Gene-editing: The Genetic Technology (Precision Breeding) Bill

Third Reading

Summary

- We ask Members of the House of Lords to support this Bill during its first reading and subsequent committee stage of the process.
- The legislation sets out the process and rules surrounding any commercialisation of gene-edited products, eventually enabling consumers to benefit from the availability of novel foods.
- Gene editing allows scientists and breeders to develop foods with a range of benefits such as improved nutritional quality, less environmental impact, disease resistance and climate resilience.
- Traditional methods to introduce traits through conventional breeding can take 8-15 years. Gene editing significantly speeds up this process, as it avoids the need for several years of backcrossing to remove and restore genes unnecessarily added or lost through traditional breeding.
- The Norwich Research Park is home to world leading research establishments such as the John Innes Centre, the Earlham Institute, The Sainsbury Laboratory, the Quadram Institute and we are all working on gene-editing.
- We believe that the full benefits of gene editing can only be realised if products developed this way are able to reach consumers. We therefore welcome this Bill to allow gene edited products to be brought safely to market and provide consumer confidence.
- **This Bill will catalyse industry investment in food science and innovation. The EU regulations previously stifled investment because commercial application was prohibitively over-regulated. The UK's agricultural technology sector could grow significantly if this Bill is successful, helping the Government to realise its "science superpower" ambitions.**

Background

It has been announced that the first reading of the Genetic Technology (Precision Breeding) Bill in the House of Lords will happen on Tuesday 1st November.

Introduced to enable gene-edited products to be brought to the market, the changes from previous legislation will allow scientists, farmers and food producers in England (note that this is a devolved issue so the Bill will only apply to gene-editing in England) to develop novel products with a range of benefits, such as improved nutritional quality, disease resistance and climate resilience.

This new Bill:

- Creates a simplified regulatory regime for marketing gene edited plants and animals, including new notification systems for these products;
- Establishes a new authorisation process for food and feed products developed in this way.

These changes bring England more into line with the approach taken by most countries outside the EU, many of which are compatible with the internationally recognised Cartagena Protocol.

Once the Bill has passed through both Houses, novel products will continue to go through extensive field evaluation in the UK before reaching the recommended lists. In this way, for example, the plant breeding sector will continue to be well equipped to monitor new varieties, as they do already with traditionally bred crop varieties.

What is gene editing?

Traditional breeding selects for changes/ mutations in DNA sequence that occur in each generation (genetic variation), thereby developing a variety that has a beneficial change that results from that mutation. Gene editing is a technique that allows scientists to make specific edits to DNA sequences in a targeted way – **without introducing any new genetic sequences to the final product**. Specific genes can be removed (deleted) or changed (mutated) by making changes at known target locations in the genome. It provides an effective pathway for introducing desired characteristics (traits) and for removing undesirable traits without introducing "foreign" DNA (genes originating from other species) that happens using "conventional" breeding techniques.

The gene-editing process uses genetic technologies that make the changes to the DNA; their use is essential to the process. Organisms developed using gene editing technologies will therefore contain small changes to their existing DNA but these are identical to the types of changes that could occur spontaneously in nature or that are induced using traditional breeding technologies such as mutation breeding. **The resultant seeds, plants and food from gene-edited plants, for example, are indistinguishable from the seeds, plants and food provided to us by conventional breeding techniques.**

Gene editing can be achieved using several different tools. CRISPR-Cas9 is the most well-known gene editing tool, particularly after its discovery and application to gene editing won the Nobel Prize in 2020, but other technologies are also used. Take a look at the Royal Society video which looks at how this happens. The products closest to market in the UK are soybeans with healthier oil profiles, tomatoes with enhanced flavour qualities, non-browning apples, potatoes, and mushrooms, and plants that lack antinutrients (compounds that interfere with the absorption of nutrients).

Why is gene editing quicker than traditional breeding?

Gene editing is particularly useful in crops with multiple copies of each genome such as wheat. Wheat has three copies of each genome and mutations in all three copies are often needed to cause greatest benefits. Using traditional breeding, it takes over 10 years to breed wheat varieties which contain mutations into all three genomes as each copy often needs to be mutated separately. Gene editing techniques could generate UK wheat varieties with mutations in all three copies in a fraction of the time (2-4 years).

Why Do We Need This Bill?

