A Reporter at Large

WE HAVE NO BANANAS

Can scientists defeat a devastating blight?

BY MIKE PEED

Plants have been wiped out in Asia and Australia. Latin America may be next.

Darwin, the capital of Australia’s Northern Territory, is more than a thousand miles northwest of the country’s largest banana plantations, which are centered around Innisfail, on the eastern seaboard. A ramshackle place, Darwin is known for its many impoverished indigenous residents, entertainment attractions like Crocosaurus Cove (where visitors are lowered, via “the Cage of Death,” into a crocodile-filled tank), and, as one local puts it, “not partying, exactly, but certainly drinking.”

To Robert Borsato, a fruit farmer, the area looked like an ideal place to grow bananas. In 1996, he began farming a thousand acres in Humpty Doo, which is on the road between Darwin and Kakadu National Park.

To bear fruit, banana plants need at least fourteen consecutive months of frost-free weather, which is why they are not grown commercially in the continental United States. Darwin offered this, and more. As one of Borsato’s workers told me recently, “You came up here and saw the consistency that you’ve got between the blue sky, the sunshine, the water, the fucking soil. You knew you were going to beat everybody else, hands down.’’ There were a few nuisances: crocodiles wandered onto the property, Asian buffalo trampled young plants, and dungoes chewed the sprinklers. Before long, though, the Darwin Banana Farming Company was growing lush ten-foot plants with as many as a hundred and...
seventy bananas on each stalk. In 2006, Cyclone Larry decimated ninety per cent of the Innisfail plantations; banana prices soared from ten dollars a carton to a hundred and thirty, and Borsato became a multimillionaire.

More than a thousand kinds of banana can be found worldwide, but Borsato specialized in a variety called Cavendish, which a nineteenth-century British explorer happened upon in a household garden in southern China. Today, the Cavendish represents ninety-nine per cent of the banana export market. The vast majority of banana varieties are not viable for international trade: their bunches are too small, or their skin is too thin, or their pulp is too bland. Although Cavendishes need nitrogen, they are the only variety that provides farmers with a high yield of palatable fruit that can endure overseas trips without ripening too quickly or bruising too easily. The Cavendish, which is rich in Vitamin C, potassium, magnesium, and fibre; it is also cheap—about sixty cents a pound. In 2008, Americans ate 7.6 billion pounds of Cavendish bananas, virtually all of them imported from Latin America. Each year, we eat as many Cavendish bananas as we do apples and oranges combined. Your supermarket likely sells many varieties of apples, but when you shop for bananas you usually have one option. The world’s banana plantations are a monoculture of Cavendishes.

Several years ago, Borsato spotted a couple of sick-looking plants on a neighbor’s property. The leaves turned a soiled yellow, starting at the edges and rapidly moving inward; necrotic patches appeared and, a few weeks later, the leaves buckled. What had once formed a canopy now dangled around the base of the plant, like a cast-off grass skirt. Inside the plant, the effects were even worse. Something was blocking the plants’ vascular system, causing rot, and tissue that should have been as ivory as the inside of a celery stalk was a purifying mixture of brown, black, and blood-red. When the plants were cut open, they smelled like garbage, and their roots were so anemic that the plants could barely stay upright.

Borsato feared that he was seeing the symptoms of a pestilence that had wiped out the Cavendish across Asia: Tropical Race Four. A soil-borne fungus that is known to be harmful only to bananas, it can survive for decades in the dirt, spreading through the transportation of tainted plants, or in infected mud stuck to a tractor’s tire or a rancher’s boot. It cannot be controlled with chemicals. Tropical Race Four appeared in Taiwan in the late eighties, and destroyed roughly seventy per cent of the island’s Cavendish plantations. In Indonesia, more than twelve thousand acres of export bananas were abandoned in Malaysia, a local newspaper branded the disease “the H.I.V. of banana plantations.” When the fungus reached China and the Philippines, the effect was equally ominous.

