

## **Open Letter to Bayer: Monsanto concealed the toxicity of Roundup to human health and the environment**

### **Monsanto's secret studies: bioaccumulation in all organs of the body and cataracts**

Ridley and Mirly (1988) (commissioned by Monsanto) found bioaccumulation of <sup>14</sup>C-labelled glyphosate in Sprague Dawley rat tissues.<sup>1</sup> Residues were present in bone, marrow, blood and glands including the thyroid, testes and ovaries, as well as major organs, including the heart, liver, lungs, kidneys, spleen and stomach (Table 11 Page 127). A Senior Monsanto scientist falsely claimed that glyphosate did not bioaccumulate but was excreted unchanged.

The eye is included in the list of organs (Table 8 Page 126): Incidence and occurrence of ophthalmic degenerative lens changes by glyphosate.

Table 9 Page 126: Data on unilateral and bilateral cataracts (all types) and Y-suture opacities, excluding "prominent Y suture", following glyphosate exposure to rats: this Stout & Rueker (1990) study also commissioned by Monsanto.

The rate of cataract surgery in England "increased very substantially" between 1989 and 2004 from 173 (1989) to 637 (2004) episodes per 100,000 population.

A 2016 study by the WHO also confirmed that the incidence of cataracts had greatly increased: 'A global assessment of the burden of disease from environmental risks.' says that cataracts are the leading cause of blindness worldwide. Globally, cataracts are responsible for 51% of blindness – an estimated 20 million individuals suffer from this degenerative eye disease. In the US between 2000 and 2010 the number of cases of cataract rose by 20% from 20.5 million to 24.4 million. It is projected that by 2050, the number of people with cataracts will have doubled to 50 million.

### **Glyphosate and AMPA are found to be widespread in soils throughout the EU: <sup>2</sup> Denmark is the worst**

*"A new research study by the European Commission's Joint Research Centre, the Dutch University of Wageningen and Rikilt laboratories, reveals that among 317 EU soil samples of arable land, 42% contained aminomethyl phosphonic acid (AMPA), the most toxic metabolite of glyphosate, while glyphosate was found in 21% of the soils; 18% of the samples had both. The study was conducted in six crop systems along 11 EU member states comprising soils under different geographical and climatic conditions. **Denmark, the UK and Portugal are the worst in this spectrum, with the highest detection frequency, while Italy and Greece seem to be the ones using less glyphosate on their crops. However, and most notably, these 2 molecules could be found in every tested member state. All tested crops presented glyphosate and AMPA residues.***

### **Assessment of Glyphosate Induced Epigenetic Transgenerational Inheritance of Pathologies and Sperm Epimutations: Generational Toxicology**

#### Abstract

Ancestral environmental exposures to a variety of factors and toxicants have been shown to promote the epigenetic transgenerational inheritance of adult onset disease. One of the most widely used agricultural pesticides worldwide is the herbicide glyphosate (N-(phosphonomethyl)glycine), commonly known as Roundup.<sup>3</sup> There are an increasing number

<sup>1</sup> <http://www.amsi.ge/jbpc/31515/11SA15R.pdf>

<sup>2</sup> <https://publications.jrc.ec.europa.eu/repository/handle/JRC108561>

<sup>3</sup> <https://www.nature.com/articles/s41598-019-42860-0>

of conflicting reports regarding the direct exposure toxicity (risk) of glyphosate, but no rigorous investigations on the generational actions. The current study using a transient exposure of gestating F0 generation female rats found negligible impacts of glyphosate on the directly exposed F0 generation, or F1 generation offspring pathology. In contrast, dramatic increases in pathologies in the F2 generation grand-offspring, and F3 transgenerational great-grand-offspring were observed. The transgenerational pathologies observed include prostate disease, obesity, kidney disease, ovarian disease, and parturition (birth) abnormalities. Epigenetic analysis of the F1, F2 and F3 generation sperm identified differential DNA methylation regions (DMRs). A number of DMR associated genes were identified and previously shown to be involved in pathologies. Therefore, we propose glyphosate can induce the transgenerational inheritance of disease and germline (e.g. sperm) epimutations. Observations suggest the generational toxicology of glyphosate needs to be considered in the disease etiology of future generations.

### **Latin American study: Glyphosate alters brain activity**

In Latin American countries, farmers grow almost exclusively GM ‘Roundup ready’ crops that Monsanto forced on them in 1996. ([The European Glyphosate Task Force excluded scientific papers from South America in their re-assessment of glyphosate.](#)) Three recent studies detail neurotransmitter changes in the brain that result from exposure to glyphosate-based herbicides.

In a 2017 study, Carlos Javier Baier and colleagues documented behavioural impairments following repeated intranasal glyphosate-based herbicide administration in mice.<sup>4</sup> Highlights from the article include: Intranasal glyphosate-based herbicide (Gly-BH) caused behavioral disorders in mice. Intranasal exposure to Gly-BH decreased locomotor activity. Intranasal administration of Gly-BH induced an anxiogenic behavior. Mice exposure to intranasal Gly-BH produced memory deficit.

