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My name is David Schubert. I have a PhD in Immunology and am a professor at the Salk Institute for Biological Studies in San Diego, California. The Salk Institute is considered one of the best medical research institutes in the world. As a faculty member at the Salk Institute I work on the development of drugs for Alzheimer's disease and stroke. I therefore have first hand knowledge of molecular genetics as well as toxicology and safety testing of new biological and chemical entities. I am knowledgeable about GM technology and have published numerous manuscripts in leading scientific journals on GM plants and human health. Recently I have written letters similar to this one that have contributed to the debate on the introduction of GM eggplant into India and Bangladesh. In both cases the introduction was stopped. Since eggplant is native to these areas just as maize is native to Mexico, the situations and problems are almost identical. I therefore believe that it is imperative that Mexico follows the advice of the scientific and government review panels in India, Bangladesh, the European Union, Japan, South Korea, and the vast majority of free world countries and reject the introduction of GM maize. There are multiple reasons for this conclusion, outlined below. Points 1-5 are exceptionally important, but have been addressed by others; I will focus only upon the impact of GM maize on human health, which is within my area of expertise.

1) The lack of need. Maize is not a crop threatened by an overwhelming insect infestation.

2) Environmental risk. Maize is native to Mexico and the GM genes would unquestionably contaminate and degrade the native populations. Mexico is the center of maize diversity and a world treasure of varieties to combat disease and climate change. This will be eliminated with the introduction of GM seed. All these claims have been scientifically proven.

3) Higher costs. The purchase of seeds on an annual basis as opposed to saving seed from year to year would increase costs at all levels of the food chain. The most important small-holder farming systems of Mexico will be the most impacted from the expected higher seed prices and potential crop failures due to the fact that the introduced GM maize varieties will not be suited for all locations. The introduced GM traits will eventually contaminate all local varieties.

4) Social and political dependence. Once a foreign company controls the seed market of any single food plant, seed for more GM plants will follow, and the company would have tremendous power over both the farmers, which constitute a major segment of the Mexican population, as well as the political process. This has clearly happened in the United States, where Monsanto is a major financial supporter of both political parties, and therefore has political appointees who dictate both national and international agricultural policy.

5) Nonreversible. Once GM maize is introduced, even on a modest scale, it will irreversibly contaminate all native varieties. This is an unambiguous fact and the only way to prevent it from happening is to not allow the planting of GM maize.

6) Because GM maize expressing Bt protein and herbicide resistance and the chemicals required for their cultivation pose a serious health hazard to those who consume it, I wish to address these issues in more detail. This is outmost important in a country like Mexico where maize is consumed in large quantities and with little or no processing. First, however, I would like to debunk some myths that are used by the proponents of GM maize to claim that it is safe.

Bt maize is grown in the US and it is claimed that because there has been no documented Bt maize-associated human disease, it is therefore safe to eat. This conclusion is invalid for several reasons. First, only a tiny fraction of the Bt maize produced in the US is eaten directly. The vast majority is used as animal feed and to make oil, high fructose syrup, and ethanol, none of which would contain the Bt protein. The maize containing the Bt protein that is consumed is largely in the form of highly processed corn chips and related snack foods that are not major components of the diet. In contrast the Bt protein in Mexican maize will be directly consumed in large quantities because maize is the staple food and hence a major component of the diet in Mexico. In addition, it would be prepared in an infinite number of ways, leading to potential chemical changes in the protein causing unknown toxicity and immunogenicity. Even if some feeding studies to conduct safety were done with GM maize, many other cooking methods would remain untested.

Second, it is logically false to claim that because there is no evidence of illness following the introduction of a GM product, therefore the product is safe to eat. This would require a well-designed experiment with proper controls, that may not be performed because GMO containing food is not labeled. In fact, perhaps the major concern with the introduction of any GM food should be that even if it did cause an illness, it would not be detected because of the lack of epidemiological studies and the technical limitations for detecting such an illness. For example, to detect an epidemic of a disease, an incidence of at least two-fold above the background rate of the disease is required. Therefore, if GM maize were to cause a disease, for example, like Parkinson's which has an incidence of about 20 new cases per year per 100,000 people, then in Mexico 25,000 new cases per year would have to be diagnosed and tabulated in order to identify a significant increase, and there would still be no way to associate the disease directly with the consumption of a GM crop. In addition, many environmentally caused diseases take decades of exposure to develop symptoms.

