

BANANAS

PICK OF THE BUNCH FOR GM?

Text by Charlie Furniss
Photographs by Venetia Dearden

Not merely a staple food, the banana is entwined in the Ugandan way of life. One type serves as a dowry; another to celebrate the birth of twins. Thus, attack by the banana weevil in the past decade is a major cause for concern but even worse now is the disease BXW, which destroys entire plants. Charlie Furniss examines claims by on-the-spot researchers that the banana is an excellent candidate for GM. ▶



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In the dappled shade of her banana grove in Masaaka district, south-western Uganda, Maria Namatovu bends down to search among the withered brown leaves littering the earth. Above our heads, perhaps three metres from the ground, the plants' huge green leaves create a splendid canopy that shields us from the heat of the equatorial sun. After a short time Namatovu lets out a muffled exclamation. She picks something up and turns to me, her gnarled hands clasped together as if in prayer. 'These insects cause me so many problems,' she says, and opens her hands to reveal a black beetle less than a centimetre long with vertical ridges on its back and a long hooked proboscis. 'We call them *kayovu*. They lay their eggs among the roots of the plants and their young burrow into the stems and eat away at the insides. The leaves that were green turn yellow and the fruit is too small.'

Namatovu explains that she used to grow enough bananas on her half hectare to both feed her family and sell at the market. 'That way we could send our children to school and have sugar and milk on the table.' But in the past decade the *kayovu*, or banana weevil, has caused more and more damage. She estimates that about 40 per cent of her plantation is affected, and now she has nothing to sell. 'I am very worried that eventually all my plants will become infected and I will be left with nothing.'

Her story is not uncommon in Uganda. The majority of the country's population relies upon bananas as a staple food, and they are the primary source of income for 70 per cent of its farmers. But during the past 20 years or so the insidious spread of the banana weevil and various other pests and diseases has led to a dramatic decline in banana production, particularly in central Uganda. Indeed, a recent report in *New Scientist* claimed that the African banana crop was facing the equivalent of the Irish potato famine.

It is difficult to underestimate the significance of bananas and plantains in equatorial Africa. They are a valuable source of vitamins and minerals and in some areas they supply more than a quarter of the calorific intake of the local people. Unlike many African staples, bananas require no pounding before being cooked and their cultivation involves relatively little labour. Like grass, the banana plants are



perennial and reproduce vegetatively from rhizomes. A stem takes up to 18 months to produce a ripe bunch, during which time a 'daughter' sucker will appear to take its place. Propagation simply involves sticking a new stem in the ground, after which it should bear fruit for at least 30 years. Where rainfall is fairly consistent, farmers can stagger growth to produce a continuous supply of fruit throughout the year.

Conditions in the Great Lakes region are ideal for growing bananas. Uganda alone produces around 11 million tonnes every year – more than 10 per cent of the global total and the equivalent of all global exports. It has the world's highest per capita consumption rate, which in some areas reaches 450 kilograms per year (the average in the developed world is just 13 kilograms). Uganda's farmers grow more than 100 varieties, 84 of which are endemic to the region. Known locally as *matooke* and elsewhere as East African Highland bananas (EAHBs), these green bananas are used primarily for cooking. Others, known as

THE AFRICAN BANANA CROP [IS] FACING THE EQUIVALENT OF THE IRISH POTATO FAMINE

kayinga, are grown for their juice, while there are also a number of yellow dessert types similar to Cavendish, the variety eaten by most people in Europe and North America.

Ugandans have invented countless ways of preparing bananas. Different types of *matooke* are variously steamed, boiled, fried, roasted, mashed and stewed, while *kayinga* are squeezed to produce a sweet juice that is fermented to make beer or distilled into gin. 'To most Ugandans food is bananas,' says Patrick Luganda, agriculture editor of the Ugandan daily *New Vision*. 'In fact, the word *matooke* means "food". We eat other types of food, of course, but then we say that we are eating cassava, for example, not food.'

