

*Need for Coexistence, Kearney Field Day, September 12, 2014*

# 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 trait



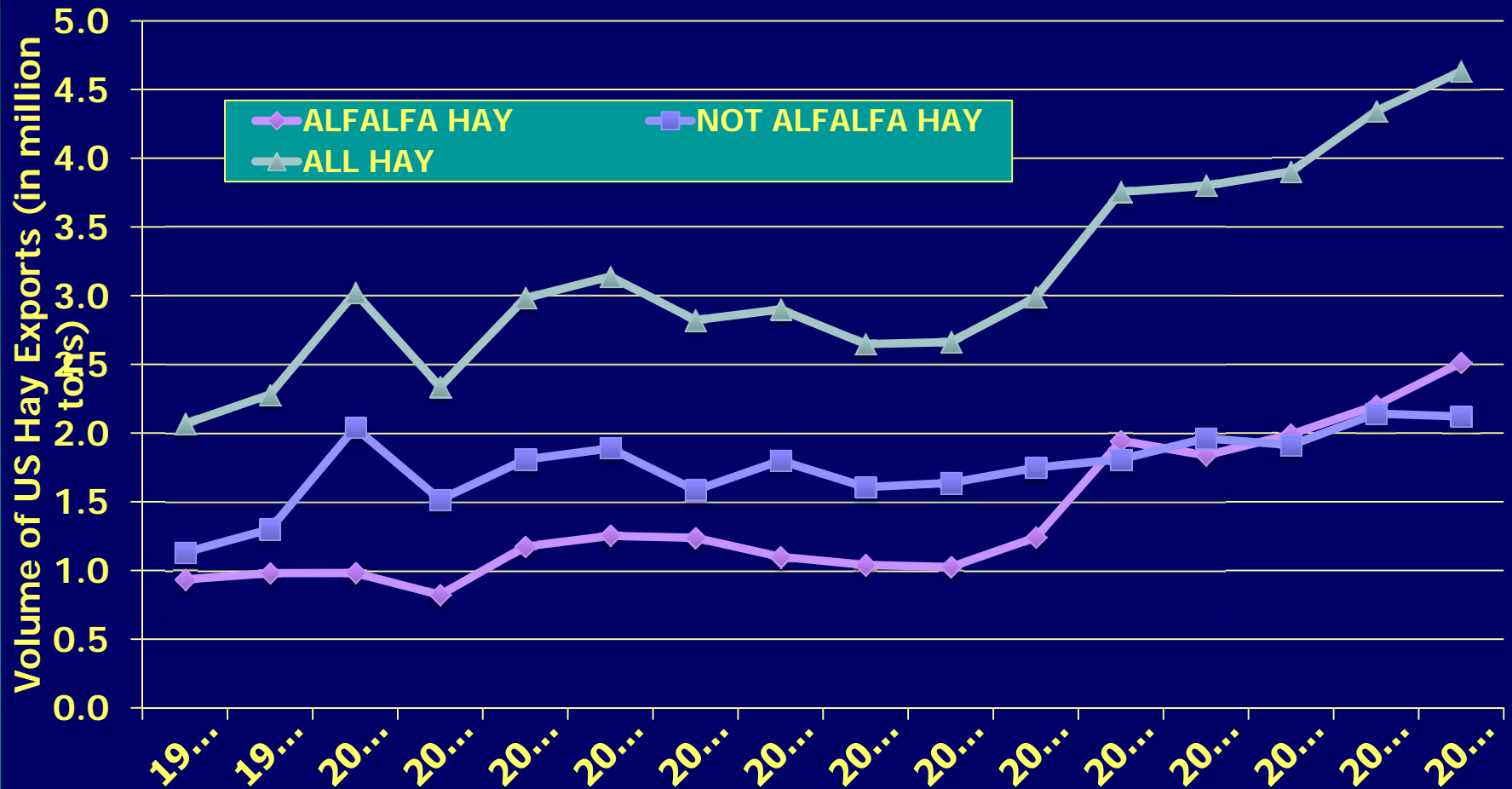
# US Organic Alfalfa Acreage

Figure 1. US Organic Alfalfa Hay Acreage (with % of total)





# Volume of US Hay Exports, 1998-2013



United States International Trade Commission, *DataWeb*

# Are Hay Markets Entirely Rational?

- Considerable 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!

