Overplanting of blight-prone varieties, including the cloned Cavendish banana Americans eat almost exclusively, worries experts in Africa (a market in Cameroun). "The banana's not about dessert or a snack," says researcher Kodjo Tomalga. "It is about survival."
BUILDING A BETTER BANANA

It is the world’s No. 1 fruit, with millions of people dependent on it to stay alive. Now diseases threaten many varieties, prompting a search for new hybrids of “The Smile of Nature” by Craig Canine
LEFT SLICES THROUGH THE SKY nearly sideways, propelled by Arctic blasts from the North Sea. I am in northern Belgium, wandering the grounds of a Baroque castle at the Catholic University of Leuven, about 15 miles northeast of Brussels. I am on a pilgrimage of sorts, seeking enlightenment about Musa sapientum, better known as the common supermarket banana. Building 13, a plain two-story brick structure within the castle walls, houses the world’s largest collection of banana varieties.

Researchers are racing to develop hardy new breeds (left, plant samples at the Catholic University of Leuven). First cultivated in Southeast Asia 10,000 years ago (a plantation in the Mekong Delta), bananas were carried to Africa and then to the Americas.

The basement room is the size of a semitrailer. It is cool and humid, with a slight musty odor. Two rows of metal shelving hold hundreds of wire racks filled with yellow-capped test tubes. Each tube contains a small, rooted plantlet about the size of your little finger. All told, the room contains nearly 1,200 varieties of bananas. They look like overgrown bean sprouts. “After you’ve worked with tissue cultures for a while, you begin to recognize different types,” says Ines Van den Houte, the Belgian agricultural engineer in charge of the collection. She points out specimens. “This one is probably a type of dessert banana. Here’s a hybrid plantain. And this looks like a balbisiana cooking banana,” she says, referring to its wild forebear, Musa balbisiana. “Roughly 90% of these are traditional cultivated varieties. Another 10% are improved varieties or hybrids from various breeding programs. And about 180 are wild relatives. We have material from 44 countries, from the plantations of Central America to the deepest rain forests in Malaysia.”

And why are they all here, in deepest Belgium? She flashes a smile. “Belgium doesn’t grow bananas, so we don’t have banana pests and diseases. It’s easy to quarantine the plants—there’s no risk of introducing dangerous diseases to a native population of bananas, because there isn’t any.”

This living library of Musa diversity stands in contrast to my neighborhood grocery store back in the United States. On a recent visit to the produce section, I counted 11 varieties of apple, four kinds of pear, six different potatoes, nine types of onion and seven kinds of lettuce. Then I came to the banana bin. To paraphrase Henry Ford’s comment about Model Ts, I could have any kind of banana I wanted, as long as it was a yellow Cavendish.

The $4 billion-a-year worldwide banana export trade is almost entirely based on vast plantations filled with genetically identical Cavendish clones. It is the supermarket banana’s lack of genetic diversity that has put it at risk, perhaps even (as some scientists say) at risk of extinction. A similar situation with another crop, the potato, set the stage for the great Irish famine of the 1840s, after the high-yielding potato varieties favored by Irish farmers fell prey to an airborne fungus that turned whole fields of tubers black and rotten overnight. Today, similar pests are stalking the banana. Tripping the list is a fungal disease called black sigatoka. Originally found in Indonesia’s Sigatoka Valley, it attacks the
leaves of banana plants, shutting down the plants' ability to photosynthesize. The wind-borne fungus has spread throughout Asia, Africa and Latin America. Many kinds of bananas are susceptible to black sigatoka, but none more so than the Cavendish. Large-scale growers can keep it from devastating their harvests only by spraying fungicides from airplanes. This escalating chemical warfare is economically unsustainable, to say nothing of its toll on the natural environment or the health of field workers. "Is sigatoka the end of the banana as we know it? No. Rumors of its demise are exaggerated," says Dave McLaughlin, an environmental director with Chiquita Brands International. "But it's a serious hindrance to per capita consumption. A typical person in Uganda, Rwanda or Burundi consumes more than 500 pounds of bananas a year. They eat (and drink in beer and juice) a type known as East African highland bananas. In Uganda, the word for this banana is matooke. It is cooked and mashed in a traditional dish that is also called matooke. In its broadest definition, matooke means "food." If you held a feast in Uganda and did not serve bananas, the guests would say you had served no food.

But in the past 20 years, banana yields in east and west-central Africa have declined by half. Black sigatoka and other diseases weaken the growing plants, which become more susceptible to attack by weevils and worms. Infected plots that supported a continuous crop for 30 years must be abandoned, and the specter of hunger looms ever larger. "Only five scientists in the world are currently leading programs to breed improved bananas," says Emile Frison, director general of the International Plant Genetic Resources Institute, a Rome-based organization that promotes genetic diversity of food crops. "Such a meager research effort is out of proportion to the scale of the problem. This must be reversed if the world's most popular fruit is not to decline further."