Wherever one looks in Uganda, there are bananas – piled up on street corners, hanging from bicycles, strapped on top

of buses and bulging out of car boots. Every household has a banana grove of some description and even in Kampala there are plants growing among the corrugated roofs, on patches of wasteland and by the roadside. But they are not just grown for their fruit. The leaves are used to steam vegetables or as basins to hold water; dried – known as *essanja* – they are made into mats, among other things, while the fibres of the pseudostem are used to make rope, baskets and cloth.

Traditionally a subsistence crop, bananas are now big business. Every day streams of trucks packed with hundreds of bunches ply the route from commercial plantations in the south-west to the growing urban centres of Kampala and Jinja. And the government is encouraging the development and diversity of banana-based products, ►





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from flour, chips and soft drinks to
calendars, notebooks and picture frames.

Bananas are also an important part
of Ugandan culture. 'If your daughter
is getting married, you give a certain
type of banana as part of the dowry,'
says Eldad Karamura, East African
coordinator of the International Network
for the Improvement of Banana and
Plantain. 'And if you have twin babies,
another type of banana is associated
with that.' Luganda explains that the
banana grove is an integral part of the
family home and is traditionally the
centre of ceremonies and festivities. 'At
weddings people gather in the banana
grove and wear a belt made from the dry
pseudostems when they dance. After a
death, people keep a vigil in the grove,
and in many cases the dead are buried
right there.'

So while *kayovu* alone could
be catastrophic for Uganda's
economy and culture, an even
bigger threat is looming. Since
the *New Scientist* report in 2003, a new
disease known as banana xanthomonas
wilt (BXW) has emerged which is far
more deadly than anything seen before.
'Those diseases which affected our
bananas historically – black sigatoka,
banana weevil, fusarium wilt – only
reduce the yield, but they would never
kill off bananas altogether,' says Dr
Wilberforce Tushemereirwe, head of
the Ugandan National Banana Research
Programme. 'But BXW is far more

serious. If we do not control it, it will be
devastating. It alone could lead to the
extinction of bananas in this country in
a matter of years.'

