GMO Labeling and The Impact on the Feed Industry Update

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Outline

- SUMMARY: Impacts of 2016 food labeling law
- Overview of current global use of GE feed crops
- Benefits of first generation (input traits) GE crops
- Global trade in GE feed crops
- Health of animals that have eaten GE crops
- Future demand for GE crops
- The pipeline of GE crops for improved animal feed
- Potential benefits and issues of this pipeline
- Costs and availability of non-GE animal feed
Must animal feed be labeled according to its GMO content under the federal National Bioengineered Food Disclosure Standard?

The federal "National Bioengineered Food Disclosure Standard" (passed July 2016) charges USDA Agricultural Marketing Service with developing a national mandatory system for disclosing the presence of bioengineered material. USDA has established a working group to develop a timeline for rulemaking and to ensure an open and transparent process for effectively establishing this new program, which will increase consumer confidence and understanding of the foods they buy, and avoid uncertainty for food companies and farmers.


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Must animal feed be labeled according to its GMO content under the federal National Bioengineered Food Disclosure Standard?

• The definition of "food" under the Federal Food, Drug, Cosmetic Act (21 U.S.C. Sec. 321) includes "articles used for food or drink for man or other animals."

HOWEVER

• "The National Bioengineered Food Disclosure Standard food labeling law states, "The term 'food' means a food as defined in 21 U.S.C. Sec. 321 that is intended for human consumption."

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The “National Bioengineered Food Disclosure Standard” food labeling law states: "Sec. 293(a)(2)- A regulation promulgated by the [USDA] Secretary shall "(A) prohibit a food derived from an animal to be considered a bioengineered food solely because the animal consumed feed produced from, containing, or consisting of a bioengineered substance: ... "

Thus, it is clear that meat, eggs, milk from animals genetically engineered (aka GMO) feed will not be labeled at bioengineered food. Hence, a strong argument can be made that animal feed is prohibited from being labeled as bioengineered.
BUT ... activists are arguing to USDA that the feed to animals intended for human consumption is a food intended for human consumption so that those animal growers who want to produce for the NON-GMO label and the organic label will want to know which "feeds" to avoid in feeding their animals. In other words, the animal products do not have to be labeled (good for those farmers who want to use GMO feeds), the failure to label the feed for animals intend for human consumption would harm those animal producers who want to avoid GMO feeds in order to earn NON-GMO and organic labels.
Must animal feed be labeled according to its GMO content under the federal National Bioengineered Food Disclosure Standard?

I think the ultimate outcome will depend on how USDA exercises its discretion in interpreting the law. The USDA (AMS) has two years to draft the regulations (i.e. by end of July 2018). During these next 18 months the USDA will be under intense lobbying and comments pressured about how to interpret the law.

“I think the correct answer to the California animal feed association is that it had better define its position (pro or con for the labeling of feed) and, once defined, it should get active in lobbying the USDA. This must be done now because the clock is ticking and time is passing rapidly.”

Of course, we have a new Administration which has not stated anything, as far as I know, specifically about this and other issues under the GM food labeling law.
I do not like the term “genetically modified” (GMO) ambiguous as to what it means.
I prefer the term genetic engineering (GE) as it means something specific

• The USDA’s current definition of genetic engineering is “manipulation of an organism’s genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA (rDNA) techniques.”

• In other words it is a breeding method. Also known as genetically modified, GM, GMO, transgenic, living modified organism, LMO, bioengineered, biotech, made with modern biotechnology, and frankenfood
Genetic engineered products are used commonly as medicines, and food processing aids – controversy arises when they are used as food ingredients.
GLOBAL AREA OF BIOTECH CROPS
Million Hectares (1996-2015)

Up to ~18 million farmers, in 28 countries planted 179.7 million hectares (444 million acres) in 2015, a marginal decrease of 1% or 1.8 million hectares (4.4 million acres) from 2014.