One of those five scientists is Kodjo Tomêlpe. "In Africa, the banana is not about dessert or a snack," Tomêlpe says. "It is about survival. Our challenge is to multiply and distribute improved varieties for people who rely on them as a central part of their daily diet."

Tomêlpe and I are sitting in a screened-in dining hall near the town of Njombe in Cameroon's Southwest Province, about 120 miles west of the capital city of Yaoundé. We have just finished a dinner of chicken and fried plantains, the
starchy type of banana favored in west Africa and elsewhere. For dessert, we have ordered a few Cavendish bananas, which our waiter has brought on a plate. They are perfectly uniform in size, shape and shade of yellow. Tomékpé, a compact, slender man in his early 50s, picks one up. "The Cavendish banana is too beautiful to be true," he says. He peels it and takes a bite. "It is beautiful, but to me this is an uninteresting banana. It has one, bland taste: sweet." He takes another bite, then wrinkles his nose and puts the banana down. "There are such diverse qualities to be found in bananas—small, medium, large, yellow, red, creamy, tart, sweet, balanced. This is the first Cavendish I've had in three years. Because I have such diversity to choose from, why would I want this one?"

Director of the African Research Center on Bananas and Plantains (CARBAP), Tomékpé oversees one of the world's largest field collections of bananas. Unlike the germ plasm preserved in test tubes in Belgium, the plants in CARBAP's collection are tree-size specimens. On six acres at the edge of Njombe, more than 3,000 varieties of bananas grow in beautifully regimented rows separated by wide strips of green turf. Black metal signs identify each variety by name: Tomola, Pelipita, Poupoouou, Red Yudé, Mbouroukou. Some fruit is long and skinny, like a witch's fingers. Others are short and squat, and grow like clusters of green peppers. One type has dark green skin with white stripes. It's known as the tiger plantain.

We stroll along the beds. "Here is a wild example of Musa balbisiana," Tomékpé says. It stands little more than head high and looks comparatively spindly. "This is one of the two wild ancestors that edible bananas are descended from. It originally grew, many thousands of years ago, in and around Malaysia." He produces a pocketknife and cuts off a single green fruit. It is the size of an olive pod or a sweet pickle. Slicing it in half lengthwise, he probes the imma-
clusters of blossoms. Oblong fruits develop at the base of each blossom. The flower-bearing tips of the fruits curve toward the sun as they mature, producing the crescent shape that Germans sometimes call “the smile of nature.”

Each layer of fruit in the ascending spiral is called a hand. Individual bananas are called fingers. A full stem, or bunch, of bananas can have as many as 20 hands and hundreds of fingers (a bunch of Cavendish bananas typically produces six or seven hands and 150 to 200 fingers). A banana's growing cycle, from baby plant to harvest-ready fruit, is between 9 and 18 months. After bearing a single bunch of bananas, the mother stalk dies or is cut down, soon to be replaced by one or more fruit,” Oviedo wrote, “...was brought from the Island of Gran Canaria by the Reverend Father Friar Tomas de Berlanga ... to this city of Santo Domingo, whence they spread to the other settlements of this island [of Hispaniola]. ... And they have even been carried to the mainland, and in every part they have flourished.”

Bananas flourished in Africa for so long after they arrived from Southeast Asia that some parts of the African continent—the eastern region around what is now Uganda, and the western region bounded by the Congo basin—became secondary centers of genetic diversity. “Farmers in various parts of Cameroon have been cultivating plantains for a very long time,” says Ofundem Tatow, an ethnohistorian from Cameroon’s University of Buea. “They possess a great deal of traditional knowledge of working with the diversity here,” Tatow is says, “with three other people in the back seat of a four-wheel-drive pickup truck. We head slowly along a road strewn with boulders of black volcanic basalt expelled from Mount Cameroon, at 13,435 feet, the tallest in West Africa.

Tatow is studying the link between plantain varieties and local culinary practices. “Traditionally, each local variety is used in a very particular way,” she says while we’re stopped at a small farm. “For example, those bigger plantains, known as nuruk type, are used for roasting when picked at a certain stage of ripeness. When picked at a slightly different stage, they are dried, crushed into a paste and served with dried fish.”

