



GMO 2.0: Science, Society and the Future

UConn



Overview of Risks and Benefits of Genetically Engineered Crops



Paul Vincelli

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



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

Genetically engineered crops in the USA



Agronomic crops

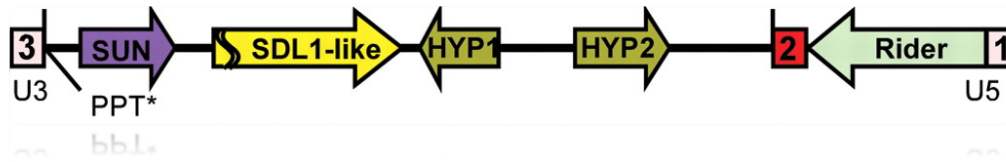
- Alfalfa
- Canola
- Field corn
- Cotton
- Soybean
- Sugar beet

Horticultural crops

- Apple (ArcticTM)
- Sweet corn
- Papaya
- Pineapple ('Rosé'TM)
- Potato ('Innate'TM)
- Yellow squash

A genetic duplication in tomato

Chr
10



Chr
7



Genetic engineering is often not the best breeding approach

Susceptible

Disease-resistant, from conventional breeding



Word processing: an analogy for genetic engineering





Imagine this sentence is a
gene

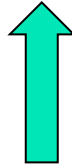
Tomato was added to the focaccia
in the late 18th century.



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...

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





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



Non-GMO breeding is less
precise, less controlled, more
disruptive

And that is OK!

Citations at

<https://vincelliblog.wordpress.com/2016/05/30/conventional-breeding-creates-safer-foods-than-genetic-engineering-fact-or-assumption/>



Genetic change: What matters is...

Not how it was **made**

But what it **does**



Are GE crops safe to eat?



DNA in our food?

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



Doesn't
represent
scientific
findings



Consumption of Genetically Engineered (=GMO¹) Crops:

Examples of Quotes from Position Papers of Scientific Organizations

Paul Vincelli
University of Kentucky
Dated 20 Dec 2017

“Genetic engineering...poses no health risks that cannot also arise from conventional breeding and other methods used to create new foods.” *Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects, Report in Brief* (2004). National Academies Press, National Academy of Sciences. http://nas-sites.org/teachers/files/2012/05/ge_foods_final.pdf, accessed 22 Nov 2014.

“The committee...found no substantiated evidence that foods from GE crops were less safe than foods from non-GE crops.” *Genetically Engineered Crops: Experiences and Prospects*, Committee on Genetically Engineered Crops: Past Experience and Future Prospects (2016). National Academies Press, National Academy of Science. ISBN 978-0-309-43738-7. <http://www.nap.edu/catalog/23395/genetically-engineered-crops-experiences-and-prospects>

“There is no validated evidence that GM crops have greater adverse impact on health and the environment than any other technology used in plant breeding.” *EASAC Policy Report No. 21, The Science Advisory Council of the National Science Academies of the EU Member States* (2013). ISBN: 978-3-8047-3181-3. <http://www.easac.eu/home/reports-and-statements/detail-view/article/planting-the.html>, accessed 1 Jan 2016.



Individual traits might pose
risk (also true for non-GMO
plants)...

