



Science and Technology Committee

Oral evidence: [GM foods and application of the precautionary principle in Europe](#), HC 328

Wednesday 5 November 2014

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Written evidence from witnesses:

- [Society of Biology](#)
- [John Innes Centre](#)
- [Syngenta](#)
- [Agricultural Biotechnology Council](#)
- [BASF](#)

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Members present: Mr Andrew Miller (Chair); Mr David Heath; Stephen Metcalfe; Stephen Mosley; Pamela Nash; Sarah Newton; Graham Stringer; David Tredinnick

Questions 141-214

Witnesses: **Professor Helen Sang**, Fellow, Society of Biology, **Professor Michael Bevan**, Programme Leader, Cell and Developmental Biology, John Innes Centre, and **Dr Paul Burrows**, Executive Director, Corporate Policy and Strategy, Biotechnology and Biological Sciences Research Council, gave evidence.

Q141 Chair: Can I welcome the three of you today? I am grateful that you have taken the trouble to give evidence and to come and speak to us this morning. I would be grateful if, just for the record, you would introduce yourselves.

Professor Sang: I am Helen Sang. I am here representing the Society of Biology, which aims to provide a focus for biology in the UK in everything from education to policy. I work at the Roslin Institute, which is a BBSRC core funding institute, but within the University of Edinburgh. My personal research is on the development and application of GM technologies in chickens. I am funded by research council funding, but some of the grants are partially funded by industry.

Professor Bevan: My name is Michael Bevan. I work at the John Innes Centre in Norwich in the UK, and I am representing them here today. Ours is a major international centre for

crop plant improvement. My expertise is in the area of plant genetic engineering and genome analysis. Both of these technologies are centrally important to the scientific issues we will be discussing today.

Dr Burrows: I am Paul Burrows. I am corporate director of policy and strategy at BBSRC. I am here representing BBSRC, but also the research councils more generally. The Biotechnology and Biological Research Council, as our name suggests, is a public funder of the biological sciences across a broad base, and a large proportion of our remit is focused specifically on food and agriculture.

Q142 Chair: I want to start off by exploring where Britain stands in this area of work. How would you describe the state of plant science in the UK currently? Has the UK's status in this field changed in the recent past, for better or worse, and what are the drivers?

Dr Burrows: As BBSRC is the main public funder of plant science, I will lead off on that one, and then my colleagues on the panel can give their view. The UK is excellent in plant science. We have a fantastic community. We have world-class institutions, like the John Innes Centre and many of our universities, and we punch above our weight. BBSRC invests broadly in plant science—I am rounding the figures—around £70 million of public funding per year, and that primarily goes to universities and research institutes to do basic and strategic research, to understand the basic biology of plants, how they function, how they respond to stress and how they protect themselves against pests and diseases. It is a broad range of basic research which helps us understand plants much better. Like many of the research councils, our budget has been flat cash over recent years. We have sought to protect our investment in plant science, but undoubtedly if we had more funding, we could do more.

Professor Bevan: I echo those comments. Plant science in the UK punches above its weight. A recent report from the Society of Biology on UK plant science identified the UK as the second most productive nation in the field, as measured by publications, patents and overall impact, next to the USA. Of course, their research venture is much larger than the UK's, so plant science is very strong and well organised in this country.

However, the current regulatory system means that the fruits of this research are not able to be applied in a straightforward manner. May I give you just three examples? I think it is good to talk about specifics in a case like this. In my own research we have discovered genes that can increase the yield of crop plants. These are being patented and licensed for application, but the fruits of this research will be harvested—literally—by farmers in the USA, because the company that has licensed the technology is doing the field trials in the USA in US crops. There is absolutely no point in their doing it in Europe and the UK.

The two other examples are the sorts of technologies that are now able to be generated by UK plant science. The first is by a colleague in Rothamsted Research, Johnathan Napier, who can make flax plants produce oils that are an important component of fish food. As you probably know, fish farming is very important in the UK; it is a major industry. Fish need to be fed on other fish that are harvested in an unsustainable way from the oceans. They have to do that because the fish require certain sorts of fatty acids for their diet. We can now produce those fatty acids in plants and literally supplant the use of harvested fish

for fish food. That is an important example where you can see the benefit for human nutrition and for the environment—in this case the marine environment.

The second example is from a colleague at the Sainsbury Laboratory in Norwich who has developed technologies for the protection of potato plants from late blight, a devastating disease. Currently, when this occurs you have to suppress it by multiple sprayings of fungicides, which have a significant and as yet unknown effect on the environment. He is able to replace this chemical control with genetic control. Those are just two examples of technologies that are ready to go, but they cannot because of the current environment and the confusion that surrounds the approval process.

Professor Sang: Plant science in the UK is undoubtedly excellent, but a recent survey identified that 96% of senior personnel in the UK in public, private and third sector plant science were concerned about gaps in skills, sustainability and the number of young people going into plant science, so there are concerns about the long-term future of the excellent plant science in the UK.

Q143 Chair: I was going to ask about skills. What are the gaps, and what are you doing to plug them?

Professor Bevan: First, as a major teaching centre we have 24 PhD students a year spread around the Norwich research park, which has over 3,000 researchers. The amount of funding for PhD students is inadequate to maintain the supply needed for industry and all the other sorts of jobs that PhD students go into. Secondly, we used to run a masters programme in plant breeding that provided people like Syngenta and so on with the skills they need. There is now no funding for masters programmes in this country, so we definitely need more money for training people in this important area.

Dr Burrows: As a major funder of postgraduate research skills—as Mike says, the PhDs—we fund 20% to 25% of all bioscience PhDs in the UK. We try to direct a good proportion of those towards food and agriculture research, but the sustainability issues about people coming into plant science stretch beyond the single reach of the research councils. It is about inspiring young people through school to go into undergraduate courses and to give them the sense of a career in plant science. This is where a lot of our public dialogue activities come in. We have seen the increasing debate about the need for food security and the greater focus on the challenges facing society in the future beginning to inspire young people to see that plants really are very important, but much more could be done at the undergraduate level and school level to keep our kids in science and keep them motivated.

Q144 Chair: Is there any more that could be done at school level?

Professor Sang: I am not so familiar with plant science, but, in biology, plant science can be seen as the poorer relation; for example, you can do human biology courses and they do not encompass plant science. Plant science can be dropped out of even biology fairly early on. Probably quite a big issue in education is that people lose the plant science part of biology pretty early.

Professor Bevan: It has never been the sexiest part of biology. Human health will always trump that, for obvious reasons. We do a lot to try to encourage school children to take an interest in the environment, and plants as key parts of that environment.

Dr Burrows: To pick up Mike's point, whether or not plant science is seen as sexy is debatable, but it should absolutely be seen as the subject to do if you think about how important plants are. They provide the air we breathe; they clothe us; they feed us; they are major parts of our countryside and the amenity; and they underpin major sections of the economy, agriculture, food security and so on.

Q145 Chair: Case made!

Dr Burrows: There really is a case for fantastic plant science.

Q146 David Tredinnick: Following on from that, we have been told that massive sums of public money have been invested in genetically modified research compared with other areas of plant science. Do you think that is fair?

Dr Burrows: That is not something I would recognise. As I said in my introduction, BBSRC are the major funders of plant science and we invest around £70 million a year in basic plant science. A proportion of that will be used in genetic modification as a very helpful laboratory tool to begin to dissect plants—a bit more of this gene and a bit less of that gene and what impact it has—to understand how they work. There is that piece. I estimate that about £10 million of that portfolio is to that sort of research, for GM as a laboratory tool.

We fund some research looking specifically at GM traits in potential crops. Mike has listed a couple of those. The high omega 3 oils in crops is something the BBSRC has backed, and the purple tomatoes—again from the John Innes Centre—is something that the BBSRC has backed, but it is a relatively small proportion of our funding.

Q147 David Tredinnick: So that I am quite clear, your funding overall is £70 million, and £10 million is the proportion of the total spent on genetically modified crops.

Dr Burrows: On using GM as a laboratory tool in plants. About £4 million is spent on the sorts of programmes Mike mentioned, exploring the potential for a GM trait in a crop. I should emphasise to the Committee that the BBSRC funds basic and strategic research. Once the interesting science has been done and proof of concept is there, BBSRC would not use public funding necessarily to come in and take that commercial crop to market. We would expect to see public-private partnership with the academics who developed the crop in the first place.

