

Monsanto's Roundup Triggers Over 40 Plant Diseases and Endangers Human and Animal Health

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While visiting a seed corn dealer's demonstration plots in Iowa last fall, Dr. Don Huber walked past a soybean field and noticed a distinct line separating severely diseased yellowing soybeans on the right from healthy green plants on the left.



The diseased field had glyphosate applied the previous season.
Photo by Don Huber

The yellow section was suffering from Sudden Death Syndrome (SDS), a serious plant disease that ravaged the Midwest in 2009 and '10, driving down yields and profits. Something had caused that area of soybeans to be highly susceptible and Don had a good idea what it was.

Don Huber spent 35 years as a plant pathologist at Purdue University and knows a lot about what causes green plants to turn yellow and die prematurely. He asked the seed dealer why the SDS was so severe in the one area of the field and not the other. "Did you plant something there last year that wasn't planted in the rest of the field?" he asked. Sure enough, precisely where the

severe SDS was, the dealer had grown alfalfa, which he later killed off at the end of the season by spraying a glyphosate-based herbicide (such as Roundup). The healthy part of the field, on the other hand, had been planted to sweet corn and hadn't received glyphosate.

This was yet another confirmation that Roundup was triggering SDS. In many fields, the evidence is even more obvious. The disease was most severe at the ends of rows where the herbicide applicator looped back to make another pass (see photo). That's where extra Roundup was applied.

Don's a scientist; it takes more than a few photos for him to draw conclusions. But Don's got more--lots more. For over 20 years, Don studied Roundup's active ingredient glyphosate. He's one of the world's experts. And he can rattle off study after study that eliminate any doubt that glyphosate is contributing not only to the huge increase in SDS, but to the outbreak of numerous other diseases. ([See selected reading list.](#))

In photos below, see how Sudden Death Syndrome is more severe at the ends of rows, where Roundup dose is strongest. (*Photos by Amy Bandy*)



Roundup: The perfect storm for plant disease

More than 30% of all herbicides sprayed anywhere contain glyphosate--the world's bestselling weed killer. It was patented by Monsanto for use in their Roundup brand, which became more popular when they introduced "Roundup Ready" crops starting in 1996. These genetically modified (GM) plants, which now include soy, corn, cotton, canola, and sugar beets, have inserted genetic material from viruses and bacteria that allows the crops to withstand applications of normally deadly Roundup.

(Monsanto incentivizes farmers who buy Roundup Ready seeds to also use the company's Roundup brand of glyphosate. For example, they only provide warranties on the approved herbicide brands and offer discounts through their "Roundup Rewards" program. This has extended the company's grip on the glyphosate market, even after its patent expired in 2000.)

The herbicide doesn't destroy plants directly. It rather cooks up a unique perfect storm of conditions that revs up disease-causing organisms in the soil, and at the same time wipes out plant defenses against those diseases. The mechanisms are well-documented but rarely cited.

1. The glyphosate molecule grabs vital nutrients and doesn't let them go. This process is called chelation and was actually the original property for which glyphosate was patented in 1964. It was only 10 years later that it was patented as an herbicide. When applied to crops, it deprives them of vital minerals necessary for healthy plant function--*especially* for resisting serious soilborne diseases. The importance of minerals for protecting against disease is well established. In fact, mineral availability was the single most important measurement used by several famous plant breeders to identify disease-resistant varieties.
2. Glyphosate annihilates beneficial soil organisms, such as *Pseudomonas* and *Bacillus* bacteria that live around the roots. Since they facilitate the uptake of plant nutrients and suppress disease-causing organisms, their untimely deaths means the plant gets even weaker and the pathogens even stronger.
3. The herbicide can interfere with photosynthesis, reduce water use efficiency, lower lignin, damage and shorten root systems, cause plants to release important sugars, and change soil pH--all of which can negatively affect crop health.
4. Glyphosate itself is slightly toxic to plants. It also breaks down slowly in soil to form another chemical called AMPA (aminomethylphosphonic acid) which is also toxic. But even the combined toxic effects of glyphosate and AMPA are not sufficient on their own to kill plants. It has been demonstrated numerous times since 1984 that when glyphosate is applied in sterile soil, the plant may be slightly stunted, but it isn't killed (see photo below).

5. The *actual* plant assassins, according to Purdue weed scientists and others, are severe disease-causing organisms present in almost all soils. Glyphosate dramatically promotes these, which in turn overrun the weakened crops with deadly infections.