...but there is no intrinsic mechanism
of harm from genetic engineering

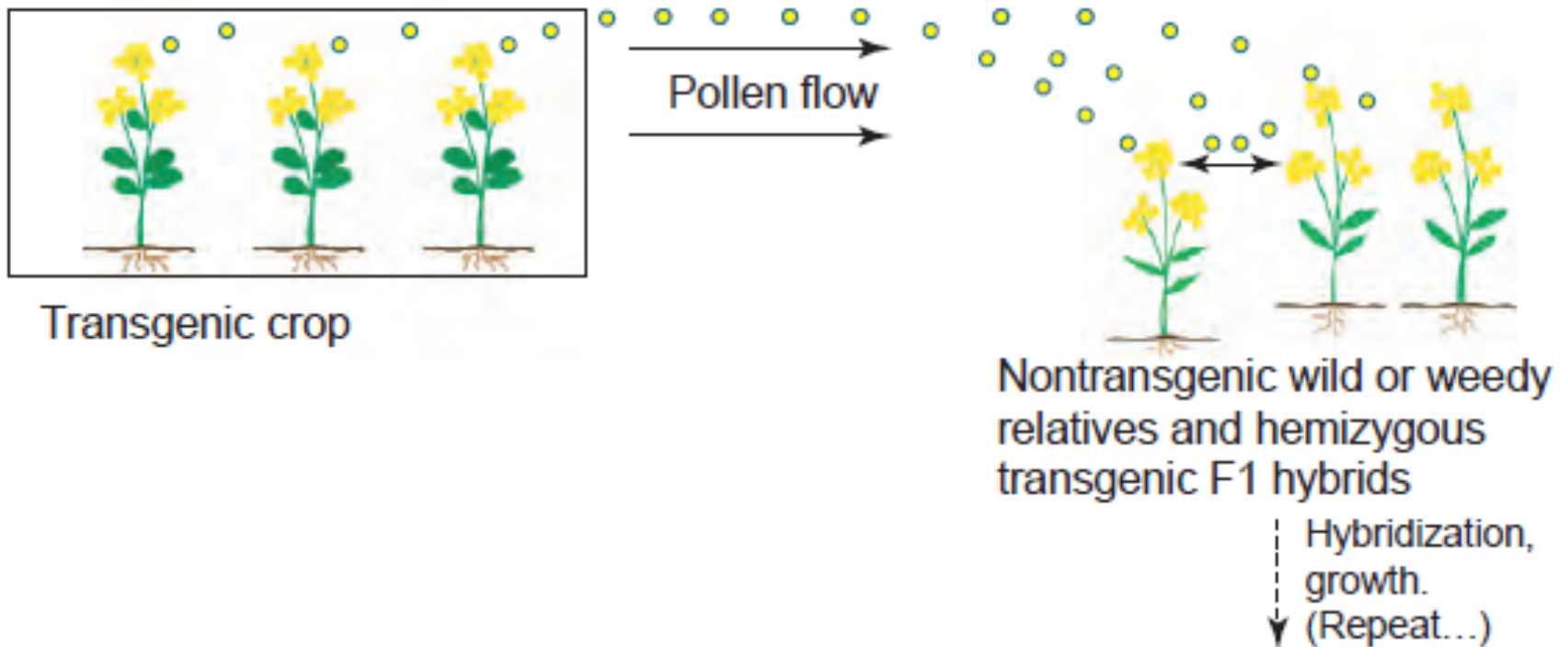


Genetic change: What matters is...

Not how it was **made**

But what it **does**

Concern: Transgene flow



Kojonup farmers caught in epic legal battle over genetically modified canola contamination

Australian Story By Belinda Hawkins

Updated Sun at 9:22pm

It started in the West Australian wheat belt with tense words between neighbours at a community working bee.

It ended up in a "genetically modified (GM) versus organic" court battle that made headlines around the world.

And next week, there will be a further chapter in the WA Supreme Court.

