

Potatoes that fight back

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Is it possible to grow potatoes that produce their own insecticide?

Researchers of the ARC are currently testing such a potato in all the major potato growing areas of South Africa. This potato is engineered to produce a protein that kills the larvae of the potato tuber moth but is friendly to bees and other animals. Three years of field trials have shown the potatoes to be highly effective against the potato tuber moth. Figure 1 shows how stored genetically engineered potatoes sprout while the non-engineered tubers are unable to sprout due to damage caused by the larvae of the potato tuber moth.

The "insecticide" that was chosen for the job is commonly known as the Bt protein (pronounced bee-tee). The protein was discovered in soil bacteria over 100 years ago. Today these bacterial spores are still used in formulations to control specific pests and are commonly used in



FIGURE 1: The genetically engineered potatoes on the right sprout normally while the non-engineered potatoes on the left do not sprout as a result of damage to the potato eyes caused by the larvae of the potato tuber moth.

organic farming systems. Like all other pesticides they need to be bought and then applied. If it rains at the wrong time the formulation can be washed off and it also needs to be applied at the right time to kill the feeding larvae. The question was asked, "Why can't we get the plant to make

this protein and save us the trouble of spraying". So the blueprint (gene) for this protein was put into potatoes at the Michigan State University in the USA. Laboratory and field tests were done to check out the potato and it worked. The ARC was approached to see if they would be interested in getting this

potato approved for small scale farmer use. The opportunity was seized as a way of developing biosafety research to support the testing process for new GMOs in South Africa. Figure 2 shows one of the field trials in Gauteng where the genetically engineered potatoes were evaluated.

Mr. Gurling Bothma is a biotechnologist working at ARC-Roodeplaat. He is responsible for the analysis of the Bt protein produced by the genetically engineered potatoes being developed at ARC-Roodeplaat. He is involved in biosafety training and was a team member of the Southern African Regional Biosafety (SARB) programme, which did biosafety

training in seven SADC countries. He is also a member of an international research project looking at gene flow and its management in sorghum in three African regions.



FIGURE 2: Field trial with genetically engineered and non-engineered potatoes in Gauteng.

Are genetically engineered potatoes safe for people and the environment?

There are people who are adamant that any crop that has been genetically engineered must be bad. How do we find out if these potatoes are good or bad for us? The logical way to do this would be to test the potatoes to see if they are poisonous or cause allergic reactions. The potatoes could then be tested to see if they have any negative impact on the surroundings.

The government places stringent controls over the testing and growing of any engineered (modified) crop. Before any genetically engineered crop is released to be grown commercially the government needs to be convinced with sound scientific evidence.

How to make sure that a genetically modified plant is safe

A research facility wanting to do this type of work must be registered with the National Department of Agriculture's Directorate: Genetic Resources. The developmental stage is where the basic laboratory work is done. Here the gene is identified and put into the plant. Tests are done to make sure the process went as planned and all the promising plants move to the next phase. Now the plants need to be tested in a greenhouse to see if they exhibit the desired engineered characteristics.

"Proof of concept" is established and the decision to take the research to the next step must now be taken. To do "confined use" trials (in a greenhouse or screenhouse), a permit is needed from the

Office of the Registrar, GMO Act 1997, NDA. They require information on the genetically engineered crop as well as a risk assessment on its potential impact on other organisms in the release environment. The application is reviewed by a Scientific Advisory Committee, who assess the potential risk and makes a recommendation to the Executive Council on whether the trial should proceed or not. They also stipulate any measures that must be in place to minimize unintentional harm.

Similar permit requirements are in place before the trials move to fields. This is seen as confined use and strict control is kept of these trials. Plant material usually needs to be transported, planted, harvested, stored and destroyed in compliance with the permit requirements.

While the field trials are being conducted to

assess their performance under normal growing conditions, the data required for safety assessments is also assembled. Depending on the genetically engineered crop, some of the following information is needed when applying for a general use permit and will be included in the application: Animal toxicity tests, allergenicity tests and protein digestibility studies may be needed to show that the crops are safe to eat. The plants may need to be assessed for any changes in the nutritional status and whether there have been any unintended effects. Unintended effects include any changes in the crop that may have occurred during its development and that are unwanted. A molecular analysis of the plant is done and expression levels of the new protein determined. A more complete environmental impact study is done to

assess any negative effects on non-target organisms, the effect on the soil microflora, gene flow effects and any other factors that may have an impact. A socio-economic impact study may also be required.