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The Customer is always **right**, right?



**Produce for the market demand!**

Need

# 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)

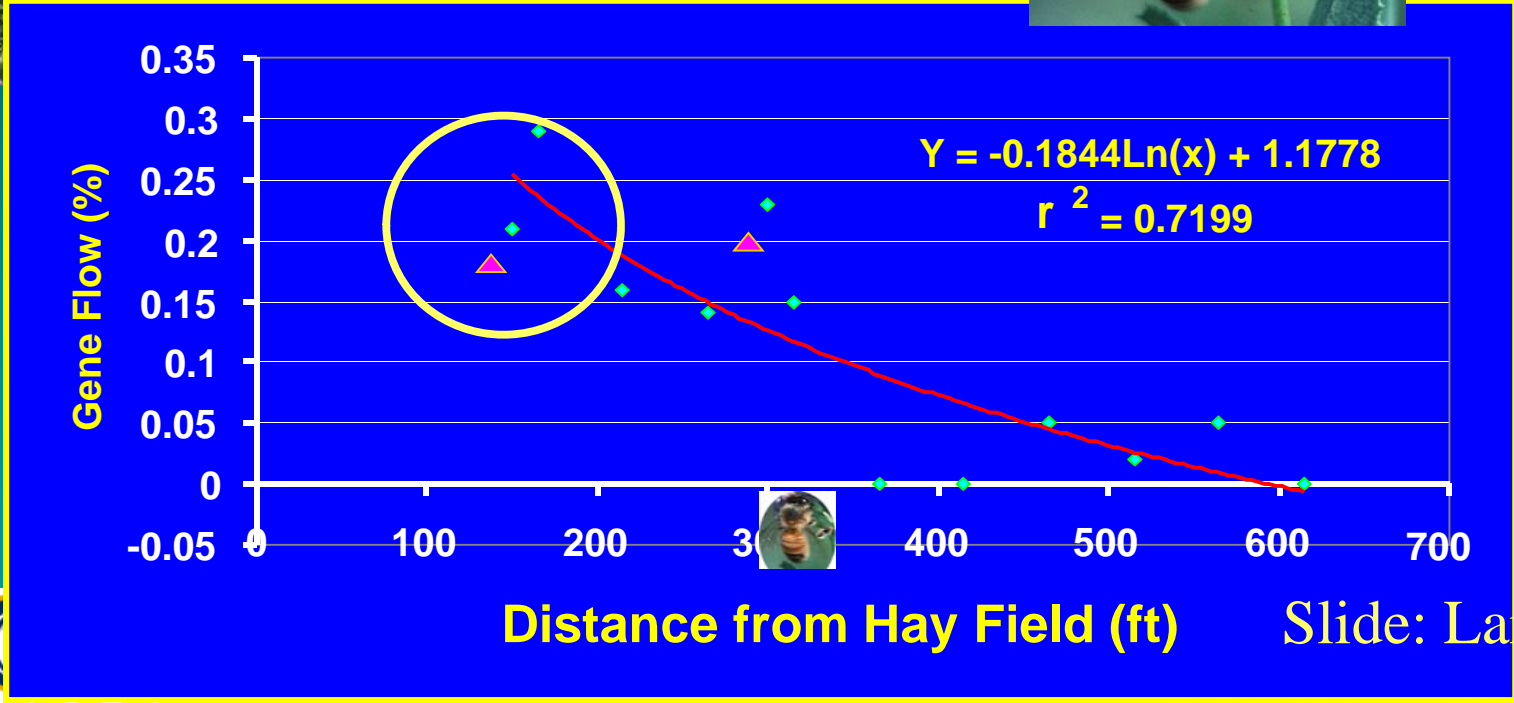
*D.H. Putnam, <http://alfalfa.ucdavis.edu>*



