UNITED STATES DISTRICT COURT

FOR THE

DISTRICT OF VERMONT

GROCERY MANUFACTURERS ASSOCIATION, SNACK FOOD ASSOCIATION, INTERNATIONAL DAIRY FOODS ASSOCIATION, and NATIONAL ASSOCIATION OF MANUFACTURERS, Plaintiffs	)	
v.	)	Docket No. 5:14-cv-117
WILLIAM H. SORRELL, in his official capacity as the Attorney General of Vermont; HARRY L. CHEN, in his official capacity as Commissioner of the Vermont Department of Health; JAMES B. REARDON, in his official capacity as Commissioner of the Vermont Department of Finance and Management; and PETER SHUMLIN, in his official capacity as Governor of Vermont, Defendants	)	

REBUTTAL DECLARATION OF DR. ALAN McHUGHEN

1. I, Alan McHughen, make this declaration as pursuant to 28 U.S.C. § 1746 and Federal Rule of Evidence 702. My qualifications and background are described in my initial declaration in this matter.

2. My initial declaration lists the materials I reviewed in preparing that report. In addition to those documents, I have also evaluated the Declarations of Dr. Charles M. Benbrook and Dr. Michael Antoniou, which were submitted as part of Vermont's response to Plaintiffs' Motion for Preliminary Injunction and Opposition to Defendants' Motion to Dismiss.

A Broad Consensus of International Scientific Experts Agree That GE Foods Are As Safe As Their Non-GE Counterparts

Consensus of Professional Societies

3. My initial declaration details the broad consensus concerning the safety of genetic engineering (GE): no fewer than 24 professionally recognized scientific and medical societies have recognized that GE-derived foods approved for sale in the U.S. market are equally as safe as foods not derived from GE. *See* Initial Decl. ¶¶ 69-71.

4. Dr. Antoniou disputes my assessment of the consensus of the professional scientific and medical community on the safety of GE foods. Antoniou Decl. ¶¶ 34-36. But his analysis is misleading, at best. He has nothing at all to say about 23 of the organizations I discussed in my prior declaration; he mistakenly takes issue with only one of them, the World Health Organization (WHO), which I discuss below. He also conflates certain organizations' support of labeling with safety concerns, although the two are entirely distinct. Finally, he relies on supposedly scientific evidence that is either stale, retracted, debunked, or otherwise rejected. In short, nothing in Dr. Antoniou's declaration serves to undermine the overall consensus concerning the safety of GE.

5. To begin, a few basic concepts need to be clarified. No food, GE or otherwise, has ever been "proven safe," as that is a scientific impossibility. Instead, foods (or other products) may be deemed "as safe as" the foods or products they will compete with in the market. None of the bodies cited by Dr. Antoniou here challenges that position. Every professional scientific and medical body worldwide that has studied the safety of GE foods agrees with the conclusion that GE foods are "as safe as" comparable non-GE foods.

6. To suggest otherwise, Dr. Antoniou cites the opinions of certain groups, such as the British Medical Association and the American Nurses Association, who support labeling of

GE-derived foods. But he confuses the basis for their support for labeling. It is non-medical; namely, to facilitate consumer choice—*not* to alleviate potential safety concerns.

7. Dr. Antoniou also references other groups, such as the California Medical Association and the American College of Physicians, who support labeling based on the possible presence of allergens. But their concerns are misplaced because current U.S. federal labeling already requires foods with allergens be so labeled.

8. Dr. Antoniou cites to a 2001 Royal Society of Canada report in his declaration. That 13-year-old report simply concurred with the 2000 report of the U.S. National Academy of Science (NAS)[1] / National Research Council (NRC) calling for "scientifically robust approaches for the safety assessment of [GE-derived] foods." Antoniou Decl. ¶ 35. That call was enthusiastically answered by scientists and subsequently implemented by government regulators. It is a testament to the robust scientific safety assessment that, almost fifteen years later, there are still no documented reports of harm from eating GE foods. It is also worth noting here that even the Royal Society of Canada endorsed voluntary labeling over mandatory.

[1] In 1863, President Lincoln established the National Academy to provide the highest level of professional expert scientific advice to the nation, to serve in the public interest. Since then, the Academy studies have proven to be among the most reliable and accurate assessments of science and technology, especially in regard to questions of safety. When the Academy conducts a study, it appoints a dozen or so of the world's top scientists, recognized world experts on the subject, to spend two or more years investigating the issue and writing a major report draft, which is then intensively peer reviewed and eventually published as a report carrying the weight and credibility of the Academy. For example, in conducting the 2004 study entitled "Safety of Genetically Engineered Foods," the Academy appointed public sector (mainly public university Professors) experts in a range of relevant disciplines, including allergies, epidemiology, food safety, plant breeding and others, to ensure a broad coverage. The Academy also ensures there is appropriate balance of viewpoints on the panel, to ensure all legitimate perspectives are given their due consideration. This panel, in its final report issued in 2004, concluded that GE was not categorically more risky than other methods of breeding. *See* National Research Council. 2004. Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects. Summary of report available at http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/ge_foods_final.pdf.

9. Dr. Antoniou cites the European Network of Scientists for Social and Environmental Responsibility (ENSSER) to support his challenge of the scientific consensus consisting of professional scientific and medical bodies I have cited. Antoniou Decl. ¶ 37 (discussing McHughen Decl. ¶ 71). The ENSSER does not appear to be a professional society. It is not in any professional scientific or medical listing I could find, and Internet searches turned up only its own website or secondary sites. Unlike the NAS or the American Association for the Advancement of Science (AAAS), there is no indication that ENSSER performs any of the usual functions of a professional scientific or medical body. ENSSER does not appear to publish a peer-reviewed journal, for example, nor does it appear to conduct technical conferences or confer recognitions and credentials (*e.g.*, fellowships). It appears to have no government charter to offer professional advice. It has no track record of conducting studies and taking positions on various safety issues, so there is no way to assess whether they are likely to be correct or not based on the organization's history, unlike the professional societies I cite in support of the consensus. Most importantly, ENSSER's position statement is simply an opinion letter with no data or analysis. Even if some of the signatories are prominent scientists, it is not the equivalent of a professional, peer-reviewed research and analysis of the safety of GE foods and crops.

10. Considering that the professional organizations cited by Dr. Antoniou to challenge the consensus actually support the consensus (although some also supporting labeling), I maintain that there is indeed a consensus in the professional scientific and medical associations on the safety of GE foods relative to non-GE foods.

11. The one and only source cited in my initial declaration that Dr. Antoniou takes issue with is the WHO. He notes that in the WHO's 2002 position statement, the WHO also stated: "Different GM [genetically modified] organisms include different genes inserted in

different ways. This means that individual GM foods and their safety should be assessed on a case-by-case basis and that it is not possible to make general statements on the safety of *all* GM foods." Antoniou Decl. ¶ 38. Dr. Antoniou confuses the meaning of the WHO's statement; it is in fact *consistent* with the consensus on GE safety—and with the policies of risk assessors worldwide. All regulators agree that a soybean with a herbicide tolerance gene should be assessed differently from a papaya with a virus resistance gene. It would be foolish and imprudent to categorically declare "all GM foods" safe—just as it would be to declare all traditional breed varieties as safe. For all new plant varieties that warrant a safety assessment, the assessment should be conducted on a case-by-case basis, considering the plant species, the introduced trait, and the region where the plant will be cultivated. My interpretation of the case-by-case approach "when warranted" is well documented in the NAS/NRC 2002 study, *The Environmental Effects of Transgenic Plants* and the NAS/NRC 2004 study, *Safety of Genetically Engineered Foods*.[2]

Studies Confirming The Safety Of GE

12. When it comes to the ample studies that do not support his position, Dr. Antoniou attempts to undermine their credibility by arguing that they are not sufficiently long-term. He asserts that animal feeding studies into GE food safety should be conducted over "a minimum of 2 years." Antoniou Decl. ¶ 39. He is wrong.

[2] *See also* Codex Alimentarius Commission of the World Health Organization and the Food and Agriculture Organization of the United Nations. Foods Derived From Modern Biotechnology. 2009. P. 58 ("Some foods may require additional testing. For example, animal feeding studies *may* be warranted for foods derived from recombinant-DNA plants *if* changes in the bioavailability of nutrients are expected or *if* the composition is not comparable to conventional foods." (emphases added)).

13. The Organization for Economic Cooperation and Development (OECD) is the international standard-setting body—of which the U.S. is a member—for establishing standard protocols for assessing new substances such as foods and feeds. The OECD has been refining safety-assessment test methods for many years, long before GE foods were developed, and have the expertise to design appropriate tests and protocols. The standard subchronic toxicity trial duration was set at 90 days after studies found this to be a highly effective period, sufficient to identify with high confidence any problems with a test substance (*e.g.*, food item). The European Food Safety Authority (EFSA) confirms that conclusion:

> Based on studies with a range of chemical compounds, it can be concluded that a 90-day study shows a relatively large capacity in terms of measurable toxicological endpoints to detect potential toxicological effects. With respect to the detection of potential unintended effects in whole GM food and feed, it is unlikely that substances present in small amounts and with a low toxic potential will result in any observable unintended effects in a 90-day rodent feeding study.
>
> Laboratory animal feeding studies of 90-days duration appear to be sufficient to pick up adverse effects of compounds that would also give adverse effects after chronic exposure, and therefore in general, chronic toxicity testing of GM food and feed does not seem to generate additional valuable information to the safety assessment.[3]

These statements, from the official EU government agency charged with assuring food safety (equivalent to our FDA) directly contradict Dr. Antoniou's assertions that 90 days is an insufficient duration to test animals.

14. I know of no national or professional authority that rejects the OECD standards, and no authority who endorses the 2-year minimum asserted by Dr. Antoniou, which is in direct contradiction to OECD's longstanding and recognized international standards.

[3] European Food Safety Authority. Safety and nutritional assessment of GM plants and derived food and feed: The role of animal feeding trials. 2008. *See also* Report of the EFSA GMO Panel Working Group on Animal Feeding Trials. *Food and Chemical Toxicology* 46 (2008) S2–S70.

15. In any event, even Dr. Antoniou's unfounded concern about the supposed absence long-term studies is not accurate. A meta-analysis (that is, a study evaluating many separate studies) of animals fed GE feeds was recently published.[4] In this peer-reviewed publication from the University of California, Davis, the authors investigated the effects on various animal species fed GE or non-GE feeds, going back nearly 30 years and representing more than 100 billion (yes, billion) animals. The studies include long-term and multi-generational studies—precisely what Dr. Antoniou claims do not exist. Critically, these studies found no indication of any health, nutrition, or other problems in any animals due to consuming GE feeds.

