

Sustainability

Saving Cavendish

Farmers have a green light to grow the first genetically modified banana. The wilt-proof strain of the Cavendish banana developed by researchers from the Queensland University of Technology is resistant to Panama disease (*Fusarium* wilt), a devastating fungus. The Office of the Gene Technology Regulator in Australia gave the go-ahead on 12 February to allow the genetically modified banana to be grown commercially. The banana is modified to resist the tropical race 4 (TR4) fungus *Fusarium oxysporum* f. sp. *cubense*, a soil-borne pathogen that attacks the roots of the banana, causing it to wilt. The fungus is aggressive and destructive and has spread to several countries worldwide. It affects many varieties, including Cavendish, which are half the global banana supply.

The wilt-resistant banana emerged from a chance observation. The Queensland scientists noticed a wild variety (*Musa acuminata* ssp. *malaccensis*) of banana thriving in a plantation devastated by the disease. Although the *malaccensis* banana is not used commercially because it has too little flesh and its yield is low, certain variations in its *RGA2* gene — also present but inactive in the Cavendish strain — allowed it to resist the fungus.

James Dale, director of the Centre for Tropical Crops and Biocommodities at the university, identified the



promoter and termination sequences for the *RGA2* gene that differed between variants. His team used a plasmid from the soil bacterium *Agrobacterium tumefaciens* to upload and transfer those *RGA2* elements into the Cavendish Grand Nain host genome. “We put different promoters and termination [sequences]s on the gene so the plant would produce more [than] it would do normally.” The researchers reengineered a whole plant starting from these genetically modified cells. The result is QCAV-4: a GM Cavendish Grand Nain banana immune to the disease, modified with a single *RGA2* gene taken from a wild banana variety.

More than 300 banana varieties exist, but 99% of exported bananas are Cavendish (*Musa acuminata* ‘Cavendish’ subgroup). In the 1950s the Gros Michel was the export banana of choice, but it was wiped out by Panama disease and replaced by the Cavendish. The Queensland group now has the licence to commercialize the wilt-resistant banana, and they are waiting for Food Standards Australia New Zealand to approve it for human consumption. They have also joined with producer Del Monte Foods, who is seeking approval for similar field trials in the Philippines.

Another GM fruit, the Rainbow variety of papaya

(*Carica papaya*), was created starting in 1985 when an epidemic of ringspot virus almost wiped out Hawaiian plantations. Eighty percent of papayas now grown on the islands are GM Rainbow papayas.

The Queensland University team is now attempting to disease-proof banana through gene editing, which is subject to fewer regulatory hurdles in some countries than GM plants. In the case of the Cavendish, they could switch on the dormant *RGA2* gene. “This is the next generation,” says Dale.

Claire Turrell