# 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



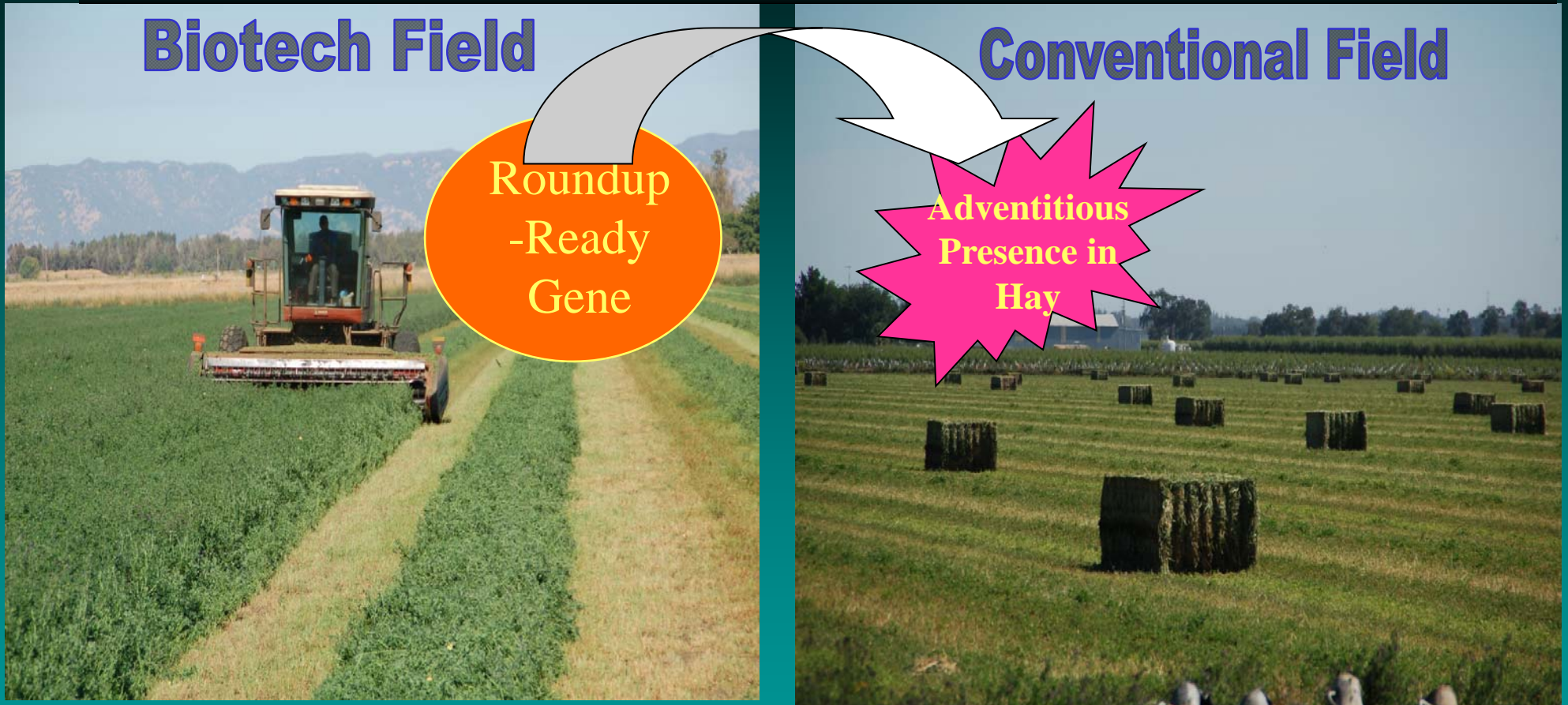


# What about Hay-Hay?

- 99% of landscape situations are hay-hay
- Will Gene flow permanently contaminate non-GE hay?

