

Scenario

The following scenario has been inspired by the work of the Bristol 2010 and Imperial 2011 iGEM teams, and the Rathenau Institute's 'Synbio Futures'.

Part 1: Synthetic beginnings

The year is 2030. For the past 15 years, farmers across the world have been using the FertiBac bacterial fertiliser system, a new kind of fertiliser which uses modified *E.coli* to detect where the soil is low in nitrate and then produce nitrate to bring the soil to its optimum level. To ensure environmental safety, FertiBac uses GeneShield, a standard gene transfer prevention mechanism based on freely available BioBrick parts from the parts registry.

FertiBac was one of the first synthetic biology technologies to be commercially released, and as such it set a precedent for the regulation of synthetic biology products. Extensive safety testing was carried out in a step-by-step fashion, first with small and then large-scale controlled field trials, and then a pilot release on a remote island off the Scottish coast, each wider release being permitted only if evidence from earlier releases indicated complete safety. Europe-wide public consultation was carried out in parallel with the testing, involving a programme of education and debate devised by scientists and policy-makers in collaboration with farmers and concerned non-governmental organisations. To ensure the debate remained unbiased, anyone with a financial interest in FertiBac could not take part, although those who stood to gain in other ways from wider acceptance of synthetic biology technology could be included. As FertiBac passed through ever-larger scale testing without incident, and as news arrived of exciting new synthetic biology products that were being developed in the lab, public opinion began to sway more firmly in support of release of FertiBac.

So it was that in 2015 FertiBac was granted permission for release to market, first becoming available in the UK and then in other countries, often backed by government subsidy to ensure that all farmers would be able to benefit from the new system. Since its release, farmers have seen their yields improve dramatically and their fertiliser expenses decrease. They can now grow crops in areas that would have previously been considered unusable and they no longer have to worry about damaging their crops from over-fertilisation. The original patents on the FertiBac technology have expired and several companies are now producing variations on the fertiliser. This first successful implementation of synthetic biology to solve a real-world problem opened the door for further technological developments in this field, and products of synthetic biology - agricultural, environmental, and medical - are in widespread use throughout most developed countries, and increasingly so in less economically developed parts of the world.

Part 2: Crisis

In the island city of Singapore, people are falling victim to a strange new disease. It starts with fever and nausea. Sufferers then experience deteriorating vision, and within a few weeks they are blind. After extensive investigation, the source of the outbreak has been traced to rice imported from Thailand, where a chemical spill has contaminated crops in the area. The affected crops are destroyed and many countries place temporary bans on the import of Thai rice.

So when dozens of new cases appear in Europe a few months later, the problem appears significantly more grave than previously thought. Imports from Cambodia, Laos, and Vietnam are also found to be contaminated, far beyond the reach of the chemical spill. Authorities are stumped - until a connection is discovered between certain affected crops

and FertiBac-based fertilizer. The chemical spill, combined with a record heatwave and unusually high amounts of rainfall, has caused the FertiBac bacteria to mutate, producing a toxin which poisoned the Thai crops. To make matters worse, the GeneShield system has been degraded, allowing the mutant genes to spread to wild-type soil bacteria, which are then transported from field to field on farmer's clothing and shared farm equipment. This has allowed toxin-producing bacteria to reach neighbouring countries - but we do not yet know how far the contamination might have spread. Cases with the same symptoms are beginning to appear the world over. This is now an international issue and we, as the European Synthetic Biology Council, have been brought together to decide on the best course of action.