Clearly, once GM maize is commercially released, there will be no way to monitor adverse health effects caused by the product and hold the producer accountable. The companies are well aware that for this reason they will never be held accountable for the damage to human health their product may cause. The majority of the GM maize strains are engineered for both insect (Bt) and herbicide (glyphosate) resistance. Both the Bt protein and the glyphosate have documented risks to human health and will be discussed separately, starting with Bt protein.

Bt Maize and Human Health

The US Environmental Protection Agency (EPA) recommended extensive safety testing of Bt crops [1], but owing to the lack of federal laws requiring safety testing for any GM food crops in the US, this was never done [2]. The US does not require the demonstration that any GM food is safe for human consumption.

There are at least four mechanisms by which the introduction of the Bt toxin gene into the maize genome can cause harm. These include (1) the random insertion of the GM genes into the plant DNA and the resulting unintended consequences [3], (2) alterations in crop metabolism by the inserted protein that results in new, equally unintended and potentially toxic products, (3) the direct toxicity of the Bt protein, and (4) an immune

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response elicited by the Bt protein. There are scientifically documented examples of all four toxic mechanisms in GM crops.

An example of the first is the discovery of unintended alterations in the synthesis of nine known carcinogens caused by the GE modification of tobacco [4]. An example of the second is the abnormally high levels of the fiber molecule lignin produced in Bt maize [5]. This trait was discovered because of dramatic changes in the stiffness of the corn stalk. Since multiple strains of Bt maize have this trait, it is most likely that increased lignin production is caused by the expression of the Bt protein itself, not due to mutations caused by the GE process itself [2]. It is very likely that there are many other unintentional changes in GM crops, and more have recently been documented [6].

The final points, toxicity and immunological hazards of the Bt protein are discussed in more detail below. It should be emphasized that all of this material has been published in peer-reviewed journals and reproduced in more than one laboratory therefore ruling out the possibility of an individual investigator's bias.

Allergies are complex responses of the immune system to foreign substances and vary widely among individuals in an unpredictable manner. Bt toxins have long been used as insecticidal sprays on a variety of crops, but the spray can be washed off of the plant and uses a less toxic form of the protein than that made by GE plants, in which the Bt toxin is inside all parts and therefore will be eaten. The spray consists of spores of the Bt toxin that must be activated in the gut of the insect. In contrast, Bt toxin in maize is a highly activated form of the Bt protein that does not require modification in the insect gut to become toxic. It is therefore much more potent than that used in sprays. There is solid evidence that the Bt proteins elicit a strong immune response in some workers [7], probably because Bt proteins have amino acid sequence homology with known allergens [8], [9]. Most importantly, it should be emphasized that the concentration and amount of active Bt toxin protein that people would eat in Bt maize are many times higher than the exposure levels of farm workers.

In support of the human data, when animals are exposed to Bt toxins, the toxin also acts as a potent immunogen, eliciting responses from both the blood and gut-based immune systems [10], [11], [12]. More recently, a longer-term feeding study was conducted on commercially farmed pigs in the USA. Pigs have a similar digestive system to humans and commercially farmed pigs are subject to more diseases than laboratory animals. Pigs were fed a mixed diet that contained Bt proteins from maize. After 5 months, GM-fed pigs were found to have markedly higher levels of severe stomach inflammation and female pigs had higher uterus weights [13].

Additional animal studies have shown that Bt toxins directly cause tissue damage. For example, Fares and El-Sayed demonstrated that feeding mice Bt potatoes caused the appearance of structurally abnormal cells in the gut [14]. Other studies reported histopathological changes in the kidney and liver of rats fed Bt maize [15], and changes in urea and protein levels in the urine of rats fed Bt rice [16].