16. There are also other "long term" feeding studies in the peer-reviewed scientific literature, as noted by Van Eenennaam and Young:

> A number of long-term (of more than 90 d[ays] and up to 2 y[ears] in duration) feeding trials and multigenerational studies conducted by public research laboratories using various animal models including pigs, cows, quail, and fish have also been reviewed (Ricroch, 2013; Ricroch et al., 2013; Snell et al., 2012). Significant among these studies are 2 thorough multigenerational studies that examined the long-term effects of feeding a GE corn variety (MON810, expressing the insecticidal Cry1Ab protein from Bacillus thuringiensis [Bt], one of the few GE corn varieties approved for cultivation in the EU) to food-producing animals, specifically, a German study in dairy cattle and an Irish study in pigs (Guertler et al., 2010, 2012; Steinke et al., 2010; Walsh et al., 2011, 2012 a, b, 2013; Buzoianu et al., 2012 a, b, c, d, 2013 a, b).

None of these studies found any reason for concern with the health or nutrition of GE feeds.

17. Hundreds of other examples are available. Bartholomeaus et al. provides a table listing peer-reviewed animal-feeding studies.[5] The studies include those feeding different GE

[4] Van Eenennaam, A.L., and A.E. Young. 2014. Prevalence and impacts of genetically engineered feedstuffs on livestock populations. *Journal of Animal Science* 92:4255–4278.

[5] Bartholomaeus et al. 2013, The use of whole food animal studies in the safety assessment of genetically modified crops: Limitations and recommendation. *Crit. Rev. Toxicol.*, 2013; 43(S2): 1–24.

feeds to cattle, pigs, and poultry, with the trials running as long as 25 months. None of these studies indicated any health, nutrition, or other problem as a result of GE feeding.

18. The Federation of Animal Science Societies (FASS), the professional society home of experts in animal science, has also compiled a list that can be found at: http://www.fass.org/page.asp?pageID=52&autotry=true&ULnotkn=true. As with the others, none of these studies found any reason for health concern.

19. In further effort to find flaws in studies supporting the safety of GE foods, Dr. Antoniou misrepresents the peer-reviewed studies in the scientific literature. No one says that these legitimate scientific studies, as he states, "prove that GE foods are perfectly safe," because "perfectly safe" is a scientifically meaningless claim. *See* Antoniou Decl. ¶ 48. Instead the studies show that the GE foods are just as safe as—perhaps safer than—non-GE foods. This is the assertion of the mainstream scientific and medical community and supported by hundreds of studies. In any event, showing that a "no-effect" experiment is flawed does not establish that the opposite is true—that is, that the product being tested is hazardous.

20. The European Union has been actively funding scientific research from public scientists into a wide range of aspects of GE safety since 1985. The studies are not limited to food safety, but include environmental issues also. The European scientists, generally of high quality and very competent, were funded to ensure the risk assessments would be scientifically rigorous enough to identify potential problems. Their success in this regard is the lack of documented problems with GE foods or feeds in the EU.

21. Dr. Antoniou claims to have had difficulty finding animal feeding studies testing GE safety, and lists only five. Antoniou Decl. ¶ 50. There are many listed in the Nicolia review,[6] which Dr. Antoniou recognizes that I cited in my first declaration. Antoniou Decl. ¶ 57. Dr. Antoniou claims the Nicolia review paper of over 1700 peer-reviewed studies on the safety of GE products did not satisfy him, as "it suffers from important omissions, fails to show GMOs are safe, and actually provides evidence of risk for some GMOs." Antoniou Decl. ¶ 57. The review was nevertheless thorough, and studies that followed have reaffirmed its findings, such as the study of Van Eenennaam and Young. *See supra* ¶ 16. It bears repeating: Nicolia documents *over 1700* recent peer-reviewed studies. And although not all of them will be relevant to every situation—*e.g.,* some relate to other aspects of GE safety—many directly address the question of GE food and feed safety. And the bulk of papers listed do stand up to peer-reviewed scrutiny.

22. In addition, Dr. C. Snell, Dr. A. Ricroch, and Dr. G. Flachowsky, well-respected European expert scientists who conduct and publish peer-reviewed animal feeding studies and analyses, also review others' animal feeding studies. Dr. Antoniou does not dispute the findings of these reviews of studies. Here are some examples of their conclusions:

- "The aim of this systematic review was to collect data concerning the effects of diets containing GM maize, potato, soybean, rice, or triticale on animal health. We examined 12 long-term studies (of more than 90 days, up to 2 years in duration) and 12 multigenerational studies (from 2 to 5 generations). We referenced the 90-day studies on GM feed for which long-term or multigenerational study data were available. Many parameters have been examined using biochemical analyses, histological examination of specific organs, hematology and the detection of transgenic DNA. The statistical findings and methods have been considered from each study. Results from all the 24 studies do not suggest any health hazards and, in general, there were no statistically significant differences within parameters observed. However, some small differences were observed, though these fell within the normal variation

[6] Nicolia, A., A. Manzo, F. Veronesi, and D. Rosellini. An overview of the last 10 years of genetically engineered crop safety research. *Crit. Rev. Biotechnol.* 2013:1-12.

range of the considered parameter and thus had no biological or toxicological significance. If required, a 90-day feeding study performed in rodents, according to the OECD Test Guideline, is generally considered sufficient in order to evaluate the health effects of GM feed. The studies reviewed present evidence to show that GM plants are nutritionally equivalent to their non-GM counterparts and can be safely used in food and feed."[7]

- "Despite the fact that a thorough, lengthy and costly evaluation of genetically engineered (GE) crop plants (including compositional analysis and toxicological tests) is imposed before marketing some European citizens remain skeptical of the safety of GE food and feed. In this context, are additional tests necessary? If so, what can we learn from them? To address these questions, we examined data from 60 recent high-throughput '-omics' comparisons between GE and non-GE crop lines and 17 recent long-term animal feeding studies (longer than the classical 90-day subchronic toxicological tests), as well as 16 multigenerational studies on animals. The '-omics' comparisons revealed that the genetic modification has less impact on plant gene expression and composition than that of conventional plant breeding. Moreover, environmental factors (such as field location, sampling time, or agricultural practices) have a greater impact than transgenesis. None of these '-omics' profiling studies has raised new safety concerns about GE varieties; neither did the long-term and multigenerational studies on animals. Therefore, there is no need to perform such long-term studies in a case-by-case approach, unless reasonable doubt still exists after conducting a 90-day feeding test. In addition, plant compositional analysis and '-omics' profiling do not indicate that toxicological tests should be mandatory. We discuss what complementary fundamental studies should be performed and how to choose the most efficient experimental design to assess risks associated with new GE traits. The possible need to update the current regulatory framework is discussed."[8]

- "A ten-generation experiment with growing and laying quails were carried out to test diets with 40 (starter) or 50% (grower, layer) isogenic or transgenic (Bt 176) corn. Feeding of diets containing genetically-modified corn did not significantly influence health and performance of quails nor did it affect DNA-transfer and quality of meat and eggs of quails compared with the isogenic counterpart."[9]

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[7] C. Snell, Bernheim A, Bergé JB, Kuntz M, Pascal G, Paris A, Ricroch AE. 2012. Assessment of the health impact of GM plant diets in long-term and multigenerational animal feeding trials: a literature review. *Food Chem Toxicol.* 2012 Mar;50(3-4):1134-48. doi: 10.1016/j.fct.2011.11.048. Epub 2011 Dec 3.

[8] Ricroch, A. 2013. Assessment of GE food safety using '-omics' techniques and long-term animal feeding studies. *N. Biotechnol.*;30(4):349-54.

[9] Flachowsky, G., I. Halle, K. Aulrich. 2005. Long term feeding of Bt-corn--a ten-generation study with quails. *Arch. Anim. Nutr.* 59(6):449-51.

23. Even of the five Dr. Antoniou managed to find, all of those studies' authors noted no "adverse effects," although there were observations of normal biological variation. The EU research projects going back to 1985 did not report any adverse effects because there were none to report. The papers cited above (Snell, Ricroch, and Flachowsky, et al.) all report no basis for health or safety concern with GE feeds, and one (Ricroch) conducted additional research showing that GE has less impact on the genome than conventional crossing.

24. I disagree with Dr. Antoniou in his statement that GE foods tested were markedly different from their non-GE counterparts, as this is a basis for rigorous controls and confidence in interpreting results. Scientists will not likely get their papers past peer review if the composition of the controls differs significantly from the experimental materials.

Dr. Antoniou's Declaration Fails To Demonstrate A Lack Of Consensus

Discredited Or Misrepresented Studies

25. In attempting to refute this broad consensus, Dr. Antoniou lists a handful of papers purporting to show "unexpected toxic and allergenic effects in GE–fed animals." Antoniou Decl. ¶ 40. The studies that Dr. Antoniou cites in his report do not legitimately call into question the scientific consensus that GE foods are safe for human consumption because every one of the studies he cites has been discounted in the scientific community, for various reasons.

26. For example, Fares and El-Sayed, according to Academics Review "did not determine the purity of their Bt preparation. . . . They also did not measure the amount of Bt or spores that were administered to the animals and it is thus impossible for other scientists to

attempt to replicate the work."[10] Thus, the unknown and likely impure Bt concoction, which is known to carry toxic impurities, was more likely to have caused any effects they recorded than the GE-derived feed itself. Supporting this interpretation is the fact that the paper was published in 1998 and, in the fifteen intervening years, no one (not even the original authors) has replicated and published confirming results. Such a dramatic toxic effect, if real, would certainly have been repeated by many scientists after the initial report in 1998.

27. Dr. Antoniou also distorts the findings in the Finamore 2008 study, which was beset with protocol problems. *See* Antoniou Decl. ¶ 40. Dr. Antoniou states that: "Young and old mice fed genetically engineered Bt corn for periods of 30 and 90 days, respectively showed a marked disturbance in immune system cells and in biochemical activity." What Dr. Antoniou fails to reveal is that the study does not show any causal relationship between genetic engineering and the small differences observed:

- First, the authors note all of the areas where there were no statistically significant differences. "There were no differences in the mean body weight between mice fed MON810 or its parental control maize for either 30 or 90 days, independent of age of the animals. No difference was found in the food consumption of weaning and elderly mice fed the MON810 or control maize."[11] The authors also noted that: "No statistically significant differences were found in the proliferative response to ConA or Cy1Ab in any group of animals (Figure 1)." In addition "[n]o difference in the total number of CD45+ cells of the small intestine, spleen, and blood between mice fed MON810 or its parental control maize was found (Table 2)."