One CARBAP mission is to introduce disease-resistant varieties that farmers can test in their own fields, side by side with the local plantains they are accustomed to growing. We stop beside a remote country road on Mount Cameroon’s east slope. Tatow, Romela’s, two local farmers (both women), a government agriculture official and I

**HUMAN BEINGS IN SOUTHEAST ASIA BEGAN TO SELECT AND CULTIVATE WILD MUSA VARIETIES AS MANY AS 10,000 YEARS AGO.**
walk single file along a narrow, pumice-covered path. To me—a Midwesterner raised on the sight of neat corn and soybean rows stretching to the horizon—we appear to be bushwhacking through a patch of wild jungle upon which Mount Cameroon regularly rains down boulders the size of Saturn. It is not jungle, however, but laboriously cultivated farmland, carefully tended plots of mixed cacao trees, oil palms, plantains, corn and papaya, with occasional patches of ground-hugging cocoyams or spindly cassava shrubs.

We step across an invisible boundary where those crops give way to bananas. A small farmers’ cooperative has planted 25 different varieties using pest-free suckers provided by CARBAP. A few are disease-resistant hybrids developed at the Honduran Foundation for Agricultural Research (FHIA), the most prolific of the world’s half-dozen banana-breeding programs. FHIA hybrids, touted in the international press as potential saviors, shrug off the effects of black sigatoka and other serious Musa scourges. In this field, farmers are experimenting with two of the hybrids, FHIA-02 and FHIA-25. Both can be cooked when green, and, unlike plantains, which remain starchy when ripe, can also be eaten out-of-hand as dessert bananas.

Someone offers me a bright yellow FHIA-02 banana. It’s medium-sized, firm and buttery in the mouth and moderately sweet with a slightly acidic, tangy edge. It seems like a fine banana to me, but it is not getting rave reviews from the farmers here. They prefer larger, starchier, more typical plantain types. Of the 25 CARBAP introductions, the favorite is a dry-textured, orange plantain from Papua New Guinea called Marius, which commands a premium at local markets. FHIA-02 often winds up as animal feed despite its disease-resistance.

Breeding an überbanana that resists lethal diseases while also meeting the exacting requirements of growers and consumers isn’t rocket science. It’s harder than that. How do you arrange matings between plants that, for the most part, can’t mate? The trick is to make ingenious use of whatever traces of fertility—pollen-bearing male flower parts and seed-bearing fruits—you can find among varieties, wild or cultivated, that have the traits you are looking for. To improve your chances of success, you need access to the largest possible pool of genetic diversity, such as the germ plasm preserved in Belgium and in CARBAP’s extensive field collection. Tomélpé and his associates found a promising pollinator in a wild banana from India called Calcutta. “It makes a good male parent,” Tomélpé explains, “because it is highly resistant to black sigatoka and nematodes, it’s highly male-fertile, and it’s a dwarf.” Dwarfism is a useful trait for CARBAP’s geneticists, because their main goal for years has been to develop disease-resistant plantain hybrids that have large bunches but short stature. Reduced height not only makes the plants easier for farmers to work with but also less prone to toppling by wind, a major cause of banana crop loss everywhere.

Phil Rowe, who led the FHIA breeding program for many years before his death in 2003, invented the now-standard procedure for creating banana hybrids. The first step is to gather as much pollen as possible from the chosen male parent and use it to fertilize potential female parents at the flowering stage. Next comes a four- to five-month wait for the plants to produce fruit. Then the bananas are harvested, peeled by hand and pressed through a sieve.

“Only five scientists in the world are currently leading programs to breed improved bananas,” says Rome-based plant researcher Emilie Frison. “This must be reversed if the world’s most popular fruit is not to decline further” (an Arlington, Virginia, store).

A ton of fruit might yield a handful of seeds, less than half of which will germinate naturally. After the precious few seedlings are planted comes another 9- to 18-month wait. Finally, up to two years after the initial mating, disease resistance and other characteristics can be evaluated.

Rowe and his colleagues repeated this painstaking procedure for tens of thousands of different parental crosses. The vast majority yielded offspring that didn’t pass muster. Only after decades of this work did Rowe’s lab release its first potentially commercial hybrid, FHIA-05, a.k.a. Goldfinger. It is the world’s first disease-resistant sweet banana with the potential to take on the almighty Cavendish.

The process is not quite as slow today, thanks to molecular genetics techniques. “We can also use molecular techniques to perform rapid screening of hybrids for susceptibility to diseases, as well as for nutritional and other characteristics, such as fruit texture and taste,” says Pascal Nkogudja, the leader of CARBAP’s breeding lab. “We use molecular techniques for screening and propagation. But we are working only with conventional breeding, with pollen

MEDIUM-SIZED, FIRM AND BUTTERY, IT SEEMS LIKE A FINE BANANA TO ME, BUT IT IS NOT GETTING RAVE REVIEWS FROM THE FARMERS HERE.
And you thought all bananas were alike: in fact, nearly 1,200 varieties have been documented. Clockwise from top left: Pongole, a cooking banana from Polynesia; Cavendish, a Sigatoka-resistant dessert fruit being tested in breeding programs; Bisraamu, a cooking banana from Mount Cameroon; H53, an experimental hybrid created in Jamaica; the Akiat, used in cooking, has yellow fruit and red sap; the ice cream banana, a Pacific variety, tastes of vanilla.
and flowers—no gene splicing. We leave genetic modification of bananas up to other labs."

