Viewpoint: How the anti-GMO movement devolved from dangerous to irksome to irrelevant

Introduced in the 1990s, crops genetically engineered (GE) to withstand exposure to the weed killer glyphosate (Roundup) were a game-changer for agriculture. They saved many farmers money on weed control, slashed greenhouse gas emissions caused by tilling and fossil fuel use, and indirectly boosted crop yields, all of which translated into lower food prices for consumers.

But these incredible benefits came at a cost, namely herbicide-resistant weeds. The combination of GE seeds and glyphosate worked so well that some growers overused it, which accelerated the evolution of weed populations that could survive glyphosate exposure. Developing solutions to this growing problem is now a major focus for agricultural scientists, and a study recently published in PNAS may contribute to that effort.

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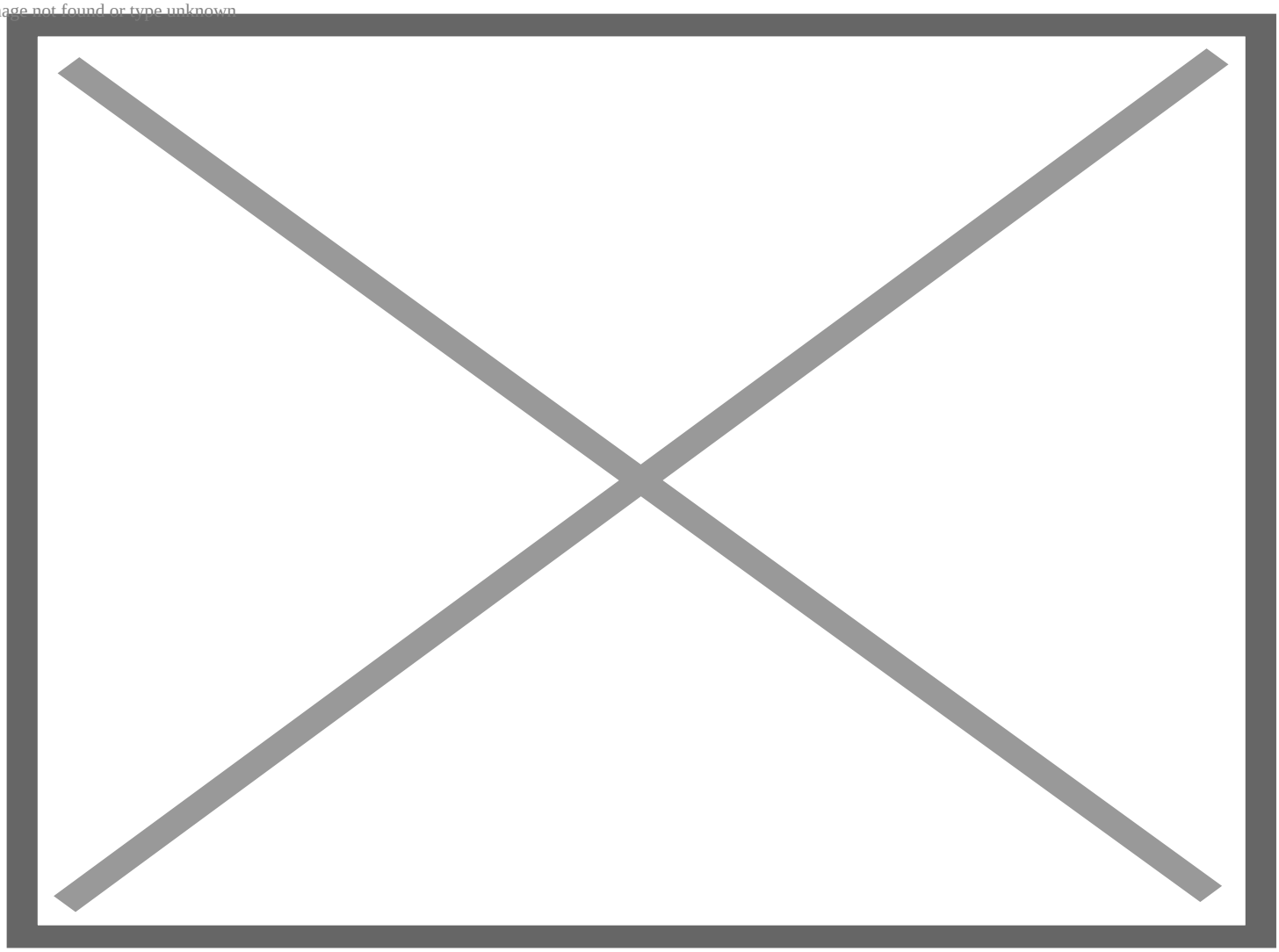