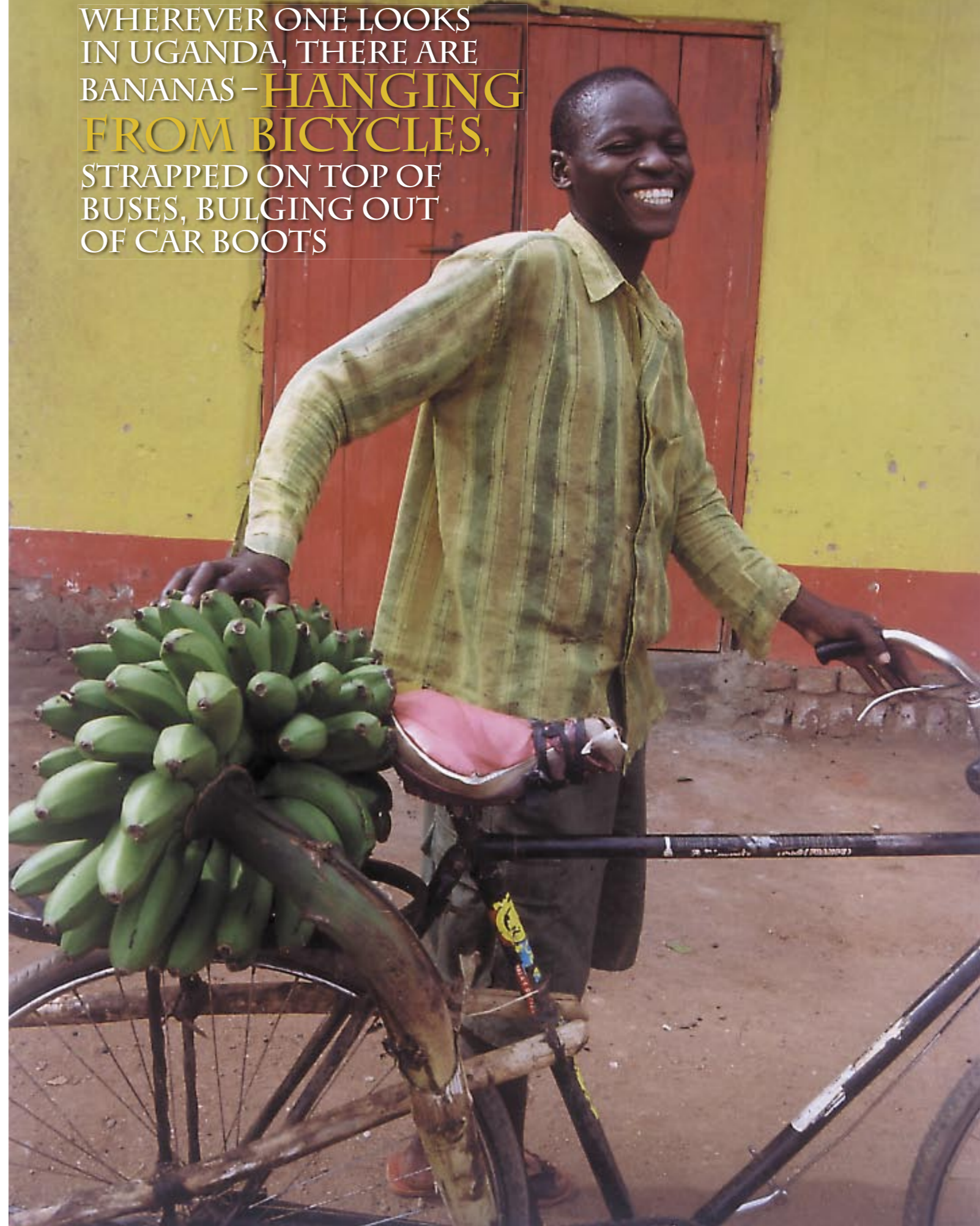
BXW was first identified in Ethiopia
in 1968, where it affected *enset*, a large
banana-like plant grown for the starch
in the stem. Caused by the bacterium
Xanthomonas campestris pv. *musacearum*,
it is spread through contact with con-
taminated bodies, so farmers have
unwittingly been spreading the disease
with their tools. However, scientists
believe that in Uganda BXW is dispersed
primarily by flying insects because
the first sign of infection is often the
shrivelling of the male flower bud.
From here, the bacterium quickly
spreads to the bunch and then invades
the pseudostem and eventually the
rhizome, from where it affects the
daughter suckers.

BXW has had little impact in Ethiopia
firstly because *enset* plants are harvested
before the flowers emerge and secondly
because bananas are less important
there, says Simon Eden-Green of EG
Consulting, who is one of the world's
leading authorities on bacterial diseases.
'But similar diseases have devastated
crops in Latin America and South-
east Asia. In large parts of Indonesia, a
bacterial wilt known as blood disease
has removed certain banana types from
the cultivation system.'

When BXW was diagnosed in Uganda's
Mukono district in September 2001,
the Ministry of Agriculture instigated
emergency measures. Extension workers
were dispatched to oversee the removal
of infected male flower buds and the
destruction of infected plants. Tools
were disinfected and quarantine was
imposed on the movement of any
banana material. The quick response
was deemed a success. It was announced
that the disease was under control and
farmers were able to plant new, clean
stems. Everyone breathed a sigh of relief.

