Gene Editing in the context of crops

The Evolving Debate on Gene Editing

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Original thinking... applied

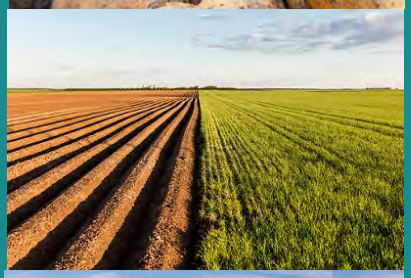
The Evolving Debate on Gene Editing

The EU Court of Justice recently ruled that organisms obtained by Gene Editing (GE), or more precisely directed mutagenesis, should be treated as Genetically Modified Organisms (GMOs)[1]. It could be argued that this delays the roll-out of the technology in Europe and buys time for wider consultation. Interestingly, whilst not directly challenging the EU Court of Justice's decision, the report on the ruling by the EU Group of Chief Scientific Advisors points to the need for greater transparency "where reasons other than scientific evidence inform decision-making, such as ethical, legal, social and economic considerations"[2]. The ruling has generated much debate and opinion, in terms of science, commercial value and peoples' beliefs. However, there is inevitably a subtext underlying the views that we hear which is coloured by vested interests i.e. 'Academia', 'Big Industry' or 'Campaign Organisations[345]'.

A Point of Science and the Public Interest

The core of this debate is in the mechanics of GE and the principled ethical concern of what constitutes an 'unnatural intervention' leading to a crop with a novel trait or traits. GE can create changes to DNA that are indistinguishable from those which could be arrived at by natural mutagenesis or induced mutagenesis, but GE can also, if intended, be used to add exogenous DNA. This latter process meets the definition of a 'classical' GMO. The new contentious area is not about GE that produces a classical GMO, but about GE that gives rise to an organism that is 'substantively equivalent' to what might be produced by natural or induced mutagenesis. Unlike classical GMOs, there is no reliable method that we can use to detect or monitor the presence of 'substantively equivalent' organisms produced by GE in the environment or in food. Hence, any public interest that may be served by the legal control of GE organisms (derived by edits not insertions) cannot currently be supported by a test for its presence. Thus, we do not have the facility for directly attributing environmental impact on GE crop cultivation (e.g. gene migration beyond the intended ecology) or providing choice to consumers that take an ethical position to not consume GE food.

Our primary observation on GE is levelled at the inability to detect GE organisms, as we can with 'classical' GMOs, and how that plays out in monitoring potential impacts in the environment and with respect to food labelling and consumer choice.



Gene Edited Crops, Global Trade and Regulation

In setting out this distinction between GE and classical GMOs and the extent that these may be detected and tested for in the environment and food and feed chains, it is significant that a number of countries have already approved, or are legislating to approve, GE crops for cultivation[6]. How will a mix of countries with divergent regulations on GE cultivation and food labelling co-exist without the ability to reliably discriminate between GE and conventional products? If we consider the Americas, where classical GMO and GE crops are cultivated or at advanced stages of approval (where approval is required), the export of such produce can only be monitored for presence of classical GMO and not GE crops, thus compromising existing legislation the importing country may have relating to the labelling of GMO food and feed. Has the opportunity to regulate the technology already passed? If it has, what might the options be?

Going back to the GE report by the EU Group of Chief Scientific Advisors, a further recommendation is to revisit and update the existing GMO regulations based on the larger evidence-base now available on this technology and to consider other technology advances, such as GE, as appropriate. Importantly, this report also identifies the need for an "inclusive discussion on how we want our food to be produced" and how the "safety of an organism is determined by multiple factors" other than the technology used to produce it or organism itself. This may point to a better basis for evaluating and regulating for the outcomes of using these technologies in the context of environmental protection and agricultural practice. It could be considered that the Chief Scientific Advisors' statements tend to support the formation of regulations that manage the outcome of technologies, rather than each technology itself i.e. irrespective of whether GE, classical GMO or conventional methods were used. This approach is taken by Canada, who have adopted classical GMO cultivation and will adopt GE cultivation without recourse to technology-specific legislation.