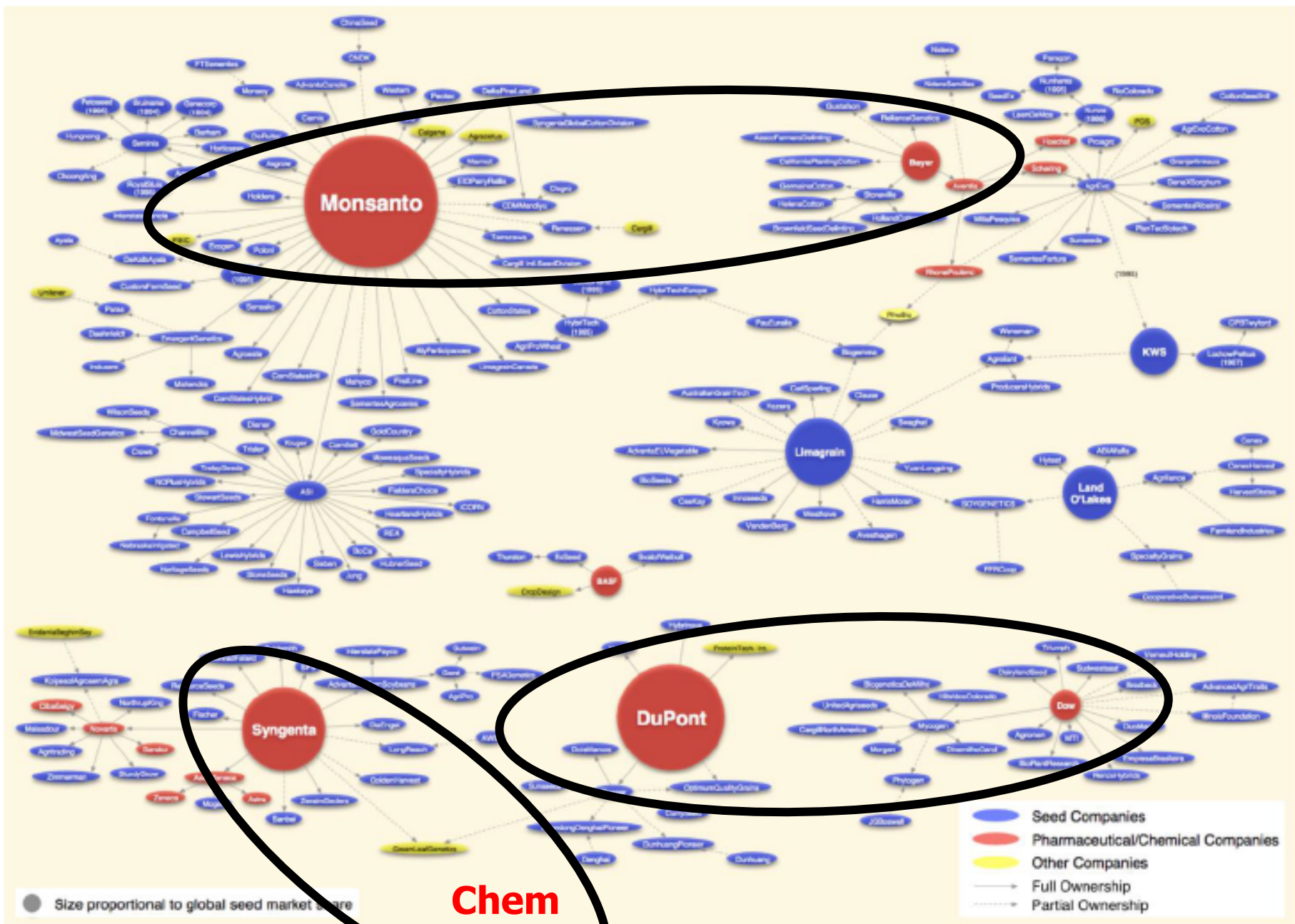
Speaking out for the first time in interviews for tonight's Australian Story, family members from the opposing sides have described the intense emotional impact of the legal battle.

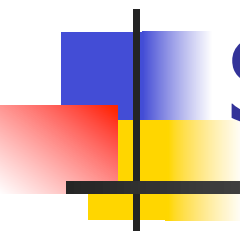


PHOTO: Michael Baxter has fought a protracted legal fight with his neighbour over his use of genetically modified canola.
(Australian Story: Belinda Hawkins)