The final decision on release does not lie with the developer. Once the developers of the new plant believe they have enough evidence to prove the safety and value of a new genetically engineered crop, they will apply for a general release permit. At this point the Executive Committee will assess all the scientific evidence, socio-economic studies and any other relevant information submitted by stakeholders. To date, all general release permits issued in South Africa have been conditional. One of the conditions for the general release of a genetically engineered crop may be that monitoring for a specific impact must be undertaken for a period of time. This gives feedback to substantiate any assumptions that may have been made and to keep tabs on any unanticipated environmental impact.

Even though such a plant may get approval for general release, this

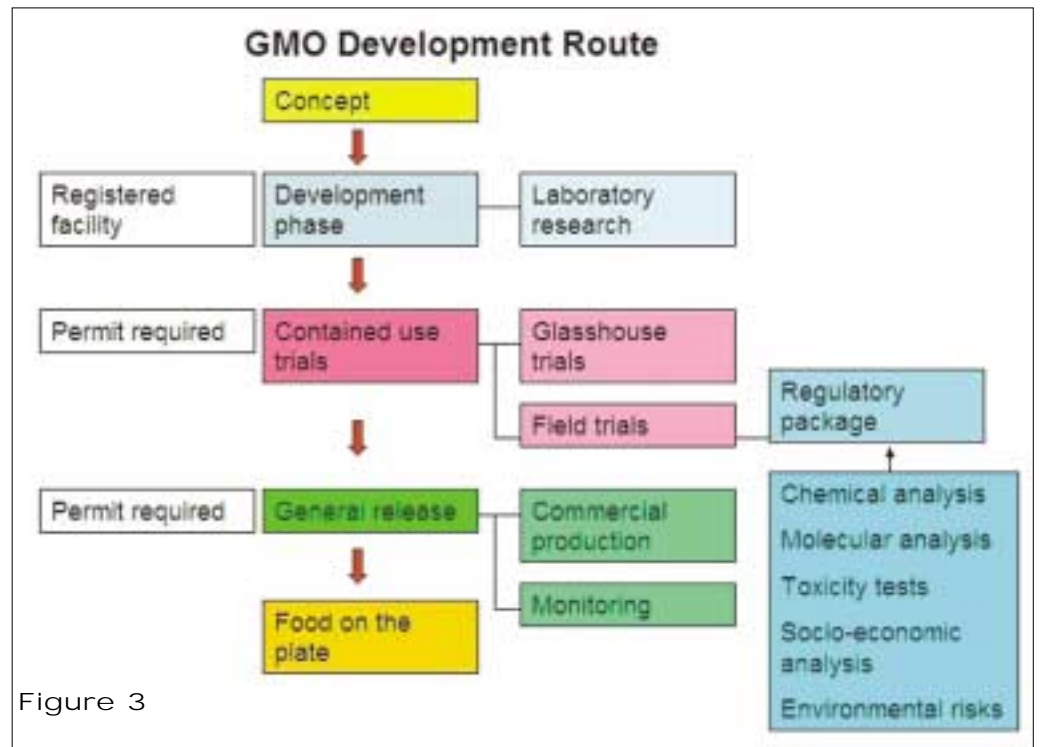


Figure 3

does not mean the plant will be a commercial success. Acceptability to the producers and end users of this new crop will determine its ultimate commercial success. It has become essential for the developers of these crops to include the public in the development process and trials from an early stage so as to cultivate a sense of "buy in". To spring crops developed with this new technology on consumers can lead to suspicion and rejection. Most people don't fully understand all the complexities

and processes involved in the development of genetically engineered crops and can easily be scared off by alarmist tactics employed by those opposed to the use of this technology. Armed with reliable information the consumer can make an informed decision on whether or not food from genetically engineered crops is acceptable to him or her.

South Africa has a well-developed regulatory system that puts the safety of the general public and environment first. The

process between the initial conception of a novel genetically engineered crop and getting it on the plate is a long and thorough process. Figure 3 summarises the steps in the commercialization process of a genetically engineered crop. Very few ideas get past the initial laboratory stage. The public should not fear that genetically engineered foods will bypass the scientific scrutiny, social acceptability and regulatory requirements of the Government.