Professor Bevan: I would echo that. Genetic engineering is a critically important research tool used probably in almost every research project funded by BBSRC, the EC and industry. There are a few special projects, two of which I have described, and a handful of others, that are funded by BBSRC, to genetically engineer a crop plant and, as part of that, to have a test in the environment.

Q148 David Tredinnick: Have you made any commitments to the Government about future levels of research funding in this area?

Dr Burrows: We have made no specific commitments on figures.

Q149 David Tredinnick: What is the reason for that?

Dr Burrows: Our budget comes through the science budget, and it is up to our governing council to apportion that budget across our whole remit. The challenge for us is to get the right balance across our remit. There are areas of our remit we would expect to see grow. We are keen on funding the sustainability of agriculture much more. We are blind to the particular technologies that would allow us to develop that strategic approach to sustainable agriculture. We would not necessarily just pick out a technology and say to Government, “We will spend x million pounds in this direction.”

Professor Sang: For example, there is discussion about developing a big focus on animal and plant health in the UK, and that may or may not include GM.

Dr Burrows: Exactly. We set the strategic directions, and one of those at the moment is to fund profitable, productive but also sustainable agriculture. We are delighted to fund any of the range of technologies or approaches which will help us achieve productive yet more sustainable agriculture, and we will be expecting to fund more as we go forward, but it all depends on forward budgets and spending reviews.

Q150 David Tredinnick: In 2009 the Royal Society recommended greater investment in non-GM fields such as agro-ecology and soil science. Has that had a bearing on your thinking? Has that made a difference?

Dr Burrows: Yes, it has.

Q151 David Tredinnick: In which way?

Dr Burrows: We refreshed our strategic plan about 18 months ago and made specific commitments in the strategic plan that we would do more on taking a systems approach to agriculture, so it is exactly that—looking more at agro-ecology and the soil science. We have had an initiative recently with our sister research council, the Natural Environment Research Council, on soil science—actually, the interface between root surfaces and soils, technically the soil-rhizosphere interface. We have had a grant call and grants proposals on that initiative. NERC itself has a programme on sustainable soils, which is leading out to 2018, so we are investing more in that space, and have the intention to do so, simply because we recognise, with that strategic aim of having more sustainable agriculture, that that is where the evidence base lies. That is where research is required.

Professor Bevan: Some of the biggest investments the BBSRC has made in plant science recently have been in the area of genomics. The objective of this work is to help accelerate more traditional types of breeding and non-GM approaches. This has proved to be catalytic in accelerating the rate of progress and generating new crop varieties.

Q152 David Tredinnick: Has that been widely advertised? Do you think it is well known that you are doing this?

Professor Bevan: The science is in early days. Nevertheless, from my scientific perspective it is absolutely clear that this investment in sequencing the genomes of very large and complicated organisms, like oilseed rape and wheat, is going to bear fruit very quickly in all methods of crop improvement.

Q153 Stephen Mosley: We received evidence from the STEPS Centre at the University of Sussex that GM “cannot readily co-exist” with other agricultural approaches and “locks out” alternative innovation options. Would you agree with that statement?

Professor Bevan: I have thought about that because it is fundamentally incorrect. GM is very widely used in other agricultures. I have some figures here. It is used by 18 million farmers in 27 countries. In 2013, 175 million hectares of land was planted to GM crops. The UK has 5.8 million hectares, so 30 times the growing area of the UK was growing GM crops in 2013. The question is: how come? Why is this? I believe it is because the success and benefits of growing those crops far outweigh the benefits of growing a non-GM crop. It is farmers making a sensible commercial choice that they can have a GM soya bean that costs less to produce and is high yielding. That is one of the reasons why GM is becoming so successful.

You have to realise that there are very few GM traits at the moment. In the future, with more and more GM traits, I can see genetic engineering and other more high-tech ways of producing crops becoming the standard. There really will not be any other types of crops produced in the future. Does that partly answer your question? I think the point of your question is that somehow the companies promoting GM seed production are somehow forcing out other alternatives. That is not the case.

Q154 Stephen Mosley: But because they produce them at a lower cost and more effectively, in the long term they will dominate the market.

Professor Bevan: They have started to dominate the market.

Professor Sang: But they have to be, and they will be, integrated with the more traditional breeding because that has already achieved great advances. You do not want to come along with a crop that has a genetic modification but does not have the advances already achieved, and that will continue to be achieved, by increasingly sophisticated breeding. They are always going to be integrated; they are not going to be GM or “other”.

Professor Bevan: You talked about co-existence. I presume that the report was based on the physical co-existence of, say, an organic crop and a GM crop and the wish to avoid cross-pollination between crops. This can be readily solved in the field. It already is; for example, farmers who produce pure seed that goes on for sale commercially have to segregate those plants to reduce the amount of cross-pollination. Those distances between plants are already known and they can be used in the field. It is, however, not the case in this country; because there is no GM in this country, it is not a problem.

Dr Burrows: I think this is a much broader societal, political and organisational issue than the science. The science can tell us that crops cross-pollinate, the distances at which they cross-pollinate and how that tails off with distance. But in terms of the need to produce segregated supply chains to give consumers the choice of whether to buy or not buy GM crops, it goes far beyond the science. The science evidence base is there. As Mike says, we know that crops cross-pollinate and how far they cross-pollinate and the dynamics of that, but the co-existence of different forms of agriculture in the same crowded countryside is a much bigger issue than just the scientific evidence.

Professor Bevan: It is a more important issue in this country, where the agricultural landscape co-exists with other types of landscape. In the US and the pampas of Argentina there are huge areas of monoculture: soya beans, corn and that sort of thing. That is where GM crop production predominates. We have to think very carefully when we introduce a GM crop into this country what its influence will be on the growing ecosystem.

Professor Sang: That depends on which crop you are talking about; it is very different for different crops.

Professor Bevan: Which crop, which trait and so on, case by case.

Q155 Stephen Mosley: On a slightly different issue, most commercially available GM crops have been developed by industry. Do you think there are any options available for publicly funded scientists who want to commercialise crops that they have developed in the laboratory?

Professor Bevan: There are major opportunities for that, but maybe you should also ask that question of colleagues behind me. There is a big cost in taking something from the laboratory to the field. We wish to do more of that in the public sector because we believe that there are some traits that may be of less interest to commercial producers but that will have important societal benefits. Some of those might include the nutritional composition of food, for example, that might not be a commercially valuable trait, but that we see would be valuable to consumers. We would wish to be able to take our products from the lab to the field, but the costs, the regulatory burden and any uncertainty surrounding that mean that you just do not consider it. Back in the '90s—I think in 1995—there were something like 20 or 30 field trials in this country; last year there were just two. You can see that the regulatory uncertainty is stymieing the work of researchers who wish to take their work closer to application, and eventually perhaps even commercialise it.

Professor Sang: Scientists in this country would like to contribute to work supported by organisations like the Gates Foundation and so on for improving crops in the third world, so that they can apply their expertise and technologies where there is not enough commercial reward for the large plant breeding companies to contribute.

Dr Burrows: There is a broader point as well. I absolutely agree with Helen: when we say “commercialisation”, in BBSRC-speak it means driving an impact, whether it is a societal or an economic impact. That impact does not necessarily have to be realised just in the UK or the European Union. One of the strands that runs through the Government’s agritechnology strategy is that we are fantastic in this science, and we can sell our expertise and know-how on a global stage and contribute to development goals. There is

also the case of the purple tomatoes at the John Innes institute, which have high levels of anthocyanins and antioxidants, and in feeding trials with rats are protective against certain cancers. It is likely that that is going to come to market first in North America.

Q156 Chair: Before we leave this topic, I want to be clear about your response to Stephen's observations about the evidence we got from the STEPS Centre. I will read what they say: "Analysis has shown...that in fact, GM as a putative option, cannot readily co-exist with alternatives, but locks out all such alternative innovation options in a 'monopoly-demanding' strategic innovation logic." They added that "important openings" in agricultural R and D had been "closed down by political interventions." Do you recognise this?

Professor Bevan: No. It is not the reality in the field, literally. Farmers make the ultimate choice about what they grow in their fields.

Q157 Chair: This is coming from another academic institution. How do you engage with them to get clarity on these very important issues? Perhaps that is a question for BBSRC and the Society of Biology.

Professor Sang: It is quite challenging, because things are so polarised. To find a position where we can meet requires a lot of discussion and debate, which is not yet happening because of the pro-GM and the anti-GM. It is something on which we need to work more, going away from looking at GM as an entity and the whole technology approach, to looking at valuable traits and how those can be developed, whether through conventional breeding or genetic modification.

