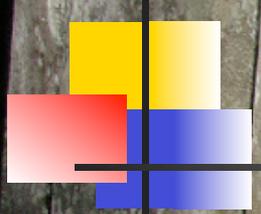


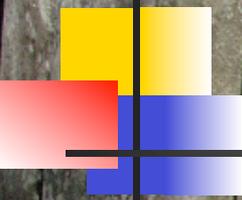
Promoting Dialogue on Genetically Engineered Crops (=GMO Crops, =Bioengineered Crops)



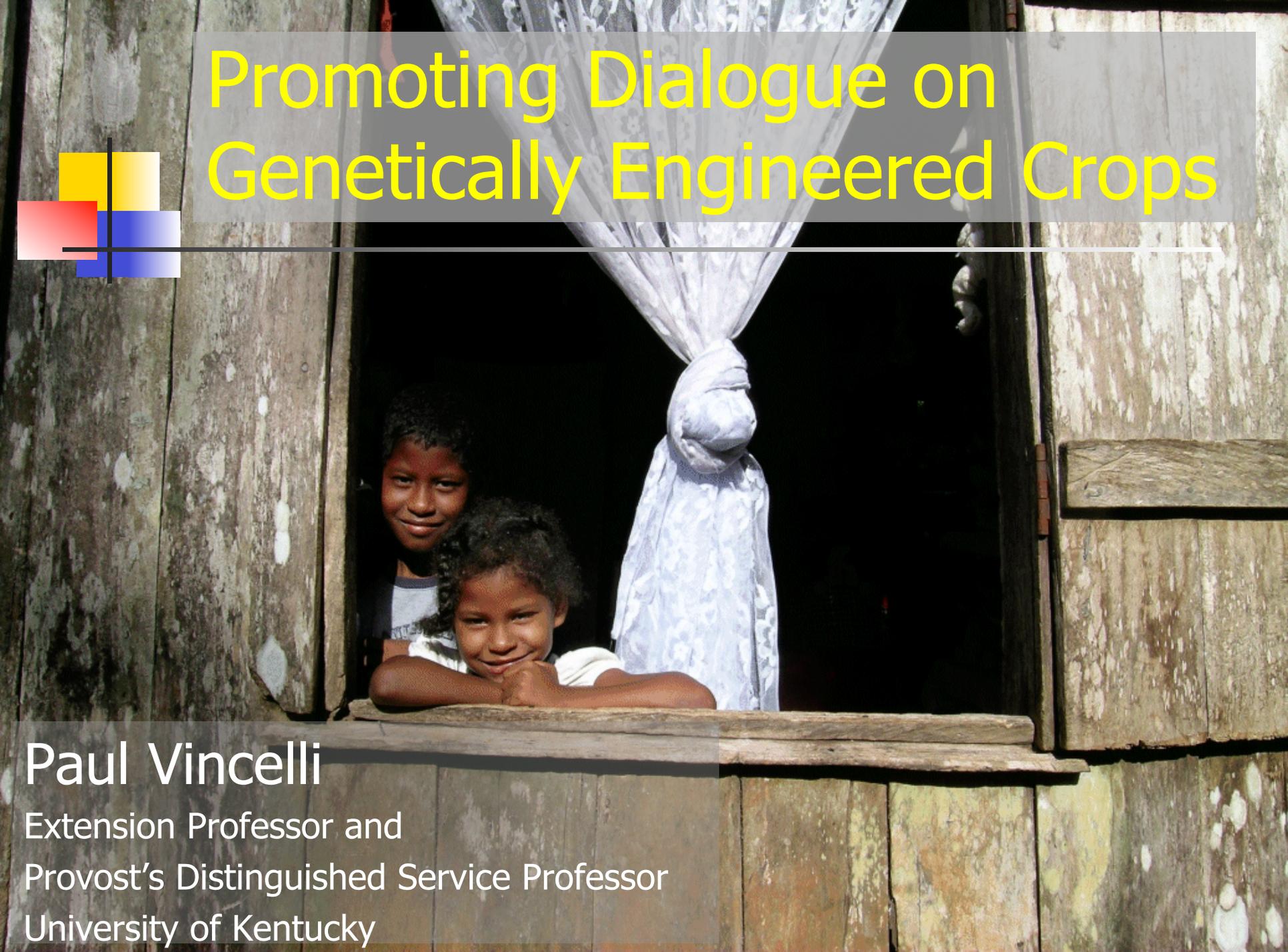
Paul Vincelli

Extension Professor and
Provost's Distinguished Service Professor
University of Kentucky



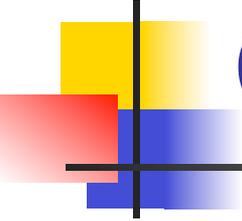


Promoting Dialogue on Genetically Engineered Crops



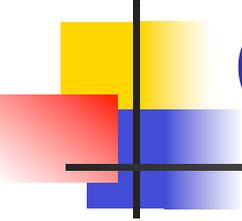
Paul Vincelli

Extension Professor and
Provost's Distinguished Service Professor
University of Kentucky



General topics

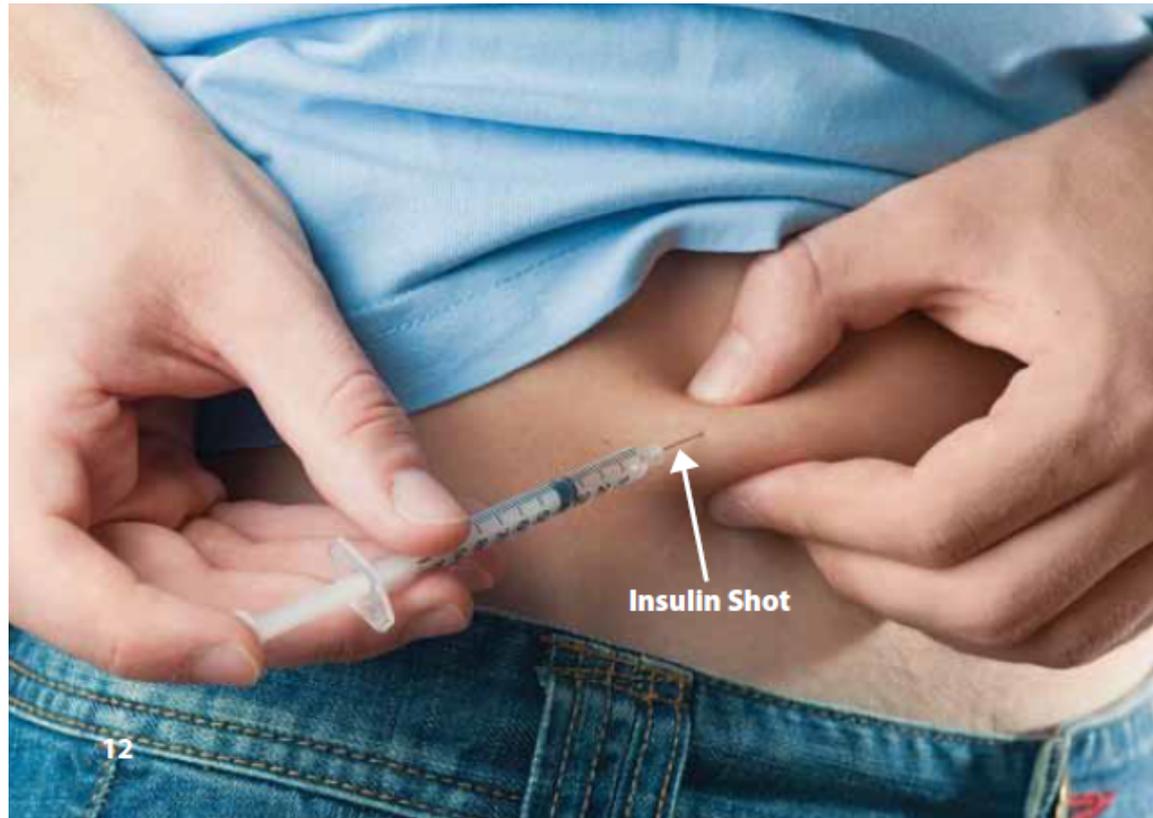
- Ways to communicate key biology of GE crops
- Guidance from social sciences



