The Need for Coexistence with GMO Alfalfa

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Is coexistence possible with alfalfa hay?

- Yes, definitely (with caveats). Why?
  - Demonstrated history with other systems (sweet/ field corn, sunflower seed, cotton)
  - Gene flow is low with hay crops

- However, there are issues!

- Caveat: Depends upon both technical factors and human factors

- If neighbors don’t want to coexist, they won’t

Seed crops require a different level of attention
Alfalfa Hay Market Sensitivities:

- 2005: Estimated that <3-5% of US Alfalfa Production is ‘sensitive’ to Biotech trait (US)
  - Organic
  - Export
  - Some horse markets
  - Others

- This includes those whose ability to farm or market hay would be harmed by unwanted ‘adventitious presence’ of RRA gene.

- This doesn’t include growers that simply don’t want or need the trail
Figure 1. US Organic Alfalfa Hay Acreage (with % of total)

(US Economic Research Service)

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<th>Year</th>
<th>US Organic Alfalfa Acreage (X 1,000)</th>
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<td>1998</td>
<td>0.48%</td>
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Volume of US Hay Exports, 1998-2013

United States International Trade Commission, DataWeb
Considering Evidence to the Contrary

- Long seed heads on timothy
- Emphasis on color for quality
- Arguments over 1/10% TDN, 5 points RFV

- Horse, Export particularly ‘subjective’
- Food/ feed safety is largely an issue of ‘trust’, which is built over time.
- ‘The customer is always right’ - hay growers must respond!
The Customer is always right, right?

Our Policy

Rule 1
The Customer is always right.

Rule 2
If the Customer is ever wrong, re-read Rule 1.

Stew Leonard

Produce for the market demand!
Hay Demand

Important to give the customer what they want.
Methods to enable co-existence of Biotech and non-biotech alfalfa

- Plant non-GE seed when growing for sensitive markets
  - This is the most important step!
  - Testing seed at planting, buy Certified Seed
  - Option 1. APS Certification (AOSCA) - 5 mile isolation (independent certification)
  - Option 2. APS Testing (NAFA BMPs for AP Sensitive Seed). Non-Detect (<0.1% AP, 95% confidence level)

What’s the threshold: How pure is pure?

- In (human) food (for approved traits):
  - 0.9% must be labeled GMO in EU
  - 5% labeled in Japan

- For non-approved traits (zero)

- There is no “official” threshold for hay
  - Organic (cannot use GM, but no threshold)
  - Export (some countries will accept, many customers will not, no threshold)
  - Chinese have been testing using PCR - perhaps 0.01 to 0.03% sensitivity.
Hay to Seed Gene Flow

\[ Y = -0.1844 \ln(x) + 1.1778 \]

\[ r^2 = 0.7199 \]

Gene Flow (%)

Distance from Hay Field (ft)

Slide: Larry Tueber
What about Hay-Hay?

- 99% of landscape situations are hay-hay
- Will gene flow permanently contaminate non-GE hay?
Process of Gene Flow in Hay Fields

What is required for genes to move from one alfalfa hay field to another to cause Adventitious Presence?
Process of Gene Flow in Hay Fields

Steps required
Determining potential Gene Flow in hay (example)

- Start with measured Hay to Seed gene flow = 0.25%
  L. Teuber) on edge of fields (165 feet) (average in whole field would be a fraction of this).
- X simultaneous Flowering (100% )
- X % of seed that matures (e.g. x10% ) = 0.025
- X % of seed that remains (x10% ) = 0.0025
- X % of seed that result in plants (10% ) = 0.00025%
  Adventitious Presence in the subsequent hay crop
- Remember that if the crop if any of these steps = 0, gene flow is zero.
  But is it zero?
Gene flow in Hay crops

- In general, the potential for gene flow in alfalfa hay crops is no different in magnitude from the possibility of other impacts between neighbors (weed seeds, insects, pesticides, fertilizers).
- Probability of gene flow in hay crops very low (but is it zero??)
What are Neighbor Impacts?

- Pesticides, Fertilizers, Gene Flow
- Weeds, Manures, insect pests

Remember, neighbor effects can go either way!
SAMPLING (using NFTA protocols)

Identify a single lot of hay

Randomly sample 20 cores from hay lot

Combine samples and mix
Using Test Strips

0% RR

5% RR

100% RR
## TEST STRIP RESULTS CORED SAMPLES

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Market Assurance:

- **Producing Non-GE (Non-RR) alfalfa**
  - Most markets may accept a ‘process-based’ assurance, similar to organic?
  - Planting non-RR seed, taking steps to limit gene flow, machine contamination, identify hay lots, Verify with hay sampling
  - Do customers want certified non-GE hay?
What are the human factors?

It seems blatantly obvious that cooperation is a key ingredient of coexistence between diverse systems.
 Approaches to controversies surrounding GMOs:

- Just ban GMOs, problem solved
- Let judges and lawyers decide these issues
- Let activists decide these issues
- Let big multinationals decide these issues
- How about lots of government regulations?
- Grower, industry-led ‘bottom up’ approach?
- Develop tolerance strategies that enable diverse production systems to thrive.
What about the promise of GMOs?

- **Roundup Ready** -
  - Widely adapted in Western States

- **Coming Traits:**
  - Low Lignin trait may improve quality as well as yield (2016)

- **Genes of further interest for alfalfa:**
  - Tannin lines for improved protein
  - Delayed flowering for higher yields
  - Salinity tolerance, drought
  - Pest/ nematode resistance

- Consumer reaction may stop such technologies
Summary:

- Coexistence of GE and non-GE is possible (with caveats)
- The risks of GE impacts upon neighbors in hay production are similar to other technologies (fertilizers, pesticides, pests, weeds)
- There is a strong need to promote success of diverse production systems (organic, export, GE-rejecting, GE-adapting) in practice
- A ‘bottom up’ approach and cooperation is key.
Thanks