Australia was next. Over the following three years, Borsato watched as the other banana farmers in Darwin succumbed to the disease. “A lot of people were in denial,” he recalled. “Most growers tried to hide the fact that they had it. It would’ve devalued their property immensely. But today nearly everybody is out. The guy across the street now grows melons.” He went on, “The government tried to put in a quarantine. You couldn’t move equipment around. There were footbaths to wash your shoes in. Stuff like that. We put a new car park in, paved it all up for the sake of the quarantine, went to that level of expense, and you know what happened? The first idiot to drive up went screaming past all our new signs. Drove right up on the muddy road, up to the shed! It was a bloody idiot government official!”

Scientists believe that Tropical Race Four, which has caused tens of millions of dollars’ worth of damage, will ultimately find its way to Latin America—and to the fruit that Americans buy. “I don’t have a crystal ball,” Randy Ploetz, a plant pathologist at the University of Florida, who was the first researcher to identify Tropical Race Four, said. People are bringing stuff in their luggage, moving stuff around the world that they shouldn’t be. I hope it doesn’t happen, but history has shown that this kind of stuff does happen.” Borsato was more blunt: “Shit’s gonna move. Americans are snookered. They’d better wake up and realize it, or they’re not going to have any bananas to eat.”

W e were prepared to give up,” Borsato told me one afternoon, as he and his farm manager, Mark Smith, showed me around their plantation. “But you just can’t get excited about melons.”

Borsato, who is fifty, has a fringe of white hair and the shoulders of a rugby fullback. (He used to play in high school.) He told me that he had taken much of the money he had earned from the Cyclone Larry shortage and invested it back into his farm. For a while, he and Smith tried to grow bananas only in soil that Tropical Race Four had apparently not yet reached. They soon ran out of virgin land. Then they planted cassava and pinto peanuts, hoping to rejuvenate the soil, and applied quicklime to lower the soil’s acidity; these efforts failed to counteract the blight. A few years ago, Borsato leased ninety acres of a seemingly unsullied property twenty miles away. To ensure that infected machinery wasn’t used, Smith and a small crew planted forty-three thousand banana stalks by hand. Within eight months, Tropical Race Four had appeared. Today, Borsato farms only a quarter of his land, and every week he and Smith chop down two hundred infected plants. “In another month, that’ll be three hundred,” Smith said.

As we walked through the fields, Tropical Race Four seemed as abundant as the mosquitoes circling our heads. “There’s one,” Smith said, pointing. “That’s two. You can see that one there? He’s coming out. There’s another one.” Some plants were just turning yellow; others were a desiccated mass of rawumber. At one point, Smith unsheathed a cane knife, which is similar to a machete, but with a shorter, wider blade. An axe is not needed to cut down a banana plant, which is not a tree but, rather, the world’s largest herb. The part that is usually called the trunk is the pseudostem—a barkless staff composed only of leaves waiting to unfurl. In one stroke, Smith sliced through a diseased plant. The inside resembled a crushed-out cigar, and the fetid odor was overwhelming. Smith said, “You
smell that, and you think, Ah, fuck.”

Borsato shook his head. “Cruel,” he said. “Just cruel.” Lately, he had been obtaining fresh plants from a laboratory that cultivated the seeds in antiseptic petri dishes. But, because the fungus is in the soil, he could get only one or two bunches before the plants died.

Smith was wearing a blue baseball cap that depicted a banana above the slogan “Get Bent Into Shape.” He removed it and wiped his brow. “You see one plant, and you know pretty soon you’ll be up shit creek,” he said. “All this work we’re doing—it’s not viable. The only way to keep going is to breed a disease-resistant variety, one with commercial potential. That’s the only way.”

Borsato knew that attempts to replace the Cavendish through traditional breeding—crossing two bananas to create a third, disease-resistant fruit—had failed. After a series of phone calls, Internet searches, and chance encounters, he found James Dale, a professor at Queensland University of Technology, in Brisbane, who experiments with genetically modified crops. In 1994, Dale produced one of the first genetically transformed Cavendishes. He and his team members inserted what is known as a marker gene; the resulting banana, when placed under ultraviolet light, glowed fluorescent green. More recently, in research supported by the Gates Foundation, Dale has been trying to increase the provitamin-A content of locally grown bananas in Uganda, where villagers eat several bananas daily.

