Earthworms appear to be particularly vulnerable to the toxic effects of Bt insecticide.

It has also been found that Bt toxin is released in root exudates.

Are there benefits or disadvantages for farmers growing GE crops?

US farmers who bought into GE technology were promised higher yields and reduced pesticide use.

After extensive analysis of the economic performance of GE crops in America, the US Department of Agriculture concluded in May 2002 that it is difficult to explain the rapid adoption of GE crops when farm financial impacts appear to be mixed or even negative.

A rigorous comparative study of soybean crops showed that yields of glyphosate (Roundup) resistant GE-cultivars are suppressed 5-10 percent relative to their non-GE counterparts.

The primary beneficiaries of GE herbicide-resistant soybean and Bt corn are the companies that supply the seed and the chemicals. Farmers growing GE crops:

- pay biotech developers a technology fee when planting GE seed,
- agree not to save seed for the next season's planting and
- agree to allow crops to be inspected.

Farmers have been sued for unknowingly growing GE crop plants without paying a technology fee.

Insurance companies have stated they will not insure against damage or contamination from GE crops.

Bio-security and genetic engineering

GE contamination of honey and corn crackers has resulted in their recall from some markets, notably Asian and European. Kernels of GE corn have been detected in batches of seed imported into New Zealand, requiring destruction of the entire harvest from that batch.

Careful border surveillance is required to maintain the local harvest in a state acceptable to trading partners.

How will GE affect consumers?

GE experiments are taking place with:

- commercial crops such as wheat, rice,
- grass, trees, fish, poultry and animals,
- foods, food additives and enzymes,
- dietary supplement production,
- medicines, such as pharmaceutical production,
- plants to produce drugs and vaccines,
- crops to produce chemical compounds
- used in the laboratory,
- in science, with analytical applications.

The vast majority of transgenic crops are engineered to make them resistant to herbicides like Roundup or to contain an insecticide derived from the soil bacterium, Bacillus thuringiensis.

Before food derived from RoundupReady crops was approved for sale in New Zealand, regulatory authorities increased the amount of residual Roundup allowed in food 200-fold.

GE foods have been introduced into the food chain without adequate testing and there have been no proper epidemiological studies to investigate their consequent effects.

Genetic Engineering Facts for Consumers

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What is genetic engineering?

Genetic engineering (GE) - also called genetic modification - usually means that genes are taken from their natural host and inserted into a new host. For example, New Zealand researchers have engineered genes from a toad into a potato and human genes into cows. US researchers have engineered rat genes into lettuce, corn and rice to produce foreign proteins, plants to produce infertile seed, and seed so that it needs an application of a proprietary chemical in order to germinate.

Is GE the same as selective breeding?

No.

Selective breeding involves crossing closely-related varieties or species whose genes are mostly similar in structure and function. Scientists can cross two varieties of rose to create a new variety, a horse can cross with an ass, but scientists cannot naturally cross a rat with a lettuce, or a toad with a potato, or a fish with a strawberry. Conventional breeding techniques and hybridization are very different technologies from genetic engineering.

How is genetic engineering done?

First, a section of DNA is isolated whose genetic function is associated with some characteristic of an organism. This can be done quite precisely.

The isolated genetic information is then inserted into the genome of a new host. This is done by constructing a VECTOR that can invade the genome of the new host and insert the foreign DNA sequences into it.

The inserted DNA sequence is usually made up of the TRANSGENE (the chosen genetic information), and a MARKER gene (usually conferring antibiotic resistance) along with a PROMOTER sequence that encourages expression of the new genes in the target cells. When the foreign transgene is expressed in the target cells, a novel protein is usually produced as a result.

The incorporation of the vector cargo into the target genome is a hit and miss process.

Genes operate in highly complex, barely understood relationships. Any change to the DNA of the new host at any point can affect the function of genes throughout the genome in unpredictable ways.

What unpredictable ways?

Insertion of novel DNA into a genome may:

- disrupt vital genes; this is a very common result that genetic engineers have to overcome,
- cause the production of allergens and proteins that were never present previously in the human diet,
- cause toxic chemicals to be produced,
- interfere with the function of chemical signalling processes,
- inhibit or make unstable the function of other genes in the host,
- 'silence' genes so that they do not function.

Should we be concerned about GE crops?

There are grounds for serious concern about GE crops, especially the diversion of global agricultural resources into this new mode of production.

The Royal Societies in the UK and Canada, the French Food Safety Authority, and many eminent scientists and physicians world-wide have urged caution. These are some of the concerns.

*****Antibiotic-resistant marker genes are used in GE biotechnology practices. Further proliferation of these genes may enhance antibiotic resistance of microbes harmful to humankind and animals.

*****The vectors used to engineer new genes into cells have features that facilitate horizontal gene transfer. Retention of such features by the inserted genetic sequence can confer instability, raising the probability of subsequent horizontal gene transfer into non-target species (see below).

*****Corn engineered with Bacillus thuringiensis (Bt) expresses an insecticide endemically in the plant. The epidemiological effects of large-scale ingestion of such toxins has not been studied.

*****Engineered genes do not remain contained. They have crossed between corn varieties, and between canola varieties.

*****Introduced genes may sometimes be transferred to other species in a process called horizontal gene transfer.

What is horizontal gene transfer (HGT)?

Genes move freely between varieties that interbreed. More rarely, genes move from one species to another, usually between closely related species. This is known as horizontal gene transfer. HGT between species from different kingdoms is extremely rare in nature, even on an evolutionary timescale.

Genetic engineering has now become the main cause of HGT in the biosphere. Novel genes introduced into one host by engineering may be more prone to further transfer because of the way they have been inserted.

*****It has been reported at an International Weeds Conference, organized by the British Crop Protection Council, that GE glyphosate-resistance has been found in weeds.

*****Transgenic DNA in GE soy has been found to survive passage through the small bowel and be taken up by gut bacteria.

*****Gene flow has been observed from herbicide-resistant canola crops to nearby non-GE crops. Transgenic canola pollen travels hundreds of metres, making it impossible effectively to separate GE and non-GE – for example, organic - crops.

*****Government scientists in Mexico have confirmed that contamination of native corn land races has occurred.

Are soils affected by GE plants?

Yes.

Canadian scientists found an accumulation of Bt toxin in the sediment of the St Lawrence River. They suggest the roots of Bt corn plants transfer the transgene to soil bacteria which then secrete the Bt insecticide into the groundwater.