



A Silent Spring for academic dialogue: biotech industry leaves critique unopposed

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Few inventions of biotechnology have been as commercially successful, scientifically contested and publicly debated as glyphosate-tolerant transgenic soy in industrial agriculture. During the past decade our research group—which is based in Norway but which has international colleagues and collaborators worldwide—has conducted numerous studies and risk assessments of transgenic crop varieties, notably to understand the potential combinatorial effects of crop–herbicide interplay. Focusing on glyphosate-tolerant soy, we have found that this crop is substantially different from conventional non-GMO¹ soybean, not least regarding composition of nutrients and residual content of glyphosate, which is surprisingly high [1]. Our research has concluded that one main reason that previous studies into the same subject have not found such differences between transgenic soybean and unmodified varieties has been the fact that numerous previous studies are methodologically flawed [2].

Our review of 30 studies in which glyphosate-tolerant transgenic crops (soy, maize, canola) were assessed in comparison with unmodified varieties showed that most such studies were conducted with material produced under unrepresentative, artificial circumstances: notably, the glyphosate-tolerant crops were grown without the complementary herbicide (14 out of 30 studies). Reviewing the studies that *did* employ the herbicide, we saw that (a) it was difficult to ascertain whether the dosage was representative of real-life applications, and (b) the crops thus produced were not analysed for herbicide residues. These flawed studies were predominantly funded by industry, whereas the “independent studies” conducted by researchers from universities and without conflicting interests were found to have been conducted methodologically more correctly. These studies overwhelmingly (8 out of 9) showed significant differences [2]. Our retrospective view urges us to recommend research to investigate whether these negative effects of GMO are correlated with high levels of herbicide residue in those crops [7].

In a further series of tests, we conducted ecotoxicological and animal feeding studies in model aquatic environments. These studies showed that glyphosate

itself was up to 300 times more toxic to the test animal (*D. magna*) than claimed in similar studies that had been conducted (by industry) three decades previously [3]. Our feeding studies showed that animals fed glyphosate-tolerant soy performed worse (growth, reproduction) than animals fed non-GMO soybean [4]. A further series of feeding studies with eight independent diets made from separate harvests of transgenic soybean (with levels of glyphosate residues ranging from 1.1 to 15.1 ppm) showed a consistently significant correlation linking higher glyphosate levels in the soy feed to stunted growth, delayed reproduction and reduced fecundity [5].

We also reviewed 20 industry studies from the 1970s and 1980s that investigated the ecotoxicology of glyphosate [6]. We found the research reports to be partly flawed; e.g., with hand-written changes that altered the conclusions, downplayed indications, or exaggerated regulatory importance by placing too strong interpretative weight on weak industry studies, thereby inflated to become core evidence of low toxicity. Our documentation was obtained through FOIA and indicates that the US EPA contributed to such skewing of evidence, assisting industry and establishing the non-toxicity of glyphosate as a regulatory fact [6].²

In a third review [7], we collected available evidence on glyphosate effects in non-target organisms and concluded that one of the main challenges with this chemical at present is that it is used indiscriminately, in high volumes and in diverse types of applications/crop systems. In addition, the use of glyphosate as a preharvest desiccant in agriculture places an unnecessary additional burden on consumers, as is evident from our findings of high levels of residues in crops such as lentils (i.e., 14 ppm [7]). Thus, through a decade of analysis, numerous animal studies, archive studies and literature reviews we have amassed considerable evidence, which has been published (refs 1–7).

Throughout our work we have promulgated a series of open questions, and have expected industry scientists to respond to our findings, which are so obviously different from those presented by industry. In particular,

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¹ Abbreviations: GMO, genetically modified organism; US EPA, United States Environmental Protection Agency.

² We obtained these confidential documents (i.e., the reports) directly from the United States Environmental Protection Agency via a request under the US Freedom of Information Act (FOIA).

we expected a storm of arguments and strong attempts at rebuttal of our assertions that several industry studies are actually flawed, some even to such an extent that specific publications should be retracted and disregarded as evidence. Although we are impartial and disinterested regarding the commercial interests involved, it has not escaped our attention that transgenic crops as well as the complementary herbicide glyphosate have both been inventions of the Monsanto Company.

Our main objection towards that company relates to the fact that they have not responded to our letters, e-mails or telephone calls; they have not been willing to share information, have not been willing to let us have access to their patented transgenic material and have not commented upon any of our findings nor answered any of our questions. Other independent researchers have noted the fact that the glyphosate-tolerant crops, the so-called “Roundup Ready” biotechnological package, have been commercially hugely successful and a source of large revenues for the patent holder. However, following concerted criticism and new research findings on, primarily, the toxicity of the herbicide, the World Health Organization (WHO), the European Food Safety Authority (EFSA) and other acknowledged regulatory authorities have embarked on initiatives to thoroughly reevaluate the toxicity of glyphosate, notably accentuated by the claims of potential carcinogenicity. We note that the producer, Monsanto, has not expended any visible effort on responding, either officially or academically, to the wave of new research findings on glyphosate and Roundup. The new findings thus stand unopposed, despite being in stark contrast to former findings presented by industry. Our concern is not lessened by the fact that on previous occasions when independent researchers presented findings that were unfavorable towards biotechnological inventions (e.g., specific GMOs) and voiced consternation, concerted efforts were made to swiftly discredit them in “witch-hunts” (e.g., the cases of the individual researchers Emma Rosi-Marshall [8], Árpád Pusztai, [9] Ignacio Chapela and, notably, the cynical ridicule inflicted on Irina Ermakova by the editors of the journal *Nature Biotechnology* in 2007 [10]). It has been inferred that these often brutal “reprisals” were orchestrated by industry scientists cooperating with the editors of certain scientific journals, editors who are supportive of such biotechnological products or are even perceived as having conflicts of interests [11, 12]. It has also been averred that for decades there has been a strong discrepancy in the manner that results which found unfavorable effects of transgenic products were

received, when compared to studies that found no substantial differences between transgenic produce and unmodified controls [13].

Thus, we had expected that our findings would be carefully scrutinized by the researchers whom we had criticized and we had braced ourselves to stand upright in expectation of the habitual vexatious storm of harassment from the biotech industry and its allies. But no such thing happened: instead the Monsanto shareholders sold the company, numerous countries banned GMO crops and US President Obama signed legislation that effectively means that food from GMOs—such as the glyphosate-tolerant soybean—will be labeled and consumers will finally be informed about the contents of the produce on supermarket shelves. Numerous recent publications present indications and scientific conclusions in line with our findings: that glyphosate, Roundup and Roundup Ready crops present significantly higher risks than previously acknowledged. By and large, these recent scientific results stand unrefuted and un-commented upon by the industry making the products. Thus, it seems that industry has locked its doors and turned off the lights, possibly waiting for the turmoil to subside and business to return to normal. However, researchers from independent scientific communities as well as professionals of regulatory agencies are still waiting for responses, with numerous questions unanswered.

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