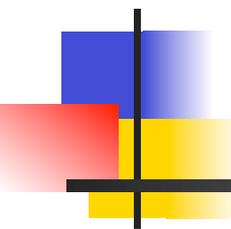
General topics

- Ways to communicate biology of GE crops
- Guidance from social sciences

Insulin from GE bacteria



12



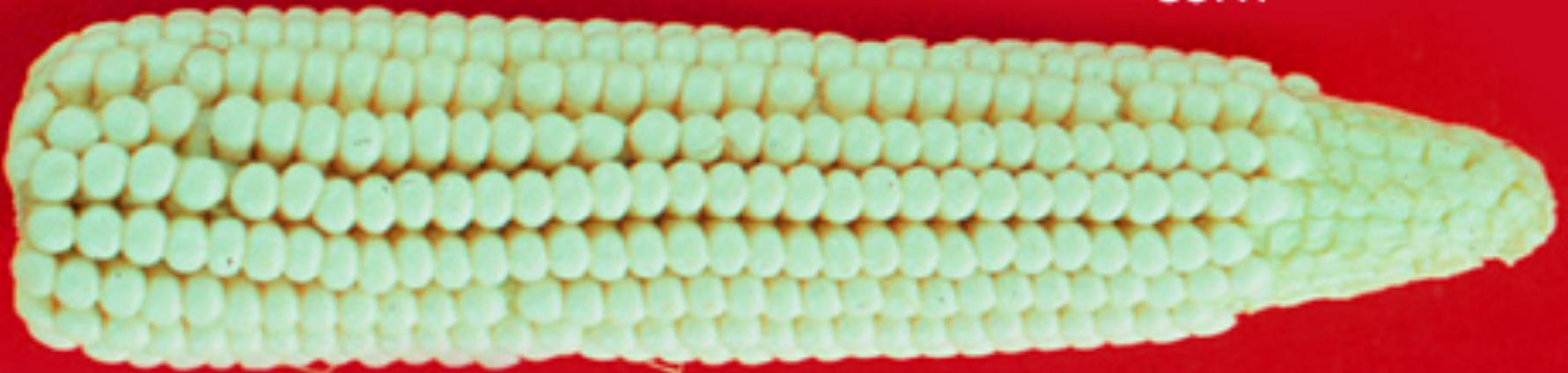
DNA in our food?

If I eat a banana,
will I become a banana?

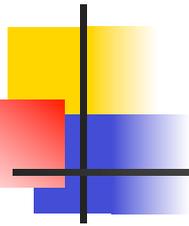
teosinte



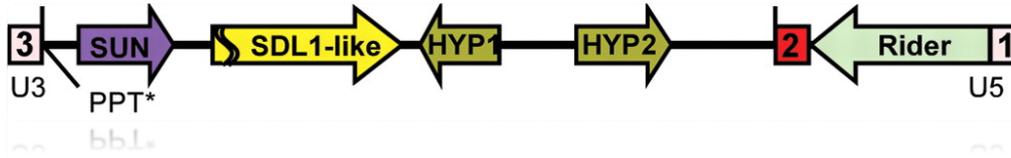
corn



A genetic duplication in tomato

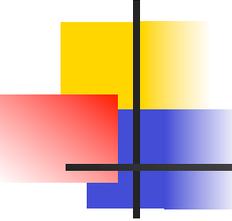


Chr
10



Chr
7



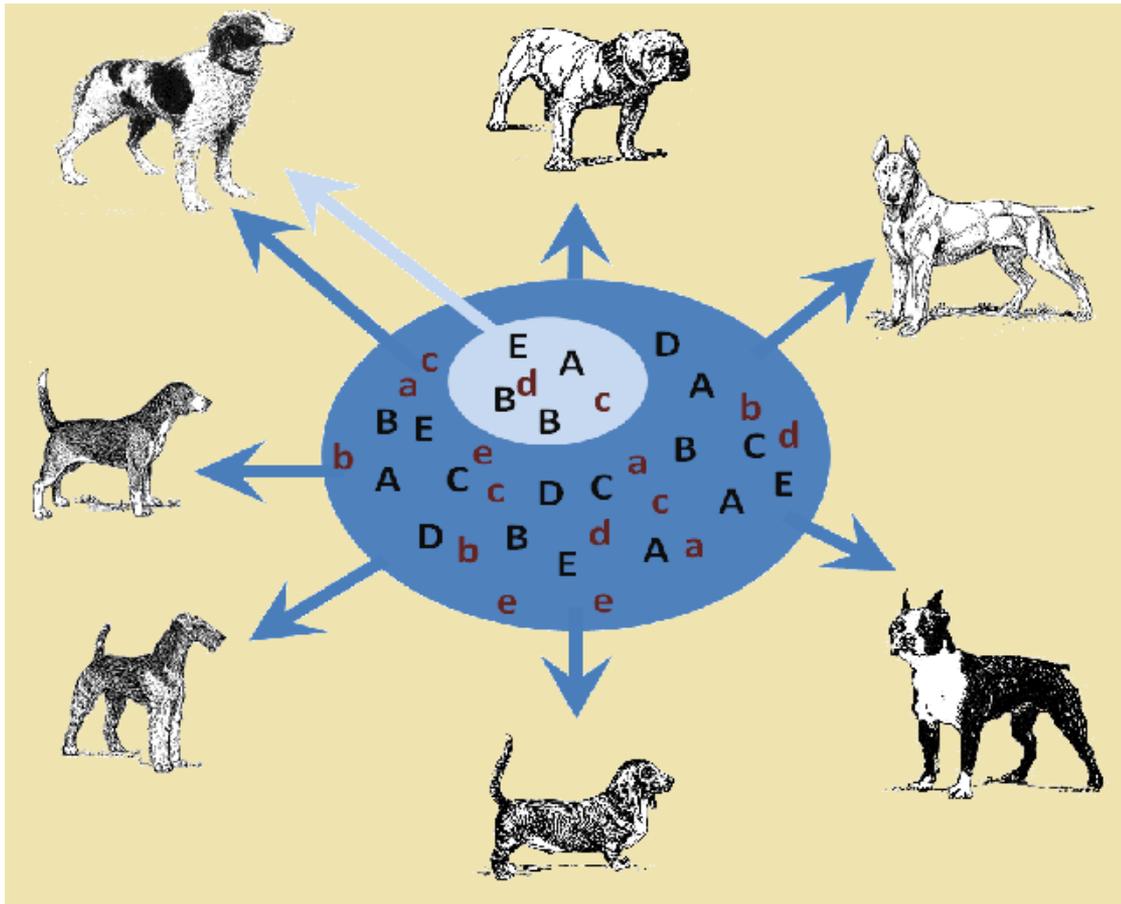


Sweet potato, a natural GMO



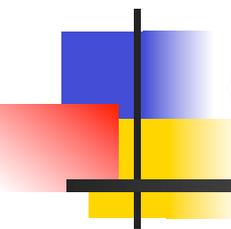
**At least four
bacterial genes**

Gene pool

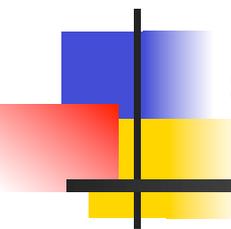


Word processing: an analogy for genetic engineering





Imagine you are writing a
cookbook on Italian cooking



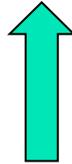
Imagine this sentence is a
gene

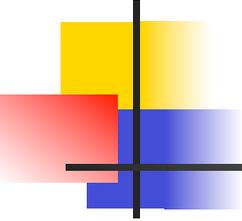
Tomato was added to the focaccia
in the late 18th century.

Plant transformation

Copy and paste

1. Cut tomatoes in half.
2. Squeeze out the seeds.
3. Grate tomato flesh into a bowl.
4. Discard skins...





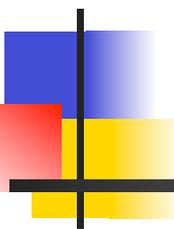
Plant transformation

Copy and paste

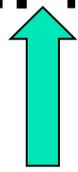
1. Cut tomatoes in half.
2. Squeeze out the seeds.
3. Grate tomato flesh **Tomato was added to the focaccia in the late 18th century.** into a bowl.
4. Discard skins...