1 - https://curia.europa.eu/jcms/upload/docs/application/pdf/2018-07/cp180111en.pdf
2 - https://ec.europa.eu/info/sites/info/files/2018_11_gcsa_statement_gene_editing_2.pdf
3 - http://www.cpm-magazine.co.uk/wp-content/uploads/2018/09/180903-Michael-Gove-letter.FINAL_.pdf
4 - http://foe.org/wp-content/uploads/2018/09/FOE_GenomeEditingAgReport_final.pdf
5 - https://www.croplife.org.au/media/media-releases/luddites-rejoice-as-european-agriculture-is-consigned-to-the-dark-ages/
6 - Lutz Grohmann 29th ENGL Plenary Meeting - 3rd October 2018

Michael Gove pledges genetic food revolution

As reported in the Times newspaper:

Mr Gove told the Country Land and Business Association: "**Even if there are individual lobby groups that express their legitimate concerns we will ensure those scientific tools are there for those who can improve productivity in a genuinely sustainable way. Gene editing allows us to give mother nature a helping hand, to accelerate the process of evolution in a way which can significantly increase yield and also reduce our reliance on chemicals and other input. There is a potential there for Britain and our scientists and our farmers to lead the way.**"

https://www.thetimes.co.uk/article/michael-gove-pledges-genetic-food-revolution-dfcbvq6qw

Future Strategies for Gene Edited Crops

In considering options for applying and regulating GE, we might see a 'workaround' whereby the GE organism is required to house a genetically introduced marker sequence solely for purposes of detection as a condition of commercial release. In this way GE organisms would always be classical GMO. Intuitively this does not seem a 'right' choice and does not solve the problem of GE products evading detection, but it does lead to a position of least change and one that provides a path to commercial release, albeit encumbered in some countries and regions by regulations that many perceive as effectively a block to GMO product development and commercialisation (e.g. the EU).

The alternative, of considering the outcome of the technology in context of 'on-balance positive benefits' to the farming system, the environment and the values of consumers is ideologically attractive, but not with a good precedent of success. In the early 2000s the UK Government led on the most comprehensive scientific and public consultation on GMOs. This evaluation combined elements of scientific review, research under the 'UK Farm Scale Evaluation[78]' which included the evaluation of GM crops, and public consultation. From these activities the scientific aspects led to the first (and what remains the only) UK Government recognition for a GM crop to have satisfied environmental criteria for commercial release; on the proviso, arising from the public consultation, that the practice of GM cultivation supported the 'co-existence' of GM and conventional cropping systems and the labelling of GM food.

Whilst, in-principle, the position reached paved the way for the commercial release of a GM crop in the UK, industry deemed the rules on co-existence as unworkable and no commercial release took place[9]. Thus, if we were to consider a 'farming, environment and food systems' outcome-based regulation for GE/ GMO crops it would be necessary to reconsider co-existence as put forward at that time.

Time to Revisit the Debate on GE/GMO Crops and their Cultivation

With the precedent of the current GE/ GMO debate and given the right consultation on farming, food, environment and associated values (ethical, environmental, commercial), which includes understanding of the big picture of food security, climate change and sustainability, can a different regulatory system for new technologies that delivers beneficial crop traits be attainable?

To table one option, could GE/ GMO cropping be accepted as 'conventional cultivation', with 'organic cultivation' remaining set apart. Under this scenario we observe that an organic status is largely an inspection and certification-based compliance by which the risk associated with an inability to test for GE contamination would be largely controlled for. An unintended positive consequence of this for the organic sector may be increased sales from consumers that remain ideologically opposed to GE/ GMO methods. Associated with such growth at a landscape scale (if we accept the petitioning of the organic industry that organic farming is 'pro-environment'), an increase in organic cultivation would also be likely to bring ecological benefits; acknowledging that organic systems already benefit by co-existing in a landscape dominated by conventional farming where pests and diseases are controlled by the use of pesticides and potentially in the future GE/ GMO crops.

Fera would welcome such a debate that would ultimately serve the public interest.

[7] - http://news.bbc.co.uk/1/hi/sci/tech/3194574.stm
[8] - https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1046/j.1365-2664.2003.00787.x
[9] - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1299063/#b13

Fera Science Ltd, is a provider of scientific evidence and services to the UK Government and to industry, in protecting crops, the environment, supply chain integrity, food and the consumer.

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