Legal Uncertainties Obstruct Breeders

Unavailable **carrots,** uncertain **tomatoes,** stored up **potatoes** and forbidden **apples**

Marianne Heselmans

Genetically modified or not? Legally, there is a huge difference. But some new breeding techniques are in a grey area. As long as their status is unclear, companies are reluctant to use them.

European seed companies are encountering a problem. They own new, promising breeding technologies, but do not know whether the EU considers the seeds to be genetically modified. The definition of that classification has become a vague one. A guideline dating from 2001 states: 'a genetically modified organism is an organism, with the exclusion of human creatures, in which the genetic material is changed in a way which is not provided by nature through mating and/or natural recombination'.

Money

The importance of a European judgment is not only a correct definition; it is also a matter of money. The introduction of a genetically modified crop on the European market would cost 7-10 million Euros more than a traditionally bred one.

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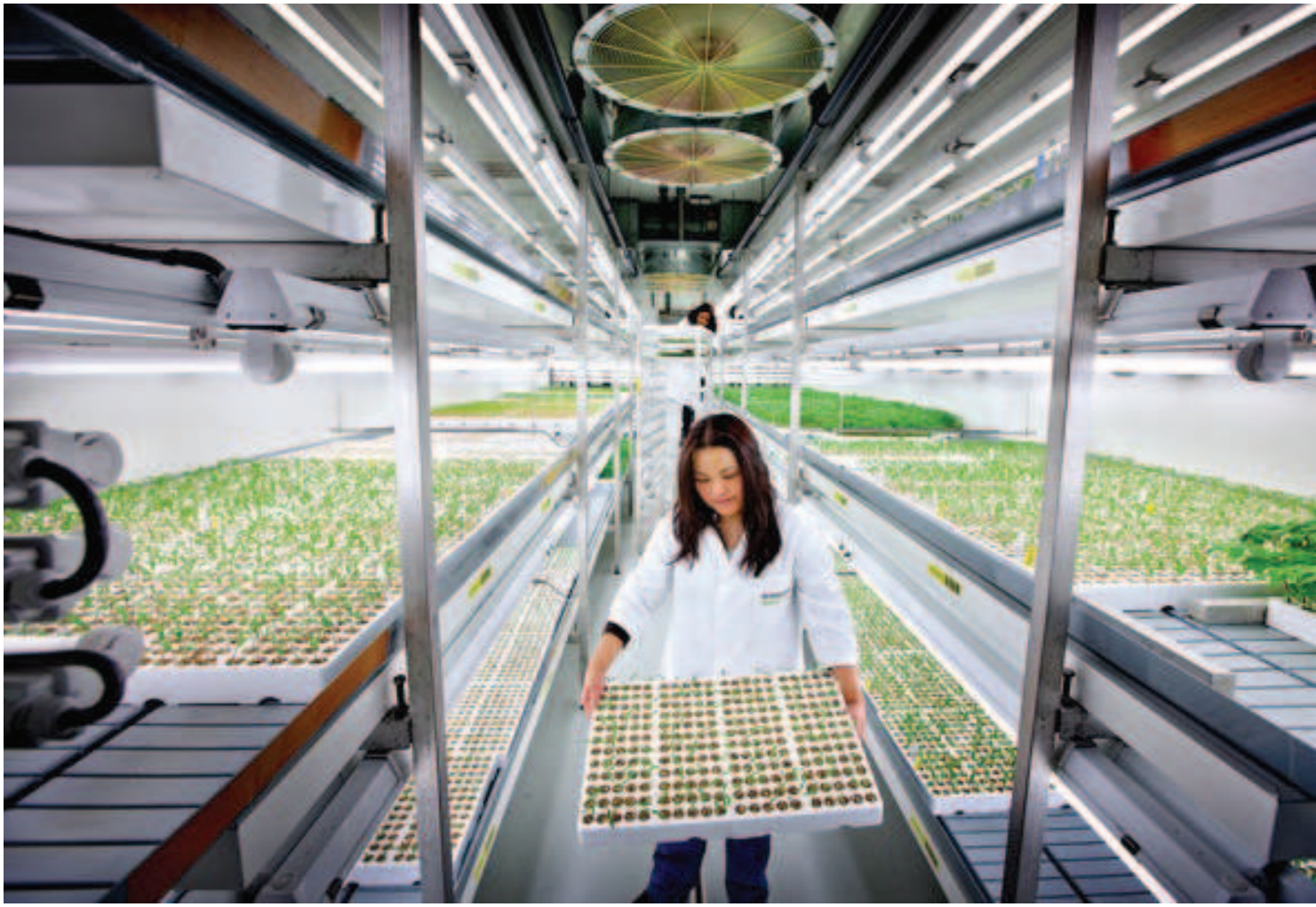
The procedure for market approval of a GMO is unaffordable for many companies. It would also be much too slow. A lettuce variety, for example, is marketed for only two or three years. The problem is further complicated for European companies not (yet) bought by Monsanto, BASF or by one of the other large multinationals. These independent seed companies have to compete with multinationals, who can afford the GMO procedure in Europe, and with seed companies in the United States and Canada, where market approval is much simpler and cheaper. As long as it is not clear whether the vegetables produced through the new breeding technique is a GMO, European seed companies keep it on hold, no matter how promising it looks. It would be catastrophic if the European Committee decides to brand a vegetable variety already on the market, as a

