IMPACTS OF GENE POLLUTION DUE TO TRANSGENIC ORGANISMS

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Abstract: The environmental integrity and biodiversity of the world's food supply is very important to our survival. Genetic engineering and hybridization techniques facilitate scientists to produce plants, animals and micro-organisms by manipulating genes in a way that does not occur naturally. But both public and few scientists believe that these genetically modified organisms (GMOs) can spread through nature and interbreed with natural organisms, thereby contaminating natural environments and future generations in an uncontrollable way.

Some conservation biologists and conservationists consider this technique is undesirable as it may hybridize with native species and cause genetic pollution. They also expressed that the introduction of genetically engineered organisms (GMOs) into complex ecosystems may bring about adverse effects which are unable to control. The gene pollution is a recent and controversial term. It is linked with the gene flow from genetically modified organisms (GMOs) to a native or non GMO organism. The transgenic organisms or GMOs are capable to interact with other native forms of life and can transfer or mutate their characteristics by reproduction which may cause serious ecological harm.

The GMO supporters claim that genetically engineered crops use fewer pesticides than non-GMO crops, but in reality GMO crops require even more chemicals. This is duo to that weeds become more resistant to pesticides leading farmers to spray more on their crops. This contaminates the environment, exposes food to higher levels of toxins, and creates greater safety concerns for farmers and farm workers. However, adequate research has not yet been carried out to identify the effects on animals and human that have been feed grain of GMOs, nor have sufficient studies are also lacking to see the effects of directly consuming GM crops like corn and soy. Even so, despite our lack of knowledge, GMO crops are extensively used throughout the world as food for both human and animal. Therefore, in this research review article we provide a review of growing knowledge in health and environmental impacts of gene pollution which may provide a view on the lessons learned from the frequent negligence or twisting of dangers. We collected the information from, reviews, books, blogs, social media and various websites. Our research found that gene flow is common and natural phenomenon. It was even present in the past hybridization and interbreeding techniques. Here also few cases were reported a possible link between GMOs and gene flow with negligible percentage. However, we suggest that the regulatory authorities should check the transgenic crops prior to release into the market. The outcomes and conclusions of this research may help to improve the understanding of already acknowledged or suggested statements related with gene pollution and its possible link with transgenic crops.

Keywords: Biodiversity, Environmental concerns, GMOs, Gene pollution,

Introduction: The term gene pollution was coined by Rifkin, which means the unintentional or accidental process of genetically modified organisms (GMOs) dispersing their genes into the natural environment by breeding with wild plants or animals [1]. The Food and Agricultural organization of US (FAO) describes it as the 'Uncontrolled spread of genetic information into the genomes of organisms in which such genes are not present in nature [2].However, Patrick Moore a famous environmentalist and an ex-member and cofounder of Greenpeace, feels that the term genetic pollution is more political than scientific and it is arouse emotional feelings towards the subject matter [3]. Since 2005, Green watch of UK and Green peace maintained a register named as GM contamination Register in which they included all the incidents of genetic pollution due to genetic engineering whether accidental or intentional [4]. The advanced tools in agriculture like uncontrolled hybridization, introgression and genetic engineering cause gene pollution. These processes can lead to replacement of local genotypes or homogenization as a result of either a numerical and/or fitness advantage of

introduced plant or animal [5]. Genetic contamination is a multifaceted destruction which is irreparable in nature. It also causes a fundamental loss to farmers and consumers of their right to sow and source the crop of their choice. It is also an environmental damage which causes the genetic pollution of our biodiversity, impacts to our native ecosystems that are also beyond repair [2].Genes can be transferred from one species into others by genetic engineering. Such organisms are known as transgenic organisms or genetically modified organisms (GMOs). The controversy about genetically modified (GMOs) organisms can seem like a discouraging task. Many members of the public and conservation biologists are raising questions and concerns in various conferences and workshops about GM crops to the human health or the environment. Therefore the subject of GMOs is a controversial and debatable feature. This technology has many advantages like higher yield, reduced use of pesticides and manpower, improved food quality and high nutritive value. But it has few worrisome issues like allergy, biodiversity and appearance of new disease as viruses and bacteria are employed in this technology [6].

Methodology: This research review paper is based on information from the fact sheets from USDA [7], green peace [3], and Monsanto [8] literature bases. Information was also obtained from blogs, web sites and articles addressing the gene flow and gene pollution which can be found in the Appendices of the working document. Additionally, many press reports have been reviewed on a regular basis.

Results: A 10 year long term study of M. J. Crawley et al (2001) on four varieties of crops found that none of the genetically engineered plants were found to be more invasive or more persistent than their natural plants [9]. Another disputed study of Quist and Chapela (2001) claimed an example of genetic pollution of transgenes from Genetically Engineered maize in farmland in Oaxaca, Mexico [10]. However their report has been dishonored on methodological grounds [11], [12]. More recent efforts to replicate the original studies have concluded that genetically modified corn is absent from southern Mexico in 2003 and 2004 [13]. One more study in 2009 verified the original findings of the controversial 2001 study in which transgenes were found in about 1% of 2000 samples of wild maize in Oaxaca, Mexico, was proved to be wrong. As a result the journal 'Nature' withdrawn the 2001 initial study. The study also explained why a previous study failed [14]. A different study from L. Watrud *et al.* 2004, near an Oregon field trial for a genetically modified variety of creeping bent grass (*Agrostis stolonifera*) revealed that the transgene and its associate trait (resistance to the glyphosate herbicide) could be transmitted by wind pollination to resident plants of different *Agrostis* species, up to 14 km from the test field[15]. A new clear example of genetic pollution is the genetically modified, herbicide resistant creeping bent grass produced by the Scotts Company. In 2004, this species was seen to be easily transmitted over long distances by wind pollination and breed with naturally occurring species of bent grass. For this USDA imposed a civil penalty of $500,000. The USDA alleged that Scotts "failed to conduct a 2003 Oregon field trial in a manner which ensured that neither glyphosate-tolerant creeping bent grass nor its offspring would persist in the environment [7].