Gene editing (CRISPR)

Targeted edits

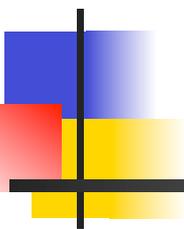


The precursor of pizza was probably the focaccia, a flat bread known to the Romans as *panis focacius*, to which toppings were then added. Modern pizza developed in...

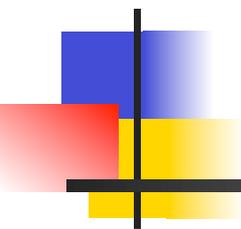


Gene editing (CRISPR)

Targeted edits



The precursor of pizza was probably the focaccia, a flat bread known to the Romans as *panis focacius*, to which toppings were then added. **Tomato was added to the focaccia in the late 18th century.** Modern pizza developed in...



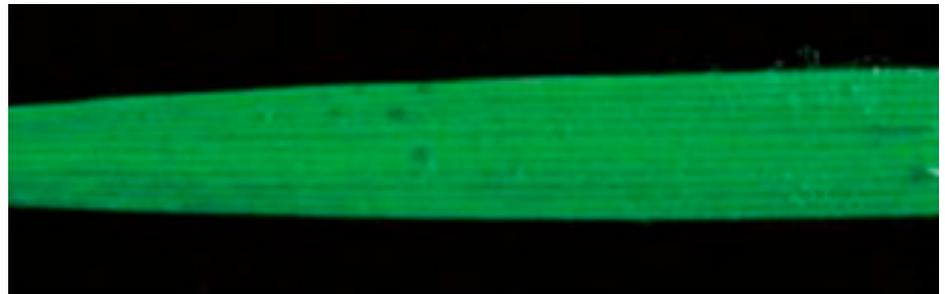
Gene editing (CRISPR) **Targeted edits**

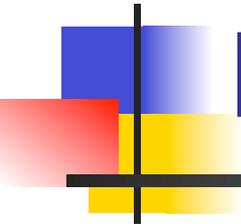
Wine is made from grape ~~juice~~ juice.

Emulating natural mutation

MLO-A1: TCGCTGCTGCTCGCCGTCACGCAGGACCCAATCTCCGGATATGCATCTCCCA
M3: TCGCTGCTGCTCGCCGTCA...AGGACCCAATCTCCGGATATGCATCTCCCA
M6: TCGCTGCTGCTCGCCGTCA.GCAGGACCCAATCTCCGGATATGCATCTCCCA

0.00000001%
change





Non-GMO breeding techniques

For comparison

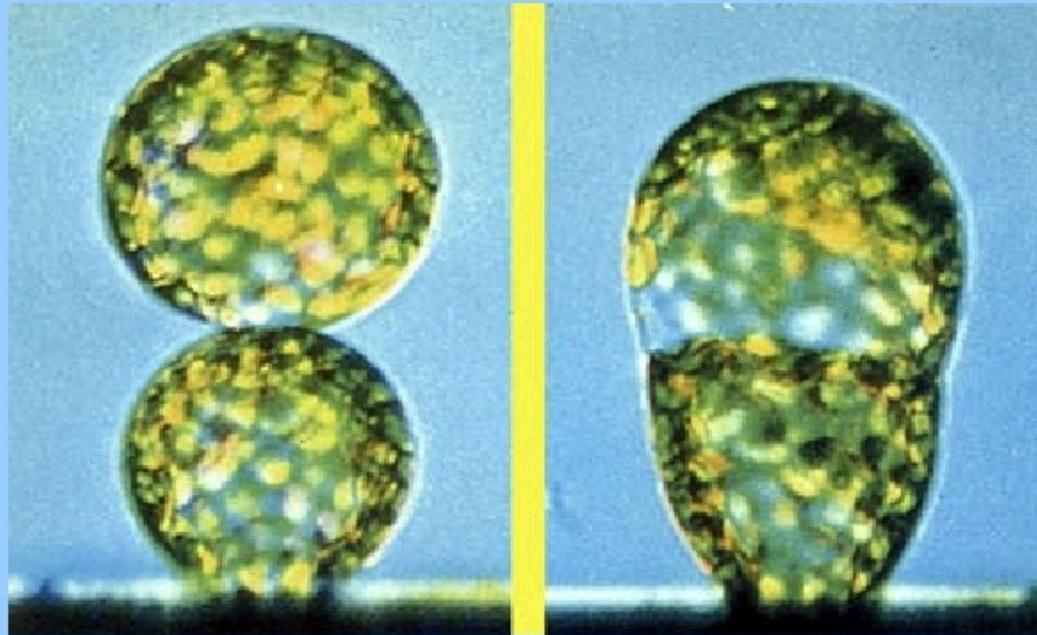
Hybridization by hand



Image from <http://perennialreport.mortonarb.org/>

Forcing hybridization

Protoplast fusion



Credit – Vincent Colantonio; M.S.
- Molecular Biology,
Microbiology, and Biochemistry
Springfield, Illinois





Credit – Vincent Colantonio; M.S.
- Molecular Biology,
Microbiology, and Biochemistry
Springfield, Illinois



Credit – Vincent Colantonio; M.S.
- Molecular Biology,
Microbiology, and Biochemistry
Springfield, Illinois

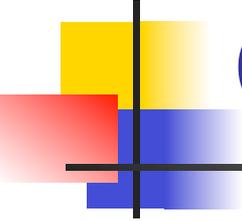
Tissue culture



See: Scnnell et al, 2015. A comparative analysis of insertional effects in genetically engineered plants: considerations for pre-market assessments. *Transgenic Research* 24:1-7, etc.

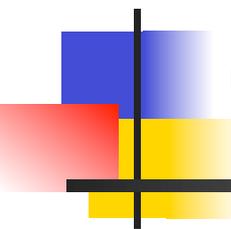
Which causes greater genetic change: genetic engineering or conventional breeding?





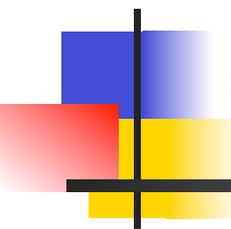
Genetic change...

- ... is normal and desirable
- ...comes about in lots of ways



Genetic engineering...

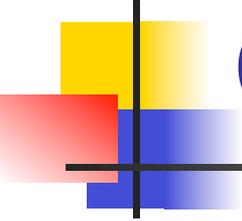
...offers more control in making genetic changes



Genetic change: What matters is...

