DÁIL ÉIREANN

AN COMHCHOISTE UM THALMHAÍOCHT, BIA AGUS MUIR

JOINT COMMITTEE ON AGRICULTURE, FOOD AND THE MARINE

Dé Céadaoin, 9 Márta 2022

Wednesday, 9 March 2022

Tháinig an Comhchoiste le chéile ag 5.30 p.m.

The Joint Committee met at 5.30 p.m.

Comhaltaí a bhí i láthair / Members present:

Teachtaí Dála / Deputies	Seanadóirí / Senators
Martin Browne,	Victor Boyhan,
Matt Carthy,	Paul Daly,
Michael Collins,	Denis O'Donovan.
Michael Fitzmaurice,	
Joe Flaherty,	
Paul Kehoe,	
Michael Ring.	

Teachta / Deputy Jackie Cahill sa Chathaoir / in the Chair.

Business of Joint Committee

Chairman: We will suspend for a couple of minutes while we bring in the witnesses.

Sitting suspended at 5.06 p.m. and resumed at 5.08 p.m.

CRISPR-Cas9 Gene Editing: Discussion

Chairman: Before we begin, I remind members, witnesses and those in the Public Gallery to turn off their mobile phones completely or to switch them to airplane, safe or flight mode, depending on their device, for the duration of the meeting. It is not sufficient to put phones on silent mode because this will maintain a level of interference with the broadcasting system.

The purpose of today's meeting is to discuss CRISPR-Cas9 gene editing. The committee will hear from several experts, officials from the Department of the Environment, Climate and Communications and representatives from Teagasc.

On 28 February, the legal requirement for mask wearing in all settings was removed. However, it is still good practice to continue to use a face mask cover, in particular in crowded areas. The service encourages all members of the parliamentary community to wear a face mask when moving around the campus or in close proximity to others. While the easing of restrictions has removed the general requirement of maintaining a 2 m physical distance, the public health advice continues to state that maintaining a distance from other people is good practice. It is important that everyone in the parliamentary community continues to respect the physical space of other people.

Witnesses giving evidence within the parliamentary precincts are protected by absolute privilege in respect of the evidence they give to the committee. This means that a witness has full defence in any defamation action for anything said at a committee meeting. However, witnesses are expected not to abuse this privilege and may be directed by the Chair to cease giving evidence on an issue. Witnesses should follow the direction of the Chair in this regard and are reminded of the long-standing parliamentary practice to the effect that, as is reasonable, no adverse commentary should be made against an identifiable third person or entity. Witnesses who are giving evidence from a location outside the parliamentary precincts are asked to note that they may not benefit from the same level of immunity from legal proceedings as a witness giving evidence from within the parliamentary precincts and may consider it appropriate to take legal advice on this matter. Privilege against defamation does not apply to the publication by witnesses, outside the proceedings held by the committee, of any matter arising from the proceedings. Members are reminded of the long-standing parliamentary practice to the effect that they should not comment on, criticise or make any charges against any person outside of the Houses or an official, either by name or in such a way as to make him or her identifiable. Parliamentary privilege is considered to apply just to members participating online in this committee meeting when their participation is within the parliamentary precincts. There can be no insurance in relation to participation online from outside the parliamentary precincts and members should be mindful of this when they are contributing.

During the first session today members will hear from several experts on CRISPR-Cas9 gene editing. Dr. Thomas McLoughlin has worked as a research scientist with leading biotechnology companies and in universities in Ireland and the United States of America in the

areas of soil microbiology and molecular genetics for 20 years. Dr. McLoughlin later worked as a senior scientist for the Environmental Protection Agency, EPA, and is now retired, on the implementation of GMO regulations of Ireland.

Dr. Barbara Doyle Prestwich is head of plant science and principal investigator at University College Cork, UCC, and her research area includes plant science, biotechnology, sustainable agriculture and genetics. Dr. Doyle Prestwich was appointed the first female president of the International Association for Plant Biotechnology in 2015.

Dr. Raghuram Badmi is a molecular biologist, and a postdoctoral scientist in Dr. Doyle's laboratory at UCC, funded through the Career-FIT PLUS programme. Dr. Badmi is working on generating a disease-resistant strawberry using CRISPR gene editing.

Dr. Patrick Harrison is head of the cystic fibrosis gene editing group at the department of physiology in UCC. The main research focus of this laboratory is the development of CRISPR gene base and prime editing to study and potentially treat human genetic disorders such as cystic fibrosis.

I now call on the witnesses to read their opening statements, commencing with Dr. McLoughlin. The witnesses have been instructed to keep their opening statements to a maximum of five minutes.

Dr. Thomas McLoughlin: Dia dhaoibh, a Theachtaí Dála agus a Sheanadóirí. I wish to thank the committee for the kind invitation to come before it this evening. In particular, I wish to thank Senator Paul Daly for getting this important subject on the agenda.

Gene or genome editing is also referred to as new genomic techniques and new breeding techniques. I will use the acronym GE.

The world faces enormous challenges in producing sustainable food for its growing population, given the escalating pressures of climate change and biodiversity loss. There can be no doubt that the Covid-19 pandemic reminded us of our vulnerability and the need to be prepared for potential future pandemics. The same can be said of how we produce our food and the potential for food shortages due to drought, floods, forest fires, the advent of more aggressive plant and animal diseases or pests, and the threat due to war.

The EU's farm to fork strategy is the cornerstone of its green deal. Its objective is to contribute to a more sustainable food production system by reducing, among other things, dependency on pesticides by 50%. The strategy refers to GE, which may play a role in increasing sustainability.

I shall turn now to mutation breeding. Over the past 70 years, mutations in plant genomes have been induced by plant breeders using ionizing radiation or chemicals to increase genetic variability. This method of modifying genetic material is called random mutagenesis and the resulting organisms are technically genetically modified organisms, GMOs, and are exempt from the scope of EU GMO legislation on the basis that they have a long history of safe use. Much of the food we eat today originated from the use of this technology.

What is gene editing? GE, which can be defined as all techniques to alter the genome of an organism developed after 2001 - when the EU's legislation on GMOs was adopted - has rapidly developed over the last two decades in many parts of the world, with some applications already on the market. The most recent addition to the breeder's toolbox, discovered in 2012, is a GE

technique called CRISPR-Cas9, which is what we are talking about this evening. It is described as a genetic scissors that can be used by scientists to change the DNA of animals, plants, and microbes with extremely high precision. Two scientists, Jennifer Doudna and Emmanuelle Charpentier, won the 2020 Nobel Prize in chemistry for discovering this technique.

In 2018 the European Union Court of Justice, ECJ, ruled that organisms obtained by induced or classical random mutagenesis constitute GMOs, and that these are exempt under the GMO directive. However, the ruling also stated that organisms obtained through techniques of directed mutagenesis involving techniques like CRISPR-Cas9 are not excluded from the scope of the directive. Since that ruling, there has been much debate about its implications. Industry, breeders, farmers and academia were alarmed at the court's decision.

The ruling prompted many European plant and life science companies to submit a paper to the EU Commission outlining the negative consequences for agriculture if all organisms developed with GE will have to comply with EU rules on GMOs. This prompted the EU Council in November 2019 to request the Commission to submit a study in light of the ECJ ruling regarding the status of GE techniques under Union law.

Contributing towards this process, 12 legal and scientific experts - including myself - published an article in January 2021. In this article we analysed the court's judgment and concluded that the ruling merely sheds light on the court's general thinking but did not address the legal status of organisms developed through GE techniques in general, nor was it asked to do this. Also, the precise implications of the ECJ ruling are far from settled, as is also highlighted by the Council's request to the Commission. Furthermore, in November 2021, the French authorities took a second case to the ECJ seeking further clarity on the 2018 judgment.

The EU study was published in April 2021, following stakeholder consultations. The main findings were that GE technology has the potential to contribute to sustainable food systems; and that the 2001 GMO legislation is not fit for purpose and needs updating. It is more than 20 years old and the science has moved on but the legislation has not moved on. Concerns were also raised over potential impacts on biodiversity, coexistence and labelling. The European Food Safety Authority, EFSA, concluded that targeted mutagenesis techniques that modify the DNA of plants, like some CRISPR technologies, do not pose more hazards than conventional breeding or techniques of GMO. The executive summary states that organisms obtained through GE are subject to the GMO legislation. In a submission to the Commission in May 2021, a number of EU regulatory experts, including myself, concluded that this statement was not substantiated by the report and we urged the Commission to elaborate on the points raised in our analysis in order to reduce the ambiguity in the regulatory status of organisms obtained with GE.

With regard to the next steps, the EU Commission is working on a targeted policy action on crop plants derived from targeted mutagenesis. This policy aims at a proportionate regulatory oversight to maintain a high level of protection of human and animal health and the environment, and to achieve the goals of the farm to fork strategy, which is of paramount importance. An impact assessment, including a public consultation, will be carried out by the Commission to examine potential policy options this year and a proposal for legislation by the middle of 2023.

We can ask whether EU attitudes are changing on GE. There is certainly an increasing interest in GE technology worldwide. This was driven by the part played by modern biotechnology in the identification of the vaccines, PCR and antigen tests, and genomic sequencing that are

enabling the world to protect us against the Covid pandemic. These are all examples of advances in modern biotechnology over the past 40 years. I put it to the Chairman that these are of paramount importance. Science is taking us out of this terrible pandemic.

Will GE technology be used in the EU? GE technology has the propensity to revolutionise agriculture, environment and medicine for the benefit of people worldwide. It is of paramount importance that this technology is regulated in a proportionate manner at EU level and harmonised with other countries. We hope that the intransigence regarding GMO adoption in the EU for the past 30 years does not continue to blight the adoption of GE technologies like CRISPR into the future. This message needs to be communicated by the Irish Government at EU level. Gabhaim míle buíochas leis an gCathaoirleach.

Chairman: I thank Dr. McLoughlin.

Dr. Barbara Doyle Prestwich: I thank the committee for the invitation to speak on CRISPR-Cas9 gene editing in plants.

As Dr. McLoughlin outlined in his opening remarks, we face enormous challenges in producing sufficient food to feed a growing population, estimated to be 10 billion by 2050. It cannot be business as usual in terms of crop food production. The most recent IPCC report paints a damning picture of our collective inaction in terms of greenhouse gas emissions. Ireland is currently ranked first in the world in terms of global food security in the Global Food Security Index, but the index is dynamic and we cannot afford to become complacent. Unexpected external shocks can have a huge impact on a nation's food security as evidenced by the ongoing situation in eastern Europe. In addition, under the European green deal and to meet the United Nations sustainable development goals, we in Ireland must make changes in how we produce and manage our crops.

My colleague Dr. Raghuram Badmi will focus more closely on the actual technology. For my part, I will focus on the international scene and why I believe we cannot afford to ignore CRISPR technology in Ireland, and more broadly across the European Union.

The constraints we face in terms of sustainable food production include, but are not limited to, land use, water availability, drought, heatwaves, flooding, disease control and soil health, coupled with an ever-diminishing list of available agri-chemicals. Some might argue that Ireland is not quite at the coalface in terms of impacts of climate change on food production, but it would be a grave mistake to ignore the writing on the wall. At present, we have a toolkit that includes new genomic techniques, also known as new breeding techniques, NBTs, which Dr. McLoughlin referred to and which are continually being rolled out in many countries around the world. These techniques offer precision genetic engineering capabilities that can introduce discrete changes in a plant's DNA in order to make improvements such as disease resistance and drought tolerance, as well as many others.

What is the international experience of this technology, including CRISPR? As Dr. McLoughlin pointed out, this is a relatively new technology, but already we are seeing its adoption in many countries to great effect. Argentina has been a leader in the regulation of these NBTs since 2015. Data gathered there offers us some insight into the potential of this technology and its impact, not just on crop production but on technological innovation and its democratisation. What I mean by democratisation is that SMEs and the public sector have an opportunity to participate in product development and commercialisation. According to Whelan in 2020, "As a source of codified knowledge, regulations have a direct impact on technology

diffusion because they affect the generation of new technologies, as well as decisions on their adoption by potential users". This is very important for both Ireland and the EU.

Over the past 30 years, one of the main criticisms levelled at the plant biotech industry globally has been that the production of biotech crops is in the hands of approximately four multinationals, leading to issues connected with food sovereignty. To a large degree this has been due to the huge cost and time involved in the regulatory and commercialisation process, with no guarantee of subsequent product approval. Due to delays caused by over-regulation, some biotech industries have left Europe - BASF in 2012 is a case in point. Compare this with the development of crops via NBTs over the past three years. I have included a table in my report, Table 1, taken from Eriksson in 2018, where already we are seeing a diverse range of traits being produced. Some have been produced from within the public sector. One can see in the table crops such as soybean, maize, mushrooms and potatoes and the traits vary from drought and salt tolerance to oil content, anti-browning and so forth. Among the players in that table are places such as the Donald Danforth Plant Science Center in the United States and Pennsylvania State University, among others.

Safety and regulation must be top of any country's list when it comes to the introduction of new technologies. A regulatory process needs to be effective and efficient, and enabling of technological innovation, which should be a major consideration of policy makers. Again, if we look to Argentina, its regulations do not include a list of named techniques *per se*. As a consequence, they can be agile and are able to respond quickly to small incremental steps in technological innovation. This has led to more innovation. At least seven countries, so far, exempt genome edited products from genetically modified organisms, GMO, regulation where there is no additional DNA incorporated into the plant. Those countries are Argentina, Australia, Brazil, Chile, Colombia, Japan and the USA.

