



‘We didn’t have  
to spray our bananas’



GREENHOUSES HOLD OUT HOPE FOR THE TROPICS

# Dutch bananas!

**The first Dutch bananas were harvested in a Wageningen greenhouse last December, to great acclaim. They had not been grown in the soil but in rockwool and coconut fibre. This could help farmers in the tropics to outsmart the dreaded Panama disease, say the researchers.**

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It was a media hit last December: the harvesting of six bunches of bananas – about 800 pieces of fruit – at the first Dutch banana plantation, in a greenhouse on the Wageningen campus. ‘There were 15 camera crews,’ says Harold Meijer, a researcher at Wageningen Plant Research. ‘Bananas appeal to the imagination. I used to do research on potatoes, and occasionally somebody would come and have a look; but with the bananas we sometimes hosted 10 excursions a day.’ The greenhouse cultivation was an experiment to mark Wageningen University & Research’s centenary. It was suggested by extraordinary professor of Tropical Phytopathology Gert Kema, as a way of put-

ting Wageningen in the spotlight. He had been wondering whether bananas could be grown on substrate. And the experiment was a resounding success, albeit only in the nick of time before the centenary year ended.

## A BIT NERVOUS

The bananas were put in the greenhouse in January 2018, as undersized houseplants. They grew rapidly, but by August there was some doubt about them, says Meijer, because none of the plants had flowered. ‘We were getting a bit nervous: will we make it in 2018? Then we cut one up to see if there was a bud coming. A few days later we realized that was unnecessary, as the first plants began to flower.’ >

On a visit a week after the media hype, peace has returned to the greenhouse complex. As the December rain patters on the glass, it is pleasantly warm inside, but not boiling hot. A borderline temperature for the development of the fruit: these heat-loving plants are not in their element, says Meijer. ‘The hot summer was very welcome. The temperatures were high and there was plenty of sunlight: tropical conditions in fact. Now, in the winter with the short days, the lack of light is limiting and temperatures are on the low side. The bananas lack the energy to make the fruit grow fast. In retrospect, we should have started months earlier.’

These are not the only teething troubles the experiment has suffered from. The 53 banana plants are very close together, in six rows with a bit more than a metre between the plants. The lowest leaves have been removed to create some room for manoeuvre in this jungle. ‘If we could have left those leaves on the plants, production would have been higher,’ says Meijer.’ And the top leaves at over six metres got stuck between the pipes at the top of the greenhouse. We are now working on a demonstration collection for visitors, and there the individual plants get a lot more room.’

## RIPENING

But the plants are now full of lovely bunches of Dutch bananas, ready for the second harvest – even if they are on the small side due to the light and temperature conditions. The fruit is harvested green, just as it is in the traditional places of origin in the tropics. Those bananas travel by sea to destinations such as western Europe, where they go into a ripening facility. Here they ripen evenly under the influence of the plant hormone ethylene – through which starch is converted into sugars – and a smart temperature regime. The Wageningen bananas don’t have so far to travel: they are ripened at a Chiquita



Pieter Vink of the Boerenhart cooperative proudly receives the first bunch of Dutch bananas from Professor Gert Kema.

facility in Gorinchem.

So it has been established that bananas can indeed be grown on substrate. This has important advantages. ‘It enables us to avoid soil pathogens and prevent the waste of nutrients,’ says Kema. In the greenhouse, the plants are either in tubs of coco peat (a coconut waste product) or in mats of rockwool. It is a strange sight: a bag of rockwool with drip tubes for water and nutrients, and a gigantic banana plant growing out of it. ‘We chose coco peat because it is widely available in most of the production countries,’ explains Meijer. ‘Rockwool because we have a lot of experience with it in Dutch greenhouse horticulture. For plant growth we have not seen any difference between the two types of substrate. We have delivered proof of principle here: you can grow bananas above the ground, and that is an innovation. It has never been done on such a large scale.’ On substrate, nutrients can be better adjusted to the needs of the plants, and no nutrients are washed away and wasted. ‘Substrate cultivation also makes research on what the crop wants easier,’ says Meijer. ‘What does a plant need, and when? We don’t know much about that in the case of the banana.’