This spring, Dale expects to plant on Borsato’s land four acres of banana plants that have been genetically modified to resist the blight. The Australian Research Council will pay for much of the field trial, but Borsato is also investing a quarter of a million dollars. “And we’ll go to the millions,” he told me. “Someone has to do this work. Otherwise, there’ll be grief.”

The Queensland University of Technology borders Brisbane’s City Botanic Gardens, where students read under weeping figs and cabbage-tree palms. Dale’s office, at the university’s Centre for Tropical Crops and Biocommodities, is less picturesque. “Our lab was once the ugliest building in Brisbane,” Dale told me. “It was painted pink and gray—appalling, just dreadful. The university’s solution was to give each floor a different color scheme. Now we’ve got a lime-green-and-red interior.”

Dale leads a team of a dozen scientists, and on the day I visited he informed them of the Australian Research Council’s decision to fund the Darwin field trial. “It’s all go!” he said. The news aroused only muted enthusiasm.

“They know that the plants have to perform,” Dale explained later. “Otherwise, we don’t keep getting money.” Dale, an affable, diminutive man with a wispy white beard, noted another challenge that banana scientists faced: bad jokes. He said, “I hate when people ask, ‘Hey, James. How are you going to straighten the banana?’ Yeah, we get it: bananas are phallic. I always say, ‘Well, you dickhead...’”

Despite the fruit’s priapic associations—the refrain from an old blues song contains the line “Let me put my banana in your fruit basket”—the bananas we eat are sterile. Unlike wild bananas, the Cavendish doesn’t have seeds, because it has three sets of chromosomes; it’s what biologists call a triploid—in this case, the haphazard product of two wild, seeded diploids that mated thousands of years ago. (Wild bananas, which have flinty seeds the size of peppercorns, can be found across Asia.) Cavendish and other domesticated banana plants produce fruit without fertilization. In a healthy nine-month-old Cavendish plant, a secondary stalk rises from the center of the pseudostem and, a few months later, droops with a single eighty-pound bunch. A bunch consists of a dozen “hands,” and each hand has some twenty “fingers,” or individual bananas. (Fingers do not hang down but, instead, curl toward the sky.) Meanwhile, small suckers poke out from the plant’s roots. When growers harvest the bunch, they cut down the “mother” plant and all but the heartiest sucker. In another year, that sucker sprouts a new bunch. In this way, commercial banana plants can produce genetically identical fruit for decades. Tropical Race Four has upended this efficient method of cultivation; one of the main ways that farmers spread the disease is by uprooting contaminated suckers that appear to be clean and replanting them elsewhere.

On a wall in Dale’s office, there was a painting of a gyrating Josephine Baker, naked except for a pendulous skirt of bananas. “It’s a real leap of faith,” he said of the Cavendish project. “We trust the gene’s in there, but until the plant grows up we don’t know if it will be blight-resistant. That’s the mystery and the magic.”

Despite the danger posed by Tropical Race Four, only a handful of scientists are working to modify bananas.
Whereas other biotechnology researchers have focussed on trying to insert an antifungal gene into the Cavendish, Dale wants to insert a gene that will starve the fungus to death. For years, scientists believed that the fungus injected toxins into the plant, killing cells and gorging on the waste. “Now there’s good evidence that these toxins don’t actually kill,” Dale told me. “Instead, they switch on a certain mechanism in the plant and the plant actually kills itself.” That mechanism is known as programmed cell death. In stressful situations, plants fortify themselves by, say, dropping leaves; they kill weaker cells so that stronger ones may live to fight. “Our thinking,” Dale said, “is that we can insert a gene that inhibits this process, that tells the plant not to kill its own cells.”