The paper contains references to many papers from around the world that confirm the glyphosate-based herbicides are damaging to the development of the foetal brain and that repeated exposure is toxic to the adult human brain and may result in alterations in locomotor activity, feelings of anxiety and memory impairment.

Highlights of a 2018 study on neurotransmitter changes in rat brain regions following glyphosate exposure include:

- Glyphosate oral exposure caused neurotoxicity in rats.
- Brain regions were susceptible to changes in CNS monoamine levels.
- Glyphosate reduced 5-HT, DA, NE levels in a brain regional- and dose-related manner.
- Glyphosate altered the serotonergic, dopaminergic and noradrenergic systems.<sup>5</sup>

Highlights from a third study, from 2014, examined mechanisms underlying the neurotoxicity induced by glyphosate-based herbicide in the immature rat hippocampus.<sup>6</sup>

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<sup>4</sup> Carlos Javier Baier et al. (2017), Behavioral impairments following repeated intranasal glyphosate-based herbicide administration in mice, *Neurotoxicology and Teratology* 64:63–72, <https://doi.org/10.1016/j.ntt.2017.10.004>.

<sup>5</sup> M. A. Martínez et al. (2018), Neurotransmitter changes in rat brain regions following glyphosate exposure, *Environmental Research*, 161:212–219, <https://doi.org/10.1016/j.envres.2017.10.051>

<sup>6</sup> Daiane Cattani et al. (2014), Mechanisms underlying the neurotoxicity induced by glyphosate-based herbicide in immature rat hippocampus: Involvement of glutamate excitotoxicity, *Toxicology* 320:34–45, <https://doi.org/10.1016/j.tox.2014.03.001>.

Roundup® induces Ca<sup>2+</sup> influx through L-VDCC and NMDA receptor activation. The mechanisms underlying Roundup® neurotoxicity involve glutamatergic excitotoxicity. Kinase pathways participate in Roundup®-induced neural toxicity. Roundup® alters glutamate uptake, release and metabolism in hippocampal cells.

### **Glyphosate damages blood-testis barrier via NOX1-triggered oxidative stress in rats: Long-term exposure as a potential risk for male reproductive health**

#### Highlights

- Glyphosate (GLY) causes blood-testis barrier (BTB) damage and low-quality sperm.
- GLY-induced BTB injury contributes to sperm quality decrease.
- NOX1-derived oxidative stress results in the disruption of BTB integrity.
- NOX1 upregulation may be due to the interaction of GLY with estrogen receptor- $\alpha$ .

#### Abstract

Blood-testis barrier (BTB) creates a privileged niche indispensable for spermatogenesis. Glyphosate (GLY), the most commonly used herbicide worldwide, has been reported to decrease sperm quality.<sup>7</sup> However, whether and how GLY destroys the BTB to affect sperm quality remains to be elucidated. Herein, this study was designed to investigate the influence of GLY on the BTB *in vivo* and *in vitro* experiments. The results showed that male rats exposed to GLY for 4 months exhibited a decrease in sperm quality and quantity, accompanied by BTB integrity disruption and testicular oxidative stress. Additionally, GLY-induced reactive oxygen species (ROS) contributed to the downregulation of BTB-related proteins in primary Sertoli cells (SCs). Intriguingly, we identified a marked upregulation of oxidative stress-related gene *NOX1* in GLY-exposed testis based on transcriptome analysis. *NOX1* knockdown blocked the GLY-induced oxidative stress, as well as prevented BTB-related protein decrease in SCs. Furthermore, the estrogen receptor (ER)- $\alpha$  was significantly upregulated *in vivo* and *in vitro* models. An ER- $\alpha$  inhibitor decreased the expression levels of both ER- $\alpha$  and NOX1. Mechanistically, GLY directly interacted with ER- $\alpha$  at the site of Pro39 and Lys401 to promote ER- $\alpha$  activation, which boosted NOX1 expression to trigger ROS accumulation. Collectively, these results demonstrate that long-term GLY exposure adversely affects BTB integrity, which disrupts spermatogenesis via activation of ER- $\alpha$ /NOX1 axis. This study presents a better understanding of the risk of long-term GLY exposure to male fertility.

### **Roundup causes serious liver disease in rats**

In 2017, a study based on multiomics (new biological analyses, to study life in a concerted way) revealed non-fatty acid liver disease (NFALD) in rats following chronic exposure to an ultra-low dose of Roundup herbicide.<sup>8</sup> “Overall, metabolome and proteome disturbances showed a substantial overlap with biomarkers of NFALD and its progress to steatohepatitis and this confirms liver function dysfunction resulting from chronic ultra-low dose Glyphosate-based Herbicide exposure.” This is the first ever to show a causative link

<sup>7</sup> <https://www.sciencedirect.com/science/article/pii/S0160412021006632>

<sup>8</sup> Robin Mesnage et al. (2017), Multiomics reveal non-alcoholic fatty liver disease [NAFLD] in rats following chronic exposure to an ultra-low dose of Roundup herbicide, [www.nature.com/ScientificReports](http://www.nature.com/ScientificReports), 9 January, <http://www.nature.com/articles/srep39328>.

between consumption of Roundup at a real-world environmentally relevant dose and a serious disease. NFALD currently affects 25% of the US population and similar numbers of Europeans. Risk factors include being overweight or obese, having diabetes, or having a high cholesterol or high triglycerides (a constituent of body fat) in the blood. However, some people develop NFALD even if they do not have any of these risk factors.

