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Measure to Manage (M2M) Farm and Food Diagnostics for Sustainability and Health

Recent Events:

- The Independent has published Charles Benbrook's [letter on the state of GM science](#).
- [Keynote presentation slides \(pdf\)](#) to the [Organic Agriculture Research Symposium](#) speech by Dr. Benbrook on February 25, 2015 and accompanying [blog post](#).
- Blog post (December 9, 2014): [Narrowing the Conventional Versus Organic Farming System Yield Gap](#).
- [Genetically Modified Food Debate](#) featuring Dr. Benbrook on Wednesday, December 3, 2014.



Web Tools:

- M2M's [Pesticide Dietary Risk Analytical System](#), which provides information on pesticide residues in different foods, is available in beta
- M2M's [Pesticide Use Data System](#), providing the pounds of active pesticide ingredient applied per acre for various crops, is available in beta

M2M Journal Articles:

- Journal publication: "[Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses](#)" published in British Journal of Nutrition on July 11, 2014
- Journal publication: "[Organic Production Enhances Milk Nutritional Quality by Shifting Fatty Acid Composition: A United States-Wide, 18-Month Study](#)" published in PLOS ONE on December 9, 2013.
[in the U.S. — the first sixteen years](#)

Blog Posts by Charles Benbrook:

- Blog post (December 9, 2014): [Narrowing the Conventional Versus Organic Farming System Yield Gap](#)
- Blog post (October 24, 2014): [Promoting Global Food Security One Crop of Tomatoes at a Time](#)
- Blog post (July 11, 2014): [New Meta-Analysis Identifies Three Significant Benefits Associated With Organically Grown Plant-Based Foods](#)
- [All blog posts by Charles Benbrook](#)

Our Goal: To develop, validate, and apply analytical systems quantifying the impacts of farming systems, technology, and policy on:

[Nutritional Quality](#)

[Pesticide Use](#)

[Pesticide Dietary Risk](#)

[Environmental Impacts of Pesticides](#)

[Embedded Attributes](#)

[Performance of Organic Farming and Food Systems](#)

[Sustainable Paths Toward Global Food Security](#)

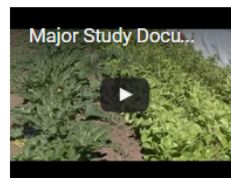


Links:

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Tools:

- [Pesticide Dietary Risk Analytical System](#)
- [Pesticide Use Tools](#)



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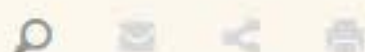
The scope of M2M program activities, and the pace of progress, will depend on the program's ability to attract and sustain a diversified base of funding. Current and future M2M program activities are and will be funded by government and foundation research and educational grants, and grants from individuals, organizations, and private companies.

Initial start-up funding for the M2M program have been provided by United Natural Foods, Whole Foods, Organic Valley/CROPP, and Stonyfield. In addition, the Clif Bar Family Foundation has provided a generous three-year, \$250,000 grant to support the dissemination of analytical systems and results via the M2M website.

Work on calculating the embedded attributes of food products has been advanced by a \$25,000 gift grant from Annie's, a company working to quantify the benefits stemming from its purchase of a wide range of organic ingredients.

If you are interesting in supporting any of M2M's core activities, please contact the M2M Program leader, [Dr. Charles Benbrook](#).

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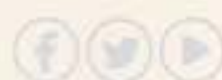
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OCTOBER 1, 2012

FOR IMMEDIATE RELEASE

by **Brian Clark**

SOURCE CONTACT

Chuck Benbrook

[541-828-7918](tel:541-828-7918)

Pesticide Use Rises as Herbicide-resistant Weeds Undermine Performance of Major GE Crops, New WSU Study Shows

PULLMAN, Wash. — A study published this week by Washington State University research professor Charles Benbrook finds that the use of herbicides in the production of three genetically modified herbicide-tolerant crops — cotton, soybeans and corn — has actually increased. This counterintuitive finding is based on an exhaustive analysis of publicly available data from the U.S. Department of Agriculture's National Agriculture Statistics Service. Benbrook's analysis is the first peer-reviewed, published estimate of the impacts of genetically engineered (GE) herbicide-resistant (HT) crops on pesticide use.

In the study, which appeared in the the open-access, peer-reviewed journal "Environmental Sciences Europe," Benbrook writes that the emergence and spread of glyphosate-resistant weeds is strongly correlated with the upward trajectory in herbicide use. Marketed as Roundup and other trade names, glyphosate is a broad-spectrum systemic herbicide used to kill weeds. Approximately 95 percent of soybean and cotton acres, and over 85 percent of corn, are planted to varieties genetically modified to be herbicide resistant.

"Resistant weeds have become a major problem for many farmers reliant on GE crops, and are now driving up the volume of herbicide needed each year by about 25 percent," Benbrook said.

The annual increase in the herbicides required to deal with tougher-to-control weeds on cropland planted to GE cultivars has grown from 1.5 million pounds in 1999 to about 90 million pounds in 2011.

Herbicide-tolerant crops worked extremely well in the first few years of use, Benbrook's analysis shows, but over-reliance may have led to shifts in weed communities and the spread of resistant weeds that force farmers to increase herbicide application rates (especially glyphosate), spray more often, and add new herbicides that work through an alternate mode of action into their spray programs.

A detailed summary of the study's major findings, along with important definitions of terms used in the study, are available online at <http://bit.ly/esebenbrookmajor>. Benbrook's study, "Impacts of genetically engineered crops on pesticide use in the U.S. — the first sixteen years," is available online at <http://bit.ly/esebenbrook2012>.



Dr. Charles Benbrook, research professor, WSU Center for Sustaining Agriculture and Natural Resources. Photo courtesy Washington State University. Click image to download hi-resolution version.

Dr. Charles Benbrook, research professor, WSU Center for Sustaining Agriculture and Natural Resources. Photo courtesy Washington State University. Click image to download hi-resolution version.

GENETICALLY ENGINEERED FOODS & THE ENVIRONMENT

March 2013

Industry developed genetically engineered (GE) crops and introduced them to the market with the promise of higher crop yields, but the only things that have increased are the use of toxic herbicides and pesticides, the number of resistant weeds and bugs, contaminated crops and chemical industry profits.

SUPERWEEDS

When the first herbicide-tolerant GE crops were planted in the U.S. 15 years ago, some experts warned that the technology would accelerate the development of “superweeds” that would be resistant to the herbicides used with the crops. They were right. Superweeds, which evolve to withstand the very chemicals designed to kill them, have now become an epidemic on farmland in many locations across the country.

The most common superweeds are resistant to glyphosate, the active ingredient in Monsanto’s popular herbicide Roundup, but resistance is appearing to herbicides used with other GE crops as well. Today, more than 61.2 million acres of U.S. farmland are infested with weeds resistant to Roundup, which has been the world’s best-selling weed killer for 32 years. A 2012 survey showed that 49 percent of U.S. farmers reported finding “superweeds” in their fields.¹

As weeds became resistant, growers have applied still more herbicides to try to control them. A recent study found that over the 16 years from 1996 to 2011, the use of GE crops increased herbicide use by 527 million pounds,² putting consumers and the environment increasingly at risk.

The emergence of glyphosate-resistant superweeds has led growers to turn to older herbicides such as dicamba and 2,4-D, an ingredient used in Agent Orange, the notorious Vietnam War era defoliant, resulting in the emergence of weed species that are resistant to multiple chemicals. Already, a recent study found, 28 species worldwide are resistant to 2,4-D and/or dicamba.³ By 2019, the study concluded, these trends could result in enormous additional increases in herbicide use, such as a 30-fold increase in the amount of 2,4-D applied to the American corn crop.

Both dicamba and 2,4-D are volatile chemicals that evaporate and can drift well beyond their targets, especially in warmer weather, posing a significant public health risk to nearby rural communities. Studies have linked springtime applications of 2,4-D to reproductive problems, spontaneous abortions, birth defects⁴ and an elevated risk of non-Hodgkin’s lymphoma.

The emergence of superweeds resistant to multiple herbicides has demonstrated that the strategy of combatting weeds by engineering crops that can withstand herbicides and then blasting fields with

those chemicals is no match for evolutionary adaptation. This approach leads to a dangerous, toxic dead end, one that will leave the landscape infested ever more varieties of resistant superweeds while undermining efforts at safe, sustainable farming.⁵

SUPERBUGS

In 2003, Monsanto introduced the first crop engineered to kill insect pests that attack it. Its scientists modified the DNA of corn with genetic material from the bacterium *Bacillus thuringiensis* (Bt) to induce the plants to produce a protein fatal to rootworms, which cause a devastating corn blight.

As with superweeds, however, recent evidence has shown that rootworms have begun developing resistance to the protein produced by Bt corn. First observed during the 2009 growing season, these “superbugs” are now prevalent throughout the corn belt, predominantly in Illinois, Iowa, Minnesota, Nebraska and South Dakota.⁶

Certain agricultural “best practices,” such as rotating GE and non-GE crops, can slow the development of superweeds and superbugs, but a 2011 study found that around 40 percent of U.S. farmers do not follow those practices.⁷

To date, crops engineered to reduced sprayed insecticide use have done the opposite, increasing the need for insecticides. Continuing the application of these insecticides will increase insect resistance in the long run and could have damaging effects on honeybee populations and soil diversity.⁸

CROSS-CONTAMINATION

With genetically engineered crops covering about half of all harvested cropland in the United States,⁹ many organic farmers are struggling to prevent cross-contamination, which occurs when seed or pollen from GE cropland drifts onto neighboring plots. It has become evident that current industry standards for separating GE fields from organic cropland are inadequate. Wind, insects, floods and machinery spread seed and pollen over considerable distances.

This has become a major issue for growers hoping to sell their crops to countries that strictly regulate or ban GE foods, hurting exports and farmers’ profits. According to one estimate, the potential losses in sales or lower prices for farmers growing organic and GM-free corn may total \$90 million annually.¹⁰

Contaminated seed can spread remarkably far. In 2000, a GE corn crop accounting for just 1 percent of the total harvest, which was not approved for use as food, managed to contaminate half the national supply,¹¹ resulting in a nationwide recall that ultimately cost the company that developed the Bt corn about \$1 billion.¹²

Once a field has been planted with GE seed, it is difficult to assure future plantings will not be affected. GM crops can persist and remain viable in soil for years. In one case, residual GM canola seeds were found in the soil 10 years after they had been planted.¹³

CONCLUSION

Advancements in GE technology that were intended to make it easier for farmers to protect their crops from weeds and pests have instead increased the use of herbicides and pesticides and led to the emergence of superweeds and superbugs. This bitter outcome calls for a more integrated approach to crop and pest management.

ENDNOTES

1. Farm Industry News “Glyphosate-resistant weed problem extends to more species, more farms.” January 2013 <http://farmindustrynews.com/herbicides/glyphosate-resistant-weed-problem-extends-more-species-more-farms>
2. [“The Impact of Genetically Engineered Crops on Pesticide Use in the U.S., the First Sixteen Years”, Charles Benbrook, PhD, June 14-15, 2012] <http://www.enveurope.com/content/24/1/24>
3. [“The Impact of Genetically Engineered Crops on Pesticide Use in the U.S., the First Sixteen Years”, Charles Benbrook, PhD, June 14-15, 2012] <http://www.enveurope.com/content/24/1/24>
4. [“The Impact of Genetically Engineered Crops on Pesticide Use in the U.S., the First Sixteen Years”, Charles Benbrook, PhD, June 14-15, 2012] <http://www.enveurope.com/content/24/1/24>
5. (GMO Myths and Truths, An evidence-based examination of the claims made for the safety and efficacy of genetically modified crops, by Michael Antoniou, Claire Robinson, and John Fagan, June 2012, p. 70) <http://bit.ly/YHERbh>
6. Gassmann, A. J., J. L. Petzold- Maxwell, R. S. Keweshan, and M. W. Dunbar. 2011. Field- evolved resistance to Bt maize by western corn rootworm. <http://bit.ly/XG1SvW>
7. Rodale News “Superbugs Prompt Urgent Warning From Scientists”, March 2012 <http://www.rodale.com/gmo-corn>
8. BBC News “GM Study Shows Potential Harm”, March 2005 <http://news.bbc.co.uk/2/hi/science/nature/4368495.stm>
9. [“The Impact of Genetically Engineered Crops on Pesticide Use in the U.S., the First Sixteen Years”, Charles Benbrook, PhD, June 14-15, 2012] <http://www.enveurope.com/content/24/1/24>
10. Hewlett, KL, Azeez, GSE. 2008. The Economic Impacts of GM Contamination Incidents on the Organic Sector. <http://bit.ly/XpQ2Y5>
11. Lin W, Price G & Allen E (2001), ‘StarLink: impacts on the US corn market and world trade’, Feed Yearbook, Economic Research Service/USDA, April 2001 <http://naldc.nal.usda.gov/download/36491/PDF>
12. Soil Association “Seeds of Doubt: North American farmers’ experiences of GM crops” September 2002 <http://bit.ly/UQGYvs>
13. D’Hertefeldt T, Jørgensen RB, Pettersson LB. Long-term persistence of GM oilseed rape in the seedbank. Biology Letters. June 23 2008; 4: 314–317. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2610060/>

From: Mary Ellen Kustin <mkustin@ewg.org>
Sent: Friday, June 12, 2015 5:44 PM
Subject: Re: Update on July 8th and request for any Pre-read materials for the Wal-Mart team
Attachments: 2015Mellman[2].pdf; JLI factsheets_PP01[1].pdf; CFS World Map[1].pdf; Kai-Roberston-Food-Labeling-Study-2013[1].pdf; Glyphosate factsheet[2].pdf; Benbrook[3].pdf; FeedWorld Report[1].pdf; FactSheet_24D_Health.pdf; LetterToEPA_Enlist_MedSci_FINAL_06_30_14_0.pdf; Mortensen Critical Juncture - Bioscience Jan 2012(1)[3][3].pdf

Hi Gary,

Thanks again for making this meeting happen. As for your request for pre-read materials, I'm attaching some for your consideration to include when communicating back to the Wal-Mart team. Do others have any additional info that want to be sure we include ahead of time?

Mary Ellen

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**From:** Gary HIRSHBERG <[GHIRSHBERG@Stonyfield.com](mailto:GHIRSHBERG@Stonyfield.com)>  
**Date:** Tuesday, May 26, 2015 at 9:27 PM  
**To:** "[phil.landrigan@mssm.edu](mailto:phil.landrigan@mssm.edu)" <[phil.landrigan@mssm.edu](mailto:phil.landrigan@mssm.edu)>, Curt DellaValle <[curt@ewg.org](mailto:curt@ewg.org)>, "[cslu@hsph.harvard.edu](mailto:cslu@hsph.harvard.edu)" <[cslu@hsph.harvard.edu](mailto:cslu@hsph.harvard.edu)>, "[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)" <[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)>, Mary Ellen Kustin <[mkustin@ewg.org](mailto:mkustin@ewg.org)>, "[davemortensen@comcast.net](mailto:davemortensen@comcast.net)" <[davemortensen@comcast.net](mailto:davemortensen@comcast.net)>, Emily Cassidy <[ecassidy@ewg.org](mailto:ecassidy@ewg.org)>  
**Cc:** Scott Faber <[sfaber@ewg.org](mailto:sfaber@ewg.org)>  
**Subject:** Update on July 8th and request for any Pre-read materials for the Wal-Mart team

Hi all, thank you again for your willingness to participate in Just Label It's half-day briefing and discussion with senior members of Wal\*Mart's management on July 8th. I just concluded a call with them in which we agreed to the following meeting agenda to take place from 1-5:30pm at Wal\*Mart's offices in downtown Washington, DC. As you will see, we have intentionally kept the presentation times relatively brief to enable as much discussion as possible. We're assuming that each pair of presenters will decide among you how best to divide up your individual discussions.

1pm – 1:15 *Introductions, Welcomes, Explanation of the Goals of this Meeting* **Gary Hirshberg and Scott Faber**

1:15-1:40 *Herbicides Are Damaging Public Health* - **Phil Landrigan and Curt DellaValle**

Philip J. Landrigan, MD, MSc, FAAP is Dean for Global Health and Ethel H. Wise Professor and Chairman, Department of Preventive Medicine; Professor of Pediatrics; Director, Children's Environmental Health Center; Icahn School of Medicine

at Mount Sinai. Dr. Landrigan is known for his many decades of work in protecting children against environmental threats to health. His research combines the tools of epidemiology with biological markers derived from clinical and laboratory medicine. Dr. Landrigan is deeply committed to translating research into strategies for health protection and disease prevention. He is a pediatrician and epidemiologist. He has been a member of the faculty of Mount Sinai School of Medicine since 1985 and Chair of the Department of Preventive Medicine since 1990. He was named Dean for Global Health in 2010. Dr. Landrigan is also the Director of the Children's Environmental Health Center. Dr. Landrigan graduated from Boston College in 1963 and from Harvard Medical School in 1967. He has published more than 500 scientific papers and 5 books. He has chaired committees at the National Academy of Sciences on Environmental Neurotoxicology and on Pesticides in the Diets of Infants and Children. Dr. Landrigan has served as a member of the National Academy of Sciences, Editor-in-Chief of the American Journal of Industrial Medicine, and as the senior advisor on children's health to the Administrator of the U.S. Environmental Protection Agency.

Curt DellaValle, Scientist, Environmental Working Group -Curt holds a Ph.D. in environmental health from Yale University and a B.S. in biology from the University of Connecticut. was a fellow at the National Cancer Institute where he conducted research evaluating environmental contaminants and risk of cancer, with a particular emphasis on the improvement of exposure assessment methods in epidemiologic studies. He brings his background in epidemiology and cancer research experience to work on the development of EWG's Cancer Prevention Initiative.