Then in 2003 it emerged that BXW
was more widespread than had been
originally thought. The Ministry
activated the eradication plan once
more, but it was too late. The bacterium
had spread to 12 more districts by
October 2004, and by May this year it
had reached 31 (out of 56). In some
areas, up to 90 per cent of plants have
been affected and productivity has
dropped to as little as 10 per cent of
pre-disease levels. It is estimated that
the economy is losing US\$360-million a
year as a result. ▶

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More than a year ago the Ministry proposed implementing a 'fire-line' to contain the spread of the disease but, even though the government has approved a budget of US\$1.2-billion (R4.7-million or US\$725 000), nothing has yet been done. One source believes there may be 'a certain amount of fatigue' among the policy makers. 'It's not the first time epidemics have arisen in Uganda,' says the source. 'They've recently had coffee wilt disease and cassava mosaic virus. In most cases, they've suffered loss and have found solutions.'

Experts in general agree that BXW is a far more serious prospect, partly because of the speed at which it has spread and

partly because bananas are so important in Uganda. 'If the disease is allowed to take hold and spread to the south-west, there will be severe implications,' says Karamura. 'The social fabric of the country would erupt in the first place, and we would have to start importing food. Not only this country, but the whole of the Great Lakes region would face a severe food shortage.' In fact, an outbreak of BXW has already been confirmed in the eastern Democratic Republic of Congo. 'Given that war has already devastated livelihoods and the infrastructure in the region,' says Eden-Green, 'an epidemic of BXW here would be extremely serious.'

The reason for the rapid spread of BXW in Uganda is that none of the EAHBs appear to have any resistance to it. In fact, scientists have yet to identify resistance to BXW in any cultivated varieties of banana or plantain. What they have noticed, however, is that some varieties are less susceptible to infection than others, and this may hold the key to managing the disease. 'In Ethiopia, a dessert variety known as Dwarf Cavendish grows alongside heavily infected *kayinga* but is almost completely unaffected by BXW, probably because the floral morphology is such that the plants do not get infected in the same way,' says Eden-Green. At present, Dwarf Cavendish is not widely grown in Uganda. 'But if such types were introduced as replacements for those more susceptible to insect-borne infection, then it could help to control the spread of the disease.'

For this approach to be successful, farmers would have to maintain high standards of management. 'This may work in large commercial plantations,' says Rony Swennen, head of the Laboratory of Tropical Crop Improvement at the Catholic Universiteit Leuven in Belgium, 'but among Uganda's smallholders, continued outbreaks will be inevitable.' This is one of the reasons why many feel that the only effective long-term solution to pathogens such as BXW is to develop resistant varieties.

This is easier said than done. The banana is the Cinderella of crop breeding. The first long-term banana breeding began only in the 1960s, in Honduras, when scientists began working to develop a commercial dessert banana resistant to black sigatoka. It was not until 1985 that research began on non-commercial



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varieties and only in 1994 that breeders began looking at EAHBs.

None of these efforts have had much success. With any cultivated plant, breeding is hit and miss: it involves mixing up the genes of two varieties and seeing what happens, so while you might produce a resistant variety, it might not taste very good or the fruit might be too small. With bananas, the process is further handicapped because most edible varieties produce no seeds and even among those which do, few are fertile; among the 80-plus EAHBs, for example, only 16 are viable as female parents. Add to that the time it takes for a plant to produce a bunch – up to 18 months – and the whole process becomes painfully slow.

'For 40 years, the breeders in Honduras have failed to put a single variety on the market because the Europeans and

Americans don't like the taste of the new varieties,' says Tushemereirwe. 'And here in Uganda, we've failed to get a single cooking banana which tastes as good as our *matooke*. We've never come up with a single line which is acceptable to consumers.'

Given the difficulty associated with breeding bananas, many scientists advocate the use of genetic engineering. 'GM is a lot more specific and a lot faster than conventional breeding,' says Karamura. 'We can identify a gene which is responsible for resistance to a particular disease and then transfer it to the favoured varieties so that all their characteristics remain.' This is particularly important in Uganda, he says, where the cultural value of bananas is related to their diversity. In the case of BXW, genetic engineering may be the only option. 'Because we have ►

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ONCE THE PROTOCOLS ARE IN PLACE, UGANDA'S FARMERS COULD BE GROWING THEIR FIRST TRANSGENIC BANANAS WITHIN THE NEXT 10 YEARS

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not yet found resistance to BXW among any cultivated *Musa* [banana] varieties,' says Leena Tripathi of the International Institute of Tropical Agriculture, 'the only way to confer resistance within bananas is by introducing a gene from another organism.'