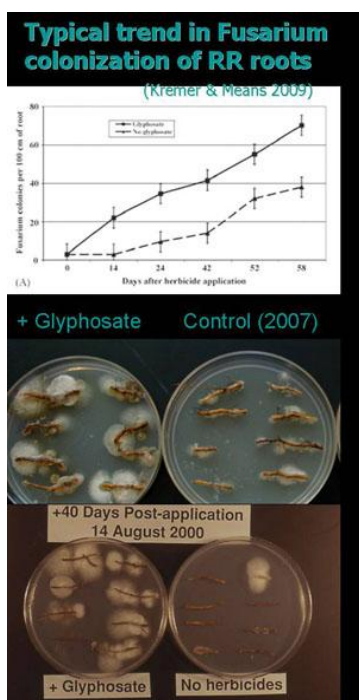
"This is the herbicidal mode of action of glyphosate," says Don. "It increases susceptibility to disease, suppresses natural disease controls such as beneficial organisms, and promotes virulence of soilborne pathogens at the same time." In fact, he points out that "If you apply certain fungicides to weeds, it destroys the herbicidal activity of glyphosate!"



Glyphosate with sterile soil (A) only stunts plant growth. In normal soil (B), pathogens kill the plant. Control (C) shows normal growth.

By weakening plants and promoting disease, glyphosate opens the door for *lots* of problems in the field. According to Don, "There are more than 40 diseases of crop plants that are reported to increase with the use of glyphosate, and that number keeps growing as people recognize the association between glyphosate and disease."

Roundup promotes human and animal toxins



Some of the fungi promoted by glyphosate produce dangerous toxins that can end up in food and feed. Sudden Death Syndrome, for example, is caused by the *Fusarium* fungus. USDA scientist Robert Kremer found a 500% increase in *Fusarium* root infection of Roundup Ready soybeans when glyphosate is applied (see photos and chart). Corn, wheat, and many other plants can also suffer from serious *Fusarium*-based diseases.

But *Fusarium's* wrath is not limited to plants. According to [a report by the UN Food and Agriculture Organization](#), toxins from *Fusarium* on various types of food crops have been associated with disease outbreaks throughout history. They've "been linked to the plague epidemics" of medieval Europe, "large-scale human toxicosis in Eastern Europe," oesophageal cancer in southern Africa and parts of China, joint diseases in Asia and southern Africa, and a blood disorder in Russia. *Fusarium* toxins have also been shown to cause animal diseases and induce infertility.

As Roundup use rises, plant disease skyrockets

When Roundup Ready crops were introduced in 1996, Monsanto boldly claimed that herbicide use would drop as a result. It did--slightly--for three years. But over the next 10 years, it grew considerably. Total herbicide use in the US jumped by a whopping 383 million pounds in the 13 years after GMOs came on the scene. The greatest contributor is Roundup.

Over time, many types of weeds that would once keel over with just a tiny dose of Roundup now require heavier and heavier applications. Some are nearly invincible. In reality, these super-weeds are resistant not to the glyphosate itself, but to the soilborne pathogens that normally do the killing in Roundup sprayed fields.

Having hundreds of thousands of acres infested with weeds that resist plant disease and weed killer has been devastating to many US farmers, whose first response is to pour on more and more Roundup. Its use is now accelerating. Nearly half of the huge 13-year increase in herbicide use took place in just the last 2 years. This has *serious* implications.

As US farmers drench more than 135 million acres of Roundup Ready crops with Roundup, plant diseases are enjoying an unprecedented explosion across America's most productive crop lands. Don rattles off a lengthy list of diseases that were once under effective management and control, but are now creating severe hardship. (The list includes SDS and Corynespora root rot of soybeans, citrus variegated chlorosis (CVC), Fusarium wilt of cotton, Verticillium wilt of potato, take-all root, crown, and stem blight of cereals, Fusarium root and crown rot, Fusarium head blight, Pythium root rot and damping off, Goss' wilt of corn, and many more.)

In Brazil, the new "Mad Soy Disease" is ravaging huge tracts of soybean acreage. Although scientists have not yet determined its cause, Don points out that various symptoms resemble a rice disease (bakanae) which is caused by *Fusarium*.

Corn dies young

In recent years, corn plants and entire fields in the Midwest have been dying earlier and earlier due to various diseases. Seasoned and observant farmers say they're never seen anything like it.