Dr Burrows: From our perspective, it is not something we recognise—if I understood it correctly, it was about GM as a technology closing down other technologies. We specifically encourage a whole range of technologies to be developed to meet the challenges facing us in the future to produce more food with lower inputs—I will not rehearse the arguments, which I am sure the Committee is well familiar with—in the face of climate change and so on. There are really demanding traits in the next generation of crops and livestock, and we need every tool in the box, so from a research perspective we encourage innovation in the sorts of tools, including the wider genomic approaches, that are going to help us to generate that next generation of crops to meet the challenges of the future. I am not a social scientist, so I do not quite recognise some of the social science language in the statement you read out, Chair, but in my simplistic understanding of it, I cannot see GM as an approach closing down any other technologies at all, at research level.

Professor Sang: In animal breeding, understanding and knowledge of genomes in farm animal species is now getting so detailed that the people who do the more traditional genomic selection, marker-assisted selection, can begin to see how they can use the tools of genetic modification that are coming along to use the traits they recognise in one way and move them around, into different breeds and so on. The two are very interlinked.

Chair: I will leave that point at this stage, but we would welcome your more detailed comments on their evidence, and we are saying to them that we would welcome their detailed comments on your evidence.

Q158 Sarah Newton: I would like to move on to intellectual property and transparency in research. We have been given evidence in previous sessions to indicate that the industry's use of intellectual property rights is frequently cited as a barrier to objective independent research into the potential effects of genetic modification. To what extent do you think intellectual property rights have acted as a barrier to independent research into commercially developed GM products?

Professor Bevan: I am deeply involved in genetic engineering research, and I understand well the background patent situation. I think it is best if I give you some examples from my own work, which hopefully will illustrate that there is no inconsistency in the goals of maximising the impact from research, making data freely available to other researchers and protecting any important and potentially commercialisable discoveries. For example, most major universities and research centres, including John Innes, would have a patent and intellectual property office where people can go for advice. In my own work, for example, you make a discovery and discuss it with Plant Bioscience Ltd, a company in Norwich that runs these affairs for us. They say, "That's a potentially important discovery. You should write a patent on that." They provide help in writing a patent. It takes two to three weeks. It is interesting for the students and post-docs involved to do that, and some of them go on to work in that field. You can write a patent and then you publish. As long as you do not disclose the nature of the invention before you try to patent it, that's fine. I think the pathway for protecting discoveries through patents is very clear and is well understood, in juxtaposition to the regulatory issues we are discussing.

I think some of your question concerned how companies can use patents to compete with one another. That's the world we live in; that happens. For example, some of the early patents on genetic engineering were held by Monsanto and other companies, but they have come to an agreement. Most of those patents have now expired anyway. Does that help to answer some of your concerns?

Q159 Sarah Newton: It does. We have come across this in other inquiries into medicines and pharmaceutical companies. There is deep public distrust of big companies and a feeling that if research is paid for by the company, somehow the information and evidence that is gathered is not able to be shared, and it is used as a way to cover up, hide or not disclose potentially harmful effects. In a nutshell, that is the issue, which goes along with your comments and those of Dr Burrows, about straying into social science, public perception and politics. However, it is critical to understand and overcome those concerns, so that the science can be properly heard and we can address those barriers, where you've got businesses funding research, with the availability of sharing data with other scientists who can independently scrutinise and evaluate that work.

Professor Sang: It is very important for all research done in universities and institutes. Our output is publication, and that is what we are evaluated on. If we have a company involved in any research, all our contracts have clauses that cover publication. Publication can be delayed for a limited period to allow the filing of patents, but beyond that it is expected that we will be allowed to publish. It is very important to us to keep that open and put the information and data out there.

Q160 Sarah Newton: Is it always published, or sometimes are things held back from publication? Should there be penalties inflicted if things are not published?

Professor Bevan: Sometimes if work is funded by a company, in my lab for example, there would be restrictions on publication until they had vetted the information that you have generated. That is one example.

Q161 Sarah Newton: I can understand delays, but is it always published in the end?

Professor Bevan: It is published, or in many cases, the data are put out in forms that other people can explore, use and critique.

Professor Sang: For example, a genomic sequence will be put out there, not as a publication but on databases that make it accessible.

Professor Bevan: A lot of the examples you may be thinking of come from the pharmaceutical industry. I think the agricultural biotechnology industry is substantially different from that in terms of public access to data about the environmental or health effects of a particular GM crop or food. I believe most of that data is in the public domain.

Q162 Sarah Newton: Are there any other barriers I have not identified in my questions that prevent independent scrutiny of research?

Dr Burrows: No. I think we have to differentiate the purely public sector-funded research where we have a clear expectation of full publication and disclosure. On the intellectual property side, the research councils have clear statements and policies that the intellectual property is owned by the employer of the inventor. If we are funding an academic in a university, that intellectual property isn't assigned to any of the research councils but to the university, and there is a clear expectation that they will use that intellectual property for the widest possible impact, be that economic or societal. As Mike says, there will be situations where research is funded in public institutions and sponsored by the industry, and to protect that industry investment, there will be a delay in publication to allow proper evaluation, whether or not it is worth applying for intellectual property.

Sarah Newton: I am reassured that it does eventually emerge, and that is a big difference between the pharmaceutical industry and yourself.

Q163 Chair: For clarity, one witness told us that Monsanto would not allow research using their seeds. Are you saying that is not correct?

Dr Burrows: That's not something I can deal with. Mike would be better answering that.

Professor Bevan: For example, Monsanto would wish to be assured that their seeds would be used just for research purposes, maybe not passed on to others and all sorts of things like that.

Q164 Chair: The exact quote is: “Monsanto licensing agreements specifically preclude research on their seed, so it is not something that can be done in another forum.” That was a witness from G M Freeze. You are saying you do not recognise that.

Professor Bevan: I have never done any research on Monsanto seeds, but I have certainly worked on seeds and genetic material provided by other companies. They are quite interested in digging a bit deeper into explaining some of the traits that have been caused in their plants.

Q165 Graham Stringer: The European Commission applies the precautionary principle where there is lack of scientific certainty and a plausible case that harm will be done if precaution is not used. Do you agree with that interpretation of the precautionary principle and those conditions on the way the Commission applies it?

Dr Burrows: The scientific consensus, as reflected in the European Academy’s report recently, on which I think the Committee has had evidence, and also in the excellent report David Baulcombe wrote for our Council for Science and Technology recently, paraphrasing it, is that there is no credible reason to believe that in 15 or 20 years of use of GM technology in crops, surveying all the scientific evidence, GM is per se any more harmful to human health and the environment than the equivalent conventionally bred crops. The scientific consensus is quite sound. One can keep saying, “We need more evidence,” but what more evidence do we need? Quite frankly, my experience of the research community is that they are scratching their heads thinking, “What more can we do?” If the Commission is applying the precautionary principle on that basis, personally, I do not think it is applying it because of the science. We have to recognise that the science evidence base is one thing, but GM has become a lightning rod for many other issues—about fairness, access and corporate control of the food system. It would seem to a casual adviser that the Commission and politicians around Europe are concerned more about those kinds of issues than about the specific science, and they could be using science as a reason not to take that next step. That is just my personal opinion.

Q166 Graham Stringer: Can we conclude from that that you do not agree with the universal application of the precautionary principle to all GM crops?

Dr Burrows: The precautionary principle is a useful tool if it is applied in an evidence-based and proportional manner. If one looks at the scientific evidence base, one is forced to the conclusion that the Commission is not applying it in that way.

Q167 Graham Stringer: That is very helpful. Do you think the way it has applied it has encouraged or discouraged research into GM?

Professor Bevan: I think it has been profoundly discouraging. The technology has been available for 20 years, and they have been exploring the potential risks associated with the process of genetic engineering for 20 years. The technology has been proven with respect to human health over that period, because a significant proportion of the world’s population is fed by genetically engineered crops, primarily soya bean and maize. All the evidence is that there should be an exit from the precautionary principle and a start to

looking at the actual traits put into plants by genetic engineering. The process is then neutral; it is what the new trait is. That is what I think a new regulatory regime should explore.

Q168 Graham Stringer: You have given a perfect answer to my next question. It is very clear that you would like to move to a regulatory system based on traits rather than GM. Would you also like evaluation to take into account benefits as well as threats? Would that be helpful?