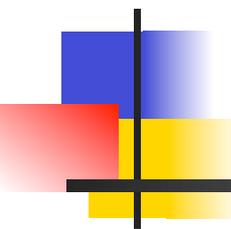
Not how it was made

But what it does

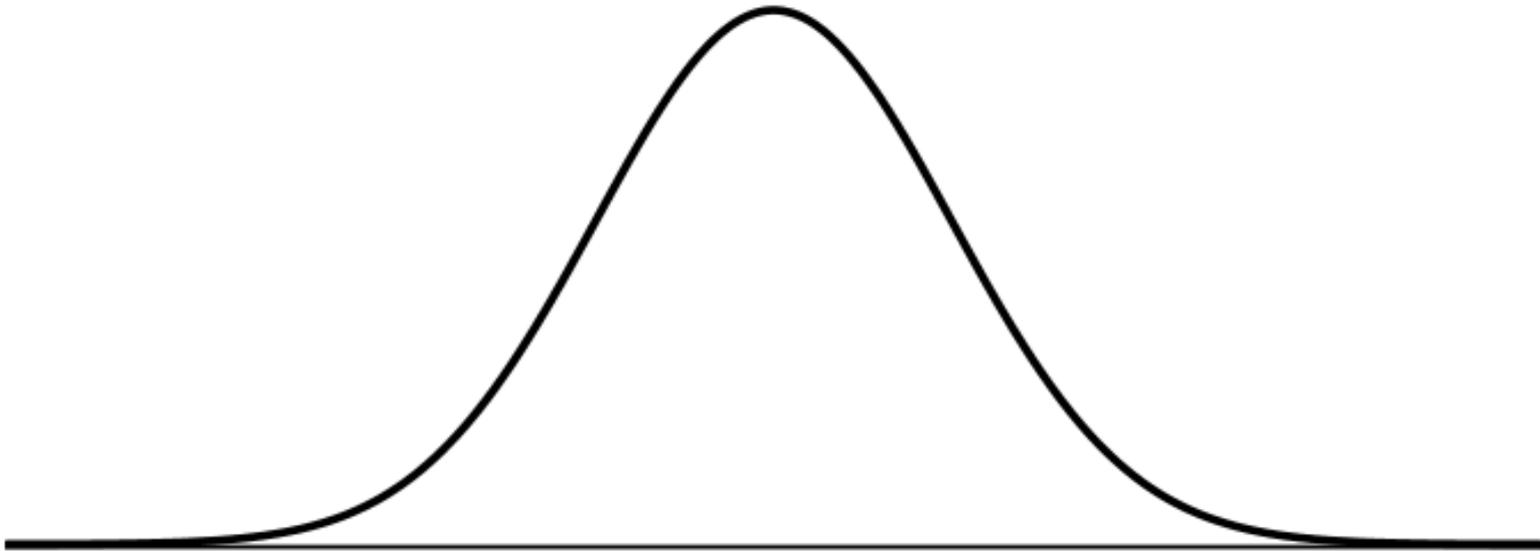


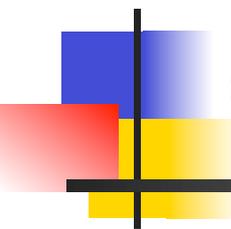
General topics

- Ways to communicate biology of GE crops
- **Guidance from social sciences**



Presenting the science is
necessary but insufficient





I know what to do to promote
dialogue.

I am not always successful in doing
what I am telling you to do.



H & H Farms

GMO Corn

Springfield, KY

▶ ⏩ 🔊 0:09 / 6:19

⚙️ 📺 🗉

Who Grows GMOs?

 Peterson Farm Bros

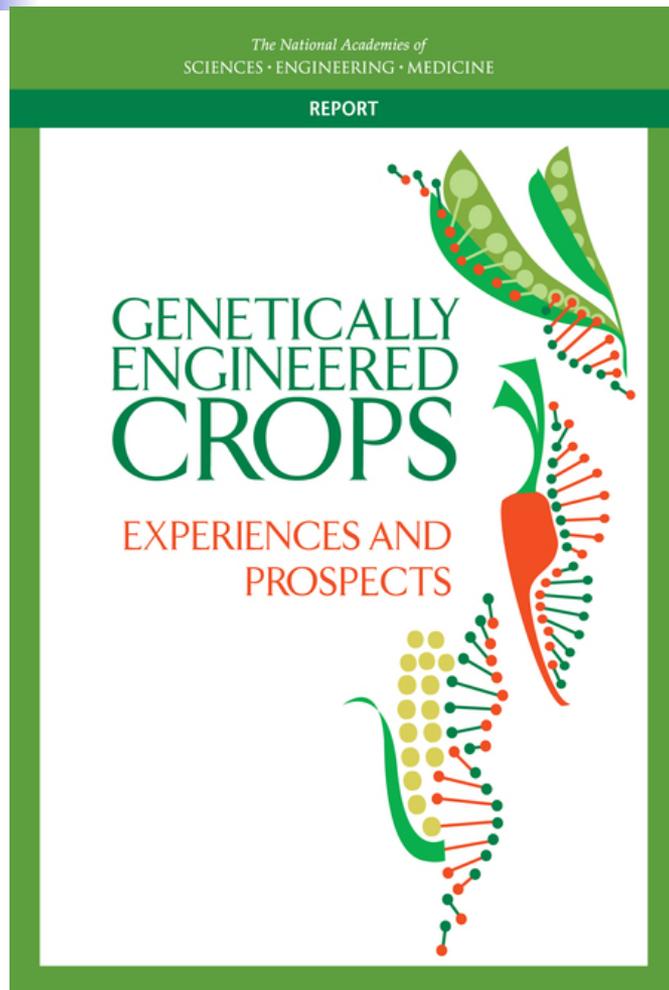
Promoting Dialogue on Genetically Engineered Crops (GMOs)¹

Paul Vincelli
Extension Professor and
Provost's Distinguished Service Professor
University of Kentucky

The following are useful guidelines for engaging the public on genetically engineered (GE) crops.² These are easy to understand but difficult to put into practice, especially in emotionally charged moments. But thanks to the expertise of social scientists, you will find that these suggestions will help open lines of communication, and build trust, on this emotional topic (as well as on other sensitive topics).

- **Let critics speak first.** Ask, “What are your top concerns?”
- **Remember that communication begins with a connection with, and the trust of, our audience.**
 - Tell a story about yourself. Explain why you are motivated to talk about the subject.
- **Speak to shared values and to common interests.** Your critics care deeply about food safety

Be grounded in the science



European Academies

ea sac

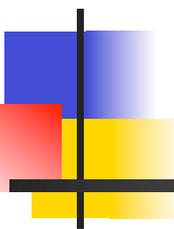
Science Advisory Council

Planting the future: opportunities and challenges for using crop genetic improvement technologies for sustainable agriculture



Let critics speak first

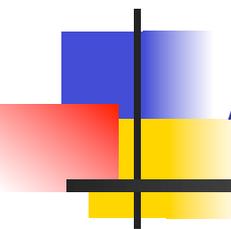
Genetically engineered crops (GMOs)



What are your principal concerns
and questions?

Paul Vincelli

Extension Professor and Provost's Distinguished Service Professor
UK Coordinator, Sustainable Agriculture Research and Education Program
University of Kentucky



Are you trying to poison
America's children?

Resist that impulse to respond
with anger!



Doesn't
represent
scientific
findings



Let critics speak first

Practice active listening

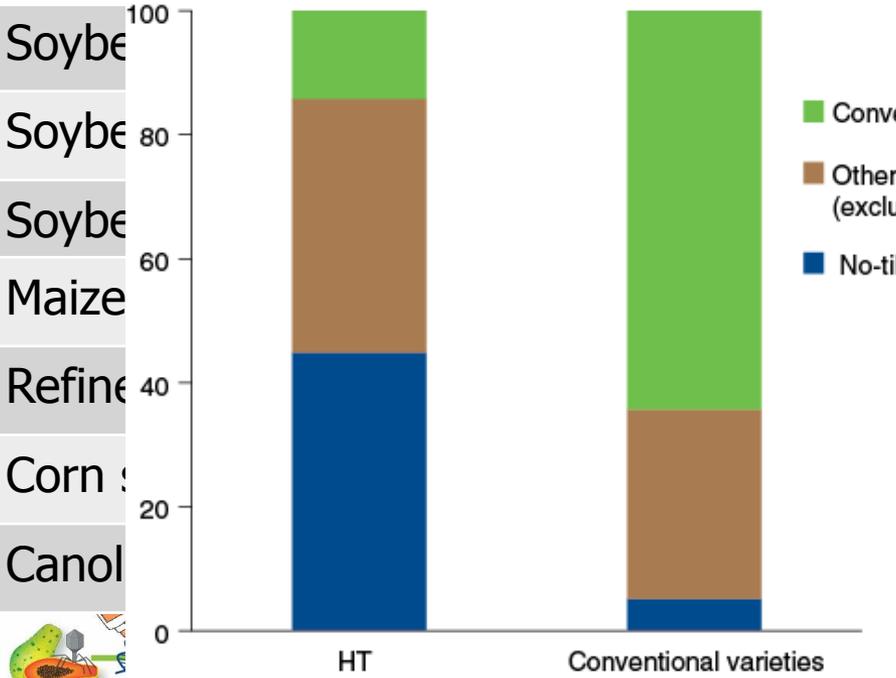
Seek consent

Don't bombard the public with everything you know

Adopters of HT soybeans had higher rates of adoption of conservation tillage practices than users of conventional varieties, 2006

Com

Percent planted acres



[OSD2%20Glyphosate%20residues.pdf](#)

[ov.au/code/applications/documents/OSD2%20Glyphosate%20residues.pdf](#)

[ov.au/code/applications/Pages/](#)



soybean, and wheat. Impacts for different years were normalized to and per ton. ACD = acidification, EUT = eutrophication, = freshwater ecotoxicity, HHC = human health cancer, and

Transgenesis
Polyploidy
Mutagenesis
C

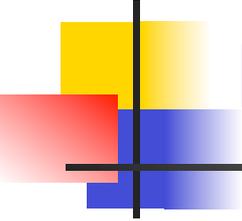
The Rainbow Papaya gene that gives Papaya Ringspot

Conservation tillage includes no-till, ridge-till and mulch-till.