### 1:40 - 2:05 *GMOs Are Leading to Very Significant Increases in the Use of Toxic Herbicides* -**Alex Lu** and **Chuck Benbrook**

Chenseng (Alex) Lu, PhD is Associate Professor of Environmental Exposure Biology in the Department of Environmental Health, Harvard University. Dr. Lu's primary research is to use variety of biomarkers for assessing human exposures to environmental chemicals in order to facilitate the identification of risk factors, as well as the formation of hypotheses for potential health effects. He is collaborating extensively with scientists/researchers in the following research projects; 1) children's residential pesticide exposures with Boston Housing Authority and the Committee for Boston Public Housing, 2) dietary pesticide exposures with Food and Drug Administration (FDA) regional labs, 3) biomarkers of pesticide exposure and health effects with Agricultural Health Study, 4) honeybee colonies collapsing disorder (CCD) with Harvard Center for the Environment, 5) community-based farmworker housing, exposures and health with Wake Forest University School of Medicine, and 6) exposure characterization of endocrine disrupting chemicals among custodians using conventional and green cleaning products with University of Connecticut/School of Medicine.

Charles (Chuck) Benbrook is the Program Leader of the Measure to Manage (M2M) Program, Center for Sustaining Agriculture and Natural Resources (CSANR), Washington State University. Over a long career, Dr. Benbrook has developed a variety of analytical systems quantifying food quality and safety, and the impacts of agricultural technology and policy. He has worked extensively with several major government data sets, translating, for example, detailed statistics on pesticide use and residue levels into measures of pesticide risk, and government data on the levels of nutrients in food into measures of a food's nutritional value. He spent the first 18 years of his career working in Washington, D.C., first working for the Executive Office of the President (1979-1980), then as the Executive Director for a U.S. House of Representatives agricultural subcommittee (1981-1983). He was the ED of the National Academy of Sciences Board on Agriculture from 1984-1990, and has run a small consulting firm since 1991. He moved to the west in 1997, and served as the Chief Scientist for The Organic Center from 2004 through June of 2012. He has participated as an expert witness in several lawsuits involving pesticides and agricultural biotechnology.

### 2:05 – 3:00 Q&A / Discussion

### 3:00-3:10 Break

### 3:10-3:20 *GMOs Are Not Improving Overall Yields* - **Emily Cassidy**

Emily Cassidy is a Research Analyst at Environmental Working Group. Emily earned her master's and bachelor degrees in natural resources science from the University of Minnesota. As a research analyst at EWG, she investigates the impact of agriculture on land, water, and air. Her projects have focused on ways to change the food system to yield healthier, more sustainable food. Prior to joining EWG, she co-authored a highly cited paper, "Solutions for a Cultivated Planet," which investigated how to sustainably feed 9 billion people. For her master's thesis she developed a novel metric, quantifying the number of people fed per acre of cropland. Her research has been featured on NBC News, Scientific American and National Geographic, among others.

### 3:20 – 3:40 Q&A / Discussion

### 3:40 – 4:05 *Alternatives to GMOs and the Chemical Treadmill*: **Dave Mortensen** and **Mary Ellen Kustin**

David Mortensen is Professor of Weed and Applied Plant Ecology, Penn State University. Dr. Mortensen has a long-standing interest in making weedy plant management more sustainable through understanding how management tactics interact. His work focuses on methods of enhancing weedy plant invasion resistance in northeastern forests. He applies his background in applied



plant ecology and ecologically-based pest management to improve the sustainability of land resource management. His work takes a landscape approach to assessing the interplay between the ecology of agricultural fields, field edges and forest fragments. He earned his undergraduate degree in botany from Drew University in 1978, his MS in botany from Duke University in 1983, and his PhD in crop science from North Carolina State University in 1987.

Mary Ellen Kustin joined EWG's government affairs team after working on conservation and environmental campaigns for the Pew Charitable Trusts and the National Wildlife Federation. She holds an M.S. in Sustainable Development and Conservation Biology as well as an M.P.P in Environmental Policy from the University of Maryland. She earned her B.S. in Mathematics from the University of South Carolina.

4:05 – 4:35 Q&A / Discussion

4:35-5:30 *Conclusions, Proposals and Next Steps- Why a Mandatory GMO Labeling Policy can contribute to positive change and increased consumer confidence*

5:30 Adjourn

The Wal\*Mart team has asked that I send them in advance any useful papers, summaries or abstracts that could help them to be fully prepared for this meeting. If you have any suggested pre-read materials, can you kindly get them or the references to me by Friday, June 12th? I will put the package together and resend it to all participants.

We will also send you directions, contact information and all other logistics in advance of the meeting.

Again, thanks for participating in what should be a very interesting and dynamic day.

Sincerely,



**Gary Hirshberg**  
**Chairman, Stonyfield Farm**  
**Chairman, Just Label It**



June 30, 2014

Administrator Gina McCarthy  
U.S. Environmental Protection Agency  
1200 Pennsylvania Ave NW  
Washington, DC 20460

RE: Dow AgroSciences application to amend their 2,4-D choline salt herbicide for use on 2,4-D tolerant corn and soybeans. Docket EPA-HQ-OPP-2014-0195

Dear Administrator McCarthy:

We the undersigned scientists, medical professionals, and researchers are writing to urge the U.S. Environmental Protection Agency not to register a double herbicide mix of 2,4-D and glyphosate (the “Enlist Duo<sup>TM</sup>” weed killer) for farm field spraying in combination with a new breed of genetically engineered corn and soybeans.

This 2,4-Dichlorophenoxyacetic acid (2,4-D) and glyphosate herbicide system developed by Dow AgroSciences, a wholly owned subsidiary of the Dow Chemical Company, would put public health at risk if sprayed on millions of acres of cropland.

Dow Chemical Company promotes 2,4-D-resistant corn and soybeans to be used in conjunction with Enlist Duo<sup>TM</sup> because the widespread planting of the glyphosate-tolerant Roundup Ready corn and soybeans has resulted in accelerated herbicide resistance in numerous weed species.<sup>1</sup> Now, instead of re-evaluating the genetically engineered crop strategy in the United States, the U.S. Department of Agriculture and EPA are close to approving the 2,4-D-resistant corn and soybeans despite the risks that the increased use of 2,4-D would pose to human health and the environment.

2,4-D is a notorious herbicide that has been linked with adverse health effects to the thyroid<sup>2</sup> and an increased risk of non-Hodgkin’s lymphoma<sup>3</sup> in human epidemiological studies. Although studies of pesticide exposure among farmers and their families are confounded by exposure to multiple pesticides, there is a large and compelling body of data that demonstrates the link between occupational exposure to herbicides and insecticides and non-Hodgkin’s lymphoma.<sup>4</sup> Studies of farmers who worked with 2,4-D found a link between exposure to this herbicide and suppressed immune function,<sup>5</sup> lower sperm count,<sup>6</sup> and a greater risk of Parkinson’s disease.<sup>7</sup>

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<sup>1</sup> Owen MD. Weed species shifts in glyphosate-resistant crops. *Pest Manag Sci.* 64(4): 377-87. and Owen MD, Young BG, Shaw DR, Wilson RG, Jordan DL, Dixon PM, Weller SC. 2011. Benchmark study on glyphosate-resistant crop systems in the United States. Part 2: Perspectives. *Pest Manag Sci.* 67(7): 747-57.

<sup>2</sup> Goldner WS, Sandler DP, Yu F, Shostrom V, Hoppin JA, Kamel F, LeVan TD. 2013. Hypothyroidism and pesticide use among male private pesticide applicators in the agricultural health study. *J Occup Environ Med.* 55(10): 1171-8.

<sup>3</sup> Miligi L, Costantini AS, Veraldi A, Benvenuti A; WILL, Vineis P. Cancer and pesticides: an overview and some results of the Italian multicenter case-control study on hematolymphopoietic malignancies. *Ann N Y Acad Sci* 1076:366-77, 2006.

<sup>4</sup> Schinasi L, Leon ME. 2014. Non-Hodgkin lymphoma and occupational exposure to agricultural pesticide chemical groups and active ingredients: a systematic review and meta-analysis. *Int J Environ Res Public Health* 11(4): 4449-527.

<sup>5</sup> Faustini A, Settini L, Pacifici R, Fano V, Zuccaro P, Forastiere F. 1996. Immunological changes among farmers exposed to phenoxy herbicides: preliminary observations. *Occup Environ Med.* 53(9): 583-5.

<sup>6</sup> Lerda D, Rizzi R. 1991. Study of reproductive function in persons occupationally exposed to 2,4-dichlorophenoxyacetic acid (2,4-D). *Mutat Res.* 262(1): 47-50.



These findings from human studies, whether small-scale, pilot studies or large cohort studies, point out significant risks from 2,4-D to human health even for the relatively healthy adults who work in agricultural jobs. Such risks would be much higher for young children, especially young children in residential communities, schools, and daycare centers near the 2,4-D-sprayed fields.

Also worrisome is the fact that the manufacturer did not conduct any toxicity tests for simultaneous exposure to the combination of 2,4-D and glyphosate, which could pose a much higher human and environmental toxicity risk than either herbicide alone. EPA acknowledges that, “there could be additional toxicological effects (synergistic or additive) because of the presence of two herbicides.”<sup>8</sup> Yet, the Agency disregarded these data gaps and both human and environmental toxicity concerns in its proposal to register the Enlist Duo™ herbicide.

If the EPA were to approve Dow’s application for 2,4-D-glyphosate herbicide to be used on 2,4-D-resistant crops, USDA estimates at least a tripling of use of 2,4-D by 2020 compared to the present amounts used annually for agriculture in the United States.<sup>9</sup> The increase in 2,4-D spraying on corn and soybean fields would lead to pollution of food and water and increased drift of 2,4-D from the fields into nearby residential areas. The Dow Chemical Company claims that their 2,4-D choline salt formulation has low volatility and low drift. However, the large-scale, blanket spraying that has become standard practice with genetically engineered crops would make herbicide drift from sprayed fields into nearby residential areas and ecosystem habitats highly likely to occur.

In addition to putting human health at risk, increased 2,4-D spraying would harm the already-vulnerable ecosystems in intensely farmed regions of the United States; affect dozens of endangered species; and potentially contribute to the decline of pollinators and honeybees. EPA itself has identified these likely outcomes of 2,4-D spraying in the agency’s ecological risk assessment for 2,4-D. Such direct and indirect effects of 2,4-D would have significant **negative** economic consequences.

Finally, increased 2,4-D application is likely to accelerate and exacerbate the evolution of yet more 2,4-D-resistant weeds.<sup>10</sup> This pattern is known as the “pesticide treadmill” when farmers end up using larger amounts of increasingly toxic chemicals to control herbicide-resistant weeds eventually requiring the use of different pesticides.

Decades of research have continuously demonstrated the risks of using 2,4-D, a notoriously toxic herbicide. Allowing large-scale 2,4-D spraying in combination with 2,4-D-tolerant genetically engineered crops would worsen the problem. We urge the EPA to do the right thing and deny the approval of the new mixtures of 2,4-D and glyphosate in order to protect human and environmental health.

---

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Sincerely,

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*The signers of this letter have done so in their personal capacities. Institutional affiliations are provided only for identification purposes and do not imply any institutional position.*

# Backers of mandatory GMO label laws take aim at glyphosate

By [Daniel Enoch](#)

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WASHINGTON, July 8, 2015 - Proponents of mandatory labeling of food products made with genetically modified organisms (GMOs) rolled out a trio of academics Wednesday in a bid to raise public awareness of the public health and environmental costs of herbicides used in the production of genetically engineered crops.

The panelists at a Washington breakfast sponsored by the Just Label It campaign included [Charles Benbrook](#) with the Center for Sustaining Agriculture and Natural Resources at Washington State University; [Alex Lu](#), an associate professor in the Department of Public Health at Harvard University; and [David Mortenson](#), professor of weed and applied plant ecology at Penn State's College of Agricultural Sciences.

Their main target was U.S. agriculture's increasing use of glyphosate, the key ingredient in Monsanto's Roundup herbicide and a chemical that has been classified as “probably carcinogenic” by the International Agency for Research on Cancer, the cancer research arm of the World Health Organization.

Benbrook asserted that glyphosate now accounts for about two-thirds of the active ingredients farmers use on their crops and that its use exploded following the introduction of genetically-engineered glyphosate resistant crops - mostly corn and soybeans -- letting farmers kill weeds without killing the crops. That's up from about 10 percent in the mid-1980s.

“At some point, the cost to farmers and the environment is going to become intolerable,” Benbrook said.

Lu argued that the Environmental Protection Agency, in allowing continued use of the product, is ignoring evidence from Europe and elsewhere of glyphosate's harmful health effects. And Mortenson noted that there are alternatives farmers can use to get off what he called the “pesticide treadmill,” including cover cropping, rotational tillage and increased use of crop rotation, without facing reduced yields.

CropLife America, which represents agricultural chemical companies, disagrees. According to the group, up to 40 percent of the world's potential crop production is lost each year because of the effects of weeds, pests and diseases, and these losses would double if existing pesticide uses were abandoned.

The Environmental Working Group, which organized today's briefing, said that contrary to the GMO seed industry's promise that the production of GMO crops would result in a decreased use of pesticides, the exact opposite has occurred over the past two decades. Use of glyphosate has increased 16-fold since the 1990s, primarily due to its use on GMO crops, it said. In 2012, growers sprayed 280 million pounds of glyphosate on their crops, according to [U.S.](#)





# GMOs, Herbicides, and Public Health

N Engl J Med 2015; 373:693-695 | [August 20, 2015](#) | DOI: 10.1056/NEJMp1505660

 **Comments** open through August 26, 2015

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Genetically modified organisms (GMOs) are not high on most physicians' worry lists. If we think at all about biotechnology, most of us probably focus on direct threats to human health, such as prospects for converting pathogens to biologic weapons or the implications of new technologies for editing the human germline. But while those debates simmer, the application of biotechnology to agriculture has been rapid and aggressive. The vast majority of the corn and soybeans grown in the United States are now genetically engineered. Foods produced from GM crops have become ubiquitous. And unlike regulatory bodies in 64 other countries, the Food and Drug Administration (FDA) does not require labeling of GM foods.

Two recent developments are dramatically changing the GMO landscape. First, there have been sharp increases in the amounts and numbers of chemical herbicides applied to GM crops, and still further increases — the largest in a generation — are scheduled to occur in the next few years. Second, the International Agency for Research on Cancer (IARC) has classified glyphosate, the herbicide most widely used on GM crops, as a “probable human carcinogen”<sup>1</sup> and classified a second herbicide, 2,4-dichlorophenoxyacetic acid (2,4-D), as a “possible human carcinogen.”<sup>2</sup>

The application of genetic engineering to agriculture builds on the ancient practice of selective breeding. But unlike traditional selective breeding, genetic engineering vastly expands the range of traits that can be moved into plants and enables breeders to import DNA from virtually anywhere in the biosphere. Depending on the traits selected, genetically engineered crops can increase yields, thrive when irrigated with salty water, or produce fruits and vegetables resistant to mold and rot.

The National Academy of Sciences has twice reviewed the safety of GM crops — in 2000 and 2004.<sup>3</sup> Those reviews, which focused almost entirely on the genetic aspects of biotechnology, concluded that GM crops pose no unique hazards to human health. They noted that genetic transformation has the potential to produce unanticipated allergens or toxins and might alter the nutritional quality of food. Both reports recommended development of new risk-assessment tools and postmarketing surveillance. Those recommendations have largely gone unheeded.

Herbicide resistance is the main characteristic that the biotechnology industry has chosen to introduce into plants. Corn and soybeans with genetically engineered tolerance to glyphosate (Roundup) were first introduced in the mid-1990s. These “Roundup-Ready” crops now account for more than 90% of the corn and soybeans planted in the United States.<sup>4</sup> Their advantage, especially in the first years after introduction, is that they greatly simplify weed management. Farmers can spray herbicide both before and during the growing season, leaving their crops unharmed.

But widespread adoption of herbicide-resistant crops has led to overreliance on herbicides and, in particular, on glyphosate.<sup>5</sup> In the United States, glyphosate use has increased by a factor of more than 250 — from 0.4 million kg in 1974 to 113 million kg in 2014. Global use has increased by a factor of more than 10. Not surprisingly, glyphosate-resistant weeds have emerged and are found today on nearly 100 million acres in 36 states. Fields must now be treated with multiple herbicides, including 2,4-D, a component of the Agent Orange defoliant used in the Vietnam War.

The first of the two developments that raise fresh concerns about the safety of GM crops is a 2014 decision by the Environmental Protection Agency (EPA) to approve Enlist Duo, a new combination herbicide comprising glyphosate plus 2,4-D. Enlist Duo was formulated to combat herbicide resistance. It will be marketed in tandem with newly approved seeds genetically engineered to resist glyphosate, 2,4-D, and multiple other herbicides. The EPA anticipates that a 3-to-7-fold increase in 2,4-D use will result.

In our view, the science and the risk assessment supporting the Enlist Duo decision are flawed. The science consisted solely of toxicologic studies commissioned by the herbicide manufacturers in the 1980s and 1990s and never published, not an uncommon practice in U.S. pesticide regulation. These studies predated current knowledge of low-dose, endocrine-mediated, and epigenetic effects and were not designed to detect them. The risk assessment gave little consideration to potential health effects in infants and children, thus contravening federal pesticide law. It failed to consider ecologic impact, such as effects on the monarch butterfly and other pollinators. It considered only pure glyphosate, despite studies showing that formulated glyphosate that contains surfactants and adjuvants is more toxic than the pure compound.

The second new development is the determination by the IARC in 2015 that glyphosate is a “probable human carcinogen”<sup>1</sup> and 2,4-D a “possible human carcinogen.”<sup>2</sup> These classifications were based on comprehensive assessments of the toxicologic and epidemiologic literature that linked both herbicides to dose-related increases in malignant tumors at multiple anatomical sites in animals and linked glyphosate to an increased incidence of non-Hodgkin's lymphoma in humans.

These developments suggest that GM foods and the herbicides applied to them may pose hazards to human health that were not examined in previous assessments. We believe that the time has therefore come to thoroughly reconsider all aspects of the safety of plant biotechnology. The National Academy of Sciences has convened a new committee to reassess the social, economic, environmental, and human health effects of GM crops. This development is welcome, but the committee's report is not expected until at least 2016.

In the meantime, we offer two recommendations. First, we believe the EPA should delay implementation of its decision to permit use of Enlist Duo. This decision was made in haste. It was based on poorly designed and outdated studies and on an incomplete assessment of human exposure and environmental effects. It would have benefited from deeper consideration of independently funded studies published in the peer-reviewed literature. And it preceded the recent IARC determinations on glyphosate and 2,4-D. Second, the National Toxicology Program should urgently assess the toxicology of pure glyphosate, formulated glyphosate, and mixtures of glyphosate and other herbicides.