### **Quantifiable urine glyphosate levels detected in 99% of the French population, with higher values in men, in younger people, and in farmers**

#### Abstract

France is the first pesticide-consuming country in Europe. Glyphosate is the most used pesticide worldwide and glyphosate is detected in the general population of industrialized countries, with higher levels found in farmers and children. Little data was available concerning exposure in France. Our objective was to determine glyphosate levels in the French general population and to search for an association with seasons, biological features, lifestyle status, dietary habits, and occupational exposure. This study includes 6848 participants recruited between 2018 and 2020.<sup>9</sup> Associated data include age, gender, location, employment status, and dietary information. Glyphosate was quantified by a single laboratory in first-void urine samples using ELISA. Our results support a general contamination of the French population, with glyphosate quantifiable in 99.8% of urine samples with a mean of 1.19 ng/ml + / - 0.84 after adjustment to body mass index (BMI). We confirm higher glyphosate levels in men and children. Our results support glyphosate contamination through food and water intake, as lower glyphosate levels are associated with dominant organic food intake and filtered water. Higher occupational exposure is confirmed in farmers and farmers working in wine-growing environment. Thus, our present results show a general contamination of the French population with glyphosate, and further contribute to the description of a widespread contamination in industrialized countries.

### **France's Railway Company SNCF Bans Glyphosate Use on National Network**

The Société Nationale des Chemins de Fer Français (SNCF), France's national state-owned railway company, has announced that it will ban the use of glyphosate on the whole of its rail network in 2022. SNCF is currently the largest user of glyphosate-based herbicides in the country, so its decision has sent shockwaves through the pesticide industry.<sup>10</sup> "SNCF Réseau will no longer use glyphosate in 2022, in accordance with its green commitments," Matthieu Chabanel, SNCF deputy general manager in charge of projects, maintenance and operation, told AFP on Tuesday.

"We are working on alternative treatment solutions, as well as their terms of use, in view of the next treatment period in the spring," Chabanel added.

SNCF owns over 30,000 km of railways and has been using 35 to 38 tonnes of glyphosate per year, which is 0.4% of all of the glyphosate-based herbicides used in France.

### **Bayer faces class action suit over Monsanto takeover in Germany, law firm says**

BERLIN, Dec 15 (Reuters) - Bayer ([BAYGn.DE](https://www.bayer.com)) faces a billion-dollar investor class action lawsuit in Germany over the takeover of U.S. seed manufacturer Monsanto, specialist law firm Tilp Rechtsanwaltsgesellschaft said on Wednesday.

<sup>9</sup> <https://link.springer.com/article/10.1007/s11356-021-18110-0>

<sup>10</sup> <https://sustainablepulse.com/2021/12/30/frances-railway-company-bans-glyphosate-use-on-national-network/#.YeBA1C8w00o>

Tilp said it was representing more than 250 institutional investors and a large number of private investors who believed Bayer misled them about the economic risks of the \$63 billion acquisition and are demanding damages.<sup>11</sup>

The value of the lawsuits amounts to more than one billion euros (\$1.13 billion), the law firm said.

Tilp said it believed Bayer deceived shareholders about the risks of consumer lawsuits pending in the United States linked to the glyphosate-containing weed killer Roundup, which was brought into the company with the 2016 Monsanto acquisition.

Bayer said any complaints were unfounded.

"Bayer has complied with the law and with its disclosure requirements," the group said. "We will therefore defend ourselves."

### **Monsanto will plead guilty to multiple environmental crimes: \$22million since 2019**

*Beyond Pesticides*, (December 15, 2021) Monsanto has pleaded guilty to multiple environmental crimes in Hawai'i for the second time in less than four years, and the island communities are left asking "*when is enough enough?*"<sup>12</sup>

In the most recent case, Monsanto will [plead guilty to 30 environmental crimes in Hawai'i](#), related to pesticide use violations and putting field workers at risk. In both cases, they admit that they knowingly violated pesticide law and put field workers in harm's way. They will pay a \$12 million fine this time, bringing their criminal fines and "community service payments" to a total of \$22 million since 2019.

At the center of these cases is the fact that the Monsanto field workers had to transport, apply, and suffer exposure to these toxic and banned pesticides as a part of their job. Autumn Ness, director of Beyond Pesticides' Hawai'i organic land management program, said: "*In small island communities of Hawai'i, Monsanto workers are our friends and family. Folks live just downwind and next door to these fields. We are concerned about their health, and those concerns are glaringly missing from news reports and in the distribution agreements for the community service payments.*"

There are two separate incidents that have become related because of a deferred prosecution agreement between Monsanto and the courts.