Source: Clive James, 2015 ISAAA Brief 51 -2015
Globally there have been substantial benefits from first generation (input trait) GE crops

“On average, GE technology adoption has reduced chemical pesticide use by 37%, increased crop yields by 22%, and increased farmer profits by 68%. Yield gains and pesticide reductions are larger for insect-resistant crops than for herbicide-tolerant crops. Yield and profit gains are higher in developing countries than in developed countries.”

GE technology has added 110 million tonnes of soybeans and 195 million tonnes of corn to global production of these crops since the introduction of GE crops in the mid-1990s (due to better pest management).
What crops are GE in US?

- 90% of all corn planted in U.S. was GE in 2013
- 90% of all cotton planted in U.S. was GE in 2013
- 93% of all soybeans planted in U.S. was GE in 2013
- 95% of all sugar beet planted in U.S. was GE in 2013

Also canola, papaya, some squash, melons and sweetcorn and an increasing acreage of GE alfalfa

NON-GE FEEDSTUFFS CURRENTLY INCLUDE

- Wheat
- Sorghum
- Oats
- Rice
- Millet
- Barley
In the US there have been substantial benefits from GE crops

Since GE seeds were introduced in the mid-1990s, farmers have opted for these products. A 2010 report from the National Research Council of the U.S. National Academy of Sciences, "The Impact of Genetically Engineered Crops on Farm Sustainability in the United States," offers an insight as to why. The report concludes that U.S. farmers growing biotech crops "are realizing substantial economic and environmental benefits — such as lower production costs, fewer pest problems, reduced use of pesticides, and better yields — compared with conventional crops."


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Genetically Engineered Crops: Experiences and Prospects

May 17, 2016
Report Release Event

BOARD ON AGRICULTURE AND NATURAL RESOURCES
Committee on Genetically Engineered Crops

Entomology
Fred Gould (Chair), North Carolina State University

Molecular Biology and Genomics
Richard M. Amasino, University of Wisconsin–Madison
C. Robin Buell, Michigan State University

Crop Biotechnology
Richard A. Dixon, University of North Texas
C. Neal Stewart, University of Tennessee

Risk Communication
Dominique Brossard, University of Wisconsin–Madison

Economics
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Toxicology
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Law
Michael Rodemeyer, University of Virginia (formerly)
Daniel Magraw, Johns Hopkins University School of Advanced International Studies

Food Safety
Robert J. Whitaker, Produce Marketing Association

Agronomy
Timothy S. Griffin, Tufts University

This study was supported by the Burroughs Wellcome Fund, the Gordon and Betty Moore Foundation, the New Venture Fund, the U.S. Department of Agriculture, and the National Academy of Sciences.
Committee’s Process

• Examined the relevant literature (1000+ research and other publications)

• Held information-gathering meetings
  – 80 presentations (archived)

• Read more than 700 comments submitted by members of the public
GE Crops Planted on 12% of World’s Cropland

~40% of all GE crops planted in U.S.
Experiences:
Human Health Effects

The committee re-examined most of the original studies:

- Studies conducted with animals. (Not optimally designed)
- Long-term data on the health and feed-conversion efficiency of livestock.
- Comparative data on nutrient and chemical composition.
- Epidemiological data of specific health problems for populations in the United States and Canada compared to United Kingdom and western Europe.
Experiences: Human Health Effects

CONCLUSION: No persuasive evidence of adverse health effects directly attributable to consumption of foods derived from GE crops.

CAVEAT: With any new food, GE or non-GE, there may always be some subtle favorable or adverse health effects that are not detected even with careful scrutiny, and health effects can develop over time.
GE and conventional corn and soy produced (MMT) by selected countries 2012 – hatch marked slices represent GE, solid are conventional.