Concern: GE crops promote
corporate ownership of food supply





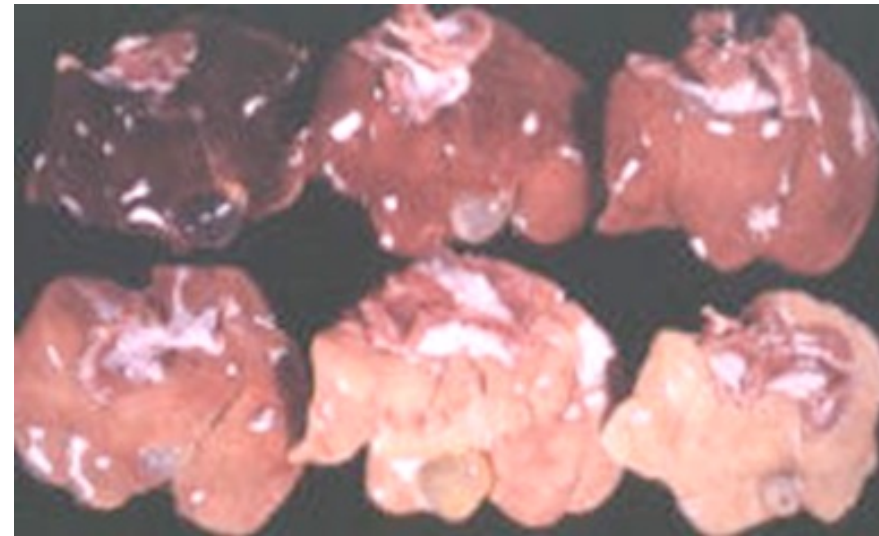
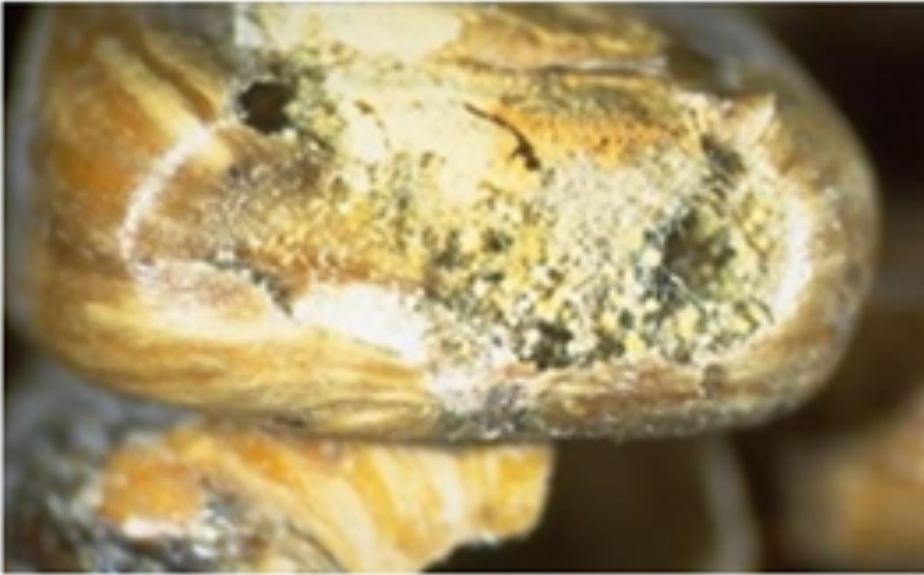
Some examples of GE

