

Soon they will start the test by setting out more than 2,000 transplants in a fenced field at the Irish agricultural research service's farm. "There's a lot of public interest" in his work, said Mullins, "not all of it is friendly. Genetic engineering remains highly controversial in Europe and the research in Ireland has spawned a campaign against it." The field trials in Carlow are "harming Ireland's reputation for local, organic and artisan food", said Kaethe Burt-O'Dea, a Dublin-based local food activist. "People feel that once you let GM in, there's really no turning back," she said. But supporters of the GM potato say it could prevent harmful and expensive applications of pesticides and increase potato yields.

The potato is the third most consumed crop on the planet after wheat and rice, and has become increasingly important in the developing world, which now has more potato fields than developed countries.

- <http://www.guardian.co.uk/science/2013/apr/02/gm-potato-blight-ireland-famine>

### Golden rice

In 2014 golden rice - normal rice that has been genetically modified to provide vitamin A - could be given to farmers in the Philippines for planting in paddy fields. It has been developed to reduce blindness and other diseases in children in the developing world caused by lack of vitamin A.

Bangladesh and Indonesia have indicated they are ready to accept golden rice and other nations, including India, have also said that they are considering planting it.

"Vitamin A deficiency is deadly," said Adrian Dubock, a member of the Golden Rice Project. "It affects children's immune systems and kills around two million every year in developing countries. It is also a major cause of blindness in the third world. Boosting levels of vitamin A in rice provides a simple, straightforward way to put that right."

Recent tests have revealed that a substantial amount of vitamin A can be obtained by eating only 60 g of cooked golden rice.

It has taken an extremely long time for the GM crop to be approved. Golden rice was first developed in 1999, but its development and cultivation has been opposed by campaigners who have refused to accept that it could deliver enough vitamin A. They also feel that the crop's introduction in the developing world would make farmers increasingly dependent on western industry.

- <http://www.guardian.co.uk/environment/2013/feb/02/genetic-modification-breakthrough-golden-rice>



# GM plant dilemmas

## Background information

### Genetic modification

Genetic modification (GM) has been in use commercially since 1996. GM crops are described by many different names - genetically modified organisms (GMOs), genetically engineered (GE), "transgenic" or "biotech" crops. GMO is the official term used in the EU. In general, these all refer to a plant carrying DNA from another organism.

Genetic-engineering has been used in different ways. In medicine, it has been used to produce artificial insulin, drugs and vaccines. More controversially, it is being used to produce new types of agricultural crops to feed animals and for human consumption.

In 2010, GM crops were commercially grown in 29 countries, including 8 in the EU, 5 in Asia and 3 in Africa, amounting to approximately 10% of global crop land. The majority were the four crops: maize, soybean, cotton and oilseed rape but many more are in development.

This website gives a very comprehensive overview:

<http://www.gmo-compass.org/eng/home/>

## Less toxic oilseed rape

Oilseed rape is an important food crop. It started to be grown in the UK in the 1970s. The varieties of oilseed rape used today are suitable for use in cooking and food processing. The oil is widely used by the food industry and is now being increasingly processed for use as biodiesel.

The use of the oil is limited because of 2 compounds found in it, erucic acid and glucosinolates. Erucic acid tastes bitter and has prevented the use of rapeseed oil in some food. Glucosinolates, which were found in rapeseed meal left over from pressing, are toxic and have limited the use of the meal in animal feed. New GM varieties known as 00 “double-zero” rapeseed have been developed. They are called 00 as they are very low in erucic acid and glucosinolates. In Canada, where “double-zero” rapeseed was developed, the crop was renamed “Canola” (Canadian oil).

Although many field trials with this genetically modified rapeseed have been conducted in Europe, it is not yet being grown commercially. Several GM varieties have been given a green light but are waiting for final EU approval. GM rapeseed has been grown in Canada since 1996 and is also grown in the US and in certain states in Australia.

- [http://www.gmocompass.org/eng/grocery\\_shopping/crops/21.genetically\\_modified\\_rapeseed.html](http://www.gmocompass.org/eng/grocery_shopping/crops/21.genetically_modified_rapeseed.html)
- [http://www.ukagriculture.com/crops/oil\\_seed\\_rape.cfm](http://www.ukagriculture.com/crops/oil_seed_rape.cfm)

## GM crops as food aid

Over the last 10 years genetically modified (GM) food aid has been sent to countries in Africa. The fact that it is GM has caused issues with governments, scientists, activists, consumers and aid workers.

