GMO

BEYOND

THE SCIENCE

SHOULD UNIVERSITY AGRICULTURAL RESEARCH SCIENTISTS PARTNER WITH INDUSTRY?

Paul Vincelli, extension professor and Provost's Distinguished Service Professor at the University of Kentucky.

HIGHLIGHTS

- Biases, conflicts of interest come from many sources, including associations with industry, advocacy groups, other non-profits
- Industry funding of studies on GE crops does not appear to be important bias source
- Personal experience suggests corporations receptive to negative results, as they improve products, limit liability
- Limited resources for much agricultural research without industry support
- Dubious "shill" accusations against biotech scientists discourage public engagement, depress discourse

Agricultural scientists who interact with the public often feel under enormous scrutiny. One of the most common concerns is that professional ties with industry—especially obtaining funding from industry—compromise scientific credibility. This concern is particularly acute in the area of genetically engineered crops (GE crops, commonly known as GMOs).

Research into genetically engineered crops is not my specialty—my work is focused on plant pathology—and I have never solicited nor received private-sector funding on this issue. Over my career, my industry interactions have dealt with non-GMO products for plant disease control. My interest in GE crops arises from their potential to address

genuine human needs and to reduce the environmental footprint of agriculture. And I am concerned that a dark shadow has been cast over many independent scientists because of their collaborative efforts with various stakeholders, including companies.

BIASES FROM MANY SOURCES

Across multiple disciplines, industry-funded projects may be more likely to report positive outcomes, or less likely to report negative outcomes [1-4]. However, industry funding is not always associated with biased outcomes [5, 6]. Furthermore, many sources of funding—NGOs, non-profits, other civil and governmental organizations—may engender conflicts of interest (COIs) and biases that influence reported research. Powerful biases may arise for non-monetary reasons [7] in both researchers and in non-researchers...possibly including you and me.

Regarding GE crops, I am aware of three journal articles on the topic of industry funding and bias. In the first [8], the authors found no evidence of bias due to financial COIs (studies sponsored by an industry source that may benefit from the outcome), but they did document bias associated with professional COIs (where at least one author was affiliated with a company that could benefit from the study outcome). In that study, among the 70 studies examined (see their Table 2), 61% had either a financial or a professional COI. Among the much larger sample size (698 studies) examined by Sanchez [9], the majority had no COI, and only one quarter had "COIs related to author affiliation and/or declared funding source."

A recent study by Guillemaud et al [10] had similar findings: among 579 studies with definitive COI information (see their Figure 3), the majority did not report a COI. How-ever, among those with COIs, there was a higher probability of reported outcomes favor-able to the GE crop industry. In addition to these journal articles, another independent analysis [11] suggested that industry funding did not bias study outcomes for GE crops, but these data have not been analyzed statistically nor published in a peer-reviewed journal.

Thus, while evidence to date shows that the majority of studies on GE crops are not influenced by COIs, some fraction is so influenced. Therefore, there is value in remaining alert to the possibility of bias and in continuing to practice full disclosure. I believe it is important to remain alert to COIs and biases of all sorts—not only those associated with corporate influences, but also those of NGOs or other civil organizations that may have explicit or implicit agendas.

Some people simply do not trust corporations. This is understandable, given the indefensible behavior of some in business, such as the tobacco industry, the chemical industry, Exxon, and Volkswagen [12-15]. Consequently, some members of the public perfunctorily dismiss commercial-sector scientists who may have solid scientific skills and high personal integrity. I personally must admit to a measure of distrust of corporations, which may even express itself occasionally as an anti-industry bias. But I also believe it is unwise to categorically reject all industry-funded data, solely on the basis of their provenance. In fact, I would label such an attitude a bias itself. Thoughtful, evidence-based analysis must always trump bias and ideology...and does, for a good scientist.

