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A Path Forward

Science should drive public policy and the public's understanding of the strengths and weaknesses of GM crop and food advances. Activists have dismissed the opinions of the world's leading scientists to undermine public trust in the benefits of GM crops and foods. Holding activists accountable for increased regulatory costs and public policy proposals that limit innovation in the public and private sector is vital to ensuring that millions of consumers can realize the crop, environmental and nutritional benefits offered by GM technology.

- ✓ Activists dismissal of science to oppose GM technology negatively impacts the public discussion and the regulatory environment
- ✓ Activists limit the ability of lawmakers to develop sound policy that fosters technology innovations
- ✓ Activists ignore credible scientists and foster distrust of safe food-system technology and innovations that can improve nutrition and environmental sustainability
- ✓ Public acceptance of beneficial food technology is undermined in an environment where activists lead the public discussion while ignoring sound science
- ✓ Holding activists accountable will foster an environment that advances research and development in the field of GM food and crop science

Movement

"Food is a personal and cultural topic. It is the stuff on the table in front of us, it is the sustenance we present to our families and dearest friends. For these reasons it is a ripe topic on which to culture fear."

One of the cornerstones of any anti-intellectual movement is the propagation of opinions or philosophies that run counter to accepted scientific consensus. The movement against biotechnology ~~is an intellectually bankrupt one that~~ has much in common with movements that

oppose vaccines, deny climate science or contend evolution is a myth. Proponents often ignore sound science and credible scientists, and instead rely on low-quality data, spread misinformation ~~within communities~~, appeal to fear, and exhibit an endless addiction to logical fallacy.

Biotechnology critics of GMOs (for this report, "transgenic," "genetically modified," "GM" and "GMO" are synonymous) wage ~~an~~ aggressive campaigns against any facet of transgenic technologies that could be interpreted as advantageous to the farmer, the environment, the consumer, or the poor locked in nutritional deficit. They exploit the human desire to avoid risk, impeding progress in using biotechnology as a tool to improve the human condition.

Science Denial in the GM Realm

"The non-scientific vilification of sound technology is a hallmark of the anti-GMO movement."

A hallmark of anti-GMO activists is a disturbing reliance on information that is not solidly supported by qualified empirical research produced by mainstream scientists in high level peer reviewed journals. Each year there are hundreds of scholarly papers that reinforce the utility, efficacy and safety of transgenic technologies that rarely receive attention from mainstream media, despite the fact that these reports must pass rigorous peer review before they are assimilated into scientific literature. Yet ~~science, and~~ activists continue to frequently revisit and quote from the same handful of retracted or low quality studies despite an abundance of reliable GM scientific information available. ~~Each year there are hundreds of scholarly papers that reinforce the utility, efficacy, and safety of transgenic technologies that rarely receive attention from mainstream media, despite the fact that these reports must pass rigorous peer review before they are assimilated into scientific literature.~~

One recent example is the report headlined, "GMOs linked to gluten disorders plaguing 18 million Americans ~~report~~"^[1]. The article shows offers no data or references to research. The ~~numbers and concept come from claims originated by author and documentarian~~ Jeffrey Smith, a popular anti-GMO crusader with no scientific credentials, and his interview with a chiropractor. None of ~~this is what was reported was~~ actual research; ~~t~~ There ~~is was~~ no formal "link." To actual research. ~~The article reflected is~~ the opinion of a non-scientist. Yet it was widely distributed and read around the world. ~~news~~ News outlets often do not discern, presenting the story speculation as science, ~~not speculation~~.

Bold headlines capture attention and sensationalism fuels the news cycle, permitting unsupported scientific claims to become headlines. These sensational claims are picked up by news outlets and propagate quickly. Social media spreads these claims even further, even among otherwise credible outlets.

Blaming New Technology for Historical Problems

"The most troubling part of this false blame is that less attention is paid to the discovery of the actual causes."

Weed and insect resistance have been cited as significant drawbacks stemming from adoption of GM technology. The activist hyperbole speaks of "superweeds." Yet they are hardly "super." They are resistant to one herbicide, a challenge facing modern agriculture for decades preceding the introduction of GM crops.

Much of the criticism focuses on the use of the herbicide glyphosate used in conjunction with many herbicide resistant GM crops. Farmers have been able to substitute glyphosate for far more toxic chemicals, reducing the overall toxicity sprayed on crops per acre. While the increase in acreage and number of weeds resistant to the herbicide "glyphosate" is a legitimate problem [12], the same challenges occur in every cultivation system. The use of a single herbicide simply reveals the age-old battle between weeds and man's attempts to control them. It is an endless arms race, and glyphosate resistance is just another example of that reality.