Finally, we believe the time has come to revisit the United States' reluctance to label GM foods. Labeling will deliver multiple benefits. It is essential for tracking emergence of novel food allergies and assessing effects of chemical herbicides applied to GM crops. It would respect the wishes of a growing number of consumers who insist they have a right to know what foods they are buying and how they were produced. And the argument that there is nothing new about genetic rearrangement misses the point that GM crops are now the agricultural products most heavily treated with herbicides and that two of these herbicides may pose risks of cancer. We hope, in light of this new information, that the FDA will reconsider labeling of GM foods and couple it with adequately funded, long-term postmarketing surveillance.

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[Disclosure forms](#) provided by the authors are available with the full text of this article at NEJM.org.

From the Department of Preventive Medicine, Icahn School of Medicine at Mount Sinai, New York (P.J.L.); and the Department of Crops and Soil Sciences, Washington State University, Pullman, WA (C.B.).

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dichlorophenoxyacetic acid. Lancet Oncol 2015 June 22 (Epub ahead of print).

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The disclosure form for Dr. Charles Benbrook was updated on August 27, 2015. Both the updated form and the original form are included here.

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2. Surname (Last Name)  
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01-July-2015

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☐ Yes ☒ No

Corresponding Author's Name  
Philip Landrigan

5. Manuscript Title  
GMOs, Herbicides, and Public Health

6. Manuscript Identifying Number (if you know it)  
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Based on the above disclosures, this form will automatically generate a disclosure statement, which will appear in the box below.

Dr. Benbrook has nothing to disclose.

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Charles

2. Surname (Last Name)  
Benbrook

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27-August-2015

4. Are you the corresponding author?

☐ Yes

☒ No

Corresponding Author's Name  
Philip Landrigan

5. Manuscript Title  
GMOs, Herbicides and Public health

6. Manuscript Identifying Number (if you know it)  
15-05660

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Member of the USDA Advisory Committee on Biotechnology and 21st Century Agriculture. Principal of Benbrook Consulting Services, which has worked on pesticide risk and soil health for clients including Consumers Union, the Farm Foundation, the Noble Foundation, and the IPM Institute of North America. Expert witness in litigation involving the labeling of genetically engineered foods.

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### Section 6. Disclosure Statement

Based on the above disclosures, this form will automatically generate a disclosure statement, which will appear in the box below.

Dr. Benbrook reports that he is a member of the USDA Advisory Committee on Biotechnology and 21st Century Agriculture. He is also Principal of Benbrook Consulting Services, which has worked on pesticide risk and soil health for clients including Consumers Union, the Farm Foundation, the Noble Foundation, and the IPM Institute of North America. In addition, he has acted as an expert witness in litigation involving the labeling of genetically engineered foods.

### Evaluation and Feedback

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---

**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Tuesday, June 04, 2013 12:28 PM  
**Subject:** Re: RR Wheat Etc

Christine --

I will be in DC for an Agree meeting July 7-9, and would have the morning of the 8th open, through noon. I was hoping we could get together then in your office, and then maybe have a relaxed dinner the evening of the 8th??

I have learned a lot re the wheat debacle. It is clear that Oregon State University is going to bear a significant share of the blame, when all is said and done. The production field with the RR wheat in it is near where OSU used to have RR wheat plots, managed by a very gung-ho, pro-GE scientist that announced publicly circa 2000 that Oregon wheat farmers would have RR wheat to plant by 2003. Apparently, when the wheat industry and Monsanto pulled the plug, this OSU wheat breeder was cavalier re how the plots were and seed and breeding lines were handled. There is speculation he let some seed, and maybe even breeding lines go out that had the RR gene in it, without telling the people receiving the seed.

It will be interesting to see how this plays out. If no more positives are found, it will likely be a flash in the pan, but just a few positives will mean this will drag out for months and cost a gazzillion in disrupted trade.

Chuck

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**From:** Christine Bushway <[cbushway@ota.com](mailto:cbushway@ota.com)>  
**Date:** Tuesday, June 4, 2013 7:37 AM  
**To:** Charles Benbrook <[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)>  
**Subject:** RE: RR Wheat Etc

Hi Chuck:

We are having a conference call today with some of our members involved in what production or are big users. Basically just an opportunity for everyone to come together and talk threw what they are hearing, experiencing, etc. As you say it is very hard to know where this is all going to go and land but of course Monsanto is saying they have no idea how this happened!!!!!! As for yoyur further work let me see what comes out of today's call and then it would be good for you and I to talk.



Aren't you coming to DC sometime soon?

*Christine*

---

**Christine Bushway, CEO**

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Direct: (202) 403-8510 Mobile: (703) 501-0760

Follow OTA :    

---

**From:** Benbrook, Chuck [<mailto:cbenbrook@wsu.edu>]

**Sent:** Sunday, June 02, 2013 3:29 PM

**To:** Christine Bushway; Jessica Shade

**Cc:** Laura Batcha

**Subject:** RR Wheat Etc

Christine, Jessica, Laura --

It is impossible to predict the scope and impact of the current episode, but by next week, the first results will be reported of testing in the PNW. If there are ANY positives, this will go on for a long time with enormous impacts, probably well over a billion \$\$ when all is said and done. I am especially eager to hear if Genetic ID finds any in the testing going on as we speak. I suspect some sort of an announcement from them by the end of the week.

WSU has already tested multiple breeding lines and found zero contamination, which is good news. I have not spoken with Steve Jones, the organic wheat breeder at WSU, but will soon. I am sure he will have some interesting perspectives to add.

As this plays out, we obviously will have a series of teachable moments. I still owe TOC a wheat-related report re pesticides, and wonder whether we should not figure out a variation of the theme to better address what will be on people's minds.

RR wheat was a huge controversy back in the 2000-2005 period. It was shelved around 2004, and few have paid it much attention since. But there are lots of critical issues that were considered before, and are now coming to pass. Back in the day, Karen and I did Ag Biotech InfoNet, once the largest open website on ag biotech on the internet. We have not posted anything for close to 10 years, but the coverage for 1999-2003 is pretty good. There are some classic RR wheat items at -- <http://www.biotech-info.net/herbicide-tolerance.html#wheat>

You will note about 1/3 of the links are broke; we have all those files backed up. So one option/task, is someone could do a history of RR wheat, and post it along with most of these files. There are gems buried in that material, including results from Canadian research showing RR wheat increases fungal disease pressure (as Kremer's and Huber's et al work now confirms, explains), and a fascinating long story re WSU controversy over Clearfield (BASF) wheat. That story, toward the end, quotes Norman Borlaugh raising deep concerns over corporations gaining control over public seed supplies and breeding priorities. Geez, I sure don't recall many people noting that part of Borlaugh's worldview in all the testimonials upon his death.

Another key theme — there are other big issues with glyphosate, including some specific to wheat right now, esp. glyphosate use as a harvest aid late in the season to kill wheat/barley plants in the northern tier states. Millions of acres are being treated in late August-September, just weeks before harvest. Killing the plants speeds up harvest 7-10 days. But is also guarantees relatively high residues in the wheat, and anything made from whole wheat flour. Residues/exposure through wheat-based products plus residues via soybeans plus residues in drinking water = major human exposure. Glyphosate has the second highest Reference Dose of all registered pesticides, meaning EPA regards it as nearly non-toxic. That is why EPA

and other regulatory bodies keep issuing high tolerances for any food that Monsanto wants to spray it on. But many toxicologists feel that the glyphosate RfD is too high; some argue for a 3-X reduction, others an even greater reduction. A 10-X reduction would still leave it as one of the least toxic pesticides registered, but because of the massive human exposure, it would be in deep, deep regulatory trouble. The point someone needs to drive home is that human exposures have ballooned in just the last 4-6 years, and during this period, regulators have had glyphosate on auto-pilot. What Monsanto asks for, they get.

The gov't is trying to keep this from turning into a debacle by reassuring foreign markets that the genes/technology are safe, but they/gov't spokespeople are in a very weak position to do so, since the gov't has no basis to reach an independent judgement on this. Remember 2-3 months ago, I was quoted in some story saying there will be a next health scare, and when it happens, all the U.S. Gov't can say, honestly, is that Monsanto told the FDA that the technology was safe, and we (the FDA) had no basis or reason not to believe them, so we did. This HAS TO COME OUT, and is already starting. Recall, I sent around earlier the FDA letter to Monsanto, closing out the "voluntary consultation." It is attached again, above, along with the FDA's "scientific review." Note that this review just restates what Monsanto said in its package, and provides ZERO critical or independent analysis.

And then there are the coexistence issues and implications.

Chuck

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**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Tuesday, October 29, 2013 6:24 PM  
**Subject:** Re: Yes on 522's New Rocking GMO Salmon Ad; Dr. Bronner's Donates Another \$500,000

I had hour+ interviews with both "The Economist" and the Wash Post, with reporters who seemed much more open-minded than most in WA. Holding my breathe re the stories, I was pretty "out there."

At some point, I would like a chat re new developments on the allergen front.

Chuck

Charles Benbrook, Research Professor and Program Leader  
"Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
Center for Sustaining Agriculture and Natural Resources  
Washington State University

Office and mailing address:  
90063 Troy Road  
Enterprise, Oregon 97828  
Work Phone: 541-828-7918  
Cell (works only when on travel): 208-290-8707  
Email: cbenbrook@wsu.edu

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**From:** O'Brien Robyn <[robyn@allergykids.com](mailto:robyn@allergykids.com)>  
**Date:** Tuesday, October 29, 2013 1:09 PM  
**To:** Charles Benbrook <[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)>  
**Subject:** Re: Yes on 522's New Rocking GMO Salmon Ad; Dr. Bronner's Donates Another \$500,000

You are awesome. Wall Street is paying attention, too. Chipotle's stock hit a record high last week when they announced they would have to raise prices to go non GMO. It's up 44% on the year. Have spoken with Target and Nestle in the last week.

Sending a hug to you, Chuck. You are such an inspiration and mentor to me. Thank you for all that you do.

Robyn

On Oct 29, 2013, at 2:03 PM, Benbrook, Chuck wrote:

The "Unity" ad is terrific. I have had calls today from "The Economist" and the Wash Post. There is going to be a huge amount of media focus the next 10 days or so. Really important to craft the right messages post-vote, because this is a marathon and the beat will go on.

Chuck



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**From:** Lisa MacLean <[Lisa@moxiemedial.biz](mailto:Lisa@moxiemedial.biz)>  
**Date:** Tuesday, October 29, 2013 12:49 PM  
**To:** David Bronner <[allone@drbrunner.com](mailto:allone@drbrunner.com)>  
**Cc:** Trudy Bialic <[trudy.bialic@pccsea.com](mailto:trudy.bialic@pccsea.com)>, "Alexis Baden-Mayer Esq. ([alexis@organicconsumers.org](mailto:alexis@organicconsumers.org))" <[alexis@organicconsumers.org](mailto:alexis@organicconsumers.org)>, "Alisa Gravitz ([alisagravitz@greenamerica.org](mailto:alisagravitz@greenamerica.org)) ([alisagravitz@greenamerica.org](mailto:alisagravitz@greenamerica.org))" <[alisagravitz@greenamerica.org](mailto:alisagravitz@greenamerica.org)>, "Andy Amy's Kitchen ([andyberliner@amyskitchen.net](mailto:andyberliner@amyskitchen.net))" <[andyberliner@amyskitchen.net](mailto:andyberliner@amyskitchen.net)>, "Steve Crider ([stevecrider@amyskitchen.net](mailto:stevecrider@amyskitchen.net))" <[stevecrider@amyskitchen.net](mailto:stevecrider@amyskitchen.net)>, Arran Stephens <[AStephens@naturespath.com](mailto:AStephens@naturespath.com)>, Michael Hansen <[hansmi@consumer.org](mailto:hansmi@consumer.org)>, Charles Benbrook <[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)>, "maria@naturespath.com" <[maria@naturespath.com](mailto:maria@naturespath.com)>, Ronnie Cummins <[ronnie@organicconsumers.org](mailto:ronnie@organicconsumers.org)>, "Steve A. Rye ([steve.a.rye@mercola.com](mailto:steve.a.rye@mercola.com))" <[steve.a.rye@mercola.com](mailto:steve.a.rye@mercola.com)>, "Dave Murphy ([dave@fooddemocracynow.org](mailto:dave@fooddemocracynow.org))" <[dave@fooddemocracynow.org](mailto:dave@fooddemocracynow.org)>, "Steven Hoffman ([steve@compassnaturalmarketing.com](mailto:steve@compassnaturalmarketing.com))" <[steve@compassnaturalmarketing.com](mailto:steve@compassnaturalmarketing.com)>, "Steve Hallstrom ([letusfarm@earthlink.net](mailto:letusfarm@earthlink.net))" <[letusfarm@earthlink.net](mailto:letusfarm@earthlink.net)>, lori lively <[lori@marlenesmarket-deli.com](mailto:lori@marlenesmarket-deli.com)>, Maralyn Chase <[maralynchase@gmail.com](mailto:maralynchase@gmail.com)>, Gary Hirshberg <[GHIRSHBERG@Stonyfield.com](mailto:GHIRSHBERG@Stonyfield.com)>, "George Kimbrell ([gkimbrell@centerforfoodsafety.org](mailto:gkimbrell@centerforfoodsafety.org))" <[gkimbrell@centerforfoodsafety.org](mailto:gkimbrell@centerforfoodsafety.org)>, "Todd Kluger ([tkluger@lundberg.com](mailto:tkluger@lundberg.com))" <[tkluger@lundberg.com](mailto:tkluger@lundberg.com)>, "Bill Weiland (PMIDPI-MW) ([bweiland@pmidpi.com](mailto:bweiland@pmidpi.com))" <[bweiland@pmidpi.com](mailto:bweiland@pmidpi.com)>, "Liz Ahern (PMIDPI-MW) ([lahern@pmidpi.com](mailto:lahern@pmidpi.com))" <[lahern@pmidpi.com](mailto:lahern@pmidpi.com)>, "Corinne Shindelar ([cshindelar@infretailers.com](mailto:cshindelar@infretailers.com))" <[cshindelar@infretailers.com](mailto:cshindelar@infretailers.com)>, "Mary Ann Hunt ([director@NPANW.ORG](mailto:director@NPANW.ORG))" <[director@NPANW.ORG](mailto:director@NPANW.ORG)>, Elysa Hammond <[ehammond@clifbar.com](mailto:ehammond@clifbar.com)>, George Siemon <[george.siemon@organicvalley.coop](mailto:george.siemon@organicvalley.coop)>, "John W Roulac ([john@nutiva.com](mailto:john@nutiva.com))" <[john@nutiva.com](mailto:john@nutiva.com)>, "Katrina Morales ([kmorales@boulderbrands.com](mailto:kmorales@boulderbrands.com))" <[kmorales@boulderbrands.com](mailto:kmorales@boulderbrands.com)>, Ken Cook <[ken@ewg.org](mailto:ken@ewg.org)>, "Kristin Lynch ([klynch@fwwatch.org](mailto:klynch@fwwatch.org))" <[klynch@fwwatch.org](mailto:klynch@fwwatch.org)>, "Esteban, Marissa" <[marissa.esteban@pccsea.com](mailto:marissa.esteban@pccsea.com)>, "Mark Schlosberg ([mschlosberg@fwwatch.org](mailto:mschlosberg@fwwatch.org))" <[mschlosberg@fwwatch.org](mailto:mschlosberg@fwwatch.org)>, "Marlene Beadle ([marlene@marlenesmarket-deli.com](mailto:marlene@marlenesmarket-deli.com))" <[marlene@marlenesmarket-deli.com](mailto:marlene@marlenesmarket-deli.com)>, "Jimbo Someck ([jimbo@jimbo.com](mailto:jimbo@jimbo.com))" <[jimbo@jimbo.com](mailto:jimbo@jimbo.com)>, Megan Westgate <[megan@nongmoproject.org](mailto:megan@nongmoproject.org)>, Melissa Hughes <[melissa.hughes@organicvalley.coop](mailto:melissa.hughes@organicvalley.coop)>, Michael Funk <[mfunk@unfi.com](mailto:mfunk@unfi.com)>, Spector Rebecca <[rspector@icta.org](mailto:rspector@icta.org)>, Robynn Shrader <[robynn.shrader@ncga.coop](mailto:robynn.shrader@ncga.coop)>, "RussellParker@NaturesBest.net" <[RussellParker@NaturesBest.net](mailto:RussellParker@NaturesBest.net)>, Sara Bird <[sbird@annies.com](mailto:sbird@annies.com)>, Thao Pham <[thao@clifbar.com](mailto:thao@clifbar.com)>, "water4fish@comcast.net" ([water4fish@comcast.net](mailto:water4fish@comcast.net))" <[water4fish@comcast.net](mailto:water4fish@comcast.net)>, Errol Schweizer <[Errol.Schweizer@wholefoods.com](mailto:Errol.Schweizer@wholefoods.com)>, O'Brien Robyn <[robyn@allergykids.com](mailto:robyn@allergykids.com)>, Grant Lundberg <[grant@lundberg.com](mailto:grant@lundberg.com)>, "T. Cody Swift" <[cody@riverstyxfoundation.org](mailto:cody@riverstyxfoundation.org)>, "Amy Berliner ([amyberliner@amyskitchen.net](mailto:amyberliner@amyskitchen.net))" <[amyberliner@amyskitchen.net](mailto:amyberliner@amyskitchen.net)>, Kimbrell Andy <[kimbrell@icta.org](mailto:kimbrell@icta.org)>, "Arjan Stephens ([arjans@naturespath.com](mailto:arjans@naturespath.com))" <[arjans@naturespath.com](mailto:arjans@naturespath.com)>, "lisa@fooddemocracynow.org" <[lisa@fooddemocracynow.org](mailto:lisa@fooddemocracynow.org)>, "Zuri ([Zuri@organicconsumers.org](mailto:Zuri@organicconsumers.org))" <[Zuri@organicconsumers.org](mailto:Zuri@organicconsumers.org)>, "Stacy Malkan ([stacy@safecosmetics.org](mailto:stacy@safecosmetics.org))" <[stacy@safecosmetics.org](mailto:stacy@safecosmetics.org)>, "Archer, Lisa ([larcher@foe.org](mailto:larcher@foe.org))" <[larcher@foe.org](mailto:larcher@foe.org)>, Walter Robb <[Walter.Robb@wholefoods.com](mailto:Walter.Robb@wholefoods.com)>, "Karen Swift ([kswifta@gmail.com](mailto:kswifta@gmail.com))" <[kswifta@gmail.com](mailto:kswifta@gmail.com)>, Matthew Dillon <[matthew@organicintegrity.com](mailto:matthew@organicintegrity.com)>, "gary@clifbar.com" <[gary@clifbar.com](mailto:gary@clifbar.com)>, "Carin ([carinchase@hotmail.com](mailto:carinchase@hotmail.com))" <[carinchase@hotmail.com](mailto:carinchase@hotmail.com)>, "Paul Towers ([ptowers@panna.org](mailto:ptowers@panna.org))" <[ptowers@panna.org](mailto:ptowers@panna.org)>, "TJ McIntyre ([tjmccintyre@boulderbrands.com](mailto:tjmccintyre@boulderbrands.com))" <[tjmccintyre@boulderbrands.com](mailto:tjmccintyre@boulderbrands.com)>, Rob Everts <[reverts@equalexchange.coop](mailto:reverts@equalexchange.coop)>, "Joe Rogoff (PN RSF)" <[Joe.Rogoff@wholefoods.com](mailto:Joe.Rogoff@wholefoods.com)>, Scott Faber <[sfaber@ewg.org](mailto:sfaber@ewg.org)>, "paul.newman@barleans.com" <[paul.newman@barleans.com](mailto:paul.newman@barleans.com)>, "Delana Jones ([delana@yeson522.com](mailto:delana@yeson522.com))" <[delana@yeson522.com](mailto:delana@yeson522.com)>, "Rachel Padgett