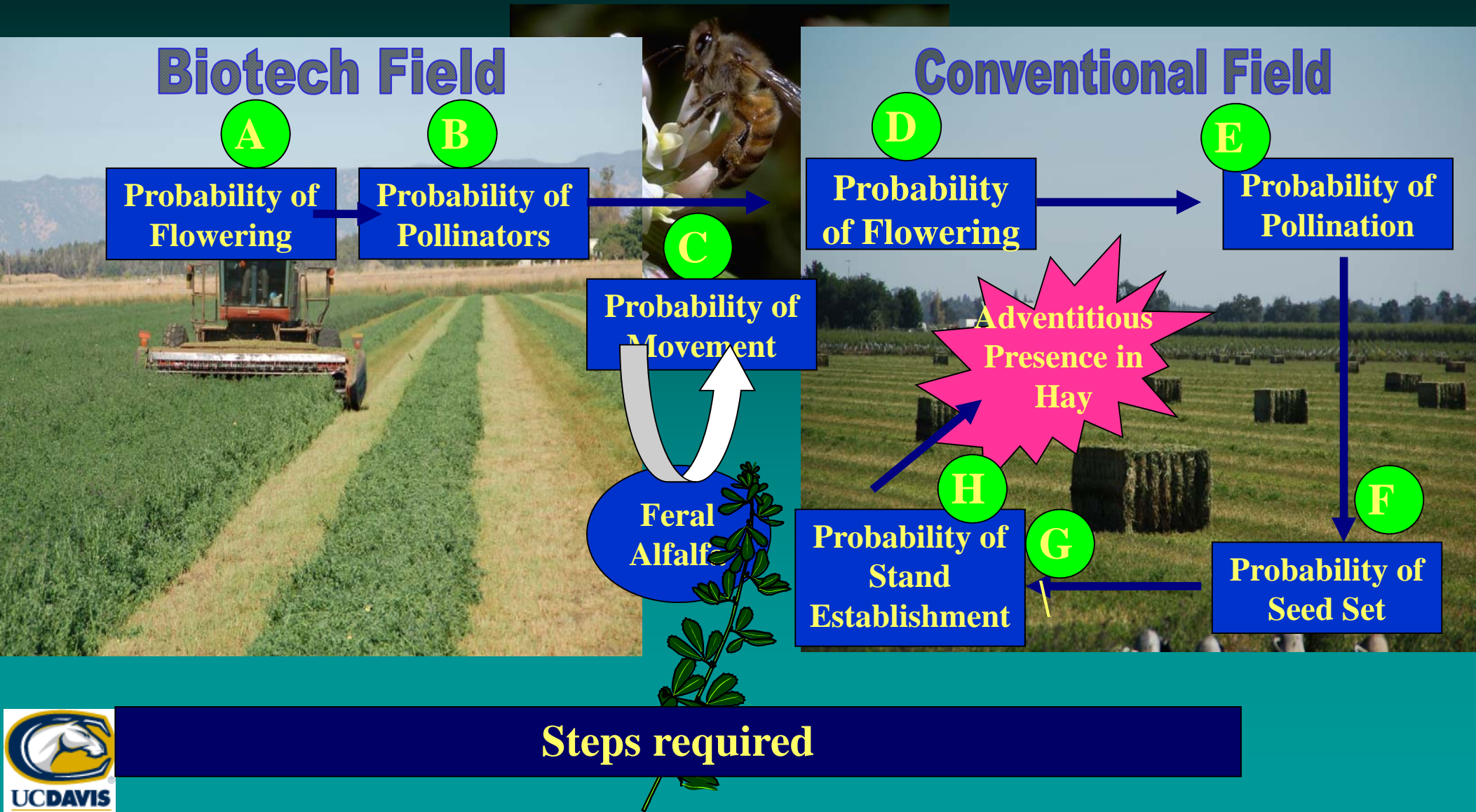


# Process of Gene Flow in Hay Fields



**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





# 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!*

**Organic or GE Sensitive**

**Conventional or GE**



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# Field Study (ID, WA, CA)





