

Modifying rice crops to resist herbicide prompts weedy neighbors' growth spurt

September 23 2013, by Emily Caldwell

Rice containing an overactive gene that makes it resistant to a common herbicide can pass that genetic trait to weedy rice, prompting powerful growth even without a weed-killer to trigger the modification benefit, new research shows.

Previously, scientists have found that when a genetically modified trait passes from a crop plant to a closely related weed, the weed gains the crop's engineered benefit – resistance to pests, for example – only in the presence of the offending insects.

This new study is a surprising example of [gene flow](#) from [crops](#) to weeds that makes weeds more vigorous even without an environmental trigger, researchers say.

The suspected reason: This modification method enhances a plant's own growth [control mechanism](#), essentially making it grow faster – an attractive trait in crops but a recipe for potential problems with weedy relatives that could out-compete the crop.

"Our next question is whether this method of enhancing [plant growth](#) could be developed for any crop. We want to know whether growers could get higher yields in the crop and then, if it happened to cross with a related weed, whether it might make the weed more prolific as well," said Allison Snow, professor of evolution, ecology and organismal biology at The Ohio State University and a lead author of the paper.

"It's unusual for any transgene to have such a positive effect on a wild relative and even more so for [herbicide resistance](#)," she said. "But we think we know why: It's probably because the [pathway](#) regulated by this gene is so important to the plant."

The work is the result of Snow's longtime collaboration with senior author Bao-Rong Lu, a professor at Fudan University in Shanghai. Their publication appears online in the journal *New Phytologist*.

The weed-killer glyphosate, sold under the brand name Roundup, kills [plants](#) by inhibiting a growth-related pathway activated by the epsps gene. Biotech companies have inserted mutated forms of a similar gene from [microbes](#) into [crop plants](#), producing "Roundup Ready" corn and soybeans that remain undamaged by widespread herbicide application.

But in this study, the researchers used a different method, boosting activation of the native epsps gene in rice plants – a process called overexpressing – to give the plants enough strength to survive an application of herbicide. Because companies that genetically modify commercial crops don't fully disclose their methods, Snow and her colleagues aren't sure how prevalent this method might be, now or in the future.

"This is a relatively new way to get a trait into a crop: taking the plant's own gene and ramping it up," Snow said. "We don't know yet if our findings are going to be generalizable, but if they are, it's definitely going to be important."

To overexpress the native gene in rice, the scientists attached a promoter to it, giving the plant an extra copy of its own gene and ensuring that the gene is activated at all times.

The researchers conducted tests in rice and four strains of a relative of

the same species, weedy rice, a noxious plant that infests rice fields around the world. By crossing genetically altered herbicide-resistant rice with weedy rice to mimic what happens naturally in the field, the researchers created crop-weed hybrids that grew larger and produced more offspring than unaltered counterparts – even without any herbicide present.

In regulated field experiments, the hybrids containing the overexpressed gene produced 48 percent to 125 percent more seeds per plant than did hybrid plants with no modified genes. They also had higher concentrations of a key amino acid, greater photosynthetic rates and better fledgling seed growth than controls – all presumed signs of better fitness in evolutionary terms.

"Fitness is a hard thing to measure, but you can conclude that if a gene gives you a lot more seeds per plant compared to controls, it's likely to increase the plants' fitness because those genes would be represented at a higher percentage in future generations," Snow said.

When Snow and Lu set out to study this new genetic engineering method, they didn't know what to expect.

"Our colleagues developed this novel transgenic trait in rice and we didn't know if it would have a fitness benefit, or a cost, or be neutral," Snow said. "With most types of herbicide resistant genes, there's no benefit to a wild plant unless the herbicide is sprayed. A lot of transgenes in crop plants are either selectively neutral in wild plants or, if they have a benefit, it depends on environmental factors like [insects](#), diseases or herbicides being present."

Snow has a history in this area of research. She has found that [genes](#) from crop plants can persist in related weeds over many generations. In 2002, she led a study that was the first to show that a gene artificially

inserted into crop plants to fend off [pests](#) could migrate to weeds in a natural environment and make the [weeds](#) stronger. She also has served on national panels that monitor and make recommendations about the release of genetically engineered species into the environment.

She is interested in identifying new possible outcomes of the growth of crop-weed hybrids that contain genetic modifications, but she doesn't take sides about possible risks and benefits of genetically modified crops.

"It's not always the end of the world if a weed starts to become a lot more common after acquiring a new trait – there may be effective ways to manage that weed," Snow said. "You just can't make sweeping generalizations about genetic engineering, and knowledge from ecological studies like ours can help inform risk assessment and biosafety oversight."

More information:

onlinelibrary.wiley.com/doi/10.1111/nph.12428/full

Provided by The Ohio State University

Citation: Modifying rice crops to resist herbicide prompts weedy neighbors' growth spurt (2013, September 23) retrieved 16 April 2024 from <https://phys.org/news/2013-09-rice-crops-resist-herbicide-prompts.html>

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