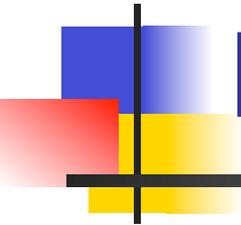
Source: USDA Economic Research Service using data from 2006 ARMS Phase II soybean

biofort survey.

HHNC = human health non-cancer.

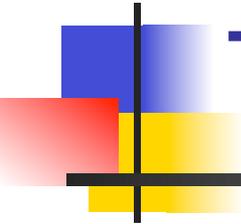


List of all industry funding received for GE work (=GMOs)



Practice full disclosure

Accepting funding is not scientific misconduct. It does not disqualify you.



The Common Good

Food security

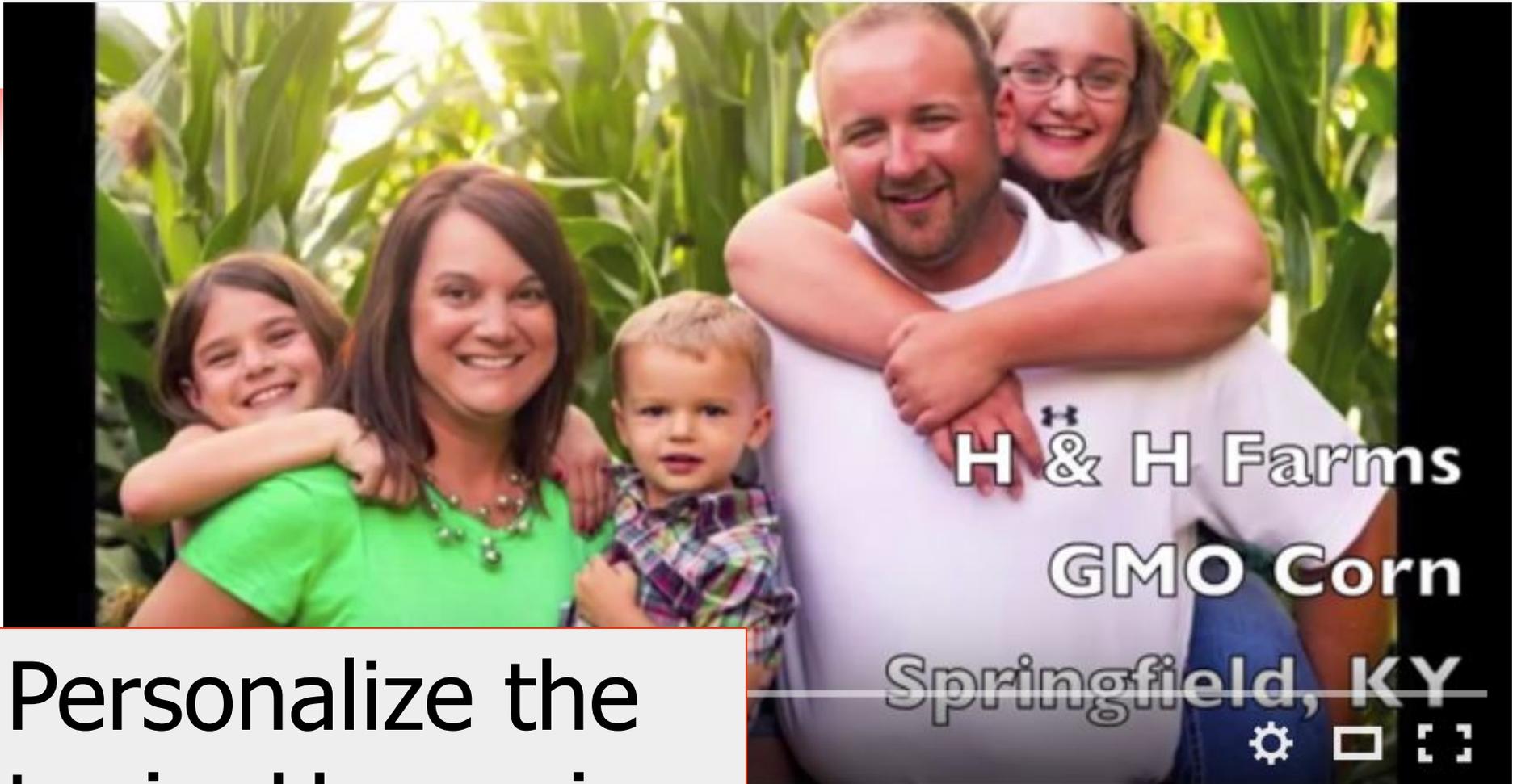
Sustainable food systems

Reduced pesticide use against
diseases and insects



Speak to shared values





Personalize the topic. Humanize the technology.





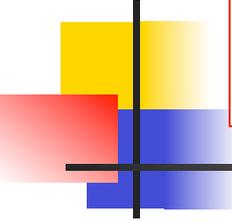
**Personalize the
topic. Humanize
the technology.**

“Thanks for your feedback”

Keep it respectful



Dear Dr. Vincelli,
Thanks so much for contacting me.
The biotech team agrees with what you wrote.



“Thanks for your feedback”

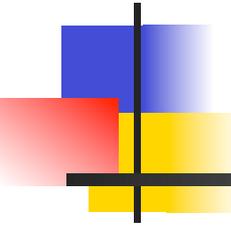
[Redacted]

No reference in the study to FLAVOR. It's apparent that epicure is diminished when the purpose of the study is to prove that genetically modified GE corn is

You're welcome. I appreciate the amount of work you have put into studies in this field.