What are the challenges for Ireland? The European Commission's farm to fork strategy is recognised as a cornerstone of the European green deal. This green deal has committed to no net emissions of greenhouse gases by 2050, a decoupling of economic growth from resource use and no person or country being left behind. However, in realising these ambitions, Ireland will face some serious challenges in terms of crop food production. Under the farm to fork strategy, there is an ambition to halve chemical pesticide use by 2030 under the sustainable use of pesticides directive. However, what are the alternatives on offer with this diminishing use of agri-chemicals? I refer to the technological toolkit, the NBTs that I mentioned earlier, which we cannot afford to ignore. In fact, last month the recently elected chair of the EU Parliament's agriculture committee, Norbert Lins, called for progress on NBTs.

In conclusion, we in Ireland and Europe cannot afford to ignore the technological advances that CRISPR has to offer in terms of addressing our commitments under the European green deal, specifically climate, biodiversity and food systems. We must also be cognisant of how different national regulatory standards will impact international trade. The EU imports over 32.5 million tons of soybean and soybean meal from South and North America and approximately 5 million tons of rapeseed and rapeseed oil from Ukraine, Canada and Australia. I am not mentioning wheat in that figure. Finally, it was originally thought that the EU Court of Justice ruling that limited access to this technology would also have a large impact on Africa. However, it is now accepted that China, whose five- year plan prioritises new breeding techniques, could fill the gap if the EU fails to engage with the technology. For consumers, food producers and European economies, this would be a grave mistake. I thank the members for listening.

Dr. Raghuram Badmi: I wish to convey my sincere thanks for this opportunity to share

my views on the CRISPR-Cas9 or, more generally, genome editing technologies. Genome editing tools such as CRISPR-Cas9, clustered regularly interspaced short palindromic repeats - CRISPR associated protein 9, transcription activator-like effector nucleases, TALENS, and zinc finger nucleases, ZFNs, are all, in their basic forms, a pair of specific DNA scissors. They are specific for a particular DNA code, meaning that they can only recognize one specific stretch of a DNA sequence. If these scissors encounter a DNA sequence that does not match with their own DNA binding code, they cannot bind or cut that sequence.

These scissors scan the DNA, recognize and bind to their specific DNA sequence and perform the cut. Once there is a cut in the DNA, the cellular repair machinery recognizes the cut and initiates the repair process. Any cut in the DNA is a signal to the cell for recruiting the repairing tools at that site and completing the repair process. When the cell decides to repair the DNA, it mostly chooses a repair mechanism called non-homologous end joining, NHEJ. During the NHEJ repair process, a different DNA base - A, T, G or C - is added to the DNA 30% to 70% of the time, thereby changing the DNA code. The part of the DNA with the changed code loses its function and the plants that have these different bases are selected. This is how the editing of the genome or genome editing is achieved. This type of editing comes under the site-directed nuclease type-1, SDN-1, technology where it does not require an outside DNA and occurs as a result of an error-prone DNA repair mechanism of the cell. This method would be the first-choice for any researcher because the only aim here is to break the DNA at the desired location, then the cell takes over for the rest of the process. One example of SDN-1 is soybean oil with no trans-fat, with high oleic oil and low linolenic oil content developed by Calyxt using TALENS. This is the first commercially-available gene-edited plant product in 2019. The second example is camelina, the plant in the mustard family used for oil with enhanced omega-3 oil. It was developed by using CRISPR by Yield10 Bioscience and cleared by the United States Department of Agriculture, USDA, in 2017.

However, sometimes only breaking the DNA is not enough. When there is a need to improve the function of a certain gene, a stretch of DNA which is functional, it might require adding, deleting or changing specific DNA bases at a particular DNA location. To do such precise editing, a repair DNA template is introduced, along with the scissors - DNA scissors plus repair DNA template. The repair DNA template has the correct bases that we want to add or delete and the DNA address for where it should go and stick to. When we do this, the cell chooses a different repair mechanism called homology directed repair, HDR, about 5% to 10% of the time at best. During HDR, the cell copies the DNA bases present in the repair DNA. The copied DNA segment replaces the original DNA segment and completes the repair process.

A modified version of CRISPR-Cas9 known as base editing is emerging. Base editing, as the name suggests, is used to convert the specific base in the DNA from A to G or from C to T, without the need for a repair DNA template. These types of editing come under the category of site-directed nuclease type-2, SDN-2, technology that includes making small but precise edits to the DNA in the order of a few bases, which in most cases are sufficient to improve functions of the gene. Examples of base editing are high nitrogen use efficiency in rice by changing one base cytosine, C, to thymine, T, using cytidine base editor, and high yield in rice by changing adenine, A, to guanine, G, using adenine base editor and simultaneously C to T at specific places of SPL genes. Site-directed nuclease type-3 technology involves inserting entire genes or DNA fragments, which can comprise more than 1,000 base pairs. SDN-3 is used to provide novel functionalities to the plants that are not present before. An example of SDN-3 is golden rice, a variety of rice engineered to produce beta-carotene, pro-vitamin A, to help combat vitamin A deficiency.

SDN-1 and SDN-2 both mimic natural mutations caused by chemicals or irradiation. However, unlike other mutations that occur randomly in the entire genome of an organism, SDN-1 and SDN-2 are very precise, which is almost everything we could ask for.

On the next sheet of my written opening statement I have some additional information for all the members to go through.

Dr. Patrick Harrison: I thank the committee for this opportunity. As mentioned in the Chairman's prefatory comments, my interest in gene editing is for medical purposes.

Sixty-five years ago scientists discovered that a single specific mutation in the sequence of our DNA was enough to cause the genetic disorder sickle cell anaemia. The same is true of cystic fibrosis, muscular dystrophy, spinal muscular atrophy and 4,000 other inherited disorders. Collectively, these diseases affect 7% of the world's population. It is not rare to have a rare disease but it is extremely rare to have an effective treatment.

In 1970 the concept of gene therapy was proposed. The idea was to add a corrected copy of the defective DNA sequence into cells of an affected individual. In 1993 the technology finally caught up with the idea and the first clinical trials began. However, three decades and 5,000 clinical trails later, with remarkable advances, we still have only two gene therapies that have been licensed. Peter Marks of the Food and Drug Administration recently stated that it would take 600 years to increase that number to 100 approved medicines if we were to continue with existing tools at the current rate.

Rather than paper over the cracks in the genome, can we delve into the genome, find those mutations and fix or edit them? Yes, but I ask the committee to consider for a moment the magnitude of the problem. The book I am holding up contains about a million letters or bits of information; our genome contains 3 billion bits of information, or 3,000 of these books stacked on top of one another. That is the height of the Spire of Dublin, which, by coincidence, is overlaid with the double helix pattern of DNA. However, the mutation we need to fix is just one letter in those 3,000 volumes, and all that information is in the DNA of a cell that cannot be seen without a microscope, so it is quite a challenge.

In 2005 scientists in California described one of the techniques already mentioned, with the first precision gene-editing technique to correct a mutation in cells from a patient with severe combined immune deficiency. The symptoms of that disease are as bad as its name suggests. A few years later my lab in Cork became the first to use that technique to correct the most common cystic fibrosis mutation in cells. However, progress with these early editing techniques was slow and we really needed a paradigm shift.

The breakthrough, as mentioned, came in 2012 with CRISPR-Cas9, a programmable RNA-guided DNA endonuclease. It was the missing piece of the puzzle. CRISPR-Cas9 could target any mutation in any gene in any organism. For academic labs it was free and easy to use. Within a year a new CRISPR study was being published every day. Currently, a new CRISPR study is published every 60 minutes. These research publications are describing proof-of-treatment studies for hundreds of rare diseases in animal models and in human cells. The first ethically approved clinical trial of CRISPR reported its results in *The New England Journal of Medicine*, the most prestigious medical journal in the world, for a handful of patients with a rare liver disease just last summer. There are many more clinical trials ongoing as we speak, and more sophisticated and refined CRISPR strategies are constantly emerging with improved specificity and safety. We require additional tools to target specific tissues in patients, and those will need

to be underpinned by appropriate medical, regulatory and access frameworks to pay for them. However, for individuals with these diseases - cystic fibrosis, sickle cell disease, muscular dystrophy, certain types of cancer and thousands of other conditions - there is now real hope and real prospects because of CRISPR.

Chairman: I thank all the witnesses for their comprehensive and extremely interesting opening statements. This topic is unusual for the committee - we usually deal with more mainstream topics - but what the witnesses have said is extremely interesting and thought-provoking.

I invite Senator Paul Daly, as he was the instigator of this discussion, to ask his opening questions.

Senator Paul Daly: I welcome the witnesses. I have already had contact with Dr. McLoughlin, which aroused my interest in this area, so I asked for its inclusion on the work programme. I thank the Chair and the committee for accepting that. Today is a beginning and more an educational process for us. In the second session, in which we will have Teagasc and the Department before us, we will be able to carry on and query them based on the information we will have gathered from the witnesses in this session.

I have a couple of questions. To the witnesses, who are all professionals in this area, they might sound very naive. I am starting from square one on this and educating myself as much as anything else. The kernel of the issue I see, from reading the witnesses' opening statements and from their presentations, is that, based on the European Court of Justice ruling, the GMO directive, in the witnesses' opinion, should not include CRISPR-Cas9 because, in layman's terms, as I read it, GMO technology involves bringing in outside DNA or combining two unrelated organisms, whether plant, animal or whatever else, whereas with CRISPR there is no outside influence.

Dr. Thomas McLoughlin: There could be. CRISPR could be used such that there would not be a need to introduce any foreign DNA, but the CRISPR technique could also be used such that a gene from another organism is inserted. It depends on what is used. Dr. Badmi mentioned SDN-1 and SDN-2. They are deregulated, if you like, in other jurisdictions. They are CRISPR techniques that, in our view, should not be regulated as GMO. A number of other countries in the world, such as the United States, Argentina and now the UK, can see this technology as hugely important rather than bulking everything together in the GMO regulations. As for the definition of GMO, our argument against the ECJ decision was that it has to involve something that occurs naturally. Mutations occur naturally in plants and micro-organisms. They are not included in the GMO regulations. The ECJ has bulked them all in together. The 12 people who wrote that article, including me, and other people since have argued that that decision was probably not the right one. Even the Council of the European Union was not happy with it either. We might have another chance with the French going back and asking for more clarity. As for the decision and the EU study, that is where the Department of the Minister, Deputy Eamon Ryan, will come in. It is the policymaker in Ireland. However, if we lose this technology in Ireland and if both techniques are treated as GMOs, they will never see the light of day. That is the concern I and my colleagues have.

Senator Paul Daly: Dr. McLoughlin has somewhat answered where my question was going. If we had a magic wand and if the directive or the EU's attitude were to change, it would not be a *carte blanche* CRISPR-Cas9 that would be acceptable to the witnesses. They would want to see it defined as non-crossing of genes. They would want it to stay within the gene of the specific plant or animal.

Dr. Thomas McLoughlin: Yes.

Dr. Barbara Doyle Prestwich: Yes, and the thing about the CRISPR we are talking about is that while additional sequences can be introduced, there is also CRISPR whereby a change is made and the change is not any different from one that might occur in nature or one that could be included through X-ray mutagenesis, which are not labelled under the directive as GMO techniques.

Senator Paul Daly: I would like to get a better idea of this. As for the technologies that are evolving in the countries that have accepted CRISPR, how far behind the curve are we compared with those countries on specific production yields, use of pesticides, etc.? Were the directive to change, how long would it take us to catch up? Could we piggyback on advances that others have made or would we need to make specific modifications, given our soil types, climate and the types of crop we are sowing? If so, how long would it take? Would we have the labs and expertise if we got the green light in the morning?

While reading the submissions, I thought about how we had had many meetings on the forestry sector, during which ash dieback was often discussed. One of the solutions proposed to us had to do with how people were in the process of trying to develop ash trees that were resistant to ash dieback. If we start interfering like that by developing a new ash, when will the new ash stop being native Irish ash? Could this technology be used to develop an ash dieback-resistant ash that was still a native Irish ash so that we would not have to import anything?

Dr. Barbara Doyle Prestwich: In terms of the number of changes that could be incorporated, the simple answer is "Yes". As to the Deputy's question on the technology that is available on the island of Ireland, Dr. Badmi is a molecular biologist working in my lab in UCC. His project – he can say more about it himself – involves looking at the strawberry plant to develop a strawberry that is resistant to a particular disease using CRISPR. The technology is there to generate disease-resistant varieties that will have very few changes compared with the unmodified plant.

Dr. Raghuram Badmi: As Dr. McLoughlin mentioned, we can use CRISPR to insert entire genes, but what we are seeing with SDN-1 and SDN-2 are precise changes. They do not insert or delete genes. Rather, we are targeting just a few letters among a billion base pairs.

My project involves identifying certain genes that can make strawberries resistant to diseases. Making those changes in the strawberry plant could just involve a couple of letters in its entire genome. We can see great results with this approach. Other countries have done this.

Dr. Thomas McLoughlin: If we do not use it in Ireland, we will be importing wheat, for example, and we will not be able to apply the EU's legislation on traceability and labelling because there will be no way of identifying that wheat if the changes to the genome are small. For example, one letter in the genome could be changed to make it tolerant to some disease. It is a major issue in the EU right now.