"A decade ago, corn plants remained green and healthy well into September," says Bob Streit, an agronomist in Iowa. "But over the last three years, diseases have turned the plants yellow, then brown, about 8 to 10 days earlier each season. In 2010, yellowing started around July 7th and yield losses were devastating for many growers."

Bob and other crop experts believe that the increased use of glyphosate is the primary contributor to this disease trend. It has already reduced corn yields significantly. "If the corn dies much earlier," says Bob, "it might collapse the corn harvest in the US, and threaten the food chain that it supports."

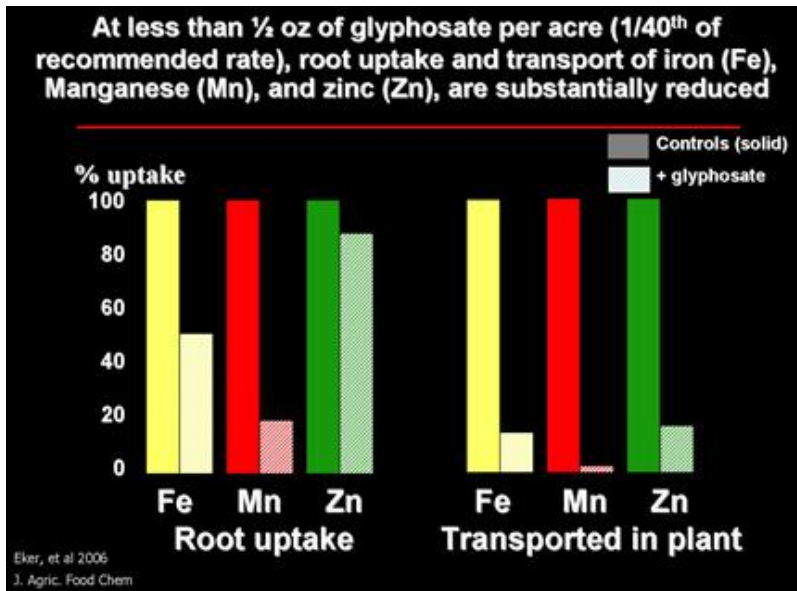
A question of bugs

In addition to promoting plant diseases, which is well-established, spraying Roundup might also promote insects. That's because many bugs seek sick plants. Scientists point out that healthy plants produce nutrients in a form that many insects cannot assimilate. Thus, farmers around the world report less insect problems among high quality, nutrient-dense crops. Weaker plants, on the other hand, create insect smorgasbords. This suggests that plants ravaged with diseases promoted by glyphosate may also attract more insects, which in turn will increase the use of toxic pesticides. More study is needed to confirm this.

Roundup persists in the environment

Monsanto used to boast that Roundup is biodegradable, claiming that it breaks down quickly in the soil. But courts in the US and Europe disagreed and found them guilty of false advertising. In fact, Monsanto's own test data revealed that only 2% of the product broke down after 28 days.

Whether glyphosate degrades in weeks, months, or years varies widely due to factors in the soil, including pH, clay, types of minerals, residues from Roundup Ready crops, and the presence of the specialized enzymes needed to break down the herbicide molecule. In some conditions, glyphosate can grab hold of soil nutrients and remain stable for long periods. One study showed that it took up to 22 years for glyphosate to degrade only half its volume! So much for trusting Monsanto's product claims.



Glyphosate can attack from above and below. It can drift over from a neighbors farm and wreak havoc. And it can even be released from dying weeds, travel through the soil, and then be taken up by healthy crops.

The amount of glyphosate that can cause damage is tiny. European scientists demonstrated that less than half an ounce per acre inhibits the ability of plants to take up and transport essential micronutrients (see chart).

As a result, more and more farmers are finding that crops planted in years *after* Roundup is applied suffer from weakened defenses and increased soilborne diseases.

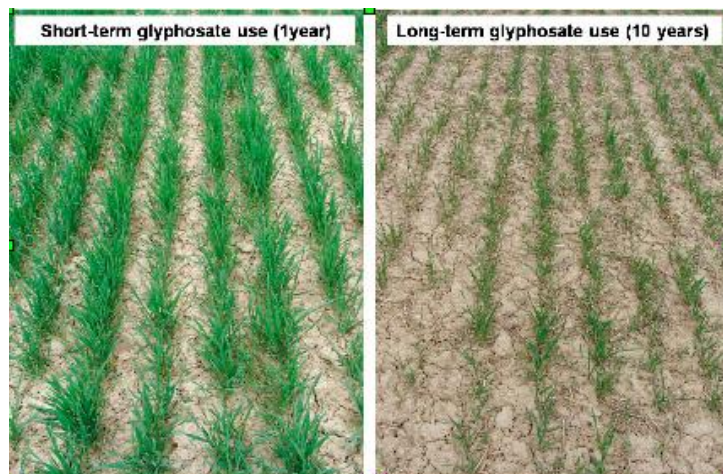
The situation is getting worse for many reasons.