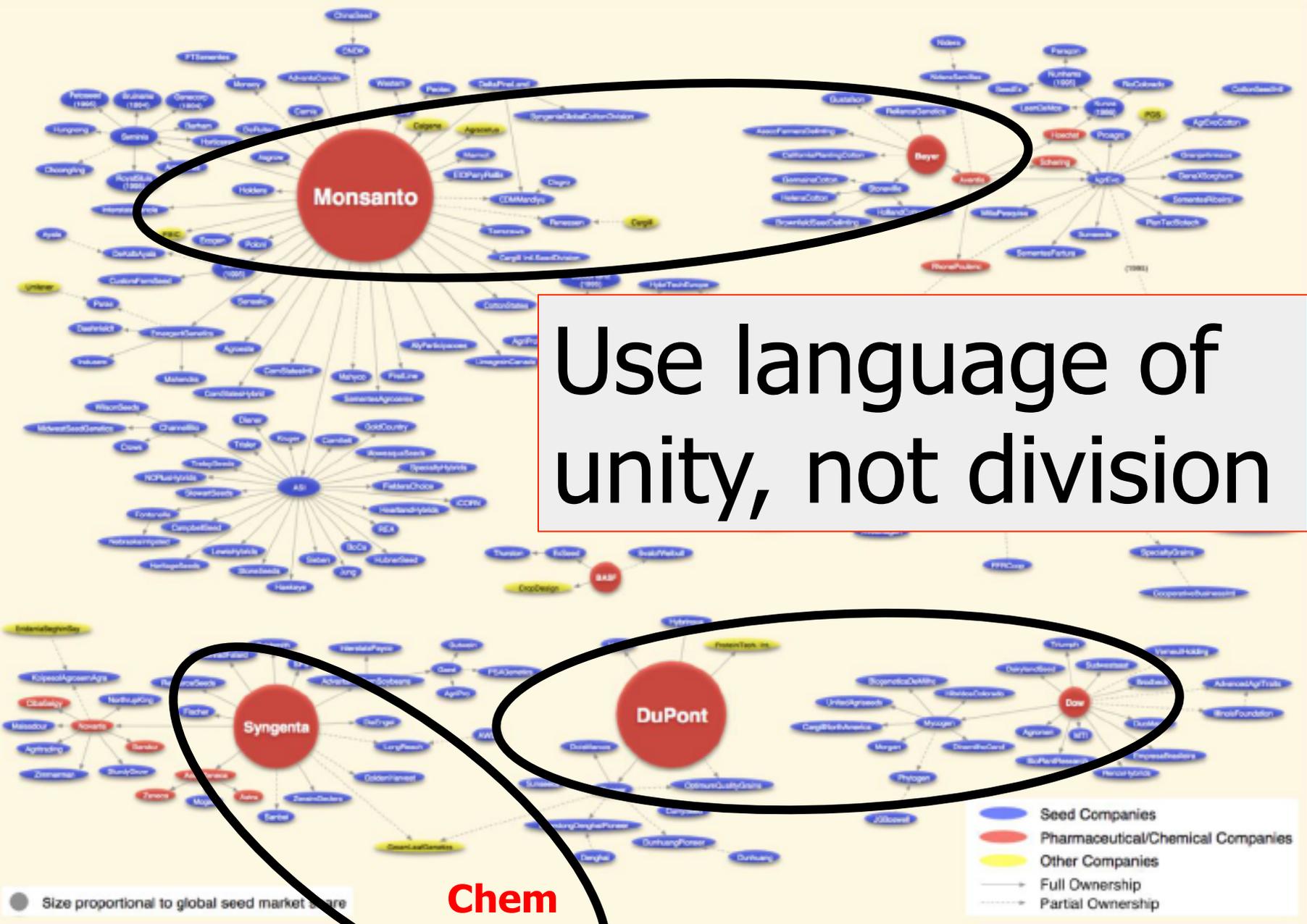
Paul Vincelli @Pvincell

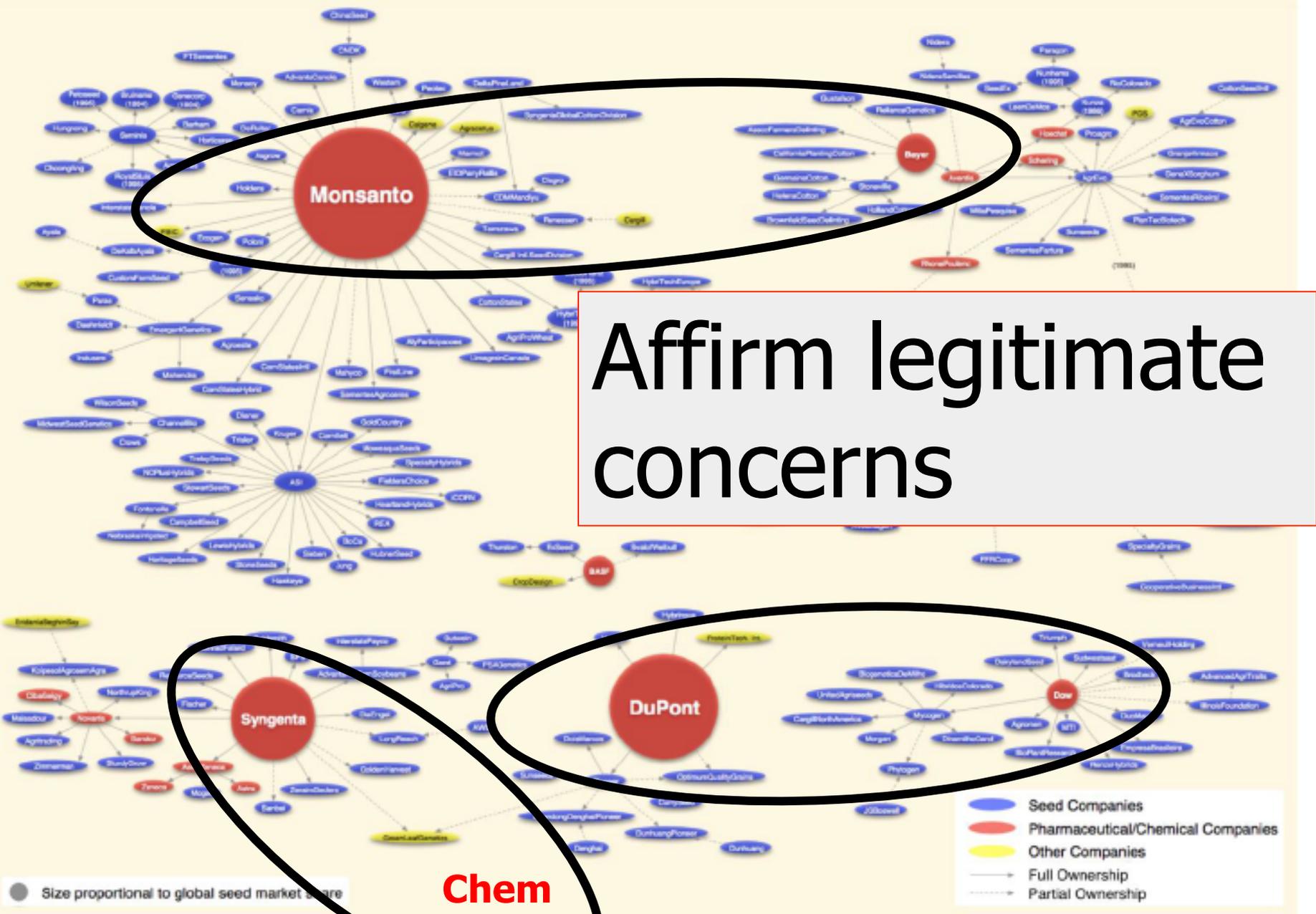
Genetically engineered corn: less contamination by natural (and hazardous) mycotoxins [nature.com/articles/s4159...](https://www.nature.com/articles/s4159...) This benefit has been widely documented in peer-reviewed research.



Empathize

“People must know how much you care before they care about how much you know.”





Affirm legitimate concerns

Chem China

Roundup-Ready® corn

Active ingredient = **glyphosate**



“Pesticide treadmill”

Affirm legitimate concerns



Glyphosate-tolerant weeds



OXFORD

JNCI J Natl Cancer Inst (2018) 110(5): djx233

doi: 10.1093/jnci/djx233

First published online November 9, 2017

Article

ARTICLE

Glyphosate Use and Cancer Incidence in the Agricultural Health Study

Gabriella Andreotti, Stella Koutros, Jonathan N. Hofmann, Dale P. Sandler, Jay H. Lubin, Charles F. Lynch, Catherine C. Lerro, Anneclaire J. De Roos, Christine G. Parks, Michael C. Alavanja, Debra T. Silverman, Laura E. Beane Freeman