- Second, the authors did not have control of their corn varieties at the mycotoxin level, and mycotoxins are known to affect the immune system. The presence of mycotoxins/ aflatoxins B1, B2 G1, and G2, fumonisin B1 (FB1), deoxynivalenol (DON), ochratoxin, and zeralenon needs to be measured and taken in to account

[10] "These aren't even GM Potatoes!" *Academic Review.* Available at: http://academicsreview.org/reviewed-content/genetic-roulette/section-1/1-4-gm-potatoes-are-safe/.

[11] Finamore, A., M. Roselli, S. Britti, et al. 2008. Intestinal and peripheral immune response to MON810 maize ingestion in weaning and old mice. *J. Agric. Food Chem.* 56: 11533-11539.

for this type of study. The authors note that the differences that they observed may have been caused by a higher level of mycotoxins in non-GE crops. "The amount of DON was higher in the transgenic than control parental maize, whereas the amount of FB1 in the control maize was almost double that of the transgenic maize. These mycotoxins are frequent contaminants of maize and may exert immunotoxic activity, depending on dose, exposure, and timing of administration."

- Finally, the authors note that it was unclear if the observed differences actually matter. In their conclusion, the authors state: "Although the significance of these data remains to be clarified to establish whether these alterations reflect significant immune dysfunctions, these results suggest the importance of considering the gut and peripheral immune response to the whole GE crop, as well as the age, in the GMO safety evaluation." Dr. Antoniou neglected to mention this part of the author's conclusion.

28. Similarly, Dr. Antoniou cites Ewen and Pusztai, 1999, which was a controversial study of rats fed on GE potatoes laced with a toxin. *See* Antoniou Decl. ¶ 40. When some of the rats got sick, the authors blamed the illness on the GE nature of the feed, not on the toxin (which is not and has never been used in commercialized GE plants at all). That report has been extensively reviewed and found to have no scientific value.[12] For example, the UK Royal Society (the equivalent of our U.S. National Academies of Science) reviewed the data on the possible toxicity of GM potatoes. They stated that "[w]e found no convincing evidence of adverse effects from GM Potatoes."[13] The UK Royal Society sent the available information to "six independent, impartial reviewers whose experience included statistics, clinical trials,

[12] *See, e.g.*, Press Release, European Food Safety Authority, *Séralini et al. study conclusions not supported by data, says EU risk assessment community* (Nov. 28, 2012). Available at http://www.efsa.europa.eu/en/press/news/121128.htm.

[13] The Royal Society. June 1999. *Review of data on possible toxicity of GM potatoes*. Available at https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/1999/10092.pdf.

physiology nutrition, quantitative genetics, growth and development, and immunology."[14] The reviewers found a number of problems with the study. Among other things:

- There were problems with the experimental design in that it was not a double blind study.
- More significantly, the reported results were simply inaccurate. As the Royal Society stated: "Inappropriate statistical tests had been applied to the data and, when the appropriate comparisons are made, there are no interpretable differences."[15]
- The Royal Society concluded that "[i]n the form currently available, the data reviewed provide no reliable or convincing evidence of adverse (or beneficial) effects, either of lectins added to unmodified potatoes or of potatoes genetically modified to contain a lectin gene, on growth of rats or on their immunological function."[16]

29. The 2009 De Vendomois study cited in footnote 42 has also been rejected by regulatory bodies. For example, Food Standards of Australia New Zealand ("FSANZ", equivalent to our FDA) rejected the conclusions of the De Vendomois study and others from Séralini's group.[17] In doing so, FSANZ noted that "Séralini and colleagues have used a non-conventional statistical approach to analyze and interpret data from animal toxicity studies with three different corn lines." FSANZ also noted that "[r]eliance on statistics alone to determine treatment-related effects in toxicity studies is not regarded as indicative of a robust toxicological analysis." Moreover, "FSANZ is confident that the minor differences observed between test and control groups in the toxicity studies are neither sex- nor dose-related and are primarily due to

[14] *Id.* at 2.

[15] *Id.* at 3.

[16] *Id.* at 4.

[17] Food Standards Australia New Zealand (FSANZ). 2013. Response to studies cited as evidence of adverse effects from GM foods. Available at http://www.foodstandards.gov.au/consumer/gmfood/adverse/Documents/11_Table%20of%20studies_update_16Jan14%20(2).pdf.

normal biological variability." FSANZ concluded that "[t]he statistical analyses published by Séralini and colleagues therefore provide no grounds to revise previous conclusions regarding the safety of food derived from GM corn lines MON863, NK603 and MON 810."

30. Dr. Antoniou also cited Gab-Alla et al, 2012,[18] and El-Shamei, et al, 2012,[19] as showing adverse "toxic and allergenic effects" of GE-derived foods. *See* Antoniou Decl. ¶ 40. These studies are also problematic. No other scientist has been willing to even cite the papers, let alone try to replicate their findings. The problems with the papers are several, and they are severe:

- Those studies used undocumented, obscure GE strains.
- The experimental methodology does not conform to internationally accepted protocols. For example, the animals were not divided into sexed groups which could provide important information; only one concentration of corn was fed so it is impossible to tell if the differences observed were due to the corn or normal variation.
- There is not enough detail provided (for example, incomplete descriptions of GM and control corn and diets) to replicate the work.
- Perhaps most importantly, the conclusion that "[i]n general, GM corn sample caused several changes by increase or decrease organs/body weight or serum biochemistry values [indicating] potential adverse health/toxic effects of GM corn and further investigations still needed" is not justified by the data.[20] Statistical significance does not mean biological significance. The kind of measurements observed here are typical of the differences observed in animal studies. The differences observed were small, trivial, typical, and, more importantly, followed no particular pattern that would be expected if a toxicological effect was operating.

[18] Gab-Alla, A.A., Z.S. El-Shamei, A.A. Shatta, E.A. Moussa, and A.M. Rayan. 2012. Morphological and biochemical changes in male rats fed on genetically modified corn (Ajeeb YG). *J. Am. Sci.* 8(9):1117–1123.

[19] El-Shamei, Z.S., A.A. Gab-Alla, A.A. Shatta, E.A. Moussa, and A.M. Rayan. 2012. Histopathological changes in some organs of male rats fed on genetically modified corn (Ajeeb YG). *J. Am. Sci.* 8(10):684–696.

[20] *See* Gab-Alla, *supra* note 18.

31. Dr. Antoniou's supports his concern of "unexpected allergenicity," by citing a study from 2005,[21] which was later repudiated by T.J. Higgins, the lead scientist on the study, when he realized there was a mistake in the initial experiment that lead to the allergenicity concern.[22] This is *in addition to* the Lee et al., 2003 study that Dr. Antoniou recognizes repudiated the 2005 study. *See* Antoniou Decl. ¶ 40 n.44. This additional repudiation (Reiner et al., 2013) confirmed that the mice were *reacting to a natural component of the legumes*, not the GE, because feed from both GE and non-GE peas elicited the same reaction. In any event, like before, if the dramatic results of the 2005 study that Dr. Antoniou cites were valid, they would attract many other scientists to replicate the results. There have been none. Nor have the studies been published in mainstream scientific journals or picked up by the press—a telling sign that they lack validity and credibility.

Stale or Retracted Published Studies

32. The small number of published and not-retracted studies that Dr. Antoniou cites are stale, going back to the 1990s. They also have not been verified or replicated, which raises serious doubts about their validity.

33. Dr. Antoniou cites one recent published study, the 2012 Séralini study. *See* Antoniou Decl. ¶ 42. The problem is, that study was retracted. And although it was reprinted,

[21] Prescott, V.E., P.M. Campbell, A. Moore, et al. 2005. Transgenic expression of bean alpha amylase inhibitor in peas results in altered structure and immunogenicity. *J. Agric. Food Chem.* 53:9023–30.

[22] Reiner et al. Genetically modified a-amylase inhibitor peas are not specifically allergenic in mice. *Clinical and Translational Allergy* 2013, 3(Suppl 3):P84. *Available at* http://www.ctajournal.com/content/3/S3/P84. Higgins participated in this study as well.

the reprint was without peer review.[23] Even aside from its retraction, the paper has ample problems:

- The original paper purports to find toxic effects in rats fed GE corn. However, many authorities have rejected the study and criticized the failure to follow OECD protocols and for using the wrong strain of rat (which naturally forms tumors starting after 90 days, so the tumors formed on both GE corn fed and non-GE corn fed rats) and the wrong statistical analysis.

- Antoniou's belief that the 2012 Séralini study "found that both extremely small amounts of Roundup (well below regulatory limits) and the GE corn (both sprayed with Roundup and left unsprayed) caused toxic effects in the rats" runs against the considered judgment of the bulk of the scientific community. *See* Antoniou Decl. ¶ 42.

- The Editor-in-Chief of *Food and Chemical Toxicology* retracted the study,[24] explaining that "there is legitimate cause for concern regarding both the number of animals in each study group and the particular strain selected. The low number of animals had been identified as a cause for concern during the initial review process, but the peer review decision ultimately weighed that the work still had merit despite this limitation. A more in-depth look at the raw data revealed no definitive conclusions can be reached with this small sample size regarding the role of either NK603 or glyphosate in regards to overall mortality or tumor incidence. Given the known high incidence of tumors in the Sprague-Dawley rat, normal variability cannot be excluded as the cause of the higher mortality and incidence observed in the treated groups."[25]

- Governmental organizations from around the world also rejected the validity of the Séralini study: "[N]umerous agencies for food safety, namely the German agency 'Bundesinstitut fur Risikobewertung' the European authority 'EFSA', the Australian and New Zealand agency 'Food Standards Australia and New

[23] Dr. Antoniou misleadingly states that the retracted paper was "republished" by another peer reviewed journal. This implies the Séralini paper had undergone peer review for the reprinting journal. In fact, it was not re-reviewed. When the paper was retracted, the peer review used to support initial publication is also retracted. In order to be legitimately "republished," a paper must undergo new peer review for the new journal.

[24] Dr. Antoniou asserts that the Séralini paper was retracted for unscientific reasons. The facts show otherwise: the editor explained the reasons at the time of the retraction—and all were based on science.