Once a year, Dale explained, his lab assistants extract cells from sterilized banana plants and attempt to multiply them in liquid media. Their success rate is five per cent. The cells that survive are selected for gene transformation, which Dale accomplishes by making clever use of a common soil bacterium, Agrobacterium tumefaciens. When the pathogen invades the nucleus of a cell, it installs a few of its own genes, hoodwinking the cell into making food for it. To sneak his desired genes into a banana plant, Dale swaps a few of the bacterium’s genes for the ones he wants. The bacterium then installs those genes into the cells. Later, the bacterium is killed off with an antibiotic. “It’s a natural genetic engineer,” Dale said. “It still amazes me that we can do it.”

Two years ago, Dale and his team inserted into banana cells one of nine genes, which were taken from life-forms as diverse as rice, thale cress, and an armysworm. Each gene was known to impede programmed cell death. “The toxin will still get in, but the cells don’t die,” Dale theorized. “And if the cells don’t die the fungus hasn’t got anything to live on.”

That afternoon, Dale and I drove east of Brisbane to a state-owned greenhouse. A yellow biohazard sign was posted on the front door. Inside, on waist-high tables, young banana plants grew in six-inch plastic pots. Several staff members, wearing white lab coats and white surgical gloves, were slicing open two hundred and fifty genetically altered banana plants and checking for disease resistance. After digging a plant out of its pot, they used a chef’s knife to split the plant’s stem lengthwise. The two halves were photographed, side by side, on a plastic tarp.

“The sap from the stems gets everywhere, and it never comes out,” a research fellow said. “We didn’t use to have the tarp. Management got a bit pissed off.”

Four months earlier, the plants in the greenhouse had been infected with two hundred times as much fungus as they would face in the field. The fungus, however, was not Tropical Race Four but an earlier, more widespread strain of the disease called Race One. “We’re not allowed to bring the Race Four fungus down here,” Dale said. “That’s how paranoid people are.” This problem had led to another: Cavendish is resistant to Race One. So the banana plants here were actually a variety known as Lady Finger, which is susceptible to Race One. When I asked Dale how his science could be sound when he was experimenting with a different fungus on a different banana, he replied, “Race One and Race Four are very, very closely related, and we believe that they use the same mechanism of killing. If they both use programmed cell death, then the same mechanism should stop both. That’s our hypothesis, anyway.”

We were talking in a side room of the greenhouse when a young researcher suddenly called to us. “Oh, they’ve got something!” Dale said. In the main room, the group members were bent over the tarp, examining a pair of bifurcated plants; with their coats and gloves and camera, they looked like forensics experts at a crime scene. The two leading gene candidates, I was told, were taken from the armysworm and the thale cress. A plant harboring the armysworm gene was soot-colored, its roots a mush of corrosion. “Ewww,” Dale said. A plant with the thale-cress gene was as spotless white as a wedding gown. “Well done, guys!” Dale said. “We’ll definitely be talking this one up to Darwin.”

As we drove back to Brisbane, he said, “No one’s ever taken any of these genes and put them in and seen that they’ve given resistance. What you saw today was a world first.” He went on, “It looks like we’ve got the potential to produce a product that uses a plant gene rather than an animal gene. That makes me happy. The general public will be much more willing to accept a plant gene.”

Bananas, which Alexander the Great introduced to the West in 327 B.C., initially came from jungles in India, China, and Southeast Asia. There are fuzzy bananas whose skins are bubble-gum pink; green-and-white striped bananas with pulp the color of orange sherbet; bananas that, when cooked, taste like strawberries. The Double Mahoi plant can produce two bunches at once. The Chinese name of the aromatic Go San Heng banana means “You can smell it from the next mountain.” The fingers on one banana plant grow fused; another produces bunches of a thousand fingers, each only an inch long.

Many of these varieties are known as plantains; they are starchy and inedible until cooked. In 1870, when a Cape Cod fishing-boat captain named Lorenzo Dow Baker imported a hundred and sixty bunches of bananas into Jersey City—the first bananas in the U.S.—he chose a kind of banana that is sugary and eaten raw, and that he’d seen growing in Jamaica. Baker’s variety, called the Gros Michel, offered a sweet and complex flavor, and its skin was resilient. Baker could throw the bunches directly into the hold of his ship without worrying that he’d bruise the fruit or hasten its ripening. When the bunches arrived in stores, shopkeepers hung them up and, at a customer’s request, cut off the desired number of bananas. As Dan Keppel notes in “Banana: The Fate of the Fruit That Changed the World,” by 1900 Americans were eating fifteen million bunches of GrosMichels every year; by 1910, the number was forty million. Two decades later, Baker’s company, renamed United Fruit—and today called Chiquita—was worth more than two hundred million dollars.