([rachel@oldmixonhill.com](mailto:rachel@oldmixonhill.com))" <[rachel@oldmixonhill.com](mailto:rachel@oldmixonhill.com)>, "Lennon Bronsema ([lennon@yeson522.com](mailto:lennon@yeson522.com))" <[lennon@yeson522.com](mailto:lennon@yeson522.com)>, "Zach Silk ([zachariahslilk@gmail.com](mailto:zachariahslilk@gmail.com))" <[zachariahslilk@gmail.com](mailto:zachariahslilk@gmail.com)>, "Elizabeth Larter ([liz@yeson522.com](mailto:liz@yeson522.com))" <[liz@yeson522.com](mailto:liz@yeson522.com)>, "Julie Norton ([jnorton@skdknick.com](mailto:jnorton@skdknick.com))" <[jnorton@skdknick.com](mailto:jnorton@skdknick.com)>, "Michael Bocian ([mbocian@gbastrategies.com](mailto:mbocian@gbastrategies.com))" <[mbocian@gbastrategies.com](mailto:mbocian@gbastrategies.com)>

**Subject:** Re: Yes on 522's New Rocking GMO Salmon Ad; Dr. Bronner's Donates Another \$500,000

We have them on the run! Let's close strong and seal this victory!

**Lisa MacLean**

partner & principal

**MOXIE MEDIA**

206-322-6009

[www.moxiemedia.biz](http://www.moxiemedia.biz)

On Oct 29, 2013, at 12:48 PM, David Bronner wrote:

Hey all Lisa and Delana have advised that for the campaign to effectively use funds they need to be received by tomorrow ... Either overnight check today or wire tomorrow

OCA just stepped up with another 50 k :)

Rock on  
David

Sent from my iPhone

On Oct 29, 2013, at 10:18 AM, "David Bronner" <[allone@drbronner.com](mailto:allone@drbronner.com)> wrote:

Dear all:

After consultation with Yes on 522 campaign staff, it's clear we are in a dogfight that is coming down the wire. The most recent campaign track polling shows us rebounding from previous track polls, and we are now holding a 47% to 42% lead in line with recent public polling. The opposition knows this and recently put over \$4 million more into the No side; they are now the most expensive campaign in WA state history which I'm sure they very much wanted to avoid.

Fortunately the Yes campaign has released a new bomb ad focused on GMO salmon that can be viewed until 2 PM PST only <https://vimeo.com/album/2587394> Password: Yeson522 (the ad is dropping tomorrow and we don't want to give the opposition any heads up to minimize their time to respond). This clearly exposes the opposition lies that 522 does not cover genetically engineered meat while highlighting that FDA is about to greenlight a weird ass fish made with genes from an eel-like pout onto our dinner plates without any labeling. And this is brilliantly accomplished through an edit of a Diane Sawyer broadcast, a neutral credible third party delivering with unassailable veracity this hard and incredible truth to Washington voters. I believe this may well be the knockout blow rotating in with our other great ads in the close. The Consumers Union ad continues in rotation along with a sweet new Endorsements ad that will be posted soon.

We should all reach as deep as we possibly can now and throw down here in the final week to help drive the Yes side to victory. The Yes on 522 voter contact and GOTV effort is off the Richter with tens of thousands of calls being made, but it's up to us to fuel the crucial air war. How much would it suck if we

lose by 0.1% and we didn't all do what we can to rock this victoriously over the finish line. Worse comes to worst we run up the score on a win, or we have a narrow loss that continues our huge forward momentum as a movement... but more than likely this is going to be a photo finish race down to the wire. Dr. Bronner's is stepping up with another \$500 K to help the campaign close this out toe to toe with BIO all guns blazing in all media markets; another \$500 K would sure be sweet.

Also I recently contributed an article to the [GOOD.is](http://GOOD.is) website (that's not yet public and should run any day) that plainly explains the pesticide industry boondoggle driving the genetic engineering of food crops. I've attached that and be sure to click on the disturbing Boston Globe photoessay on the impact of GE crops and spiking pesticide use on farming communities in Argentina. A win in Washington will blow things open for other states and inevitably lead to national labeling, which will lead to less pesticide being blasted on our food and farming communities.

Thanks all for all you've already contributed. I hope you reach even deeper for one more heroic gift to the 522 effort.

Onwards!  
David

<GOOD GMO Article Final3.docx>

<GOOD GMO Article Final4.docx>

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**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Thursday, December 05, 2013 6:45 PM  
**Subject:** Re: Reporters access to the narratives, FAQ, Primer?  
**Attachments:** Outreach\_People\_Plan-12-1-13.docx

Yes, we are giving them the url to the material, which is also under the embargo. I attach the latest update re the outreach plan — it has a sample of the email I have sent out to reporters; it can be modified to professional colleagues. I will forward you an example right after sending this.

Very good 1 hr on phone with Ken Chang, NYT.

Chuck

Charles Benbrook, Research Professor and Program Leader  
"Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
Center for Sustaining Agriculture and Natural Resources  
Washington State University

Office and mailing address:  
90063 Troy Road  
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Work Phone: 541-828-7918  
Cell (works only when on travel): 208-290-8707  
Email: [cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)

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**From:** Donald R Davis <[d.r.davis@utexas.edu](mailto:d.r.davis@utexas.edu)>  
**Reply-To:** Don Davis <[d.r.davis@mail.utexas.edu](mailto:d.r.davis@mail.utexas.edu)>  
**Date:** Thursday, December 5, 2013 3:05 PM  
**Cc:** Charles Benbrook <[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)>  
**Subject:** Reporters access to the narratives, FAQ, Primer?

Chuck--

During the embargo period, do reporters have links to the narratives, FAQ, and primer?

There are no such links in the press release that I have (Dec. 4, Benbrook\_PLOS\_ONE\_Press\_Release\_Final.docx)

Don

On 12/5/2013 4:59 PM, Nicholas Potter wrote:

Thanks Don. There are many links and it will be a challenge making sure every one goes to the right place.

In this case, the press release and the blog post have not yet been posted, so I can't make links to them, but the links will be made as soon as they are up and ready to go. If it would be more clear, I can just make the



link refer back to the page itself, but since the site is still in beta, this shouldn't be an issue. On Monday when everything goes live the links will be changed and ready to roll.

~nap

On Thu, Dec 5, 2013 at 2:56 PM, Donald R Davis <[d.r.davis@utexas.edu](mailto:d.r.davis@utexas.edu)> wrote:  
Chuck and Nick--

At the Web site Chuck sent to coauthors a couple of days ago,  
<http://csanr.cahnrs.wsu.edu/program-areas/m2m/research-areas/nutritional-quality/organic-production-enhances-milk-nutritional-quality-by-shifting-fatty-acid-composition-a-united-states-wide-18-month-study/>

three of the links are identical--Press Release, Blog Post by Charles Benbrook, and Major Findings all link to what we called the narrative, with 13 figures.

Don

## **PLOS ONE Paper Release Team and Activities**

[Note to the Team – This is a living document, now in version # 3. Updates cover contacts by Benbrook through COB 12/1].

Key new items –

- **The WSU press release follows at the end of this document.**
- **A sample of the emails sent by Benbrook to reporters also appears.**
- **The revised and improved “Three Key Points” document also appears at the end – the Eric Sorensen inspired (mandated) elevator speech.**

Our initial focus is the ***SCIENCE*** content of the study, and its significant scientific findings.

The goal of the team is to assure that the coverage of the PLOS ONE paper is high-level and accurate; reinforces our core messages; is intense in the first few days, and then sustained; is shaped to help support and drive heavy social media interest and activity.

We are still working on a plan that will make some video footage available – more on this effort in a separate message.

Contact information for these and other key players appear alphabetically at the end of this document.

## **Potential Timeline-Sequencing and Key Dates**

12/9 Release by PLOS ONE, and end of embargo, 5:00 pm EST

12/2– WSU issues press release and offers embargoed copies of study. Reporters granted access to figures and FAQs on M2M/WSU website, and list of people to speak with

12/17 – CMB shoulder surgery, will be back on line 12/18, and on the phone 12/19

12/11-12 [Tentative] CMB attends Earthbound Farm Science Advisory Committee meeting, San Juan Baptiste (90 miles south of San Francisco). Will be available for key calls throughout, will have office phone forwarded directly to cell.

1/6-1/14 – Benbrook family vacation to Cozumel, MX, will have excellent internet and phone service, and will be keeping up with general flow.

1/20-23/14 – CMB trip to D.C. for AGree meeting, can do PLOS ONE related briefings etc.

### **The “A” Team of Commentators, Strategists, Influencers**

People who are likely to help out with strategic Tweets, comments to media, etc. Can be asked upfront to take defined actions at key time, and play certain roles in specific communities.

Michael Pollan (Chuck, DONE)  
Ken Cook (Chuck, DONE)  
Melinda Hemmelgarn (Elizabeth/Theresa, initial contact)  
Tom Philpott, Mother Earth News (Chuck, DONE)

These individuals will be fully briefed on the paper and provided access to it and associated material on the M2M website by or about 12/2. They will be asked if they would be willing to help assure that the release and outreach effort is broad and on-message. We should ask them to be prepared for media interviews; tweet re the study release, and then again in response to media dialogue and the unfolding discussion of, and reaction to the study’s findings. They will also be asked if they would be willing to help, on short notice, with a key strategic tweet or comment, usually on social media.

### **Nutrition/Science Community**

Chris McCullum (DONE, Chuck)  
Melinda Hemmelgarn (Contact -- Elizabeth and Theresa)  
Alan Greene (DONE, Chuck)  
Marion Nestle (DONE, Chuck)  
Mardi Mellon and Doug Gurian-Sherman (DONE, Chuck)  
Susan Roberts (??)  
Cindy Daley (DONE, Chuck)  
Heather Darby (Contact – Chuck)  
Jessica Shade (Contact – Chuck)  
Coach Mark Smallwood (Contact – Elizabeth/Theresa)  
Dr. Mercola (Melinda/Elizabeth help approach)  
Dr. Oz (Contact – Chuck)  
Others from Melinda H’s list

Re this list, these are people with professional experience and technical expertise in nutrition/dairy science who are likely to be contacted by media for comments, and who also might be willing to actively participate in ongoing social media efforts.

## **Nutrition/Food and Wellness Consumer Media**

[Amy is searching Meltwater for reporters covering omega fatty acid issues in the last 6 months, and will provide names to Eric to include in initial targeting. This will reach top-tier health and food writers we might otherwise miss, and will help keep focus on the omega-6/omega-3 ratio].

Joy Bauer (Contact – Elizabeth or ?)  
Sara Snow (Contact – Elizabeth or ?)  
Robyn O'Brien (DONE, Chuck)  
Keri Glassman (Contact – Elizabeth or ?)  
Ashley Koff (Contact – Chuck)  
Siobhan O'Connor, Prevention (Contact – Elizabeth or ?)  
Celia Barbour, Health (Contact – Elizabeth or ?)  
Jill Waldbieser, Women's Health (Contact – Elizabeth or ?)  
Regina Ragone, Family Circle (Contact – Elizabeth or ?)  
Samantha Cassety, Good Housekeeping (Contact – Elizabeth or ?)  
Tracey Whitney, Natural Health (Contact – Elizabeth or ?)  
Marjorie Korn, SELF (Contact – Elizabeth or ?)  
Leah Zerbe, Rodale.com (Contact – Elizabeth or ?)

## **Short Lead Targets w Broad Reach**

### **Tier One--Science**

NYT – Kenneth Chang confirmed for George deskside 12/4 in NYC. Chuck made initial contact 12/1, sent press release and paper.

Hope is that piece will run in the Science section on Tuesday.

Dan Charles, NPR – George deskside confirmed for 12/4 in D.C. Chuck contacted 12/1.

Ira Flatow, Science Friday, NPR  
Science writer, AP (defer to WSU team)  
Other key leads from WSU/Environmental News Service  
Emma Schwartz, ABC News (No longer there)  
Erik Stokstad, Science (DONE, Chuck)  
Monya Baker, Nature (DONE, Chuck)  
Janet Roloff, Science News (DONE, Chuck)  
Sarah Nassauer, WSJ -- lunch meeting with George confirmed 12/5 in NYC



## **Tier Two—Wire Services**

Carey Gillam, Reuters (Chuck, DONE)  
J. M. Hirsh, AP Wire (Chuck to contact; Elizabeth to send contact into)  
Jack Kaskey, Bloomberg (Chuck, DONE)  
Voice of America (Chuck to identify contact; Eric to include on press release list)

## **Key Organic-Influencer Writers**

NY-based

Mark Bittman, NYT  
Michael Moss, NYT  
Adam Gopnik, New Yorker, etc.  
Kim Severson, NYT  
Jane Black, Wash Post, etc.  
Corby Kummer, Atlantic, Vanity Fair, etc. (EH)  
Nicholas Kristoff, NYT (Elizabeth, maybe with help from Bansen)

Maria Rodale, Huffington Post

DC-based

Jerry Hagstrom, Hagstrom Report (Kathleen)  
Joan Nathan  
Phil Brasher (Executive Briefing/Roll Call)  
Alison Aubrey, NPR (EH)  
Mary Clare Jalonick (AP)  
Charles Abbott (Reuters) (If Carey cannot cover)  
Doug Palmer (Reuters) (If Carey cannot cover)  
Ron Nixon (DC Bureau NYT)  
Marion Burros (NYT contributor, based in DC area)  
Joe Yonan (Wash Post, etc.)  
USA Today, (Nanci Hellmich)  
Gannett (Christopher Doering)  
Dan Campbell (Rural Cooperatives)  
Alan Bjerga (Bloomberg) (If Klosky cannot cover)  
Paula Crossfield ? (Civil Eats)  
Amanda Peterka (Greenwire)  
Edward Maixner (Kiplinger Ag Report)  
Erika Bolstad (McClatchy)  
Wendy Wasserman  
Eddie Gehman Kohan,  
Danielle Nierenberg (Chuck, DONE)  
Wayne Percelle (Contact – Kathleen)  
Sarah Wyatt, Agri-Sense (DONE, Chuck)

## **Tier 2 Targets**

Georgina Gustin, St. Louis Post-Dispatch  
Eryn Brown, LA Times  
Sandi Doughton, Seattle Times (Chuck, DONE)  
Other regional and local media (defer to WSU; see note below about press conference)  
Elizabeth Weiss, USA Today, S.F. CA Bureau  
Andrew Bast, Newsweek  
Brian Walsh, TIME (EH)  
Brian Halweill, Edible Publications (DONE, Chuck)

## **Ag and Food Industry Media**

Clay Masters + Kathleen Masterson, NPR ag (EH)  
Many more to blast out to after initial pitching  
Cookston Beecher, PNW freelancer (Chuck, DONE)  
Len Richardson, Calif. Farmer (Chuck close friend, will approach)  
David Schardt, CSPI Newsletter (Chuck, DONE)  
Elizabeth to flesh out dairy other ag media  
Jim Carper, Dairy Foods  
Christine Kapperman, Natural Foods Merchandiser  
Elisa Bosley, Delicious Living  
Dan McGovern, Sustainable Food News (Elizabeth to contact)

## **Possible Scenarios**

Assuming 12/9 release:

- ABC or other broadcast news Monday evening, Science section NYT Tuesday and other print media
- Eric idea – Tuesday press conference in Seattle, great idea to leverage “local” story angle for national press, too. Perhaps Seattle bureaus of AP, other wires, broadcast affiliates, public radio, other syndicates, etc. could lead to national coverage/carriage?

## **Influential People, Organizations, Allies**

NODPA, WODPA, MOFGA, Other Industry Partners etc – Theresa/Vicky to help develop plan  
Peter Melchett, Soil Association, London, UK (Chuck, DONE)  
Urvashi Rangan, Consumers Union (Chuck, DONE)  
Laura Batcha/Jessica Siegel, OTA/TOC  
Michael Jacobsen et al CSPI

## **Contact Information Key Players –**

Charles Benbrook, Research Professor and Program Leader  
"Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
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[eric.sorensen@wsu.edu](mailto:eric.sorensen@wsu.edu)

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## **WSU Press Release**

Embargoed until 5 p.m. ET Monday, Dec. 9

Contact:  
Chuck Benbrook, research professor, Washington State University, 541-828-7918,  
[cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)

## Researchers See Added Nutritional Benefits in Organic Milk

### Organic forage raises levels of beneficial fats

PULLMAN, Wash.—A team led by a Washington State University researcher has found that organic milk contains significantly higher concentrations of heart-healthy fatty acids compared to milk from cows on conventionally managed dairy farms. While all types of milk fat can help improve an individual's fatty acid profile, the team concludes that organic whole milk does so even better.