Recent changes have simplified regulation of gene edited products used in research, but when it comes to developing such products, they are still unnecessarily over-regulated, by treating them in the same way as Genetically Modified Organisms (GMOs).However, where gene editing is used to produce a trait in an organism that could have been achieved using conventional breeding methods, any "risk" is the same regardless of whether it was made through gene editing or traditional

breeding methods. The traits introduced are identical and therefore the risks are the same. **Gene editing is therefore at least as safe as any other current conventional breeding method.**

As British farmers look to a new future post-Brexit, gene-editing will help to modernise the agriculture and food industry and reinvigorate investment in safe, nutritious, and profitable food production. This new Bill will set out how that can happen.

This Bill would have a significant, positive impact on how industry views the UK as a potential investment opportunity in food science and innovation. The EU regulations previously stifled investment because commercial application of the research was prohibitively over-regulated. The UK's agricultural technology sector could grow significantly, if this Bill is successful, **helping the Government to realise its "science superpower" ambitions**.

Benefits of gene editing

1. **Environmental Benefits**
   Genetic solutions can help reduce the need for chemical inputs in agriculture and aquaculture. Developing new varieties with favourable characteristics (such as increased resistance to pests and diseases and less reliance on pesticides and fertilizers) and bringing them to market sooner, we have an opportunity to reduce our chemical inputs and use less water and land. A regulatory regime which supports the development of environmentally-sensitive traits and encourages farmers to change their practices accordingly, would be a significant step in moving towards lower-input agriculture and aquaculture in the UK.

2. **Health and Nutrition Consumer Traits**
   A growing world-population, decreasing areas of arable land and the growth in demand for plant-rich diets poses challenges around key micronutrients for human health. Gene editing allows us to improve specific qualities such as the accumulation of higher levels of vitamins and minerals which are found in low levels in many crops, or to improve oil and carbohydrate profiles, delivering foods that benefit consumers and reduce the burden on healthcare providers. Gene editing offers the potential to develop innovation in a wider range of plants for consumers.

3. **Climate resilience**
   Increased temperatures and changes to rainfall are already impacting harvests and yields in the UK, as well as around the globe. Gene editing can be used to develop crops which are more tolerant to heat, drought and salt and better able to withstand changing climates.

4. **Accelerating innovation**
   The traditional methods that plant breeders use to introduce traits can take 8-15 years. Gene editing techniques can significantly speed up the crop breeding process to just a few years, bringing about essential scientific development much sooner and at a much lower cost of investment.

5. **Putting the UK back at the forefront of crop research and stimulating industry**
   In the early 1990s, the UK was considered a global leader in crop biotechnology, but seed and breeding companies moved their advanced breeding activities to outside the EU, put off by the additional cost and time for product development as a result of the regulation. By allowing research findings to progress through to field evaluation at a much faster pace, this regulatory change in England will provide greater opportunity for smaller companies and start-ups to get involved in this area. This will increase innovation across the sector and diversify the market, helping put the UK at the forefront of crop science.

6. **Gene editing as a research tool**
   Gene editing is not just used to create new products; it is also a useful research tool for understanding the role of genes, helping us map genomes, and understand how genetic changes affect properties and varieties.

Call to Action

The science research institutes based on the Norwich Research Park are developing the plants and food products of the future using gene editing. **We urge Members of the House of Lords to support this Bill during its first reading and onward in the subsequent committee stage.**

The full nutritional quality, less environmental impact, disease resistance and climate resilience benefits of gene editing technology and research will only be realised if crops and products developed this way are able to reach farmers and consumers, either in the UK or in external markets.

We therefore welcome the Government's intention to implement proportionate and science-based regulations to allow gene edited products to be brought safely to market and provide consumer confidence.

Progressive and proportionate regulations, based on scientific evidence of safety will provide consumer confidence in gene edited plants. Investment in plant science depends on the Government ensuring the commercial potential for this important research.

Some examples of research on gene-editing at the Norwich Research Park include:

- The John Innes Centre is using gene editing to map genes in wheat and brassicas such as oilseed rape, to increase resilience to climate change and develop new varieties.
- The Quadram Institute is working with gene edited wheat with an increased amount slowly-digested and resistant starches which reduce the elevated blood glucose levels and insulin response to refined carbohydrates.
- The Sainsbury Laboratory have used gene editing to create mildew resistant tomatoes which, if deployed, would dramatically reduce the use of fungicides.
- Tropic Biosciences are using gene-editing to boost the resilience of current banana varieties to the deadly *Fusarium* wilt disease.

Further information on these examples or full case studies can be provided.

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