Professor Bevan: Absolutely: benefits for human health and risks to human health—this is talking about one particular trait—and benefits and risks to the environment. That's the special thing about genetically engineered crops: they have potential to influence the environment and human health, so you need two different types of analyses based on sound scientific evidence to judge whether or not these things are beneficial.

Professor Sang: But starting from the trait.

Q169 Graham Stringer: Professor Sang, you have advocated a move to national regulation rather than European regulation. Do you still hold that view?

Professor Sang: Do you mean the Society of Biology?

Graham Stringer: Yes.

Professor Sang: The society does not have a fully settled position. I think it has focused on the principles and the importance of thinking about the instrument you use to deliver, and that this should be compatible with the scientific advisory process and the environment for science. It is still up for further discussion before taking a settled view.

Q170 Graham Stringer: Do the proposed amendments to the deliberate release directive go far enough in passing power down to the nation states?

Dr Burrows: It is certainly an interesting move by the Commission. I think it will flush out from the collection of member states those who are—I am trying to choose my language carefully—blocking the commercial cultivation of GM crops for reasons other than purely scientific ones. The broader issue on the regulatory system, coming back to the trait-based system, is that there is a scientific driver for this as well. BBSRC has just published a position statement looking at many of the newer technologies for breeding livestock, or creating genetic changes in crops and livestock—the so-called genome-editing suite of technologies. What it means is that in the various methods—the toolbox for creating variation in crops and animals for breeding crops and livestock—the boundaries between what was GM and not GM are blurring. I think Ottoline Leyser made the point very firmly to the Committee that we need to move away from a system that focuses on the method by which a particular crop or animal was produced. What is the trait, case by case? What is the animal; what is the trait? What is the crop; what is the trait? How will it be used? There are great anomalies in the regulatory system as it stands at the moment.

We absolutely understand that that is not going to happen overnight. BBSRC is not a lobbying organisation. Nevertheless, in producing this position statement we are seeking to have the debate and start talking about that more sensible and logical approach, in many people's view, to the regulatory system as a whole. Look at it as a trait-based system, because the technology will continue to develop and the lines will continue to blur. In five or 10 years' time there will be new technologies we have not even conceived of yet, so we need to get a regulatory system that is fit for purpose.

Q171 Mr Heath: As a passing thought, I have some sympathy for the view that we should move to a trait-based regulatory system, but if we do, I hope we are not going to bring into regulation a whole lot of lower technologies, so that the flower person carefully developing the perfect purple bloom suddenly finds himself in a regulatory framework that he is not in at the moment.

Dr Burrows: That is the risk, which is why we want to try to begin to have the debate. It surely cannot be beyond the wit of man or womankind to develop a regulatory system which is evidence-based and proportionate.

Q172 Mr Heath: There speaks a man who hasn't been to an Agriculture Council at the EU.

Dr Burrows: But I understand absolutely the concerns of others who say, "Well, if we start to pull all this apart, what we will end up with"—given the track record of the member states and the Commission—"is a dog's breakfast and worse than what we've got now, so let's not do it."

Professor Sang: There are issues with existing crop breeds that possibly would fall under that regulation but do not now, so I think it needs to be investigated and thought about in more depth.

Q173 Pamela Nash: I wanted to talk about the regulatory framework, so you have answered most of my questions already. Can you give the Committee a brief summary, if possible, of how the technologies we are using today differ from those of the past?

Professor Bevan: Perhaps I can answer that question first. The technology of the past used, and still uses, a mechanism that randomly introduces DNA into a plant. That random integration means that you then have to sort through literally hundreds of events to find one event in the right place in the genome that gives you the effect you want, and you discard the rest. That has turned out to be quite an expensive, laborious process. Now there are technologies where you can guide the bit of DNA that you are putting into a plant to a precise locus in the plant. That locus is predetermined and you know you can get a reliable effect from that technology, so that is one way in which so-called old-fashioned technology can be made more precise.

As to other new technologies, there has been a report written by BBSRC that should be very helpful in explaining them. Basically, you can now use different methods to specifically guide any piece of DNA into a plant genome, or any genome, so it enables you to make very precise changes. You can put genes in from any source—you can put a

tomato gene into wheat, for example, or a gene from bacteria into wheat—and you know exactly where it goes. That is an advance in the technology. The same types of technologies can be used to make very precise changes. It can remove a gene or introduce another wheat gene into a different place, say into a wheat genome.

Q174 Pamela Nash: That would be genome editing.

Professor Bevan: Exactly.

Q175 Pamela Nash: Is that covered by the regulatory framework at the moment if foreign DNA is not integrated?

Professor Bevan: My understanding is that the regulatory framework does not cover these sorts of technologies.

Dr Burrows: I think it is still an open question.

Professor Sang: It is still a bit open. I believe that in the US the USDA said they won't regulate genome-edited crops.

To make a couple of points to follow on, I heard in previous evidence that the old technology is random. It is true that the site of integration of the gene you were adding was random, but the whole process was not random, because it was then selected to find the best one and that was highly characterised. It was only the initial step that was random; the ones taken through as crops were thoroughly characterised and risk assessed. What the new technology gives us is that we avoid that whole selection of the right event.

Genome editing is coming along in animals in the same way as in plants. If we identify a version of a gene in one breed that gives you a great characteristic, like better yields, we can identify the single mutation or genetic difference that underlies that and use genome editing to make that change in a different breed altogether. Ian Crute gave you a nice explanation of that. You are moving a very specific genetic difference between one breed and another, whereas, if you are breeding, you move whole collections of genes around and you can move things you do not want at the same time as things you do want. The thing about these is identifying whether it has been achieved by breeding or by genome editing. You won't be able to tell the difference. That is a whole issue in terms of regulation; you would not be able to say, "This has this version of this gene because it has been put there by crossing or it's been done by genome editing," because there is no difference you can identify.

Professor Bevan: That is why a move to a trait-based analysis is imperative if we are going to have correct oversight of the impact of these new technologies. The process of moving a gene around or changing a genome is not what is regulated; it is what the outcome is in terms of a gene moving in or a new trait.

What Mr Heath was saying was very important. You could bring a whole lot of new regulation to bear on things that currently are not regulated, but there are ways you can address that. I would propose that if the genetic variation used is within the natural genetic variation found in species—those that can be used by breeding; if you put a wheat gene

from one wheat species into another—that would not be covered by regulation, because essentially everything like that can be found in nature or can be created, however laboriously, by traditional breeding.

Q176 Pamela Nash: If it was necessary, is it possible to put in a marker to show which method has been used?

Professor Bevan: That would be retrograde, because why would you do that if the method has no bearing on the trait? Technically, you could do it.

Q177 Pamela Nash: My view was that if there was any public pressure or a reason for them to do it, I was interested to know whether it was possible.

Professor Bevan: It could be done. I can imagine an industry doing that. These things that you have in DNA are literally called barcodes; you can say, “Oh, farmer X over there is growing a crop that looks very much like one we’ve produced, but he hasn’t bought it from us,” so you test it and see whether he is using something that perhaps he should have paid for—or she.

Professor Sang: You might put it in for traceability.

Pamela Nash: You have already answered the rest of my questions, so thank you.

Chair: It has been an extremely helpful session. Thank you very much for your attendance this morning.

Examination of Witnesses

Witnesses: **Dr Mike Bushell**, Principal Scientific Advisor, Syngenta, **Dr Julian Little**, Chair, Agricultural Biotechnology Council, and **Dr Geoff Mackey**, Sustainable Development and Communications Director, BASF Europe North, gave evidence.

Q178 Chair: Good morning, gentlemen, thank you very much for coming in. I would be grateful if you would be kind enough to introduce yourselves.

Dr Little: My name is Julian Little. I am chair of the Agricultural Biotechnology Council, which represents the main companies involved in bringing GM crops to market around the world. My pay and rations, for the record, are from Bayer CropScience.

Dr Bushell: I am Mike Bushell. I am from Syngenta, based at Jealott’s Hill international research station. I have spent 34 years in research and development.

Dr Mackey: I am Geoff Mackey. I am director of BASF in the UK and on the management team in northern Europe.

Q179 Chair: For the record and for total transparency, I cross paths with Dr Mackey from time to time as I chair an innovation board at the University of Chester's science park on which Dr Mackey also serves.

Welcome, gentlemen. First, can I ask how you would describe the current state of agricultural biotechnology in the UK?

