Recent Research in Science and Technology 2013, 5(5): 26-29
ISSN: 2076-5061
Available Online: http://recent-science.com/

Impact of GMO'S on environment and human health

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Abstract
Genetic pollution is the term of genetics in which the genetic information is transferred in to the organisms where it is not needed or where this information never existed before. Genetic pollution is a controversial[1][2] term for uncontrolled [3][4] gene flow into wild populations.This flow of genetic information is usually undesired and cannot be controlled. The flow of genetic information usually takes place between the genetically modified organisms into the organisms which are not genetically modified. Genetic modification of genome uses techniques like site directed mutagenesis, selective breeding, somaclonal variations, horizontal gene transfer (transgenesis), cisgenesis and their modifications. The causes of gene pollution may be Cross-breeding of GM crops with the wild varieties by cross pollination, consumption of GM foods and improper disposal of unsuccessful GM crops. The transfer of modified genes by wind-borne pollen might wipe out countless species of organisms. Microbiologists have come up with an important point that if genetic modification is carried out extensively, new viruses with greater potential to harm mankind may evolve anytime, and the probability of this occurring can be quite high. This form of dangerous biotechnology will only benefit largely towards the GM crop farmers in form of monetary gain. According to relevant statistics, farmers would save more than US$3.3 billion annually on herbicides, insecticides, and fungicides. So come to think of it. Is it worthwhile to become the guinea pigs just to save a few bucks, while those farmers are sitting down there counting their huge earnings without inflicting any risks on themselves? While some countries have banned GMOs or placed a moratorium on their release, others are increasing both investment levels and land area devoted to cultivating genetically modified (GM) crops. In 2006, GM crops were grown commercially by 10.3 million farmers (9.3 million resource-poor small farmers in developing countries) in 22 countries, on 102 million hectares - about 4 per cent of total arable land worldwide [5]

Keywords: GMO's; GM; transgenesis; cisgenesis; somaclonal variations.

INTRODUCTION

Genetic engineering has made it possible to make genetically modified organisms and plants. In other words new genes from another source have been inserted into the organism and as a result organism shows changes in it according to the gene's function in the body. These inserted genes are called as transgenes and scientists can take them from other sources or species to see certain changes in the organism. In some cases the genes which are already present in the organism can be taken out and desirable changes can be made in them. Scientists make all these changes just to see the different traits or characteristics of genes in an organism.

When the genetically modified organisms are allowed to breed with the organisms which are not genetically engineered, then these organisms will pollute the genetic of non-genetically engineered organisms. Due to this reason the whole ecological system will get affected. There are few possibilities if GM organisms are bred with non-GM organisms. 1) Genetically modified might lead the non-GM organisms to extinction. 2) Their genetics will change and they will not be able to show their characteristics. 3) There are chances that these organisms might develop resistance against pesticides or herbicides and it will be a nightmare for the farmers. This gene flow is undesirable according to some environmentalists and conservationists, including groups such as Greenpeace, TRAFFIC, and GeneWatch UK.[6][7][8][9][10][11]

Invasive species

Conservation biologists and conservationists have, for a number of years, used the term to describe gene flow from domestic, feral, non-native and invasive species into wild indigenous species, which they consider undesirable.[3][11][10] For example, TRAFFIC is the international wildlife trade monitoring network that works to limit trade in wild plants and animals so that it is not a threat to conservationist goals. They promote awareness of the effects of introduced invasive species that may "hybridize with native species, causing genetic pollution".[11] The Joint Nature Conservation Committee (JNCC) is the statutory adviser to the Government of United Kingdom and international nature conservation. Its work contributes to maintaining and enriching biological diversity and educating about the effects of the introduction of invasive/non-native species. In this context they have advised that invasive species:
"will alter the genetic pool (a process called genetic pollution), which is an irreversible change."[13]