The main reason to get banana plants out of the soil, however, is that farmers in

Central America, Asia and Africa are plagued by two fungal diseases: Black Sigatoka and Panama disease. Black Sigatoka causes the leaves to deteriorate and can only be controlled with large doses of chemicals – spraying the plants 60 times a year. As for Panama disease (see inset), no plant can resist it. The disease is caused by the fungus *Fusarium*, which lives in the soil and attacks the plant’s vascular system. Once soils are infested with this pathogen, a plantation is unusable for at least 30 years, and probably longer, and the farmer has to find another location. The fungus poses a threat not just to our western fruit bowls, stresses Meijer, but also to food security. Most local banana varieties are vulnerable to the fungus too. ‘There are regions of Africa where people literally live on bananas, eating a kilo of them per day.’ The thinking in Wageningen is that by keeping the plants out of the soil, the farmer can outsmart Panama disease. Bananas can then still be grown on infested plantations, on substrate.

## GENETICALLY UNIFORM

Professor Kema was in the Philippines in December for consultations about upscaling the substrate experiment in the open air. ‘That is a pragmatic approach to soil-related problems, but the real Achilles

## ‘This is proof of principle: you can grow bananas above the ground’

heel of global banana farming is its genetic uniformity. About 95 per cent of the dessert bananas worldwide are of the Cavendish variety,’ he explains. The plant’s DNA doesn’t get changed through sexual reproduction, as these bananas are propagated using tissue cultivation, a form of grafting really. Over hundreds of thousands of hectares in tropical countries there is a monoculture of clones, a paradise for pests. According to Kema, more genetic diversity is a must for tackling the fungus problems. ‘That’s why we have set up the MusaRadix company, which has joined forces with breeding company KeyGene to take the initiative on breeding bananas. A programme like that doesn’t develop by itself, and it takes a lot of time and money,’ says Kema. ‘Chiquita opted recently to work with Wageningen and partners on tackling genetic uniformity. Not just because of resistance

to disease, but also for other reasons, such as flavour. The ultimate goal is to make global banana cultivation more sustainable.’

### REGIONAL PRODUCT

Meanwhile, the question is whether there is any commercial mileage in the Dutch banana. The first harvest was marketed by Boerenhart, a cooperative that supplies regional products from the province of Gelderland to companies, hospitals and catering outlets. The Wageningen banana project fits the cooperative’s vision on sustainability and corporate social responsibility, as Pieter Vink of Boerenhart told the media. Kema and Vink are exploring the potential for a semi-commercial trial in the Netherlands. Harold Meijer: ‘You might think in terms of a niche market for banana varieties that taste delicious but are not yet for sale here.

Perhaps because the skins are not tough enough to cope with transport, or because their appearance is spoiled by insect and fungal damage. Western Europeans only want nice yellow bananas. We don’t get those pests in our greenhouses, and we don’t even have to spray the crop. Of course it is more logical to pick countries with more sunshine for the cultivation. But the question then is: won’t those bananas be black and blue after two days in a truck from Spain? And banana farming is hard work: it remains to be seen whether it is commercially viable here.’

Later in December, Meijer emails: ‘We received the bananas from the ripening facility on the last day before the Christmas holidays. Tastes differ, but we were very pleased with them, and so was Chiquita. They tasted fantastic.’ ■

[www.wur.eu/banana-cultivation](http://www.wur.eu/banana-cultivation)



Gert Kema

### AGGRESSIVE FUNGUS

Until the mid-20th century, most of the bananas in our fruit bowls were of the Gros Michel variety. That was until Panama disease, caused by the *Fusarium* fungus, ravaged banana plantations all around the world. The resistant Cavendish banana provided a solution, but this variety is not unassailable either. In the 1980s, a new strain of *Fusarium* appeared in Asia, the Tropical Race 4 (TR4), which loves Cavendish bananas. Given that most bananas are clones, this new fungus poses a huge threat to the sector.

An international team led by Gert Kema from Wageningen is trying to find out more about the cause of the disease. In October, team member Martijn Rep, professor of Molecular Phytopathology at the University of Amsterdam, Kema and his colleague Harold Meijer made an important discovery: the protein that makes the banana fungus so aggressive. The model in the research was a related fungal disease in tomatoes. ‘In that tomato fungus, the protein SIX1 contributes to the virulence of the fungus,’ says Rep. ‘The fungus is not nearly as aggressive without that protein. We found a similar protein in the banana fungus.’

Tomatoes have a receptor on the cell wall that recognizes the SIX1 protein and sets an immune response in motion. The Cavendish banana lacks this defence mechanism. Rep: ‘We could now look for a banana variety that recognises this protein and is therefore resistant to the disease.’