



Impacts of GMO Crops

A type of genetically modified organism (GMO), herbicide-tolerant (HT) crops have been planted on nearly three-quarters of the cropland in the Midwest for well over a decade, triggering the emergence and spread of nearly a dozen glyphosate-resistant weeds.

For the first few years of GMO-HT crop use, the technology brought about a modest, overall reduction in herbicide use. By the early 2000s, however, overall average herbicide use had risen slightly above the level in 1995 – the year before the first commercial planting of GE-HR, “Roundup Ready” soybeans.

Tougher-to-kill, glyphosate-resistant weeds now infest around two-thirds of the ~180 million acres producing GE corn and soybeans in the U.S. Many fields are infested with two different species of resistant weeds, and some harbor three.

The presence of weeds resistant to glyphosate and/or other herbicides forces farmers to:

- Spray more often,
- Apply herbicides at higher rates per acre,
- Make applications later in the season to target weeds that survive earlier control efforts, thereby extending the time period when drift and volatilization can lead to human exposures and damage to nearby vegetation, and
- Augment standard weed management programs through practices like tillage or by spraying additional herbicides targeting specific, hard-to-control weeds.

The vast majority of herbicide-tolerant crops have been modified to tolerate post-emergent applications of the broad-spectrum herbicide [glyphosate](#) (Bayer/Monsanto’s Roundup, and many other brands).

So-called “Roundup Ready” (RR) GMO crops account for around two-thirds of all acres planted globally to GMOs since 1996. As glyphosate use rose sharply, the use of other herbicides declined, at least for the first five-to-10 years of steady use.

Over time, excessive reliance on one weed management tactic (herbicides), and one herbicide active ingredient (glyphosate), triggered shifts in weed communities to species less sensitive to glyphosate. It also led to the emergence of weed phenotypes that were, at first, partially tolerant of glyphosate, and eventually resistant to it.

Both shifts forced conventional farmers to spray additional herbicides, apply some herbicides more than once, and often at higher rates per acre.

Independent weed scientists had warned since the early 1990s that excessive reliance on glyphosate and RR technology would trigger the emergence and spread of resistant weeds, warnings that were dismissed by Monsanto and other pesticide-biotech industry leaders.

Instead, the pesticide-seed industry promised that GMO crops would reduce pesticide use, a claim that soon became hard to square with herbicide use data released annually by the USDA.

Glyphosate is a relatively high-dose herbicide, typically applied at a one-time rate of between 0.66 and 0.9 pounds per acre. As farmers adopted RR crops and came to rely largely on glyphosate, farmers sprayed markedly less of over a dozen low dose (~ 0.1 pound/acre) herbicides, as well as less of another half-dozen very low dose herbicides (~ 0.01 pound/acre) herbicides.

This dramatic shift in herbicide choices led to an obvious question – how could replacing herbicides applied mostly at 0.01 to 0.1 pound/acre with a herbicide (glyphosate) applied at 0.66-0.75 pounds/acre reduce overall herbicide use?

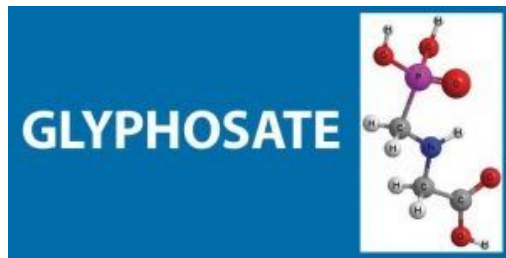
A series of research papers have now been published that track in detail changes in herbicide use brought about by GMO-HT technology, see [our bibliography](#) for more.

Key Science: Impacts of GMO Crops

Two papers published by HHRA Executive Director Chuck Benbrook provide a detailed accounting on the ways GE crops have altered herbicide use patterns:

- [Benbrook, 2016](#): “Trends in the use of glyphosate herbicide in the U.S. and globally,” *Environ. Sci. Europe*, 28:3 doi 10.1186/s12302-016-0070-0; [FAQs on Paper Findings, Health Implications, and Funding](#)
- [Benbrook, 2012](#), “Impacts of Genetically Engineered Crops on Pesticide Use in the U.S. – the First Sixteen Years,” *Environmental Sciences-Europe*, 24:24.

Glyphosate Use



Use of the glyphosate herbicide has increased dramatically in the years since the introduction of glyphosate-tolerant GMO crops. **Data from the USDA** shows that over three quarters of corn acres and nearly all of soybean and cotton crops in the US are now treated with glyphosate.

Glyphosate is now, by far, the most heavily applied pesticide in the U.S., and globally, in history. Enough glyphosate was applied on U.S. cropland in 2014 to spray about 0.8 pounds of active ingredient on every cropland acre in the country.

Worldwide, enough glyphosate is now applied each year to spray about 0.5 pound of this one herbicide on every cultivated cropland acre on the planet.

The unprecedented volume of glyphosate now applied annually is why concern has grown so acute over the spread of resistant weeds, the collapse of glyphosate-dependent weed management systems, this herbicide’s environmental effects, and human exposures and risk.

Other Glyphosate Resources:

- Myers et al., 2016, [Concerns over use of glyphosate-based herbicides and risks associated with exposures: a consensus statement](#); *Environmental Health*, 15:19. DOI 10.1186/s12940-016-0117-0).
- [Glyphosate articles](#) in our bibliography