From March 2013 through August 2014, Monsanto stored 160 pounds of Penncap-M hazardous waste at a facility on Molokai. In 2014, they transported Penncap-M to its valley farm on a neighboring island, and "*failed to use a proper shipping manifest to identify the hazardous material and failed to obtain a permit to accept hazardous waste at its Valley Farm site.*"

Monsanto admitted using Penncap-M on corn seed and research crops at its facility on Maui, knowing that its use was prohibited after 2013 because of a "*cancellation order*" issued by EPA, [a news release](#) said. Monsanto also admitted that, after the 2014 spraying, it told employees to re-enter the sprayed fields seven days later — even though Monsanto knew that workers should have been prohibited from entering the area for 31 days.

Two Maui residents who live directly downwind from their fields are currently suing Monsanto over birth defects. "*Monsanto's reckless use of pesticides and harmful chemicals near a residential neighborhood have put numerous Maui families at risk,*" said Ilana Waxman, partner at Galihier DeRobertis & Waxman, [in a news release last week](#). "*Monsanto knew these dangerous substances would drift into nearby communities.*"

<sup>11</sup> <https://www.reuters.com/business/bayer-faces-class-action-suit-over-monsanto-takeover-germany-law-firm-says-2021-12-15/>

<sup>12</sup> <https://beyondpesticides.org/dailynewsblog/2021/12/its-time-for-bayer-monsanto-to-leave-hawaii-after-pleading-guilty-to-multiple-violations-that-harm-people-and-environment-of-the-state-advocates-say/>

### **Monsanto has unpaid taxes in Switzerland 2005-2014: they were left for Bayer to pay**<sup>13</sup>

C'est un jugement important du Tribunal fédéral qui fera date. Monsanto va devoir rattraper dix ans d'impôts non-perçus dans le canton de Vaud, soit un peu plus de 34 millions de francs pour la période 2005-2014. La multinationale était alors au bénéfice d'une exonération fiscale.

L'entreprise américaine, active dans les semences agricoles et mère du controversé Roundup, a en effet bénéficié d'une exonération fiscale du canton de Vaud, pendant dix ans, lorsqu'elle était installée à Morges. Sauf qu'en 2018, elle a été rachetée par Bayer et a quitté Morges pour Bâle deux ans plus tard.

Or, dans les conditions de son exonération fiscale, figure la clause dite du "claw-back": elle prévoit qu'une entreprise doit rester encore dix ans sur place après la fin de l'exonération si elle ne veut pas devoir rattraper les années d'impôts.

Pour Monsanto cela veut dire qu'elle aurait dû rester sur sol vaudois jusqu'en 2024. Mais elle est partie en 2020.

### **Bayer confirms end of sale of Glyphosate-based herbicides for lawn-garden market in the US**

Bayer have announced that they will no longer sell glyphosate-based herbicides to U.S. gardeners as of 2023, following the costly litigation battle over their cancer causing weedkiller Roundup.<sup>14</sup>

Bayer Monsanto stated Thursday that *“the company and its partners will replace its glyphosate-based products in the U.S. residential Lawn & Garden market with new formulations that rely on alternative active ingredients beginning in 2023, subject to a timely review by the U.S. Environmental Protection Agency (EPA) and state counterparts...”*  
*“As the vast majority of claims in the litigation come from Lawn & Garden market users, this action largely eliminates the primary source of future claims beyond an assumed latency period. There will be no change in the availability of the company’s glyphosate formulations in the U.S. professional and agricultural markets,”* Bayer continued.

### **Non-glyphosate herbicides have toxic compounds**

Monsanto announced they had produced Roundup without glyphosate which was supposedly less toxic. But the French team found that when glyphosate was replaced with another acid, the formulations were still contaminated with a number of heavy metals and other toxicants.<sup>15</sup> In an article published in 2020, Gilles-Eric Séralini and Gerald Jungers describe finding toxic compounds in herbicides without glyphosate.

Glyphosate has been banned in some herbicidal formulations. We analyse for the first time 14 marketed products in Europe where glyphosate was replaced by acetic, pelargonic, caprylic or capric acids, or even benzalkonium chloride, to be supposedly less toxic. 35 heavy metals, 16 polycyclic aromatic hydrocarbons (PAHs), and essential minerals were tested by specific mass spectrometry associated with gas chromatography or inductively coupled plasma methods in the formulations. Essential minerals do not reach toxic levels, but heavy metals

<sup>13</sup> <https://www.rts.ch/info/regions/vald/12736607-monsanto-devra-payer-10-ans-dimpots-nonpercus-dans-le-canton-de-vaud.html>

<sup>14</sup> <https://sustainablepulse.com/2021/07/29/bayer-confirms-end-of-sale-of-glyphosate-based-herbicides-for-us-lawn-garden-market/#.YeF5LS8w00o>