Roundup-Ready® corn

Active ingredient = **glyphosate**

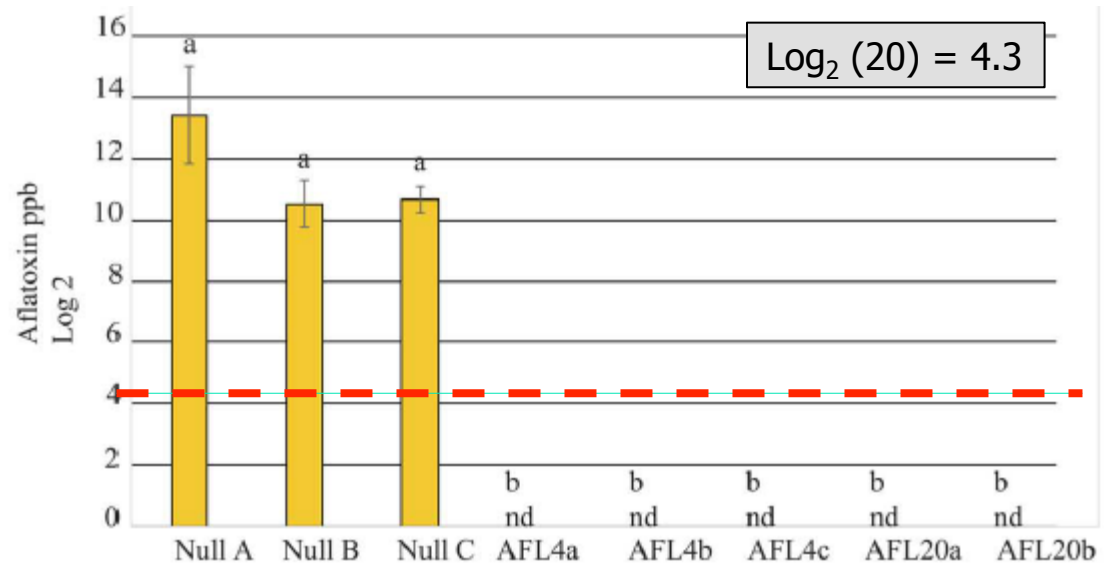
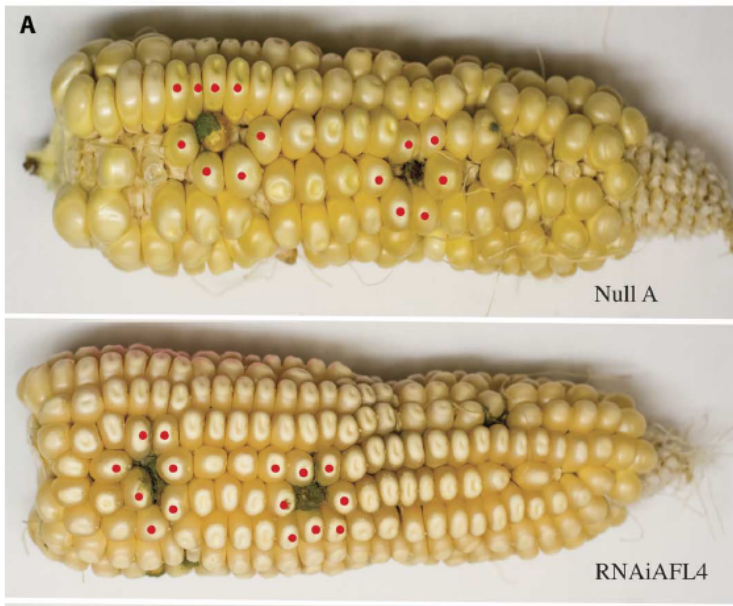


***Aspergillus*, Aflatoxins**



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







<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

Disease-resistant tomato with a single gene from pepper



Figure 3. Photographs of non-transgenic and Bs2-transgenic VF36 lines in field trials. Top. Plants of the non-transformed VF36 line. Bottom. Plants of the transgenic VF36 line containing the 35S::Bs2 gene. Balm, FL, Spring 2008 Trial. doi:10.1371/journal.pone.0042036.g003



Example of a boom sprayer. (Photo credit: University of Georgia)

Bacterial wilt of banana



Staple food for 100,000,000 people in Eastern Africa

<http://www.promusa.org/Xanthomonas+wilt>

<http://r4dreview.org/2008/09/the-future-of-african-bananas/>

<http://www.asareca.org/content/regional-efforts-control-banana-wilt-disease>

Control of bacterial wilt of banana

a



b



GMO
(*Hrap* or *Pflp*
from pepper)

Control

Ugandan scientists research GE solutions to bacterial wilt of banana (US-AID funded)



Field trial of BW-resistant banana in Uganda





Case by case