In converting a tropical fruit into a global commodity, United Fruit amassed land across Latin America, from Guatemala to Colombia, replacing virgin jungle with vast tracts of Gros Michels. Poorly compensated workers, battling malaria, dengue fever, tarantulas, pythons, and jaguars, constructed
miles of railroad track, telecommunications lines, and irrigation canals. By the nineteen-sixties, United Fruit controlled nearly seven hundred million acres of land. “Tropical nature left to herself creates foodless jungles and miasmatic swamps,” a historian wrote at the time. “The banana of commerce is one of Man’s proud triumphs over Nature.”

United Fruit eventually commanded ninety per cent of the American banana market, and in Latin America it became known as El Pulpo—the Octopus. When a head of state tried to thwart its progress, the company often responded with militaristic force. It clandestinely aided the 1911 coup in Honduras and the 1954 coup in Guatemala. At the company’s urging, Colombia’s Army launched a campaign against striking workers, which culminated in a massacre. In 1975, the company’s chairman, Eli Black, jumped to his death from the forty-fourth floor of the Pan Am Building, in New York; the Securities and Exchange Commission soon discovered that he had given a high-ranking Honduran official a one-and-a-quarter-million-dollar bribe.

Early in its ascendancy, United Fruit began contending with crop disease. “Fruit Blight Costs Millions in Costa Rica and Part of Panama: No Remedy Is Available,” the Times reported in 1927. “As much mystery surrounds the banana disease as the plague in medieval times and so far it has not been possible for modern science to cope with it.” This was Race One. Over the next thirty years, a hundred thousand acres of GrosMichels were wiped out across Latin America, and the industry lost $2.3 billion. As the historian John Solari has pointed out, before United Fruit arrived Latin Americans farmed small, diffuse tracts of land. But as jungle diversity was replaced with monolithic fields of GrosMichels, fungi like Race One were provided with many more hosts. In the words of one reporter, “Acts of God have not been wholly unsolicited.”

In the nineteen-forties, a distant rival, Standard Fruit, reacted to the blight by shifting to Cavendish bananas, the Chinese variety, which were growing in the private greenhouse of the Duke of Devonshire, in Chatsworth, England. The bananas proved naturally resistant to Race One. In every other way, however, the Cavendish was less than the GrosMichel. The Cavendish was susceptible to other diseases, which were controllable only with costly pesticides. It had a tendency to bruise, which meant that, rather than shipping bananas directly on the stalk, Standard Fruit had to box them in elaborate new packing houses. The Cavendish also needed special ripening rooms, where the green bananas, after arriving in the U.S., were helped along with doses of ethylene gas. When the bananas made it to stores, they lasted only a week before spoiling. And to those who knew the GrosMichel the flavor of the Cavendish was lamentably bland.

United Fruit, fearing that consumers would reject the taste of the Cavendish, was slow to switch, and saw its profits drop from $66 million in 1950 to $2.1 million in 1960. Standard Fruit (now known as Dole) became the country’s largest seller of bananas, and remains so today. In 1960, United Fruit opened a research center in La Lima, Honduras, and hired Phil Rowe, a former rice breeder from Arkansas, to breed the perfect export banana: flavorful, hardy, and disease-resistant. The company also wanted the new plant to sprout big bunches, and to be sturdy enough to withstand the high winds that occasionally blew through Latin America. Because domesticated bananas are sterile, Rowe was forced to cross wild diploids that offered a good bag of good and bad traits. In four decades of work, he grew twenty thousand hybrids, but he never found a replacement for the Cavendish. His leading candidate, called Goldfinger, withstood Race One, but consumers rejected it as acidic and starchy. In the end, the unrelenting capriciousness of his work proved too much. One morning in 2001, Rowe walked into his experimental-banana fields and hanged himself from a tree. United Fruit was stuck growing the Cavendish.

