Biosafety of transgenic plants released for human consumption- Dr. William H.L. Stafford

Humans have been modifying their food sources for thousands of years, selecting for favourable characteristics. These breeding techniques rely on fertilization by cross-pollination *of the same species*. Biotechnology has provided us with the tools to engineer a plant with any chosen characteristic. *Species barriers can be crossed*- we can take a gene from one organism and place it in another unrelated organism to create genetically modified (GM) organisms. The production, marketing and consumption of GM foods are highly controversial. Several countries have placed bans on GM foods or label GM foods so that the consumer can decide. South Africa has already planted over 350 000 hectares of GM crops (maize, soya, cotton) and imports large amounts for processing in human and animal foods without labeling, monitoring or long-term experiments to determine risks on the environment or human health.

GM crops have failed to deliver promised benefits. Unknown benefits of adopting GM crops in a South African context

Independent research and on-farm surveys since 1999 have shown that GM crops have failed to consistently deliver the promised benefits of significantly increasing yields or reducing herbicide or pesticide use. For example, USDA data show that Bt maize did not reduce insecticide use. Furthermore, Bt cotton crops in India (Madya Pradesh) or South Africa (Makhatini flats) have not been successful.

South Africa is unique from its social, economic, and climatic perspectives and has exceptionally high plant diversity. Therefore, the impact of adopting a new agricultural technology in South Africa is likely to be unique and research and trials conducted elsewhere are not automatically applicable. Additionally, the real benefits of GM crops should be assessed by comparison to other methods of agriculture such as integrated pest management, agroecology, sustainable agriculture, permaculture and organic farming. Many of these methods contribute to agricultural and environmental biodiversity, food and livelihood security, efficient production, environmental sustainability and rural development.

Lack of independent scientific evaluation and suppression of scientific evidence. A history of misrepresentation and avoidance of liability.

There are very few independent scientific studies dedicated to the safety of GM crops on human health or the environment. Most of the studies have been carried out by the same Agrochemical companies that market the GM crops. These studies cannot be considered unbiased and are often unavailable to the public to independently asses. Biowatch (www.biowatch.co.za) have recently spent two years and great expense obtaining information for field release of GM crops in South Africa which the public is legally entitled to. Furthermore, the Agrochemical companies (who have developed this technology, assure us it is safe, and stand to make profits from it) have largely avoided liability. Presently, in South Africa the liability for any harms to the environment or health rests on the farmer or consumer themselves!

Extensive contamination of natural crop varieties and loss of diversity

Pollen flow and cross-breeding may occur over large distances (kilometers for crops such as maize and canola). Transport, storage and processing of seeds and crops are also routes for contamination. Contamination has occurred in maize varieties growing in remote regions in Mexico despite a ban on planting GM maize. High levels of contamination have been found in Canadian certified GM-free canola seed stocks. There is a great concern of losing the diversity of crops that have been bred by conventional means by both farmers and plant breeders. Conventional breeding has been carried out for hundreds or thousands of years and the seed diversity forms part of the indigenous knowledge systems and unique seed banks. This seed diversity is vital insurance against outbreaks of crop diseases, and improves the long-term resilience to adverse conditions or shocks. For example, the selection and saving of maize seed allowed a diverse seed bank that was largely responsible for saving maize production in tropical Africa from destruction after unintentional introduction of the fungal disease, tropical rust.

Loss of food security and reliance on Agrochemical inputs

GM crops are covered by patent and the seed remains the property of the Agrochemical company so farmers must re-purchase seed every year. Many farmers who have saved their GM seeds have suffered lawsuits from Agrochemical companies. Furthermore, the aggressive take-over and

marketing by USA based multinationals has resulted in the purchasing of many seed companies world-wide. These multinationals want a world where all crops are GM- "full adoption of GM crops globally will result in income gains of US$200 million per year within the next decade with the largest potential gains coming from developing countries" (Monsanto report). This indicates their desire for control of the world's food-supply.

GM crops are unnatural and have not been proven safe.
We have never eaten these new genes and gene products and they have never been part of our food chain. They can only be engineered in the laboratory and are unlike what nature has produced in the course of thousands of years of evolution. This introduces new risks to the environment and health: - GM foods should be tested as thoroughly as any engineered product (e.g. pharmaceutical medicines). However, the Food and Drug Administration (FDA) in the USA decided in 1992 that GM crops were just an extension of conventionally bred crops so these risk assessments were unnecessary.

Direct risks to the environment and health
About 70% of all GM crops currently grown worldwide are engineered to be tolerant to broad-spectrum herbicides manufactured by the same companies that hold patents on these GM crops. These broad-spectrum herbicides not only kill plants indiscriminately, but are also harmful to practically all other species. A common herbicide, Glufosinate ammonium, is linked to neurological, respiratory, gastrointestinal and haematological toxicities in humans and mammals, is toxic to and a number of beneficial insects such as butterflies and can inhibit beneficial soil bacteria that fix nitrogen.
About 25% of all GM crops currently grown worldwide contain insecticidal toxins, such as the Bt toxin from the bacteria *Bacillus thuringiens* in order to protect the plant against Lepidopteran insect pests. Bt was found be harmful to mice, butterflies and lacewings up the food chain. Bt plants exude the toxin through the roots into the soil where it may remain for up to 234 days, with potentially large impacts on soil ecology and fertility. Bt toxins may be allergens for human beings since Philippine farmers exposed to Bt experienced mild to moderate allergic reactions.

Rapid Insecticide and Herbicide Resistance.
The development of rapid resistance is expected since the insecticide gene or herbicide resistance gene is expressed throughout the GM plants growth. This effectively means that the insecticide is continuously been applied and not only when necessary. Triple herbicide-tolerant oilseed rape (canola) plants have emerged in Canada and the USA, and Agrochemical companies now recommend the planting of refugia to help prevent the spread of this resistance.

Indirect effects on the environment and health
Despite its importance for safety assessment, applications submitted requesting permission to commercialise a transgenic line provide neither the sequence of the genomic DNA flanking the inserted transgene nor a comparison with the original genome so it is unknown how many genetic changes are present. In addition to the gene for herbicide resistance or pesticide resistance (desired trait), the GMO food crops on the market include additional pieces of DNA - a **selectable marker gene** and a **viral promoter**. This poses health and environmental risks in the spread of antibiotic resistance and the activation or creation of new viruses. The risk that antibiotic resistance marker genes will spread to human intestinal bacteria and soil bacteria resulting in the spread of antibiotic resistance amongst disease-causing bacteria is considerable. Nearly every scientific-based organization has expressed its concern and the E.U. has decided to prohibit or phase out GMOs with antibiotic resistance genes after the 31st December 2004 (directive 2001/18EC and 90/220/CEE).

Many members of the scientific community have raised their concerns. For example, members of the Independent Science Panel on GM (a group of more than 600 scientists from 72 countries www.i-sis.org.uk/) signed an 'Open Letter from World Scientists to All Governments', calling for a moratorium on the environmental release of genetically modified organisms (GMs), a ban on patents on living processes, organisms, seeds, cell lines and genes, and a comprehensive public enquiry into the future of agriculture and food security.