Redder tomatoes

KeyGene is able to change DNA in a tomato accurately on a letter level. With its DNA-synthesis machine, it can introduce characteristics such as more healthy compounds or a redder colour. The machine almost identically copies a part of the gene that has to be switched off or altered. This piece of artificial DNA is then inserted into a protoplast of a tomato cell during mitosis, where it sticks on to the gene that has to be changed. Because the letter sequence of the tomato's own gene and the inserted synthetic molecule are not exactly the same the cell starts to repair the different letter. After cell division, the altered own gene remains and will be transmitted to its offspring. The synthetic particle of about twenty letters is broken down. COGEM has recently advised to exclude this technology from the GMO legislation, because changing genes in the classical way by mutagenesis – with chemicals or radioactive radiation – is likewise excluded. The users of the KeyGene technology have yet to decide whether they dare to use this technology for commercial varieties.



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As long as the EU-government has not made a decision, seed companies are wary to use the novel technologies

GMO. Supermarkets may decide to remove that vegetable from the shops and sue the breeding company.

Novel technologies

For decades, the world of plant breeders seemed clear and peaceful: they renewed their potato, cucumber and tomato varieties through cross-breeding or spontaneous mutations. Around 1940, two important new techniques were added: inducing random small changes in DNA (mutagenesis) with either radio-active radiation or chemicals. The genetic effects of these techniques were unpredictable, but at the time nobody thought it a problem.

Firm broccoli

The sweetest carrot or the firmest broccoli is often a hybrid. These excellent crops cannot be used in traditional breeding programmes. With reverse breeding, seed companies are able to produce perfectly complementing homozygous parental lines, through engineered meiosis. The method is based on reducing genetic recombination in the selected heterozygote by eliminating meiotic crossing over. During selection, breeders choose those plants that do not have the inserted synthetic DNA. It would take a company five years from the moment of discovery of the excellent plant to the market introduction of a new variety, if it would not be considered a GMO.

Opposition arose, however, when in 1985 the universities of Leiden, the Netherlands, and Gent, Belgium, succeeded in genetically modifying plants by introducing DNA that originated from a different species. In the last 25 years, GMO varieties have become popular in many countries across the world except for, amongst others, Europe, where only a few varieties have been approved. But as genetic modification was beyond the scope of the European seed companies, they did not waste time seeking alternatives. Together with universities, they developed novel breeding techniques. During the breeding process DNA is introduced, but in the final product the new DNA is no longer present. It has, for example, been outcrossed. Are those varieties GMO or not? The EU legislation is not clear, as it is about twenty years old, when those techniques did not exist. Rijk Zwaan has, for example, developed the reverse breeding technique, a technique that enables quick propagation of hybrid tomatoes or broccoli, coincidentally found to be very successful. “We have found an ideal tasting tomato in a greenhouse between less tasty tomatoes”, says Kees van Dun, molecular biologist at Rijk Zwaan. “It is a very sweet variety.” Researchers discovered how to block the genetic variation that occurs when chromosomes are crossed. They were able to produce seed from the tasty tomato. The small piece of DNA needed to block the cross-over, is no longer present in the final product.