<sup>15</sup> Gilles-Eric Seralini and Gerald Jungers (2020), Toxic compounds in herbicides without glyphosate, Food and Chemical Toxicology 146:111770, <https://doi.org/10.1016/j.fct.2020.111770>

are found in levels up to 39 mg/L depending on the product and include silicon, arsenic, lead, iron, nickel and titanium. Their presence at up to several hundred times the admissible levels in water may be due to nanoparticles embedding pesticides. PAHs reach levels of 32–2430ug/L in 12 of the 14 samples; for instance, the carcinogen benzo(A)pyrene was detected. It was found up to be present at up to several thousand times above the norm in water, as was benzo(A)anthracene. These compounds did not add significant herbicidal effects. Low levels of glyphosate were detected in 2 samples. These variable levels of undeclared toxic chemicals violate European Union rules on pesticides and may have health and environmental consequences, especially when exposure is long term.

### **Heavy metals in chemical formulants of GBH in our diet**

A French team has found heavy metals in chemical formulants of glyphosate-based herbicides in our diet.<sup>16</sup>

As with other pesticides, 10–20% of GBH [glyphosate-based herbicides] consist of chemical formulants. We previously identified these by mass spectrometry and found them to be mainly families of petroleum-based oxidized molecules, such as POEA, and other contaminants. . . In this work, we also identified by mass spectrometry the heavy metals arsenic, chromium, cobalt, lead and nickel, which are known to be toxic and endocrine disruptors, as contaminants in 22 pesticides, including 11 G-based ones.

### **Glyphosate is associated with Parkinson's Disease**

**Glyphosate exposure exacerbates the dopaminergic neurotoxicity in the mouse brain after repeated administration of MPTP<sup>17</sup>**

#### Highlights

- The herbicide glyphosate has been used widely in the world.
- Exposure of glyphosate potentiated MPTP-induced dopaminergic neurotoxicity in the mouse brain.
- Glyphosate exposure may be an environmental risk factor for Parkinson's disease.

#### Abstract

Parkinson's disease (PD) is a chronic and progressive neurodegenerative disorder. Epidemiological studies suggest that the exposure of the herbicide glyphosate may influence the development of PD in humans. In this study, we examined whether the exposure of glyphosate can affect the reduction of dopamine transporter (DAT) in the striatum and tyrosine hydroxylase (TH) in the substantia nigra (SNr) of mouse brain after repeated administration of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP). Repeated injections of MPTP (10 mg/kg × 3, 2-h interval) significantly decreased the density of DAT-immunoreactivity in the striatum and the number of TH-immunoreactivity in the SNr. Glyphosate exposure for 14 days significantly potentiated MPTP-induced dopaminergic neurotoxicity in the striatum and SNr of mouse brain. This study suggests that glyphosate exposure might exacerbate MPTP-induced dopaminergic neurotoxicity in the striatum and

<sup>16</sup> N. Defarge, J. Spiroux de Vendômois, and G. E. Séralini, (2018), Toxicity of formulants and heavy metals in glyphosate-based herbicides and other pesticides, *Toxicology Reports* 5:156–163,

<sup>17</sup> <https://www.sciencedirect.com/science/article/abs/pii/S0304394020303025>

SNr of adult mice. It is likely that exposure of glyphosate may be an environmental risk factor for PD since glyphosate has been used widely in the world.

### **The Ramazzini Institute 13-week pilot study glyphosate-based herbicides administered at human-equivalent dose to Sprague Dawley rats: effects on development and endocrine system<sup>18</sup>**

#### Abstract

**Background:** Glyphosate-based herbicides (GBHs) are broad-spectrum herbicides that act on the shikimate pathway in bacteria, fungi, and plants. The possible effects of GBHs on human health are the subject of an intense public debate for both its potential carcinogenic and non-carcinogenic effects, including potential effects on the endocrine system. The present pilot study examines whether exposure to GBHs at the dose of glyphosate considered to be "safe" (the US Acceptable Daily Intake - ADI - of 1.75 mg/kg bw/day), starting from in utero life, affect the development and endocrine system across different life stages in Sprague Dawley (SD) rats.

**Methods:** Glyphosate alone and Roundup Bioflow, a commercial brand of GBHs, were administered in drinking water at 1.75 mg/kg bw/day to F0 dams starting from the gestational day (GD) 6 (in utero) up to postnatal day (PND) 120. After weaning, offspring were randomly distributed in two cohorts: 8 M + 8F/group animals belonging to the 6-week cohort were sacrificed after puberty at PND 73 ± 2; 10 M + 10F/group animals belonging to the 13-week cohort were sacrificed at adulthood at PND 125 ± 2. Effects of glyphosate or Roundup exposure were assessed on developmental landmarks and sexual characteristics of pups.