# SAMPLING (using NFTA protocols)



Identify a single lot of hay

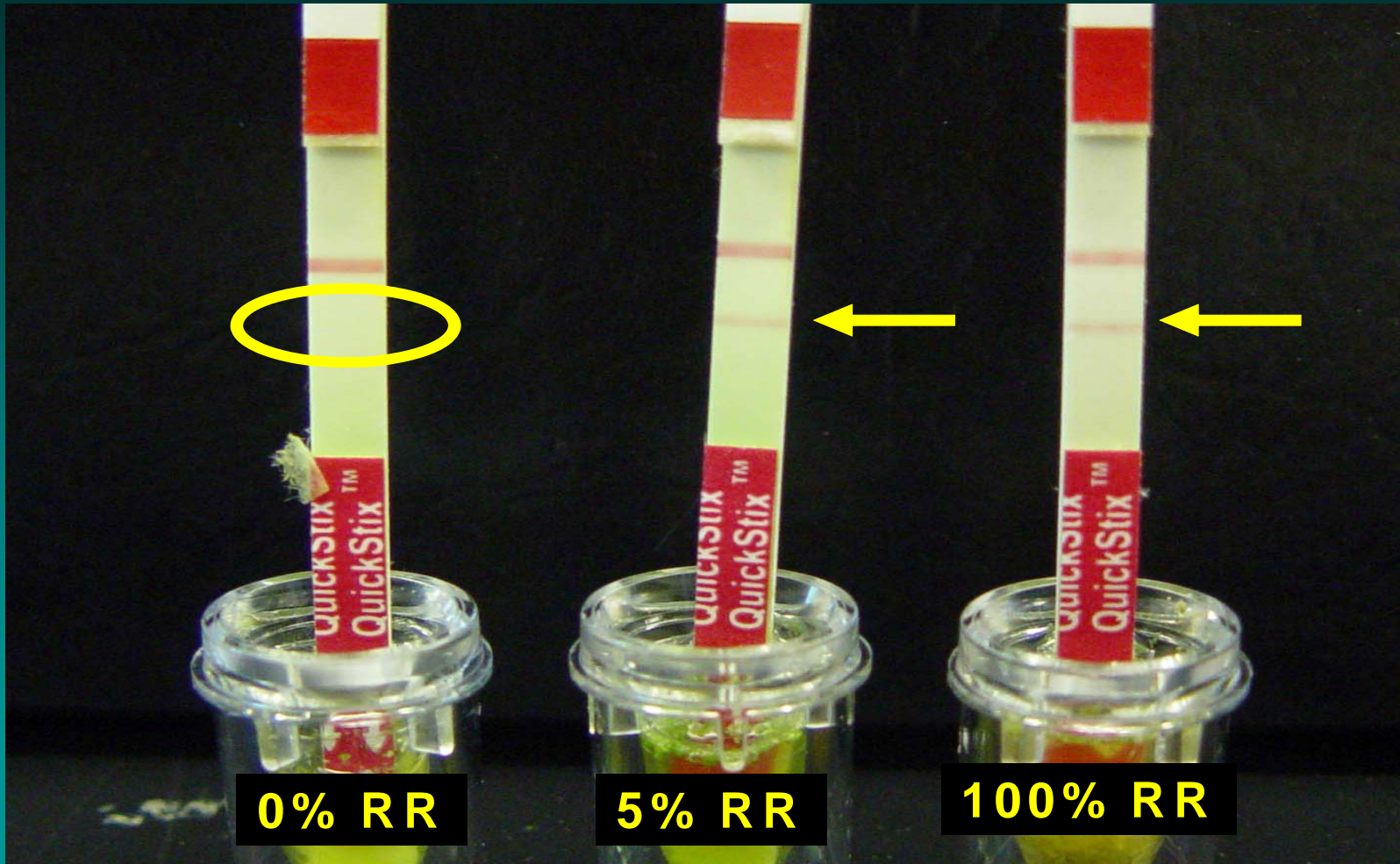


Randomly sample 20 cores  
from hay lot

Combine samples and mix



# Using Test Strips





# TEST STRIP RESULTS CORED SAMPLES

cut	trt	rep	11-Nov-05		18-Nov-05		1-Dec-05	
			ENV ID	SDI ID	ENV WA	SDI WA	ENV CA	SDI CA
cut 2	Zero %	1	-	-	-	-	-	-
cut 2		2	-	-	-	-	-	-
cut 2		3	-	-	-	-	-	-
cut 2		4	-	-	-	-	-	-
cut 2		5	-	-	-	-	-	-
cut 2	One %	1	-	+	+***	+*	+***	+**
cut 2		2	+*	+	+**	+	+***	+**
cut 2		3	-	-	+**	+**	-	+***
cut 2		4	-*	+	+*	+*	-	+**
cut 2		5	+*	+	+**	+**	-	+**
cut 2	Five %	1	+	+	+*	+	+	+
cut 2		2	+	+	+*	+	+***	+*
cut 2		3	+	+	+*	+	+***	+
cut 2		4	+	+	+*	+	+	+
cut 2		5	+	+	+	+	+*	+
cut 2	Ten %	1	+	+	+	+	+	+
cut 2		2	+	+	+	+	+	+
cut 2		3	+	+	+	+	+	+
cut 2		4	+	+	+	+	+	+
cut 2		5	+	+	+	+	+	+

\* Indicates a very faint stripe. The more asterisks - the fainter the line.