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According to Greenpeace a cisgenic plant is a GMO and should be considered a biohazard

Improved potato

The research department of potato starch factory, AVEBE, in Foxhol in the Netherlands, faced similar difficulties. Research manager, Peter Bruinenberg, is eager to tell the problematic history of the potato containing only amylopectine. That is the type of starch that has industrial applications, amongst others in the paper industry. AVEBE developed this amylopectine-potato, because it was cheaper and environmentally friendlier to use. It is not necessary to remove the other type of starch which the potato produces naturally, with chemicals and high temperatures. But as the potato contained bacterial DNA, it was not accepted by the EU.
Ten years ago, AVEBE decided to focus on potatoes containing only potato-DNA. Last year, AVEBE's second potato entered the EU mills for approval. By now, the application file was over two thousand pages long and the board was asking themselves how long AVEBE could afford this. "Again and again, we receive additional questions, which force us to conduct extra field trials", says Peter Bruinenberg. "The costs are 250,000 Euros per trial."
The latest starch potatoes by AVEBE are coming closer to an 'ordinary' potato. These varieties possess three small fragments of potato-DNA that provide resistance against phytophthora. The DNA fragments have a letter-sequence that is exactly the same as three genes from a wild potato species. But also these so-called 'cisgenic' potatoes have been put more or less on hold by the board.

Clarification

Six years ago, seed companies started to request clarification from Brussels. The Dutch government asked its scientific advisory committee on GMOs, COGEM, whether nine 'GMO-like' technologies would fall under GMO-legislation. Scientists at Wageningen University studied the matter and came to the expected conclusion that there are no scientific arguments to put varieties, in which no DNA from other species is present, under the GMO rule.
"The consequences for the environment and for food safety are comparable with products that

Long lasting apples

The Canadian biotechnology company, Okanogan, has created apples that have a longer shelf life. A small piece of synthetic DNA is made with approximately the same letter sequence as the gene responsible for the brown discolouring of apples. As it is not exactly the same sequence and the sequence is also reversed, the plant starts a defence mechanism, comparable with a reaction to a virus. The plant prevents the brown discolouring gene from translating into the enzyme responsible for the discolouring. It is called an 'intragene' apple, as the gene is not natural but improved DNA.
Okanogan is striving to introduce the first apples as GMO on the American and Canadian market in 2013. Director, Neil Carter, has absolutely no plans to ask permission to enter the EU. "It would be unaffordable."
Wageningen University did it even more naturally. The Wageningen breeders have produced apples (variety Gala) containing the scab resistant genes from wild apples. That DNA is inserted in exactly the same way as it would be if it occurred naturally through cross-breeding.

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are considered non-GMOs", declares research leader, Richard Visser, professor of plant breeding at Wageningen University. "There is after all no DNA present that would not be there naturally." Richard Visser also sees a practical problem: if varieties have the same DNA as 'ordinary' varieties, it is not possible to verify whether companies have or have not used those techniques. The EU put a similar request to a technical committee in 2007, but that committee is still waiting for the results of two studies. According to a spokesman, the committee will publish an advice this summer. It will then have to pass the European Commission and maybe even Parliament. A concept report has been circulating, but that report has been withdrawn again. It is rumoured that the committee suggested that cisgenic plants (such as apples with apple DNA) should not be subject to GMO legislation, while this is politically unfeasible. There are too many parties who consider cisgenic plants true GMOs. The multinationals belong to these parties - they do not want to limit themselves to cisgenesis, they simply want to be able to insert the best working pieces of DNA. But also the Dutch food safety institute, RIKILT, is making things difficult for breeders. In August 2010, it produced a report that cisgenic plants had to be treated in the same way as transgenic plants. The insertion of DNA using Agrobacterium could lead to 'genome disturbance' (unexpected interactions between genes in the plant) which would increase the chance that it produces allergenic substances. The Dutch parliament now wants a third study on cisgenesis.

Virus resistant root stocks

Some grape research institutes in Germany and France are wondering whether their grapes, cultivated on a root stock that has been genetically modified, are themselves GMOs. Grape plants are always grafted on root stocks of another variety, with better resistance against soil diseases. Ten years ago, the AIPlanta institute in Neustadt (southern Germany) developed root stocks that are resistant against grapevine fan leaf virus. The virus genes that were used are not present in the grapes themselves. At the moment, field trials are being conducted in Neustadt as well as by the French institute, INRA. The German authorities decided last year that, for the time being, grapes and wine produced on a GMO root stock must be labelled.

Ten years

In Amsterdam, Herman van Bekkem, campaign manager of Greenpeace, is following the discussion with fascination. And, yes, according to him a cisgenic plant is a GMO and should be labelled as such. "We do not say this because cisgenesis would not be natural, but from the precaution principle: people should know that there are extra risks", he says as he points at the rikilt report. Van Bekkem does not know yet what to think of the reverse breeding technique or of the focused mutation that KeyGene has developed. "I am studying the subject." He cannot say anything about possible actions about crucial EU decisions. "We never do that in advance." Meanwhile, the Dutch advisory committee has to squirm to present reasonable arguments why a product is a GMO or not. President, Bastiaan Zoeteman: "It may take as long as ten years before anything changes in the rule."