Why do researchers accept industry funding? Public-sector and private-sector scientists may share common interests. Industry scientists and I share a common interest in knowing what works in the field and what doesn't. Consequently, industry sources provide funding for field tests of their products for plant disease control. Furthermore, public funding for science in the USA is insufficient to support even a fraction of the worthy research projects. Inadequate funding can quickly and thoroughly undercut a career in science at any stage. Since researchers are hired to do research on important topics and not to whine about the difficult state of public funding, some will welcome funding from commercial sources, if it allows them to continue to do research they believe is intellectually compelling, important to society, or both. Also, industry scientists may have knowledge, skills, and facilities that we public scientists may not.

MY FUNDING CHOICES: SCIENTIFIC RIGOR COUPLED WITH PERSONAL INTEGRITY

Discussing my own practices should provide an idea of how many scientists work. Roughly half of my funding over the years has been from industry, primarily to support product testing for plant disease control. I have commonly tested synthetic fungicides, but I have also tested natural products of various sorts. In fact, commercial pesticide manufacturers can fairly accuse me of an anti-pesticide bias. I say this because I have tended to favor testing products that might be perceived as more consistent with sustainability (biocontrol products, for example) than applications of synthetic chemicals, often requesting limited, or no, funding for such tests. Besides industry funding, I have received federal funds for research and outreach on detection and management of plant diseases.

I publish all efficacy trials in Plant Disease Management Reports. We commonly publish data showing inadequate efficacy or phytotoxicity, and I never consider funding sources when the report is drafted. In fact, the reports are drafted by the Senior Research Analyst who conducts the field work, and he doesn't know who provided funding nor for what amount. Thus, our testing program does not suffer from publication bias. This approach is not exceptional [16, 17].

I accept no personal gifts—monetary or material—from private-sector sources.

I have no hesitation about challenging multinational corporations. For example, I provided a degree of national leadership in challenging a major pesticide manufacturer over certain uses of a commercial crop fungicide. I was one of the lead authors of a letter to the US Environmental Protection Agency raising questions about the paucity of public data to support "plant health" claims. I gave a similar talk in a major scientific conference, the 2009 American Phytopathological Society meeting.

Several factors may help me and other scientists to offset natural human tendencies towards bias:

- **Personal integrity.** Scientists like to live with integrity, no differently from the activists who may challenge us. For me, personal integrity is a core personal value. While this may be naïve, I believe that it helps to inoculate me against biases due to source of funding.
- **Desire not to be wrong.** Long ago I learned that the most important thing a scientist has is her/his credibility. Having been very publicly wrong once on a professional issue, I decided that, forevermore, I would be impeccably faithful to the scientific method. Better to express scientific uncertainty than to be wrong again! These thoughts help me be watchful for personal biases, and they help me maintain my fidelity to scrupulous scientific practice.
- **Personal growth.** Experience with endeavors in personal growth, as well as with meditation, have "turned up the volume" on those surprising and unwelcome inner thoughts such as biases, allowing me to recognize them for that they are, and to make more principled choices.
- **Curiosity.** Good scientists are intensely curious, and given time, that trait often overcomes the preconceptions and biases that one can't help but have as a human being.
- **Scientific culture.** I seek peer input and peer review all the time. It not only improves my work; it helps guard against biases. Peer-review is an important component of modern science and it helps to reduce the influence of bias due to funding source. Good "scientific culture" goes along with this concept of peer review. I enjoy witnessing and participating in the frequent scientific discussions that happen informally and spontaneously among excellent researchers in my department. Such exchanges are always collegial yet they are quite direct; creative thinking is welcome yet statements of fact must always be evidence-based. If you have a bias based on your funding source, it won't help you one bit in the face of respectful interrogation by highly intelligent, intensely curious, deeply knowledgeable professors of science.

A common concern is that providing funding buys "access" to researchers. This may sometimes be the case, but for me, this criticism doesn't fit. I am an Extension Specialist—everybody has access to me and my expertise. I don't recall a single instance in my entire career when I failed to return a phone call or email from anyone. In fact, it is a federal requirement that Extension programming be grounded in engagement with diverse stakeholders—including, but certainly not limited to, industry [18].

WHAT HAPPENS WHEN DATA FALL SHORT OF COMPANY EXPECTATIONS?