According to the paper, some glyphosate-tolerant weeds defeat the herbicide roughly the same way

cancer cells dodge the lethal effects of drugs designed to kill them: by pumping the chemicals out of the region of the cell where they're most effective, using proteins called ABC transporters.

This is a helpful insight for farmers and weed scientists, but the finding also highlights two important reasons the anti-GMO movement is losing its cultural relevance that are worth considering.

Brief recap

The researchers identified the over-expressed ABC transporter genes in an herbicide-resistant population of Echinochloa colona (barnyard grass), a weed species most common in tropical and subtropical regions. They then introduced those genes into rice and treated it with glyphosate to reveal the source of herbicide resistance. Finally, the researchers targeted one of the genes with CRISPR/Cas9-mediated knockout to increase the plant's susceptibility to glyphosate.

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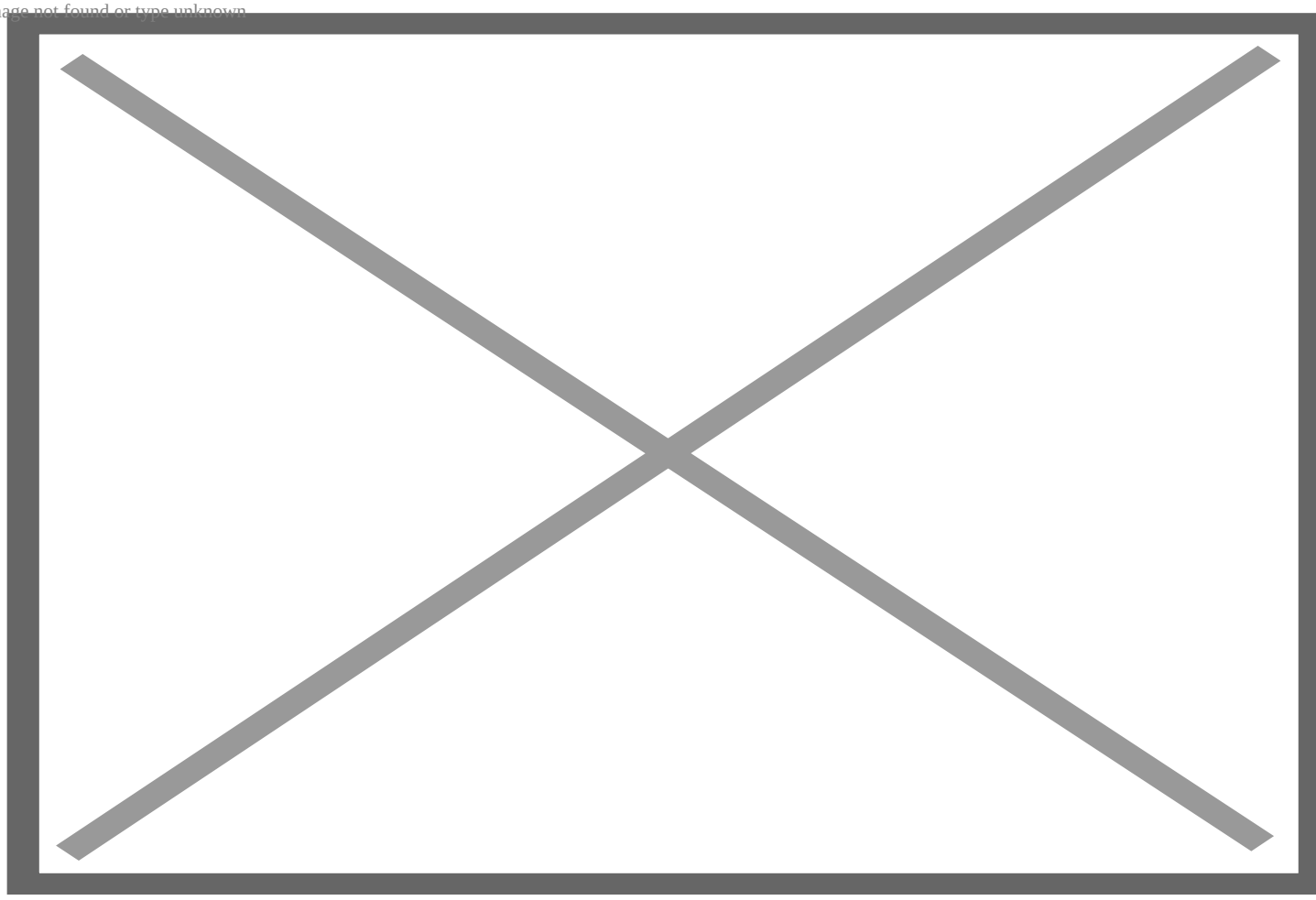