Toxicological Profile for Glyphosate

Draft for Public Comment
April 2019



U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

CS2019-4

Table 2-13. Carcinogenicity Classification

Organization	Reference	Classification	Justification
Domestic organizations			
U.S. Environmental Protection Agency	EPA 2017c	Strongest support is for "not likely to be carcinogenic to humans".	According to 2005 Guidelines for Carcinogen Risk Assessment, EPA (2005a), considered that the strongest support for a carcinogenicity classification for glyphosate is the descriptor "not likely to be carcinogenic to humans." EPA (2017c) concluded "there is not strong support for the 'suggestive evidence of carcinogenic potential' cancer classification descriptor based on the weight-of-evidence, which includes the fact that even small, non-statistically significant changes observed in animal carcinogenicity and epidemiological studies were contradicted by studies of equal or higher quality."
International organizations			
Australian Pesticides and Veterinary Medicines Authority	APVMA 2017	Exposure does not pose a carcinogenic risk to humans	Concluded "that the scientific weight-of-evidence indicates that exposure to glyphosate does not pose a carcinogenic risk to humans".
European Chemical Agency	ECHA 2016	No hazard classification for carcinogenicity is warranted	Conclusion is "based on epidemiological data as well as on data from long-term studies in rats and mice, taking a weight of evidence approach, no hazard classification for carcinogenicity is warranted for glyphosate according to the CLP criteria"
European Food Safety Authority	EFSA 2015	Unlikely to pose a carcinogenic hazard to humans	Conclusion is based on very limited evidence for an association between glyphosate-based formulations and non-Hodgkin lymphoma, overall inconclusive for a causal or clear associative relationship between glyphosate and cancer in human studies, "no evidence of carcinogenicity" in rats or mice, and "unlikely to be genotoxic".
Food and Agricultural Organization/World Health Organization Joint Meeting on Pesticide Residues	FAO and WHO 2016	Unlikely to pose a carcinogenic risk to humans from dietary exposure	Conclusions were "in view of the absence of carcinogenic potential in rodents at human-relevant doses and the absence of genotoxicity by the oral route in mammals, and considering the epidemiological evidence from occupational exposures."
Health Canada	Health Canada 2015, 2017	Unlikely to pose a human cancer risk	In consideration of the strength and limitations of the large body of information on glyphosate, which included multiple short- and long-term (lifetime) animal toxicity studies and numerous <i>in vivo</i> and <i>in vitro</i> genotoxicity assays, as well as the large body of epidemiological information.
International Agency for Research on Cancer	IARC 2017	Group 2A (<i>probably carcinogenic to humans</i>)	This classification is based on IARC's conclusions that there is " <i>limited evidence</i> " in humans, " <i>sufficient evidence</i> " in animals, and evidence that glyphosate and glyphosate-based formulations are genotoxic and capable of inducing oxidative stress.
New Zealand Environmental Protection Agency	NZ EPA 2016	Unlikely to be genotoxic or carcinogenic to humans	This conclusion is "based on a weight of evidence approach, and taking into account the quality and reliability of the available data – glyphosate is unlikely to be genotoxic or carcinogenic to humans."

"Toxicological Profile for Glyphosate," CDC report, 2019,
<https://www.atsdr.cdc.gov/toxprofiles/tp214.pdf>

SCIENTIFIC REPORTS



OPEN

Assessment of Glyphosate Induced Epigenetic Transgenerational Inheritance of Pathologies and Sperm Epimutations: Generational Toxicology

Deepika Kubsad, Eric E. Nilsson, Stephanie E. King, Ingrid Sadler-Riggelman, Daniel Beck & Michael K. Skinner

Received: 2 October 2018

Accepted: 9 April 2019

Published online: 23 April 2019

Affirm legitimate concerns

<https://www.nature.com/articles/s41598-019-41598-4>

Consider your position on labeling



<http://www.campbellsoupcompany.com/>

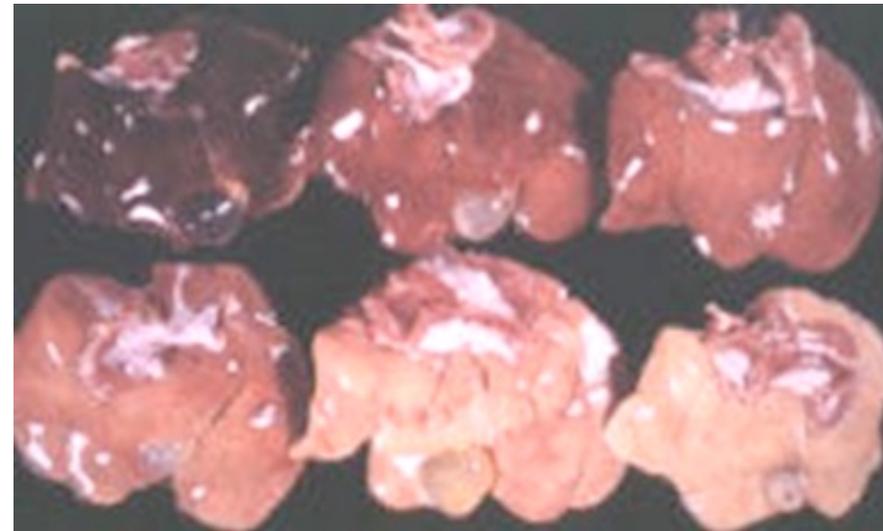
Personalize the topic. Humanize the technology.



Traditional papaya variety, highly susceptible

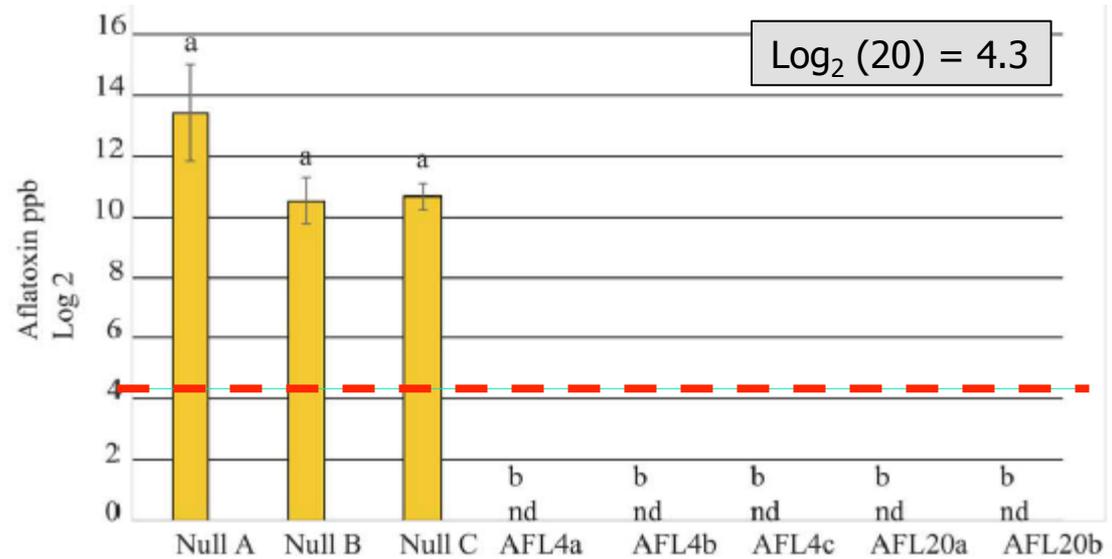
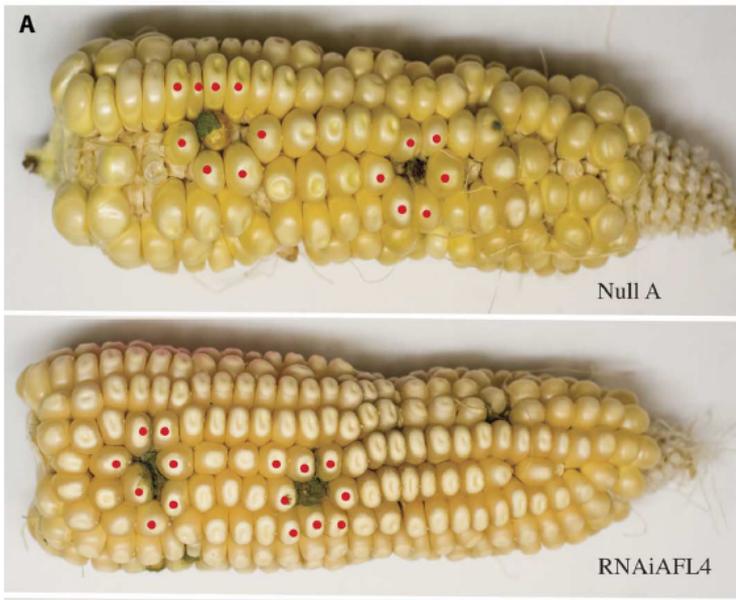