1. The glyphosate concentration in the soil builds up season after season with each subsequent application. Glyphosate can also accumulate for 6-8 years inside perennial plants like alfalfa, which get sprayed over and over.
2. Wheat affected after 10 years of glyphosate field applications.
3. Glyphosate residues in the soil that become bound and immobilized can be reactivated by the application of phosphate fertilizers or through other methods. Potato growers in the West and Midwest, for example, have experienced severe losses from glyphosate that has been reactivated.
4. Glyphosate can find its way onto farmland accidentally, through drifting spray, in contaminated water, and even through chicken manure!

Imagine the shock of farmers who spread chicken manure in their fields to add nutrients, but instead found that the glyphosate in the manure tied up nutrients in the soil, promoted plant disease, and killed off weeds or crops. Test results of the manure showed glyphosate/AMPA concentrations at a whopping 0.36-0.75 parts per million (ppm). The *normal* herbicidal rate of glyphosate is about 0.5 ppm/acre.

Manure from other animals may also be spreading the herbicide, since US livestock consume copious amounts of glyphosate--which accumulates in corn kernels and soybeans. If it *isn't* found in livestock manure (or urine), that may be even worse. If glyphosate is not exiting the animal, it must be accumulating with every meal, ending up in our meat and possibly milk.

Add this threat to the already high glyphosate residues inside our own



diets due to corn and soybeans, and we have yet another serious problem threatening our health. Glyphosate has been linked to sterility, hormone disruption, abnormal and lower sperm counts, miscarriages, placental cell death, birth defects, and cancer, to name a few. (See resource list on glyphosate health effects.)

Nutrient loss in humans and animals

The same nutrients that glyphosate chelates and deprives plants are also vital for human and animal health. These include iron, zinc, copper, manganese, magnesium, calcium, boron, and others. Deficiencies of these elements in our diets, alone or in combination, are known to interfere with vital enzyme systems and cause a long list of disorders and diseases.

Alzheimer's, for example, is linked with reduced copper and magnesium. Don Huber points out that this disease has jumped 9000% since 1990.

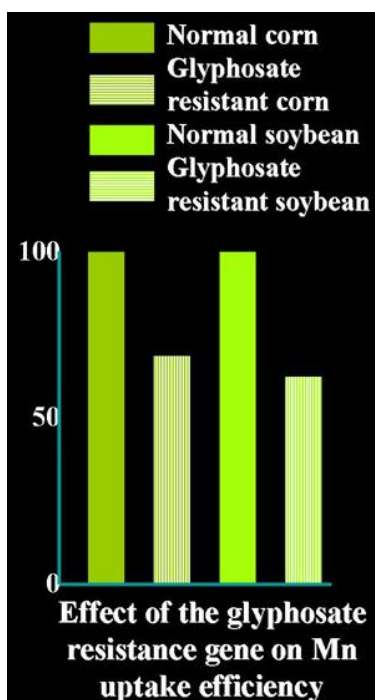
Manganese, zinc, and copper are also vital for proper functioning of the SOD (superoxide dismutase) cycle. This is key for stemming inflammation and is an important component in detoxifying unwanted chemical compounds in humans and animals.

Glyphosate-induced mineral deficiencies can easily go unidentified and untreated. Even when laboratory tests are done, they can sometimes *detect* adequate mineral levels, but miss the fact that glyphosate has already rendered them unusable.

Glyphosate can tie up minerals for years and years, essentially removing them from the pool of nutrients available for plants, animals, and humans. If we combine the more than 135 million pounds of glyphosate-based herbicides applied in the US in 2010 with total applications over the past 30 years, we may have *already* eliminated millions of pounds of nutrients from our food supply.

This loss is something we simply can't afford. We're already suffering from progressive nutrient deprivation even without Roundup. In a UK study, for example, they found between 16-76% less nutrients in 1991, compared to levels in the same foods in 1940.