"Cavendish is fairly bland," James Dale told me. "But, if you have no option but one, then that option looks pretty good." Today, there are millions more acres planted with the Cavendish than ever were planted with the GrosMichel.

This past fall, I flew to Honduras to visit the La Lima research station, which is now a nonprofit traditional breeding facility known as the Fundación Hondureña de Investigación Agrícola, or FHIA. The head banana breeder is a man named Juan Fernando Aguilar, and outside his office hangs a sun-blanketed picture of Phil Rowe. Aguilar, a thicketed, gregarious Guatemalan, with a salt-and-pepper mustache and glasses with light-sensitive lenses, picked me up one morning at my hotel—the Banana Inn—and gave me a tour of a gated residential community called the Zona Americana. "This is where all of United Fruit's workers lived," he said. "La Lima is ugly, but the American Zone is beautiful!" Aguilar pointed out the old company swimming pool and two golf courses, which are still in use, and stopped the car in front of a white mansion. "This was the house of the general manager," he said. "Look at the size! And two tennis courts!" When we arrived at FHIA's headquarters, down the road, a dead mule lay near the entrance, its dis tended belly rising above the weeds. I remembered that a United Fruit executive had once joked, "A mule costs more than a Honduran deputy."

Rowe's death, ten years ago, coincided with advances in biotechnology, and many researchers now dismiss the traditional breeding of bananas as too reliant on happenstance. In 2003, the director of research at Chiquita told a British journalist, "We supported a breeding program for forty years, but it wasn't able to develop an alternative to Cavendish. It was very expensive and we got nothing back." Aguilar, however, has crucial leverage: nearly fifty per cent of Americans, and sixty per cent of Europeans, oppose genetically modified food. For this reason, Chiquita reversed its position in 2004 and signed a confidential agreement with FHIA, hiring the center that it once owned to naturally engineer a better banana. (The
contract is said to be worth two million dollars.) Dole and FHIA are negotiating a similar deal. “We never left traditional breeding,” a spokesman for Chiquita told me. “In our core markets, in America and Europe, a genetically modified banana would never be marketable. At the end of the day, we’re interested in continuing to sell bananas.” Jorge Gonzales, Dole’s senior vice-president of agricultural research, said, “Traditional breeding is getting closer. This may be a shot in the dark, but if you don’t take the shot you’ve got absolutely zero chance of hitting the target.”

Aguilar’s operation has the rusticity of a summer camp; the buildings have rough-hewn wooden exteriors, tin roofs, and chicken-wire windows. “I am glad you have come,” Aguilar told me. “The hybrid plants are like women. To look at a woman from afar is not to know the woman. To know her, you must be with her. And to know the hybrids you must be with the hybrids.” Aguilar begins his work by planting twenty thousand plants of a single variety. Once the plants have flowered, at nine months, workers manually dust them with the pollen of another banana plant that has a desirable trait, such as disease resistance. Three months later, Aguilar harvests the bunches, in the hope that the forced fertilization has impelled the plants to produce seeds. Every Monday, local women peel a hundred thousand bananas. Two days later, after the bananas have fermented and softened, the women smash them on a sieve, let the pulp ooze through, and retrieve any seeds.

On average, Aguilar recovers one seed from every ten thousand bananas—about ten seeds a week. If any of these seeds provide a working embryo—the odds aren’t great—Aguilar might be able to grow a new hybrid. But even if that plant acquires the trait of blight resistance, it will likely pick up several other, less desirable attributes, such as a low yield of fruit. One round of this exercise lasts three years. “The people in Australia don’t like this—it’s too time-consuming for them,” Aguilar said. “Many people call me crazy, but I’m very confident that I can develop a Cavendish replacement.”