The above citations clearly show that the family of Bt proteins can act as both allergens and toxins in animals and some humans. Most importantly for the health of the Mexican population, if the introduction of Bt maize is allowed, an enormous number of individuals are going to consume amounts of Bt toxin that are thousands of times higher than anytime previously in the short history of this GM technology. This population is extremely heterogeneous in genetic makeup, age, and also with respect to underlying health. It is the genetics and health status of the individual that determines his or her response to foreign proteins such as Bt toxin. Less healthy individuals are much more prone to negative toxic and immune reactions. Since the ability of Bt toxin to cause an allergic response in some individuals is unambiguous, it is virtually certain that within the vast Mexican population, a large number of people eating Bt maize will become allergic to this foreign protein. This number cannot be predicted and some of the immune responses would likely be severe, causing anaphylaxis and possibly fatalities. Since there is no system for tracking these adverse reactions within any population, if Bt maize is commercially grown, its genetic presence within a major calorie source for the Mexican population would be irreversible. Therefore, its introduction must be prevented.

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Roundup and Other Herbicides

In addition to the high levels of Bt toxins, most GM maize also is engineered to be herbicide resistant. While a number of herbicides are in use, the best studied is glyphosate, the active ingredient in Roundup and related products. If GM maize and/or soy is introduced in Mexico, there will be an enormous increase in the use of this pesticide in Mexico, since its use increased ten fold between 1996 (27 million pounds) and 2009 (250 million pounds) in US agriculture following the introduction of GM crops [17]. Similar increases in use occurred in Argentina [18]. Most importantly, contrary to claims by its producers, glyphosate and its active formulation is harmful to human health. As with many environmental toxins, it has taken years to identify the problems, but they are currently entering the public domain in the form of scientific publications at a high rate. Some major human health risks are outlined below along with some facts that are rarely discussed.

1) Glyphosate (GP) spray is not just GP but a mixture with compounds that help GP get into all plant tissues, including those we eat. The additional compounds, called surfactants, are not publically disclosed (they are trade secrets) and are not listed or tested for safety, nor are they monitored in plants, drinking water, or humans, even though they are more abundant in the herbicide formulation than GP. These are completely untested chemicals whose human and livestock consumption will dramatically increase with the introduction of GM maize [19]. In the US, the EPA does not assay GP in drinking or ground water, and it repeatedly requests and receives approval to increase residue limits in food.
2) The herbicide spray and all of its components stay inside plants and are eaten. They are not washed off!
3) Within 10-15 years weeds will become resistant to GP, so that even more toxic herbicides will be required for GM maize production. The next in line is 2,4,D, a known carcinogen[20, 21].
4) GP is found in the urine of a large fraction of the population in some areas [22].
5) Part of the increase in GP levels in drinking water, food and animal feed is due to the fact that it is now being used as a drying agent where it is sprayed on the plants directly before harvest [23].
6) Some of the published toxicities of GP are listed below, and all can or have been extrapolated to a serious risk to human health.
    a. When consumed as food or in water GP kills beneficial gut bacteria, and dramatically shifts the flora to less friendly microbes [24].
    b. In further support of the evidence for GP affecting the gut, when GP-treated GM feed was fed to pigs for 9 mo, there was a large increase in stomach inflammation relative to non-GM feed [25].
    c. When herbicide resistant, GP-treated maize was fed to rats for their 2-year life time, there was a huge increase in tumor formation [26].
    d. There has been a recently documented increase in human disease in Argentina directly linked to GP exposure [18].
    e. Low levels of GP cause developmental defects in amphibians and chickens of the same kind observed in humans in the Argentina study [18] [27] [28].
    f. GP has profound effects on testosterone production in rats [29] and promotes the growth of human cancer cells at GP levels well below those found in blood and urine of some individuals [30].

The above citations are only a few of the large number of papers that together clearly demonstrate both identified and projected effects of glyphosate on human health. GP levels will rapidly increase in food and the environment with the introduction of GM maize, and within ten to fifteen years GP will be useless because weeds will become herbicide resistant as has occurred throughout the world. Is this health risk worth it to Mexico?

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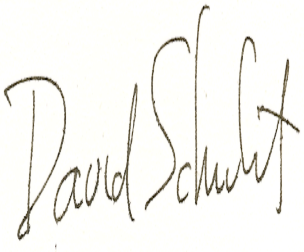
My conclusion is that GM maize will l but would present an enormous hazard to the health of the Mexican population. It w ice to Mexico if GM maize were allowed to enter her food supply.

Respectfully,



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