In August 2012 Kenya was suffering from a serious drought. On 18 August 2012 the Kenyan government fired the head of its National Biosafety Authority for allowing milled food aid which might have contained genetically modified organisms (GMO) to enter the food chain. This sparked a public debate on the issue with some extreme positions either for or against GM food.

*“When you have people starving in your country you don’t simply turn your back on food at your door-step just because it is labelled GM - this has serious consequences for starving people”* says Diran Makinde, director of the African Biosafety Network of Expertise (ABNE).

There have been different degrees of resistance to GM food and GM food aid in Africa. In 2002 Zambia announced it would not accept GM food aid in any form. The debate became heated when a quote from a US state department official, *“Beggars can’t be choosers”*, hit the headlines. It prompted the then president, Levy Mwanawasa, to say; *“hunger is no reason for feeding our people poison”*.

Zimbabwe, Malawi and Mozambique said they could allow imports of GM food aid in its milled form as this eliminated the risk of the germination of whole grains and limited possible contamination of local varieties. In 2004, Angola and Sudan announced restrictions on GM food aid.

- <http://www.irinnews.org/Report/93991/Food-Rumpus-over-GM-food-aid>

## Turbocharged rice

Green plants all photosynthesise but the pathways which they use are not all the same. Rice uses a pathway which, in some ways, is less efficient than the pathway used by plants such as maize.

Scientists think that plants like rice evolved at a time when the planet had a very high concentration of CO<sub>2</sub>. They are now limited by the lower CO<sub>2</sub> concentration in the atmosphere today. Maize plants are able to concentrate CO<sub>2</sub> so they grow more quickly. In addition they can get enough CO<sub>2</sub> even when their stomata are not fully open, so water loss by transpiration is reduced.

The IRRI (International Rice Research Institute) has begun a project to genetically modify rice - the C<sub>4</sub> rice project, or “turbo-charged rice”. The project is attempting to make rice more efficient at photosynthesis by converting it from the rice pathway to the maize pathway. Rice already has all the components required for this type of photosynthesis, but they are distributed in a different way within rice cells. By using genetic modification, it is theoretically possible to switch rice over to the maize pathway for photosynthesis - potentially increasing productivity by 50%.

In 2012, the turbo-charged C<sub>4</sub> rice project got an injection of financial support valued at US \$14 million over 3 years from the Bill and Melinda Gates Foundation and the UK government. “This is exactly the sort of innovative scientific research that the [UK] Prime Minister was calling for at the Hunger Summit at Downing Street,” said Lynne Featherstone, UK Parliamentary Under-Secretary of State for International Development. “This new funding will enable IRRI to begin producing prototypes of this ‘super rice’ for testing. This could prove a critical breakthrough in feeding an ever-growing number of hungry mouths.”

- [http://irri.org/index.php?option=com\\_k2&view=item&id=12438#Turbo](http://irri.org/index.php?option=com_k2&view=item&id=12438#Turbo)

## New potatoes

Potato Blight is caused by a fungus *Phytophthora infestans*. It spreads through the air and develops when the weather conditions are warm and humid. There was a terrible famine in Ireland between 1845 and 1849, sometimes known as The Irish Potato Famine. Potatoes were the staple food in Ireland and, at the time the potato blight struck, the Irish grew a very limited number of varieties of potatoes. If they had grown more varieties some may have been resistant to the blight and the famine’s effects could have been lessened.

Ewen Mullins is a plant scientist who is working on a genetically modified potato. From his laboratory and greenhouse at a research farm outside Carlow, 42-year-old Mullins deals daily with a disease which haunts his native land. Potato blight is caused by a fungus that still thrives in Ireland’s wet, cold climate. The disease has become even more damaging in the past five years with the arrival of new, highly aggressive strains. Mullins and his team have spent the winter cloning new potato stock in a locked temperature control room and, nearby, a secured greenhouse bay where the plant is isolated and any waste must be sterilised in a steamer.