This train has left the station. Other jurisdictions are already using this technology and are moving ahead. The main question is, if we do not use this technology, what will our farmers be doing? We will be importing apples but we will not know how they are produced. With a GM variety, we can identify it because there is a new piece of DNA in the apple. With some gene editing techniques, however, we cannot identify the relevant varieties.

In light of the Commission's study, it is of paramount importance that a decision be made in

2023. This matter is dear to my heart. I retired five years ago, having worked in the area for 40 years. If we lose this technology in Europe, it will be a crying shame. This is the science that is taking us out of the pandemic. It is just another tool of modern biotechnology.

Senator Paul Daly: That covers all of my questions. I thank the witnesses.

Deputy Joe Flaherty: I thank the witnesses for attending. Their contributions have been informative. This discussion is probably much more highbrow than what we are used to, but it is good to have it. What is happening in Ukraine has put a focus on food sovereignty. Covid has been mentioned. There is probably no more pertinent a week for the witnesses to appear before us on this issue.

Teagasc will be appearing before us later. I am unsure as to whether the witnesses before us now have seen its opening statement, but Dr. O'Mara's submission reads:

> However, since the European Court of Justice ruling in 2018, the European Food Safety Authority concluded that editing techniques do not pose any more hazards than conventional breeding. A multitude of scientific organisations across the EU have arrived at a similar conclusion.

We agree, Teagasc agrees and the witnesses agree, but this is a battle that we will have to take to the EU. Of EU countries, we seem to be the most adversely affected in terms of farm to fork and our ability to produce. Where the witnesses' peers across Europe and the experience of European academics are concerned, is there an appetite to take this on at European level or are we swimming against the tide?

Dr. Barbara Doyle Prestwich: There is definitely an appetite to take it on at European level. I am part of a European Cooperation in Science and Technology, COST, action and we have more than 300 members from all EU countries. Ireland is not swimming against the tide at all. We have a project of work to do in terms of communicating with the public. Senator Daly alluded to that in his example of ash dieback and how different a modified plant would be from the original. In our business, we are still hearing the same or similar arguments that were out there 20 years ago about the technology and the public's fears, so there is definitely a communication project to be done in that regard.

Deputy Joe Flaherty: A concern among the public, which Dr. Doyle Prestwich referenced, has to do with the sovereignty and integrity of food production and the domination of this area by four multinationals. Should we have done more as a country, ideally through Teagasc, research and our universities, to take a greater role and put more investment into it? Academics will always say that we should have given them more money, but with the benefit of hindsight, is that something that each European country should have done?

Dr. Barbara Doyle Prestwich: Most definitely. Those four big multinationals have been at the forefront because of the cost of regulation. That has been the real problem. We have been doing this kind of work in our labs for years through undergraduate and postgraduate projects, but when we reach the stage of wanting to commercialise a product, it could cost up to an estimated €20 million. Even where the older version of this technology is proven okay on safety grounds, it might still be blocked in Europe. CRISPR is different, though. A different kind of scene is emerging. I cited a number of examples in table 1 of my submission, which references some universities that are now able to be in the game and be competitive doing it. We are moving away from domination by multinationals. That was purely on financial grounds, not

because of technology or expertise.

Deputy Joe Flaherty: I was struck by Dr. Harrison's work on cystic fibrosis, CF, and his references to the progress that had been made over the past ten years or so in the treatment of CF patients. Is it fair to say that we have evolved and come a long way in terms of licensing and producing new drugs and modified treatments for human health but we are probably light years behind in terms of licensing the same for food production?

Dr. Patrick Harrison: Yes. There have been great changes in clinical gene editing. I remember the first studies being published 16 or 17 years ago, which piqued my interest in this field. Something that is interesting is the way that CRISPR is used in the medical sense compared with how it is being discussed in the food sense. If the committee approaches the EU about this, it is important that it be clear about all the different things that CRISPR can do. It can make small deletions and change individual base pairs, but it can do much more sophisticated things that we need to do to treat some of these horrible diseases. That is not necessarily what people are proposing in respect of food, though. The things that we are trying to do in cells for patients would be more similar to what could be regarded as GMOs. One of the main differences in humans is that we use somatic gene therapy – we treat a person and he or she cannot pass it on. The exact opposite is the case in the food industry where we have to produce lots of seeds so that we can produce more crops.

If we are having an honest conversation, then CRISPR can do all sorts of things. We need it for medicine and my colleagues are using specific aspects of it for gene modification in crops. That is a very different thing.

Deputy Joe Flaherty: I thank Dr. Harrison.

Deputy Matt Carthy: I thank the witnesses for their very interesting presentations. I must admit that, like Senator Paul Daly, I am not clear on how it all works. I wish to have a few points clarified for my own understanding. Under the ECJ ruling, GMO products are largely banned across the EU but there are some exceptions, of which Spain is the most notable. Where does CRISPR fit in? Is the ruling of the ECJ interpreted and implemented across the EU on an equal basis or are there anomalies, as there are with GMO?

Dr. Thomas McLoughlin: The ECJ is the final arbiter of EU law. Many people, including those I have been working with, came to the conclusion, when we deciphered the ruling, that it was only speaking in a general sense. We must remember that those are legal people who have no idea about molecular biology or science, although I have no doubt they would probably have consulted people. Academia, farmers and plant breeders were amazed at the decision. When we submitted a report on the Commission's study, which was published last April, we said we believed the Commission had also taken the ECJ's side. The consultation, which has already started, will hopefully be finalised this year and there may be a decision next year. All is not lost, but at the moment nothing is happening as regards putting products on the market. Deputy Carthy is right that in Spain an insect-tolerant maize plant is being used that protects the plant against the European curved corn borer. We do not use it here because we do not have that pathogen. Portugal is also using that plant, which is very small. In 2019, worldwide-----

Deputy Matt Carthy: I am sorry to interrupt Dr. McLoughlin but for clarification, are Spain and Portugal operating under a derogation or do those particular GMO products have a licence?

Dr. Thomas McLoughlin: No, they are licensed.

Deputy Matt Carthy: They are licensed across the EU. It just happens that they are the countries that use it.

Dr. Thomas McLoughlin: Exactly. We should remember that in this jurisdiction we banned the cultivation of GM crops in 2018 under the regime of the then Minister for Communications, Climate Action and Environment, Deputy Naughten.

Deputy Matt Carthy: Going back to my original question, is the CRISPR technology being used anywhere in the EU at present?

Dr. Thomas McLoughlin: Only at laboratory level, for research and development, but we are ready to go. I am sure the Deputy will hear more about it. He heard the story from Dr. Harrison about strawberries. It is being used for research and development, pending the outcome of the Commission's final decision. Member states will have a significant input into the decision.

Deputy Matt Carthy: The great anomaly with GMO products is that goods produced from practices and products that are banned in the EU are permitted to be imported, which is an inherently unfair system.

Dr. Barbara Doyle Prestwich: Yes.

Deputy Matt Carthy: If we are going to ban a practice, we should ban the importation of products for which the practice is used as well. Otherwise, we are putting the likes of our grain growers at a distinct disadvantage. Then, when there is an emergency, we ask why we do not have more of them. That issue needs to be addressed.

In terms of CRISPR technology, does the EU also allow the importation of products that use it in the same way as we allow GMO products to enter the EU?

Dr. Thomas McLoughlin: They will be allowed. This is not easy for the committee members to decipher - it is hard enough for us. As we tried to explain, we cannot identify a wheat plant or soya bean coming in that was produced used CRISPR. There is no technology available to identify it, whereas it was produced using a GMO, that would involve taking a piece of DNA and putting it into that plant and we could identify it. We cannot do that with some CRISPR techniques and that is the crux of the issue. It would not comply with EU legislation and we would not be able to enforce the EU legislation. The Commission is very well aware of this. It has spent a lot of money to see if it could get any techniques it could work with, but it is nearly impossible. It is akin to looking for a needle in a haystack.

Deputy Matt Carthy: To mask my ignorance and for the layperson in the audience at home, I want to ask a question that has already been asked. What is the biggest distinction between GMO and CRISPR in terms of the specifics? I understood that one technique involved two different organisms, but Dr. McLoughlin is saying that CRISPR could also use two organisms. What is the biggest distinction in terms of process and outcome?

Dr. Barbara Doyle Prestwich: I will say something on that and then hand over to Dr. Badmi, who is our molecular biologist. Reference was made to Spain and Portugal. Those crops, using what I will call the previous technology, which is still very much operational, would have genetic information from another organism incorporated in them. I think Deputy Carthy understands that.

Deputy Matt Carthy: Yes.

Dr. Barbara Doyle Prestwich: With CRISPR, we have the choice either to incorporate something or not to incorporate anything. It is the latter that we are talking about when it comes to the regulations. As Dr. McLoughlin indicated, with CRISPR, we can make changes that cannot be detected. They are minute changes in the genome. We are not incorporating any foreign DNA, if I can call it that.

Deputy Matt Carthy: How does that work in practice? How is that done?

Dr. Barbara Doyle Prestwich: I will hand over to Dr. Badmi.

Dr. Raghuram Badmi: We can do it in multiple ways. Basically, the CRISPR-Cas9, which we are talking about, is a pair of scissors. We can tell the CRISPR where to go and bind and it then goes and binds at that specific sequence in the millions of base pairs in the DNA. It goes specifically and binds there and it cuts the DNA. That is what CRISPR basically does. Then the cell recognises that there is a cut in the DNA and it has to repair that, as it cannot be left unrepaired. When the cell tries to repair the DNA, that is when it introduces a different DNA base. Let us say there is a piece of DNA we want to change, when it tries to repair the cut DNA - we call it ligating - by trying to glue the different pieces, the cell itself changes the base from A to C, for example. When it changes from A to C the DNA core is changed. The single letter change out of millions of base pair changes will lead to loss of function of the gene which harbours this changed nuclear type. It stops functioning. What we are trying to do is to stop the gene from functioning by asking the cell to introduce a mistake or perhaps it is not a mistake to the cell.

Dr. Barbara Doyle Prestwich: Was that clear?

Deputy Matt Carthy: To be quite honest, it is at times like this that I wish I had paid more attention in biology class. In fairness, Dr. Badmi makes is sound very simple. It is just that I am not fully sure if it has sunk in yet.

Dr. Barbara Doyle Prestwich: Just to add to what Dr. Badmi was saying, when we talk about introducing a change, it is a change from within the organism. It is not introducing an external change.

Deputy Matt Carthy: I get that.

Dr. Barbara Doyle Prestwich: That is the key difference.

Deputy Matt Carthy: Perhaps Dr. Harrison wants to come in on this. The obvious concern, which is the one that is raised most often, both in terms of the older GMO technology, as it has been described, but it will apply equally here, is that changes made to one crop might have an unforeseen implication either for other crops, biodiversity, climate or something else. There could be some knock-on consequence for the animals that eat the product, including humans, or whatever the case may be. Do the witnesses share those concerns or are they mitigated with the protections that could be put in place?

Dr. Raghuram Badmi: I do not see how these single base changes can be damaging or how they could influence anything because when we talk about chemical or natural mutagenesis, even in those processes we are talking about changing single base pairs or multiple base pairs and those are in random places. In SDN-1 and SDN-2, however, of 50 million or 1 billion base pairs, we know exactly which letter has changed. I do not see how single base or multiple base

changes can affect the environment, other than the plant itself.

Dr. Thomas McLoughlin: To follow on from that, we have spent more than €300 million of EU taxpayers' money on safety research into GM technology over the past 30 years. In 2010, the then European Commissioner Máire Geoghegan-Quinn published a study that stated GM technology per se was no more harmful than conventional plant breeding. As a case in point, if we look back to Teagasc and the GM potato, which I am sure we will hear more about, that DNA that came from a wild variety of potato made it blight tolerant. That was done using GM technology and the same could have been done using plant breeding. What was done in Teagasc and Wageningen University was to speed up the process. Senator Paul Daly mentioned the resistance to ash dieback as well. The power of this technology can be used to speed up the plant breeding process.

As for safety, EU studies have concluded it is no different, and I imagine the same will be said about gene editing. As Dr. Badmi said, some of the gene editing techniques happen in nature, and that is why we cannot differentiate between some CRISPR techniques and what happens in nature. There is no technique to evaluate that change. In the case of many of the GM products on the market at the moment, such as in Spain, there has been a reduction in the use of pesticides. That must be good for both climate and biodiversity, two very important issues. Of course, the European Green Deal seeks to reduce the use of plant-protection products but, as Dr. Doyle Prestwich asked, if we reduce their use and get rid of them, how will Irish potato farmers farm their potatoes without the use of some of these techniques? This is why we are arguing that CRISPR-Cas9 could take the place of some of the chemicals we use to control potato blight in Ireland. We have to be very careful.

Deputy Matt Carthy: One of the main arguments traditionally made against GMO relates to corporate influences, as Dr. Doyle Prestwich mentioned in her opening remarks. We have all heard stories of the power of companies such as Monsanto and the control they have over farmers in particular. Farmers are penalised for seed leakage, for example, and there is a significant level of control whereby farmers and the wider food chain become beholden to one big corporate enterprise. How can that be mitigated? Will our guests describe how they would foresee circumstances playing out? Dr. McLoughlin gave the example of potato growers in Ireland. How would they operate if we were using this system? Would they annually have to get seeds from a particular company and be bound by contract to that company? How would that relationship evolve over time and how would farmers be protected? Dr. Doyle Prestwich mentioned democratisation whereby smaller companies would play a part, but the nature of global capitalism is that large companies come in and take over successful small companies and sometimes they can become monoliths. How would that be mitigated?