[25] Elsevier. 2013. Elsevier Announces Article Retraction from Journal Food and Chemical Toxicology. Available at http://www.elsevier.com/about/press-releases/research-and-journals/elsevier-announces-article-retraction-from-journal-food-and-chemical-toxicology.

Zealand', the Danish agency 'Danmarks Tekniske Universitet', the Netherlands agency, the French agency 'ANSES', the French High Council of Biotechnologies 'HCB', the Belgian Biosafety Advisory Council, the Health Canada and Canadian Food Inspection Agency (DFIA) and the Brazilian National Biosafety Technical Commission refuted these claims."[26]

- A recent peer-reviewed assessment of the paper stated: "We and many others have criticized the study, and in particular the manner in which the experiments were planned, implemented, analyzed, interpreted and communicated. The study appeared to sweep aside all known benchmarks of scientific good practice and, more importantly, to ignore the minimal standards of scientific and ethical conduct in particularly concerning the humane treatment of experimental animals."[27]

- Needless to say, the credibility of this paper and researcher is questionable. In any case, the retracted paper should not be cited, as it is no longer "peer reviewed."

34. In short, Dr. Antoniou incorrectly repeats that GE foods tested caused "unexpected, potentially adverse effects in GE fed animals." All of the studies that appear to show such potentially adverse effects have been retracted, debunked, or unable to withstand replication. That my point is correct is evidenced by the fact that none of the studies cited by Dr. Antoniou has been replicated, although several are many years old.

Dr. Benbrook's Declaration Also Fails To Demonstrate A Lack Of Consensus

35. Dr. Benbrook's assessment of an absence of consensus suffers from similar problems. Dr. Benbrook misunderstands the nature of food/feed safety, dismissing in one fell swoop many GE studies as having nothing to do with human food safety and stating that only a "[f]ew published studies . . . directly address the safety of GE foods." Benbrook Decl. ¶ 69. Dr.

[26] *See* Ricroch, 2013, *supra* ¶ 22 n.8.

[27] Arjó et al.. 2013. Plurality of opinion, scientific discourse and pseudoscience: an in depth analysis of the Séralini et al. study claiming that Roundup™ Ready corn or the herbicide Roundup™ cause cancer in rats. *Transgenic Res* 22:255–267.

Benbrook is wrong; many studies do indeed demonstrate that GE-derived foods are as safe as non-GE-derived foods.

36. The traditional and well-accepted method for assessing food safety follows a progressive and systemic approach, starting with compositional analysis in the lab. Scientists look to see what substances are present in the food/or feed in question, focusing on nutritional composition (especially allergens, toxicants, and other anti-nutritional factors) as compared with the standard food of the same type. Thus a GE soybean would be analyzed and the composition compared with the composition of standard, non GE soybeans as commonly consumed. If there are uncertainties in the composition, such as elevated levels of some metabolite relative to the standards, then safety tests may move up to test on microbes, then, if warranted, to small animals and ultimately, and again only if warranted, to large animals.

37. In dismissing nutritional composition studies, Dr. Benbrook implies that food safety studies require actual human feeding trials. Not only is this not true, it is a violation of ethical standards to subject humans to food that may be unsafe. It is only through the sequence of safety studies beginning with nutritional analyses that we acquire a reasonable confidence on the safety of a given food.

38. Dr. Benbrook also challenges my statement that GE crop technology is the most heavily studied food technology and attempts to support his challenge by citing a very limited search on PubMed, restricting his "hits" to papers mentioning "health effects genetically engineered food." Benbrook Decl. ¶ 71. PubMed is a reasonable place to start, but it is notoriously incomplete and non-comprehensive as a database of food and agricultural biosafety studies. Even within PubMed, such a restricted search term as Dr. Benbrook used will return few

matches, as not all safety studies use those terms.[28] As a result, his list grossly underrepresents the published literature covering GE crop and food safety. In addition, PubMed does not capture all the experiments and data used in regulatory assessment dossiers pertaining to safety issues, nor the studies and reports on various aspects of GE crop and food safety conducted by national and international government agencies such as FDA, USDA, EPA, EFSA, OECD, and WHO.

39. As a counter example, Dr. Benbrook cites the number of papers retrieved using "artificial sweeteners" or "DDT," suggesting that these examples are more common in the PubMed database. This is disingenuous, as these examples are all chemicals, not foods or crops.

40. Once again: GE crops and foods are the most rigorously tested of any foods and crops in the marketplace—as confirmed as recently as 2012 by the American Association for the Advancement of Science (AAAS), the world's largest society of professional scientists and publisher of the premier scientific journal *Science*. Furthermore, humans (and farm animals) have been consuming foods from GE crops since 1996, and in that time there is not a single verified case of harm from consumption of those foods or feeds. Many organizations share this view, as I listed in my prior declaration following paragraph 71.

41. In challenging these prestigious professional bodies, Dr. Benbrook (like Dr. Antoniou) can muster only a handful of individuals and studies in obscure journals, none of which have been independently replicated by reputable scientists or endorsed by mainstream scientists and, perhaps more compellingly, they have not been able to present as much as one person verified as having been harmed by GE foods.

[28] For example, Benbrook's search may not collect the multitude of safety studies using the term "genetically modified" or "transgenic" or "bioengineered" in place of his explicit and restrictive "genetically engineered." It also fails to capture those published safety studies that omit "health" in favor of terms like "allergenicity" or "toxicity" or "anti-nutrients" or other terms known to be safety related and typically used in detailed studies.

42. Dr. Benbrook complains that "one or more traits in almost all of today's market-leading GE corn and soybean varieties have not been analyzed or addressed in any human-health relevant studies published in peer reviewed journals." Benbrook Decl. ¶ 72 (emphasis omitted). This is very misleading as it implies that, if not published in peer-reviewed journals, the varieties have not undergone any safety assessment. But peer-reviewed journals do not typically publish routine analyses (unless there are unexpected or otherwise surprising results). USDA, FDA, and EPA require developers to submit massive stacks of data relating to various aspects of safety, and they will not sign off on the GE crop until their scientific staff is confident that the GE crop is as safe as similar crops and foods. The fact that supporting data sets are not published in peer-reviewed journals does not mean the safety studies were not conducted and analyzed by the expert scientists in our regulatory agencies.

43. Dr. Benbrook argues that combining GE traits together to breed a new variety ("stacking") may create new risks not seen in the individuals. Benbrook Decl. ¶ 73-74. However, as Dr. Benbrook notes, FDA studied the matter and determined that combining individual traits in a "stack" generates no new risks. In spite of Dr. Benbrook's concern that combining genes might generate new allergens, if this were a legitimate concern, we would have seen it with conventional breeding, where every new variety is derived from combinations ("stacks") of thousands of genes. To my knowledge, no new allergens have ever been recorded from the combination of genes or parents that were not themselves allergenic. Furthermore, any foods that can be safely consumed individually can be safely consumed when combined, so the concerns for "stacked" genes has no scientific foundation.

The Erroneous Conclusions Of Vermont's Experts Are Caused By Their Misunderstanding Of The Similarities And Differences Between "Conventional" Breeding And Genetic Engineering

Dr. Antoniou

44. Dr. Antoniou's conclusions are based on a misguided opinion that "[g]enetic engineering is inherently riskier than traditional breeding." Antoniou Decl. ¶ 25. His opinion runs counter to accepted findings, and, unsurprisingly, he provides no hard evidence in support.

45. For example, Dr. Antoniou agrees that "all plant breeding methods may cause unintentional consequences," but then states that "food crop plants derived from traditional breeding, which draw on gene pools for food crops often established over millennia, have a history of safe use." *Id.* This contention is wrong. While there is generally a history of safe use with all methods of breeding, including genetic engineering, traditional breeding has resulted in some hazardous exceptions.

- Lenape Potato, for example, was a traditionally bred variety of potato that had to be removed from the market due to food hazard risk.
- Similarly, traditional breeding has not always relied on millennia for the gene pool. Kiwifruit, for example, is a relatively new food developed by traditional breeding only half a century ago. It is now known to cause allergies.

46. In contrast, there remains not a single example of an approved GE food having to be recalled from the market due to health hazards, and there remains not a single documented example of actual harm to any human or animal from eating GE foods.

47. Dr. Antoniou goes on to claim that "[s]uch unintended effects can include altered composition of the plant and the production of new toxins and allergens." Antoniou Decl. ¶ 25. But he neglects to mention a critical fact: such unintended effects have only been recorded from

traditional breeding, and in any event, those events are rare.[29] No unexpected allergens or toxins have been documented as appearing in commercialized GE crops or foods. As NRC explains, there is no categorical difference in risk between traditional and GE methods of breeding.

48. Nonetheless, Dr. Antoniou cites as contrary evidence the findings of the NAS/NRC 2004 study, *Safety of Genetically Engineered Foods*. Antoniou Decl. ¶ 27. He misunderstands and misinterprets those findings. The entire study, which took two years of research and analysis to compile, concluded that there was *no* higher risk of introducing unintended changes (as an indicator of risk) with genetic engineering compared with traditional forms of breeding. Specifically, Dr. Antoniou cites figure ES-1 from that NAS/NRC study as agreeing with his conclusion. But, as one of the authors of that NAS/NRC report, I can state with confidence that the figure notes no statistical difference in the likelihood that the several different methods of GE and traditional breeding represented would generate unintended effects.

49. Dr. Antoniou also misunderstands the statement from that report that genetic engineering "has increased the number and type of substances that can be intentionally introduced into the food supply, as well as the magnitude of the changes." Antoniou Decl. ¶ 27 (quoting NRC). That statement does not signal danger of GE; indeed, the report states shortly after the language quoted by Dr. Antoniou: "In contrast to adverse health effects that have been associated with some traditional food production methods, similar serious health effects have not been identified as a result of genetic engineering techniques used in food production."[30] Rather, as the first page of the Preface makes clear, this statement means that GE can provide a way to improve crops when traditional breeding cannot. For example, the nutritional enhancement of β-

[29] *See* National Research Council. 2004. *Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects* (citing examples).

[30] *See id.* at ix-x.

carotene in rice or bananas may help overcome Vitamin A deficiency in poorer parts of the world.

50. Additionally, the assertion that GE crops can have unexpectedly different composition is not correct. *See* Antoniou Decl. ¶ 28. While there is some variation in nutrient and metabolite balance, it is well within the range of values seen in traditional breeding and agronomy, and to date no GE crop has unexpectedly shown a completely new substance. Contrary to Dr. Antoniou's assertion, molecular analytical methods actually show GE crops are *less* disrupted and *more* stable and predictable than crops bred using traditional breeding methods.[31] The specific examples he provided are also grossly exaggerated.