Dr Little: Agricultural biotechnology in the UK is a very good example of a country that does some fantastic fundamental work. You already heard in the previous session that when it comes down to fundamental work in terms of plant science and, in some cases, how that might be commercialised at a later date, we are punching well above our weight. Unfortunately, we are not in a position to be able to commercialise a lot of the work done either through UK universities and research institutes or via the companies represented here today. That is pretty much entirely due to the issue around European legislation, which essentially has brought in a de facto moratorium on the commercialisation of new products.

You may be aware that a small amount of GM crops are being grown around Europe, mainly in Spain and Portugal, but that work has essentially come out of research done in the 1990s. Since 2000 there have been no new agricultural crops available to farmers anywhere in Europe.

Dr Bushell: You heard from the previous panellists that it is a very exciting time to be a plant scientist. There has never been a time when plant scientists were able to do stuff in terms of unlocking how plants work in practice. A massive amount of good work is going on in universities. We use things like GM as a tool in our own research laboratories at Jealott's Hill. What we do not do there is any work towards the development of GM crops, but we do use some advanced plant science—genetics and genomics—in our traditional plant breeding approaches, including for wheat.

Dr Mackey: From a BASF perspective, we have no research, or employees of our plant science business, either in the UK any more, or indeed in northern Europe, unfortunately.

Q180 Chair: Do any of you have any R and D operations? I know BASF withdrew from Europe. Are the same pressures on other people?

Dr Bushell: Yes. Our plant biotechnology targeted towards GM crops closed in the mid-2000s. All of those jobs moved to North Carolina and subsequently to a new research laboratory opened in China. The investment made in that area continues to pour in, and we have fabulous facilities elsewhere. We have fabulous facilities in the UK, but we are not working on GM crops.

Q181 Chair: Are British people going out there and taking some of those jobs?

Dr Bushell: About 30 people went out there, and in many cases are still working in the North Carolina area. Our current research director was one of those people, but she has come back to sit in Basle now.

Dr Little: More generally, pretty much all of our members have moved out of Europe when it comes to research, with the exception of the company I work for, Bayer CropScience, whose main facilities are in Ghent, in Belgium. However, and very disappointing from our perspective, the vast majority, if not all, of that work is targeted on GM applications outside Europe. Probably all our members still do work with universities, research institutes and SMEs, both in the UK and elsewhere in Europe, because we will always look for the best science wherever it may be.

Q182 Chair: A significant amount of that is here.

Dr Little: Absolutely. When you are looking for good science you will always go to the best countries. I can give you an example from Bayer CropScience; we are currently running 40 projects in 25 universities on agricultural subjects. Some of those will be GM, some of them will not.

Q183 Chair: There is all sorts of speculation about what is likely to emerge from the current round of transatlantic trade talks. Is there any input from the agricultural biotechnology sector in the context of those talks and, if so, what are you hoping to get out of it?

Dr Little: The TTIP negotiations are essentially trying to find a way of getting good trade between North America and Europe. Agriculture is such a big topic that inevitably it is going to be part of those discussions. I sat in a discussion—I believe you were present as well—led by Ken Clarke where the agricultural interests of the UK were discussed in the area of TTIP. In the end, what we would be looking for are good, solid regulatory discussions around how things can be regulated in a more science-based and maybe a little less politically-based way. As to whether we believe that is likely to succeed in the early stages of TTIP, we have already heard this morning that changing a European legislation system is not a trivial issue.

Dr Bushell: I would agree with that. The UK, and Europe more widely, is a massive importer of food, and of course an exporter of certain commodities too, so it is very important that artificial trade barriers are not erected in this area, particularly where regulatory issues are causing safe food that has been grown in other countries to be rejected at the borders of Europe for entirely spurious reasons. That would be a really bad thing to happen. Unfortunately, that is a big risk with our current regulatory system and the way it is operated.

Dr Mackey: One of the realities with TTIP and some of the other negotiations going on between Europe and other countries is simply to align the regulatory environments, so no additional costs are created and we can get good safe standards, not just in this area but across all technologies. That is part of the reason for having them in the first place.

Q184 Chair: In the context of these technologies, that would mean a regulatory environment led by the science.

Dr Mackey: Absolutely.

Dr Little: Absolutely.

Q185 Stephen Mosley: We have received evidence from GM Freeze suggesting that the promotion of GM crops by industry has led to a silver bullet mentality. In your view, does genetic engineering potentially represent a universal remedy for food security issues?

Dr Little: No, and it is very important that we put on record that we do not believe GM will be the silver bullet for all problems out there. When you look at issues of food security around the world, it is not just about whether you have enough food but whether you can get food to the right people at the right time in the right circumstances. It is about weather. GM can do a lot, but it cannot deal with political issues to do with food security.

However, we believe that this is a technology that you would not ignore. If we have such a big issue around feeding so many more people on the planet and wanting to use fewer resources, such as water, nutrients and fertilisers, we have to be in a position to use all the available tools. You heard in the previous session that GM is not used just as the end product; it can be used so well in identifying genes in a plant that need to be either up-regulated or down-regulated, or something. Once you've got that, you may use GM; on other occasions you may not. It will always be about the best way of dealing with the issue. Our members are equally strong in non-GM seeds and in GM seeds, and in many cases stronger. It will always be horses for courses.

Dr Bushell: I absolutely agree with what Julian said. I do not think we have ever said that GM is a silver bullet or a magic bullet of any sort; it is just a very important part of the farmer's toolkit. If you look at traditional breeding, that is also being massively advanced by our current plant science, our knowledge of genetics and genomics, and our ability to sequence plant genomes very quickly now in order to breed in new varieties. When you are dealing with complex multigenic traits—for example, drought tolerance—it is much more likely to be an approach that will be successful through traditional breeding rather than GM approaches, but in most cases we will use both technologies to bring the best possible technology to bear, depending on what is available via the regulatory frameworks. For corn in America, we have a range of Agrisure Artesian drought-tolerant traits, but we will be stacking those alongside the other traits that farmers want, in terms of insect control and herbicide tolerance. In Europe—if we are ever going to bring those traits into Europe—we will not have the GM components.

Dr Mackey: As a business, from our side of things we talk long and hard about sustainability. We take that right back to the three aims of sustainability, which are economics, environment and how to move it forward as regards protection. Building on what Julian said, the reality is that there is no one answer; it is all about having the tools and allowing people to choose what is right for their situation. That is what businesses like ours provide.

Q186 Stephen Mosley: From an industry point of view, you see no attempt to lock out any alternatives.

Dr Little: On the contrary, we absolutely see bringing all the tools to bear, because the problems we have are too big to say, "We'll only do it this way." As Mike said, there will be situations where GM does not make sense. Why would you do it that way? There may

be a much better alternative way of doing it. Some of the decisions will be based on pure science; in some cases it will be politics. If we are bringing something new to Europe, it will take a very brave person in any of our companies to say, "Do you know what? I think the best way of doing this would be a GM way." The chances of bringing it to the market are so slim that it is almost inconceivable that you would go in that direction.

Q187 Graham Stringer: Are you inherently opposed to the precautionary principle?

Dr Little: No.

Dr Bushell: We are inherently opposed to abuse of the precautionary principle, and in many cases that is where Europe is getting into trouble. You heard from the previous panellists that precaution is very important. When you are talking about agricultural technologies, or technologies associated with our food, of course we should take a precautionary approach, but existing regulatory frameworks are highly precautionary already. What we are seeing in many cases is not the application of the precautionary principle as defined in the Commission's own documents, but actually a smokescreen of uncertainty being put around technology to stop it happening for politically motivated reasons.

Dr Little: Can I give you an example? One of our members has been trying to introduce a new GM maize. It is not dissimilar from the GM maize currently being grown in a few countries in Europe. They submitted it for approval 12 years ago. It went through the safety approval system under the European Food Safety Authority, and it was sent back to be re-reviewed, and re-reviewed. To date, it has had seven positive EFSA safety opinions, so it has been demonstrated by EFSA to be entirely appropriate from a science-based perspective; yet again this year, we saw prevarication and people mentioning the precautionary principle as a way of stopping this getting to the market. In the end, the precautionary principle is about needing to be careful if you do not know enough about a subject. How long do you need to be careful, and how many times does a product need to be demonstrated to be safe before you give up and say, "This is not a precautionary issue; this is a political issue"?

