ethically sound they must have clear risk assessments and the benefits must be obvious for all (Bennett, 2013).

Overview of environmental costs of Bt maize

As stated above, there are few legitimate environmental concerns that have been backed up by sound science. A positive outcome of growing Bt crops (compared to their non-transgenic counterparts), is that there is a substantial decrease in the amount of chemical pesticides being sprayed onto the land (Velkov et al, 2005). This directly beneficial to the environment and the health of the farmers alike (Yu, Li and Wu, 2011). Many studies are adamant that Bt crops have no adverse effect on the surrounding environment (Review by: Velkov et al., 2005). Robinson (1999) added that communication between the scientific community carrying out testing on GM foods and the public is crucial in order to improve the acceptance of GM foods in the EU and also in other areas. It was explained by Velkov et al (2005) that there is no current regulatory system that completely assesses the safety of GM crops. If guidelines were produced that covered all areas of the safety of crops (human consumption, biodiversity, ethics, environment and effects on non-target organisms) perhaps the public's perception of these seemingly harmless crops would change for good.

Recommendations

Currently in the EU the legislation allows for countries to make executive decisions about growing GMOs in their country (Scienza in Rete, 2014). Italy has a ban on growing GMOs in their country and this agrees with current EU law that states that member states have the freedom to decide whether to grow GM crops on their land (Loc.gov, 2014).

In 2010, Fidenato broke a regional law in the 'Letta' region that was against the cultivation of GMO crops. This law had not officially been approved by Brussels, and thus was against European legislation so was considered not valid (Scienza in Rete, 2014). Although Giorgio Fidenato broke the national law, it was not a legitimate framework. From this point, it is obvious that the authorities did not have the right to destruct the Bt corn fields in Italy as the current framework in Italy illegal. Due to this fact, it has been decided that the farmers should be reimbursed for the destruction of their land by the regional government. The environmental issues outlined above show that there is not a significant amount of clear evidence that shows that Bt corn has ill effects to the environment, so as an environmental ethicist I advise that the laws in Italy should be changed so the growth of Bt corn is allowed, under strict monitoring.

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