Echinochloa colona (barnyard grass). Credit: CNAS

The experiment, the researchers wrote, provides "evidence of a plant ABC transporter (ABCC8) that likely serves as a plasma membrane glyphosate exporter, lowering the cytoplasmic glyphosate level and thereby endowing glyphosate resistance." This mechanism bears a striking resemblance to the drug-

fighting pump found on certain cancer cells:

> *I*n small cell lung carcinoma, for instance, cancer cells are equipped with a pump that allows them to eject drugs that would typically bind to the cells and kill them, making the disease effectively untreatable.
>
> Using a mechanism called RNA interference (RNAi), cancer researchers can silence (turn off) this pump gene and thus make the cancer cells sensitive to chemotherapy again. This innovation is in its infancy, but RNAi is helping experts develop more targeted cancer drug therapies, and there are dozens of clinical trials in progress to test RNAi-based cancer treatments.

With that research in mind, the study authors suggested their discovery could lead to the development of herbicides that weeds can't beat with the same mechanism. "New well-designed anti-cancer drugs cannot be pumped out of human cancer cells and this herbicide resistance finding should further stimulate the search for new chemical and non-chemical solutions for weed control in global agriculture," study co-author Stephen Powles, emeritus professor at the University of Western Australia, wrote in an email.

Other ongoing projects are pursuing similar approaches. Monsanto, years ago, developed an RNA-based product that shuts off herbicide resistance in weeds. More recently, researchers in the UK devised two methods, virus-induced gene silencing (VIGS) and virus-mediated protein overexpression (VOX), that can re-sensitize some resistant weeds to another herbicide called glufosinate.

The bigger picture

Much more research needs to be done before these studies yield commercial products for farmers, but there are still two important takeaways for us to consider today.

Consider the risks and the benefits

While anti-biotech groups often warn that GE crops speed the development of herbicide-resistant "super weeds," they have little say about these herbicide resistance-fighting applications, except that they don't like them. Therein lies takeaway number one: consider the risks and benefits of a technology. GE crops, to some extent, contributed to the problem of pesticide resistance; nobody denies that. But it's misguided to downplay workable solutions. This is why the anti-GMO movement is gradually campaigning itself into irrelevancy—it's complaints about the dangers of crop biotechnology either never materialized or are being solved.

"GMOs" aren't uniquely harmful

On a related note, while the anti-GMO movement coalesced around food safety issues in the 1990s, this was because earlier attacks on the use of genetic engineering in medicine failed to rouse public concern, not because agricultural biotechnology poses some unique risk. As University of California, Riverside molecular geneticist Alan McHughen pointed out in 2007:

> The same technology, with the same kind and degree of risks, when used to create medical products attracts minimal such concerns. That is, if GM soybeans, due exclusively to the process of r[ecombinant]DNA in their development, were eventually found to cause some unexpected medical disorder, then GM insulin should also cause the disorder and warrants the same current concern. But it does not; the public seems not only to tolerate medical applications of biotechnology, but also to embrace them.

Watching anti-biotech groups strain to justify their opposition to biotechnology in agriculture while defending its use in medicine offers a powerful confirmation of McHughen's analysis and another clear reason why these advocacy groups are gradually sliding back into obscurity.

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