Dr. Barbara Doyle Prestwich: I might take that first. One of the reasons I mentioned democratisation relates to the fact that the biggest difference with CRISPR technology in the context of regulation relates to the fact that what happened, say, 30 years ago will not happen again. We are seeing this already within the public sector and among SMEs. If we correctly regulate this and do not classify it under a GMO, we can democratise the process. People such as us in academic labs around Ireland will have greater access, and access to commercialisation will be a more level playing field.

Furthermore, more than 30 years ago, two of the main traits in genetically modified crops were insect resistance and herbicide tolerance. In the few years in which CRISPR has been used in this way, however, we are seeing a much more diverse range of traits that will suit smaller holdings as well. I refer to resistance to drought, for example, or, in the context of health, the

issue of increased oil the Deputy mentioned and so on. Certainly, in terms of democratisation, there will be significant changes if CRISPR is regulated in the right way such that we do not push towards the large multinationals. As I said, it has been well documented that the regulation of crops is very expensive. Applying to get a product onto the market can cost up to €20 million. As universities, we cannot afford this, and neither can SMEs, which are being pushed out of the market in that regard.

Dr. Patrick Harrison: I might return to an earlier question. It struck me when Dr. Doyle Prestwich and Dr. Badmi were talking that there is a massive parallel to gene editing in humans. We knew how to edit mammalian cells in the 1980s but we could not do it for therapeutic purposes because a marker had to be added. The breakthrough in 2005, which I mentioned earlier, was that cells could be edited with CRISPR without adding that marker. This is something Dr. Doyle Prestwich and Dr. Badmi touched on. With CRISPR, there is a choice. Editing can be done without the marker, which is what they are arguing should go forward, or with a marker, which I think they are arguing against. If that distinction is made, we cannot hide the fact that certain things can be done with CRISPR that people may not want, but there is much that can be done with CRISPR that people could be quite happy with and that could have many benefits for people.

Senator Victor Boyhan: I thank our guests for attending. I do not think four doctors have ever appeared together before an Oireachtas agriculture committee. That does not mean we are daunted by them; we are an incorrigible bunch. There has been much bad publicity about this issue in the past. There is no Green Party member of the committee in attendance at the moment, although perhaps he is attending remotely. Nevertheless, there are fears of a loss of control in regard to production, issues with seed production and scaremongering in regard to whether there will be plants that do not have valid or high-quality seeds. Another member mentioned Monsanto and there has been much international publicity about that company. This is very powerful technology. There was a reference earlier to how similar technology has been used in the context of human healthcare and it does not seem to present the same problem.

Will our guests elaborate on the issue of sustainable agriculture and the European Green Deal? How does this all fit in to the bigger picture and architecture of the European Green Deal? It is a very current issue that everyone is buying into. It is part of the CAP discussions and wider environmental issues. This country has a coalition Government including the Green Party, which has expressed strong views on the issue. Even so, when I ran a quick search within the programme for Government in advance of this meeting, I found no reference to the issue. It does not seem to be a commitment for the Government one way or the other. The then Minister for Agriculture, Food and the Marine, Deputy Creed, stated that Government would keep it under active consideration but there were no commitments. Clearly, there have been advances and it is a developing technology, but there genuine concerns and, in the absence of facts, people are somewhat frightened by it all.

How do our guests foresee the European Green Deal fitting in with all this aspiration, vision and planning? It is very important. In Ireland, responsibility for GMO policy and regulation comes under the Departments of the Environment, Communications and Climate Action, Agriculture, Food and the Marine and Health, the EPA and the Food Safety Authority of Ireland. Do our guests have views on that? Should it be more centralised? I appreciate there is overlap and I can see why, but they might outline their views. In the interests of reassuring people, how can all this be squared up? We have to make the language simple for people to understand. I again thank the witnesses for coming in and for providing their papers in advance which we have all

had an opportunity to read.

Dr. Thomas McLoughlin: There have been concerns. The technology is more than 30 years old and has been used worldwide, especially in North America and South America. Most of the soybean that we import is GM and the corn is GM. In fact, a good argument for the GM potato is whether consumers in Ireland would eat a potato that was not sprayed ten or 13 times during the year? The other question I have is that organic farmers in Ireland and elsewhere in the European Union are allowed to use copper sulphate to control potato blight fungus. Copper sulphate is actually a heavy metal from copper. It is crazy that such products are on the market. To have consumers using a GM potato has to be much safer but, as Dr. Doyle Prestwich said, communicating that message to the public is hugely important.

One of the Deputies asked whether there were any concerns over the years. The big concern 30 years ago with herbicidal tolerant plants was that those plants would become invasive within the environment. That did not happen. However, we have a lot of invasive species in the west of Ireland. In my own part, Achill Island, there is gunnera. There are rhododendron and Japanese knotweed all over the country and no one is doing anything about it. They are not even on the list at the EU because they are out of control, yet we are worried about something that probably will never happen with a GM crop, let alone CRISPR. I think the CRISPR technology is much safer again and, as I have stated, is the same as traditional plant breeding and GM technology. Communicating it to the public is very important. An example is the GM potato and perhaps the Teagasc representatives will mention that when they come in later.

Dr. Barbara Doyle Prestwich: To add to what Dr. McLoughlin has said, under the European Green Deal and the farm-to-fork strategy, to my mind, the biggest selling point is that, as a country, we have committed to certain climate targets. For farmers in Ireland, I honestly do not understand how we can efficiently and effectively reduce our pesticides by half by 2030, which is the commitment. We may well reduce our pesticides but the disease is still out there, so what do we do to treat the disease? Dr. McLoughlin referred to copper sulphate in the organic sector, which is banned in a conventional setting, but what do farmers conventionally use? What is available to them?

Again, coming back to communication, this is something we have suffered from within this industry for a very long time because other groups will get out ahead of the scientists and say certain things. Those are real concerns that we have to take on board as well but, sometimes, the truth gets lost in the story. A quick sound bite gets out there and it is run and all the rest, so the real science gets lost. We definitely have a battle in terms of the communication.

This could be one of our solutions, although I do not think any of us would say that this is the only way forward. As stated earlier, and we all alluded to it, what we are talking about is a toolkit. From that toolkit, there are certain things we can take, and this is just one of them. For example, we have the integrated pest management strategy. This does not take from maintaining good soil health, crop rotation or good agricultural practice, but what it does is give every farmer in the country the possibility to reduce their spraying regimes and, as a consequence, reduce emissions as they do not have to spray with fossil fuel-based chemicals. I see huge advantages with this technology. Communication is going to be our stumbling block but we can get it right.

Dr. Thomas McLoughlin: In last week's *Irish Farmers Journal*, there was a very good editorial by the editor questioning the green deal and how we produce our food in the European Union in view of what has happened in eastern Europe. Are we going to reduce the acreage of

food? Are we going to be rewetting given biodiversity and climate change is very important? He has questioned it. I am sure all of the committee members have read the editorial, and I see the Cathaoirleach is smiling. It is a very good editorial and a timely intervention because we need to be using all the tools in the toolbox, but we also have to be very careful of what is happening because Ukraine and Russia produce a lot of wheat for the world market. On the European Green Deal, we need to bí cúramach.

Senator Victor Boyhan: I want to also ask about herbicide intolerance under this technology, which is a frightening thought for some. In many ways, I can see the benefits of controlling herbicides and it is clearly better than spraying all the bits and pieces. Will Dr. Doyle Prestwich explain that technology because there are people listening in here and those who will be looking at "Oireachtas Report" tonight and saying this is very interesting. Herbicide intolerance is bred into many crops under this technology. It is used in other places in the world, so we know it works. Can she explain some of that technology, how it works and how it all happens, in very simple language, if possible?

Dr. Barbara Doyle Prestwich: That is not what we are talking about in terms of CRISPR so I think the Senator wants to talk about this separately.

Senator Victor Boyhan: It is not to confuse matters.

Dr. Barbara Doyle Prestwich: We all know that herbicides are not just used with genetically modified crops and we use herbicides all of the time. Herbicides have been around for a lot longer than genetic but, somehow, that argument has become kind of confused, if we like. Generally, and very briefly, the science behind herbicide tolerance is that herbicide tolerance is a trait that is exhibited both by plants and by microbes in the soil. With some of the stuff we see in terms of what is happening in the United States, like herbicide-tolerant maize, for example, it may be that a gene has been taken from a microbe and inserted into a plant, and that is one way. There are different strategies and I will not go into all of them, but that is just one way. Again, herbicides are not around because GM crops are around, but the two have been conflated.

Senator Victor Boyhan: I accept that but there is confusion. They are conflated and people say that, so there is a lot of explaining to do.

Dr. Barbara Doyle Prestwich: I think so. This is where we come back to the good communication strategy. The Senator might remember that, in 2018, we ran an international biotechnology conference at the Convention Centre Dublin. We tried to do as much public outreach on that as possible but we have to address the communication, which is key, and that is what we are here today to do. We are very grateful to have this opportunity to talk to all of the members here and to try to get the message across that some of those old arguments that are still being rolled out are not relevant to this technology. That is not to say there are not real concerns as well and that is what we are hoping to discuss.

Dr. Thomas McLoughlin: On the herbicide tolerant genes, the Senator is right that at that time, 20 or 30 years ago, there was a concern that, for example, with oilseed rape the gene would flow from the pollen into related breed species and there would then be herbicide tolerant weeds that we could not control in Ireland. That did not happen. However, as I said, we have invasive species that came in, such as Japanese knotweed and others, and no one is concerned about them at all. I would call that the irony of ironies.

Senator Victor Boyhan: I thank the witnesses. That is very helpful.

Deputy Michael Fitzmaurice: I thank the witnesses for attending. I have several questions. Perhaps these are myths but these things need to be talked about. I have heard that in America, going back many years, companies would have modified corn. The farmer had to sew it under licence and if some of it was brought to the next field on the wind, the farmer was tied into having to pay a fee even though they might not be involved in it. I have read that but is it correct? On top of that, on the European green deal, unfortunately, they probably did not listen to the most important people in all of this, the farmers. In academia, they were doing this up but they will have to go back to the drawing board because we are now in a wartime era, although we had talked about having food nearly coming out of our ears, with all they were telling us. There was talk of cuts and different things being done in Mayo, in the west, or in Donegal, and that there would be rewetting and that the sheep, cattle or whatever would be taken. They have got this very wrong and, in my opinion, Europe must become self-sufficient. I say that because of what have we tended to do in Europe, and I mention the Green Deal. We are becoming the sales people. If it is dirty, we get Brazil or some other country or continent to produce it. We will sell it on as long as it does not produce carbon emissions. It should be brought home to us now that heat and food are two of the most important things. We are stuck at the moment. We are like birds in the nest with our beaks open because we are waiting for oil and different things to arrive. We have left ourselves high and dry. Do the witnesses have a problem with that?

I listened with interest to Dr. Patrick Harrison. He talked about the different problems people have in health and that one can change a plant to perform better. Blockages were mentioned. Is the big blockage EU regulation? Reference was made to member states. Do member states make independent decisions or does everything hang on a European decision?

Dr. Barbara Doyle Prestwich: The Deputy has asked good questions.

Dr. Thomas McLoughlin: The regulation will depend on what happens in the European Union. I hope the directive could be amended to allow for certain types of CRISPR classed technologies. I hope that can be done quickly and that it would be harmonised with the rest of the world, so grain coming in will be exported.

Deputy Michael Fitzmaurice: The word "amended" has been mentioned. Surely Dr. McLoughlin does not think the civil servants in Ireland will amend it?

Dr. Thomas McLoughlin: I hope that it will be done in Brussels. The Government or the Department of the Environment, Climate and Communications will be involved in those debates. It is at EU level.

I will answer one other question. The Deputy mentioned what happened many years ago in the States. There were a number of cases but that was in the early days of crops of GM technology. A few farmers took a case against a neighbour for cross-contamination. I think there were a few court cases and cross-contamination was found to have occurred because pollen will flow but the question was whether it caused environmental harm. If one grows oil-seed rape on the border of County Mayo and it went into the Deputy's county of Galway, then the question would be whether it caused environmental harm. I believe that would not. Those are the key things. There were a few court cases but we have not heard of any in years.

Deputy Michael Fitzmaurice: Is it under licence? Does a farmers pay a fairly dear price to have this? Will farmers be tied to this practice with the company?

Dr. Thomas McLoughlin: It did not pertain to Ireland. Only one crop has been approved

for use in the European Union, which is the maize crop that is tolerant to the European corn borer and that would not pertain to Irish agriculture because we do not have that. I would imagine there are some sort of technologies that farmers might have to pay for but I suggest the Deputy addresses his question to Department officials when they come in. I am not very *au fait* with the matter but I think there are some royalties or whatever. Let us remember that in Ireland, the Teagasc potato breeding programme has been very successful over the last 70 or 80 years and it gets royalties from some of its technologies. One can see that happens with company State bodies as well.