~ 35% (57 million hectares) of the corn planted globally was GE

~ 79% (89 million hectares) of the soybean planted globally was GE

Van Eenennaam and Young. 2014. J. Anim. Sci. 92:4255-4278

Van Eenennaam GFIC 2017
Corn Production
Production, Imports, Export, Feed by Country 2013

Van Eenennaam GFIC 2017
Van Eenennaam and Young. 2014. J. Anim. Sci. 92:4255-4278
Soybean Meal Production
Imports, Exports and Crush by Country 2013

Van Eenennaam GFIC 2017
Van Eenennaam and Young. 2014. J. Anim. Sci. 92:4255-4278
Share of global crop trade accounted for by GE crops 2011/12 (million tonnes)

<table>
<thead>
<tr>
<th></th>
<th>Soybeans</th>
<th>Maize (Corn)</th>
<th>Cotton</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global production</td>
<td>238</td>
<td>883.5</td>
<td>27.0</td>
<td>61.6</td>
</tr>
<tr>
<td>Global trade (exports)</td>
<td>90.4</td>
<td>103.4</td>
<td>10.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Share of global trade from GE producers</td>
<td>88.6 (98%)</td>
<td>70.0 (67.7%)</td>
<td>7.15 (71.5%)</td>
<td>9.9 (76%)</td>
</tr>
<tr>
<td>Share of global trade that may be GE</td>
<td>96.7%</td>
<td>67.7%</td>
<td>71.5%</td>
<td>76%</td>
</tr>
</tbody>
</table>


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The EU imports a lot of GE feed to support its animal agriculture

- 80% of all livestock feed in the European Union (EU) is imported
- 98% of EU soybean meal is imported from Brazil, the USA, and Argentina; ~ 80% of this imported soybean meal animal feed is GE
- If the EU were not able to import soybean protein from outside the EU it would only be able to replace 10-20% of imports by high protein substitutes, resulting in a substantial reduction in animal protein production, exports and consumption, and a very significant increase in animal protein imports and cost in the EU*

HAMBURG, Feb 18 (Reuters) – German poultry producers have given up a promise to consumers to avoid feeding birds with soy containing genetically-modified organisms (GMOs) because of lower supplies of non-GMO soybeans, poultry producers association BBH said on Tuesday.

Brazil, the main bulk supplier of GMO-free soybeans, was likely to cut its supplies of GMO-free soybeans by 50 percent this year partly because of cross-pollination with conventional beans, the association said.

The danger of cross-contamination between GMO and conventional crops during transport has also risen, it said.

“Feeding for chicken and turkey production in Germany without use of genetic technology can no longer be undertaken,” the association said. “Specialist feed factories for production of poultry feed requires a seamless supply chain with impeccable GMO-free soybeans, but supplies can no longer be guaranteed in the required volumes.”

The association said Germany was not alone with such problems and some British and Danish poultry producers had in the past year also given up commitments not to use GMO soybeans.  

Global livestock populations have been eating predominately GE feed for well over a decade.

70-90% of harvested GE biomass is fed to food producing animals.


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There have been hundreds of animal feeding studies using GE crops.

<table>
<thead>
<tr>
<th>Animal species/category</th>
<th>Number of experiments</th>
<th>Nutritional assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruminants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>23</td>
<td>No unintended effects in composition (except lower mycotoxin concentration in Bt-plants)</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Pigs</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broilers</td>
<td>48</td>
<td>No significant differences in digestibility and poultry health as well as no biological relevant unintended effects on performances of animals and composition of food of poultry origin</td>
</tr>
<tr>
<td>Laying hens</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Other poultry</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Others (fish, rabbits etc.)</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

FASS maintains a list of animal feeding studies with GE crops; and transgenic DNA and protein in livestock products.

Scientific References

FASS is committed to assisting in the dissemination of scientific information to accomplish our goal for the pursuit of scientific and educational good of animal agriculture. To support this effort, we have assembled the following list of references. We hope that you find value in this list of scientific articles, organized by topic and species when planning your research.

References - Feeding Transgenic Crops to Livestock
PDF Available
Updated May 2012

References Pertaining to Transgenic DNA and Protein and Livestock Products (Meat, Milk, Eggs)
PDF Available
Updated April 2012

http://www.fass.org/page.asp?pageID=43
The majority of the more than 100 billion food animals raised in the US between 2000-2011 consumed varying levels of GE feed.

