

How did scientists design an herbicide that affects green plants but not animals?



Weed Warriors

Herbicide-Tolerant Crops

Some of the first GM crops to hit the fields are popular with farmers but controversial with some people. These crops are engineered to withstand herbicides that are sprayed on fields to kill weeds.

Weeds can take over a field, and keeping them out takes backbreaking work. In Africa, most farmers are women, and they spend half their time weeding! Many farmers spray **herbicide** to kill specific weeds at different times. (“Herb” mean plant and “cide” means kill, as in homicide.) In Africa, some weeds are parasites that can’t be sprayed without destroying the crop. Where herbicides can be used, weeds can become resistant to them, so farmers need ever-stronger and more diverse chemicals to kill them. But many herbicides harm animals and insects, and they last a long time in the environment.

Scientists developed less toxic herbicides to reduce these risks. One such chemical is **glyphosate**, which is marketed as Roundup®. Glyphosate kills green plants by shutting down the production of essential amino acids. Insects and animals get these compounds in their food, but

plants have to make them. To do so, a molecular “key” fits into a protein “lock,” turning on an essential amino acid “machine.” Glyphosate mimics the key, slips into the lock, and jams it so the machine can’t start. The plant starves to death! Animals don’t have that molecular lock because we don’t need the machine, so glyphosate doesn’t affect us. It also breaks down quickly and doesn’t stay in the environment.

If farmers sprayed glyphosate on their fields, it would kill both weeds and crops. Thus, scientists made crops that withstand this herbicide. They added a gene to produce a slightly different lock. The mimic key can’t fit it, but the plant’s own key can. The essential amino acid machine keeps working, so the crops survive while the weeds die. “Roundup Ready®” crops also allow farmers to kill parasitic weeds. The new gene doesn’t change the crop plant in any other way.

Before, farmers only had the option of hoeing or plowing the fields to kill weeds before planting. This practice causes soil erosion and water pollution. With herbicide-resistant crops, farmers no longer have to till, saving them work and money. Zero tillage also helps preserve the soil and water.

Farmers in the United States adopted GM seeds for crops that traditionally need a lot of herbicides. In just four years since their introduction, more than half of the US soybean crops grew from GM seeds. Did you know you eat soybeans all the time? Look at the labels on your snack foods!

Think about it!

What could happen if no farmers used herbicides?

Are herbicide-resistant crops good or bad for the environment? Make a chart of the pros and cons! Should we use them?

Risks and Benefits

Soon, critics questioned the wisdom of GM crops. They might be convenient for farmers, but are they safe to eat? A GM plant has a tiny change in the protein lock that our bodies just digest like any other protein. Glyphosate itself is less toxic to us than table salt. However, the spray contains other ingredients that may pose risks to fish and wildlife if used irresponsibly – and to people who get the spray on them. Still, it is much less toxic than other herbicides. Also, farmers spray it before the edible parts of the plants form, so it isn't on the food we eat.

Superweeds?

Another concern is whether herbicide-resistant crops will lead to “superweeds.” Could the crops pollinate weeds and give them herbicide resistance? Would these resistant weeds spread out of control like the invasive kudzu vine in the south? Scientists began studying this possibility when developing herbicide-tolerant crops through conventional crossbreeding.

A herbicide-resistant crop can only pollinate a closely related weed. The Western Hemisphere has no wild relatives for soybeans, so herbicide-resistant weeds seem unlikely in this case. In the Eastern Hemisphere, the soybean does have weedy relatives that could get the herbicide-resistant gene. But in the wild, no one sprays herbicides, so herbicide resistance wouldn't be an advantage and the weed might not take over in nature. In the soybean field, farmers could use other herbicides to kill the weed, since it would only resist glyphosate. U.S. regulatory agencies are closely monitoring fields to make sure herbicide-resistant weeds are destroyed if they appear.

Food Safety

Food safety is no laughing matter. Every year, hundreds of people die from food poisoning and many more are sickened by bacteria on food. Likewise, the green parts of potatoes contain a toxin (glycoalkaloid), which breeders monitor before they release the potato seed.

U.S. regulatory agencies test produce for leftover chemicals (residues), and they also test GM crops. People are concerned that GM goods could create new, unknown food allergies. Companies test the introduced gene for allergic properties and they must label a food if the gene comes from a known allergen such as nuts or wheat. Fungus and molds on foods cause health risks, and they are more common on organic crops that don't use fungicides to kill them. A mold that grows on corn and peanuts produces the cancer-causing chemical aflatoxin and can cause

a whole crop to be rejected.



Peanuts can cause deadly allergic reactions. Scientists have identified three genes that code for the allergic proteins. They are trying to deactivate these genes to make a non-allergenic peanut.

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Bypass for
herbicide-
tolerant crops

GLYPHOSATE

Essential Amino Acidville

Herbicide-resistant crops have a gene that lets them bypass the glyphosate road block. They can still make the amino acids they need to live.

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