Dr. Barbara Doyle Prestwich: There must be some pay back in terms of the investment in research and development. I suppose that is where part of that comes from. The Deputy mentioned Ukraine and food issues. We cannot say that tonight CRISPR is going to solve the problems that have come about with the most recent shocks in the food system. I really think it would be a mistake on our part if we ignored this technology. We are not talking about today or tomorrow. In the near term we need to embrace this technology, and we need an increase in research and development. We have the expertise in our universities. We must increase that expertise and growth facilities to make sure we are ready for the next shock that is going to come along. In my paper I referenced how Ireland is currently comfortably ranked No. 1 on the global food security index but last year it was Singapore and that is now relegated to 17th place. Therefore, this is a very moveable and dynamic index so we should not become complacent in this country. If we are to realise the Government's ambitions in terms of the Green Deal and the farm to fork strategy, then it cannot be business as usual. That is just not possible. The diseases that farmers are faced with are not going to disappear overnight because we have some ambitions in terms of the climate and all the rest. We really need CRISPR technology and, therefore, we need to invest in research in Ireland to make sure we are ready to go. CRISPR is not an overnight solution. We can be doing CRISPR in our laboratories but we need to know how these products will perform at field trial level. Field trials take a little bit of time to develop in terms of proof of concept, conduct analysis and so we need to be ready.

Deputy Michael Fitzmaurice: Are these under licence?

Dr. Barbara Doyle Prestwich: In terms of CRISPR, no. This is what Dr. McLoughlin talked about in terms of the ruling.

Dr. Thomas McLoughlin: Yes.

Dr. Barbara Doyle Prestwich: It is really important that our politicians are fully engaged with this and are aware of the advantages of this technology, what the regulations will mean and what it will mean if we do not or are not able to use this as non-GMOs.

Dr. Patrick Harrison: Road blocks have been mentioned. The regulations that apply to CRISPR or gene editing or gene therapy for medical purposes are completely different and governed in a completely different way, so that would not apply to the kind of stuff we are doing for medical development. That is a whole different ball game.

Dr. Thomas McLoughlin: In June 2020, the European Commission had to withdraw the power from the 27 member states when they placed the vaccines on the market to protect the population of Europe because it is very bureaucratic system. Most of those vaccines were produced using GM technology but many people in Ireland or, indeed, across the European Union did not realise that happened so the European Commission had to expedite the whole thing. If it had not done so, or we could be still waiting for vaccines. Ironically, it is the same GM tech-

nology that produces plants as produced the Oxford-AstraZenica vaccine. Science and gene editing are hugely important. If we do not use it in the European Union, then we will have to import all of their food and our farmers will be doing nothing and that will be an awful shame. That is why I am adamant about this matter.

Again, I thank the member for raising this topic and suggesting that we come in. I also appreciate that the members have listened to us. As someone who has worked in this area, and I retired five years, I felt there was an onus on me as a former regulator who knew a bit about the regulations and where they are going in Europe. Things do not happen that fast in Europe, and I am a little bit concerned.

Chairman: I thank the witnesses for their very informative briefing and discussion. As was said by others, the timing of this debate is very opportune because food security is very much back on the agenda. As a farmer, I think people definitely did not listen to some of us over the last couple of years but we will get a better reception now going forward in terms of ensuring food security not just for this country but for Europe.

Sitting suspended at 7 p.m. and resumed at 7.04 p.m.

Chairman: The second session will deal with the same subject matter. We will hear from officials from the Department of the Environment, Climate and Communications, and Teagasc. Joining us remotely from the Department are Mr. Eoin Deegan, principal officer of the environment policy division, and Ms Susan Fleming, assistant principal officer. From Teagasc, we are joined by Professor Frank O'Mara, director, Dr. Ewen Mullins, head of corporate research, and Mr. John Spink, head of the crops, environment and land use programme. They are all welcome.

Mr. Eoin Deegan: I thank the Chair and members of the committee for inviting my colleague and I to assist the committee in its discussion on the issue of CRISPR-Cas9 gene editing. I am principal officer of the environment policy division in the Department of the Environment, Climate and Communications. I am joined by my colleague, Ms Susan Fleming, assistant principal officer. In my role as principal officer, I lead the division with responsibility for environmental policy matters, including in relation to the deliberate release of genetically modified organisms, GMOs, into the environment, the transboundary movement of GMOs and the contained use of GMOs. The Environmental Protection Agency, EPA, is the competent authority in this area. Responsibility for regulating seed for cultivation and animal feed in relation to GMOs falls under the Department of Agriculture, Food and the Marine. The Department of Health has responsibility for policy matters concerning food safety with respect to genetically modified food.

A GMO is any organism whose genetic material has been modified using genetic engineering or transgenic technology, for example, by insertion of genetic material from another living organism or through gene editing. This modification confers certain traits that are considered advantageous, such as increased productivity for crops or resistance to disease. No genetically modified crops are commercially cultivated anywhere on the island of Ireland and the only GMOs approved for cultivation in the EU are not suitable or relevant to Irish agricultural conditions. International policy on GMOs is governed by the Cartagena Protocol on Biosafety. The protocol is an international treaty governing the movements of GMOs from one country to another. The treaty is an agreement under the UN Convention on Biological Diversity, which is the main international instrument for addressing biodiversity issues. The protocol recognises that modern biotechnology and the cultivation of GMOs presents the potential to enhance hu-

man well-being while also recognising the need to protect human health and the environment from the potentially harmful impacts of GMOs. The protocol also sets out how risk assessment and risk management procedures should be conducted, to assess and control any potential risks arising from the importation of GMOs. All EU member states and the Union itself are parties to this protocol.

To implement the provisions of the protocol, the EU has put in place a comprehensive legal framework to deal with all aspects of the cultivation, transportation, labelling and use of GMOs, including the assessment and authorisation of genetically modified crops for cultivation; the assessment and authorisation of genetically modified products for use in food and animal feed; the cultivation of authorised genetically modified crops alongside conventional and organic crops; and the transboundary movement of genetically modified crops. The main aim of this legislation is to protect the environment from potential harm arising from the cultivation of genetically modified crops or other genetically modified organisms, as well as giving the consumer a clear choice, through labelling, between genetically modified and non-genetically modified products, and the confidence that all genetically modified products can be traced back to source.

Given the multifaceted nature of GMOs, an inter-agency meeting is held yearly between relevant bodies to support inter-agency working and policy positions while a statutory EPA advisory committee on GMOs is in place, providing advice to the EPA board on GMO matters. This committee has a broad remit and may be consulted on any aspects of its functions in relation to GMOs which the EPA considers appropriate.

I return to the Department's two main policy areas. The deliberate release of a GMO means any intentional introduction into the environment of a GMO or a combination of GMOs for which no specific containment measures are used. Deliberate release includes the placing on the market of genetically modified products or cultivation of genetically modified crops, including, for example, field trials in the case of genetically modified plants or any experimental release into the environment and clinical trials involving human medicinal products containing or consisting of GMOs. Deliberate release is governed by Directive 2001/18/EC at EU level and regulated at national level through SI 500 of 2003 - Genetically Modified Organisms (Deliberate Release) Regulations 2003. The EPA is the competent authority.

Contained use refers to the use of GMOs or genetically modified micro-organisms in a controlled setting and for which specific containment measures are used in order to limit their contact with, and provide a high level of safety for, the general population and the environment. As well as being physical, barriers can be chemical and-or biological. In Ireland, the contained use of GMOs is predominantly carried out in laboratories in colleges, universities and hospitals and by industry, for example, by biopharmaceutical companies. Contained use is governed by Directive 2009/41/EC at EU level and regulated at national level through SI 73 of 2001 - Genetically Modified Organisms (Contained Use) Regulations 2001, as amended. The EPA is the competent authority.

On this evening's discussions on CRISPR-Cas9, CRISPR stands for clustered regularly interspaced short palindromic repeats. It differs from traditional genetic modification methods as CRISPR is able to resequence an organism's DNA without the insertion of DNA from another organism. This technique, in the main, does not involve the transfer of genes or DNA from another variety or species but alters the existing DNA sequence of the organism. These new mutagenesis techniques are referred to as new genomic techniques, NGTs. In July 2018, the European Court of Justice ruled that organisms obtained using NGTs are GMOs and are subject to the full rigour of GMO legislation. In the EU this is likely to slow the development

of GM crops produced using these techniques and make research using CRISPR more costly to undertake.

In particular, for member states, difficulties arise with the identification and quantification of the products produced using these techniques making enforcement more difficult. Many of these new mutagenesis techniques have been developed since the introduction of the GMO legislation.

The EU will need to address this matter through inter alia revising EU GMO legislation. The 2018 ruling prevents the EU from benefiting from the technological advances and competitiveness available to societies elsewhere, for example in the USA, China, Canada and in post-Brexit UK. This ruling has been also criticised by industry and a number of breeding companies are considering relocating their advanced mutagenesis breeding programs outside the EU.

Subsequent to the European Court of Justice ruling, a number of member states expressed a desire to amend EU legislation to facilitate the registration of NGTs for possible cultivation and use in the EU. As a result, the EU commissioned a study on the regulation of NGTs, which was published on 29 April 2021. There were a number of expert contributors to the study and some of the main conclusions included the following.

Many NGT products have been developed over the past 20 years with some already on the market in third countries and many more expected in the coming years. Regulation at trade level is problematic as detection and differentiation of NGT products that do not contain foreign genetic material is extremely difficult. A different regulatory regime for NGTs in the EU versus third countries will lead to disruption in trade between member states and their trading partners, potentially leading to trade disputes. The current regulatory regime in the EU, where NGTs are regulated in the same way as GMOs, restricts research and development and has a particularly negative impact on research and development work emanating from research institutions and SMEs.

The study concludes that NGTs can contribute to the objectives of the European Union Green Deal and the farm-to-fork strategy by developing plants more resistant to diseases, improved tolerances to environmental stress due to climate change, improved agronomic and nutritional traits, reduced toxins and allergens and reduced use of inputs such as fertiliser and plant protection products. In the pharmaceutical sector, NGTs would afford faster development of medicinal products, including vaccines, which could address unmet medical needs.

Negative aspects are identified, such as concerns regarding potential safety, potential negative impact on biodiversity, concerns regarding cross-contamination when cultivated beside conventional and organic crops, as well as regulation of labelling and consumers' right to information and freedom of choice. Stakeholders have different and often opposing views on these aspects.

The European Food Safety Authority concluded that plant products derived by conventional breeding techniques, which are not currently classed as GMOs and which target mutagenesis and cisgenesis, can have similar risk profiles. Thus, a different regulatory oversight for products with similar levels of risk would not be justified. The current risk-assessment procedures are rigid and not open to adaptation to evolving scientific progress, as will inevitably occur with further development of NGTs. The study indicates that the risk-assessment procedure employed for traditional GMOs is not fit for purpose for NGTs and their products and it needs adaptation to scientific and technological progress. Any new legislation needs to be resilient,

future proof and uniformly applied, as well as contribute to sustainability objectives.

Following the publication of the study in April last year, the European Commission proposes to develop a policy action on NGTs which will facilitate a proportionate regulatory oversight, while at the same time maintaining a high level of protection of human and animal health and the environment and, allow the Community to reap the benefits from innovation.

Inception impact assessments aim to inform citizens and stakeholders about the Commission's plans in order to allow it to provide feedback on an intended initiative and to participate effectively in future consultation activities. In this regard, the Commission published an inception impact assessment on a proposal on the introduction of legislation for plants produced by certain new genomic techniques in September 2021 and received more than 70,000 responses.

The Commission is currently carrying out an impact assessment, including a public consultation, to examine potential policy options and a wide-ranging communication effort to share the results of the study and to discuss its outcome and next steps with the EU institutions and stakeholders. The impact assessment will also ensure policy consistency with other initiatives, for example food sustainability. It is expected that the legislative proposal will be available for public consultation in the second quarter of 2022 with a final adoption in 2023 and aims to tackle the issues I have highlighted.

GMO crops are not commercially cultivated anywhere on the island of Ireland. In addition, there was a Government decision in 2018 to transpose Directive 2015/412, which has been completed and enables Ireland to prohibit or restrict the cultivation of GMOs, and to change Ireland's voting stance from abstention to voting against the cultivation of GMOs. This currently sets the direction of GMO cultivation policy in Ireland. However, it is important that the GMO area be kept under review as it is ever evolving and has potentially wide-reaching socioeconomic and environmental implications. The legislative proposal which is due from the European committee in the second quarter of this year will be carefully examined by the Department of Environment, Climate and Communications and the Environmental Protection Agency, as well as other relevant Departments, Government agencies and stakeholders once published.

Chairman: I now call Dr. O'Mara. I believe this is his first time to appear before the committee since he took up his new role. I wish him the best of luck as director of Teagasc.

Dr. Frank O'Mara: I thank the Chairman for his good wishes. I have two colleagues to assist me this evening Dr. Ewen Mullins and Mr. John Spink.

The process of breeding high-performance varieties is dependent on the ability to generate and exploit genetic diversity within breeding populations. The more diverse the population the greater the chance of identifying a highly valued trait for farmers, processors and consumers. For over 70 years mutagenesis has been an established method of generating that diversity.

By treating seeds or plants with radiation or chemical mutagens, mutagenesis changes the function of thousands of genes in a plant. Consequently, this changes how the plant performs. By evaluating tens of thousands of plants over several years, new varieties with enhanced performance or quality can be identified.