<table>
<thead>
<tr>
<th>Industrya</th>
<th>U.S.\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broiler</td>
<td>105,426,000,000</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>410,000,000</td>
</tr>
<tr>
<td>Dairy Cows</td>
<td>35,000,000</td>
</tr>
<tr>
<td>Hogs</td>
<td>105,000,000</td>
</tr>
<tr>
<td>Total</td>
<td>105,976,000,000</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Numbers for broilers, hogs (barrows and gilts) and beef cattle (steers) are for slaughtered animals during calendar year. Dairy animals are number of dairy cows in a calendar year divided by three to account for three lactations per animal.


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Milk, beef, swine, and broiler production trends in US prior to and subsequent to the introduction of GE crops in 1996

Average milk yield (kg/cow)

Average beef cattle slaughter weight (kg/steer)

Average broiler slaughter weight (kg/broiler)

Average milk yield (kg/cow)

Average hog slaughter weight (kg/pig)

Milk, beef, swine, and broiler production trends in US prior to and subsequent to the introduction of GE crops in 1996

Milk production statistics and somatic cell counts in US prior to and subsequent to the introduction of GE crops in 1996

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US broiler statistics prior to and subsequent to the introduction of GE crops in 1996. Slope differs between time periods 1983-1994 and 2000-2011 (*P < 0.05)


Unpublished data based on Freedom of Information Act Request of USDA FSIS records.
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Does it affect livestock (milk, meat, eggs) from animals eating GE feed?

- No GE rDNA or the newly expressed proteins encoded have ever been found to be present in the milk, meat, or eggs from animals that have eaten GE feed.
- It is not possible to distinguish any differences in the nutritional profile of animal products following consumption of GE feed.
- **Labeling of such animal products is not currently mandatory in either US or Europe.**
Safety of Meat, Milk, and Eggs from Animals Fed Crops Derived from Modern Biotechnology

Animal Agriculture’s Future through Biotechnology, Part 5

SUMMARY

As the global land area of biotechnology-derived crops modified for agronomic input traits such as herbicide tolerance and/or insect resistance continues to increase, these crops have become an increasingly important source of feed-stuffs for farm animals, and it is important to review the safety of meat, milk, and eggs derived from animals fed these crops. Once the safety of the newly expressed protein has been established, then nutritional equivalence between
Past and projected trends in consumption of meat and milk in developing and developed countries

The pipeline of GE crops for improved animal feed: Challenges for commercial use.


- ~100 events relative to animal nutrition in development and regulatory pipeline
  - US ~ half of these events
  - EU – 14 events
  - China – 12 events
  - Japan – 10 events

- There are 4 main feed traits currently under research
  - Low phytate content
  - Amino acid rich
  - Improved digestibility
  - Enhanced oil content because oils have 2.25X more metabolizable energy than starch; or altered oil composition (e.g. ω-3 fatty acids for fish feed to replace ocean capture feed)
<table>
<thead>
<tr>
<th># Events in pipeline</th>
<th>Countries</th>
<th>Crops</th>
<th>In field trials?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low phytate and/or high phytase</td>
<td>20</td>
<td>China, Czech Rep., Denmark, Germany, Japan, Netherlands, Taiwan, USA</td>
<td>Alfalfa, Barley, Corn, Rapeseed, Rice, Soybean, Wheat</td>
</tr>
<tr>
<td>Amino acid Rich (Cys, Arg, Met, Lys, Thr, Trp, Phe, Arg, Leu)</td>
<td>34</td>
<td>China, Germany, Hungary, Israel, Japan, USA</td>
<td>Alfalfa, Casava, Corn, Rapeseed, Rice, Sorghum Soybean, Wheat</td>
</tr>
<tr>
<td>Improved digestibility (especially low lignin content)</td>
<td>15</td>
<td>Canada, China, France, Spain, UK, USA</td>
<td>Alfalfa, Corn, Rice, Ryegrass, Sorghum Switch grass, Tall Fescue</td>
</tr>
<tr>
<td>Enhanced oil content</td>
<td>15</td>
<td>Australia, Canada, Germany, USA</td>
<td>Corn, Cotton, Rapeseed, Soybean</td>
</tr>
</tbody>
</table>