# TEST STRIP RESULTS GROUND SAMPLES

cut	trt	rep	11-Nov-05		18-Nov-05		1-Dec-05	
			ENV ID	SDI ID	ENV WA	SDI WA	ENV CA	SDI CA
cut 2	Zero %	1	-	-	-	-	-	-
cut 2		2	-	-	-	-	-	-
cut 2		3	-	-	-	-	-	-
cut 2		4	-	-	-	-	-	-
cut 2		5	-	-	-	-	-	-
cut 2	One %	1	-	-	+***	+***	-	+**
cut 2		2	-*	+*	+***	+**	+***	+*
cut 2		3	-	+*	+***	+**	+***	+*
cut 2		4	-*	+*	+**	+**	-	+*
cut 2		5	-*	+*	+***	+**	+***	+*
cut 2	Five %	1	+	+	+	+	+**	+
cut 2		2	+*	+*	+	+**	+***	+
cut 2		3	+	+	+	+*	+***	+
cut 2		4	+	+	+	+	+	+
cut 2		5	+	+	+	+	+*	+
cut 2	Ten %	1	+	+	+	+	+*	+
cut 2		2	+	+	+	+	+	+
cut 2		3	+	+	+	+	+	+
cut 2		4	+	+	+	+	+	+
cut 2		5	+	+	+	+	+	+

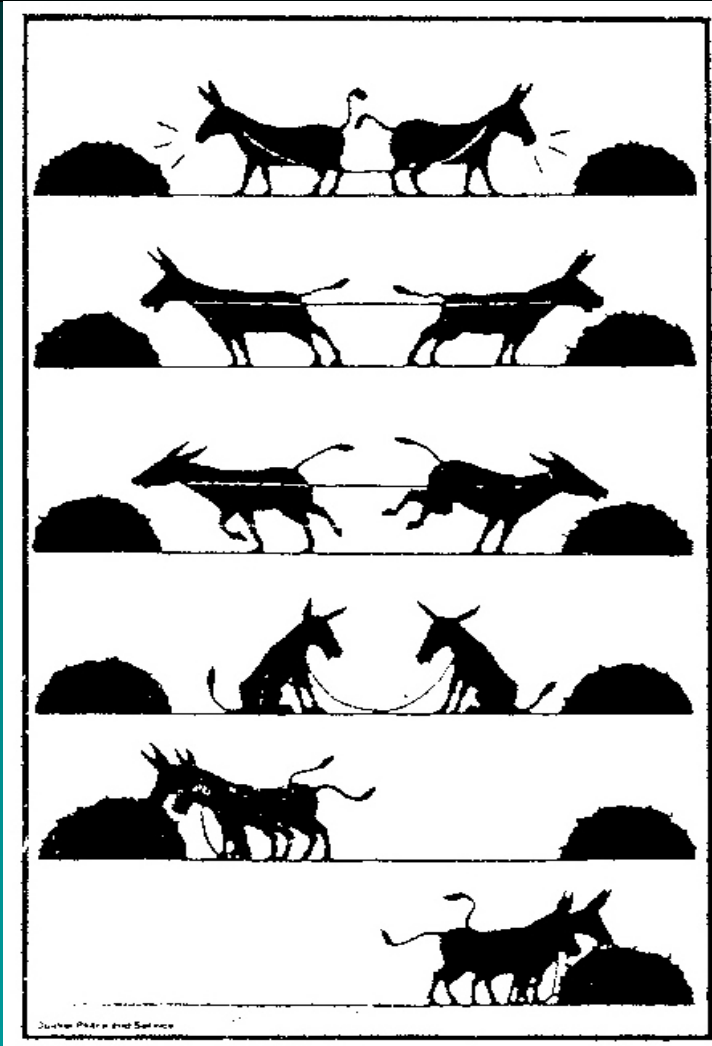
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# Market Assurance:

- **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.

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Thanks

