Case study: Preventing fungal disease in plants

The global challenge

Diseases of plants and trees caused by fungi and closely related organisms, such as wheat rust or potato blight, are the fastest growing cause of crop diseases. Historically these diseases have been devastating, leading to the Irish potato famine in the nineteenth century for example. Nowadays fungal diseases of the top five food crops worldwide – rice, wheat, maize, potatoes and soybeans – destroy at least 125 million tonnes of these crops every year (about 4% of the total production). The economic cost of these losses for rice, wheat and maize have been estimated at US $60 billion. Whilst fungal diseases affect crops everywhere, they are disproportionately damaging in low-income countries where people rely more on staple food crops.

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Approaches to preventing fungal disease

The most common way of controlling fungal diseases is spraying fungicides – chemical compounds or organisms like bacteria that kill fungi or their spores. However, many fungicides are only effective at preventing outbreaks of fungal diseases rather than treating infected plants. Some fungicides are certified for use in organic agriculture.

Plants have their own defences against fungal infections, so another approach is to selectively breed new crop varieties that are resistant to fungal infections. For example, in August 2017, the Dutch company Solynta announced that it had successfully bred a potato variety resistant to late blight, the disease that caused the Irish potato famine.

A common problem with fungal infections is that fungi evolve rapidly, so effective fungicides or resistant crop varieties can quickly become ineffective. Farming practices, such as how far apart plants are planted and removing dead plant material from fields, are also important for preventing fungal infections.

A genetic technologies example

British scientists have developed a genetically modified (GM) variety of the Désirée potato that is resistant to late blight. They did this by introducing a gene from a wild South American potato variety that activates defence systems within the plant to resist blight. These modified potatoes have successfully resisted blight in UK trials, but are not grown commercially here. The scientists have since licensed the technology to an American potato company, Simplot, which has secured regulatory approval for the commercial production of GM blight-resistant potatoes in the USA and Canada.

UK facts & figures

- The UK produces 6 million tonnes of potatoes a year and late blight is the most significant threat to this crop
- Farmers can spray their crops up to fifteen times a season with fungicides to prevent late blight. Prevention measures and crop losses cost British farmers around £55 million per year
- Blight-resistant varieties of Sarpo potatoes have already been selectively bred using conventional methods and are commercially available in the UK.

Arguments made in favour of GM blight-resistant potatoes

- Blight-resistant plants reduce the need for fungicides, which are expensive and can be environmentally harmful
- Introducing blight resistance using genetic engineering as opposed to conventional breeding is faster and likely to have fewer impacts on other valuable properties such as yield and flavour
- If evolution of the fungi that cause infection mean engineered resistance is no longer effective, then it is relatively easy to insert new resistance genes. It is also relatively easy to introduce multiple resistant genes at the same time meaning that the resistance is likely to be effective for longer
- There are no wild plants related to potatoes in the UK that the engineered trait could be accidentally transferred to. If the trait were transferred to non-GM potatoes, then the way potatoes are propagated from tubers rather than from seeds mean this should not affect future crops.

Arguments made against GM blight-resistant potatoes

- The process for developing and trialling GM varieties of crops is more expensive than using conventional breeding
- The market for GM potatoes is uncertain given general consumer concerns about negative health effects from eating GM foods and the involvement of large agribusinesses in developing GM crops.