A key problem with mutagenesis is that the process is purely random and induces thousands of other unwanted genetic changes in the variety, which are not required. In contrast, gene editing is a precision breeding technique which makes it possible to enhance the performance of an organism via a targeted approach that changes a single gene at a time.

This is achieved using a molecular technique termed CRISPR-Cas, which is composed of two parts, a "molecular scissors" used to cut the DNA an, a molecular "satnav" to guide the scissors to the specific gene. Together these two parts form the CRISPR-Cas machinery that can be used to modify a single gene or indeed if necessary, tens of genes at the same time.

What does this mean in practical terms? Looking to crop breeding for example, editing now allows breeders to deliver a range of traits such as yield enhancement, disease resistance or quality improvement. An important point to make is that editing an existing variety enhances the value of that variety for the farmer or the processor, without changing any of the other traits of the original variety.

For example, many existing potato varieties meet the requirements for processing and baking but lack durable resistance to late blight disease. Because of this susceptibility to late blight, the potato crop requires approximately 12 fungicide sprays per year. Editing provides breeders with the toolbox to make precise changes to the potato DNA and increase resistance to late blight and other potato diseases, without compromising any of the important qualities of the variety.

Another recently reported example describes how editing a single gene in wheat, the MLO gene, can deliver a wheat variety with resistance to mildew. In its natural state, this gene makes wheat susceptible to mildew, which can decrease yield potential. By editing the MLO gene, the researchers turned off the MLO gene and hence enhanced the existing variety giving it resistance to an important disease, without affecting the variety's yield potential. This is simply not possible using conventional breeding techniques, such as mutagenesis, when every step in the breeding process will alter thousands of genes at a time.

This highlights the precision of the editing technique. Compared with humans, who have approximately 24,000 genes, there are more than 300,000 genes in wheat. Having the ability to precisely disrupt a single gene among 300,000 is groundbreaking and illustrates the power of editing as a breeding tool.

As members know, in 2019 the European Commission published the Green Deal. As part of that, the farm-to-fork strategy aims for a 50% reduction in the use of chemical inputs and a 20% decrease in nutrient inputs on cropping systems. As it takes on average ten years to develop a new cereal variety and up to 13 years for a potato variety, if we are to meet farm-to-fork goals, all available innovations, technologies and tools must be considered.

The potential of new breeding techniques is real. For example, I point to the field experiment carried out at Oak Park from 2013 to 2015 as part of an EU-funded project led by Dr. Mullins. That work assessed the impact of a blight-resistant potato variety generated using a new breeding technique. With this novel potato variety, fungicide applications were reduced from 12 sprays to two sprays per season, hence maintaining the sustainability of the crop and demonstrating how farm-to-fork ambitions can be achieved.

An important remit of Teagasc is to investigate the potential impact of novel technologies on the performance and sustainability of the agrifood sector. Editing is but one application of technology that has the potential to assist in the breeding of novel crop varieties and animal breeds. Currently we are using several genomics-based techniques within conventional breeding programmes to improve productivity and underpin farmer returns. One of these is marker-assisted selection, which is much like the economic breeding index, EBI, in cattle. However, although these can improve the rate of genetic improvement, it is still a slow process.

A judgment of the European Court of Justice in 2018 ruled that organisms generated through editing must be regarded as genetically modified organisms, GMOs, within the meaning of EU Directive 2001/18. At a practical level, this means a novel crop variety developed through editing is technically defined as a GMO and hence must pass through the regulatory system within the EU prior to its commercialisation. As has been well documented, this process is both lengthy and extremely expensive. However, since the European Court of Justice ruling in 2018, the European Food Safety Authority concluded that editing techniques do not pose any more hazards than conventional breeding. A multitude of scientific organisations across the EU have arrived at a similar conclusion.

To conclude, Teagasc is not in the business of commercialising or promoting genetically modified crops. We are responsible for supporting the profitability and environmental sustainability of the sector. To achieve this, it is incumbent on us to investigate and assess the impact of new scientific developments, be they positive or negative, so that the relevant sectors and society as a whole can make a decision based on objective information specific to Ireland.

We are happy to answer any questions members may have.

Chairman: Teagasc is the national research body for the agrifood industry. If I hear clearly what Professor O'Mara is saying, it is that GM crops and the available technology can make food production more sustainable going forward.

Dr. Frank O'Mara: Yes. That is clearly the case.

Chairman: This technology will allow more sustainable food production.

Deputy Matt Carthy: I thank our guests for being here. I thank Mr. Deegan for his opening statement. I have a couple of questions on it. I am trying to get my head around where the Department and the Government currently stand. He mentioned the Government decision in respect of GMOs, whereby Ireland's voting stance has moved from abstention to voting against the cultivation of GMO. Leaving aside the ECJ ruling, what would the Irish position have been with regard to new genomic techniques, NGTs? Does Mr. Deegan believe that position with regard to the ban on cultivation of GMOs would also have incorporated NGTs?

Mr. Eoin Deegan: I want to make sure I understand the question correctly. My understanding is that if the ruling was that NGTs were outside the GMO legislation, the matter would not arise, so to speak.

Deputy Matt Carthy: A better way of putting it is to ask whether, prior to the ECJ ruling, it was the Irish position that NGTs were incorporated in our stance on GMOs?

Mr. Eoin Deegan: That is my understanding. I will defer to my colleague, Ms Fleming, if that is okay.

Deputy Matt Carthy: Before Ms Fleming comes in, Mr. Deegan mentioned in his opening statement that several member states have expressed a desire to amend EU legislation to facilitate the registration of NGTs for possible cultivation and use in the EU. Is Ireland one of those states?

Mr. Eoin Deegan: Ireland engages at several forums on the issue of GMOs at a competent authority level and also through the process of how GMOs are approved at EU level. There is a voting process there. I will have to defer to my colleague Ms Fleming but I am not aware of

a specific issue on CRISPR-associated protein 9, Cas9, that it would have been dealt with as a GMO issue. Our policy on that at the moment is to avail of a derogation under the EU legislation. Obviously, we always act within the EU legislation and the framework policy that is there, but we, along with 19 member states, have taken a stance that we reserve the right not to allow GM crops to be cultivated here on a case-by-case basis.

Deputy Matt Carthy: I am not sure whether Mr. Deegan answered my question on whether Ireland was one of the states that has expressed a desire to amend EU legislation.

Ms Susan Fleming: I will come in on that issue. The first question was whether our stance would have been different if NGTs were included in that Government decision. NGTs are GMOs. The 2018 ruling of the European Court of Justice clarified that situation. It was a clarification based on a request from France because there was confusion regarding whether they should be treated as GMOs. There was certainly no means of identifying them as GMOs and that would cause significant problems in the context of the current legislation so there had to be clarification. The clarification from the ECJ was black and white. It ruled that these are GMOs and are to be treated as such within the current GMO legislation. That clarified the situation but it did not help because there is no way of identifying these new breeding techniques as GMOs. It is clear the science is such that these new breeding techniques are not as sensitive or dangerous to the environment as more commonplace GMOs. The Commission has been seeking a more light-handed regulation to be put in place to treat new breeding techniques and get around those difficulties.

As regards the position of Ireland, they are GMOs. They were not GMOs prior to the 2018 ruling but Ireland did acknowledge that if there was no way for us to identify these or treat them within the EU regulatory system, it was a problem. That is the position we put back to Europe.

Deputy Matt Carthy: To clarify matters again, is Ireland among the member states that have expressed a desire to amend EU legislation?

Ms Susan Fleming: Yes.

Deputy Matt Carthy: Okay. I thank Ms Fleming. What is the position of the Department in respect of the issue I mentioned at the earlier hearing, that is, GM crops that are currently banned for cultivation in Ireland and Europe being permitted for importation? I suspect the Department of the Environment, Climate and Communications, above all Departments, has strong views on that. Is that a fair or sustainable approach to continue with in the long term? Have any moves been made by Ireland at EU level to rectify the situation?

Mr. Eoin Deegan: The first point is that we have to operate within the EU directives that are in place. We have taken the option of availing of a derogation whereby we can, on a case-by-case basis, opt out of GM crops being cultivated here. At EU level, we have to comply with the directives and legislation that are in place. If they allow the importation of these crops, then these crops can be imported. Does Ms Fleming have anything further to add?

Ms Susan Fleming: Is the Deputy talking about food and feed or cultivation?

Deputy Matt Carthy: I am talking about products that are banned for the purposes of cultivation but which can be imported as products. I am talking about products that were produced using GMO technology that is banned here.

Ms Susan Fleming: Again, going back to what Mr. Deegan said, products banned for culti-

vation in Europe cannot be cultivated in Europe. Products which are food and feed have to go through the Food Safety Authority of Ireland *vis-à-vis* the EU regulations on food safety and if they are found to be safe as food or feed, they can be placed on the market here.

Deputy Matt Carthy: Is that the case regardless of the fact that their production involved methods that are banned in Europe:?

Ms Susan Fleming: Yes, absolutely. From our perspective and from that of the EU, the issue is whether cultivation of the crops is likely to cause harm to the environment, to neighbouring crops or to animals. It is the cultivation aspect of it that requires more attention.

Deputy Matt Carthy: I know the witnesses cannot deal with policy, but this is quite telling. If something is harmful to the environment in Europe, it would also be harmful to the environment in the United States or Argentina, for example, but I accept that the officials cannot deal with that issue.

I want to move on to Teagasc now. Professor O'Mara has been unequivocal in stating his belief that this technology is a route that needs to be pursued. I am not sure if he had the opportunity to hear the earlier presentations. I asked previous witnesses about some of the concerns around GMO. It is not the case that some EU commissioners woke up one morning and decided that GMO technology would be banned. The ban came about because there was huge public demand for it, in line with the precautionary approach. I have mentioned some of the concerns that have been raised with us previously, including the potential effect and impact on biodiversity, on associated or neighbouring crops and on the wider environment, as has already been mentioned. Other concerns centre on the ownership of the technology and the seeds associated with it. Has Teagasc carried out any research into those concerns and is it satisfied that they can be addressed, as our previous guests indicated, through a regulatory approach?

Dr. Frank O'Mara: I will ask Dr. Mullins to come in on the detail of that in a moment but in relation to the contribution it could make, we have very challenging targets in the farm-to-fork strategy which reflect the very challenging objectives of society. We want to produce our food in a way that has less impact on the environment. We want to use less fertiliser and pesticide but we also want high quality food and plenty of it. To do all that, we need every tool that we can get. We need to find ways to bring innovation and advances to the food production system and these new genetic technologies are one extra tool to enhance our ability to close the circle. It is not that they are the be-all and end-all but they certainly could be a help to us. As I outlined in our opening statement, work that we did some years ago, on which Dr Mullins will expand, demonstrated that really clearly, where we were able to grow a potato crop with a lot less pesticides, resulting in a lot less of an impact on the environment. The farm-to-fork strategy calls for less pesticide use because of the potential impact of pesticides on the environment and if we have a technology that can allow us to do that safely, then that is a good thing. I will ask Dr. Mullins to expand on some of the safety aspects of the work we have done.

Dr. Ewen Mullins: Deputy Carthy asked if we have done research, and we have done so. We have looked at the impact on biodiversity and co-existence, or the issue of pollen-spread across the landscape. In terms of biodiversity, in our potato study we took a gene from a wild potato which gives a conventional potato resistance to late blight. The overwhelming majority of our potato varieties are very susceptible to late blight so by giving them that resistance gene, we effectively gave the crop immunity. We used a new breeding technique which was not editing but a different type of technique which still comes under the umbrella of new breeding techniques. Over the three years of the EU study, we grew the potato in the field in Oak Park

and looked at the biodiversity impact below ground on soil microbes and also on insects above the ground. There was no difference between the conventional variety sitting 6 m away in other plots versus what we were seeing with this new-bred variety of potato. What we did see was that it reduced the fungicide load on the crop by approximately ten sprays.

That was purely a proof of concept and it just illustrated the fact that with new breeding-----

Deputy Matt Carthy: I am sorry to interrupt but did it eliminate the need for pesticides entirely? When Dr. Mullins says ten sprays, what does he mean?

Dr. Ewen Mullins: While it depends on the year, the average would typically be 12 sprays but in that year, it was down to ten sprays.

Deputy Matt Carthy: It only went down to ten sprays?

Dr. Ewen Mullins: Sorry, it went from ten sprays down to two. The control which had no resistance required ten sprays to maintain the crop. It really depends on the environment, including weather, humidity and the various factors for late blight that we know. We used an integrated pest management approach that included modelling the weather. Our default position was that we would not spray unless we absolutely had to. At the moment, that is not necessarily the practice because farmers must protect their crop from late blight. We reduced the sprays from ten down to two but those two sprays were purely precautionary. What we could see is that in another year we might have one spray or three sprays but we are getting the spraying down below the 50% target, which is what is needed for farm to fork.

The key issue, as I said, is that there was no impact on biodiversity relative to what we would see with a normal potato crop. That is exciting at one level because, as I said, it is a proof of concept. However, the key point is that it takes a long time to breed new varieties. We are talking a decade or up to 13 years for a potato variety. We know that because we have been breeding them in Teagasc for over 50 years now. With the new breeding techniques, we are accelerating that breeding process. We are effectively halving the amount of time it takes to get a new variety. It ticks all of those boxes. We could still cross a wild potato with a conventional potato to get resistance but when we do that, we are mixing all of the genes from the wild potato with all of the genes from the conventional one and we get a lot of traits that we do not want. It takes many years to dilute out that background of genetic material that is there.

