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Banana genome unpeeled

Fruitful start to banana sequence.
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TOM CLARKE

Banana genome: due to ripen within five years.
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Plans to sequence the banana genome within five years have been announced by a global consortium. Although sidelined by some as a comical fruit, bananas and the related plantain are staple foods worldwide; bananas are the fourth most important crop behind rice, wheat and maize. Identification of disease-resistance genes could help halt the banana's decline.

Most banana varieties grown worldwide are hybrids originating from two species native to Asia: *Musa acuminata* and *Musa balbisiana*. The sequencing effort will begin with *M. acuminata*, from which the majority of bananas are descended.

The spread of pests and diseases has led to a steady fall in the yields of some banana varieties over the past 50 years. Technical difficulties breeding resistant fruit make this decline difficult to halt. And lack of investment, in a crop consumed largely in the developing world, has compounded the problem. "Investment is ridiculously small given the importance of the crop," says Emile Frison, director of the International Network for the Improvement of Banana and Plantain (INIBAP) based in Montpellier, France.

INIBAP, part of the Rome-based International Plant Genetics Resources Institute, has spearheaded the move to sequence the banana genome, the fruit's complete genetic sequence.

Genetic information should help breeders to identify key

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banana genes - for improved ripening and resistance to disease and pests - as well as molecular markers to help track the genes down. The project's gene-sequence information will be made freely available to smallhold farmers, but commercial institutions, which are absent from the 24-member genome sequencing consortium, will have to pay for access to the data.

Staple crop

Smallhold farmers in the developing world produce 87% of the world's bananas, nearly all of which are grown and consumed locally. These bananas are usually green, starchy varieties such as plantains.

Bananas: a staple food in the developing world.
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Because these locally produced fruit are of little commercial interest, advances in crop science made during the 'green revolution' in the middle of the twentieth century passed the banana by, argues Frison.

But bananas missed the boat partly because they have an image problem, as a sweet, yellow supermarket fruit. "It's hard to believe how strongly this image is anchored in people's minds," says Frison.

Yields of the 'supermarket banana' - a single variety called Cavendish - have been growing, but only as a result of the increased use of agricultural chemicals.

Genome data will allow local growers to catch up by allowing them to create improved varieties of banana. "We're behind other crops by 50 or 100 years," says Frison. "Now using genomic techniques we have the opportunity to make up for the backlog in as little as ten years."

The researchers particularly hope to find the genes that make some wild varieties resistant to the black sigatoka fungus. The fungus, which destroys banana leaves, was first discovered in Honduras in the 1980s and has been spreading steadily ever since. Many smallholders are losing about half of their crop to the disease. "We know there are resistance genes in wild species," says Frison.

Fruity but celibate

Current banana varieties are seedless, sterile hybrids of the founder species; bananas with seeds are inedible. Bananas can reproduce asexually, so sterile varieties can easily be cultivated, but new varieties cannot be produced by crossing them. This is one of the main reasons why bananas have not been bred to fight off disease.

Sequencing the genome of the original wild species will make it easier to produce new varieties, agrees Ronny Swennen, a banana expert

Genetic data should improve a bunch.
© SPL

at the Catholic University of Leuven in Belgium. Genes for disease resistance could be inserted into varieties with other desirable characteristics, such as hardiness or flavour.

Using genetic markers it will also be possible to weed out plants lacking desirable genes without waiting for them to reach maturity. "We'll be able to throw them away within a couple of weeks," says Swennen.

The celibacy of cultivated bananas is one of the main reasons for the fruit's susceptibility to disease, but it also makes them scientifically interesting. Because there is no genetic exchange during reproduction, the banana genome has remained "frozen in time", says Swennen, apart from random mutations. Some varieties are believed to have been in cultivation for up to 8,000 years

By comparing the gene sequence of these cultivated strains to those of wild varieties, the researchers hope to learn how much the wild banana has changed in this time in response to new pests and diseases.

There is no comparable situation in other major crops, so the information is valuable beyond the banana world. "[The banana genome] is enormously important from a comparative genomics point of view," says Claire Fraser, director of the Institute for Genomics Research in Rockville, Maryland, which is a partner in the project.

And unlike the huge genomes of many hybrid crop plants, the banana genome is relatively small, says Fraser. "A small genome can be done in a small amount of time," says Fraser - so the venture should soon bear fruit.