- The GE soy with lower isoflavones came from an experiment where the researchers did not follow standard protocol (by comparing the GE variety against a completely different non-GE variety, instead of using a near-isoline, as protocol dictates). More importantly, isoflavones are highly variable in the field, with variations by as much as 400%, making the reported 12-14% variation insignificant. It is unsurprising, then, that in the ten years since that report was published no one else has obtained similar results, despite intense research on soy, including studies comparing GE with non-GE soybeans.

- The second example, which refers to a Monsanto study, is also erroneous. *See* Antoniou Decl. ¶ 28. A careful reading of the cited paper reveals no references to a 27% increase in trypsin inhibitor.[32] Indeed, the paper actually states that "[a]nalysis indicated that there were no significant differences in trypsin inhibitor content between GTS and the control soybeans (Table 5)." Table 5 showed the content as almost identical. In any event, Dr. Antoniou's conclusions regarding soy should have been confirmed in the nearly two decades since the studies he cites were conducted. They have not been.

- The canola example, Antoniou Decl. ¶ 28, is not an unexpected compositional change, but a result of the experiment, which was *designed* to change the oil profile. This is no surprise and not unexpected. Indeed, all of Dr. Antoniou's other examples are similar in that they show, at most, normal and expected biological variation in ordinary metabolites. In none of these cases did a new

[31] *See, e.g.*, Ricroch, 2013, *supra* ¶ 22 n.8.

[32] Padgette, S.R., N.B. Taylor, D.L. Nida, et al. 1996. The composition of glyphosatetolerant soybean seeds is equivalent to that of conventional soybeans. *J. Nutr.* 126(3):702-716

> substance or metabolite appear unexpectedly. This is in contrast to conventional breeding, where new substances have appeared "out of the blue"—although that, too, is so rare as to be ignored.

51. Contrary to Dr Antoniou's assertion at ¶ 29, no verified peer review studies show commercialized GE plants to be different from their parents, except for the inserted trait. Dr. Antoniou claims "the GE process can cause biochemical changes in the plant in addition to the insertion of the transgene," but offers no evidence to support this contention.

52. Dr. Antoniou, however, presses on with increasingly less scientifically valid arguments. For example, he disputes my use of the sugarbeet example to explain how ingredients derived from GE plants are identical to those derived from non-GE plants. *See* Antoniou Decl. ¶ 30. His argument otherwise is unpersuasive. The sugar refined from sugarcane plants, GE sugarbeet plants, and non-GE sugar beet plants is identical in composition: it is sucrose, with the chemical formula $C_{12}H_{22}O_{11}$. Dr. Antoniou has not provided any scientific data or even a plausible hypothesis for how it might be different. And, to be clear: I place no testing limit on DNA or protein. Indeed, the refining process for sugar eliminates not only DNA and protein, but other substances as well. If, for some reason, there were hidden allergens in sugar, we would know about it by now. But there have been no documented cases of people having an allergic reaction to sugar.

53. In an effort to show how toxins may supposedly and unknowingly be introduced through GE into foods consumed by humans, Dr. Antoniou uses as an example the tragic case of the microbial produced dietary supplement L-Tryptophan, which carried a contaminant and caused the deaths of 37 people in 1989, before any GE foods were on the market, but GE microbes were increasingly common. Antoniou Decl. ¶ 30. Dr. Antoniou cites reports from 1994 and 1990 speculating on the actual cause of the outbreak, whether due to the GE bacteria or to the reduced filtration the Japanese company introduced at the same time, to facilitate

production. It remains uncertain, even today, because the company destroyed their records. However, subsequent analysis shows the medical condition (EMS) was likely due to certain contaminants that are not removed by the reduced filtration process, and that occur naturally in high concentrations of L-Tryptophan, even from other supplement manufacturers who use non-GE microbes to produce L-Tryptophan who continue with the traditional filtration. Additionally, EMS is rare, but has been documented in people who take excessive doses of L-Tryptophan, again suggesting the contaminants occur naturally and not due to the GE process. Finally, Dr. Antoniou claims that L-Tryptophan with the contaminants present would be considered "substantially equivalent" to pure L-Tryptophan. This is incorrect, as L-Tryptophan is not considered a food product and, in any case, FDA has still not found L-Tryptophan to be "safe" at any dosage.[33]

54. The tragic L-Tryphtophan event does not demonstrate anything inherently unsafe about the use of GE bacteria. After all, GE bacteria are used to make human medicines such as insulin and many other lifesaving pharmaceuticals every day without adverse incident.

55. Dr. Antoniou also attempts to cast GE as an entirely artificial process, opining that it "is an artificial laboratory-based technique specifically designed to enable the transfer of genes between very distantly related organisms." Antoniou Decl. ¶ 31. But the most common method of genetic engineering used for plants is a natural one: Agrobacterium, which naturally enables the transfer of genes between very distantly related organisms across biological kingdoms. Scientists merely swap out the specific genes to be transferred, with the gene transfer process itself conducted by the Agrobacterium. In this sense, GE is like a tool, allowing plant breeders to transfer any small piece of DNA, consisting of one or two genes that confer a disease resistance,

[33] Pandora's Picnic Basket. Oxford Univ. Press, 2000. New York. Pp. 114-117.

or a nutritional enhancement like β-carotene. As the NAS/NRC reports have consistently concluded since their studies began in the 1980s, the GE process itself is no more risky than traditional breeding methods. Instead, one must evaluate the features of the final product, not the method by which the product was made.

56. Dr. Antoniou is misleading when he suggests that natural gene transfer must take place over millennia. Dr. Antoniou agrees that genes can transfer across species in traditional plant breeding, but then claims it "is accompanied by genetic selection by food crop breeders and natural conditions over millennia." Antoniou Decl. ¶ 32. This is not correct. Many common foods are relatively recent additions to the table, including things like carrots, broccoli, watermelon, and others developed not over millennia but over dozens of years or less. Some are very recent, including kiwi fruit and triticale, developed by human plant breeders in the last half century. Gene (DNA) transfer is a natural process and has been going on for millennia, but a single, specific DNA transfer itself occurs in a matter of minutes.

57. Dr. Antoniou is also incorrect in suggesting that GE crops fail to undergo the selection to identify and select out any toxic or unhealthy plants. In reality, once a GE plant is developed, the seeds are provided to traditional breeders and agronomists who spend years conducting the same field trials and tests as would be completed for traditionally bred crops. They select out any "off types," which are plants that even remotely appear different from the parent type (apart from the introduced new trait). Any GE plants that appear to be more susceptible to disease, to produce a lower yield, to be less robust, to have nutritional deficiencies, or to carry any new allergens or toxins are eliminated from progress toward commercialization. Nor does GE cause radical changes in the genome. Several genomic studies have now shown that genetic engineering is far more precise, limited, and less disruptive of the genome than

traditional breeding.[34] Dr. Antoniou concedes my point that gene transfer from one species to another does occur naturally. Antoniou Decl. ¶ 33. I agree with him that the fact that gene transfer among species "has taken place does not mean that the process is safe or desirable." Indeed, the products of such natural gene transfers can and have resulted in unexpected hazards. Fortunately, the incidences where a hazard has occurred from gene transfer are extremely rare.

Dr. Benbrook

58. In a related argument, Dr. Benbrook concludes that GE crops are unnatural, but his conclusions are based on faulty assumptions. For example, Dr. Benbrook claims in his declaration that genetic engineering (GE) is an unnatural process, and that transferred material (DNA) "could not be moved into the plant's genome via normal reproductive and/or plant breeding processes." Benbrook Decl. ¶ 15. This is simply false. First, GE is a natural process, and occurs in nature without any human intervention whatsoever. Although there are many examples of this natural process, *Agrobacterium tumefaciens* is apropos here. Agrobacterium is a soil living bacterium that has the natural ability to transfer pieces of DNA from its own genome into the genome of certain plants. This naturally occurring genetic engineering agent is itself undeniable and refutes Dr. Benbrook's contention that the process is unnatural, or that "transferred material" (DNA) "could not be moved into the plant's genome." Indeed, modern plant breeders make use of Agrobacterium's natural gene transferring ability to make GE crops, including many that have been commercialized.

59. Second, this natural process of gene transfer can be used to transfer any given piece of DNA (with limits on size), including pieces of DNA that could and are moved using "normal reproductive and/or plant breeding processes." GE is sometimes used to transfer genes

[34] *See, e.g.*, Ricroch, 2013, *supra* ¶ 22 n.8.

from one plant variety to a different plant variety of the same species; this could be accomplished using "normal . . . plant breeding" but the GE process may be quicker or more efficient. For example, the *Xa21* disease resistance gene in rice has been transferred using both traditional crossing and also GE to develop new rice varieties. Both natural processes end up with a rice plant carrying and expressing the *Xa21* gene, conferring disease resistance.

60. Furthermore, there are examples of non-GE plant breeding methods that overcome natural barriers and are used to develop new crops improved with genes that "could not be moved into the plant's genome using normal reproductive and/or plant breeding processes." Benbrook Decl. ¶ 15. These methods, requiring substantial human intervention, are considered "natural" and "traditional" breeding, even though they result in the transfer of genes to provide gene combinations that do not occur naturally, so both the method of gene transfer and the resulting combination of genes are, according to Dr. Benbrook's argument, "unnatural." One example is tomatoes, carrying the *Mi* gene conferring resistance to nematodes. The gene could not be crossed into cultivated tomatoes by natural means as it existed in a different (albeit related) species, so scientists used a technique called interspecies embryo rescue to achieve the transfer, and develop new tomato varieties with successful nematode resistance. Approximately 20% of current U.S. tomato varieties carry this gene.

61. Dr. Benbrook asserts that the combination of genetic elements and their expression in the right amount and the right time "could not occur as a result of natural processes." Benbrook Decl. ¶ 16. In fact, this perfectly describes a process of evolution, as natural a process as anyone can think of. Dr. Benbrook provides a list of some genes that "would not be found in commercial crops without genetic engineering." A closer inspection of this list shows some problems. One, the Bt gene (and corresponding protein) and other genetic

elements, notably the CaMV 35s promoter are commonly consumed in foods, especially those foods consisting of crops where the Bt bacterium lives in the soil, or where Bt spores are sprayed on the crops to provide protection from insects. The Bt gene, like all other genes, is non-toxic to humans; we eat plenty of genes in every meal. The Bt protein is also harmless to humans, as it is non-toxic to us (and other non-target animals; that is, animals other than insects). We digest it as an ordinary protein, with no undue effect. Similarly, the CaMV virus is also commonly consumed as it is often found in cruciferous vegetables, especially broccoli and cauliflower. Like Bt, it is harmless to humans.