**Results:** In pups, anogenital distance (AGD) at PND 4 was statistically significantly increased both in Roundup-treated males and females and in glyphosate-treated males. Age at first estrous (FE) was significantly delayed in the Roundup-exposed group and serum testosterone concentration significantly increased in Roundup-treated female offspring from the 13-week cohort compared to control animals. A statistically significant increase in plasma TSH concentration was observed in glyphosate-treated males compared with control animals as well as a statistically significant decrease in Dihydrotestosterone (DHT) and increase in Brain-derived neurotrophic factor (BDNF) in Roundup-treated males. Hormonal status imbalances were more pronounced in Roundup-treated rats after prolonged exposure.

**Conclusions:** The present pilot study demonstrates that GBHs exposure, from prenatal period to adulthood, induced endocrine effects and altered reproductive developmental parameters in male and female SD rats. In particular, it was associated with androgen-like effects, including a statistically significant increase of AGDs in both males and females, delay of FE and increased testosterone in female.

### **Roundup causes high levels of mortality following contact exposure in bumble bees<sup>19</sup>**

#### Abstract

1. Pollinators underpin global food production, but they are suffering significant declines across the world. Pesticides are thought to be important drivers of these declines. Herbicides are the most widely applied type of pesticides and are broadly considered 'bee safe' by regulatory

<sup>18</sup> <https://pubmed.ncbi.nlm.nih.gov/30857531/>

<sup>19</sup> Edward A. Straw, Edward N. Carpentier, and Mark J. F. Brown (2021), Roundup causes high levels of mortality following contact exposure in bumble bees, *Journal of Applied Ecology*, 6 April, <https://doi.org/10.1111/1365-2664.13867>.



bodies who explicitly allow their application directly onto foraging bees. We aimed to test the mortality effects of spraying the world's most popular herbicide brand (Roundup®) directly onto bumble bees *Bombus terrestris audax*.

2. We used three Roundup® products, the consumer products Roundup® Ready-To-Use and Roundup® No Glyphosate, the agricultural product Roundup® ProActive, as well as another herbicide with the same active ingredient (glyphosate), Weedol®. Label recommended pesticide concentrations were applied to the bees using a Roundup® Ready-To-Use spray bottle.
3. Bees exhibited 94% mortality with Roundup® Ready-To-Use® and 30% mortality with Roundup® ProActive®, over 24 hr. Weedol® did not cause significant mortality, demonstrating that the active ingredient, glyphosate, is not the cause of the mortality. The 96% mortality caused by Roundup® No Glyphosate supports this conclusion. Dose-dependent mortality caused by Roundup® Ready-To-Use, further confirms its acute toxicity. Roundup® products caused comprehensive matting of bee body hair, suggesting that surfactants, or other co-formulants in the Roundup® products, may cause death by incapacitating the gas exchange system.
4. These mortality results demonstrate that Roundup® products pose a significant hazard to bees, in both agricultural and urban systems, and that exposure of bees to them should be limited.
5. *Synthesis and applications.* Surfactants, or other co-formulants, in herbicides and other pesticides may contribute to global bee declines. We recommend that, as a precautionary measure until co-formulant identities are made public, label guidelines for all pesticides be altered to explicitly prohibit application to plants when bees are likely to be foraging on them. As current regulatory topical exposure toxicity testing inadequately assesses toxicity of herbicide products, we call for pesticide companies to release the full list of ingredients for each pesticide formulation, as lack of access to this information hampers research to determine safe exposure levels for beneficial insects in agro-ecosystems.

**Glyphosate is top of the top ten products used on major crops in the US by volume: and two neonicotinoid insecticides are in the top ten: all three are owned by Bayer**

According to the UN's *Global Chemicals Outlook II*, glyphosate, thiamethoxam and clothianidin were in the top ten products used on major crops in the United States, by volume, in 2016.<sup>20</sup> Clothianidin's half-life in soil is 545 (13-1386) which is illegal according to EU regulations but nevertheless the corrupt EU authorised it.

*The second **Global Chemicals Outlook**, which was released in Nairobi on March 11<sup>th</sup> 2019, said the world will not meet international commitments to reduce chemical hazards and halt pollution by 2020. In fact, the study by the United Nations Environment Programme found that the industry has never been more dominant nor has humanity's dependence on chemicals ever been as great. Depending on the chemical and degree of exposure, the risks can include cancer, chronic kidney disease and congenital anomalies. The World Health Organization estimated that the burden of disease was 1.6 million lives in 2016. Halpaap said this was likely to be an underestimate. In addition to the human health dangers, he said chemicals also affect pollinators and coral reefs.*

**Continued growth in the pesticide/crop protection industry**

Pesticides include herbicides, insecticides, termiticides, nematocides, rodenticides and fungicides. These products are largely used for crop protection in agriculture. Today the industry is valued at over US dollars 50 billion and there are around 600 active ingredients.

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<sup>20</sup> <https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions>

Herbicides account for approximately 80 per cent of all pesticide use (Phillips McDougal 2018).