On the issue of co-existence or the pollen spread, we looked at ways to minimise that. There are very practical ways to minimise pollen spread within a crop. We looked at oilseed rape, which produces a lot of pollen that can travel for up to 150 m from the crop. That tails away very quickly away from the crop, which is not surprising. Measures such as isolation distances, keeping the crop in the centre of the farm and farmers working together in a co-operative environment all help. With the latter, farmers communicate with each other and provide information on when they are growing material and where. All of these very practical measures can ensure effective co-existence. The important point about co-existence is that it is preserving the identity of the crop that is being grown but for organic growers it is extremely important that they can grow their crop on their farm and know there is no risk of the organic thresholds being exceeded. That is very important for certification of organic systems.

Deputy Carthy also asked about seed ownership. Basically, in North America, Canada, and Argentina, farmers go to the seed co-op and they sign an agreement that if they purchase genetically modified seed and grow it, they are prohibited from saving it. Farmers do not have to

grow it if they do not want to in that scenario. When they go back to the co-op each year, as is the case in Ireland, they want to purchase the best seed. As is the case with farmers in Ireland when purchasing seed, they want to purchase the best seed. Putting the best seed in the ground lays the foundation for a good crop. That is typically the approach taken in North America, Canada, etc. There are ownership rights when someone purchases a genetically modified seed, obviously outside Europe as GM crops are not grown in Europe. That is well documented.

Deputy Michael Fitzmaurice: I thank both groups for attending. I wish Dr. Frank O'Mara the best of luck. I presume our paths will cross fairly often. Dr. Mullins and Dr. O'Mara spoke about genetics. Dr. O'Mara might be able to answer this question. We have been able to make progress with genetics on the cattle side, although some might say it has gone too far. We have bred better cattle in many cases. Can Dr. O'Mara explain why this area is such a stumbling block on the crop side when we have been able to make progress with it on the animal side?

Dr. Frank O'Mara: I thank the Deputy for his question and good wishes. I have no doubt we will see a good bit of each other in the coming years, please God. On the cattle side, with the economic breeding index, we are basically using the performance data of the cattle to select the next generation. One measures the progeny of a bull and identifies which is the best bull and breeds from that bull. That is conventional breeding. We have used genomics or genomic selection in cattle breeding in recent years. We have used the DNA profile of the animals as a additional way of identifying, and doing so at an early stage, which of them might be the best but we are not using any technique to alter the DNA of the animal. In conventional plant breeding we do all the same things. We are talking about a technique that could improve that process of getting better genes in an organism. We are talking mainly about plants. The same could happen with animals. The CRISPR-Cas system could be used in animals. Some of the applications for that discussed in the scientific world would include eliminating the need to dehorn animals. The trait of animals producing horns could be removed.

Deputy Michael Fitzmaurice: A polled system.

Dr. Frank O'Mara: Exactly. It could be done in all breeds. It has been done in the Angus breed and other breeds. That could be done in all breeds through these new breeding techniques.

Deputy Michael Fitzmaurice: Dr. Mullins spoke about crops being grown that needed two sprays while others needed ten. Will he elaborate on that as I cannot get my head around it. Generally, farmers would follow weather forecasts and be advised to spray potato crops to protect against blight. How does Dr. Mullins know not to spray at those times compared with every other farmer?

Dr. Ewen Mullins: That is a very good question. In the study in question, we were linked with an EU consortium in the Netherlands and were using a modelling app from our Dutch partners. We would get a ping on the app five days beforehand indicating if there was going to be a high, medium or low threat of blight. It was very insightful at the time because it allowed us to plan ahead. For example, if the temperature gets beyond 20°C and there is no rain or wind, that is an opportunity not to spread. It is important to point out this was a research project that spanned three years in the field from 2012 to 2015. It was not a commercial crop. Farmers growing potato crops will not take that risk. They will be risk averse because they have invested in their crop. Since that project concluded, we have been developing with Met Éireann a new way to inform farmers on blight risk. We hope to be able to publish and launch that in the next two or three months. It is to give people more confidence about when there is a blight risk. As the Deputy said, the default position is that Met Éireann will advise when there is blight risk

but farmers have probably already sprayed once the crop grows up through the soil.

Deputy Michael Fitzmaurice: I may have picked Dr. Mullins up wrong. When speaking about GM crops grown outside the EU he referred to a licence or different systems. Is be concerned about the licence system in America we read about many years ago?

Dr. Ewen Mullins: Things have changed from what they were 25 or 30 years ago. As Deputy Carthy said, at that time there was a precautionary approach because the technologies were new in the late 1990s and early 2000s. Things have evolved. As far as I know, farmers currently sign a contract or an agreement. If there was a development in Ireland or Europe in that regard, we would be talking about standard GM crops, those that are grown in North America, whether they be insect resistant or newer crops that are drought resistant. On editing, from listening to the European Commission, and to use the language it used, the Commission has said the current legislation is not fit for purpose and is too rigid relative to how science has advanced during the past ten years.

Deputy Michael Fitzmaurice: From what I picked up, a big family seems to be examining all of this. I have raised waste issues and the Environmental Protection Agency, EPA, has been considering them for the past two and a half or three years and it does not seem to be bothered about them. It appears the EPA will be the guiding light for Ireland on nearly everything but no results have emerged on most of the issues with which it is dealing. Does Teagasc have to feed the information on this to the EPA? I note the EPA, the Departments of Health and Agriculture, Food and the Marine and the Department with responsibility for climate action will be involved. Off the top of my head, I noted five different parties would be involved. It is hard to get the family to sit down on many an occasion to discuss an issue but if we are trying to get five different crowds to sit down, it is no wonder there is frustration about moving things on and trying to get results.

I spoke to Dr. O'Mara and I note Teagasc is doing research on different areas. Has Teagasc been appointed to do the research on X, Y or Z and report back? Who is making the call on all of this or doing the research? I presume it is under licence when there is a European programme or that a few countries would do it to find out what the results would be in different climates and soils. I am trying to find out who is feeding the information to whom. There are five different groups involved. It is similar to our discussion on hemp growing last week when we seemed to be going around in circles. Is there a cohesive way to feed information into the middle in such a way that we would get a decision to confirm it is good?

I could not believe what I heard Deputy Carthy say. Am I correct in believing that genetically modified soya can be imported on the basis that it is a sound product and would not do harm in the food chain but we cannot grow the same crop here? Did I hear that right? Is Europe such a bureaucracy that this is what we are now facing? I heard about the VAT issue this morning but every time the committee meets, we hear something else about Europe.

Dr. Ewen Mullins: I can answer the Deputy's first question. Our goal is to investigate the technologies and carry out an impact assessment. That is very important. The Deputy asked if that has an impact on policy, etc. There has been a clear impact from the all the research organisations across Europe during the past 18 to 24 months on foot of the European Court of Justice ruling. The Commission's science advisory mechanism and multiple institutions in Europe have published studies on new breeding techniques. All of that has fed into the Commission's considerations and that, in turn, has fed into what has happened as well as the current process, consultations, etc., mentioned by Mr. Deegan. That seems to have traction. The Commission

has made it clear and set out a pathway down for where it wants to see this going.

Deputy Michael Fitzmaurice: How long is that pathway?

Dr. Ewen Mullins: It referenced 2023, and I think Mr. Deegan mentioned it. The policy draft should be published by the end of this year. I am not aware of when or what will be in it. There is no doubt that would not happen without the public-funded research from Teagasc but also the universities and all of the other public institutions around Europe. There is a weight of evidence then. There is not just one study in one field in one country; it is multiple studies across Europe and multiple perspectives.

Deputy Michael Fitzmaurice: I am trying to establish what part of the EU the information is fed into. Is it DG X? My understanding is that DG XI, is environmental? Is it to one of these Teagasc feeds the information or is it the five different parts of the orchestra here?

Dr. Ewen Mullins: In terms of the information we would publish, it is available to the Department and the EPA. The research that we would do primarily would be read by the Commission and the European Food Safety Authority, EFSA, which looks at the impact assessment work, but it is public. It is out there for anybody to digest it. Dr. O'Mara might like to clarify further.

Dr. Frank O'Mara: Dr. Mullins has already clarified. The legislation under which Teagasc was established requires it to look at all of the technologies and science advances that are there and to evaluate them for application in Ireland. That is why we would be interested in this.

Deputy Michael Fitzmaurice: With the best will in the world, Teagasc could be doing the greatest work. I am not questioning that. I am trying to establish who contacts Teagasc in regard to research on this or that. Is that done by the EPA, the Department of Agriculture, Food and the Marine or the Department of Health? Is Teagasc asked to carry out research over, say, a two-year period, and to feed all of that information back to the relevant agency or Department or does Teagasc simply publish that work in a journal and hope that everyone looks at it?

Dr. Frank O'Mara: It is a bit of both, I would say.

Dr. Ewen Mullins: Exactly. We would have done funded research for the EPA, the Department of Agriculture, Food and the Marine and for the Commission through publicly funded research initiatives. The research we do feeds back into these organisations. That should inform policymakers and form policy.

Dr. Frank O'Mara: The research mentioned by Dr. Mullins in regard to the potatoes was funded by the EU. It was not funded by the regulatory part of the EU, but the science part that wanted to see what advances there had been.

Deputy Michael Fitzmaurice: Does all of the research undergo peer review in a journal and so on?

Mr. John Spink: Yes. That is its badge of quality that will cause the Commission, the European Court of Justice or whoever to take it seriously. Other than that, people would say that they do not know whether they can depend on it.

Deputy Michael Fitzmaurice: I did not get a response to my question about the soya that is travelling the world. Am I correct in saying that it can grown somewhere else and brought in?

Mr. John Spink: In Europe, we can import products from crops that we are not allowed to grow in Europe. As stated by Ms Fleming, the assessment is that it is safe to eat or to be fed to animals but there may be more of a risk from growing in a field. The conclusion they have come to is that there could be an environmental risk. Other countries have taken a different view so they will grow it.

Deputy Michael Fitzmaurice: For those who carry out the research, is there any facility whereby under licence, which is how many of these studies are done, they could take a portion of that and grow it here or in some country in Europe to prove there is or is not damage to the soil? Is Teagasc permitted to do that?

Mr. John Spink: Yes. The study described by Dr. Mullins - the potato study - was done in the field in Oakpark under licence from the EPA. There were various restrictions and regulations we had to comply with but that work was done in the field in Carlow. The idea was to look at the impact agronomically and if there was an impact on the environment, which impacts Dr. Mullins has outlined. We can do it under licence.

Deputy Michael Fitzmaurice: I do not wish to hold up the meeting. Mr. Deegan spoke about the legislation and he referenced the term "likely slow". What is meant by "likely slow" in regard to legislation? Is it three years, five years or longer for different directives in terms of this research?

Mr. Eoin Deegan: In terms of the legislative proposal that is coming in, we are likely to get a draft of that in the coming months, probably in quarter 2 of 2022, with a view to it being adopted in 2023. There was some suggestion it might happen in quarter 2 of 2023. At this point in time, we do not have a draft of what the EU is going to propose. It is very aware that there is an issue with the CRISPR-cas9 issue. We have discussed a lot of those here this evening. The roadmap sets out a potential change to the legislation at EU level.

To return to a point made earlier by the Deputy, we are bound by that legislation. It is legislation at EU level that allows for the importation of GM feed if it passes the authorisation standards and at the same time allows member states to take a stance that they do not wish to cultivate genetically modified crops on an opt-out basis. In terms of a timeframe for legislative change, the Commission has indicated it hopes something will be adopted in 2023.

Deputy Michael Fitzmaurice: I understand the EPA and the Departments of Agriculture, Food and the Marine and Health are involved. In regard to this issue, should we not have one body that would have all the expertise within it? My fear is that there would be a going over back from one to the other and that that would delay processes. Is there any fear of that?

Mr. Eoin Deegan: I do not think so. There is an inter-agency group that meets. There is the issue that there are different responsibilities assigned to different Departments. There is expertise within the EPA on the GMO front and, depending on the particular issue, in regard to food, health issues and the cultivation of crops and its potential impact on the environment. There are structures in place to make sure that Departments are aware of the developments on different fronts across different GM techniques and in different GM areas. I certainly would not have a fear on that front.

Chairman: I thank the witnesses. The next speaker is Senator Paul Daly.

Senator Paul Daly: I welcome the witnesses. I would like to be associated with the good wishes to Dr. O'Mara.

Speaking hypothetically, if CRISPR was allowed, do the witnesses think it would enhance the role of Teagasc? In other words, is Teagasc being held back by virtue of the fact that it cannot use CRISPR? In talking about CRISPR, we are all talking about non-transgenic and the modification of the indigenous DNA of the specific plants or products we are discussing. This is trans-European but as we are Irish we will worry about the green jersey. How far behind the curve are we and are we in a position where we can turn up? In terms of Teagasc's research, has it ever provided feedback to the Department of Agriculture, Food and the Marine specifically to the effect that it is being hamstrung by virtue of the fact that there is need for a change in Europe? Teagasc's Marginal Abatement Cost Curve, MACC, was adopted. The witnesses will often say that they only do the research and we formulate the policy, but the Teagasc research carried out in that regard has almost become policy. Does Teagasc have any leverage in terms of being able to say to the Department of Agriculture, Food and the Marine in particular that it is hamstrung and that it will never be able to keep up? Food security is in danger if we do not get a change in European law or the European directive such that we can start using the CRISPR-cas9. Is it ever the case that at meetings within the organisation there are people asking for the use of this to be allowed and saying that there is so much they could do with it? Is it holding Teagasc back?

