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The cost-effective way to feed the world

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By 2050, the world will have to feed 9 billion people, adapt to climate change, reduce agricultural pollution, and protect fresh water supplies - all at the same time. Given that formidable challenge, what are the quickest, most cost-effective ways to develop more productive, drought-, flood- and pest-resistant crops?

Some will claim that genetically engineered (GE) crops are the solution. But when compared side-by-side, classical plant breeding bests genetic engineering. Coupled with ecologically based management methods that reduce the environmental harm of crop production, classical breeding could go a long way toward producing the food we will need by mid-century.

Producing better crops faster certainly would help the world feed itself, but genetic engineering has no advantage on that score. Not only can classical breeding programs introduce new varieties about as fast as genetic engineering, technical improvements are making classical practices even faster.

Early steps in the genetic engineering process avoid the multiple rounds of cross-breeding inherent in classical plant breeding by directly inserting engineered genes into the crop. But seed companies then use classical breeding to transfer engineered genes to the crop's numerous varieties for different markets and climates - and that takes time. And just as in classical breeding, new engineered varieties must be tested in the field for several years to ensure they perform as expected.

Second, GE crops are significantly more expensive to develop. Industry estimates of the cost of developing a single GE trait are in excess of \$100 million. By contrast, a classical breeding program for similar traits typically costs about \$1 million. Most of the cost differential is attributable to GE crops' research and development requirements, which include DNA synthesizers and sequencers and other expensive equipment, in addition to classical breeding facilities.

Genetic engineering might be worth the extra cost if classical breeding were unable to impart such desirable traits as drought-, flood- and pest-resistance, and fertilizer efficiency. But in case after case, classical breeding is delivering the goods.

Plant breeders have already produced drought-tolerant varieties of sorghum, corn, rice, cassava and pearl millet - all critical for poor farmers in developing countries. Genetic engineering, meanwhile, has yet to commercialize its first drought-tolerant crop varieties. U.S. biotech companies have been working for years on drought tolerance, but two of the three varieties they plan to introduce within the next two years are the result of classical breeding.

Scientists using classical breeding enhanced with genomic information - a process called marker-assisted breeding - also have produced rice varieties that can tolerate flooding. These varieties, now cultivated in the Philippines, Bangladesh and India, are expected to increase food security for 70 million of the world's poorest people.

Classical breeders likewise have developed papaya resistant to ringspot virus and corn that can fend off destructive rootworms - traits previously touted as requiring genetic engineering. And in Uganda, scientists have successfully bred sweet potatoes to resist virus diseases, while a multimillion-dollar, multi-year project in Kenya to genetically engineer similar virus resistance failed.

Finally, classical breeding and better farm management are responsible for all the yield increases for soybeans and most of the yield increases for corn in the United States. Recent yield increases are often erroneously attributed to genetic engineering, but data from the U.S. Department of Agriculture and academic scientists show that even during the past 15 years that GE crops have been commercialized, classical breeding and crop management improvements contributed the large majority of the increases, not the newly inserted genes.

Public sector crop breeders have succeeded despite shoestring budgets at public universities, international institutes and the USDA. By contrast, the biotech industry's lavish budgets have produced commercial crops with only two types of GE traits. More than 60 percent of all GE crops planted worldwide are merely designed to survive being doused with herbicides.

So if the conventional wisdom is wrong, and classical breeding is superior, what does that mean for public policy?

Federal and state governments should dramatically increase their support for tried-and-true, cost-effective classical breeding technology - including better funding for breeding programs at public universities and nonprofit institutes where breeders can work with farmers to develop a wider range of farmer-ready crop varieties. Big biotech companies do not focus on small-acreage crops, which include most fruits and vegetables. Nor do they market many classically improved varieties without including their patented engineered traits, which doesn't help farmers who don't want to grow GE seeds or pay the high prices biotech companies charge for them.

We are not suggesting that genetic engineering has no role to play in developing improved crops. But its modest contributions come with an extremely high price tag. If we are going to meet the challenges of feeding a growing population and protecting the environment, the scientific evidence says we place our bets on technology that works - classical breeding.

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