Geneticists reveal what makes great rice

Gene responsible for long grains and pleasing texture can now be bred into existing varieties without sacrificing yield.

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Xiangdong Fu

Breeders in China have discovered the secret for creating rice varieties that could improve breakfast, lunch and dinner for millions of people in Asia. Two teams of molecular geneticists, working independently, have identified a gene that controls both shape and texture and can be selected for without sacrificing the yield of the crop.

“The implications are enormous,” says Susan McCouch, a rice geneticist at Cornell University in Ithaca, New York, who was not involved in either study. “The rice-breeding community has had this problem — they have been able to improve yield or quality, but almost never simultaneously.”

In Southeast Asia, where up to 76% of the caloric intake comes from rice, savvy shoppers know what to look for in the grain. Good rice is transparent; opaque spots indicate a disagreeable chalky taste. And for many, the best rice has long, slender grains. “This shape is associated with quality,” says Xiangdong Fu, a geneticist at the Chinese Academy of Sciences in Beijing and the senior author of one of the studies[1].

Consumers will pay so much more for quality that breeders in some countries have been prepared to sacrifice yield to create elite varieties. A grain-improving gene in an Indian favourite, Basmati, comes with a 14% decrease in yield. But Chinese farmers will often accept lower quality to keep yields high.

Two papers published on 6 July in *Nature Genetics*[1,2] identify a gene that is associated both with long, slender shape and with reduced chalkiness — and can be bred into rice lines with little or no cost in terms of yield.

Shape shifter

The gene can induce radical changes in shape by promoting longitudinal cell division over transverse cell division. The more copies of a particular version — or allele — of the gene that a variety has, the longer the grain. The gene is dominant, which makes it useful for creating hybrid varieties. A neighbouring gene, which codes for a protein involved in transcribing DNA into RNA, represses the effect but can be disabled.

The real heroes in the story are the breeders, says McCouch. The gene, known as both *GL7* and *GW7*, is highly expressed in two US varieties, as well as in a new Chinese line called TaifengA. “The breeders have already accomplished this; they don’t need these people doing the molecular genetics.”

But now that the miracle gene has been identified, it can be manipulated with advanced tools. “There are already some varieties that

exist in the Chinese market that contain these alleles," says Guosheng Xiong at the Chinese Academy of Agricultural Sciences in Shenzhen and an author of one of the papers[1]. "But with this knowledge, we can introduce it to some varieties that have good taste and cooking qualities but don't look good."

Other staple foods are roughly the same throughout the world, but preferences for rice size, shape and flavour vary widely from country to country. The Japanese famously like their rice short, fat and sticky, which explains why their breeders have bred out a second copy of *GL7* in a variety introduced from the Americas.

But irrespective of local preference, hardly anyone likes chalkiness. Chalky rice also breaks easily, reducing the value of a crop and the amount of money that a farmer can earn in a year.

In whatever line it is included, the gene will improve the look and taste of bulk Chinese rice. "It will be much more beautiful and better tasting," says Fu. And that is no small accomplishment for a country where many eat rice three meals a day, according to McCouch. "It will bring pleasure to some of the world's poorest people," she says.

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References

1. Wang, S. *et al. Nature Genet.* http://dx.doi.org/10.1038/ng.3352 (2015).
2. Wang, Y. *et al. Nature Genet.* http://dx.doi.org/10.1038/ng.3346 (2015).