Before Teagasc responds, I have a question for the Department. What seems to come across from the Department is the enforcement of the directive almost with blinkers on. The message that came across is that the Department is trying to ensure no environmental damage through the cultivation of GMO or whatever. When looking at that, does the Department ever do a balance sheet and look at the negatives of not having GMOs? As part of the European green deal, there is a goal to reduce the use of chemicals. When the potential environmental damage of cultivation is being analysed, is the other side of the balance sheet taken into consideration? If reducing the use of chemicals by 50% were to negate environmental damage, is it considered whether it might be more advantageous to the environment to use these alternative technologies? Following on from that, is it suggested to the Minister that he should be knocking on doors in Europe? We are following the pied piper but, if we are going to achieve the targets the Department is the main instigator in setting, we need to get things changed in Europe. Should we just wait and hope that the next judgment or ruling is better or that the new legislation or directive being proposed in Europe suits us or are we trying to influence these discussions in a way that will suit us? That is a question for both parties.

Mr. Eoin Deegan: I will come in and answer the question on whether we look at the balance. There has been very little movement in terms of crop cultivation and files coming forward at EU level in recent years. It has been very quiet on that front. Perhaps that tells a story in itself. We look at any potential crop cultivation issues on a case-by-case basis. It is very timely to bring up this issue as there is now an opportunity to address it through the legislative proposal that is to come back from the European Commission. We will be in a better position when we see what that legislative proposal entails. It will give us an opportunity, in consultation with all of the Departments, Government and State agencies and research bodies that are involved, to see whether we need to rethink any of our policy positions. It is just very timely. We will get that opportunity once we see what proposals come forward from the European Commission. It is acknowledged that the system is not working particularly well at the moment in respect of CRISPR-Cas9 techniques. Let us see what the Commission will put forward and we can evaluate it then.

Dr. Frank O'Mara: The Senator asked whether we are being held back. I would say "Yes." Not only Teagasc, but also Irish agriculture is being held back. I say that as a scientist

and through the lens of having a tool or technique that could advance things. With due regard to the legislators and regulators, they may have to take account of issues such as those raised by Deputy Carthy, including the public's attitude to things and so on. The scientist's view is sometimes a bit narrow with regard to some things. Sentiment can often be very powerful and also has to be factored in. However, specifically from a scientific point of view, if we had access to this technique, we believe we could do better breeding. We breed three field crops in Ireland: potatoes, clover and grass. We do not breed wheat, barley or other cereals in Ireland. While we do have access to this technique, if we could use it in our breeding programmes, we feel we could improve those programmes and develop better varieties of grass, clover and potatoes for Irish farmers. Wheat, barley and oats are generally bred in other European countries because our market is not big enough to support a breed programme. If those countries had access to this technique, they would be breeding better varieties for us and we could feed into them the types of traits we would like to see enhanced in the crops they breed. I will hand over to either of the experts here to talk to the Senator a little bit more.

Dr. Ewen Mullins: I will pass to Mr. Spink in a moment but the Senator asked about our capacity to do this. We enabled our capacity when CRISPR first came to the fore and have maintained it since. We use it as a functional tool to study how genes behave in plants and whether knocking out certain genes impacts on certain traits in plants. It is very important as a research tool. This research has left us with capacity to capitalise quite quickly if the policy environment were to change. That is important because, as Professor O'Mara said, breeders across Europe are going to be doing that as well.

Mr. John Spink: I echo what Professor O'Mara said. In our breeding programmes, we use all of the genomic techniques we are allowed to use, which are those that are classed as conventional breeding. If gene editing was deemed to be a conventional technique and if there was not a great cost attached to complying with the regulations, I am certain we would use it. We have used genomic selection to stack disease and pest resistances within newer potato varieties. If we could do that faster and more efficiently, we certainly would.

Senator Paul Daly: Do both parties believe we can achieve our climate targets and our targets to reduce the use of chemicals and fertiliser under the European green deal while maintaining food security and a liveable income for our family farm units without this technology?

Mr. John Spink: Without this technology, it will be very difficult. We have known for a number of years that not only because of the European green deal targets to reduce the use of crop protection products, but also because of the rate at which we are losing such products because they do not comply with regulations or because pests or diseases are overcoming them, we are going to need better varieties with better pest and disease resistance to maintain productivity. It is becoming increasingly difficult to keep pace with the loss of crop protection products and the rate at which pests and diseases are overcoming them. It will be very hard to keep winning the fight.

Senator Paul Daly: Does Professor O'Mara ever make that point to the relevant Departments or the people who employ him to do his research? Does he beat that drum in their offices? I refer to the Department of Agriculture, Food and the Marine in particular.

Dr. Frank O'Mara: We certainly make them aware of the possibilities this technique would open up for us. We absolutely do make that case.

Senator Paul Daly: I suppose Professor O'Mara will not tell me the response he gets.

Dr. Frank O'Mara: As I said earlier, I believe the Department recognises that as well. Its representatives can answer much better than I can because they know the system much better than I do. However, there is a very complex European framework in this area that Ireland is part of. The Department also has to balance other views. We come at the issue from the science and technology point of view. As Deputy Carthy said earlier, if you go back 20 or 30 years, there was a very strong fear among consumers about these types of new technologies. That has changed to some extent. The whole Covid crisis was quite instrumental in building people's trust in science and in what science can do. We saw the rapid development of a vaccine based on mRNA, which brought that kind of language into people's daily use. I hope and actually do believe that there is a more mature attitude among people to the use of technology in dealing with the types of problems we are trying to address. They are difficult problems, such as the Senator has outlined. We want to increase food production, to reduce the impact on the environment and to improve livelihoods while we are doing so. Those three things can often pull us in different directions. If we have a technology that can help us get in the bullseye where they meet, it is a shame not to use it where appropriate.

Senator Paul Daly: Perhaps the Department's representatives would like to comment on how they see us achieving these targets without the use of this technology.

Mr. Eoin Deegan: I will go back to a point that has been made a couple of times this evening, which is that at the moment the technology is classified as a GMO technology. We are waiting on a proposal from the European Commission with regard to amending the legislation. From our point of view, we are constantly looking at options across the spectrum to combat climate change. On this issue, we are looking for solutions to ensure continued protections for health and the environment. There is a balancing act. The issue here is that the technology is classified as a GMO and, as a member of the European Union, we are bound to follow EU directives and manage applications or regulation of CRISPR-Cas9 accordingly.

Deputy Matt Carthy: I have a tangential question for Teagasc, in particular. Its representatives were invited in on a different pretext so are entitled not to answer it, but it concerns the debate this week on the ongoing emergency with regard to food production, potential food shortages, input costs and all of that. Teagasc will have a critical role in advising Government, farmers and all of us on meeting those challenges. There has been a question about the capacity to increase grain and other feed production, in particular. Are the witnesses free to comment on our capacity and ability to meet the challenge in the short period available around feed stocks, particularly grain? How do we do that in the context of shortages and substantial cost increases regarding fertiliser, as well as fuel costs and all that is encompassed in those dual crises?

Chairman: The Deputy has asked a pertinent question. The witnesses may not have all the facts and figures but will they give a short synopsis regarding that question to the committee? There are issues with the pig and poultry industries at the moment. I had a couple of pig farmers on to me this week. They are caught in a perfect storm and are under huge pressure. A man was on to me today who cannot get feed for his pigs. He was told the barley is not available. How do the witnesses see those two sectors surviving this? For dairy, beef and grain, the farm gate price looks like it will respond to the prices that are there but in the white meat sector, the response seems to be the opposite way. There is a negative price response. I do not understand, given this food scarcity, why those sectors are under such pressure price-wise. I understand the increase in the cost of inputs but not the prices they are getting in the marketplace. How will those two sectors survive, even in the short term, given the way input costs have gone and their prices?

Dr. Frank O'Mara: I am happy to talk about it insofar as I can. It is a rapidly evolving situation. First and foremost, a major humanitarian issue has captured all our attention and sympathy for the people of Ukraine. On top of that is the impact that will have on our food system. Over the last six months, we have had a significant challenge for the sector. We have had rising prices for fertiliser since late last year. That was a significant challenge, particularly for dry stock farmers. Dairy farmers' incomes and the price of milk are reasonably good so they are better positioned. That challenge is being exacerbated and, in addition, feed prices are increasing significantly.

The pig sector was already in a significant price-cost squeeze, in that the price of pig meat had fallen and the price of feed has risen quite a bit not only in recent weeks, but in the last few months. The pig industry has been under serious pressure regarding profitability in recent months and that will be exacerbated with current developments. We will see increases in the price of grain-based feeds in the coming weeks and have the worry of availability because Ukraine and Russia are big grain-growing and, in the case of Ukraine, grain-exporting countries. What impact will the war have on short-term supply and product moving out of those regions and getting to Ireland and other countries? What will be the impact in the medium and long term on next year's harvest in Ukraine. They are big growers of wheat and maize. Most of the wheat is sown already. It is a winter crop. Will it be harvested? Will the crops be minded in the growing season? Will the maize crop that is due to be sown in a month or so get sown?

We have huge uncertainty about the global supply of grains and how that will play out in the food and feed markets. Not too long ago - 2005, I think - we had a spike in grain prices around the world and it led to much civil unrest and regime change. A huge issue is building. We need as a country and as individual farmers to make sure we have a secure supply of feed for our animals. Every farmer needs to look at the number of animals he or she will have next winter and whether there will be sufficient food for them. That is a big part of the work we will do with farmers to plan the resilience of their feed supply at an individual level for the next year.

We are heading into a critical period for livestock farmers in relation to the silage-making season. Before the Ukraine crisis arose and we were just dealing with the fertiliser issue, we told farmers to make better use of organic manures to reduce the amount of fertiliser they might have to buy, and not to cut short fertilisation, whether organic manures, slurries or chemical nitrogen for their silage crop. We will double down on those messages with livestock farmers.

We will encourage tillage farmers to see if we can grow more grain in this country. I will let Mr. Spink come in on this in a minute. We have a short window left in the sowing season and many of our crops are winter-sown and already in the ground. Within the remaining period and depending on the availability of seed and the likelihood of having fertiliser to grow those crops, is there an opportunity to grow more grain?

Poultry producers and especially pig produces are in the hot seat. It will be a difficult period for the coming weeks and months, initially regarding affordability of feed and, in the medium or long term, the potential disruption to supplies of feed. On top of that is the potential disruption to supplies of fertiliser through manufacturing capacity in Russia, which we rely on to a reasonable extent. Of the order of 30% of our fertiliser, or maybe not quite that high, came from Russia last year. The price of gas, which is a big component of fertiliser making, went through the roof a long time ago. I do not know what it has gone through at this stage. That is all impacting on the fertiliser business. In my time in the industry I have never seen as much uncertainty around those issues as we have now. Allied to that uncertainty, I have never seen as high a risk for us. If things go wrong, they could go very badly wrong in relation to our food

supply and the feed supply for our animals. It is a situation that will require very close monitoring and action and working closely with farmers. There is a big job to be done to support farmers in terms of securing their fodder supply for the coming year. Does Mr. Spink wish to come in on the tillage end of it and the possibilities there?

Mr. John Spink: If tillage farmers could land at a reasonable cost, they would certainly grow more cereals.

Chairman: There is no more being made available.

Mr. John Spink: There is no more being made available. It has to be suitable land in the right places. There are a huge number of considerations. I believe there is enough seed, perhaps, to increase our spring planting by about 50,000 ha, which would give somewhere in the order of 350,000 tonnes of additional grain. However, there are many other things. One has got to have-----

Deputy Matt Carthy: What is that in percentage increase?

Mr. John Spink: We have about 300,000 ha of tillage, so from 300,000 ha to 350,000 ha, roughly speaking.

Chairman: What is the growing capacity for that?

Mr. John Spink: These are all of the other things. There has to be the combining capacity, which we would probably have if we have a decent harvest. However, if we get a very wet and broken harvest, would we have the capacity? In addition, there is the cleaning and drying. We have the storage capacity, but the cleaning and drying would be another issue. If there were good harvesting conditions and you were bringing it in dry, there would not be a problem. However, if we hit a bad harvest, we could be bunched.

Chairman: There are so many things and so many imponderables. For example, if grain is coming with a high moisture, the cost of drying it would be absolutely astronomical.

Mr. John Spink: In addition, you have to the fuel to be able to harvest it, to do the cultivations and the fertiliser. There is a heap of moving parts.

Chairman: I thank Professor O'Mara for that. We will be coming back to that discussion fairly frequently in the next couple of weeks. I thank the witnesses for coming and participating in today's meeting as it was very informative and worthwhile. The next public meeting of the committee will take place on Wednesday, 23 March at 5.30 p.m. The committee will be examining horticultural peat supply and the willow scheme. The witnesses will be from Bord na Móna. As there is no further business, the meeting now stands adjourned.

The joint committee adjourned at 8.22 p.m. until 5.30 p.m. on Wednesday, 23 March 2022.