Genetic engineering

In the field of agriculture, agroforestry and animal husbandry genetic pollution is being used to describe gene flows between GE species and wild relatives[12]. An early use of the term genetic pollution in this later sense appears in a wide-ranging review of the potential ecological effects of genetic engineering in The Ecologist magazine in July 1989. It was also popularized by environmentalist Jeremy Rifkin in his 1998 book The Biotech Century.[13] While intentional crossbreeding between two genetically distinct varieties is described as hybridization with the subsequent introgression of genes, Rifkin, who had played a leading role in the ethical debate for

over a decade before, used genetic pollution to describe what he considered to be problems that might occur due the unintentional process of (modernly) genetically modified organisms (GMOs) dispersing their genes into the natural environment by breeding with wild plants or animals.[12][14][15]

The usage of genetic pollution by the Food and Agriculture Organization of the United Nations (FAO) is currently defined as:
"Uncontrolled spread of genetic information (frequently referring to transgenes) into the genomes of organisms in which such genes are not present in nature."[17]

Since 2005 there has existed a GM Contamination Register, launched for GeneWatch UK and Greenpeace International that records all incidents of intentional or accidental[7] release of organisms genetically modified using modern techniques.[8]

Genetic pollution is threatening consumers' right to choose

The International Federation of Organic Agriculture Movement has made stringent efforts to keep GMOs (genetically engineered /modified organisms) out of organic production, some US organic farmers have found their corn (maize) crops, including seeds, to contain detectable levels of genetically engineered DNA.
"Those who claim ownership rights to these genes should be held liable for their uncontrolled spread in the environment and into our food," says Gunnar Rundgren, President of the International Federation of Organic Agriculture Movements (IFOAM), which unites 730 member organisations in 103 countries.

The organic movement is firm in its opposition to any use of GMOs in agriculture, and organic standards explicitly prohibit their use. The farmers, whose seed is contaminated, have been under rigid organic certification, which assures that they did not use any kind of genetically modified materials on their farms. Any trace of GMOs must have come from outside their production areas. While the exact origin is unclear at this time, it is most likely that the pollution has been caused by pollen drift from GMO-fields in surrounding areas. However, the contamination may have also come from the seed supply. Seed producers, who intended to supply GMO-free seed, have also been confronted with genetic pollution and cannot guarantee that their seed is 100% GMO-free.
"This is more evidence that GMOs are polluting the environment in a way that is outside the control of society or the companies that have released these GMOs, and we are outraged. Organic products remain the best option for consumers who wish to avoid GMO-food and resist their use in agriculture. Organic farmers and independent certification agencies will take all reasonable measures to prevent contamination.

Impact of gene pollution

For instance, the Bt corn produces wind-borne pollen (able to be spread 1km from farms) that kills the caterpillars of the Monarch butterfly. When the life cycles of this butterfly are disrupted, the beautiful Monarch butterflies can only be found in our memory and photographs.

Gardening job will be tougher as the weeds acquire the modified genes to become super competitive weeds that rampage through the countryside and destroy other life forms in the process. Would you want your beautiful garden to turn into a mess of green weeds that you can never get rid of?

The risk of the evolution of common plant viruses to become more resistant or form new strains will be greatly increased. Microbiologists have come up with an important point that if genetic modification is carried out extensively, new viruses with greater potential to harm mankind may evolve anytime, and the probability of this occurring can be quite high. A research paper commissioned by the British government supports this point. It concludes that crops genetically altered to be resistant to common plant viruses cold risk creating mutant strains that could wipe out the entire forms.

The resurgence of the pests from primary pest outbreak to a more destructive secondary outbreak may occur. After a pest has been virtually eliminated by any means, the pest population not only recovers, but also explodes to higher and more severe levels. This phenomenon is known as resurgence. To make matters worse, small populations of pests that used to be of no concern due to their significant numbers may suddenly rocket, creating new problems. This phenomenon is known as secondary pest outbreak. Do you think it is safer and more logical to sacrifice a small portion of your crops in exchange for the insurance that you can enjoy the destruction of all your available crops?

Abnormalities, mutation, and extinction of species may become widespread and cause a biological havoc that either takes ages to return back to equilibrium or enters a stage of no return. Genes produces proteins in the cells that they are programmed to work in, but when transferred into another system, the proteins may act differently, thus resulting in the outbreak of allergies and the disasters mentioned above. This will be a great blow to Gaia, as the harmony that the Earth's closely-linked ecosystems that have settled down to will vanish, leaving the Earth's inhabitants to reorganize themselves to build up the balanced structures. And this might take a few centuries, or even forever.