Q188 Graham Stringer: The agricultural biotechnology sector has called for the use of an innovation principle to be used alongside the precautionary principle. Can you explain how that would work? I am not quite sure what it means.

Dr Bushell: I can provide for the panel a link to the European Risk Forum definition of the innovation principle. It is pretty simple, really. All it is asking for is that, as part of the impact assessment when you are applying a precautionary approach, you must take into account the knock-on impacts on innovation. When I talk about the abuse of the precautionary principle, it is often the case that the impact assessment that should be part of applying a precautionary principle is not done in any meaningful or broad way. You can see that in things like the neonicotinoid issues of last year, when no meaningful impact assessment was done about what it would mean for farmers, or indeed what the alternative approaches would mean for the environment. I think that in GM we have this in spades. It is absolutely vital for Europe that we have a regulatory framework that encourages

innovation and investment, because that is where jobs, growth and economic prosperity are going to come from in Europe.

Q189 Graham Stringer: You heard the previous session when the witnesses said they were basically in favour of moving to a trait-based regulatory system. Would you agree with them?

Dr Little: I explained the issue we had with a particular product: it spent 12 years in the approval system. More and more things go into the system than ever come out of it, even for things like import and food use. The reason for that is that there are a number of countries out there that are attempting systematically to stop this happening in Europe. Our issue is always that new regulations come in, and we have tried—sorry, politicians have tried—to find a better way of dealing with this issue. Each and every time it gets slightly more political and slightly less science based, but nevertheless there is a process. Each and every time they bring in these new rules, they are broken; they are ignored; there are prevarications. We have two main concerns. First, if you decide that you are going to change the rules at European level, it will take a number of years, and in the meantime countries that are opposed to GM will say, “While this is going on we must not allow anything else to happen,” so essentially you have a de facto moratorium. Secondly, even if in many ways the idea of moving to a different way of doing things sounds as though as a result things will happen, there will undoubtedly be political pressure by a number of countries to make sure it does not happen. Our concern is that you change one set of rules that currently are not working for a new set of rules that, for all their potential, do not work either. We would say, why do we not try to make the rules we have work in the first instance? Make them more science based in terms of risk assessment, and then allow the marketplace to decide. Farmers will grow only what they can sell to retailers and consumers, and companies will sell only those GM products that farmers are prepared to buy.

Dr Mackey: As an example which may help, it took us 13 years to get a high-starch potato through the regulatory environment into the marketplace. The reality was that the goals were rapidly changed again, so that product is no longer on the market. However serious we are about the technology, or however seriously we believe it can add value, our investment is not exactly giving much of a return over 10 or 12 years. Therefore, from a business perspective it simply does not stack up. That is one of the realities in Europe today.

Q190 Graham Stringer: Have your businesses done any assessment or analysis of what the cost to the European GDP has been of these regulations and the inability to authorise the use of GM crops?

Dr Little: Some work has been done, not by us, but by other more independent groups. The Swedish Government did a report looking into this sort of area. We put some figures in our submission. If I may move the question slightly to give a slightly more tangential answer, it has had a massive impact, along with European legislation, on all our areas of business. As an industry we put about \$6.5 billion into research and development in agriculture. If you go back not that long ago, when I came into the industry, something like a third of that amount of money was invested in products for Europe in general. It is now on average about 8%. It used to be nearly a third of all the money we put in; it is now

8%, and going down. That tells you that, as a result, when it comes to new innovations coming through, farmers are living off what works for them and also works somewhere else in the world. They are getting things that are working somewhere else in the world. We are investing in that area and it might work in Europe, so they will get the opportunity to use some of those things. When it comes to GM, of course, they are shut out of that process. We find ourselves in a really difficult situation. We are absolutely committed to Europe when it comes to agriculture, but when it comes to GM it is a no brainer; we do not see a way of even starting.

Dr Bushell: The Graham Brookes report, of which you are probably aware, quotes a cumulative figure in excess of \$116 billion for the net benefit of growing GM crops since they were first planted in 1996. All of those benefits are being denied to European growers. On top of that, there is a substantial reduction in the field footprint of agriculture because of the ability to take on a lot more no-till agriculture, where people are growing intensive corn and soya using GM crops, so not only economic benefits but also environmental benefits are being denied.

Q191 Graham Stringer: What impact do you think the deliberate release directive will have if it is implemented in its current form?

Dr Little: This is the concept of individual member states being able to have a little more choice as to whether they can access it. I would like to make a general statement before we go into that. We absolutely understand the frustrations of many member states, of which the UK is one. They can see the potential of GM to work in some cases in some member states, but the current legislation does not work. Therefore, they do not see a route to market within those member states. A number of countries have tried to look at whether, if they had maybe a little more independence once they have an EFSA okay, if you like, on the safety side of things, individual member states should have a bit more choice. We absolutely understand that and have a lot of sympathy for those countries.

Our concern, however, is that the way it is currently shaping up in the European Parliament—and that we are even discussing it at a European level as this—means that this is going to be more a licence to ban than a licence to operate. Our concern is that it will give cover for countries that want to ban the use of these products, but very little for countries that want to move forward. Again, given the way the Parliament seems to be putting through its amendments, I doubt that this piece of legislation will allow UK farmers to access GM. I really doubt that.

Dr Bushell: There is uncertainty anyway about the ability to unblock the regulatory process with this. We are grateful for the large amount of scientific analysis that has gone on in DEFRA in looking at these issues, and the leadership that the Department has shown in this area in Europe. It is a beacon of enlightenment in this area in many respects, but we are being asked to speculate about something that is still going through the Parliament. We will just have to wait and see. There are some advantages. If the market changes, we may react to that, but it rather risks damaging the principles of a single market and bringing in all sorts of intra-common market trade issues.

Chair: That was clearly to make your question softer, David.

Q192 Mr Heath: It follows on directly from what Dr Little and Dr Bushell have been saying. Without wishing to ask you to give a general critique of the structure of the European Union, is it not the case that the more we have co-decision making and the involvement of the Parliament, the more difficult it is to have science-based policy? Whereas you can talk directly to the Commission and to member states at Government level, talking to the membership of Parliament, who are swayed in this country by the *Daily Mail*, which makes reference to “Frankenstein crops” every couple of seconds, and equally in other countries by their press and public environment, makes it much more difficult to make advances.

Dr Little: With power comes responsibility, and the European Parliament really does have to sit back and say, “What does this mean?” We talked before about impact assessments before and the need to understand not just the consequences of going forward but the consequences of not going forward. We see the issue around innovation in Europe; we see companies withdrawing innovation. Apparently the European Union is set up to try to push innovation, jobs and everything else, yet it seems to be adopting essentially a more museum agriculture approach to the whole issue of food security. It is almost as if they believe, “Don’t worry. If we can’t produce enough food, somebody else can do it for us.”

One of the things we talk to MEPs about is the concept that just a 1% increase in overall agricultural productivity in Europe feeds 10 million more people, but the reverse is also true. It is absolutely critical that as Europe we understand that for every 1% reduction in productivity—because that is the way European legislation is targeting at the moment—we need to import enough food to feed another 10 million people in Europe. That is totally mad, because we know we can do it in Europe. We know that farmers, given the tools and, most importantly, the policies, can feed more people in Europe and be less reliant on imports of food. That is the sort of message the European Parliament has to understand when it is making some of the more mad amendments to this legislation.

Dr Mackey: We are continually talking about food. Let’s be very clear about where primary agricultural production goes. It’s not just food; we’ve also got fibre, fuel and feedstock becoming more and more important within this conversation. How this links up with a green economy, bio-economy and possibly decarbonising our industry may well be part of this conversation going forward. What we are doing in Europe is ensuring that we cannot play a part, because one of the tools has been removed.

Q193 Sarah Newton: On that very salutary segue to my questions, I go back to what I was asking about before; I appreciate that you were listening. I am interested in the whole area of intellectual property and patenting. From what you said, there is very little GM crop production that is going to need patents or intellectual property protection, but obviously you are still very engaged with the techniques and the science for producing it. I would like to ask Dr Mackey and Dr Bushell in particular about the policies of their organisations regarding intellectual property. Perhaps you would start, Dr Mackey.

Dr Mackey: As an innovation business, BASF registers over 1,000 patents a year. Fewer than 40 of those were plant biotechnology patents. The reality of what we do is outside Europe. We are working extensively with our partners. Our strategy is not to bring the products to market, but to bring the traits to a partner who will then market them for us.