We regularly see poor product performance in our experiments. In a memorable instance, we observed visible injury to a creeping bentgrass putting green from a particular formulation of the widely used fungicide, chlorothalonil. On the day of application, the turfgrass was suffering exceptionally severe drought stress, due to an irrigation equipment failure, which probably was a predisposing factor.

I notified the company of my observations, which is my standard practice if a product provides unexpectedly poor performance or unexpected phytotoxicity. This is not to provide the company the opportunity to "help me see the error of my ways." Rather, this is simply good scientific practice. I want industry scientists to collect their own samples, so that they may better understand the poor results obtained; and to offer hypotheses or insights that may account for the unexpected results, as they often know things about their product and its performance that I do not.

In the case of the turfgrass injury caused by chlorothalonil, a company representative and I visited the experiment together and shared observations. I listened to the representative's hypotheses and shared my own. After the meeting and additional lab work, I reported my findings in various outlets. In my research program, unfavorable results get reported no differently than favorable results.

I must state emphatically that, in my 34 years of product testing for plant disease control, I cannot recall a single instance where a company representative attempted to pressure me to report "favorable results." Company representatives do not like to receive bad news, but in my experience, almost every company representative I have interacted with has been professional enough to recognize the importance of discovering the limitations of their products sooner rather than later. The consequences of introducing an inadequate product can be catastrophic for a corporation.

CORPORATE FUNDING FOR OUTREACH

What about private-sector funding for outreach? To my knowledge, such funds are never provided with a quid pro quo that the scientist will make particular claims about a company's products. To the contrary, private-sector representatives take note of speakers whose scientific understanding is consistent with their own. They may approach those speakers to discuss possible support for outreach, but without specifying the content of such presentations. Although I refuse industry funding for all aspects of GE crops, I do not suspect undue industry influence when funds are provided for travel expenses or supplies of invited speakers. Even honoraria or stipends for speaking engagements don't particularly concern me. This is true for such funding across the full spectrum of possible funding sources, ranging from advocacy groups for organic agriculture to multinational pesticide manufacturers. I want to see the scientific methods and data, no matter who did the study.

WHO SHOULD PAY FOR RESEARCH?

Should publicly funded professors even do product testing? Yes: there is a public interest in independent assessments of how products perform. The more public data on performance, the better.

If you agree that third-party testing is desirable, the question arises, "Who pays for it?" I believe that, usually, the manufacturer is responsible, not the taxpayer. Of course, this raises concern about funding bias. If a researcher wishes to avoid funding bias, can they tap into other sources? Not in my discipline. Pools of public funding for product testing are essentially non-existent.

What about studies of possible impacts of products to the environment? Who should pay for that? Again, in my opinion, such costs fall to the manufacturer, although in some cases, there is a compelling public interest that justifies the use of public funds for product testing.

Final thoughts: Does industry-researcher cooperation undermine the credibility of scientific research?

For me, the answer is, "No." We should be cognizant of possible biases and COIs due to source of funding—whether the source is industry, NGOs, advocacy organizations, or other sources. Disclosure is critical [7, 19]. However, industry scientists are often excellent scientists who take pride in their work, no differently than any industry critic. Yes, we should exercise a degree of caution when reviewing industry-funded research, but the same holds for research funded by advocacy organizations, since each has an agenda. Personally, in all cases, I will not reject either source out of hand; I will judge the work based on its scientific merit.

Sometimes the bias against industry-funded research on GE becomes hurtful, especially in the social media. Witnessing dedicated public servants being unfairly attacked as "industry shills" is demoralizing to public scientists, and it has the unintended consequence of discouraging public engagement by scientists who already have very busy professional and personal lives. Such unfounded charges are not only divisive and unproductive: they are unkind and can be abusive. (Sadly, unkind behavior can be found in all sides of the GMO debate.)