The study is the first large-scale, U.S.-wide comparison of organic and conventional milk, testing nearly 400 samples of organic and conventional milk over an 18-month period. Conventional milk had an average omega-6 to omega-3 fatty acid ratio of 5.8, more than twice that of organic milk's ratio of 2.3. The researchers say the far healthier ratio of fatty acids in organic milk is brought about by a greater reliance on pasture and forage-based feeds on organic dairy farms.

A large body of research has shown that grass and legume forages promote cow health and improve the fatty acid profile in organic dairy products. Still, said WSU researcher Dr. Charles Benbrook, the study's lead author, "We were surprised by the magnitude of the nutritional quality differences we documented in this study."

After fruits and vegetables, dairy products are the largest category of the growing, \$29 billion organic food sector, according to the Organic Trade Association's 2013 Organic Industry Survey. Organic milk and cream sales were worth \$2.622 billion, the survey found. Overall, organic milk accounted for 4 percent of fluid milk sales last year, according to the Milk Processor Education Program.

The consumption of more omega-6 fatty acids than omega-3 fatty acids is a well-known risk factor for a variety of health problems, including cardiovascular disease, cancer, excessive inflammation, and autoimmune diseases. The higher the ratio of omega-6 to omega-3, the greater the associated health risk.

Western diets typically have a ratio of about 10-to-1 to 15-to-1, while a ratio of 2.3-to-1 is thought to maximize heart health. The team modeled a hypothetical diet for adult women with a baseline omega-6 to omega-3 ratio of 11.3, and looked at how far three interventions could go in reducing the ratio to 2.3.

They found that almost 40 percent of the needed nine-point drop could be achieved by switching from three daily servings of conventional dairy products to 4.5 daily servings of mostly full-fat organic dairy products. Women who also avoid a few foods each day that are high in omega-6 fatty acids can lower their fatty acid ratio to around 4, 80 percent of the way to the 2.3 goal.

"Surprisingly simple food choices can lead to much better levels of the healthier fats we see in organic milk," says Benbrook.



The team also compared the fatty acids in dairy products to those in fish.

“We were surprised to find that recommended intakes of full-fat milk products supply far more of the major omega-3 fatty acid, ALA, than recommended servings of fish,” says co-author and WSU research associate Donald R. Davis. Conventional milk had about nine times more ALA than fish while organic milk had 14 times more, he says. Organic milk is also a significant source of two other omega-3 fatty acids, EPA and DPA, but not DHA.

The study was published December 9 in the online journal PLOS ONE. It analyzed organic milk from cows managed by farmer-owners of the Cooperative Regions of Organic Producer Pools, or CROPP, which markets through the Organic Valley brand. The two organizations helped fund the study but had no role in its design or analysis, which was funded by the Measure to Manage program in the Center for Sustaining Agriculture and Natural Resources at Washington State University.

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### ***Three Major Points – Short and Long Versions***

#### **# 1 Short –**

All milk is good for you, but organic whole milk is even better.

#### **# 1 Long –**

Milk and dairy products are an excellent and affordable source of many essential nutrients and full-fat forms also contain a much healthier balance of omega-3 and omega-6 fatty acids than other major sources of fat. Omega-3 fatty acids help balance inflammation, promote heart health, and are critical for the healthy development of infants and children.

This is why scientists track the ratio of omega-6 and omega-3 fatty acids, and use this ratio as a marker of health.

In this 18-month study of the U.S. milk supply, whole milk from cows on conventional farms had an omega-6/omega-3 ratio of 5.77, while organic milk had a 2.28 omega fatty acid ratio. This difference is highly significant and likely represents the most important nutritional benefit from consumption of organic food in the U.S.

# 2 Short –

Grass in dairy cow diets improves the nutritional quality of milk. This is a positive benefit of organic certification programs, which set minimum requirements for the grass and forages that improve milk's nutritional quality.

# 2 Long –

Organic farmers rely much more heavily than conventional farmers on pasture and forage-based feeds that promote omega-3 fatty acids in milk, while conventional dairy farmers have become increasingly reliant on corn and other grain-based feeds that favor omega-6 fatty acids in milk. Grain-heavy rations also reduce the protein content of milk.

# 3 Short –

Surprisingly simple changes in food choices can lead to much better levels of the healthier fats we see in organic milk.

# 3 Long –

Just switching from a moderate consumption of conventional dairy products (three servings per day) to a higher consumption of full-fat organic dairy products (4.5 servings per day) can reduce a person's omega-6/omega-3 ratio from around 11.3 to 7.8. This 3.5-point decline achieves 39% of the 9-point reduction needed to reach a heart-healthy target of 2.3. By also avoiding some fried foods and condiments high in omega-6 fatty acids, a person can lower their overall omega-6/omega-3 ratio to around 4, about 80% of the reduction necessary to reach the 2.3 heart-healthy goal.

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**Sample Email from Benbrook to Reporters (all included the paper and WSU press release as attachments) –**

Dear Jack –

My long-awaited PLOS ONE paper is coming out 5:00 pm EST on Monday 12/9. The paper presents an analysis of the omega fatty acids in organic versus conventional milk and dairy products, drawing on a substantial, 18-month dataset Organic Valley compiled. The paper (not in final, published format) and WSU press release are attached; the PR went out tonight via EurekaAlerts.

The paper has some extraordinary findings regarding the omega-6/omega-3 ratio in organic (2.28) versus conventional (5.77) milk. This difference is much larger and more nutritionally significant than any organic-conventional food difference among plant-based foods. In response to reviewers, we also developed a first-ever quantification of overall dietary omega-6/omega-3 intakes, based on an adult woman's diet, and calculated the impact of three interventions singly and in various combinations — switching from conventional to organic dairy products; increasing typical daily dairy product intakes from 3 to 4.5 servings per day; and, choosing more healthy alternatives to a few foods that are very high in omega-6s.

Our results drive home that switching to a high level of intake of mostly full-fat organic dairy products can markedly reduce a person's omega-6/omega-3 ratio. We also compared organic milk as an intervention to eating recommended servings of fish, and reached the surprising conclusion that organic dairy is much more impactful in shifting a person's omega-6/omega-3 ratio than fish, and is furthermore a roughly comparable source of EPA and DPA — although fish is a uniquely valuable source of DHA.

We have developed an extensive series of materials that help explain the major findings and their significance. These materials will be available via the WSU website on 12/9. Access a sneak preview of these materials at -- <http://csanr.cahnrs.wsu.edu/program-areas/m2m/research-areas/nutritional-quality/organic-production-enhances-milk-nutritional-quality-by-shifting-fatty-acid-composition-a-united-states-wide-18-month-study/>

You can access now the "Major Findings" in a series of 13 high-quality

figures with explanatory text, a set of FAQs about the study, and a really useful "Primer on the Fatty Acid Content of Milk." The figures are easily downloaded and can be used in your story.

Looking forward to a chance to discuss the study and its provocative results. I should be easy to reach at 541-828-7918 the next several days, but especially Thursday and Friday, and over the weekend.

Again, the study and web-based materials are under a media embargo until 5 pm EST 12/9.

Chuck

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**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Saturday, March 01, 2014 6:36 PM  
**Subject:** Next Draft of Our Proposal  
**Attachments:** Organic\_Trans\_Proposal\_2-25-14.docx

Team --

Thanks to everyone for sharing suggestions on the earlier draft. I wanted to get this more complete draft to you ASAP, in the event some of you have some time this weekend to go over it.

The draft is now about 14 pages, with a maximum of 20 allowed. This leaves ample space to include section (e) re project timetable, and also augment other sections.

Please, as soon as you can, go through this draft making any changes/additions in Track Changes mode. Please resist the temptation to suggest mostly editorial/stylistic changes. I will do a thorough edit prior to submission. The draft DEFINITELY needs many more references, and more discussion, of recently published studies — Brad I am hoping you will go to town on this aspect.

Franklin — can you take on developing the project timetable section (no more than 1.5 pages). Please email it to me asap. The explanation of statistical methods remains weak and incomplete, so please also focus on beefing that section up.

The RFA calls for a long list of topics to be addressed in the methods section. I have added several sections in response, but I am sure as you read through the proposal, each of you will recognize other important points to make. Please add them.

Brad, Hue and Franklin need to write 2-3 paragraphs in the introduction re recent activities — you will see where in the draft. The Intro section is light on references to relevant work, please add some as you go through it.

We have about 1 week to get this into near-finished form. In the next few days, we also need to develop the budget. Soon, each of you will need to get your subcontract budgets done/approved and back to me, so that the full budget package can be completed. In a subsequent email, I will send around a rough budget, and suggested template for your subcontract budget.

There is a \$200k limit per year, so our total cost for a 2 year project cannot exceed \$400k. I would like to keep this a 2-year project, if at all possible. We can always apply to another program for funds to continue/expand the work.

Chuck

Charles Benbrook, Research Professor and Program Leader  
"Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
Center for Sustaining Agriculture and Natural Resources  
Washington State University

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Email: [cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)



Embargoed until 10 p.m. ET Monday, July 14, 2014

Contact: Chuck Benbrook, research professor, Washington State University, 541-828-7918, [cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)

## *Major Study Sheds New Light on the Nutritional and Food Safety Benefits of Organic Farming*

PULLMAN, Wash.—The largest study of its kind has found that organic foods and crops have a suite of advantages over their conventional counterparts, including more antioxidants, fewer heavy metals and fewer, less frequent pesticide residues.

The study looked at an unprecedented 343 peer-reviewed publications comparing the nutritional quality and safety of organic and conventional plant-based foods, including fruits, vegetables, and grains. The team applied sophisticated meta-analysis techniques to quantify differences between organic and non-organic foods.

“Science marches on,” said Charles Benbrook, a Washington State University researcher and the lone American co-author of the paper, published in the *British Journal of Nutrition*. “Our team learned valuable lessons from earlier reviews on this topic, and we benefited from the team’s remarkable breadth of scientific skills and experience.”

Most of the publications covered in the study looked at crops grown in the same area, on similar soils. This approach reduces other possible sources of variation in nutritional and safety parameters.

The research team also found the quality and reliability of comparison studies has greatly improved in recent years, leading to the discovery of significant nutritional and food safety differences not detected in earlier studies. For example, the new study incorporates the results of a research project led by WSU’s John Reganold that compared the nutritional and sensory quality of organic and conventional strawberries grown in California. Responding to the new paper’s results, Reganold said, “This is an impressive study, and its major nutritional findings are similar to those reported in our 2010 strawberry paper.”

The *British Journal of Nutrition* study was led by scientists at Newcastle University in the U.K., with Benbrook helping with study design, writing the paper, and the literature review, particularly on studies in North and South America. In general, the team found that organic crops have several nutritional benefits that stem from the way the crops are produced. A plant on a conventionally managed field will typically have access to high levels of synthetic nitrogen, and will marshal the extra resources into producing sugars and starches. As a result, the harvested portion of the plant will often contain lower concentrations of other nutrients, including health-promoting antioxidants.

Without the synthetic chemical pesticides applied on conventional crops, organic plants also tend to produce more phenols and polyphenols to defend against pest attacks and related injuries. In people,

phenols and polyphenols can, in turn, help prevent diseases triggered or promoted by oxidative-damage like coronary heart disease, stroke and certain cancers.

Overall, organic crops had 18 to 69 percent higher concentrations of antioxidant compounds. The team concludes that consumers who switch to organic fruit, vegetables, and cereals would get 20 to 40 percent more antioxidants. That's the equivalent of about two extra portions of fruit and vegetables a day, with no increase in caloric intake.

The researchers also found pesticides residues were three to four times more likely in conventional foods than organic ones, because organic farmers are not allowed to apply toxic, synthetic pesticides. While crops harvested from organically managed fields sometimes contain pesticide residues, the levels are usually 10-fold to 100-fold lower in organic food, compared to the corresponding, conventionally grown food.

In a surprising finding, the team concluded that conventional crops had roughly twice as much cadmium, a toxic heavy metal contaminant, as organic crops. The leading explanation is that certain fertilizers approved for use only on conventional farms somehow make cadmium more available to plant roots. A doubling of cadmium intakes from food could push some individuals over safe daily intake levels.

More than half the studies in the Newcastle analysis were not available to the research team that carried out a 2009 study commissioned by the UK Food Standards Agency. Another review published by a Stanford University team in 2011 failed to identify any significant clinical health benefits from consumption of organic food, but incorporated less than half the number of comparisons for most health-promoting nutrients.

"We benefited from a much larger and higher quality set of studies than our colleagues who carried out earlier reviews," said Carlo Leifert, a Newcastle University professor and the project leader.

The Newcastle study cost about \$429,000 and was funded by the European Framework Programme 6, which is a research program of the European Union, and the Sheepdrove Trust, a private charity that supports research on sustainability, diversity, and organic farming.

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**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Monday, July 07, 2014 2:39 PM  
**Subject:** Materials Re Study  
**Attachments:** WSU\_Press\_Release\_FINAL.docx; 14-06-12 Final Crops Paper BJN5552.pdf; 14-05-06 Supplementary Data - Crops paper accepted by BJN.pdf; NewcastleStudy\_QA\_FINAL\_7-6-14 .docx

Andy --

Looking forward to seeing you Tuesday. Here is the WSU press release on the study, as well as a set of Q+As. I cannot remember if I sent you the whole paper, so here it is , maybe again.

Chuck

Charles Benbrook, Research Professor and Program Leader  
"Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
Center for Sustaining Agriculture and Natural Resources  
Washington State University

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Email: [cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu)

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**From:** Benbrook, Chuck <cbenbrook@wsu.edu>  
**Sent:** Wednesday, September 03, 2014 2:25 PM  
**Subject:** FW: Updated Newcastle Study Coverage  
**Attachments:** Newcastle Study Coverage - 9.3.14.xlsx

BJN meta-analysis coverage up to 566,000,000. Amazing.

Chuck

Charles Benbrook, Research Professor and Program Leader "Measure to Manage (M2M): Farm and Food Diagnostics for Sustainability and Health"  
Center for Sustaining Agriculture and Natural Resources Washington State University

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On 9/3/14 10:47 AM, "Elizabeth Horton"  
<[elizabeth.horton@organicvalley.coop](mailto:elizabeth.horton@organicvalley.coop)> wrote:

>Hi, all! For those who are still reading (and counting!) the Newcastle  
>University study continues to generate media coverage. 566 million has  
>a nice ring to it.  
>  
>Elizabeth  
>  
>From: Allyson Felser  
><[allyson.d.felser@gmail.com](mailto:allyson.d.felser@gmail.com)<<mailto:allyson.d.felser@gmail.com>>>  
>Date: Wednesday, September 3, 2014 1:24 PM  
>To: elizabeth horton  
><[elizabeth.horton@organicvalley.coop](mailto:elizabeth.horton@organicvalley.coop)<<mailto:elizabeth.horton@organicvalley.coop>>>  
>ley  
>.coop>>  
>Subject: Updated Newcastle Study Coverage  
>  
>Hi Elizabeth,  
>  
>Here is the updated spreadsheet of Newcastle Study Coverage that Chuck

>requested.

>

>Thanks!

>Ally

>

>

>

>

>

>

>

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**From:** Jessica Shade <jshade@organic-center.org>  
**Sent:** Monday, June 01, 2015 12:11 PM  
**Subject:** RE: Frontier Phase 1 research?

Hi Chuck,

I'm checking in again to get an update on the Frontier project and an estimate for when you will have the final report to me. Ravin has agreed to fund the project for an extra year, but we cannot get you those funds until we receive the deliverables from the year 1 project.

As a reminder, here is the list of deliverables you said you would complete for the year 1 of the project:

- Identify the pesticides that are most commonly found in organic crops, herbs, and teas
- Examines levels at which these pesticides occur in both organic and conventional crops
- Uses information about individual pesticide application and contamination vectors to predict likely contamination sources
- Identifies potential methods for contamination interference
- Describes dried food and herb tolerance level dilemma
- Examines herbs with pesticide residues and discusses how residues would differ if tested on fresh products
- Build calculator that allows someone to walk through the analysis comparing dried products to fresh products

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**Jessica Shade, PhD**

Director of Science Programs

The Organic Center | [www.organic-center.org](http://www.organic-center.org)

<https://www.facebook.com/TheOrganicCenter>

<https://twitter.com/OrganicCenter>

Direct: (202) 403-8517      Mobile: (202) 304-7386

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**From:** Jessica Shade  
**Sent:** Thursday, May 28, 2015 1:35 PM  
**To:** Chuck Benbrook ([cbenbrook@wsu.edu](mailto:cbenbrook@wsu.edu))  
**Subject:** Frontier Phase 1 research?

Hi Chuck,

I hope you are well and that things are settling after your move from WSU. I'm meeting with my Board next week and Frontier shortly after that to discuss the pesticide identification project.

Do you have an update about the project and an estimate for when you can have the final report to me? We'll need to get the final report by August at the latest, so let me know now if that doesn't work with your schedule.

Jessica



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**Jessica Shade, PhD**

Director of Science Programs

The Organic Center | [www.organic-center.org](http://www.organic-center.org)

<https://www.facebook.com/TheOrganicCenter>

<https://twitter.com/OrganicCenter>

Direct: (202) 403-8517      Mobile: (202) 304-7386

**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.

Case No. 5:14-cv-117

WILLIAM H. SORRELL, in his official capacity as the  
Attorney General of Vermont, PETER E. SHUMLIN,  
in his official capacity as Governor of Vermont;  
TRACY DOLAN, in her official capacity as  
Commissioner of the Vermont Department of Health;  
and JAMES B. REARDON, in his official capacity as  
Commissioner of the Vermont Department of Finance  
and Management,

Defendants.

DECLARATION OF DR. CHARLES M. BENBROOK

Introduction and Major Conclusions

1. I, Charles M. Benbrook, make this declaration pursuant to Federal Rule of Evidence 702. My *curriculum vitae* is attached as Exhibit 1 to this declaration.

2. In the course of preparing this report, I read Vermont's Act 120 governing the labeling of GE foods, the "Frequently Asked Questions" regarding Act 120, and the implementing rules for the Act. I also read documents developed as part of this litigation, including Plaintiffs' Motion for a Preliminary Injunction, Plaintiffs' Opposition to Motion to Dismiss, and the Declaration of Dr. Alan McHughen that Plaintiffs submitted in support of their Motion for a Preliminary Injunction. I also have read, and taken into account in forming my

opinions, documents provided to, and reviewed by, the Vermont Legislature during its deliberations on the legislation that became Act 120.