***Aspergillus*, Aflatoxins**



Rat livers injected with increasing doses of aflatoxin B1. Upper left=aflatoxin-free control. <http://poisonousplants.ansci.cornell.edu/toxicagents/aflatoxin/aflatoxin.html>

Aflatoxin reduction by gene silencing





Speak to shared values

<http://creativecommons.org/licenses/publicdomain/>



<https://www.youtube.com/watch?v=LokPldPopU>
<http://biotecnologiasi.tumblr.com/post/134464391394/>

Bt brinjal in Bangladesh

20 farmers in 2014
25,520 farmers in 2018



Shelton et al, 2018. Bt eggplant project in Bangladesh: History, Present Status, and Future Direction. *Frontiers in Bioengineering and Biotechnology* doi: 10.3389/fbioe.2018.00106

Viruses in African cassava



Left: <https://twitter.com/Pvincell/status/363999930349654016>

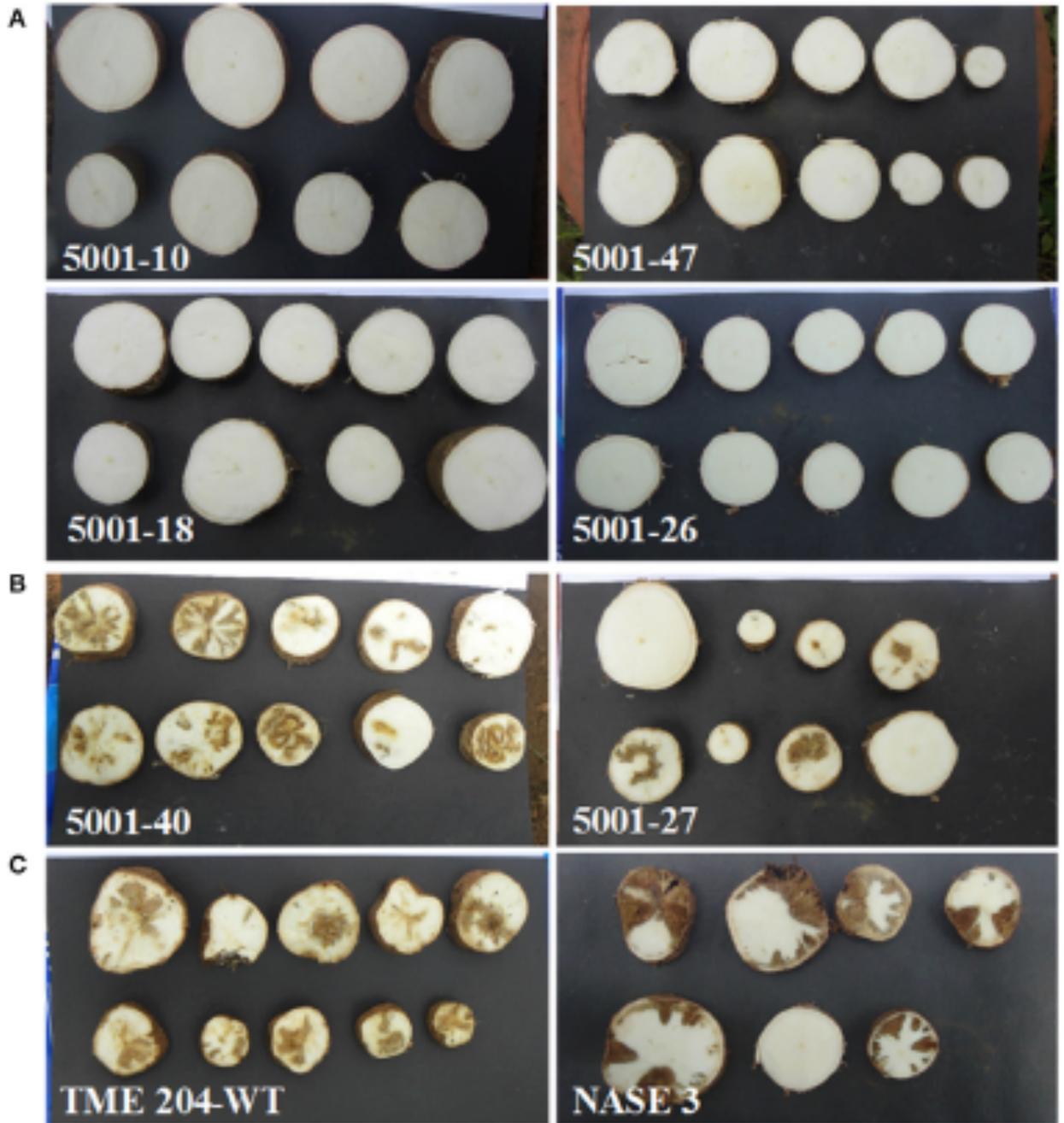
Right: Image copyright J. Legg

Cassava with resistance to viruses



https://twitter.com/mark_lynas/status/362877275470962688/photo/1

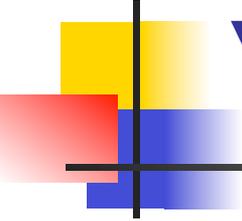
Funding: US-AID, Bill and Melinda Gates Foundation, and the Monsanto Fund



Wagaba et al, 2017. Field Level RNAi-Mediated Resistance to Cassava Brown Streak Disease etc, doi: 10.3389/fpls.2016.02060

Roundup-Ready® corn





“Pesticide treadmill”



Affirm legitimate concerns

Glyphosate-tolerant weeds

Widespread deployment of a single gene poses a risk

Southern corn leaf blight, 1970



T-urf13 mitochondrial gene

Affirm legitimate concerns



Case by case



[APS](#) > [Publications](#) > [Webinars](#) > [On-Demand Webcasts](#) > [Approachable Science on Genetically Engineered Crops \(GMOs\)](#)

On-Demand Webcasts

[Overview of Zebra Chip Research in the U.S.](#)

[Threat of Cowpea mild mottle virus](#)

[Take Your Course and Flip It](#)

[Project Reporting and Writing Impacts Webinar](#)

[Fieldside Manner: Serving Plant Pathology's Stakeholders - Part 1 & 2](#)

[Show Me the Money:Effective](#)

Approachable Science on Genetically Engineered Crops (GMOs)

Sometimes we scientists and science communicators find ourselves engaged in public controversy. GE crops certainly generate significant controversy in some settings. As scientists and science communicators, perhaps our most important task is to assure that the science underlying the controversy is adequately presented. This provides a foundation for people to make their own values-based choices, informed by the science for those that seek it. Towards this end, analogies that help teach basic scientific aspects of GE crops will be demonstrated. Specific practices that can ease emotional tensions will be demonstrated and discussed. In one or more cases, audience participation will be invited as part of the demonstration. In reducing tensions, more thoughtful, productive, and respectful exchanges are possible.



Paul Vincelli, Ph.D.

Extension Professor and Provost's Distinguished Service Professor, Department

I'VE LEARNED
THAT **PEOPLE** WILL
FORGET WHAT
YOU SAID,
PEOPLE WILL **FORGET**
WHAT YOU DID,
BUT **PEOPLE** WILL **NEVER FORGET**
HOW **YOU** MADE
THEM FEEL.

MAYA ANGELOU

SPONSORED BY THE STUDENT GOVERNMENT ASSOCIATION AND THE PRESIDENT'S OFFICE.

Sowing the seeds of skepticism: Russian state news and the anti-GMO movement

Shawn Dorius, Carolyn Lawrence-Dill

Submitted on: February 27, 2018 | Last edited: February 27, 2018

Page: 1 of 7 Automatic Zoom

TITLE
Sowing the seeds of skepticism: Russian state news and the anti-GMO movement

AUTHORS
Shawn F. Dorius^{1*}, Carolyn J. Lawrence-Dill²

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*Correspondence to: sdorius@iastate.edu

KEYWORDS
GM GMO Propaganda Russia

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Abstract

Biotech news coverage in English-lang profile of the Russian information war recent military reports. This raises the views the dissemination of anti-GMO i many divisive issues it can exploit as p GMOs serve more expansive disruptiv patterns in Russian news provide evid a coordinated campaign to turn public modified organisms. The recent brand

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