My freedom from industry funding on all aspects of GE protects me from similar accusations. Yet it doesn't surprise good scientists that, after years of studying the scientific literature, I independently arrived at an understanding very similar to that presented in the report of the National Academy of Sciences, Engineering and Medicine (NASEM) published earlier this year [20]. This isn't because industry has somehow influenced me or the members of the NASEM review committee. It is because there is a substantial body of credible

science supporting the conclusions presented in the NASEM report. In reviewing the body of peer-reviewed scientific literature on GE crops, one is likely to arrive at similar conclusions. I had an identical experience with the scientific consensus on climate change [21]. Ultimately, with enough careful study of evidence from credible sources, fidelity to good scientific practice, and a degree of humility, it is hard not to arrive at findings rather similar to those of journal-published experts of a scientific discipline. They actually do know something about their subject after all.

Paul Vincelli is an Extension Professor and Provost's Distinguished Service Professor at the University of Kentucky. Over the 26 at UK, he has developed specializations in management of diseases of corn, forages, and turfgrasses, molecular diagnostics, and international agriculture. He also has provided Extension programming on climate change and on genetic engineering of crops. He currently is UK's Coordinator for the USDA's Sustainable Agriculture Research and Education program, and he serves as Councilor-At-Large for the American Phytopathological Society.

The Genetic Literacy Project is a 501(c)(3) non profit dedicated to helping the public, journalists, policy makers and scientists better communicate the advances and ethical and technological challenges ushered in by the biotechnology and genetics revolution addressing both human genetics and food and farming. We are one of two websites overseen by the Science Literacy Project; our sister site, the Epigenetics Literacy Project, addresses the challenges surrounding emerging data-rich technologies. Find out more about the GLP at:

www.geneticliteracyproject.org

ACKNOWLEDGEMENTS

Thanks are expressed to John R. Hartman and Jon Entine, for reviewing earlier drafts of the manuscript.

DISCLOSURE STATEMENT

Disclosure documents may be found here. The author donated the full amount of his monetary honorarium for writing this article to Human Rights Watch.

LITERATURE CITED

1. Bes-Rastrollo, M., Schulze, M. B., Ruiz-Canela, M. and Martinez-Gonzalez, M. A., Financial conflicts of interest and reporting bias regarding the association between sugar-sweetened beverages and weight gain: A systematic review of systematic reviews. PLoS Medicine, 2013, Vol. 10, p. e1001578, DOI: 10.1371/journal.pmed.1001578. Available from: *http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001578*

2. Lesser, L. I., Ebbeling, C. B., Goozner, M., Wypij, D. and Ludwig, D. S., Relationship between funding source and conclusion among nutrition-related scientific articles. PLoS Medicine, 2007, Vol. 4, p. e5, DOI: 10.1371/journal.pmed.0040005. Available from: *http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.0040005*

3. Vera-Badillo, F. E., Shapiro, R., Ocana, A., Amir, E. and Tannock, I. F., Bias in reporting of end points of efficacy and toxicity in randomized, clinical trials for women with breast cancer. Ann Oncol, 2013, Vol. 24, p. 1238-44, DOI: 10.1093/annonc/mds636. Available from: *http://www.ncbi.nlm.nih.gov/pubmed/23303339*

4. Landefeld, C. S., Commercial support and bias in pharmaceutical research. Am J Med, 2004, Vol. 117, p. 876-8, DOI: 10.1016/j.amjmed.2004.10.001. Available from: *http://www.ncbi.nlm.nih.gov/pubmed/15589496*

5. Barden, J., Derry, S., McQuay, H. J. and Moore, R. A., Bias from industry trial funding? A framework, a suggested approach, and a negative result. Pain, 2006, Vol. 121, p. 207-18, DOI: 10.1016/j.pain.2005.12.011. Available from: *http://www.ncbi.nlm.nih.gov/pubmed/16495012*

6. Kaplan, R. M. and Irvin, V. L., Likelihood of null effects of large NHLBI clinical trials has increased over time. PLoS One, 2015, Vol. 10, p. e0132382, DOI: 10.1371/journal.pone.0132382. Available from: *http://www.ncbi.nlm.nih.gov/pubmed/26244868*