### **Bayer introduces ‘a new class of safe and effective pesticides’ according to Tomiwaza**

In 1991, Bayer CropScience introduced a new type of insecticide into the US; imidacloprid, the first member of a group now known as the neonicotinoids. Bayer Scientist Abbink certified that: “*imidacloprid is the first highly effective insecticide whose mode of action has been found to derive from almost complete and virtually irreversible blockage of post-synaptic nicotinic acetylcholine receptors (nAChRs) in the central nervous system (CNS) of insects.*”<sup>21</sup>

Imidacloprid differed from conventional spray pesticides in that it could be used as seed dressings or soil treatments. When used as a seed dressing the insecticide will migrate from the stem to the leaf tips, and eventually into the flowers and pollen. Any insect that feeds on the crop dies; but bees, bumblebees, hoverflies and butterflies that collect contaminated pollen or nectar from the crop are also poisoned. In 1994 imidacloprid was licensed for use in Europe. In July 1994 beekeepers in France noticed something unexpected. Over the course of a few days, just after the sunflowers had bloomed, a substantial number of their hives would collapse, as the worker bees flew off and never returned, leaving the queen and immature workers to die. The French beekeepers soon believed they knew the reason; a brand-new insecticide called Gaucho<sup>®</sup> with imidacloprid as active ingredient was being applied to sunflowers for the first time.<sup>22</sup>

## **SELECTIVE TOXICITY OF NEONICOTINOIDS ATTRIBUTABLE TO SPECIFICITY OF INSECT AND MAMMALIAN NICOTINIC RECEPTORS**

Motohiro Tomizawa and John E. Casida

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### **■ Abstract**

Neonicotinoids, the most important new class of synthetic insecticides of the past three decades, are used to control sucking insects both on plants and on companion animals. Imidacloprid (the principal example), nitenpyram, acetamiprid, thiacloprid, thiamethoxam, and others act as agonists at the insect nicotinic acetylcholine receptor (nAChR). The botanical insecticide nicotine acts at the same target without the neonicotinoid level of effectiveness or safety. Fundamental differences between the nAChRs of insects and mammals confer remarkable selectivity for the neonicotinoids. Whereas ionized nicotine binds at an anionic subsite in the mammalian nAChR, the negatively tipped (“magic” nitro or cyano) neonicotinoids interact with a proposed unique subsite consisting of cationic amino acid residue(s) in the insect nAChR. Knowledge reviewed here of the functional architecture and molecular aspects of the insect and mammalian nAChRs and their neonicotinoid-binding site lays the foundation for continued development and use of this new class of safe and effective insecticides.<sup>23</sup>

**This review was commissioned by Ralf Nauen of Bayer Crop Science**  
**Tomizawa has written 13 papers about neonicotinoid insecticides**  
**Nauen has written seven papers on neonicotinoid insecticides**

<sup>21</sup> Abbink J. The biochemistry of imidacloprid. Pflanzenschutz-Nachrichten Bayer 1991; 42(2):183-95.

<sup>22</sup> *Journal of Environmental Immunology and Toxicology* 1:1, 3-12; March/April 2013; © 2013 STM Publishing

<sup>23</sup> *Annu. Rev. Entomol.* 2003. 48:339–64 doi: 10.1146/annurev.ento.48.091801.112731

The late Henk A. Tennekes

**The significance of the Druckrey–Küpfmüller equation for risk assessment—The toxicity of neonicotinoid insecticides to arthropods is reinforced by exposure time**<sup>24</sup>

Abstract

The essence of the Druckrey–Küpfmüller equation  $dt^n = \text{constant}$  (where  $d$  = daily dose and  $t$  = exposure time-to-effect, with  $n \geq 1$ ) for chemical carcinogens is that the total dose required to produce the same effect decreases with decreasing exposure levels, even though the exposure times required to produce the same effect increase with decreasing exposure levels. Druckrey and Küpfmüller inferred that if both receptor binding and the effect are irreversible, exposure time would reinforce the effect. The Druckrey–Küpfmüller equation explains why toxicity may occur after prolonged exposure to very low toxicant levels. Recently, similar dose–response characteristics have been established for the toxicity of the neonicotinoid insecticides imidacloprid and thiacloprid to arthropods. This observation is highly relevant for environmental risk assessment. Traditional approaches that consider toxic effects at fixed exposure times are unable to allow extrapolation from measured endpoints to effects that may occur at other times of exposure. Time-to-effect approaches that provide information on the doses and exposure times needed to produce toxic effects on tested organisms are required for prediction of toxic effects for any combination of concentration and time in the environment.

Christian Maus and Ralf Nauen of Bayer Crop Science challenged Dr Tennekes' toxicology

**The late Dr Tennekes wrote a book: The systemic insecticides: a disaster in the making**

Conclusions (extracts): Since 2004 major contamination of Dutch surface water with imidacloprid has been detected by the Water Boards, particularly in the western part of the country. Consequently, high concentrations of imidacloprid have been diffusing through the environment in the Netherlands for many years now, killing or debilitating non-target insects and by doing so progressively reducing invertebrate prey for birds. Invertebrate-dependent bird species in the Netherlands have been declining on a massive scale in recent times... Elsewhere in western Europe the situation is not much different... Ground and surface water contamination with persistent insecticides that cause irreversible and cumulative damage to Aquatic and terrestrial (non-target) insects must lead to an environmental catastrophe. The data presented here show that it is actually taking place before our eyes, and that it must be stopped.