Many ~~profiteering~~ authors and activist speakers ~~are also quick to~~ point out ~~the a~~ suite of maladies ~~that has they claim has~~ increased in concert with the adoption of GM foods: ~~o~~ Obesity, liver disease, autism, asthma and many other chronic diseases ~~have been falsely associated with GM foods. Yet th~~ There is no evidence that demonstrates such links between the products and any of these disease. These diseases have also increased along with the increased consumption of organic foods.

This common ~~confusing confusion~~ of correlation with causation is massively propagated throughout ~~activist and~~ anti-GM websites and literature. Good science seeks to connect cause and effect and move beyond simple correlation but the anti-GM peer-reviewed scientific literature frequently trumpets identifies associations that may or may not be authentic. Rarely, if ever, ~~do have~~ we see evidence that demonstrates the mechanisms between treatment and outcomes, or dose-response relationships as is required by good science.

The most troubling part of this false blame is that less attention is paid to the discovery directed at trying to discover of the actual causes. The real reasons for disorders mentioned by activists are likely multifactorial, meaning, for instance, that genetic predisposition is exacerbated by environmental or other stressors. While transgenic crops have never been linked to any of these diseases, that does not stop anti-GM activists from promoting imagined associations.

Because of the fears these campaigns generate, Yet, locked in laboratories worldwide there are plants/crops proven to resist disease, drought, flooding and many other cultural stresses are locked in laboratories worldwide. Plants with higher nutrition content and enhanced fertilizer utilization have been developed but remain unreleased. Proven solutions to production or postharvest problems, nutrition, and environmental stresses sit idle, in part, because opposition to biotechnology freezes these potentially useful technologies in place. This reality harms mostly those in developing nations.

Recognizing a Scientist from an "Expert"

"Public scientists that are experts in this area are dismissed...yet charlatans, without data, are allowed to shape the scientific conversation."

Some of the most cited anti-GMO literature is not primary research, but literature reviews and surveys that have not been peer reviewed ~~that and~~ often come to speculative conclusions not necessarily supported by the cited work. In addition, a new breed of journals has emerged, posing as scientifically credible sources, but publishing anything if the authors are willing to pay, including research that has been retracted or rejected by credible journals. The retracted study of Gilles-Eric Seralini was republished without peer review in just such a journal. This payment earns the author open access (meaning articles may be downloaded for free), and sometimes can mean soft review and gentle editorial treatment.

Leading "experts" often cited by the anti-GM movement may be experts in some area of science, but have little scholarly expertise on transgenic crops. [EXAMPLE??] They use their association with credible institutions or "celebrity" status to promote books and websites espousing the dangers of GMOs. Claims linking to an individual's website are not a substitute for credible and substantiated research and many make claims without evidence of formal training or experimentation.

While charlatans, without data, are allowed to shape the scientific conversation, in this arena, public scientists ~~that-who~~ are experts in the field are often dismissed by activists as agents of a conspiracy and stooges of multinational corporations, yet ~~charlatans, without data, are allowed to shape the scientific conversation~~

And then there are the pseudo-scientific, credible-sounding organizations that claim to speak for the broad scientific community, yet are actually activist fronts. ~~Two-Three~~ such examples include-are the Institute for Responsible Technology, Center for Food Safety and the Environmental Working Group. Despite a lack of peer-reviewed scientific information, both groups are frequently cited by activists and even many journalists as authorities in the science of GMO. The Union of Concerned Scientists are-is frequently-cited/quoted as an authority against transgenic technology, yet few consider the "Consensus of Unconcerned Scientists" the overwhelming majority of scientists who are supportive of GM technology because they rely on, -an organization that exists because they are defined by data and evidence.

Discrediting Good Science

"If the data appear to support a position of GM crop safety and efficacy, they are dismissed as products of scientific malfeasance."

Critics of GM technology claim that financial incentive and collusion guide experimental outcomes from independent scientists who secretly unite-conspire with publishers, reviewers, and editors in a grand conspiracy to hide the harms of transgenic technology. Biotech critics

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frequently ~~cite-claim~~ that independent public scientists are “bought off” or ~~even~~-coerced by corporate entities to generate desired results and conclusions.

