Center for Food Safety attacks GMO drought tolerant crops, distorts big picture

A recent article by Douglas Gurian-Sherman of the Center for Food Safety on the green food website Civil Eats has me scratching my head. The subject was attempts to breed drought tolerant corn and the fact that conventional breeding methods currently outpace biotech attempts in creating commercially viable strains.

> Last month, the highly respected science journal *Nature* published a news article reporting that conventional breeding substantially outperforms genetic engineering for several very important traits—drought tolerance and the ability of crops to use nitrogen (e.g., from fertilizer or manure) more efficiently.
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> It’s unusual to see the two methods compared. Science journals have presented advances in breeding for drought tolerance. But none have been bold enough to say what has been obvious for several years—that conventional breeding is working considerably better than genetically engineered seeds for this trait.
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> The article also notes that while Monsanto hopes to get a transgenic drought tolerant seed trait to Africa “by 2016 at the earliest,” there are already about 153 varieties of conventionally-bred corn currently in trials for drought tolerance. And conventional seeds have been shown to improve yields–a scientific term for the actual amount of corn harvested–by as much as 30 percent higher than non-tolerant varieties during drought. Many other non-GMO drought-tolerant varieties are already deployed to several million farmers with yield improvements reported to be about 20-30 percent compared to previous varieties.
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> By comparison, Monsanto’s drought tolerant seeds provide only about 5 or 6 percent yield increase in the U.S., and only under moderate drought conditions (PDF).

The Nature article he refers to lays out an interesting new breeding breakthrough in the quest for drought tolerant corn.

> The CIMMYT researchers established that certain characteristics predict how a maize plant will fare in drought. One of the most telling is the number of days between when the plant’s male organs shed pollen and when the female silks emerge. When water is scarce, the silks emerge late. If the delay is long enough, they emerge after the plants have released their pollen and are not fertilized.
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> “Finding out this relationship was very important to be able to select for drought tolerance,” says Pixley. By favouring plants with shorter intervals between pollen release and silk emergence, breeders were able to produce maize that was more resistant to drought.

Is Gurian-Sherman making a meaningful point?

The reasons why biotech breeding is currently lagging the progress made through conventional breeding aren't hard to understand. Drought tolerance is really complex. It's about efficient water use, but even more about handling stress. You want the plant to use what water there is very efficiently, but under really dry conditions, you want the plant to essentially shut itself down, wait until water comes and then pick up where it left off. And you want it to do all this without making noticeable trade-offs in yield under normal conditions.

A plant has limited resources and energy, choices have to be made about how to prioritize them. The normal arithmetic is that if you want a plant to do more of one thing, it's going to do less of another. But farmers can't afford to work with corn that yields less under normal conditions on the chance that there may be a drought. They need corn that can compete under normal conditions and thrive under drought conditions. That's a lot to ask for. Luckily for breeders, there are seed banks full of many, many varieties of corn and wild relatives that do well in drought—but don't do as well under normal weather conditions. That's not a great situation which is why conventionally bred drought tolerant seeds are not being adopted in any great volume.

It's currently easier to move a bunch of desirable genes with cross breeding than with recombinant DNA. That is changing. As we saw in a recent piece on synthetic biology, genetic engineers are working on reliably moving suites of related genes around like cartridges that can be plugged into a plant to confer complex functions like drought tolerance.

What was puzzling about Gurian-Sherman's piece was the way that he framed the issue as a competition between biotech and conventional breeding. The article from Nature didn't frame it that way, in fact the same organization that he profiled, CIMMYT, uses both methods.

> Drought tolerance is a complex trait that involves multiple genes. Transgenic techniques, which target one gene at a time, have not been as quick to manipulate it. But CIMMYT and six other research organizations are also developing genetically modified (GM) varieties of drought-resistant maize, in collaboration with agricultural biotechnology giant Monsanto in St Louis, Missouri. Coordinated by the African Agricultural Technology Foundation in Nairobi, the Water Efficient Maize for Africa project aims to have a transgenic variety ready for African farmers by 2016 at the earliest.
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> Like drought resistance, maize's ability to grow in nitrogen-poor soils is genetically complex, and the need for varieties that do well with little fertilizer is pressing. Most African farmers can afford only one-tenth the amount of fertilizer recommended for their crops. This is one of the biggest problems they face, says Biswanath Das, a maize breeder at CIMMYT.
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> Researchers at CIMMYT are working to address that problem through the Improved Maize for African Soils (IMAS) project, a collaboration with the Kenya Agricultural Research Institute in Nairobi; the South African Agricultural Research Council in Pretoria; and DuPont Pioneer in

> Johnston, Iowa. The 10-year, US$19.5-million project is pursuing conventional and transgenic approaches.

This is research with long time horizons. The technology needs to be applied to the toughest problems if it's going to progress, even if conventional can get to the solution first. And of course conventional breeding benefits from the wake of technology that spins off from biotech breeding. Conventional breeders are using biotech techniques like marker assisted breeding, they sequence genomes, and they are beginning to silence and knockdown genes to make novel crosses possible. Conventional breeders benefit from the techniques that are developed as biotech breeders push up against the limits of what can be done.

Gurian-Sherman concludes with two points that many experts are likely to be sympathetic with, at least in part:

> As I have written elsewhere, genetic engineering may make some contributions to improving agriculture. But since conventional breeding is cheaper and more effective, it should get a much bigger share of public research funding and policy support. Instead, only a small fraction of the U.S. Department of Agriculture research budget supports breeding and agroecology, while Farm Bill policies subsidize and favor a few commodity crops. And due to this lack of support, there are fewer public breeders at land grant universities over the past several decades.
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> Conventional plant breeding is no panacea. As with genetic engineering, traits that look promising initially can, with further work, reveal problems like lowered yield (or "yield drag"). Breeding for industrial agriculture systems is also a problem. This has led to such dubious projects as tomatoes that are hardy enough to be harvested by machines, but taste like wax, and "green revolution" crops overly-reliant on irrigation, fertilizer, and pesticides, to the detriment of the environment, public health, and often small-scale farmers. But conventional breeding has also shown that it can be of great benefit if certain principles are followed.
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> First, it must be coupled with organic and "agroecological" farming systems, which rely on long crop rotations, cover crops, mulches, manure, and so on. Second, it must include meaningful participation from farmers. Breeders need to work with farmers on a continuing basis. Farmers know what their challenges are, and what crop characteristics are important to their communities.
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> Finally, good public breeding must supply poor and peasant farmers with free or inexpensive seed, and farmers must be able to save it and further improve it for local conditions.

There certainly has been a loss as public budgets have been cut, especially for developing countries. Breeding programs could be better integrated with agroecology and geared more for local conditions. Most public breeding programs do provide farmers with free or inexpensive seed that can be saved. But while saving seed is an appealing idea, and a necessity in some cases, the NEED to save seed is a bad sign

. It means that farmers need help with real resources. Resources like ROADS!

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