**Neonicotinoid insecticides found in children treated for leukaemias and lymphomas**<sup>25</sup>

Multiple neonicotinoids in children's cerebro-spinal fluid, plasma, and urine

Abstract

**Background:** Neonicotinoids (NN) are selective neurotoxic pesticides that bind to insect but also mammal nicotinic acetylcholine receptors (nAChRs). As the most widely used class of insecticides worldwide, they are ubiquitously found in the environment, wildlife, and foods, and thus of special concern for their impacts on the environment and human health. nAChRs are vital to proper brain organization during the prenatal period and play important roles in various motor, emotional, and cognitive functions. Little is known on children's contamination by NN. In a pilot study we tested the hypothesis that children's cerebrospinal fluid (CSF) can be contaminated by NN.

<sup>24</sup> <https://pubmed.ncbi.nlm.nih.gov/20803795/>

Toxicology 2010 Sep 30;276(1):1-4. doi: 10.1016/j.tox.2010.07.005.

<sup>25</sup> <https://ehjournal.biomedcentral.com/track/pdf/10.1186/s12940-021-00821-z.pdf>

**Methods:** NN were analysed in leftover CSF, blood, and urine samples from children treated for leukaemias and lymphomas and undergoing therapeutic lumbar punctures. We monitored all neonicotinoids approved on the global market and some of their most common metabolites by ultra-high-performance liquid chromatography-tandem mass spectrometry.

**Results:** From August to December 2020, 14 children were consecutively included in the study. Median age was 8 years (range 3–18). All CSF and plasma samples were positive for at least one NN. Nine (64%) CSF samples and 13 (93%) plasma samples contained more than one NN. Thirteen (93%) CSF samples had *N*-desmethyl-acetamiprid (median concentration 0.0123, range 0.0024–0.1068 ng/mL), the major metabolite of acetamiprid. All but one urine samples were positive for  $\geq$  one NN. A statistically significant linear relationship was found between plasma/urine and CSF *N*-desmethyl-acetamiprid concentrations.

**Conclusions:** We have developed a reliable analytical method that revealed multiple NN and/or their metabolites in children’s CSF, plasma, and urine. Our data suggest that contamination by multiple NN is not only an environmental hazard for non-target insects such as bees but also potentially for children.

### **Tribunal charges Monsanto with ecocide**

The International Monsanto Tribunal is an international civil society initiative to hold Monsanto accountable for human rights violations and ecocide. During a meeting in 2016 in The Hague, eminent judges heard testimonies from victims and experts. Then, on 18 April 2017, they delivered a legal opinion following procedures of the International Court of Justice.<sup>26</sup>

They concluded that Monsanto’s activities have a negative impact on basic human rights. Besides, better regulations are needed to protect the victims of multinational corporations. Eventually, international law should be improved for better protection of the environment and include the crime of ecocide.

### **Monsanto exposed: The ‘Monsanto Papers’**

In 2017, an incredible number of secret documents from various industries and companies were made public. In March 2017, an American judge ruled – over Monsanto’s objections – that certain [internal documents](#) could be unsealed in the frame the multidistrict litigation glyphosate cancer case. Observers were quick to rename these documents the ‘Monsanto Papers’. Four months later, a [new batch](#) of company records was released.<sup>27</sup>

Attorneys for Baum Hedlund, who were leading the lawsuit against Monsanto for Roundup causing cancers, issued an unprecedented statement. ‘It was important to release the documents now because they not only pertain to the ongoing litigation, but also to larger issues of public health and safety, while shedding light on corporate influence over regulatory bodies’, according to Baum Hedlund attorneys Brent Wisner and Pedram Esfandiary. ‘This is a look behind the curtain’, said Wisner. ‘These show that Monsanto has deliberately been stopping studies that look bad for them, ghostwriting literature and engaging in a whole host of corporate malfeasance. They [Monsanto] have been telling everybody that these products are safe because regulators have said they are safe, but it turns out that Monsanto has been in

<sup>26</sup> International Monsanto Tribunal (2016–2017), <http://www.monsanto-tribunal.org>.

<sup>27</sup> U.S. Right to Know (2020), Monsanto Papers, <https://usrtk.org/pesticides/mdl-monsanto-glyphosate-cancer-case-key-documents-analysis/>

bed with U.S. regulators while misleading European regulators’.

One of the court documents released was an email from Donna Farmer, Monsanto Senior Toxicologist: ‘The terms glyphosate and Roundup cannot be used interchangeably nor can you use “Roundup” for all glyphosate-based herbicides anymore. For example, you cannot say that Roundup is not a carcinogen . . . we have not done the necessary testing on the formulation to make that statement’.

Compiled by Dr Rosemary A Mason, MB, ChB, FRCA 25/01/2022