We have a number of partnerships in various parts of the world. Sometimes we compete with those partners in other parts of the world as well, but that's business.

The reality of the situation you are describing is that we also have the research principle, which means that people can use our products for research, and from our side of things that is something that goes on. As was touched on during the last session, anything that evaluates and gives us more data and information has to be a good thing, because at the end of the day good science is what holds our business together.

Dr Bushell: Let's be clear: intellectual property is something society gives people because there is a benefit to society for doing it that way. The reason it gives a royalty or competition-free period to operate your invention, once your patent is granted, is that you as an inventor need to make a full and frank disclosure of what that invention is, and other people can then springboard on top of your ideas. Eventually, that is how scientific innovation and progress happens. Particularly in an area where you have a very long regulatory time frame and large costs are involved, if there was no competition-free period to exploit the inventions, nobody would make the investments. In bringing a GM crop to market, we are talking of an investment in excess of \$100 million. Perhaps up to \$10 million of that might be for the regulatory part of it, but the rest of it is all the work that is needed to create the variety and breed it up in sufficient bulk for sale. For a crop protection chemical, it is in excess of \$250 million, so patents are an important part of protecting the investors who make those investment decisions, allowing them to get a fair return on those investments, but of course society benefits enormously from having those products available. If you did not have intellectual property protection, you would not have investment on the scale Julian has already said our companies are putting in.

Q194 Sarah Newton: Julian, would you like to comment about other members of your organisation?

Dr Little: There are a couple of things that go back to the previous session as well. We often get the impression that as a result, farmers somehow miss out as well, but if you are buying a genetically modified seed, it may have two or three genetically modified attributes. Frequently, those will come from a different company. Geoff has already mentioned that BASF will license one of their traits. It might, for example, be a Syngenta seed containing one Monsanto trait; there might be a Bayer trait and there may be a BASF trait as well. As a farmer, you end up with the best sort of seed with the best traits, irrespective of which company it came from. That cross-licensing of patents is absolutely endemic in agriculture. You are always sharing patents or cross-licensing patents to make sure that the end product is the best one out there.

There was also some discussion about whether we encourage publication. One thing about publication that is always really important is that it demonstrates that the scientists doing it are doing good science. From our perspective, we only want to be working with the best scientists. How do we know they are the best scientists? Because they publish in good journals, do good work and everything else. Not encouraging publication would be mad, because that is a licence to do bad work, not good work.

On the patent side of things, I give one example about the idea that it is the multinational companies that do all the patenting. Abiotic stress patents are for heat tolerance, cold

tolerance or about water—being able to survive in drought conditions. There have been about 1,000 patents to date in that area, and 50% have been filed by Chinese operations, mainly from universities. You will not be surprised that 41% of them are in rice, so there is a big connection. Eleven per cent are from multinational companies, and 39% would be universities, research institutes and other SMEs around the world, so only 11% of patents in that area are from our members. If you exclude China, that is still only 25% of the patents out there. It is always worth remembering that patents work not just for multinationals, but for all sorts of different people. As Mike says, what you end up with are great new products coming into the market.

Q195 Sarah Newton: I understand the need to have a commercially protected period to secure the potential return on investment for the investors. Apart from researchers publishing their findings in well-respected journals, in what other ways—anybody can answer this—do you enable independent researchers, not those you have sponsored yourselves to undertake research, to examine the findings of the research? I understand that it could be after a period of time.

Dr Bushell: If you take a GM crop submission in Europe, these are all basically in the public domain. We were talking yesterday about this. Are they secret? No, they are not. Between 95% and 99% of the information in those submissions would be available for public scrutiny. The only little bits that are left would be perhaps things which were redacted for personal information reasons or, in one or two cases, for commercial sensitivity, because it might relate to some sort of commercial agreement that we would not be able to make more open. In the end, we want growers to know how great our technologies are. As things are going through the pipeline, we are working with third parties who will be growing these materials and showcasing them to farmers alongside other varieties, so that farmers can choose the best possible varieties for use in their fields.

Dr Mackey: If I may be a little practical about the market, the reality of the products we bring to market is that they have to work and give benefit. I am left with a slightly wry smile: I do not see any farmers queuing up at our doors demanding our products unless they work, unless they are getting more benefit and they are better than what they already have. That is one of the key drivers for us. When we talk about a sustainable business, it is all about providing value that we can share. Therefore, the market will drive some of the answers to your questions; they just won't buy our products if they don't work.

Dr Little: I reiterate my colleagues' view on patents. A patent is one way of getting information out there; publication is another. There will always be issues that allow us to protect the \$130 million worth of investment that is going into getting a product to the market. We live and die in the marketplace. There will always be people out there who will look at our products, compare them with others and determine which ones are the best. We find that the ones who are most difficult to please are the farmers, our ultimate customers.

Q196 Chair: To summarise your answers to Sarah, you are essentially saying that the regulatory structure should examine the quality of the science and regulate on the basis of the scientific validity of the claims you are making, and then the market will determine whether the products work, because it has to work in terms of results and price.

Dr Little: Yes. The disappointing thing about all of this is that we have the most robust safety assessment in Europe and anywhere in the world, yet despite the fact that our products pass with flying colours through the science bit, there is no belief by some countries in Europe that we should work in the marketplace.

Q197 Pamela Nash: Dr Bushell, could you share with us the policies of your company when it comes to publishing research? I am particularly interested to know what proportion of the research you have to provide for regulation purposes is published.

Dr Bushell: If we are talking about the sort of journals that academics see as their top impact journals, we occasionally publish in those; for example, we were the first company involved in sequencing a crop plant genome—the rice genome—and that would have made the front cover of *Scientific American* and *Nature*, I am sure. There are relatively few of those, because our goal is not to publish papers; our goal is to bring technology and products to farmers. A lot of the information associated with our research and development is very much applied R and D. Often, if you were to submit that to high impact journals they would say, “We know all about this, because we would have to know about it in order to be able to apply it,” so the standards for publication are rather different. We publish a bit of our work, and we do not hide the rest because it is shameful and difficult; it is because we have different things to do in terms of getting on with developing the technology so that it can be deployed in practice. The percentage is quite small, in total.

Q198 Pamela Nash: Do you know what it is?

Dr Bushell: No, because we do not count it up.

Q199 Pamela Nash: You appreciate why I am asking this. It does not come as a bolt out of the blue that we would be interested to know this. There is criticism from others that without complete transparency on research that is done, the companies working in this area control what is published. People are interested to know about the research that is not published.

Dr Bushell: On any research we have in conjunction with academics, there will always be something written into the agreement that says publication will not be unduly delayed. We have already heard from previous speakers that sometimes it is delayed, perhaps for six months, maximum about a year, so that patents can be properly filed to protect the inventions for the benefit of both parties, but that is really the limit of it. We screen 100,000 chemicals at the start of our screening processes. Nobody would be interested in 99,000 negative results. Actually, we are interested in them; we stick them in our databases, and we will go back to them and look at them over time. That is part of our intellectual property, our know-how. In that case it is not very useful know-how; it is knowing that something does not work, but sometimes we go back to those chemicals and investigate them for other applications. We would not want to destroy the novelty associated with those by publishing them at too early a stage.

Q200 Pamela Nash: But that is about timing rather than publishing at all. You have given reasons why you would publish in a peer-reviewed publication only if something was noteworthy. Is that fair?

Dr Bushell: It is often published in different ways. Some people might call this the grey literature, but you see Syngenta technology being talked about in the farm trade press every week, and you see our applied R and D guys working on all sorts of aspects.

Q201 Pamela Nash: Is there any reason not to make the information in the studies publicly available, even if they are not in peer-reviewed journals?

Dr Bushell: When you are talking about regulatory submissions, a large portion of this material is already available in the open area, and of course we follow the rules—

Q202 Pamela Nash: That is not what I asked you. I asked if there was any reason not to make all of it available.

Dr Bushell: We simply do not have time. I will give you one example. All the field studies associated with the regulatory phase of our neonicotinoid insecticide in Europe were put into two papers and submitted for publication. It took more than a year and a significant rewrite and combination, forced by the journal, to get that material into the public domain. While it is important to do it in that particular case, there are many other cases where we just do not have the time to massage the data and work on it in the way that would be needed.

Q203 Chair: Is that true of all field trials?

Dr Bushell: Let's be clear: in any regulatory studies we cannot hide anything. If you were to do a study and get a result, that has to be submitted to the authorities. There is no hiding there.