7. Young, S. N., Bias in the research literature and conflict of interest: an issue for publishers, editors, reviewers and authors, and it is not just about the money. Journal of Psychiatry and Neuroscience, 2009, Vol. 34, p. 412-417. Available from: *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2783432/*

8. Diels, J., Cunha, M., Manaia, C., Sabugosa-Madeira, B. and Silva, M., Association of financial or professional conflict of interest to research outcomes on health risks or nutritional assessment studies of genetically modified products. Food Policy, 2011, Vol. 36, p. 197-203, DOI: 10.1016/j.foodpol.2010.11.016. Available from: *http://www.sciencedirect.com/science/article/pii/S0306919210001302*

9. **Sanchez, M. A., Conflict of interests and evidence base for GM crops food/feed safety research. Nat Biotechnol, 2015, Vol. 33, p. 135-7, DOI: 10.1038/nbt.3133. Available from:** *http://www.ncbi.nlm.nih.gov/pubmed/25658276.*

10. **Guillemaud, T., Lombaert, E. and Bourguet, D., Conflicts of interest in GM Bt crop efficacy and durability studies. PLoS One, 2016, Vol. 11, p. e0167777, DOI: 10.1371/journal.pone.0167777.** *Available from: http://www.ncbi.nlm.nih.gov/pubmed/25658276.*

11. **Brazeau, M., GM Food is Safe According to Independent Studies, in Cosmos. 2014. Available from: https://cosmosmagazine.com/ biology/gm-food-safe-according-independent-studies.**

12. Gates, G., Ewing, J., Russell, K. and Watkins, D. Explaining Volkswagen's Emissions Scandal. New York Times. 19 Jul 2016. Available from: *http://www.nytimes.com/interactive/2015/ business/inter national/vw-diesel-emissions-scandal-explained.html.*

13. Markowitz, G. and Rosner, D., Deceit and Denial: The Deadly Politics of Industrial Pollution, With a New Epilogue. 2013, California/Milbank Books on Health and the Public. 446 pp. pp, ISBN 9780520275829.

14. Ingram, D. Judge Orders Tobacco Companies to Admit Deception. Reuters News Agency. 27 Nov 2012. Available from: *http://www.reuters.com/article/us-usa-tobacco-idUSBRE8AQ18A20121128.*

15. Banerjee, N., Lisa Song, L. and Hasemyer, D., Exxon's Own Research Confirmed Fossil Fuels' Role in Global Warming Decades Ago. 2015 16 Sep 2015 [Accessed 18 Aug 2016]; Available from: *https://insideclimatenews.org/content/Exxon-The-Road-Not-Taken.*

16. Lipsky, P. E., Bias, conflict of interest and publishing. Nature Reviews Rheumatology, 2009, Vol. 5, p. 175-176, DOI: 10.1038/nrrheum.2009.52. Available from: *http://www.nature.com/nrrheum/journal/v5/n4/full/*

17. **Kniss, A., I Am Biased and So Are You: Thoughts on Funding and Influence in Science. 2016 [Accessed 18 Aug 2016]; Available from:** *http://weedcontrolfreaks.com/2015/08/i-am-biased-and-so-are-you-thoughts-on-funding-and-influence-in-science/.*

18. **Kelsey, K. D. and Mariger, S. C., A case study of stakeholder needs for Extension education Journal of Extension, 2002, Vol. 40, 2RIB2. Available from:** *http://www.joe.org/joe/2002april/rb2.php/*

19. **Lewandowsky, S. and Bishop, D., Don't let transparency damage science. Nature, 2016, Vol. 529, p. 459-461. Available from:** *http://www.nature.com/news/research-integrity-don-t-let-transparency-damage-science-1.19219/*

20. **National Academies Press. Genetically Engineered Crops: Experiences and Prospects. 2016, ISBN 978-0-309-43738-7. Washington DC. 420 pp. Available from:** *http://www.nap.edu/23395* Accessed 18 May 2016

21. **Vincelli, P., Scientific consensus as a foundation for Extension programming.** Journal of Extension, 2015, Vol. 53, 1COM2. Available from: *http://www.joe.org/joe/2015february/comm2.php/*