Like Phil Rowe, Aguilar focusses on diploid bananas, which have an unusual capacity to accept pollen and produce seeds. Recently, however, Aguilar forced a seed out of a Cavendish—the first banana breeder in history to do so—after hand-pollinating tens of thousands of plants. He now finds one viable seed out of every million Cavendishes. In November, at an international banana conference in Medellín, Colombia, Aguilar presented a paper arguing that the Cavendish is not actually sterile. Still, because Aguilar finds seeds only through achingly artificial means and, even then, finds so few of them, any fertility seems to be a human-induced aberration.

Aguilar led me to a small trial plot. He was unable to share many details, explained, because of confidentiality agreements, but he said that these few plants represented his best shot at success. We approached a tall, thick plant, with a dozen suckers growing around it. A robust bunch hung from the mother, but the bananas were only four inches long. “This one is strong, vigorous, full of power,” Aguilar said. “It has a high yield, but the texture of the pulp inside is very poor, just mushy.” He bounded off. “Look at this one!” he said. “This one has the same mother as that one before, but a different father. You can see it’s much thinner. The plant is healthy, but not as vigorous. I don’t know why.” He walked to a far corner of the field, near a babed-wire fence, and paused next to the tallest banana plant I’d ever seen. “Nine metres tall!” he called out. “Here you get very good resistance to winds, and a very good taste, but the bunch is small.”

Finally, Aguilar inspected a stubby plant in the center of the field. It was sectioned off by a six-inch fence made of broken sticks and lolling twine. A tag read “06-04-333.” He crushed under his foot the cigarette he’d been smoking and breathed deeply. Dragonflies buzzed, and a stray cat pawed at the dirt. Aguilar said somberly, “This is mi esperanza. My hope and my wish. Give me six years. I have to taste it and test it, but my dream is for this to be my Cavendish replacement.” The plant was by far the smallest in the field—six feet tall. Several leaves were dying. But, Aguilar said, “the mother of this plant is Cavendish.” Its “blood,” as he put it, was promising.

Aguilar touched a fist against his chest. “The field is spiritual for me,” he said. “Plant breeding, it must be a part of you, part of your emotions. Biotechnology came along, and they suddenly labelled us ‘traditional breeding.’ It’s a way to diminish our work. But we are not in competition with anyone. We are doing what we do, and they are doing what they do. The difference is that my tools are in the field, not in the laboratory.”

Near the end of my stay in Brisbane, James Dale invited me to his house for dinner. He lives with his wife, Ged, and their son, Jordan, on ten acres west of the city, in a bucolic suburb called Moggill. The Brisbane River meanders past their back yard, and on the property he and Ged grow oranges, avocados, pumpkins, pomelos, blueberries, papayas, and finger limes. “There’s not a ba-
nana to be seen,” Dale said. “It’s very embarrassing. But they’d just get blown over if we planted them.”

“That’s our excuse, anyway,” Ged said.

“It’s not an excuse,” Dale said. “It’s a reason.”

We were sitting on their front porch, cracking macadamia nuts pulled from the trees that line the driveway, drinking beer, and watching the sun drop. Flying foxes, the largest bats in the world, were swooping, warming up for their nightly hunt. Since obtaining the results from the greenhouse test, Dale and his colleagues had been waiting for the Office of the Gene Technology Regulator, which oversees the safety of the country’s genetically modified crops, to approve the field trial. A verdict was expected soon. Dale’s team had begun preparations to transport the modified plants to Darwin—airlane seats would be bought for them—where they would toughen up for a few months in “humidicrib.” In April, the plants would be released into the fungus-infested soil, and Dale hoped to have initial results sometime next fall.

Robert Borsato, meanwhile, had been looking to buy new land, confident that he would soon be able to expand his operation. He had also been travelling to Papua New Guinea, searching for new banana varieties that might thrive in the marketplace. “I found a little banana about three inches long, the color of tomato juice,” he told me. “I think I could sell it to hotels, for a breakfast banana. It’s acid-sweet, and there are lots of people who only want half a banana for breakfast.”

