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Success in failure

A failed crop trial of genetically modified wheat still provides crucial lessons for those battling to provide the planet's growing population with a sustainable food supply.

It is rare for failures to be lauded in science. History, as it is often said, is written by the winner. The history of research is no different.

But failure in science is vital. Another cliché about history is equally applicable to scientific flops: people who are ignorant of them are doomed to repeat them. Which brings us to a green — and to some, an unpleasant — field in England.

In 2012, a team based at Rothamsted Research, an agricultural-science institute a short train ride north of London, planted wheat that they had genetically modified to emit a chemical used by aphids as a warning that they are under attack. The researchers wanted to see whether this would give the crops a way of repelling the damaging pests. They thought that the chemical might also attract insect parasites alerted to the promised presence of aphids.

Before they got the chance, the crops attracted a swarm of protesters. Opponents of genetic modification (GM) technology mounted an imaginative, if sometimes bizarre, campaign against the trial, complete with dubious scientific claims, loaves of bread adorned with cartoon cow heads, and videos promising to 'Take the Flour Back' complete with rock-music soundtrack. The research itself cost £732,000 (US$1.2 million) over five years. Securing the site from those who threatened to tear it up cost nearly £1.8 million.

The idea behind what has, rather unfortunately, become known as 'whiffy wheat' showed promise in the laboratory. Yet in field trials the crop is an unquestionable failure. A paper published on 25 June in the journal *Scientific Reports* notes that the GM crops "showed no reduction in aphids or increase in parasitism" compared with controls (T. J. A. Bruce *et al. Sci. Rep.* http://doi.org/5sr; 2015).

This is disappointing on many levels. First, because of the effort — and money — that has gone into the concept. Second, because GM crops will surely have a major role in providing a future sustainable food supply. As Earth's population grows, so does its appetite. Work aimed at increasing crop yields, by both GM and non-GM methods, is among the most crucial research being conducted on the planet. So hostility towards GM research — one reason why it is rare for such crop trials to reach field-scale studies in Europe — is still among the most important societal issues for science to address.

Some opponents of GM crops have reacted with predictable claims: that the trial was a waste of money, that investment in GM science should therefore be cut off, and that this one set-back means the entire concept is flawed. Hardly.

As with most negative results in research, things can still be learnt from this trial. The team might yet modify the way their crop emits the alarm pheromone and may experiment in areas with higher densities of parasites.

The crop failed, but so did the protests. The research was done; a useful result was obtained. Ironically, had the protests succeeded and the trial been abandoned, the protesters would be unable to crow about the crop's failure. GM research continues at Rothamsted, as it does around the world. Some of it will work and some will not.

Those who wish to make an argument against GM crops face major problems. The rise of new techniques such as CRISPR means that what is and is not a GM organism is an increasingly grey area, both scientifically and for regulators.

And these crops, with all the controversy that comes with them, are no longer the sole preserve of huge agri-businesses. The use of GM technology is increasingly being passed to the people who really need it — those in developing countries who are trying to improve the agriculture of their nations.

"Considering all GM crops as a single case is increasingly problematic."

Considering all GM crops as a single case is increasingly problematic. Consumer-friendly traits, such as apples that do not turn brown, now vie with nutritional enhancement for developing nations and drought resistance. Small academic groups around the world are producing locally tailored varieties alongside the engineered staples that major companies sell in huge quantities to farmers in the developed world. And the debate is no longer limited to crops — on page 13, we report on GM pigs that could soon make their way into the human food chain.

All who care about evidence-based policy-making should thank those who continue to struggle against both the difficulties of doing science and the added difficulties caused by people who would see science abandoned. We will all need the fruits — and the cereals — of their labours. ■

Gene politics

US lawmakers are asserting their place in the human genetic-modification debate.

The revelation in April that scientists had edited the genome of a human embryo — an inevitable development to anyone paying attention to biotechnological advances — has sparked the biggest bioethical debate of the year and one that will last for decades. The overwhelming consensus is that such embryos should not be brought to term in clinical settings — at least not for now. The debate over when, if ever, that should take place has played out in the scientific literature in duelling articles, arguments about the technology's efficacy and calls for an Asilomar-like conference on bioethics.

So it is little surprise that lawmakers are weighing in. On 16 June, a subcommittee of the US House Committee on Space, Science and

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