62. Second, the EPSPS gene is also not new to the diet, as all plants carry a version of the EPSPS gene and associated protein. We eat EPSPS genes and proteins whenever we eat a green salad, for example. Transit peptides are small sections of amino acids, they have no adverse effect and are common in foods. The NPT-II gene and its associated protein are also commonly consumed by humans and are non-toxic. FDA reviewed the safety of NPT-II during the evaluation of the Flavr Savr™ tomato.

63. Third, Dr. Benbrook implies that herbicide tolerance could only be transferred using GE, citing the EPSPsynthase genes that confer resistance to glyphosate. But several other herbicide resistance genes are transferred by plant breeders without using GE. One prominent example is the Clearfield ™ crops, which carry novel herbicide resistance genes but bred/transferred by breeding methods other than GE.

64. Dr. Benbrook argues that the 247gox gene is from a bacterium "and so this gene would not be found in plants in nature." Benbrook Decl. ¶ 17. In fact, many genes are found in both bacteria and plants in nature. Indeed, there are many genes shared by humans and other animals, plants, and even bacteria (*see* http://eugenes.org/all/hgsummary.html). The earlier cited

EPSPSynthase genes, for example, are common to both bacteria and plants. Even if a given gene or protein sequence has been altered, that, too, is a natural phenomenon called mutation. Mutations can be either spontaneous (as occur in nature) or induced (by humans). Minor sequence changes in either the gene or the protein—whether occurring spontaneously or by human induction—can alter the degree of function, even to the point of non-functionality. This is well known in mutation breeding, and plant breeders have been inducing mutations in crops since the mid-20th century. More than 3,000 crop varieties have been developed using induced mutation (including prominent foods like Ruby Red Grapefruit and Calrose rice) to make changes to the gene and protein sequences in plants, and there has never been a problem or adverse reaction reported with them. And, unlike GE crops, they undergo no safety assessments prior to or after commercialization.

65. Benbrook's conclusions are further belied by the fact that the traits in many GE crops could readily be developed using "natural" crossing, such as the *Xa21* in rice mentioned above. But Dr. Benbrook has not explained how the GE version of *Xa21* rice could be unnatural if it is identical to the crossbred version. Dr. Benbrook also has not explained how a GE gene deletion (for example to remove a gene for an allergenic protein from, say, peanuts), which involves no added genetic material at all, and could readily be replicated by mutation breeding, is unnatural, while the mutation would be "natural."

66. Dr. Benbrook's reference to several definitions of GMO (Genetically Modified Organism), including Monsanto's and the World Health Organization's, cannot save his conclusions on this subject. Official documents in the U.S., (including Vermont's Act 120) do not reference "GMO," partly because it is an ambiguous term with no standard, agreed

definition. In the U.S., we use the term Genetically Engineer(ed), or GE. The term GE is a more standard definition (albeit not universal) to refer to the use of recombinant DNA, rDNA.

67. Dr. Benbrook mentions patents as a basis for supporting his argument that GE crops are unnatural. Benbrook Decl. ¶ 21-23. But patent eligibility does not distinguish "natural" from "unnatural." Traditionally bred plant varieties are also eligible for patenting, and these traditional plants are clearly within the realm of "natural" under Dr. Benbrook's definition. If GE crops are categorically "unnatural," then *ipso facto*, so are traditionally bred varieties. Worth noting here is that not all GE plants are patented, so even using patenting to dichotomize natural from unnatural will not capture all GE plants and only GE plants.

Vermont's Experts Do Not Disprove My Conclusions That GE Crops And Foods Are As Safe As Non-GE Crops and Foods

Genetically Engineered Bt Crops Are Safe

68. Dr. Antoniou has not refuted my conclusion that *Bacillus thuringiensis* (Bt) insecticidal proteins are harmless to humans and other non-target animals. *See* Antoniou Decl. ¶ 52. I base this argument not so much on the fact that farmers have been safely using Bt for many years (which is true), but on the scientific evidence and scientific literature. There are several different strains of Bt, and the Bt crystal protein associated with each strain has somewhat different properties. These "wild type" proteins can also be modified to tweak the features, such as affecting different insect pest species, but still remain very selective, affecting only the species intended. However, one feature they all have in common is that they are completely non-toxic to humans and other animals, and no amount of truncating—as Dr. Antoniou alludes to—has changed that. Antoniou Decl. ¶¶ 52-53.

69. Dr. Antoniou correctly notes that small changes in proteins can dramatically alter certain functions such as, in his example, susceptibility to an herbicide. Antoniou Decl. ¶ 54.

But such small changes are unlikely to give rise to gross changes, such as converting a benign protein to an allergen. Fortunately, even if that does happen, routine testing long before commercialization will reveal the allergen and the project will cease, as has been shown with an inadvertent allergen being genetically engineered into soybean many years ago.[35]

70. Dr. Antoniou might not be aware of the OECD consensus document, titled *Consensus document on safety information on transgenic plants expressing Bacillus thuringiensis–derived insect control proteins.*[36] The salient point, the OECD says, is that "[b]oth the long history of safe use of B. thuringiensis and the acute oral toxicity data allow for a conclusion that these and other δ-endotoxins pose negligible toxicity risk to humans."

71. Dr. Antoniou here claims that Bt induces immune response in mice, citing papers from one lab and published fifteen years ago for support. Antoniou Decl. ¶ 56. These papers are not readily available. I was not able to find them, and so I cannot comment directly on their quality. However, the fact that the papers with such a dramatic finding have not been replicated in fifteen years raises a red flag that perhaps the studies are not replicable, or perhaps Dr. Antoniou misinterpreted them. More importantly, the papers were available at the time the OECD Consensus Document on the safety of Bt was being compiled and yet that definitive work fails to even mention them.

[35] Nordlee, J.A., S.L. Taylor, J.A. Townsend, L.A. Thomas, R.K. Bush. 1996. Identification of a Brazil-nut allergen in transgenic soybeans. *New Engl. J. Med.* 334:688–692.

[36] OECD. 2007. Consensus document on safety information on transgenic plants expressing Bacillus thuringiensis-derived insect control proteins. Environment Directorate, Joint meeting of the chemicals committee and the working party on chemicals, pesticides, and biotechnology. Series on Harmonisation of Regulatory Oversight in Biotechnology.

Existing Government Regulations Adequately Protect Food Safety

72. Dr. Antoniou challenges my statement that "GE crops are subject to more safety testing than any other food on the market." Antoniou Decl. ¶ 60. But, instead of refuting my statement by giving an example of foods that undergo greater safety testing, he misrepresents the FDA role in assessing GE foods:

- Dr. Antoniou says: "the U.S. regulatory system does not require *any* animal feeding trials to be carried out with GE foods. Instead, GE foods are "deregulated," since the FDA assumes that GE foods are generally recognized as safe ("GRAS") and therefore do not require testing or special regulatory oversight." Antoniou Decl. ¶ 60. This statement shows a lack of understanding of the U.S. regulatory system.

- First, animal feeding trials are not the only form of safety testing; they may be part of a safety trial, but imposed only when warranted after non-animal safety testing—including various lab, microbial, plant and small animal testing results provide a basis for concern that only animal testing will resolve. For example, with GE plants intended to produce an insecticidal trait, such as Bt crops, EPA requires animal feeding studies to be submitted as part of their regulatory review.

- Second, FDA can indeed require animal tests, if the data suggests there is sufficient concern that only animal testing will resolve.

- Third, FDA does not "deregulate"; that is the purview of USDA.

- Fourth, FDA does NOT assume that GE foods are generally GRAS. GRAS status is for food additives and not typically applied to GE foods. These aspects of the U.S. regulatory system are detailed in the peer-reviewed handbook, *Regulation of Agricultural Biotechnology: The United States and Canada*.[37]

73. U.S. regulatory agencies make informed decisions based on sound science. Dr. Antoniou counters that university or third-party contractors who conduct experiments with GE material are "sponsored by the GE industry" and that the GE developer decides which data are sent to regulators or submitted for peer-reviewed publication. Antoniou Decl. ¶ 63. In the United States, public universities will not accept research projects with such restrictions on

[37] Wozniak, Chris and Alan McHughen, eds. *Regulation of Agricultural Biotechnology: The United States and Canada*. Springer Publishing, 2012.

publication. Furthermore, if FDA, USDA, or EPA is not satisfied with the data as supplied by the GE crop developer, they can and do demand more. In other words, the company does not get to pick and choose which data to submit and then await a rubber stamp approval, as many people—including perhaps Dr. Antoniou—seem to believe. Instead, the regulatory agency requests data sets from specified assays and trials, along with complete characterization information on the GMO. While there is some flexibility in the type of data to be submitted, the agency "stops the clock" on any submitted dossier until they are satisfied that the data are sufficient to provide confidence on the safety of the GE crop before they sign off.[38]

74. Dr. Antoniou reaches the curious conclusion that EU governments' evolving methods of regulation demonstrate disagreement about how to safely regulate foods. Antoniou Decl. ¶ 51. This conclusion does not follow from the premise. Of course it is true that EU regulators are constantly reviewing their regulations—just as U.S. regulators do at USDA, EPA, and FDA. They do this not because they cannot agree, but because technologies advance and because new data and evidence is constantly coming in. This is simply fine-tuning the regulatory approach to maintain confidence that the system works to protect society. So far it has worked well, as no one has been shown to be harmed by GE foods or feeds.

75. Dr. Antoniou also again complains that international standards, as developed over many years of experience by experts in OECD, for feeding studies are too short of duration. Antoniou Decl. ¶ 61. As before, the complaint is answered, and dispensed with, by the EFSA's explanation, quoted above at paragraph 13.

[38] For more detail on the FDA protocol, see FDA. 1992. Guidance to Industry for Foods Derived from New Plant Varieties. *FDA* Register 57. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Biotechnology/ucm096095.htm.