Discussion: The transfer of unwanted genes from crops into the environment may create more of a management dilemma than unwanted chemicals. For example a single molecule of DDT remains a single molecule ordegrades,but a single crop genehas the opportunity to proliferate itself repeatedly through the process of reproduction.It is clear from the above results that gene flow occurred in some species between transgenic crops with its native varieties. However the amount of flow was negligible. Gene flow is natural, common but a slow phenomenon. Gene flow was also was observed in human race between a white European population and a black West African population, which were recently brought together [16]. The possibility of gene flow from traditional crops to their native species with unwanted consequences was separately recognized by several scientists even in the past [17], [18] [19]. In the early 1990s, the general view was that hybridization between crops and their wild relatives occurred infrequently,even when they were growing in close relationship. This view was supported by the belief that the separate evolutionary path ways of domesticated crops

and their wild relatives would lead to increased reproductive isolation. The results of earlier hybridization experiments raised a new question in our mind is that "If gene flow from transgenic crops to their wild relatives was a problem, wouldn't it already have occurred in traditional systems?" We have gone thorough voluminous literature review to find out the consequences of natural hybridization between the world's most important crops and their wild relatives and found that hybridization with natural relatives has been occupied in the evolution of more aggressive weeds for seven of the world's 13Ýmost important crops [20]. It is prominent that hybridization between sea beet (Beta vulgaris subsp.maritima) and sugar beet (B.Ývulgaris subsp. vulgaris) has resulted in a new weed that has devastated Europe's sugar production [21]. Reports are also available in which hybridization between a crop and its wild relatives has increased the extinction risk for the natural species [22], [23]. So far a couple nof recent experiences suggest that crop-to crop gene flow may result in greater risks than crop-to-wild gene flow. The first is a report of triple herbicide resistance in canola in Alberta, Canada (MacArthur, 2000). Volunteer canola plants were found to be resistant to the herbicides Roundup (Monsanto, St. Louis), Liberty (Aventis, Crop Science, Research Triangle Park, NC), and Pursuit (BASF, Research Triangle Park, NC). It is clear that two different hybridization events were necessary to account for these genotypes. It is interesting that the alleles for resistance to Roundup and Liberty are transgene, but the allele for Pursuit resistance is the result of mutation breeding. Although these volunteers can be managed with other herbicides, this report is significant because it illustrates that gene flow into wild plants is not the only opportunity for the evolution of plants that are increasingly difficult to manage.

In a report of the Star link Cry9C allele (the one creating the fuss in Taco Bell's taco shells) appearing in a variety of supposedly non engineered corn [24]. It is clear that gene flow was present in the past from crops to natural relatives and is not latest. Hence this problem cannot be linked to only transgenic crops. Because transgenic crops not different from traditionally improved crops. It is clear from the above outcomes that the chance of problems due to gene flow from any individual grower is exceptionally low. The problem of gene flow in transgenic crops will depend on their phenol types. It is generally found that the majority of the "first generation" (F_1) transgenic crops have phenotypes that are suitable to give a weed a strength for herbicide resistance or pest resistance. Even though a strength boost in itself may not lead to increased weediness,

GM crops with such phenotypes should be aware that those phenotypes might have unwanted effects in natural populations. It is now clear that scientists who are producing and releasing new crops whether transgenic or hybridization have the possibility of negligible gene flow. So, it is the scientist to make choices about how to create the best possible products that will be beneficial for the mankind. Even if accidental mixing of seeds during transport or storage may explain the contamination of the traditional variety, inter-varietal crossing between seed production fields could be just as expected. This news is significant because it illustrates how easy it is to lose track of transgenes. There are plenty of opportunities for transgenes to move from variety to variety. Hence proper checking is required. Hence, the field release of "third generation" transgenic crops may pose special challenges for control. The products of plant improvement techniques like hybridization or by genetic engineering are not absolutely safe. Acknowledgment of that fact suggests that creating something just because we are now able to do so is an inadequate reason for embracing a new technology. If we have advanced technology for creating new farming products, we should also use the superior knowledge from ecology and population genetics and humanities to make careful choices about to how to create the products that are best for humans and our environment.

Conclusions: Some amount of gene flow also occurs naturally in the course of normal evolution. Mandatory contamination prevention measures must be put in place to mitigate gene flow from commercial GE crops. Preventing contamination should be the primary goal of the USDA.Biological diversity must be protected and respected as the global heritage of humankind, and one of our world's fundamental keys to survival. Governments are attempting to address

the threat of Genetic Engineering with international regulations such as the Biosafety Protocol. EU regulators like U.S. Department of Agriculture's (USDA), Animal and Plant Health Inspection Service (APHIS) and Draft Environmental Impact Statement (DEIS) are considering setting an "allowable limit" for genetic contamination of non-GE foods, because they don't believe genetic pollution can be controlled. Because they are alive, gene-altered crops are inherently more unpredictable than chemical pollutants.

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