3. The principal conclusions of my report are as follows:

- i. **GE plants are not the same as natural plants.** Genetically engineered crops, and the foods manufactured from them, are different from traditional crops and the foods manufactured from traditional crops. Genetically engineered crops are therefore not “natural” within the common understanding of that term.
- ii. **GE plants have led to herbicide-resistant weeds and insecticide-resistant insects.** The recurrent and widespread planting of genetically engineered, herbicide-tolerant crop varieties has led to the emergence and spread of herbicide-resistant weeds. Glyphosate-resistant weeds are now present on around 100 million acres – about two-thirds of the annual acreage planted to a GE crop variety. More frequent applications of a greater number of herbicides, often at higher doses, are required to contain the spread of resistant weeds. As a result, reliance on 2,4-D, dicamba, and paraquat – three of the most hazardous herbicides still allowed for widespread use in the United States – has risen sharply in recent years. In addition, the use of crops genetically engineered to produce insecticidal toxins has led to the emergence and spread of insecticide-resistant insects.
- iii. **GE crops have led to increased pesticide use.** Genetically engineered, herbicide-tolerant corn, soybeans, and cotton have dramatically increased reliance on herbicides, as well as the volumes that farmers are spraying on their fields, with potential consequences for health and the environment. Over the last five years, GE corn has led to substantial increases in the total volume of insecticides and *Bt* toxins required to bring a crop to harvest.
- iv. **GE plants result in the contamination of non-GE crops.** It is impossible to contain the flow of genes from fields planted to most GE crop varieties to nearby, sexually compatible crops and/or weedy relatives. Sometimes pollen carrying genes from a GE crop move onto organic farms, or a farm producing for a market offering a premium for non-GE crops. As a result, the planting decisions made by one farmer can prove costly for neighboring organic and non-GE farmers, and ultimately raise doubts as to sustainability of certain forms of agriculture. The presence of even low levels of unapproved GE proteins in U.S.-grown food and animal-feed exports has cost U.S. agribusiness billions of dollars, and reduced farm income by billions more. It has also intensified concern in foreign countries over the quality and safety of food produced in the U.S., and the scientific rigor and completeness of U.S. regulatory programs.
- v. **GE plants present environmental risks.** Widespread planting of genetically engineered herbicide-tolerant crops, and the accompanying, recurrent use of broad-spectrum herbicides, have also reduced biodiversity in and around farm

fields. As a result, there has been a dramatic decrease in the habitat supporting populations of pollinators and many beneficial insect species, including Monarch butterflies. And repeated applications of herbicides to herbicide-tolerant genetically engineered crops have altered the composition of soil microbial communities. Herbicides have also been detected in rain and groundwater, and in human urine and blood.

- vi. Existing studies do not demonstrate the safety of GE foods.** Very few, if any, studies by independent scientists have been published assessing the potential human health effects of the GE corn, soybean, and canola traits and varieties that are currently the most widely planted in the United States. Because of gaps in the science supporting the assessment of human health risks stemming from today's very heavy reliance on GE crop technology, and in particular on GE crops expressing multiple, stacked traits, I conclude that today's GE foods cannot be judged safe. Indeed, in my opinion, today's GE crop technology is among the least well studied agricultural technologies ever adopted from the perspective of human health risks.

#### Expert Background and Qualifications

4. I am currently a research professor at Washington State University's Center for Sustaining Agriculture and Natural Resources. I received a B.A. in Economics from Harvard University in 1971, and a Ph.D. in Agricultural Economics from the University of Wisconsin in 1980. I have worked on the impact of agricultural technology on pesticide use, pesticide efficacy, risks, public health, and costs for more than 30 years, as well as the impacts of regulatory policies, requirements, actions, and laws on pest management systems, pesticide use and risks, and food quality and safety.

5. I was the Staff Director for the House subcommittee with jurisdiction over the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA") from 1981 to 1983. During this period, the first hearings were held leading to the passage of the Organic Food Production Act, legislation that became part of the 1990 Farm Bill. One of the critical issues at that time was the difference between "organic" and "natural" foods. Indeed, this core question has remained a recurrent issue over the last 25 years as the detailed rules governing the labeling of organic foods have been codified.

6. From 2006-2012 I served as Chief Scientist at The Organic Center, where I was responsible for tracking developments in the scientific literature, government agencies, food industry, and non-profit organizations impacting consumer understanding of, and confidence in, the official, U.S. Department of Agriculture (“USDA”) “certified organic” seal.

7. I currently serve on the USDA’s AC-21 Agricultural Biotechnology Advisory Committee. That committee issued a report in 2013 on “coexistence” between farmers planting fields to organic, conventional non-GE, and GE crops. I have actively participated in efforts to deal with the impacts of gene flow and contamination from GE crops to nearby, non-GE and organic crops.

8. I have served for several years on the technical standards committee of the Non-GMO Project. The Non-GMO Project manages a labeling program that verifies the absence of GE content in food products within the specific technical parameters set forth by the organization. Food products that meet the Non-GMO Project’s technical parameters are authorized to bear the “Non-GMO Project” label. As part of its central mission, and in order to determine appropriate technical parameters, the Non-GMO Project examines issues concerning plant breeding, pesticide usage, animal drug (e.g., antibiotics and hormones) usage, food ingredient manufacturing processes, and use of GE ingredients by food manufacturers.

9. Since 1990, I have been President of Benbrook Consulting Services, a small consulting firm conducting projects on agricultural technology, food safety and quality, and pesticide use and regulation. For a variety of clients since the mid-1990s, I have reviewed petitions and other documents submitted by biotechnology companies seeking government approval (i.e., “deregulation”) of a new GE trait or crop.

10. I have studied over many years the content and impacts of Food and Drug Administration (“FDA”) assessments of the safety of GE crops, and Environmental Protection Agency (“EPA”) pesticide program decisions and policies relevant to insect-protected GE crops and herbicide-tolerant GE crops.

11. I have written extensively on the impacts of the commercialization of GE crops on pesticide use (encompassing both the use of insecticides and herbicides), the efficacy of pest control systems, the emergence and spread of resistant pests, and the human health and environmental impacts of pesticides. As discussed in greater detail below, in 2012 I published a peer-reviewed paper on the impact of GE crops on pesticide use in the U.S.<sup>1</sup>

12. In 2007, I published a peer-reviewed paper in a book entitled *Biodiversity & the Law: Intellectual Property, Biotechnology & Traditional Knowledge*.<sup>2</sup> My chapter was entitled “Principles Governing the Long-Run Risks, Benefits and Costs of Agricultural Biotechnology.” In that chapter I discuss, in detail, the principles that should be applied to any technology in evaluating its possible or actual impacts. The characteristics of today’s GE crops were appraised relative to a set of “first principles” for safe and sustainable agriculture, both in the U.S. and in developing countries.

13. I have followed the scientific literature on the characterization, efficacy, costs, human safety, environmental impacts, and nutritional equivalence of GE crops. I was invited along with 20 other scientists to make a presentation on September 15, 2014, before the opening

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<sup>1</sup> Benbrook, C. 2012. Impact of genetically engineered crops on pesticide use in the U.S. - the first sixteen years. *Environmental Sciences Europe* 24:24. Available at: <http://www.enveurope.com/content/24/1/24>.

<sup>2</sup> Benbrook, C. 2007. Principles Governing the Long-Run Risks, Benefits, and Costs of Agricultural Biotechnology. *Biodiversity and the Law: Intellectual Property, Biotechnology, and Traditional Knowledge* 149-167. Charles McManis, ed., Earthscan, 2007.



meeting of a newly formed National Academy of Sciences Committee charged with assessment of the risks, benefits, and costs of GE crop technology.

14. I serve as an expert witness in two other cases involving the labeling of foods derived from GE corn, soybeans, and canola. One focuses on Wesson oils extracted from GE corn, soybeans, and canola that were labeled “all natural,” and the second case involves certain Kashi products that bear an “all natural” label on their packaging. Exhibit 2 lists my past litigation experience and includes cases in which I have prepared an expert report, testified at trial, or been deposed.

#### GE Plants Differ From Those Found In Nature

15. Genetic engineering is a laboratory-based process that typically entails moving genetic material from one organism, such as a bacterium, into the genome (i.e., the set of genetic material) of another organism, such as a plant. Several genetic engineering techniques exist, and more will almost certainly be developed in the future. Regardless of the specific methods used to create a given GE event within a genetically engineered plant, however, the process relied upon is inherently artificial and unnatural, and the transferred material could not be moved into the plant’s genome via normal reproductive and/or plant breeding processes.

16. Several of the essential genetic elements within so-called transgenes (i.e., the foreign genetic material that is moved from one set of organisms into a plant genome) are synthetic constructs, pieced together through a carefully sequenced series of genetic-engineering modifications that entail both eliminating some DNA that would undermine performance in the transformed plant, and adding elements to regulate expression of foreign DNA in the target plant. The combination of genetic transformations required to move foreign DNA into a plant genome,

and then gain its expression – and the right amount of expression at the correct time – could not occur as a result of natural processes.

17. For example, the genes and genetic elements listed below, which are some of the major traits used in GE crops, would not be found in commercial crops without genetic engineering:

- YieldGard, MON810 Corn: Corn containing the *Bt* trait Cry1Ab (an insect toxin) was introduced in 1997 and remains one of the top three traits incorporated into corn hybrids. It was created to control *Lepidoptera* (moth) pests, mainly the European corn borer, and, secondarily, the corn earworm. The engineered gene of primary interest is the Cry1Ab gene from the soil bacterium *Bacillus thuringiensis* (*Bt*). This gene would not be found in corn or other plants through processes other than genetic engineering. The GE corn also contains “promoter” elements (gene sequences that regulate when a gene is expressed, or turned on) derived from the virus CaMV (Cauliflower Mosaic Virus). That viral promoter is rarely found in plant genomes in the wild, other than at CaMV sites of infection in susceptible plants, and has been further manipulated before insertion into the YieldGard GE corn.
- NK603, EPSPS (“Roundup Ready”) Corn: NK603 corn contains the CP4-EPSPS gene, which confers resistance to the herbicide glyphosate. That gene was taken from the bacterium *Agrobacterium tumefaciens*. In addition, the CP4-EPSPS gene has had a “transit peptide” (CTP2) from the weed *Arabidopsis thaliana* attached to it. It would be extremely unlikely that the bacterial EPSPS gene would end up in corn, or that any of the other genetic elements required to express and regulate the EPSPS gene would also be present in the same corn.
- Roundup Ready Soybeans: Glyphosate tolerant soybeans contain the same basic genetic elements as NK603 corn (discussed above), except that instead of the *Arabidopsis* transit peptide, the CP4-EPSPS gene contains a transit peptide (CTP4) from petunia (*Petunia hybrida*). As with NK603 corn, none of these genes or genetic elements would be found in soybeans without genetic engineering.
- MON863 RootGard Corn: The Cry3Bb1 gene in the MON863 corn event produces in the cells of corn plants a *Bt* endotoxin that controls the larvae of corn rootworm beetles and certain other soil-dwelling insects. The MON863 Cry3Bb1 gene is an altered version of the gene found in a strain of the bacterium *Bacillus thuringiensis*. The Cry3Bb1 bacterial gene, either in its full, unaltered form or in the truncated (activated) form introduced into GE events, would not be found in plants without the genetic engineering process. The GE RootGard Corn also contains genetic regulatory elements (i.e., elements that control the expression of the targeted gene) taken from the CaMV virus, wheat, and rice.

- Kanamycin Resistance Gene (npt11): RootGard corn also contains an antibiotic resistance gene that serves as a selectable marker. This gene is derived from a soil bacterium and codes for resistance to the antibiotic kanamycin (npt11). This gene does not have a purposeful, agronomic function, but is used to isolate the small percentage of transformed callous cells that contain and express the desired genes, after the transgene is introduced into the plant tissue. As with the other examples set forth above, finding any one of these genetic elements in corn, or any other plant, would be exceedingly unlikely, and finding them all together could only occur through genetic engineering.
- Roundup Ready Canola, RT73: The 247gox syn gene is a synthetic version of an oxidoreductase gene that metabolizes glyphosate and makes it harmless to a transformed crop. It is from a bacterium, *Orchobacter anthropi*, and so this gene would not be found in plants in nature. In addition, its sequence was altered in the lab, and so again would not be found in nature. This gene is turned on by a promoter from the 35S figwort mosaic virus, which is not typically found in plants (except at sites of infection in susceptible plants), and contains genetic elements from other organisms as well.

18. Accordingly, I conclude that the plants that are the end product of genetic engineering have been rendered artificial through a synthetic process of genetic manipulation. Hence, any foods, or food ingredients, derived from them cannot accurately be called or characterized as natural.

19. Indeed, the biotechnology industry has issued formal statements and definitions discussing the nature of food produced from GE crops, and those definitions make clear that GE foods are not the same as those found in nature.

20. For example, Monsanto, the market leader in the biotechnology industry, offers this definition of GMO: “Genetically Modified Organisms (GMO) – Plants or animals that have had their genetic makeup altered to exhibit traits *that are not naturally theirs*. In general, genes are taken (copied) from one organism that shows a desired trait and transferred into the genetic code of another organism.”<sup>3</sup> The crux of this definition is that a GMO has had its “genetic

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<sup>3</sup> Monsanto, *Glossary*, <http://www.monsanto.com/newsviews/pages/glossary.aspx> (emphasis added).

makeup” changed in a way that makes possible the expression of a novel trait that is not natural, or, in Monsanto's own words, “not naturally theirs.” The World Health Organization’s definition is similar: “Genetically modified organisms (GMOs) can be defined as organisms . . . in which the genetic material (DNA) has been altered in a way *that does not occur naturally*.”<sup>4</sup>

21. Significantly, the biotechnology companies that have created and sought patent protection for these (and other) GE traits and/or GE crops assert in their own patent applications that the traits and GE crops are unique and non-natural because of the insertion and expression of foreign DNA.

22. For example, Monsanto holds U.S. Patent No. 6,063,597, which covers YieldGard rootworm corn expressing the Cry 3Bb *Bt* endotoxin. The abstract of that patent states: “Disclosed are Coleopteran-toxic *B. thuringiensis* delta-endotoxins, nucleic acid sequences, and transgenic plants expressing these genes. Methods of making and using these genes and proteins are disclosed as well as methods for the recombinant expression, and transformation of suitable host cells.” The abstract further states that it discloses “novel methods for constructing synthetic Cry3\* proteins, *synthetically-modified nucleic acid sequences* encoding such proteins, and compositions arising therefrom.” U.S. Patent No. 6,063,597, col. 7 (emphasis added). Not only are the genes expressing the Cry3Bb endotoxin extracted from bacteria, but they are also altered into a synthetic form to enhance their performance in the target plants. The multiple alterations of the natural Cry3Bb gene through this patented process are described in great detail in the patent, and the alterations include “at least one amino acid substitution, one amino acid addition,

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<sup>4</sup> World Health Organization, *Frequently Asked Questions on Genetically Modified Foods*, [http://www.who.int/foodsafety/areas\\_work/food-technology/faq-genetically-modified-food/en/](http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/) (emphasis added).

or one amino acid deletion in the primary sequence of the native or unmodified Cry3Bb polypeptide.” U.S. Patent No. 6,063,597, col. 793.

23. Indeed, GE plants are not “natural” under the common understanding of that term. For example, Merriam-Webster’s dictionary defines “natural” as “existing in nature and not made or caused by people.”<sup>5</sup> The Oxford Dictionaries likewise defines “natural” as “existing in or caused by nature; not made or caused by humankind.”<sup>6</sup> It is undisputed that GE plants are “made or caused by people” – as discussed above, biotechnology developers themselves state as much.

GE Plants Have Led To The Emergence And Spread Of  
Pesticide-Resistant Weeds And Insects

24. Herbicide-tolerant crop technology is designed to enhance the farmer’s ability to spray specific herbicides to kill weeds without killing the crop (e.g., corn). The vast majority of GE, herbicide-tolerant crop acreage has been planted to glyphosate-tolerant, “Roundup Ready” varieties.

25. Herbicide-tolerant corn, soybeans, and cotton were first planted commercially in 1996. Two years later, in 1998, 42.6 million acres of these three herbicide-tolerant crops were planted, corresponding to nearly 25% of the total acres planted to these three crops. Planting of genetically engineered herbicide-tolerant corn, soybeans, and cotton rose dramatically to 132.4 million acres in 2008. That represents 77% of the total acreage planted to these three crops. By 2013, fully 84% of the 185 million acres planted to corn, soybeans, and cotton were planted to genetically engineered herbicide-tolerant varieties. The data through 2011 come from the published, supplemental tables that accompanied a journal article I published in September 2012

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<sup>5</sup> Merriam-Webster, *Natural*, <http://www.merriam-webster.com/dictionary/natural>.

<sup>6</sup> Oxford Dictionaries, *Natural*, [http://www.oxforddictionaries.com/us/definition/american\\_english/natural](http://www.oxforddictionaries.com/us/definition/american_english/natural).

in *Environmental Sciences Europe*.<sup>7</sup> The data through 2011, and more recent years, come from annual USDA statistical series on the planting of GE crops and pesticide use levels (all sources fully referenced in the supplemental tables).

26. Over-reliance by farmers on herbicide-tolerant technology, and in particular on Roundup Ready corn, soybeans, and cotton, has imposed heavy selection pressure on weed populations. While weeds that were vulnerable to glyphosate would die when exposed to glyphosate, those that had developed resistance to glyphosate would survive and go to seed – and thus increase in number over time. Heavy and repeated applications of glyphosate have imposed very strong and continuous selection pressure on weed populations, favoring or “selecting” weed variants that are less susceptible to glyphosate. If such selection pressure continues for several years, the survival of less susceptible weed variants can eventually lead to the emergence and spread of fully resistant weeds. There are now about a dozen economically significant weeds in the U.S. that are resistant to glyphosate, and more than two-dozen worldwide.