Neither Expert Demonstrates That GE Crops Lead To Harm From Herbicide Use

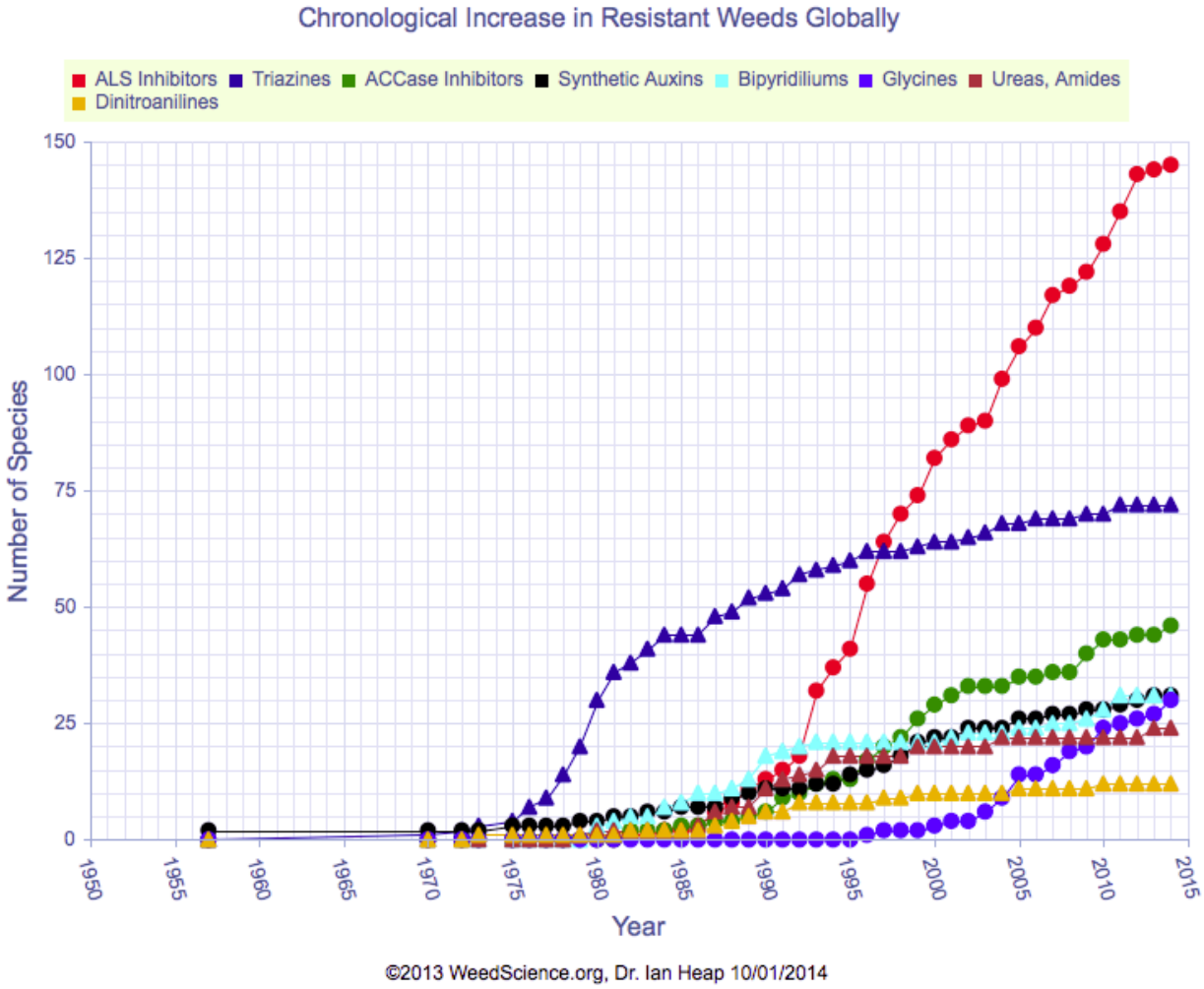
76. Dr. Antoniou and Dr. Benbrook both fail to demonstrate that GE has led to increased herbicide use that causes harm to the environment and public health. Neither author has expertise in pesticide safety or management or efficacy, and their criticisms are largely based on non-peer-reviewed studies or marginal studies that contradict mainstream science as conducted and published in the weed science community.[39] These arguments address environmental issues beyond those raised in the legislative findings, selectively discuss a few issues without looking at the whole environmental picture, and fail to assess the significant environmental benefits that flow from the use of GE crops.

77. The discussion of pesticides (including herbicides) is largely irrelevant, as Act 120 makes no reference to pesticides. GE crops are not invariably associated with herbicides or pesticides, and, conversely, herbicides and pesticides are not invariably associated with GE crops. Even the herbicide Dr. Antoniou cites most frequently, glyphosate, is used on only certain GE crops (the "Roundup Ready™" crops), and it is also widely used in other contexts (for example, in domestic gardens, by municipalities to control weeds, etc.). Restricting GE crops therefore will not alleviate whatever concerns there may be over the use of glyphosate.

78. For his part, Dr. Benbrook raises concerns about the increasing prevalence of herbicide-resistant weeds. To get there, he first identifies the growth of GE corn, soy, and cotton in the United States since 1996. Benbrook Decl. ¶ 25. I do not contest his figures and add that, according to 2014 USDA data, GE corn, cotton, and soy in the U.S. are grown on 93%, 96%, and

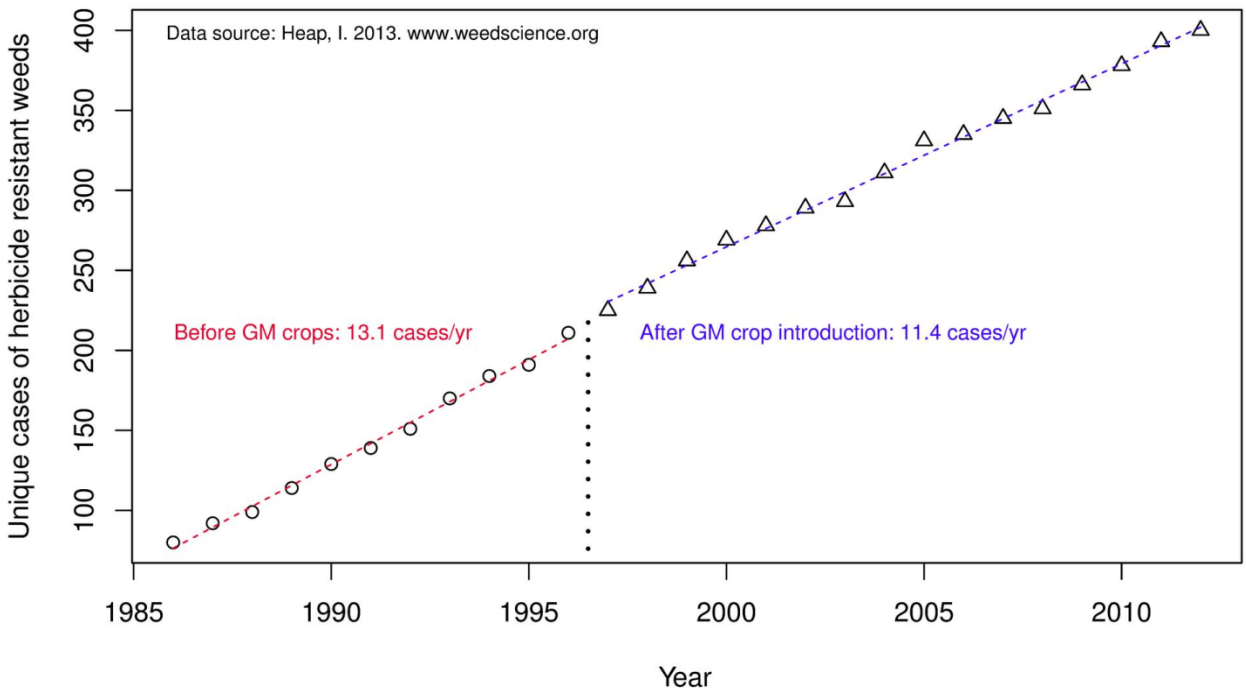
[39] For example, Dr. Antoniou relies on Benbrook's paper claiming the use of herbicides has increased with GE crops. Antoniou Decl. ¶ 65 n.83. That paper has come under severe criticism and contradicts several other peer-reviewed studies on the question, including studies by USDA. USDA-ERS. 2014. *Genetically engineered crops in the United States*. Report # 162.

94% of the acres, respectively. Weeds evolving resistance to herbicides have been recorded as long as herbicides have been used. According to the Weed Science Society of America (WSSA), weeds are developing resistance to all types of herbicides (glyphosate is represented as glycines):



While Dr. Benbrook talks only about weeds evolving resistance to glyphosate, this chart puts the problem into proper, real-world, perspective: weeds are not evolving resistance to glyphosate at any greater rate than to most other types of herbicides.

79. Furthermore, reading Dr. Benbrook's report gives the impression that herbicide resistant weeds are escalating, when they are not. This chart shows the rate of weeds evolving resistance has, if anything, slowed since the introduction of GE crops:



80. The NAS/NRC recognized and grappled with this pesticide resistance issue in their 2010 report, *The Impact of Genetically Engineered Crops on Farm Sustainability in the United States*.[40] That report concluded that planting GE crops on balance (*i.e.*, not on every farm) is *better* for the environment than conventional crops because it uses *less pesticide*, uses *safer pesticides* than those used in conventional cropping systems, and reduces tillage, leading to improvements in soil and water.

81. All plants are naturally susceptible to some herbicides, and naturally resistant to others. GE allows breeders to provide an additional herbicide resistance to crops over and above the resistances already present in their genomes. This gives farmers greater flexibility in weed control choices, as they have an additional herbicide to choose from. Not all farmers choose glyphosate (Roundup Ready™) crops; some do not use GE herbicide resistant crops at all, while

[40] National Research Council. 2010. *Impact of Genetically Engineered Crops on Farm Sustainability in the United States.* http://www.nap.edu/catalog/12804/impact-of-genetically-engineered-crops-on-farm-sustainability-in-the-united-states.

others choose GE crops with resistance to a different herbicide, such as glufosinate. Finally, not all recently bred herbicide resistant crops are GE. The sulfonylurea resistant crops were bred using so-called "traditional" breeding methods, such as induced mutation.

82. All insecticides—not just Bt—provide selection pressure and insect pests will eventually evolve resistance to that insecticide. In recognizing this issue, EPA mandates a management scheme to affect a delay in the development of resistance. This scheme seemed to work reasonably well until some farmers failed to comply. In order to overcome non-compliance, new management schemes are being developed that rely less on active participation by farmers, including "refuge in a bag" and pyramiding different Bt strains in the GE crop.