Livestock disease and mineral deficiency



Roundup Ready crops dominate US livestock feed. Soy and corn are most prevalent -- 93% of US soy and nearly 70% of corn are Roundup Ready. Animals are also fed derivatives of the other three Roundup Ready crops: canola, sugar beets, and cottonseed. Nutrient loss from glyphosate can therefore be severe.

This is especially true for manganese (Mn), which is not only chelated by glyphosate, but also reduced in Roundup Ready plants (see photo). One veterinarian finds low manganese in every livestock liver he measures. Another vet sent the liver of a stillborn calf out for testing. The lab report stated: *No Detectible Levels of Manganese*--in spite of the fact that the mineral was in adequate concentrations in his region. When that vet started adding manganese to the feed of a herd, disease rates dropped from a staggering 20% to less than 1/2%.

Veterinarians who started their practice after GMOs were introduced in 1996 might assume that many chronic or acute animal disorders are common and to be expected. But several older vets have stated flat out that animals have gotten much sicker since GMOs came on the scene. And when they switch

livestock from GMO to non-GMO feed, the improvement in health is dramatic. Unfortunately, no one is tracking this, nor is anyone looking at the impacts of consuming milk and meat from GM-fed animals.

Alfalfa madness, brought to you by Monsanto and the USDA

As we continue to drench our fields with Roundup, the perfect storm gets bigger and bigger. Don asks the sobering question: "How much of the hundreds of millions of pounds of glyphosate that have been applied to our most productive farm soils over the past 30 years is still available to damage subsequent crops through its effects on nutrient availability, increased disease, or reduced nutrient of our food and feed?"

Instead of taking urgent steps to protect our land and food, the USDA just made plans to make things worse. In December they released their Environmental Impact Statement (EIS) on Roundup Ready alfalfa, which Monsanto hopes to reintroduce to the market.

Alfalfa is the fourth largest crop in the US, grown on 22 million acres. It is used primarily as a high protein source to feed dairy cattle and other ruminant animals. At present, weeds are not a big deal for alfalfa. Only 7% of alfalfa acreage is ever sprayed with an herbicide of any kind. If Roundup Ready alfalfa is approved, however, herbicide use would jump to unprecedented levels, and the weed killer of choice would of course be Roundup.

Even without the application of glyphosate, the nutritional quality of Roundup Ready alfalfa will be less, since Roundup Ready crops, by their nature, have reduced mineral content. When glyphosate is applied, nutrient quality suffers even more (see chart).

% Reduction in Alfalfa Nutrients by Glyphosate*	% reduction compared with Non-RR	
Nitrogen	13 %	<p>The chance that Roundup would increase soilborne diseases in alfalfa fields is a near certainty. In fact, Alfalfa may suffer <i>more</i> than other Roundup Ready crops. As a perennial, it can accumulate Roundup year after year. It is a deep-rooted plant, and glyphosate leaches into sub soils. And "<i>Fusarium</i> is a very serious pathogen of alfalfa," says Don. "So too are <i>Phytophthora</i> and <i>Pythium</i>," both of which are promoted by glyphosate.</p> <p>"Why would you even consider jeopardizing the productivity and nutrient quality of the third most valuable crop in the U.S.?" he asks in frustration, "especially since we have no way of removing the gene once it is spread throughout the alfalfa gene pool."</p>
Phosphorus	15 %	
Potassium	46 %	
Calcium	17 %	
Magnesium	26 %	
Sulfur	52 %	
Boron	18 %	
Copper	20 %	
Iron	49 %	
Manganese	31 %	
Zinc	18 %	
<p>*Third year, second cutting analysis; Glyphosate applied one time in the previous year</p>		

It's already spreading. Monsanto had marketed Roundup Ready alfalfa for a year, until a federal court declared its approval to be illegal in 2007. They demanded that the USDA produce an EIS in order to account for possible environmental damage. But even with the seeds taken off the market, the RR alfalfa that had already been planted has been contaminating non-GMO varieties. Cal/West Seeds, for example, discovered that more than 12% of their seed lots tested positive for contamination in 2009, up from 3% in 2008.

In their EIS, the USDA *does* acknowledge that genetically modified alfalfa can contaminate organic and non-GMO alfalfa, and that this could create economic hardship. They are even considering the unprecedented step of placing restrictions on RR alfalfa seed fields, requiring isolation distances. Experience suggests that this will slow down, but not eliminate GMO contamination. Furthermore, studies confirm that genes *do* transfer from GM crops into soil and

soil organisms, and can jump into fungus through cuts on the surface of GM plants. But the EIS does not adequately address these threats and their implications.

