Research Into Use

Transgenic banana **could feed millions**

A safe transgenic banana could prevent nematodes (worms) destroying around 6 million tonnes of bananas a year. This is enough to feed the 60 million people in Uganda, Rwanda, Ghana, Nigeria and Cameroon for whom banana is a staple food. Because bananas are sterile, it's very hard to breed resistance to nematodes by conventional plant breeding methods.

Photo: BioImaging, John Innes Centre

And the chemicals that are used to control nematodes are harmful both to humans and the environment. The gene introduced into East African Highland Bananas stops the nematodes growing and laying eggs, but does not affect humans at all. This technology is already being used in the UK, and also in Uganda on local cooking bananas. The transgenic method is also being applied to develop nematode-resistant potatoes and rice.

Bananas are a staple crop for many food-insecure people in **Uganda, Rwanda, Ghana, Nigeria** and **Cameroon**. But nematodes (roundworms and eelworms) destroy around 6 million tonnes of bananas each year, enough to feed 60 million people in these countries. Nematodes attack the plants' roots and prevent them growing, so the bananas wilt and can't obtain water and food from the soil. The chemicals used to control nematodes are harmful to both humans and the environment, and the cost is beyond the means of poor subsistence farmers. Breeding bananas for nematode resistance will also help poor farmers cope with environmental pressures, which are likely to get worse if climate change makes droughts more frequent.

Photo: BioImaging, John Innes Centre

The technology

This research focuses on East African Highland Bananas—a type of cooking banana from Uganda. It's very difficult to improve these bananas by traditional breeding—they set few seeds and most of these don't germinate. Until now, it's also been a problem to form a cell mass that can be used for genetic transformation work. But now researchers in the UK have developed a new technique using banana flower buds that means that cell cultures of these bananas can be produced for the first time anywhere in the world. They have passed these techniques on to colleagues in Uganda who have produced cell masses from local cooking banana varieties.

Transgenic bananas

This new technique has paved the way for scientists to develop a transgenic banana resistant to nematodes. They do this by inserting an additional plant gene into the banana. This gene produces a protein (called cystatin) that affects nematodes' digestion and stops them growing and laying eggs. Cystatins are found in a normal human diet (they are present in cereal seeds and eggs, for example), so they don't affect our digestion or have any other untoward health effects. They also don't have any environmental impact on other species.

Where next?

This technology could help improve other plants too, and is being promoted worldwide through scientific articles, presentations at conferences and websites. The cystatin proteins seem to be effective against a variety of different nematodes. They have already been tried successfully in a different kind of banana to protect it against a different nematode, and similar genetically engineered rice and potato plants resistant to nematodes have also been produced.

But what about safety?

Biotechnology is a controversial subject and transgenic plants must be shown to be safe and appropriate to local needs. National programmes in different countries must test the plants in the field and under different farming systems over several years. The attitude of local governments towards biotechnology is also a key factor for success. The Ugandan government is committed to funding biotechnology-based approaches to increase cooking banana production.

The use of pesticides is not appropriate for most poor or subsistence farmers who aren't trained to use them properly and don't use protective clothing. The chemicals used to control nematodes are particularly hazardous and, if used routinely on banana plantations, harm humans and damage the environment. But people have to use them if they have no alternatives. Cystatin-based transgenic bananas offer an alternative approach with real environmental benefits.

All field trials of genetically modified banana are done under secure conditions and experiments are stopped before the fruit sets to prevent pilfering. As most bananas are sterile there's no danger that genes will be passed on by cross-pollination.

For more information

For further technical information go to the RIU online database at **www.researchintouse.com/database** and type in **PSP20** or email **riuinfo@nrint.co.uk**

This *New Options Showcase* was developed from research funded by the UK Department for International Development (DFID). The views expressed are not necessarily those of DFID. Details of the researchers involved are given in the database. Research Into Use (RIU) is managed by Natural Resources International Ltd., in partnership with Nkoola Institutional Development Associates Ltd. (NIDA), and Michael Flint and Performance Assessment Resource Centre. RIU is funded by DFID.

www.researchintouse.com

Writing, design and layout: SCRIPTORIA (www.scriptoria.co.uk)