83. Dr. Benbrook's description of the issues makes it seem much more widespread than it is. Benbrook Decl. ¶¶ 32-37. Most resistant pest populations—whether resistant insect or weed pest populations—are relatively small and isolated. Most farmers do not have to deal with herbicide resistant weeds or insects. If they did, 90% of America's corn, soy, and cotton farmers would not be growing GE varieties. With judicious plant breeding and good management strategies, they will not have to in the future, either.

84. Dr. Benbrook argues that since the commercial release of GE crops in the U.S., pesticide use has climbed, giving figures based on weight of pesticides in pounds. Benbrook Decl. ¶¶ 38-47. Dr. Benbrook has been widely criticized in the scientific community for using this weight measure, for several reasons:

85. First, the absolute weight of a pesticide used is not generally used as a measure of exposure. This is because:

- Different pesticides have different concentrations, so a powerful pesticide may need only a relatively small dose, while a more benign pesticide may require a heavier dose to control the same pests.

- Weight of a pesticide is unrelated to its toxicity, so a pesticide highly toxic to humans might require a relatively heavy weight dose to control pests, or a pesticide with low toxicity to humans might require an even higher dose to control pests.

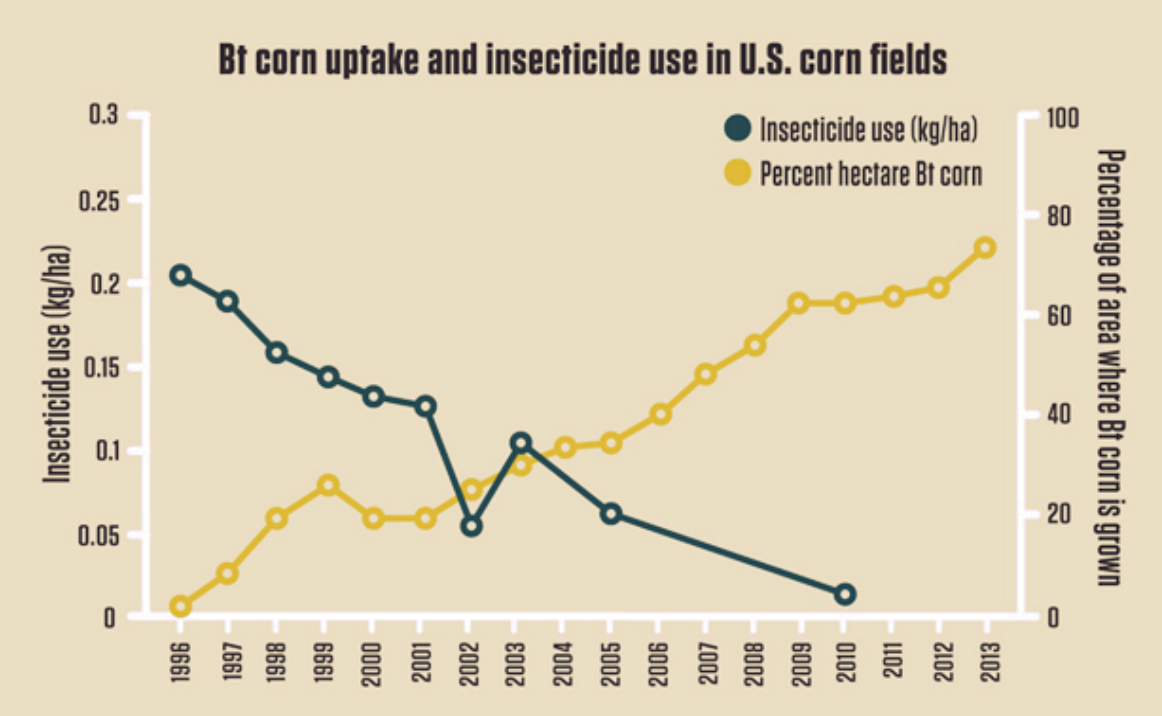
- Some pesticides facilitate the adoption of more environmentally friendly farm practices, such as non-tillage. Farmers seeking the environmental benefits of low-till may need to increase the absolute weight of herbicide above what they were applying previously to achieve the same weed control, but choose to do so for the environmental benefits.

- Weight is unrelated to environmental impacts. That is, some pesticides may control their associated pests at a dose of low weight, but that pesticide might have persist in the environment for a very long time, continuing to adversely impact other (non-pest) species long after the pest is controlled. Merely weighing the amount of pesticide tells us nothing about environmental persistence or toxicity of the product. In talking about GE crops, most farmers (though not all) report using less pesticide on GE crops.[41]

86. Second, there is no doubt that insecticide use has dropped dramatically with Bt crops (see chart below), a point that Dr. Benbrook concedes in his 2012 paper,[42] but he seems to have retreated from in this declaration. Benbrook Decl. ¶¶ 48-49.

[41] *See* NRC, 2010; USDA, 2014, and chart above.

[42] Benbrook, C. 2012. Impacts of Genetically Engineered Crops on Pesticide Use in the U.S. – the First Sixteen Years. *Environmental Sciences-Europe*, 24:24; http://www.enveurope.com/content/24/1/24.



(www.ers.usda.gov/publications/err-economic-research-report/err162.aspx).

The use of herbicides is more complicated, but most studies, including those conducted by U.S. agencies and NAS, show that in most cases farmers have reduced herbicide use as well. There are certain farmers who report a small increase in herbicide use, but they are in the minority.

87. The discussion of pesticide reduction since 1996 has been fully documented not only by Dr. Benbrook, but by authoritative government and academic scientists (in addition to industry figures). Recent peer-reviewed academic studies also support the various government agencies and NAS reports. A meta-analysis of 147 original studies conducted around the world shows that GE crops reduce pesticide use by 37% and increase yields by 22%.[43] Overall, Dr. Benbrook's figures claiming increases in pesticide use do not stand up to critical scrutiny and remain at odds with the mainstream scientific community. Dr. Benbrook here argues that the

[43] Klumper, Wilhelm and Matin Qaim. 2014. A Meta Analysis of the Impacts of Genetically Modified Crops. *PLoS ONE* 9(11): e111629.

actual amount of pesticide has actually *increased*, by including his own speculation on the amount of Bt produced within Bt crops. Benbrook Decl. ¶¶ 48-49. Apart from calculating based on the almost meaningless gross weight of Bt allegedly generated in plants, Benbrook seems to forget that Bt is a protein, it is toxic only to certain pest insects, and it is not distributed to the environment as a sprayed formulation is, so any environmental impacts are largely restricted to the pest insects eating the crop—the very pest insects farmers wish to control.

88. In contrast to Dr. Antoniou's and Dr. Benbrook's assertions that GE crops are damaging to biodiversity and wildlife, the NAS/NRC 2010 report, titled *The Impact of Genetically Engineered Crops on Farm Sustainability in the United States*, came to the opposite conclusion. The two-year study found that GE crops actually contribute to sustainability in agriculture, and is better for the environment than conventional crops because it: (1) uses less pesticide, (2) uses safer pesticides than those used in conventional cropping systems, and (3) reduces tillage, leading to improvements in soil and water.[44]

89. Overall, the U.S. National Academy of Sciences invariably concludes that, while nothing is without risk, the benefits of GE crops outweigh the risks, which are both manageable and no more severe than the risks of traditional crops. And, to date, there remain no verified cases of harm to humans or animals from the consumption of foods or feeds from GE crops.

GE Crops Do Not Increase Risks Of Gene Flow

90. Dr. Benbrook complains that gene flow between GE crops and non-GE crops is unavoidable. Benbrook Decl. ¶ 52. But he neglects to place this in context—gene flow from GE

[44] National Research Council. 2010. *Impact of Genetically Engineered Crops on Farm Sustainability in the United States.* http://www.nap.edu/catalog/12804/impact-of-genetically-engineered-crops-on-farm-sustainability-in-the-united-states.

crops occurs at the same rate as gene flow from non-GE crops of the same species. That is, gene flow is a function of plant species, not whether the plant is GE or not.

91. Dr. Benbrook is correct that gene flow can cause problems with certain crops or specialty markets. This has been the true for many years, long before GE crops were released. For example, farmers growing popcorn near field corn have to carefully manage the amount of gene flow to minimize mixing of the two types; farmers of malting barley have to limit pollen and seed movement from feed barley; canola growers have to manage pollen and seed mixing from rapeseed growers; and seed growers (special farmers who grow Certified seed to sell to grain farmers) have to maintain a high level of purity in their crops to maintain their Certified status. In all of these cases, farmers recognize that "zero contamination" is unrealistic, so they establish reasonable thresholds and discuss planting plans with neighboring farmers to minimize cross-pollination and seed mixing. The onus is generally on the farmer seeking special, higher value status for his/her crops to take appropriate measures to maintain the special status or purity. Seed growers, for example, use isolation distances, buffer rows, or other means to minimize gene movement from other crops and achieve the level of genetic purity according to the Certified status of the crop.

92. Dr. Benbrook complains that organic farmers have lost access to premium markets due to "GE-gene flow into non-GE and organic canola (rapeseed)." Benbrook Decl. ¶ 59. First, rapeseed is not the same as canola. Although closely related botanically, rapeseed produces an industrial oil (rapeseed oil) that is toxic to humans due to the high concentration of erucic acid, along with glucosinolates in the seed meal. Canola, by contrast, produces a high-quality edible vegetable oil lacking erucic acid and is almost devoid of meal glucosinolates. Farmers growing canola and rapeseed in close proximity must manage the crops to minimize the

amount of cross contamination. Obviously, getting too much toxic rapeseed in a canola crop could result in the whole crop being wasted, as it would no longer meet edible standards, at a huge economic loss to the farmer. Less dramatically, perhaps, getting too much canola in a rapeseed crop could also result in a loss to the farmers, as he/she could have the whole crop lost if the canola diluted the rapeseed oil below the threshold for the desired high erucic acid content, at an equal economic loss. Rapeseed and canola farmers typically work in a neighborly fashion to ensure each can grow their chosen crop to serve their diverse markets, both of which maintain reasonable thresholds for crop purity.

93. In conclusion, GE-derived foods approved for food and feed in the United States are as safe as non-GE-derived foods. No credible scientific evidence has shown otherwise; nor has any shown that GE causes greater harm to the environment than non-GE plants and crops. Nothing in the declaration of either Dr. Antoniou or Dr. Benbrook demonstrates to the contrary.

Dated this 5th day of December, 2014.

Alan McHughen