Instead, the USDA largely marches lock-step with the biotech industry and turns a blind eye to the widespread harm that Roundup is *already* inflicting. If they decide to approve Monsanto's alfalfa, the USDA may ultimately be blamed for a catastrophe of epic proportions.

Please send a letter to [USDA Secretary Tom Vilsack](#), urging him not to approve Roundup Ready alfalfa, and to fully investigate the damage that Roundup and GMOs are already inflicting.

About the author:

International bestselling author and filmmaker Jeffrey M. Smith is the executive director of the [Institute for Responsible Technology](#). His first book, [Seeds of Deception: Exposing Industry and Government Lies About the Safety of the Genetically Engineered Foods You're Eating](#), is the world's bestselling and #1 rated book on GMOs. His second, [Genetic Roulette: The Documented Health Risks of Genetically Engineered Foods](#), documents 65 health risks of the GM foods Americans eat everyday. To help you choose healthier, non-GMO brands, use the [Non-GMO Shopping Guide](#).

Editor's Note:

On January 27, 2011, Agriculture Secretary Tom Vilsack gave blanket approval to all genetically modified alfalfa. Following orders from President Obama, he also [removed buffer zone requirements](#). Many see this as a deliberate move to contaminate natural crops and destroy the organic meat and dairy industry which relies on GM-free alfalfa. Such genetic contamination would give the biotech industry complete control over the nation's fourth largest crop. It would also ease the transition to using [GE-alfalfa as a biofuel](#).

The organic Straus Family Creamery [issued a statement](#) February 3, 2001, protesting the USDA's decision, saying in part:

“The decision to deregulate GM alfalfa hurts both organic and conventional farmers who choose not to use genetically modified organism technologies. Alfalfa's anchor at the base of the dairy supply chain puts the entire organic food chain in peril: Contaminated alfalfa leads to contaminated milk, cheese, yogurt, ice cream, as well as any other products containing dairy ingredients.

“In 2006, Straus Family Creamery became the first organic dairy to voluntarily test organic cattle feed. Some feed corn sold to our dairy farm as organic was contaminated by GMOs, not through the fault of organic farmers. The livelihoods of all organic farmers, as well as suppliers, producers and retailers in the organic industry have been put at risk by unregulated GMOs.”

In an [interview](#) with the *Organic and Non-GMO Report* last May, Huber discussed his team's conclusions that glyphosate can, “significantly increase the severity of various plant diseases, impair plant defense to pathogens and diseases, and immobilize soil and plant nutrients rendering them unavailable for plant use.”

This is because “glyphosate stimulates the growth of fungi and enhances the virulence of pathogens.” In the last 15-18 years, the number of plant pathogens has increased, he told the *Non-GMO Report*. “There are more than 40 diseases reported with use of glyphosate, and that number keeps growing as people recognize the association (between glyphosate and disease).”

In 2010, Argentine scientists found that Roundup causes birth defects in frogs and chickens. Publishing their paper, [“Glyphosate-Based Herbicides Produce Teratogenic Effects on Vertebrates by](#)

[Impairing Retinoic Acid Signaling](#),” in *Chemical Research in Toxicology*, Alejandra Paganelli, *et al.* also produced a large set of reports for the public at [GMWatch](#):

“In Argentina and Paraguay, doctors and residents living in GM soy producing areas have reported serious health effects from glyphosate spraying, including high rates of birth defects as well as infertility, stillbirths, miscarriages, and cancers. Scientific studies collected in the new report confirm links between exposure to glyphosate and premature births, miscarriages, cancer, and damage to DNA and reproductive organ cells.”

Researcher Andrés Carrasco told GM Watch, “The findings in the lab are compatible with malformations observed in humans exposed to glyphosate during pregnancy.”

In a 2009 study, researchers linked organ damage with consumption of Monsanto’s GM maize, based on Monsanto’s trial data. Researchers [concluded](#) that the raw data from all three GMO studies reveal that novel pesticide residues will be present in food and feed and may pose grave health risks to those consuming them.

In a [2005 paper](#) published in *Environmental Health Perspectives*, Sophie Richard and team compared the toxicity of Roundup with that of just glyphosate, its active ingredient. They found Roundup to be more toxic, owing to its adjuvants. They also found that endocrine disruption increased over time so that one-tenth the amount prescribed for agriculture caused cell deformation. Citing other research, they also reported that Roundup adjuvants bond with DNA.

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