Chicago Botanic Garden

Breaking breadfruit's birth source

CHALLENGE

To find breadfruit's wild ancestor and understand its genetic information so that the crop can be improved–perhaps for increased yield, better taste and/or drought-or salt-tolerance.

SOLUTION

Analyzing DNA fingerprinting data using principal components analysis in JMP® to determine that two different wild species gave rise to breadfruit.

RESULTS

The germplasm collection is used to help understand and improve breadfruit. Farmers now can request cultivars that are optimal for their regions.

MORE INFORMATION

www.chicagobotanicgarden.org

www.jmp.com

As any classic-movie buff knows, Captain William Bligh went to quite a lot of trouble to bring breadfruit to the Caribbean. Though the particulars of the incident made epic in the film Mutiny on the Bounty remain somewhat disputed, what we know for certain is that while the HMS Bounty never completed its mission to carry breadfruit seedlings from Tahiti to Jamaica, Bligh eventually was successful in doing so–six years post-mutiny, aboard the HMS Providence.

Why such a fuss over breadfruit?

Breadfruit is a good source of starch –thus Bligh's mission to bring it to the Western world as a food staple for slaves. Breadfruit remains a dietary staple throughout the South Pacific and in parts of the Caribbean. The fruit–which sometimes grows to the size of a adult man's head–is prepared in many of the same ways as a potato: boiled, mashed, roasted, baked or fried.

Steeped in intrigue, breadfruit's greatest mystery–its origins – remained unsolved until recently. Now though, the progenitor of breadfruit has been determined, thanks to the research of the Chicago Botanic Garden's Nyree Zerega. JMP® statistical discovery software from SAS has been instrumental in that discovery.

The research has significant implications. "As with any cultivated plant," Zerega says, "we're always interested in knowing what its wild ancestor was so that we can have its germplasm available to potentially improve the crop through breeding, whether it be for better yield, better taste or perhaps draught or salt tolerance.

"This type of work has been done for many of the major crops, but there are a lot of other crops that are still important in certain parts of the world. Breadfruit falls into that category."

The breadfruit, Zerega says, had remained an enigma. That's because, in the areas where it's mostly grown (Polynesia, Melanesia and Micronesia in the South Pacific), it has no close relatives. Also it is seedless, meaning that it's been repeatedly propagated from root cuttings, which produces mutations.

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> **Nyree Zerega**

Zerega says that by analyzing DNA fingerprinting data using principal components analysis in JMP, she was able to determine that two different wild species gave rise to breadfruit to different extents in different geographic locations. She's learned that in Polynesia and Melanesia there was one wild ancestor, called breadnut, that gave rise to the breadfruit. And in Micronesia it appears that two wild species were involved in a hybridization: breadnut and a wild species that's native to Micronesia called dugdug.

She writes of her research: "When viewed in conjunction with findings from archaeology, human genetics and linguistics, the results offer intriguing insights into both the domestication and human-mediated dispersal of breadfruit. With these findings, the wild progenitors were targeted for collection and were deposited in the world's largest breadfruit germplasm collection (The Breadfruit Institute in Maui, Hawaii) where they are conserved and studied today."

"Using principal components analysis with JMP," Zerega says, "I was able to tease out the relationships of the different cultivars from different regions and was able to present a very good visual display of how these different entities are quite distinct. It's also a very good visual tool for displaying and communicating this to others."

Zerega says she also has used multivariate analyses approaches with JMP to visualize the relationships of individual breadfruit cultivars.

The germplasm collection in Maui is used today to help understand and improve breadfruit: Cultivars are identified for particular qualities for particular regions, and farmers request and receive cultivars that are optimal for their regions.

We knew how breadfruit arrived in the West: Bligh brought it. Now, thanks to Nyree Zerega, we know where it came from in the first place. Who knows where the journey may next lead?