~~Much of the research on GM crops and animals is totally independent. Funding to public universities is transparent, accessible and open. Corporations sponsor a small fraction of any university’s research. University researchers are sought out to perform important work to independently verify or refute research claims.~~

~~However, there is a keen desire to commercialize innovations—to get them to farms where they can do some genuine good. As a result, ~~Corporations~~-corporations do occasionally interact with academic, government or other industry scientists, utilizing their expertise and resources to accelerate product development. If the data appear to support a position of GM crop safety and efficacy, skeptics immediately ~~and reflexively~~ dismiss the data as products of scientific malfeasance. A simple question: Why would ~~a-compani~~es pay for independent verification or further testing if the results were to be fabricated ~~and the products were to fail, or leave them with huge liabilities if there were deleterious environmental or health consequences?~~ If results ~~are-were~~ simply fantasy, they ~~could~~ be generated in-house much less expensively.~~

The ~~United States~~SA, ~~the-country~~which grows ~~ing~~ and consumes ~~ing~~ the most transgenic ~~material food~~ on the planet, is also the most litigious. There is no incentive for a company (agriculture, pharmaceutical, automotive, etc.) to present a product for public use without ~~it-being-vett~~ing ~~ited~~ to the extreme. Critics and proponents can ~~certainly~~ agree that a central interest of corporate agriculture is generating revenue, remaining profitable, and promoting investor returns. This does not happen when products are dangerous, fail to perform, or kill customers. The specter of litigation and the pursuit of profitability are just two ~~self-sustaining~~-reasons to ~~guarantee-ensure that there will be~~ extensive ~~evidence-testing~~ of product safety, ~~let-alone-any interest-in-ethics.~~

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While biotechnology critics levy allegations about public scientists on the take, they excuse ~~identical-or~~ more egregious potential conflicts of interest among experts with ~~which-whom~~ they agree, while assuming public-sector scientists are willing to “sell-out” for a cheap grant and destroy hard-earned careers. There are ~~plenty-of~~ profiteers in the anti-biotech movement with ~~clear~~ financial incentives, closed books and vocal opposition that provides job security and the limelight.

Exploitation of Perceived Risk and Social Media “Groupthink”

“From chemtrails to JFK, the internet and social media provide a pipeline to communicate and spread bad information, including that around transgenic crops.”

In addition to U.S. government agencies assessing the safety of GMOs, various professional scientific and medical bodies worldwide ~~have also investigated~~ the safety of GMOs. Those independent professional bodies ~~usually often~~ appoint a Blue-ribbon panel of ~~a dozen or so~~ experts in the relevant fields, including genetics, medicine, nutrition, agronomy, etc., and spend as long as two years on ~~an~~the investigation. ~~A final report from the panel issues the findings.~~

All such studies to date ~~—there have been dozens issued by global science organizations—~~have conclude ~~d, unsurprisingly,~~ that no agriculture or food production method is risk free, whether GMO, conventional or organic, but that, on balance, GMOs are as safe, or safer, than other methods.*

Collateral Damage of Anti-Science Activism

"There is a need to comprehend how these technologies serve farmers, decrease environmental impact, and can assist, if not rescue, individuals in dire need."

The public at large, especially in affluent countries where food is abundant, need to understand the true strengths and weaknesses of biotechnology within ~~its each~~ specific application. There is a need to comprehend how these technologies ~~can~~ serve farmers ~~and,~~ decrease environmental impacts ~~, and can assist, if not rescue, individuals in dire need.~~

Across ~~the world of~~ plant biology, scientists worldwide lament the actions of activists and their effective ~~persuasion campaign of demonization of GMOs, which has in limiteding~~ useful innovations:

- Bt and glyphosate resistant crops are dismissed rather than improved
- Golden Rice, which can free millions from the impacts of vitamin A deficiency, is stalled
- Increasing regulation and associated costs limit participation of innovative small businesses, universities and government laboratories in the field
- Reliance on less useful or unproven breeding techniques are adopted without rigorous safety testing
- Crop, environmental and nutritional benefits and improvements are not realized

At a time when the US ~~must needs to~~ emphasize science, technology, engineering and math (STEM) disciplines ~~in order~~ to maintain international competitiveness, attacks on ~~sound~~ science from the anti-GMO movement undermine public trust in credible researchers and scientists as well as our public research institutions. This environment makes it much more difficult to help the public better understand the role the scientific method can and should play in ensuring sound public policy and personal choice based on fact, rather than fear.



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