27. The spread of glyphosate-resistant weeds has been remarkably rapid. When GE crop technology was introduced in 1996, there were essentially no glyphosate-resistant weeds in the United States. Stratus Agri-Marketing has conducted a series of surveys on the acreage infested with glyphosate-resistant weeds in the United States. On January 25, 2013, they reported that 61.2 million acres in 2012 were infested with one or more resistant weeds – about a 50% increase over the area infested in 2010 (40.7 million acres). Glyphosate-resistant weeds

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<sup>7</sup> Benbrook, C. 2012. Impacts of genetically engineered crops on pesticide use in the U.S. – the first sixteen years. *Environmental Sciences Europe* 24:24. Available at: <http://www.enveurope.com/content/24/1/24>. Supplemental tables available at: <http://www.enveurope.com/content/24/1/24/additional>.



have spread at a faster rate each year since 2010. And the percent of fields infested with two or more resistant weeds has increased from 12% in 2010 to 27% in 2012.<sup>8</sup>

28. Based on the Stratus results and academic research and commentary, I project that in 2014 there were between 110 million and 128 million acres infested with one or more glyphosate-resistant weeds, based upon a minimum projected increase of 80% from 2012 to 2014 and a maximum increase of 120%. During crop year 2014, the percentage with two or more resistant weeds was likely around 40%, with as much as 15% infested with three or more.

29. The rapid and dramatic spread of glyphosate-resistant weeds is triggering unprecedented changes in weed management systems, in part because there are no new “silver bullet” herbicides that farmers can switch to. In fact, there have been no new herbicides registered in 20 years that work through a novel mode of action (and hence would control resistant weeds).<sup>9</sup> And there is also no herbicide-based relief in sight. According to Michael Owen, Iowa State University weed management specialist, “it is very unlikely that new herbicides with new modes of action will be available within ten to 15 years.”<sup>10</sup>

30. The increase in herbicide-resistant weeds has significant costs. Each glyphosate-resistant weed in a field increases the cost of herbicides by about \$25.00 per acre, and requires farmers to spray one to three additional herbicides than they otherwise would.

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<sup>8</sup> Kent Fraser, *Glyphosate Resistant Weeds – Intensifying*, Stratus AG Research (Jan. 25, 2013), <http://stratusresearch.com/blog/glyphosate-resistant-weeds-intensifying/>.

<sup>9</sup> Gerwick. Thirty years of herbicide discovery: surveying the past and contemplating the future. *Agrow* (Silver Jubilee Edition) 2010, VII-IX.

<sup>10</sup> Owen, M. D. K. 2011. Weed resistance development and management in herbicide-tolerant crops: experiences from the USA. *J. Consumer Protection and Food Safety*, Supp. 1, 85-89.

31. Plants have also been genetically engineered to produce proteins that are toxic to insects. In 2014, about 75% of total national corn acres were planted to a GE hybrid expressing one to three *Bt* genes for corn rootworm control.

32. Multiple papers in peer-reviewed publications have shown that the planting of *Bt* corn has led to the emergence and spread of corn insects resistant to various *Bt* toxins (just as the use of genetically engineered Roundup Ready crops has led to the spread of herbicide-resistant weeds).

33. The first major paper documenting insect resistance to a common *Bt* endotoxin in GE corn (Cry3Bb1) was written by a team led by Aaron Gassmann of Iowa State University. The team documented resistance to Cry3Bb1 endotoxins in corn rootworms from fields planted for three consecutive years to GE corn expressing this form of *Bt*. According to the team, “[t]his is the first report of field-evolved resistance to a *Bt* toxin by the western corn rootworm and by any species of Coleoptera. Insufficient planting of refuges and non-recessive inheritance of resistance may have contributed to resistance.”<sup>11</sup> Subsequent studies have also documented resistance in insects targeted by the *Bt* endotoxins expressed in GE *Bt* corn and cotton cultivars. For example, a 2013 paper by Gassmann’s team reported resistance in corn rootworm populations to multiple *Bt* endotoxins in “stacked” varieties of *Bt* corn expressing two to six *Bt* genes.<sup>12</sup>

34. The initial approvals of genetically engineered *Bt*-corn varieties required farmers to plant sections in each field to a non-*Bt* corn cultivar. Such areas in cornfields serve as

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<sup>11</sup> Gassmann, et al. 2011. Field Evolved Resistance to *Bt* Maize in Western Corn Rootworm. *PlosOne*, Vol. 6(7): e22629.

<sup>12</sup> Gassmann, et al. 2013. Field-evolved resistance by western corn rootworm to multiple *Bacillus thuringiensis* toxins in transgenic maize. *Proc. Nat. Acad. Sciences*, 111: 5141-5146.

“refuges” where insects susceptible to *Bt* endotoxins will presumably survive, and then hopefully breed with any resistant insects that survive in the portions of fields planted to *Bt* corn (thus preventing the evolution of *Bt*-resistant insects). Over approximately the first decade of *Bt* corn use, a mandatory 25% refuge was required on all fields in which *Bt* corn was planted.

35. Unfortunately, compliance with *Bt*-corn refuge requirements was spotty. In 2010, for example, more than 41% of corn farmers did not comply with mandatory *Bt* corn resistance management provisions.<sup>13</sup>

36. In order to slow the spread of insects resistant to key *Bt* endotoxins produced by *Bt* corn hybrids, both the seed industry and academic insect pest management specialists are now recommending that farmers apply soil insecticides when they plant GE-*Bt* corn varieties, especially in areas where there already is evidence pointing to the presence of resistant or tolerant insect populations. For example, Dr. Michael Gray, the leading corn insect pest management specialist at the University of Illinois, has surveyed Illinois farmers in recent years regarding their intentions to apply soil insecticides in fields planted to *Bt* corn. In 2013, growers in multiple regions of Illinois reported they would apply soil insecticides on 39% to 56% of *Bt*-corn acres planted.<sup>14</sup> In 2014, it is likely that about 40% of total corn acres were also treated with a soil insecticide targeting the corn rootworm.

37. In the decade before the introduction of *Bt* corn for rootworm control, in contrast, between 18% and 23% of corn acres were sprayed with a soil insecticide. Accordingly, corn

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<sup>13</sup> Jack Kaskey, *Gene-Modified Corn Violations Triple Among U.S. Farmers*, Bloomberg Businessweek (Feb. 9, 2012), <http://www.businessweek.com/news/2012-02-09/gene-modified-corn-violations-triple-among-u-s-farmers.html>.

<sup>14</sup> Gray, M. 2013. Soil Insecticide Use on *Bt* Corn Expected to Increase this Spring Across Much of Illinois. *The Bulletin*. Univ. Illinois, March 28, 2013.

soil insecticide use has *risen* well above the pre-GE era levels – despite the fact that over two-thirds of national corn acres were planted to GE *Bt* corn hybrids in to control the corn rootworm.

The Impacts of GE Crops on Pesticide Use and Risks

38. I have carried out several studies on the impact of genetically engineered crops on pesticide use in the U.S. In 2012, I published a paper setting forth data sources, methodology, and reporting results for the first 16 years of commercial use of GE crops (1996-2011).<sup>15</sup>

39. Through 2011, the three major GE crops planted by U.S. farmers had increased total pesticide use (i.e., herbicide use plus insecticide use) by 404 million pounds above the level it would likely have been in the absence of GE-crop technology. Herbicide use rose by 527 million pounds. *Bt* corn and cotton reduced conventional insecticide applications by 123 million pounds in the sixteen-year period (1996-2011) – though, as discussed below, that reduction has been more than offset by an increase in insecticidal Bt toxins produced by GE plants.

40. The annual rate of increase in the average pounds of herbicide active ingredient applied per acre planted to herbicide-tolerant corn, soybeans, and cotton is accelerating as farmers are compelled to manage one to three-or-more species of resistant weeds in most GE corn, soybean, and cotton fields. For example, in 2000, GE crops increased herbicide use by only 2.2 million pounds in the three major GE crops. The annual increase rose to 27 million pounds in 2005, 72 million in 2008, and 90 million in 2011.

41. I have recently updated my analysis of the impacts of GE crops on pesticide use, and will publish a paper in a peer-reviewed journal on such impacts through the first 20 years (1996-2015) in early 2015. The results of the updated analysis show that use of glyphosate has

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<sup>15</sup> Benbrook, C. 2012. Impact of genetically engineered crops on pesticide use in the U.S. - the first sixteen years. *Environmental Sciences Europe* 24:24. Available at: <http://www.enveurope.com/content/24/1/24>.

increased over 20-fold since the pre-GE crop era (before 1996). In 2014, around 240 million pounds of glyphosate were applied on U.S. agricultural land – almost two-thirds of a pound, on average, across every acre of cropland in the U.S. The rate of increase in total herbicide use on an annual basis has continued to rise, and now exceeds the level in 2011 by a wide margin.

42. Even worse is the escalation in the number of different herbicides that farmers must spray on acres infested with glyphosate-resistant weeds, the added costs for farmers, and the associated environmental and public health risks. Many of the additional herbicides that farmers are turning to are applied at low rates (0.1 to 0.5 pounds of active ingredient per acre) to very low-rates (0.01 to 0.1 pound of active ingredient per acre). Thus, applications of these more biologically active herbicides do not increase overall herbicide pounds applied significantly. But they can markedly increase costs and unintended environmental and public health impacts.

43. In addition, the biotechnology and seed industry is seeking approval of new herbicide-tolerant varieties engineered to withstand applications of older, higher-risk herbicides including 2,4-D and dicamba. The USDA recently approved (deregulated) combined glyphosate and 2,4-D herbicide-tolerant corn, and commercial plantings will begin in 2015. As a result, there will be substantial increases in the use of 2,4-D on corn.

44. In my 2012 *Environmental Sciences Europe* paper, I reported the results of projections of the increase in 2,4-D use on corn in the wake of USDA approval of 2,4-D HT corn. Based on plausible assumptions regarding the percent of acres treated (55%; the label allows 100%), application rates (0.84 pound; the label allows 1.0 pound), and number of applications (2.3; the label allows three), I projected a 60-fold increase in 2,4-D applications to corn, relative to the level of spraying in 2010. About 104 million pounds of 2,4-D would be sprayed on corn annually once this technology is adopted to the degree projected in the above

analysis. An increase in herbicide use of this magnitude would add about 1.2 pounds per acre of additional herbicide across all corn acres, and would constitute almost a 50% increase over current corn herbicide use.

45. 2,4-D, moreover, is prone to movement away from the fields it is sprayed on, via both spray drift and post-application volatilization. As a result, 2,4-D causes more instances of damage to non-target plants, trees, and vines than any other pesticide, according to a review of spray drift incidents in 2002, 2003, and 2004 compiled by the American Association of Pesticide Control Officials.<sup>16</sup>

46. Human exposures to 2,4-D increase the risk of birth defects, reproductive problems, and certain cancers, as discussed and documented at length in comments dated June 30, 2014, that I submitted to the docket on the pending approval of “Enlist” herbicides that contain both 2,4-D and glyphosate.<sup>17</sup>

47. As noted above, my analysis also showed a 123 million pound reduction in corn and cotton insecticide use between 1996 and 2011. That reduction in insecticide use is the result of planting GE crop varieties that express one or more *Bt* toxins (thus reducing the need to spray insecticides). But the reduction in the use of conventional insecticides was brought about by a dramatic increase in insecticidal *Bt* toxins expressed directly by the genetically engineered corn plants themselves. Thus, while GE *Bt* corn was introduced to reduce the volume of insecticides

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<sup>16</sup> AAPCO, *2005 Pesticide Drift Enforcement Survey Report*, <http://www.aapco.org/documents/surveys/DriftEnforce05Rpt.html>.

<sup>17</sup> Letter from Charles Benbrook to Administrator, Environmental Protection Agency, regarding Docket ID No. EPA-HQ-OPP-2014-0195 (June 30, 2014), available at: [http://csanr.wsu.edu/wp-content/uploads/2014/06/EPA\\_24D\\_Comment.FINAL\\_.pdf](http://csanr.wsu.edu/wp-content/uploads/2014/06/EPA_24D_Comment.FINAL_.pdf). See also, *EWG, Scientists and Doctors Sign Letter Urging EPA to Reject Potent Herbicide Mix*, Environmental Working Group (June 30, 2014), available at: <http://www.ewg.org/testimony-official-correspondence/ewg-scientists-and-doctors-sign-letter-urging-epa-reject-potent>.



needed to produce a crop, it actually has increased the overall volume of insecticides needed to protect the crop from insect feeding damage.

48. Technology developers submit *Bt* expression level data (i.e., the amount of toxins produced by the GE plants) in whole corn and cotton plants to regulatory agencies. These data are summarized in Supplemental Tables 20-25 to the *Environmental Sciences Europe* paper. One widely planted *Bt* corn trait – MON 810, which expresses the Cry1Ab endotoxin – produces 0.183 pounds of Cry endotoxins per acre, based on the planting of 32,000 seeds per acre. The most common combination of two *Bt* toxins expressed in Dow AgroSciences-Pioneer corn hybrids produces 2.5 pounds of *Bt* endotoxins per acre. And SmartStax corn hybrids express six different *Bt* endotoxins that collectively produce a remarkable 3.7 pounds of endotoxins per acre. That corresponds to 19-times the average conventional insecticide rate of application in 2010.

49. In other words, while *Bt* plants reduce conventional insecticide use, they produce their own insecticides – the *Bt* endotoxins – and the volume of these toxins more than offsets the reduction in conventional insecticides. Prior to the emergence of *Bt* resistant insects (i.e., 1996-2010), corn acres planted to *Bt* hybrids expressing *Bt* endotoxins for control of both the European corn borer and corn rootworm *reduced* conventional insecticide use by about 0.21 pound per acre, but they also *produced* about 2 pounds of *Bt* endotoxins per acre. Ironically, in the last few years, a significant share of GE *Bt* corn acres have been sprayed with soil insecticides for rootworm control to help slow the spread of insects resistant to *Bt* endotoxins, further driving upward the ***total volume of insecticides*** compared to where it stood in 1996, at the beginning of the GE era.

50. *Bt* cotton plants produce far more *Bt* per acre than the natural *Bt* bacteria in the soil. Roughly 0.25 grams per hectare of *Bt* endotoxin is produced in the soil by natural *Bt*

bacteria (Blackwood and Buyer, 2004), compared to 400-1,000 grams per hectare in the case of *Bt* cotton, and 2,800-4,200 grams in the case of modern *Bt* corn varieties. Accordingly, *Bt* cotton produces up to 4,000-times more *Bt* than soil microorganisms per acre or on a given field, while *Bt* corn produces up to 16,800-times more.<sup>18</sup> The longer-term ecological consequences of such a profound change in the quantity of a ubiquitous soil bacterium are largely unknown.

#### Gene Flow From GE Crops To Non-GE Crops

51. One of the environmental and economic problems associated with GE crop technology arises as a result of “gene flow” from fields planted to GE crop varieties onto nearby fields growing non-GE crops. Gene flow refers to the transfer of genes from one population to another. In this context, it refers to the transfer of the genetically engineered transgene from GE crops to populations of non-GE crops (for example, by cross-pollination between GE and non-GE crops). For those consumers and markets not wanting food containing genetically engineered DNA, such gene flow contaminates non-GE crops with unwanted foreign genes.

52. Such gene flow between genetically engineered and non-GE crops is unavoidable, especially in the case of open-pollinated crops. And it has significant consequences for farmers, who may lose access to markets that pay a premium for organic or other non-GE crops. Such market impacts can hit an individual organic or non-GE producer, companies shipping grain, or food companies exporting products to GE-sensitive markets abroad.

53. There have been several past episodes of substantial costs being imposed on one group of farmers by the development and/or commercial release of a new GE variety. For example, genetically engineered StarLink corn and LibertyLink rice were found to have contaminated non-GE crops. Such an “adventitious presence” can trigger loss of foreign

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<sup>18</sup> Blackwood, C.B. and J.S. Buyer. 2004. Soil Microbial Communities Associated with Bt and Non-Bt Corn in Three soils. *J. Environ. Quality* 33:832-836.

markets and subsequent reductions in crop prices and farm income. And indeed, in both the StarLink and LibertyLink contamination cases, conventional grain producers suffered adverse marketing impacts as a result of the detection abroad of contamination in U.S. exports with a GE trait not approved, or wanted, in the importing country.

54. Currently there are two major ongoing episodes of market disruption triggered by the presence of unimproved and/or unwanted, and unlabeled GE traits in U.S. agricultural exports. The most significant involves Syngenta's Agrisure Viptera corn varieties, which are genetically engineered both to make the conversion of corn into ethanol more efficient and to control corn insects. China, however, has not approved for importation the trait that makes corn easier to convert to ethanol, even when found in trace amounts as a result of gene-flow contamination or incidental commingling during handling and transport. A lawsuit against the manufacturer has alleged nearly 3 billion dollars of damages to corn farmers, handlers, shippers, and exporters.

55. The second episode of market disruption involves the recent widespread planting of genetically engineered Roundup Ready alfalfa in the Pacific Northwest, where high-value shipments of top-quality alfalfa hay are being blocked to certain markets that have not approved and/or do not want to import hay with even a trace of genetically engineered "Roundup Ready" alfalfa. The Capital Press reported that China is importing 700,000 metric tons of high-value alfalfa, exports that are now in jeopardy because the Chinese detected traces of the unapproved (in China) Roundup Ready gene in supposedly non-GE alfalfa.<sup>19</sup> As a result, shipper-exporters are facing markedly higher testing and marketing costs. Investigations are ongoing to discover the source of the Roundup Ready gene in the alfalfa hay exports, but considerable evidence

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<sup>19</sup> Dan Wheat, *GMO test slows hay exports to China*, Capital Press (Sept. 25, 2014), <http://www.capitalpress.com/20140925/gmo-test-slows-hay-exports-to-china>.

points to a low-level of contamination of non-GE alfalfa seed. Alfalfa pollen can travel long distances, sometimes with the help of bees and other native pollinators. Hence, there is considerable risk of GE-gene contamination moving from a GE-alfalfa seed field to a nearby non-GE alfalfa seed field.

