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Scientific Life

De-Problematizing 'GMOs': Suggestions for Communicating about Genetic Engineering

Stefaan Blancke,[1,*] Wim Grunewald,[2] and Geert De Jaeger[3,4]

The public debates concerning genetic engineering (GE) involve many non-scientific issues. The ensuing complexity is one reason why biotechnologists are reluctant to become involved. By sharing our personal experiences in science communication and suggesting ways to de-problematize GE, we aim to inspire our colleagues to engage with the public.

Complex Debates

GE ('GMOs' is familiarly used to refer to genetically modified organisms) continues to be a controversial topic with the public, but there is strong consensus among scientists concerning the strengths and limitations of this technology. Biotechnologists and other scientists can play a significant role in laying public concerns to rest. However, not many feel inclined to communicate with the public, not only because science communication takes time and energy that they might rather spend on research but also because discussions with the public can become highly convoluted. Public debates concerning GE include discussions about safety for humans, animals, and the environment, topics that a scientist usually feels comfortable talking about. However, quickly enough, he or she will find him- or herself discussing a wider variety of topics, including the desirability of the use of pesticides, agricultural policies, small farmers versus multinationals, patents, politics, food production, and so on. Because of this complexity, debates concerning GE have evolved to a point where effective participation requires a substantial learning curve that deters the participation of qualified voices. Furthermore, public engagement can also be perilous. When scientists step into the public discussion, they are subjected to online smear and outright defamation that can dampen their desire to be part of the conversation. It is therefore understandable that scientists prefer not to become entangled in these debates. Nonetheless, given the increasingly important role of science and technology in agriculture and society at large, it has become more necessary than ever to contribute to an informed public understanding of science.

Because the debate about GE is a multidisciplinary discussion, we decided to merge expertise in philosophy, biotechnology, and agricultural engineering. By regularly providing lectures on the technology, applications, and public perception of GE to audiences of students and lay people, we have gradually developed a way to de-problematize the issue. By sharing our experience, we hope to encourage our colleagues to engage in science communication. With the advent of important new GE technologies, such as gene editing, the involvement of scientists in the public debates concerning biotechnology becomes ever more pressing.

A Genetic Improvement Method

Simply providing people with information about GE will not suffice. Research on science communication and the public understanding of science has amply shown that improving people's knowledge only has a limited effect on public opinions concerning GE [1,2]. Instead, people are more likely to interpret the information in personally relevant ways. If people think negatively about GE, they will either discard the information as untrustworthy or modify the information so that it fits their background beliefs [3]. We propose to frame the communication about GE in such a way that the audience is willing to listen, even if they oppose the technology (on the role and importance of framing in science communication, see [4]). Our central message is that GE is only a genetic improvement method, or rather a set of methods – nothing more, nothing less.

This observation may seem obvious to scientists and science communicators. However, we want to emphasize that it provides a good starting point for communicating about GE, especially because students and lay people often do not have the slightest notion of how even elementary breeding works. We compare genetic modification with other breeding methods, such as traditional breeding and mutagenesis, and we explain why GE *per se* poses no more risk. From this fundamental insight, three implications follow. First, opposing GE in general makes absolutely no sense. As the report of the National Academy of Sciences notes, 'the technologies, the traits and contexts of deployment of specific GE crops are so diverse that generalizations about GE crops as a single defined entity are not possible' [5]. Nevertheless, people fail to discriminate between the technology and its applications because they rely on intuitive reasoning (we explain why people do this in the first part of our presentation, based on [6]). Second, we can only check for unwanted health, environmental, or socioeconomic effects (positive or negative) of GE products on a case-by-case basis for each particular application. Third, the end-product, not the breeding method nor the technology that has been employed, needs to be evaluated on a case-by-case basis for its own risks and merits. The important question is not, for instance, whether a blight-resistant potato is the result of GE or classical breeding (both routes are possible), but whether it is safe to put it on the market, no matter how it has been developed.

Common Ground

Once the audience realizes these important distinctions, it becomes easier to show that many important criticisms targeted at genetic modification are not integral to the technology. It also enables us to meet our audience on common ground. We make clear that many of their concerns are legitimate, but that we need to decouple these concerns from the technology. This happens mostly after the talks, when we open the floor for questions and engage directly with specific concerns from the audience. Such a direct approach is labor-intensive but is more effective than communication targeted at a wider audience [7]. For instance, we often hear the remark that the widespread use of glyphosate-resistant crops has led to the emergence of glyphosate-resistant weeds that are a tremendous problem in some areas. We then explain that herbicide-resistant weeds can emerge as easily with a classically bred herbicide-resistant crop. The technique by which herbicide resistance is achieved is irrelevant. We also point out that genetic modifications of crops encompass much more than only herbicide resistance. Non-specialists rarely hear about the sustainable virus resistance that has been achieved by GE technology in the papaya, or about the tremendous decreases in insecticide use accompanying the adoption of Bt (*Bacillus thuringiensis*) insect-resistant crops such as cotton or eggplant.

In addition, the public often takes issue with patents without understanding much about the longstanding history of intellectual protection in plant breeding. Many breeders will protect classically bred plant variety with breeders' rights, a form of intellectual property protection with features very similar to patent protection. Moreover, not all GE crops are patented in all locations, whereas many conventional non-GE crops are. The issue of intellectual property rights is certainly debatable, and perhaps we need to consider a more flexible model [8]. However, the debates should not rage on the back of a single genetic improvement method. As a final example, people find it problematic that farmers tend to pay for GE seeds and not save and use their own. We then emphasize that many farmers also buy organic or conventional seeds every season because farm-saved seeds are not the best guarantee to have good starting materials and yields later on in the season. Again, it becomes clear that the debate surrounding buying seed is not inherent to GE products. Although the issue merits discussion, it cannot be used to set the technology aside.

To be clear, our message is not that scientists need to steer clear of discussing the social, political, and economic issues relating to GE. On the contrary, we invite our colleagues to become better informed on such topics so that they can engage with the public in discussions on, for instance, the problems and needs of farmers, the place of agriculture in modern society, the involvement of industry in science and technology, and so on. However, we think it is crucial to emphasize that GE should not be at the focus of these important discussions.

Concluding Remarks

A debate about GE organisms often digresses into a lively discussion about agricultural models and the societal role of agriculture. However, our approach makes clear that genetic modification is not wedded to one particular model, nor does the technology necessarily support policies or practices that people reject, or infringe public values [4]. As a result, people come to realize that GE is not the problem. On the contrary, they acknowledge that, for many significant problems in all types of agriculture, whether they are industrial, organic, or agroecological, GE can provide (part of) the solution ([9]; freely available at www.vib.be/en/about-vib/plant-biotech-news/Pages/default.aspx). In our experience, de-problematizing GE results in a more informed attitude towards a technology that can make a valuable contribution to sustainable agriculture. What more can a science communicator hope for?

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[1]Department of Philosophy and Moral Science, Ghent University, 9000 Ghent, Belgium
[2]VIB, 9052 Ghent, Belgium
[3]Department of Plant Systems Biology, VIB, 9052 Ghent, Belgium
[4]Department of Plant Biotechnology and Bioinformatics, Ghent University, 9052 Ghent, Belgium

*Correspondence: st.blancke@gmail.com (S. Blancke).
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Forum

Isothermal Amplification Strategies for Detection in Microfluidic Devices

Saheli Sarkar,[1] Pooja Sabhachandani,[1] and Tania Konry[1,*]

Isothermal rolling circle amplification (RCA) is used to detect nucleic and non-nucleic acid biomarkers