As word spread of the planned field trial in Darwin, local news outlets had begun asking Dale what, exactly, he intended to put in the ground. Critics of genetically modified foods, such as Greenpeace and Earth First!, have claimed that such foods not only violate the sanctity of nature but also could spark antibiotic resistance and allergic reactions. (In 1996, researchers found that soybeans modified with a Brazil-nut gene triggered allergies in test subjects; the product, which had been designed to have a higher amino-acid content, was never commercialized.) Opponents also fear that foreign genes might be transferred into related species, through the uncontrolled exchange of pollen. Ronnie Cummins, the co-author of “Genetically Engineered Food: A Self-Defense Guide for Consumers,” told me, “Scientists often think technologies are safe that turn out not to be. It’s not that you’re going to feel over and die as soon as you eat genetically modified papaya. It’s the unpredictable long-term health and environmental effects that concern us.”

As we sat down to dinner, Dale, who helped write the federal guidelines for genetically modified food in Australia, said, “The public isn’t necessarily wrong to be wary of them, and everything should be regulated—that’s extremely important. But you can’t name a single time when G.M.O.s did something really bad, either to humans or to the environment. And don’t forget that bananas are sterile. They don’t have seeds, and they can’t cross-fertilize. So even if we were putting something dangerous into banana plants—which we are not—there’s absolutely no way for those genes to exit the banana and enter the wider world.” Dale added that he thought it would take more than a hundred years for traditional breeding to solve the Cavendish problem. “Cavendish is a very, very well-accepted cultivar,” he said. “The taste of Cavendish, the method of growing Cavendish, the method of harvesting and transporting Cavendish—it’s all extremely well worked out. A Cavendish plant with an extra gene for Tropical Race Four—well, I think it’s a more elegant method.” Dale also seemed pleased that neither Chiquita nor Dole would own his creation. Borsato would no doubt want a return on his investment, but eventually he and Dale would offer a blight-resistant banana to the world.

For now, the limits of science force Dale to express foreign genes throughout the entire banana plant, but he hopes eventually to confine them to the roots, where the fungus attacks, and away from the fruit. Furthermore, a French institute called Genoscope is sequencing the banana genome, and once that is complete Dale might be able to insert a disease-resistance gene from a wild banana. “Then we’ll be putting a banana gene into a banana,” he said gleefully. “The public will have to love that.”

Dignified as Dale made this sound, a new Cavendish banana still didn’t seem like a panacea. The cultivar may dominate the world’s banana export market, but, it turns out, eighty-seven per cent of bananas are eaten locally. In Africa and Asia, villagers grow such heterogeneous mixtures in their backyards that no one disease can imperil them. Tropical Race Four, scientists now theorize, has existed in the soil for thousands of years. Banana companies needed only to enter Asia, as they did twenty years ago, and plant uniform fields of Cavendish in order to unleash the blight. A disease-resistant Cavendish would still mean a commercial monoculture, and who’s to say that one day Tropical Race Five won’t show up?

Dale once remarked to me that his favorite bananas are “the little sweet ones from Uganda called *ubali nitezi,* or sugar banana. They’re absolutely fabulous.” Now he added, “What we really want to do is make the Gros Michel resistant to both Race One and Race Four, and then someday, maybe, we’ll put these disease-resistance genes in any variety we want.”

It was tempting to envision a reengineered supermarket that afforded Americans a broader replication of tropical bounty: next to the McIntoshes, Granny Smiths, and Honeycrisps would sit the Cavendishes, Gros Michels, and *ubali nitezi.* Of course, before this could happen the more exotic bananas would also have to be genetically modified for seaworthiness. “Those kinds of genes—we’re years away,” Dale said.

At Dale’s house that evening, we’d seen peacocks strutting about and a hare bounding through the field. The chickens that Ged raises danced occasionally, and, even though the sun had set, the richness of the couple’s garden remained visible through a kitchen window. “From a biological perspective, I love genetic diversity,” Dale said. “That’s what makes the world safe, what makes it thrive. It means that everything is terribly healthy. And when you see the narrowing of genetic culture, that’s when you know things are going to die.”

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Scenes from the banana fields.