Q204 Chair: But all the requirements by the regulator that are covered by both laboratory and field trials will go into the public domain.

Dr Bushell: They will go into the regulatory agencies. How people can access the data will depend on the rules of the agencies. In many cases they are published.

Q205 Pamela Nash: I am going to come on to that in my next question. I was hoping Dr Mackey could fill us in on his company's internal policies on publication.

Dr Mackey: I am not a specialist in this area, but if I can talk generally, for our business we spend a substantial proportion of our turnover on research. Along the continuum from research to commercialisation there are a number of phase gates in the process. Products, not just in this area but in any other of our sectors, can fall at any phase gate for all sorts of reasons. Is all of that research published? No, it is not. Why not? The answer is that there is little value in it, I would think, but the reality of where that research then goes is that it

starts again or takes a different path to go forward. Certainly, at the pure R and D end, yes, it is published.

Q206 Pamela Nash: To be clear, when I am talking about what is published, I am specifically talking about the information and research submitted to EFSA or other regulatory bodies, not all research. With the research I am talking about, the papers are, I presume, already being produced by your respective companies. I am looking to know what proportion of those is published.

Dr Bushell: As I said before, the regulated resubmissions to EFSA will be subject to public scrutiny, and almost all of that, 99%—

Q207 Pamela Nash: But they are not automatically published if they go to EFSA.

Dr Bushell: No, they are not automatically published, but people can make freedom of information requests and see them and comment.

Q208 Pamela Nash: There are other bodies in the EU which do publish all submissions. Would you be comfortable if they started publishing everything you submitted?

Dr Bushell: We are pretty happy about publishing data and being as transparent as possible, provided the data protection is there to reward people who are investing, fairly, in terms of the amount of money they are putting in to bring forward these technologies. For example, when the competition-free period that a patent allows expires, is it okay for someone just to take your data and work with that invention, or should there be an element of data compensation? These are live issues that have been discussed a lot over the years.

Q209 Pamela Nash: Dr Little, in terms of other members of your body is this comparable with other companies in the sector?

Dr Little: What Mike has explained pretty much represents the rest of the industry. Our view, when it comes to regulatory dossiers, is that there is an element that is very useful to our competitors and, therefore, we would not be absolutely delighted to see everything published. However, individuals can always look at these dossiers under freedom of information. You will be aware that, even if the main assessment made of a particular dossier is at European level, all the member states have access to that. Our products do not have to succeed in their processes just in Europe; they have to do so in the country of origin and around the world, wherever they are being exported. That regulatory scrutiny is always there, and that is what should give everybody a degree of confidence that there is no issue around these products.

Q210 Pamela Nash: To be clear, your view and that of the council is that you would not want EFSA to publish all documentation submitted to them.

Dr Little: Our view has always been that Europe needs to sort out the issues surrounding competition. Whenever you do a blanket publication of all your data, you are giving away

your competitive advantage. It is not a question of being worried about who might see it other than our competitors. If I am working for Bayer, I do not want Syngenta seeing the whole of our dossier because that is of use to them in producing their next best crop. We would always say that the principle of being able to publish the data is absolutely fine, but there are some issues that require some thinking. We have asked the European Commission many, many times to look at this, and so far they have refused to do so.

Dr Bushell: And don't forget that full and frank disclosure to get a patent means you have to publish pretty early in the life cycle of any technology. We look at Bayer's patents on the day they are published; I am sure they look at ours. We then get an early view as to whether or not they are a new and exciting area. Because there are research exemptions in Europe, we are perfectly free to look at those patents and start to work on them. Competition is not stopped by patenting; in some respects it is encouraging competition.

Q211 Stephen Metcalfe: I would like to look a little bit at what the future holds for this technology. I think it is fair to say that Europe and the UK are perhaps difficult environments in which to cultivate genetically modified crops, but there are parts of the world where the markets are more predictable. What traits are you and other companies working on that might be marketed around the world? Are any of those applicable to the UK, or would they be applicable, putting aside the regulatory framework you have to get through?

Dr Little: There is almost no area of plant science that is not being looked at in terms of its potential commercial application. It can be making things easier for farmers to grow a crop, and essentially that is where we have been for the last 10 to 15 years. For 15 to 20 years, we have been looking at the whole area of making crops more climate-resilient. Will they withstand the frost you weren't expecting, the heatwave you weren't expecting, the drought, the floods and everything else? It is about bringing new ideas to how you maximise your yields going forward, because we know that farmers are going to have to grow an awful lot more.

We are also aware that, if you are worrying about drought, you need to think more generally about water use, because we do not have the amount of water that would be required to feed 9 million people with today's technology. We have to find ways that plants will grow with less water and fewer nutrients. Some of those ideas have been coming into the marketplace in the last couple of years.

Things like nutrient outputs are being discussed. They are quite tough ones to think about. You heard earlier about the omega 3 and omega 6 fatty acids. Their route to market is not necessarily to feed people with those crops but bizarrely, because it is more acceptable from a public perspective, you feed fish with them, and then people eat the fish to get those omega 3s. That is a bizarre way of doing things, but, hey, we will go where the market takes us.

You will have heard of golden rice, but you will not necessarily have heard of golden cassava and some of the other projects going on to improve nutrients in other crops that are normally nutrient or vitamin deficient. A lot of things are going on. Which ones come to the market first depends on the ease of doing it, the chances of market acceptance and, quite simply, where the markets are that you would do that. There is no point in bringing nutrient-supplemented cassava to the US, for example.

Dr Bushell: Most of the companies are working in similar areas, so I would not want to add anything other than echoing what Julian has just said. On the traits that are in the pipeline, if you said, “Let’s unblock GM now for what’s in the European pipeline,” most of those are not particularly relevant to UK agriculture because they have not been developed with that in mind. Of course, if the regulatory framework was different, maybe that would be different. The cost of regulation globally means that the potential for genetic modification that is going to be delivered will be less than is possible. Particularly in areas where perhaps you are interested in consumer traits—taste and flavour in vegetables—mostly they will be addressed by traditional breeding rather than GM, not just because of the regulatory issues but because those polygenic traits are probably more amenable to smart breeding approaches.

Dr Mackey: We are working on nothing specifically for the European market.

Q212 Stephen Metcalfe: The question was about what is being worked on globally. Would any of those outside the European market be applicable to the UK in your view?

Dr Mackey: I think Julian covered the list—things like drought tolerance and stresses. Given the range of risks farmers and growers have to put up with, whether or not they would choose some of those products as a way of managing those risks better could be discussed, but from our perspective we are aiming nothing firmly at Europe.

Dr Little: As Mike says, when the European regulations change—because they will have to at some point—companies will come back in. You will see research institutes and SMEs coming into the marketplace and there will be traits suitable for Europe, because in the end things like drought tolerance are just as important to farmers in East Anglia as anywhere else.

Dr Bushell: From our perspective, we are interested in what our customers are interested in. You know farmers: their issues are pretty much around growing a good crop and getting a good price for it, and that is helped by getting protection from competition from pests, weeds and diseases, and increasing the quality of the crop so they get a higher price for it. I am sure that herbicide tolerance will be an effective trait that farmers in the UK would want. Virus resistance already exists in things like sugar beet, and that could be brought in fairly quickly if things changed.

Our company’s approach is to look at agricultural technology as part of the total system. It is important that there are not only GM crops and good plant genetics, but also crop protection chemicals that go alongside it, and nutrients and mechanisation. By building a system based on those four technologies, we can give farmers a competitive edge in Europe. One of the issues of the precautionary principle is that it is putting enormous pressure on the other parts of the farmer’s toolbox, and perhaps this Committee might like to look at that further in the future.

Q213 Stephen Metcalfe: To go back to what Dr Little said about companies coming back in when the regulatory framework changes, would that apply to BASF?

Dr Mackey: I am sure that when things change we will have another look at it.

Q214 Stephen Metcalfe: But that is what is holding you back, or keeping you out at the moment—it is just not worth it.

Dr Mackey: At the end of the day, there is nothing here in Europe for our business in this area, and therefore there is no investment.

Dr Bushell: That is not quite true, because the crops we are growing in Brazil, Argentina and America are all being imported into Europe, so we are still making a significant amount of investment in pushing our submissions through the existing regulatory framework. In the end, cattle and people will be eating this food; it's just that it will not be grown in Europe, it'll be grown elsewhere.

Chair: Gentlemen, thank you very much for your attendance. It has been really enlightening.