So far, transgenic research into bananas is still in its infancy: scientists have only mapped around one per cent of the genome. What little research there has been into resistance has concentrated on black sigatoka and viral diseases. Until now, none has been directed towards EAHBs.

However, scientists at Kawanda Agricultural Research Institute outside Kampala are poised to begin work on resistance within EAHBs as soon as the Ugandan government passes legislation on biosafety and biotechnology.

'In the case of BXW, we will use two genes isolated from sweet peppers,' says Tripathi, who is leading the BXW transgenic research at Kawanda. 'These have been tested in various vegetable crops and we are confident that this will produce a good candidate for developing resistance to BXW among Uganda's *matooke*.' Once the policies and protocols are in place, says Swennen, whose lab is closely involved with the work at Kawanda, Uganda's farmers could be growing their first transgenic bananas within the next 10 years.

Is this really a good idea? After all, many European environmental groups are fundamentally opposed to genetically modified organisms (GMOs). 'Once you release GMOs into the environment, they can contaminate or cross-pollinate with other species,' says Sarah North

of Greenpeace UK. 'And once that pollution has happened, there's no way to recall it.' Corporate exploitation is another issue. 'GM technology is in the hands of a few multinational companies who have made it explicitly clear that they want to control the world's food production,' says Adrian Bebb of Friends of the Earth Europe. The worry is that poverty-stricken farmers would be forced to buy new seeds every year. 'This could have disastrous effects on developing countries, especially in Africa, where the control of agriculture will slip overnight into the hands of big, Northern-based multinationals.'

In Uganda at present there is little debate about GMOs; a recent survey by consumer group Consent revealed that the public's main worries relate to the taste, marketability and cost of GM bananas. Around Africa, however, there are various groups that are showing more concern. At a speech at the Cape Town Press Club earlier this year, David Fig, chairperson of Biowatch South Africa, amplified the fears expressed in Europe to explain why he feels genetic engineering is inappropriate for Africa. 'It will not deliver us from hunger,' he concluded, 'nor will it revolutionise our yields. It will compromise our biodiversity, our health, the health of our animals and our environment.'

In the case of bananas, says Tush-emereirwe, these concerns are irrelevant. 'Environmental pollution is not an issue,' he explains, 'because we are using biotechnology for infertile bananas. So once the genes get inside, there is no way for them to get out – they cannot cross with anything else.' Nor, he maintains, is the argument over intellectual property relevant. 'The *matooke* bananas we are targeting have no commercial value. They will be distributed to farmers locally.' And even if planting material were to be sold commercially, it would be impossible to impose any form of regulation. 'These plants are propagated vegetatively, so once somebody has a plant he can pass on a new sucker to his neighbour and no one will know.' In fact, all research in Uganda's biotech lab is being conducted in the public domain, says Swennen. 'There are no royalties on the genes, and the planting material will be supplied to the farmers free of charge.'

Swennen is concerned that the research could be hindered if environmental groups continue to polarise and simplify the debate. 'We have to look



at this on a case by case basis, and not just each crop, but each variety, each transformation we make and each protocol we use. We must carry out tests on this basis to discover whether our transformations are effective and to address fears about pollution and health. You can't generalise about GMOs.' The situation in Uganda is perhaps the best example of how transgenic technology might be used for the public good. 'But at present, the way the debate is conducted means that people are losing confidence. In the case of the EAHBs, this will only succeed in depriving the poor farmers who need this technology the most.'

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For more information about BXW and other banana pests and diseases, visit www.inibap.org