"Our program is only ten years old," Tomekpé chimes in. "But we have created several hundred plantain strains of a new type—dwarf-size plants with a high resistance to disease and pests, plus good productivity and fruit character." At the request of the European Union (EU), which provides most of CARBAP's funding, Tomekpé recently broadened his breeding program to include dessert bananas. "The EU said they'd continue to support us but asked that we work on preserving the dessert bananas. That's what Europeans know and eat. They don't want to see their bananas disappearing."

Dessert bananas, which are less genetically diverse and even less fertile than plantains, are harder to breed. The Cavendish is not the candidate for conventional breeding at all, as it produces absolutely no pollen or seeds. It's an evolutionary dead end. Because of its high susceptibility to many diseases and its inability to acquire resistance through breeding (although some scientists think gene splicing could change that, someday), scientists worry that a particularly nasty pest that spread widely could wipe it out.

The banana industry has experienced just such a doomsday scenario once before. International trade in the fruit began in the early 1870s, when Lorenzo Dow Baker, a Cape Cod fishing captain, brought the first large banana shipments to the United States. The variety that Baker carried from Jamaica to New England was called Gros Michel. "Big Mike" reigned as the No. 1 export banana until the 1940s and '50s, when a fierce soil pathogen known as Panama disease devastated it. Yet Panama disease left Cavendish-type bananas unscathed. The Cavendish didn't taste as good as the Gros Michel, and its thinner skin made the fingers more difficult to handle and ship without bruising. But the major banana export concerns, led by the huge United Fruit Company (which Baker co-founded as the Boston Fruit Company in 1884), had no choice but to replant their vast plantations with Cavendish and to overhaul the system of banana mass production that United Fruit (now Chiquita Brands International) had invented around the turn of the 20th century. In the original system, Gros Michels remained intact in enormous bunches from the farm to the grocery store. But with the fragile Cavendish, plantation owners had to build packing houses on each farm, so the big bunches could be cut down to small clusters, washed, and gently laid into protective boxes before shipping. The costly transition to a new banana took more than a decade.

A replay of that upheaval may be on the horizon. A new, more virulent strain of Panama disease has started to spread. The new strain, known as Tropical Race 4, has proved lethal to a broader range of banana hosts than earlier mutations of the fusarium bacteria that causes Panama disease. Race 4 is as deadly to Cavendish as the earlier strain was to Gros Michel. It first appeared in Malaysia and Indonesia, and has spread to northern Australia and South Africa—though not, so far, to central Africa or Latin America. No known pesticide is effective against it for long. Banana exporters fear that someone may accidentally or maliciously carry infected soil or plants from the current hot zone of containment to other commercial banana-growing regions, causing devastation. "People say this Race 4 could be the end of the banana," Tomekpé told me one evening. "That is an exaggeration. It could be the end of Cavendish and other sterile dessert bananas, but for many other types, there is hope."

One source of hope could be Yangambi King, a variety I saw during my travels with Tomekpé. It was named for the spot, three miles from the Yangambi nature preserve in the Democratic Republic of Congo where it was found and documented. "Its name in Swahili is Ibuta, which means abundance," Tomekpé said. "It yields abundantly, with big bunches and many fingers. It's highly tolerant to many pests, and very male and female fertile, so it's easy to cross with other varieties. But the peel is quite thin, so it's not ideal for handling and shipping. We are working with it, developing crosses for a thicker skin and good fruit size. It's a very promising candidate for improvement. I think there will be a market for it someday."

Ambling through several acres of bananas at a CARBAP testing station, Tomekpé found some ripe fingers of Yangambi King. He gave me one and urged me to try it. Its thin peel came off easily. The fruit was slightly shorter and stubbier than your average Cavendish. I took a bite. The flesh was creamy and sweet, though far from cloying. I detected hints of strawberry vanilla and apple—perhaps even a dash of cinnamon. I like a good Cavendish as much as anyone, but this banana was in a different league. Yangambi King has survived for centuries thanks to the care of subsistence farmers in the heart of Africa, and yet when I bit into it I imagined I was tasting the future.

BANANA EXPORTERS FEAR THAT SOMEONE MAY CARRY INFESTED SOIL OR PLANTS FROM THE CURRENT HOT ZONE OF CONTAINMENT.

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