Talk

The flightpath of genetically modified insects

They might sound like something straight out of the pages of an Isaac Asimov or Arthur C Clarke novel, but genetically modified (GM) mosquitoes are very firmly science fact and not science fiction, as visitors to the Edinburgh Science Festival learned during a talk entitled *The Buzz About GM Insects* on April 7, 2019, in Edinburgh, UK. Event host Ali Floyd, Public Engagement Manager at the Wellcome Centre for Anti-Infectives Research at the University of Dundee, Dundee, UK, opened the session by asking members of the audience to raise their thumbs, keep them level, or point them downwards depending on how they felt about the use of GM insects—a fairly equal spread of thumbs up and thumbs level signalled the crowd was open to debate on the topic, which Floyd then facilitated by inviting the three guest speakers to deliver short talks, before opening the floor to questions from the audience.

Prof Helen Sang, Chair of Vertebrate Molecular Development at The Roslin Institute in the University of Edinburgh, Edinburgh, UK, introduced the audience to the concept of genetic modification using local examples, such as Dolly the sheep, the first mammal to be cloned from an adult cell, and the Roslin's research to give chickens resistance to avian influenza and tackle porcine reproductive and respiratory syndrome in pigs. She also pointed to work being done at Rothamsted Research, Harpenden, UK, to increase the amount of omega-3 fatty acids in camelina, a plant that could then be turned into meal and fed to farmed salmon.

Neil Morrison—New Opportunities Manager for Research & Development at Oxitec, which was spun out from the University of Oxford, Oxford, UK, in 2002 and bought in 2015 by biotechnology company Intrexon, which is listed on the Nasdaq stock exchange—built on Sang's foundations by moving the discussion onto insects. He pointed to the effect that insects have on humans, explaining that 200 million people are infected by and 500 000 are killed by malaria a year, while dengue virus threatens 40% of the world's population and affects 400 000 people a year, and that hundreds of billions of dollars are spent each year trying to protect crops and livestock from insect damage. Morrison introduced the sterile insect technique (SIT), in which males are irradiated in a factory and then released into the wild, explaining how the technique had eliminated New World screwworm from North and Central America. Rather than having to separate male and female insects in the factories, he showed how genetic modification had allowed only males to be bred.

The future of GM insects was then considered by Prof Luke Alphey, Vector-borne Viral Diseases Group Leader at the Pirbright Institute, Woking, UK, who examined the key features of GM technology, explaining that it is species specific and target seeking; mosquitoes will only breed with other mosquitoes and males will actively look for females. He also introduced the concept of so-called gene drives, or selfish DNA systems, to propagate a characteristic through a population, and whether those characteristics needed to be spread locally or globally. Alphey contrasted such techniques with the cost of continually reintroducing irradiated males during SIT, such as in Panama to maintain the screwworm barrier between North and South America.

Floyd moved the evening forward by asking each of the speakers where they felt the field of GM insects would be in 10 years. The overriding theme of the ensuing debate was how government policy and regulation would be the determining factor in the speed of progress, rather than the advancement of science. Morrison expects Oxitec to move from field trials to selling products to farmers, farming cooperatives, or governments, while Sang said she felt more optimistic about progress in the insect field than in her own vertebrate arena, given opposition to GM foods in Europe. Alphey added: "Regulation and public perception are bigger factors in terms of the timescale for the uptake than technology development. There is already a gene drive system out in the field on a reasonable scale in mosquitoes, it just wasn't made using recombinant DNA methods, so it isn't classified as GM."

Questions from the audience included whether researchers should move outside Europe to find easier regulatory environments. Alphey believed that, although laboratory research could take place in Europe, field tests needed to be done overseas, and that many crop researchers had already moved abroad. But he added: "The last thing developers want is an unregulated situation. You need a credible, competent, science-led, independent regulatory system because that's a big part of how people will trust your product. We have this for aeroplanes—you get on an aircraft and you trust it to get you to the other end without crashing on the way because of the regulatory system. The last thing aerospace companies want is no regulation because that would be a disaster, and it's the same when you're developing any new technology."

At the end of the discussion, Floyd again asked the audience to give a show of thumbs to share their opinion on GM insects. Although some of the level thumbs had turned to thumbs up, many still remained to be convinced. The same trust factor in regulators that gives customers confidence to buy products is also clearly needed by the wider public when it comes to learning more about new technologies and their potential applications and benefits.

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