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The Citrus Family Tree

By Daniel Stone an editor for *National Geographic* magazine, where he covers environmental science and agriculture.

All the oranges, lemons, limes, and grapefruits you've ever eaten are descendants from just a few ancient species.

Citrus, in many ways, stands alone. So many cultivated species have come from so few primary ancestors. Just three, in fact: citrons, pomelos, and mandarins, all native to South and East Asia before they started their journeys west, to places like Florida, California, and Brazil that built entire economies around fruits from the other side of the world.

Such simple lineage is the result of impressive commonality. Almost all citrus has the rare genetic combination of being sexually compatible and highly prone to mutation. Such traits allow their genes to mix, for thousands of years on their own, and eventually, at the hands of humans. The product of so much natural crossing in the wild and selective breeding at research farms and in fields is every orange, lemon, lime, and grapefruit you've ever eaten.

No other fruit genus can boast such pedigree, and new research is bringing clarity to the origin of citrus. Grapefruits are a human discovery, less than 300 years old. But citrus itself is ancient. Fossilized leaves discovered in China's Yunnan Province in 2009 and 2011 suggest citrus has existed since the late Miocene epoch, as many as seven million years ago. Humans, however, have brought a great winnowing: Out of thousands of wild types, only a few dozen have become commercial behemoths like the navel orange, Eureka lemon, and Mexican lime. They're the citrus one percent.

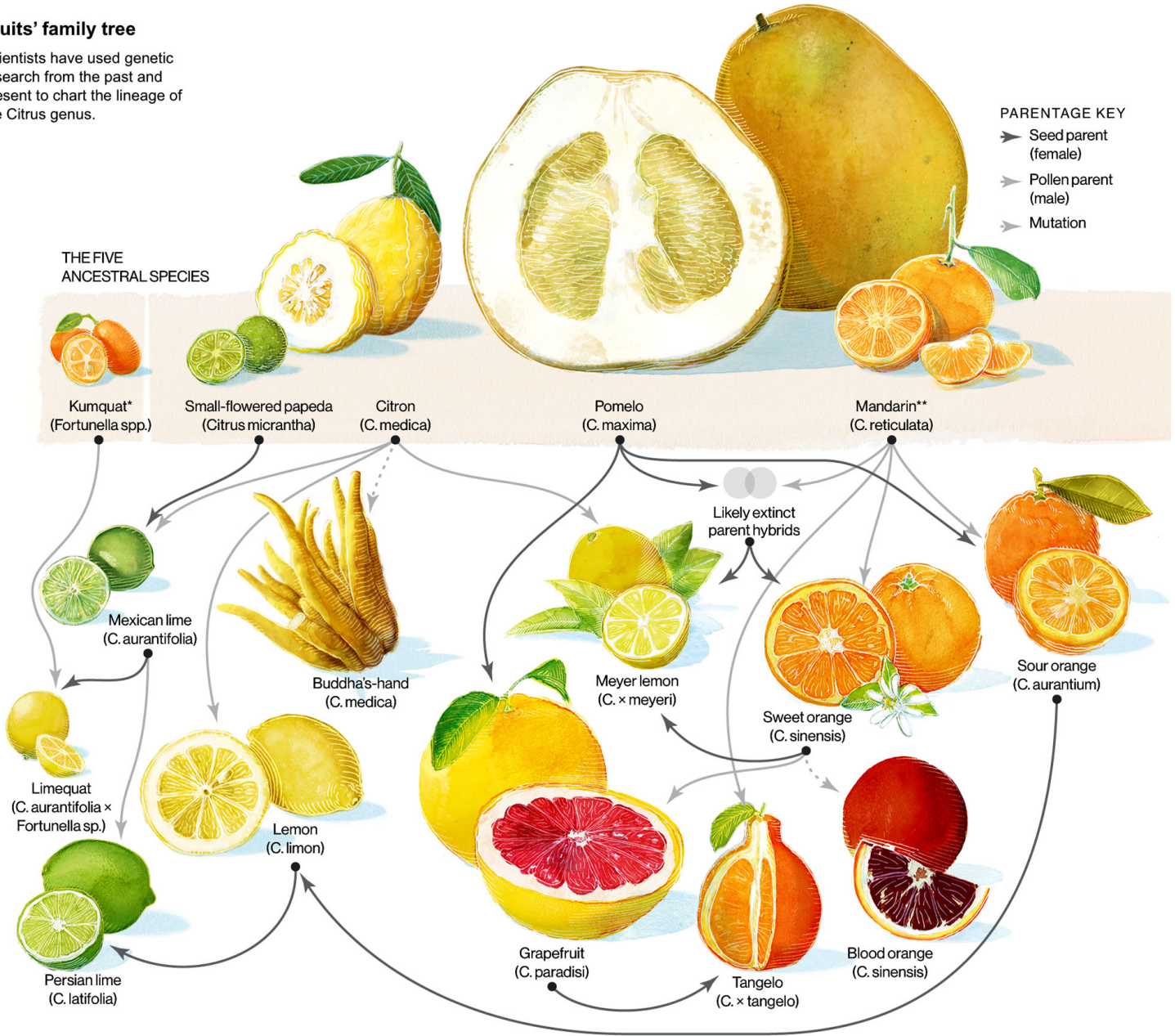
The scientists who study citrus love it for its appeal, its mystery, and its drama. "There's something fascinating, freaky, even sexy about citrus," says pomologist David Karp, whose research informs the above illustration. A bacterial disease called huanglongbing (a.k.a. citrus greening) that causes plants to defoliate, decay, and eventually die, is threatening commercial production on every arable continent, including North America, where the disease arrived in 2005.

Yet a fruit group of such illustrious history won't be exterminated so easily. The future is likely to bring more types of citrus, not fewer. "Citrus is competitive," says citrus breeder and geneticist Fred Gmitter, explaining how global researchers race to develop, say, mandarin oranges that are sweeter, seedless, and easier to peel. "In the near future you'll see a lot of outside-the-box new stuff." And, an ever expanding family tree.

Illustration by MONICA SERRANO, NGM STAFF. SOURCE: DAVID KARP, UNIVERSITY OF CALIFORNIA, RIVERSIDE

Fruits' family tree

Scientists have used genetic research from the past and present to chart the lineage of the Citrus genus.



*Researchers continue to debate whether kumquats are indeed in the Citrus genus.

**Most "pure" mandarins have a small proportion of pomelo genes.

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