56. At the request of the Secretary of Agriculture Tom Vilsack, I participated in a “Alfalfa Coexistence Working Group” convened by USDA late in 2010 to advise the Secretary on options to address the gene flow and coexistence challenges that would arise in the event of approval (de-regulation) of RR alfalfa. Our working group recommended a range of measures to reduce the odds that low-level presence of the RR gene in alfalfa hay would curtail the supply (and thus increase the cost) of alfalfa hay for organic livestock producers, or disrupt exports of alfalfa seed and hay to GE-sensitive markets. There was widespread working group support for a maximum threshold for adventitious presence (i.e., contamination) of the Roundup Ready gene in non-GE and organic alfalfa seed of less than 0.1%. That is approximately the level that is detectable by current Chinese alfalfa hay test methods, and hence serves as a *de facto* threshold for imported hay or seed in that country.

57. A January 28, 2011, story ran in the *New York Times* reporting the approval of unrestricted planting of GE Roundup Ready alfalfa.<sup>20</sup> The story states that pressure from the biotechnology industry and farm groups during a Congressional hearing led Secretary Vilsack to drop a number of measures designed to help prevent gene flow, and reduce the chances of commercially significant RR-gene contamination in non-GE and organic alfalfa seed and hay.

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<sup>20</sup> Andrew Pollack, *U.S. Approves Genetically Altered Alfalfa*, N.Y. Times, Jan. 27, 2011, at B1, [http://www.nytimes.com/2011/01/28/business/28alfalfa.html?\\_r=0](http://www.nytimes.com/2011/01/28/business/28alfalfa.html?_r=0).

The restrictions that were dropped included several that had been recommended by the Alfalfa Coexistence Working Group.

58. A modest amount of GE Roundup Ready alfalfa seed was planted in 2011, but demand and supply grew rapidly, and accounted for a reported 60% of new plantings in the western U.S. in 2013. That suggests that a majority of alfalfa seed production now contains the Roundup Ready gene, increasing the risk of Roundup Ready gene flow to non-GE and organic alfalfa. The absence of the added, preventive measures recommended by the Alfalfa Coexistence Working Group no doubt accelerated the movement of the Roundup Ready genes into other, non-GE alfalfa breeding lines. The full range of consequences, both near-term and longer-run, from the contamination of the non-GE alfalfa seed supply and germplasm stocks are not known, but could be considerable.

59. As a result of unwanted GE-gene flow into non-GE and organic canola (rapeseed) breeding lines, many organic farmers have lost access to premium markets and can no longer include canola in their crop rotations. The possible loss of alfalfa as a rotational crop option could place many contemporary organic farms in jeopardy, since canola and alfalfa are high-dollar crops that deliver sizable environmental and agronomic benefits.

#### The Impact of GE Crops On The Environment

60. The impacts of GE crop technology on natural resources and the environment fall into several general categories:

61. (i) Alterations in soil microbial communities and pest pressure: Heavy and repeated applications of glyphosate herbicides have altered the composition of soil microbial communities. Glyphosate is toxic to certain beneficial soil microorganisms that play a role in making nutrients bioavailable to corn and/or soybean plants. As a result, it has triggered

negative shifts in the composition of soil microbial communities. For example, a team led by Andy King in Arkansas documented adverse impacts of glyphosate on the efficiency of nitrogen fixation by soybean plants.<sup>21</sup> Capturing nitrogen from the air via the action of microorganisms that colonize the surface of soybean roots is one of the major agronomic and environmental benefits of legumes, including soybeans.

62. Recent research has also documented adverse impacts of repeated glyphosate applications on the ability of plant roots to take up certain minor, but essential, micronutrients in soil, especially manganese. This vital micronutrient plays an important role in the plant's response to certain pathogens and environmental stresses, and impaired uptake of manganese in Roundup Ready soybean fields has been implicated as a risk factor for several soybean diseases.<sup>22</sup>

63. (ii) Impacts associated with heightened use of pesticides and/or toxins associated with GE crops: As discussed above, around 240 million pounds of glyphosate active ingredient are now sprayed annually on the 300-plus million acres of U.S. cropland – nearly two-thirds of a pound for every acre. No other pesticide in history has been sprayed as intensively as glyphosate. Reliance on glyphosate exceeds by more than a factor of two the degree of reliance on any past herbicide, in terms of pounds applied annually across American agriculture.

64. Glyphosate is now present in the soil, air, rainfall, and drinking water in many regions around the world. Concentrations were found in 60% to 100% of rain and air samples tested in Iowa and Mississippi by the U.S. Geological Survey.<sup>23</sup> Nearly every stream, river, and

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<sup>21</sup> King, A.C., L.C. Purcell, and E.D. Vories. 2001. Plant growth and nitrogenase activity of glyphosate-tolerant soybean in response to glyphosate applications. *Agron. J.* 93:179–186.

<sup>22</sup> Johal, G.S. and D.M. Huber, 2009. Glyphosate effects on diseases in plants. *European J. of Agronomy* 31:144-152.

<sup>23</sup> Chang, F-C, M.F. Simcik, and P.D. Capel. 2011. Occurrence and Fate of the Herbicide

reservoir in heavily farmers regions contains runoff of glyphosate and its degradation products. The frequency of detections in groundwater is rising worldwide, wherever glyphosate-based herbicide-tolerant technology now dominates weed management systems.

65. Recent human biomonitoring studies, moreover, suggest that glyphosate residues are present in the blood and urine of a substantial share of the human population in developed countries.<sup>24</sup> The public health consequences of now-ubiquitous exposure to glyphosate in the air, drinking water, and food is under intensive investigation by toxicologists and risk assessment scientists around the world, but are not yet fully understood. Concern is greatest over evidence pointing to the ability of glyphosate to bind with certain metals often found in drinking water from wells in certain regions with hard water. Glyphosate is a strong chelating agent, and as a result, binds tightly to metal molecules. The bound complexes of glyphosate and certain metals can apparently lodge in the human kidney and cause chronic kidney disease if exposures last for several years.<sup>25</sup>

66. (iii) Reductions in biodiversity and habitat supporting populations for beneficial organisms and wildlife species: The biggest impact of GE crop technology on ecosystem resiliency and biodiversity has been triggered by the widespread and repeated uses of glyphosate. Glyphosate is a broad-spectrum herbicide that kills almost all growing plants, vines, and trees (except of course for resistant plants). There is also some movement of glyphosate from sprayed

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Glyphosate and Its Degradate Aminomethylyphosphonic Acid in the Atmosphere. *Envir. Toxicology Chem.* 30:548-555.

<sup>24</sup> Brandii, D. and S. Reinacher. 2012. Herbicides Found in Human Urine. *Ithaka Journal* 1:270-272; Friends of the Earth Europe. 2013. Human contamination by glyphosate. Available at: <http://foeeurope.org>.

<sup>25</sup> Jayasumana, C., et al. 2014. Glyphosate, Hard Water and Nephrotoxic Metals: Are They the Culprits Behind the Epidemic of Chronic Kidney Disease on Unknown Etiology in Sri Lanka? *Int. J. Res. Public Health* 11:2125-2147.



fields into field border areas, extending the herbicide's impact on plant diversity and biomass to field borders. In many areas, field border areas are not very wide, and hence glyphosate spray drift can cover all or most of the land between fields planted to GE Roundup Ready crops.

67. Research has shown that heavy dominance of glyphosate-based weed management systems in North America has reduced milkweed biomass throughout most of the Midwest. Milkweed is the major food source of nutrition for Monarch butterflies as they migrate through the Midwest. One study estimated that the loss of milkweed habitat in and around farm fields has caused an 81% decline in Monarch populations in the Midwest. Other studies suggest linkages between the health of introduced honeybees and native pollinators as a result of the overall pesticide and *Bt* toxin load associated with GE-*Bt* corn and cotton.<sup>26</sup>

Existing Studies Do Not Demonstrate The Safety Of GE Foods

68. In an effort to reassure individuals concerned about the human health impacts of GE foods, many people and organizations have asserted that GE crops and food are the most thoroughly tested agricultural technology in history. See McHughen Decl. ¶ 71. That claim is both misleading and factually wrong.

69. The claim is misleading because the vast majority of studies published on GE crops, animal feeds, and food address issues *other than* human food safety. The vast majority of studies on GE foods focus on one of two issues: whether the nutritional composition of GE food is “substantially equivalent” to that of non-GE varieties, and whether GE foods and ingredients deliver the same nutritional value when used in food manufacturing or as animal feed (an area of

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<sup>26</sup> Pleasants, J.M. and K.S. Oberhauser. 2012. Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population. *Insect Conservation and Diversity*, 6(2): 135-144.

interest to livestock farmers). Few published studies, however, directly address the safety of GE foods.

70. J.L. Domingo, a Spanish toxicologist, carried out the first systematic review of the nature of the published studies on GE crops and food. Two of his published papers are included in the documents reviewed by the Vermont legislature. The first study, published in 2007, reported the results of a literature search of the Medline database (a repository for scientific journal articles) for studies on GE plants from 1980 - 2007.<sup>27</sup> The second study updated and refined the analysis in 2011.<sup>28</sup> Together, the studies show that, from 1980-2011, only 75 studies address the human health risks associated with GE foods. According to the authors, after eliminating studies addressing nutrient composition, feed efficiency in livestock systems, and other studies not focused on human health risk assessment, the published studies reporting original data on health effects “remain very limited.”

71. The claim that GE crop technology is the most heavily studied food technology is also factually wrong. For example, a search of the PubMed database (the successor to Medline as the repository for scientific publications worldwide) on November 8, 2014, on “health effects artificial sweeteners” yields 4,846 citations, while a search on “health effects genetically engineered food” yields 276. “Health effects genetically engineered crops” yields 53 citations. Limiting the search to “human health effects of genetically engineered food” reduces the number of citations to 44, while “human health effects artificial sweeteners” identifies 3,057 citations. And the human health database on dozens of widely used pesticides includes hundreds to thousands of studies per pesticide. For example, a PubMed search on November 7, 2014 yielded

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<sup>27</sup> Domingo, J.J. 2007. Toxicity Studies of Genetically Modified Plants: A Review of the Published Literature. *Critical Reviews in Food Science and Nutrition* 47:721-733.

<sup>28</sup> Domingo, J.L., and J.G. Bordonaba, 2011. A literature review on the safety assessment of genetically modified plants,” *Environment International* 37:734-742.

667 references on “DDT cancer” alone, and 11,650 scientific citations on “DDT.” The insecticide “chlorpyrifos” yields 3,402 citations, while “chlorpyrifos neurotoxicity” identifies 206 citations. It is therefore inaccurate to state that GE foods are the most heavily studied food technology.

72. Moreover, most of the studies on the most widely planted GE crops in the United States – GE corn and soybeans – focus on GE corn and soybean traits that are no longer on the market. One or more of the GE 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.

73. Moreover, most GE corn varieties on the market today contain “stacked” traits – i.e., they contain more than one transgene, producing multiple traits (for example, glyphosate resistance and expression of one or more *Bt* toxins). Single-trait corn varieties account for just a few percent of total GE corn acreage, and in recent years, the average acre planted to GE corn contains more than three traits (glyphosate tolerance and at least two *Bt* toxins). Yet nearly all published studies focus on the risks of individual GE traits. I am not aware of a single study carried out by technology developers, independent scientists, or the government that tests whether there might be new and unique human health risks associated with stacked-trait GE corn cultivars.

74. The FDA considers any stacked-trait cultivar that is composed of traits previously approved on an *individual* basis to be acceptable. Thus, the FDA assumes that there will be no adverse consequences in a stacked-trait cultivar from the presence of multiple transgenes and their linked regulatory and terminator sequences, and possibly several marker genes. Yet it is known that the regulatory sequences introduced into a GE corn variety can sometimes influence

the expression of other genes that were not the target of the technology developer. This “cross-talk” between genetic elements introduced via the GE process and other gene sequences within the crop’s natural genome can alter gene expression patterns, or trigger the production of novel proteins, some of which may prove to be human allergens.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct to the best of my knowledge, information, and belief.

A handwritten signature in black ink, appearing to read "Charles Benbrook". The signature is fluid and cursive, with the first name "Charles" and last name "Benbrook" clearly distinguishable.

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Charles M. Benbrook

November 14, 2014

## **Litigation Experience**

1. Peterson, et al. v. BASF Corp. Trial Ada, Minnesota, in the District Court for Northeastern Minnesota (Red River Valley). Plaintiff's attorney, Hugh Plunkett, Lockridge Grindal Nauen, St. Paul, Minnesota.
2. James E. Fox, et al. v. Cheminova, Inc., Case Number CV 00-5145, U.S. District Court for the Eastern District of New York. Plaintiff's attorney Kevin Huddel, Jones, Verras, and Freiberg, LLC, New Orleans, Louisiana.
3. Ricardo Ruiz Guzman individually, Martin Martinez individually, and Miguel Farias and Ignacia Farias, husband and wife v. Amvac Chemical Corporation. Plaintiff's attorney, Richard Eymann, Eymann, Allison, Hunter, Jones, P.S., Spokane, Washington.
4. United Industries v. Dow AgroSciences. Plaintiff's attorney, Dudley Von Holt, Thompson Coburn LLP, St. Louis, Missouri.
5. Hardin, et al. v. BASF, U.S. District Court for the Eastern District of Arkansas. Plaintiff's attorney, William French, Looper Reed and McGraw, Dallas, Texas.
6. Adams, et al. v. United States, et al., Case No. CIV 03-049-E-BLW, U.S. District Court for the District of Idaho. Plaintiff's attorneys, Holland and Hart, Boise, ID and Denver, CO.
7. Jim Aana, et al., v. DuPont Pioneer and Gay Robinson, Inc. Civil No. CV12 00231-LEK-BMK, U.S. District Court for the District of Hawaii.
8. Conagra Foods, Inc, Case re Wesson oils, No. 11-cv-05379-MMM, U.S. District Court Central District of California Western District.
9. Laura Eggatz, Katrina Garcia, and Julie Martin v. Kashi Company. Civil Case No.: 12-21678-CIV-Lenardo/O'Sullivan, U.S. District Court, Southern District of Florida, Miami Division.

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**From:** Kelston, Henry <hkelston@milberg.com>  
**Sent:** Wednesday, June 10, 2015 1:45 AM  
**Subject:** RE: Rest of CMB Declaration  
**Attachments:** Benbrook\_Declaration\_2015-06-10\_GM\_Kix - HK edits 1am.doc

Can the patent discussion would be integrated with the discussion of the trait? Isn't there some correspondence between the traits and the patents?

I am attaching a revised version (without the new section added).

We got some feedback that it took too long to get to (and through) the section on Kix being made from GE corn. So I have tightened up the front sections (less detail about the commingling, for example). Please read through and see if you think there is anything critical missing. The science/process sections are unchanged.

Meagan, this needs to be carefully proofed and fact-checked where noted.

Please add the new patent section to this version, and if Chuck thinks it can be integrated with the discussion of the traits, please work with him on that.

We also need to redraft the opening paragraphs.

I forgot that I have an appointment tomorrow morning near home. So, I'll be out in the a.m., back by noon and working from home the rest of the day.

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**From:** Benbrook, Chuck [<mailto:cbenbrook@wsu.edu>]  
**Sent:** Tuesday, June 09, 2015 9:24 PM  
**To:** Kelston, Henry; Keenan, Meagan  
**Subject:** Rest of CMB Declaration

Henry, Meagan —

I attach the completion of my report. The para. numbering is off, but hopefully will fix itself when inserted.

I think a few more examples in the patent section of language re artificial, synthetic and non-natural would be value added, and either you or I can do that in the next few days. If I do it, no more than 2 hours will be required.

Tomorrow, I would like to discuss with Meagan all the Appendix material, to make sure we have everything in order, and that nothing necessary is included. Meagan — good time for a short chat.

I will also want, of course, one more run through the near final.

I will read your summary judgment motion tomorrow as well.

Chuck

Charles Benbrook, Ph.D.  
Benbrook Consulting Services  
90063 Troy Road

**UNITED STATES DISTRICT COURT  
DISTRICT OF NEW JERSEY**

**IN RE GENERAL MILLS, INC.  
KIX CEREAL LITIGATION**

**Case No. 12-249 (KM)(SCM)**

**Expert Declaration of Charles M. Benbrook, Ph.D.**

**Submitted in Accordance with Fed. R. Civ. P. 26(a)(2)**

**Dated: June 15, 2015**



## **I. INTRODUCTION**

1. I have been asked by Plaintiffs' counsel to offer an opinion, based on my professional knowledge and expertise, as to whether Genetically Modified Organisms (GMOs) – and the foods manufactured from them – can be accurately represented as “natural,” based on the common definitions, usage, and meaning ascribed to the term “natural” in various contexts relating to food and agricultural products. (The terminology “genetically modified organism” (GMO) is used herein interchangeably with the phrase “genetically engineered” (GE) organism).

2. In the course of my analysis, I reviewed and analyzed the factual allegations set forth in the Complaints of Plaintiffs Christina Bevans, Daniel Kellogg, Robin Marcus, and Christine Zardeneta (Complaints), which allege that the “Made With All-Natural Corn” statement on each box of the Kix Products is unfair, false, deceptive, and/or misleading. I also analyzed the disclosures regarding the corn used to make Kix cereals made by in her deposition (date). It is my understanding that\_ was designated by General Mills as the appropriate representative of the company to answer questions pertinent to the case.

3. I base my opinion on my review of the facts of this case, coupled with a detailed analysis of the impacts of the genetic engineering process on the integrity and composition of the corn from which Kix cereals have been, and still are manufactured.

**Comment [A1]:** Familiar with the patents

4. Key insights and information regarding the genetic composition of the corn in Kix cereals were extracted from my analysis of the many patents associated with the major GE corn varieties used in Kix cereal manufacturing process.

5. Appendix A to this Report contains my resume outlining professional experience, qualifications, and publications I have written, or helped write in the previous ten years.

6. Appendix B to this Report lists cases in which I have prepared an expert report, or testified as an expert at trial or by deposition.

7. Appendix C contains detailed, supplemental tables developed as part of my research in preparing this report. Each has been considered in reaching the opinions expressed herein.

8. Appendix D contains a Table of Contents of a “Dropbox.com” folder that contains additional documents that I have referenced and/or considered in reaching my factual findings and opinions in this Report.

9. I am being compensated at the rate of \$300 per hour for my work on this case

## **II. SUMMARY OF CONCLUSIONS**

10. Based on my knowledge of the U.S. corn market and supply chains for corn-derived ingredients during the class period, and