Evaluating human health risk

At least some of the genes used in GMOs may not have been used in the food supply before, so GM foods may pose a potential risk for human health. Much of the GM production currently grown worldwide is destined for animal feed. According to the UK's Food Standards Agency, food from animals fed on these crops is as safe as food from animals fed on non-GM crops[16]. The FAO has also concluded that risks to human and animal health from the use of GM crops and enzymes derived from GM microorganisms as animal feed are negligible[17]. Scientists also acknowledge that little is known about the long-term safety of consuming food made from GM products. WHO recognizes the need for continued safety assessments on genetically modified foods before they are marketed to prevent risks to human health[18] and for continued monitoring. The main potential risks to human health are discussed below.

Allergenicity

The potential of GM crops to be allergenic is one of the main suspected adverse health effects, due in part to research by Hi-Bred in the mid-1990s. They discovered that soy bean plants engineered with a gene from Brazil nuts produced beans that caused an allergic reaction in some people.

Toxicity

Another of the risks that opponents of GMOs cite is the potential for GM changes to result in changes that are toxic to

humans and animals. One of the most recent GM crops to be suspected of causing toxicity is the GM maize line known as MON 863 (YieldGard Rootworm Corn), which received approval in the US in 2003 and specifically targets the corn rootworm. MON 863 contains less Bt toxin than most Bt maize varieties, producing the toxin primarily in the roots, which is the site of entry for the western corn rootworm[19]. There is also a possibility that if foreign gene integrate into human DNA, they could switch on random genes inside of humans, leading to an overproduction of a toxin, allergen or carcinogen[20].

Antibiotic resistance

In order to increase the success rate of genetic modification, scientists have used a technique involving antibiotic resistance genes in addition to the desired gene to identify which plants have successfully absorbed the introduced gene. The antibiotic kanamycin is a frequently-used marker for plant modification yet is still used for treating many human infections[21]. As the genes have traditionally come from bacteria, human pathogens could increase their antibiotic resistance. Related to these concerns, the UK's Food Standards Agency (FSA) conducted a series of research projects to investigate the transfer and survival of DNA in the bacteria of the human gut. They concluded that it is extremely unlikely that genes from GM food can end up in bacteria in the gut of people who eat them[22]. The British Medical Association, for example, opposes the use of antibiotic resistance markers in food. The risk is considered serious enough to encourage scientists to adopt techniques to remove the marker genes before a crop plant is developed for commercial use[23]. Scientists have also recently developed an alternative marker derived from tobacco rather than bacteria[24].

CONCLUSIONS

Not all GM plants are equal in terms of their potential environmental impacts. The complexity of ecological systems presents considerable challenges for experiments to assess the risks and benefits and inevitable uncertainties of GM plants. Collectively, existing studies emphasize that these can vary spatially, temporally, and according to the trait and cultivar modified[25]. Objectively assessing such risks is extremely difficult, because both natural and human-modified systems are highly complex, and fraught with uncertainties that may not be clarified until long after an experimental introduction has been concluded. The FAO Expert Consultation carried out in 2003 concluded that the cultivation of GM crops, with their potential benefits and hazards to the environment, should be considered within broader ecosystems. Environmental risks and benefits depend on a) the specific GM constructs and the crop into which it is introduced; b) the geographical location of the crops; and c) the period or timescale of its cultivation[26]. Conventional breeding of crops and animals appears as likely as genetic engineering to create new plant varieties that might lead to the development of super weeds. Given the significant parallels between GMOs and other invasive species, greater efforts are required to address IAS, in the same way that concerns about GMOs are being addressed. This should be resolved based on good agricultural management, regardless of whether the herbicide-resistant crops are genetically modified or are traditionally bred. The risks for the introduction of a GMO into each new ecosystem need to be examined on a case-by-case basis, alongside appropriate risk management measures, such as through the precautionary approach in the Cartagena Protocol and the IPPC's Pest Risk Assessment (PRA).

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