Science Societies

A better potato, one gene at a time

New research creates 97 easier-to-breed genetic lines

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Potatoes are a plant breeder's nightmare.

Most plants resemble their parents, but potatoes are different. The potatoes we eat have four copies of each of their genes and lots of genetic variation, so it's hard to predict what sort of offspring two parent potatoes will produce. Plant breeders often grow thousands of duds just to find a handful of strong candidates for a new potato line.

New research recently published in *The Plant Genome* offers a shortcut. A team of potato breeders assembled from universities across the country developed 97 publicly available genetic lines that have only two copies of each gene. This will make it easier for breeders to pick the best candidates for new potato lines.

Potatoes are central to cuisines and cultures across the globe, and are nutritious to boot, thanks to their high amounts of protein, fiber, potassium, vitamin C, and antioxidants. They're the most widely grown vegetable crop in the world, and changing environments and consumer preferences mean that the industry is always going to need to grow new breeds of potato to keep up with the demand. But making new varieties of potatoes is a complicated process that can take a long time.

While potato plants do flower and go to seed, most commercial potato plants are grown clonally by planting tuber cuttings.

Since most commercially available potato plants have four sets of chromosomes, inheritance is difficult to predict. It also means that bad genetic mutations that hurt

potato plants can easily build up over the years. To circumvent the potato's complicated genetics, they're often grown as clones, where cuttings from old tubers are planted to get a new crop. But this adds more layers of complexity: diseases can be easily spread this way, and the process to make a desirable variety is incredibly long. Breeders are always looking for ways to reduce the amount of time it takes to release new varieties, especially when there are a lot of traits that need to be considered when developing new potato lines. Potatoes need to look nice to consumers, store well, and of course, taste great. A potato plant with only two sets of chromosomes would be a lot simpler to breed, increase seeds, transport, store, and keep disease-free.

This study developed new genetic lines, each with potatoes that have just two sets of chromosomes. To do so, plant breeders crossed 58 varieties of potatoes (including red, russet, yellow, and purple potatoes) with a special kind of potato plant that causes offspring to have half the number of genes as its parent. The offspring from those plants can serve as the foundation for new breeding programs. From those 58 initial varieties, the researchers were able to develop 97 new lines that can be used for making chips and french fries or eaten fresh.

Further maximizing impact, the researchers also sequenced the DNA of the new lines, providing a valuable resource on potato genetics for breeders and researchers. The work done here stretches from the US to China and Europe, making better potatoes on a global scale.

Tentative results showed that these new lines have high genetic diversity when compared with other major crops. This means breeders should have plenty of genetic material to work with if they want to incorporate new traits into their potato lines. In

addition, the new potatoes contain most of the genes necessary to help breed potatoes faster for key traits. That said, the new lines aren't perfect—many of them are weaker than regular potatoes, produced less yield, and likely have some bad genes themselves. But it's a promising start for potato breeders worldwide. Plus, the researchers can use the genetic information they collected combined with breeding techniques to slowly purge any bad genes that would make the potatoes sick or unappetizing. This research may give scientists and farmers new tools to bring high-quality, climate-resilient, and tasty potatoes to market.

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