Some of the potential benefits from improved animal feed crops

- Enhanced uptake of phosphorus (i.e. ↑ phytase, ↓ phytate) and better amino acid quality in animal feeds
- Reduced phosphorus pollution
- Enrichment for essential amino acids is highly desirable both from humanitarian reasons as well as economic
- 1% increase in forage digestibility would result in a 3.2% increase in weight gain in beef
- 10% increase in cell wall digestibility would generate additional meat and milk sales in dairy industry of about US$380 million yearly, decrease manure production by 2.3 Mt and reduce the needs for grain supplementation of rations by about 3 Mt (1999 estimate!)
- Alternate sources of ω-3 fatty acids for aquacultural diets
Issues related to commercialization of these animal feed events

- By definition these groups will not be substantially equivalent to non-GE isogenic lines – how will this complicate the regulatory evaluations?
- If the benefits derived from growing these crops accrue to the livestock producer or feeder and not directly to the farmer growing the crop, there will need to be some form of supply chain segregation in place to ensure a price premium is obtained for the value-added output trait.
- An additional concern is the increasing problem of asynchronous regulatory approval, or regulatory asynchronicity.
- This means cultivation approvals of GE varieties in exporting countries occurring before import food and feed approvals in importing countries.
- This has/will likely result in widespread trade disruptions.
Kalaitzandonakes et al. (2014) succinctly summarizes some emerging trends in terms of likely increased regulatory asynchronicity in the future. These include

1) the expanding pipeline of novel GE crop events, including second generation crops modified for output traits;

2) the expanding range of GE crop species being grown and traded;

3) the expanding global hectarage of GE crops and the growing number of countries that raise them; and

4) the nascent and inexperienced regulatory expertise in many countries that will be called on to manage a large number of regulatory submissions for new GE crops in the future.
More than 95% of food-producing animals in the U.S. consume feed containing GE ingredients.

Chobani uses milk from cows fed GMOs. How “natural” is THAT?

Monsanto Latte?

Tell Starbucks to serve only organic, non-GMO milk.
REAL EGGS ARE GMO FREE

The American Egg Board has good news about egg ingredients for formulators. Eggs in their natural state – in the shell – are not genetically engineered (GE) and can be used as an ingredient in GMO-free applications. A new white paper details the science behind the facts. LEARN MORE
Background in costs of organic (non-GE) feed

- Premiums for organic feeds were 57 percent above conventional feeds. In some years, organic grains may only carry premiums of 25% or so, although premiums are generally much higher, sometimes more than 100% higher.
- Assuming enough price differential producers would respond by growing more non-GE feed – which would be more expensive as there are significant cost savings associated with growing GE crops.

Non-GE crops:
- Wheat
- Sorghum
- Millet
- Barley
- Rice
- Oats

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U.S. Certified organic acreage and organic animals produced vs. conventional 2011 (USDA NASS, USDA ERS).
Will activist scaremongering win or will facts?

Now:
If GMO’s are so safe, then why are you afraid of labeling them?

Later:
If GMO’s are so safe, then why do they need warning labels?
Conclusions

- It is currently unclear if the “National Bioengineered Food Disclosure Standard” will cover animal feed
- “I think the correct answer to the California animal feed association is that it had better define its position (pro or con for the labeling of feed) and, once defined, it should get active in lobbying the USDA. This must be done now because the clock is ticking and time is passing rapidly.”
- GE feed crops are widely grown and traded
- And a bunch of sciency stuff that most people do not care about and which just make activists hopping mad
Questions

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