This PDF is a version of an online module that is part of the Principles for Transitioning to Organic Farming project. For all of our educational materials, please visit:

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Preventing GMO Contamination

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Preventing GMO Contamination

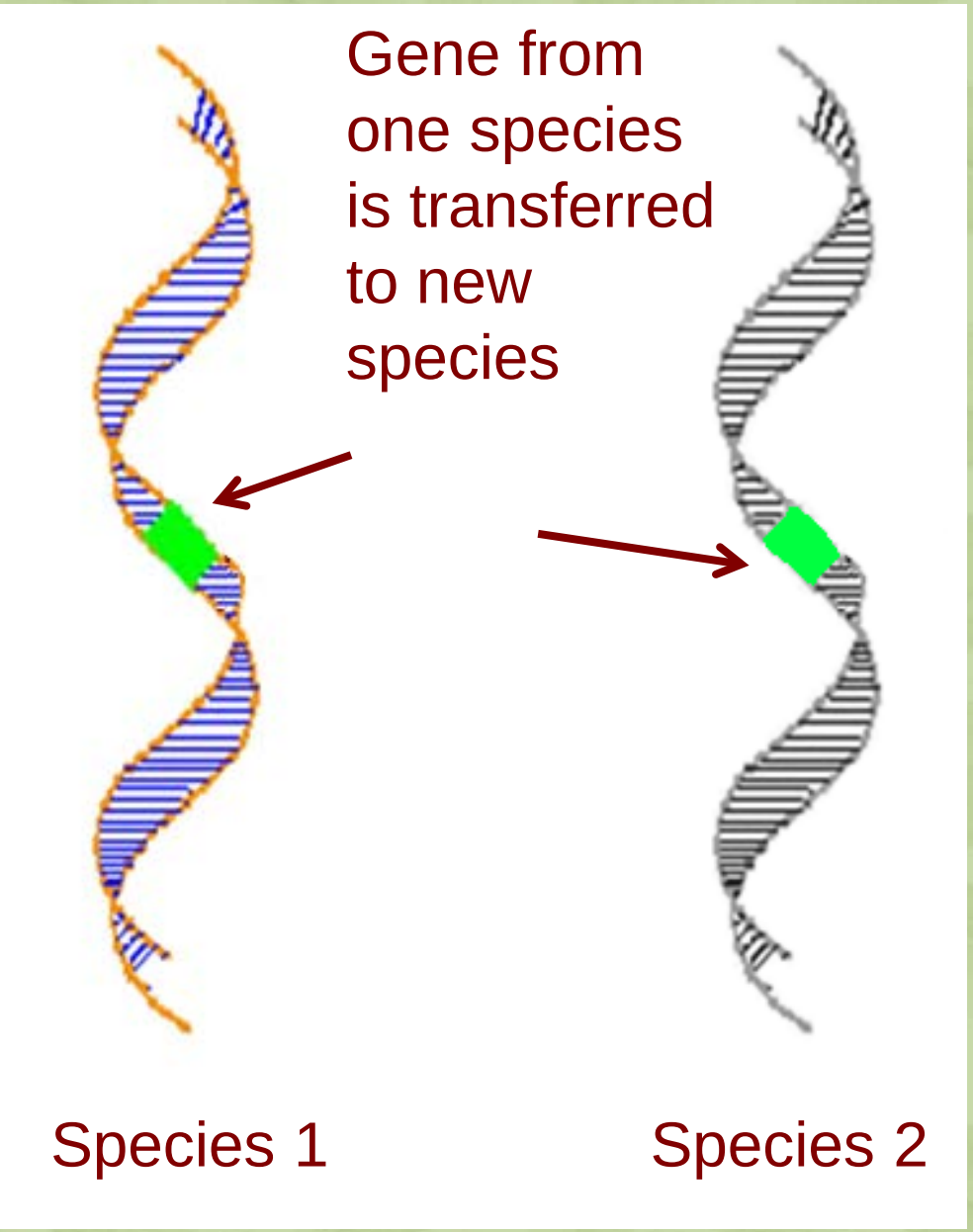
I. What is a GMO?
II. GMOs and organic agriculture
III. How contamination occurs
IV. Consequences
V. Protecting yourself
VI. Resources

What Is a GMO?

- **G**enetically **M**odified **O**rganism
- A plant or other organism bred using genetic engineering techniques
  - National Organic Program defines excluded methods

Other Terms to Know

- Genetic engineering/genetic modification (GE or GM)
- Transgenic: containing DNA from another species (transgenes)



Patented gene or trait

- Gene (or trait) whose use can be restricted by patent holder
- Trait is specific characteristic arising from transgene
- Examples
  - Herbicide resistance: allows crop to survive herbicide application
  - Bt: bacterial-derived insecticide

Which Crops Have Been Genetically Modified?

- Corn (field and sweet)
- Soybean
- Alfalfa
- Sugarbeet
- Canola
- Cotton
- Some vegetables and fruits

Which Crops Have NOT Been Genetically Modified?

- Wheat, oats, and other small grains
- Dry edible beans
- Peas
- Sunflowers
- Cover crops
- Most fruits and vegetables

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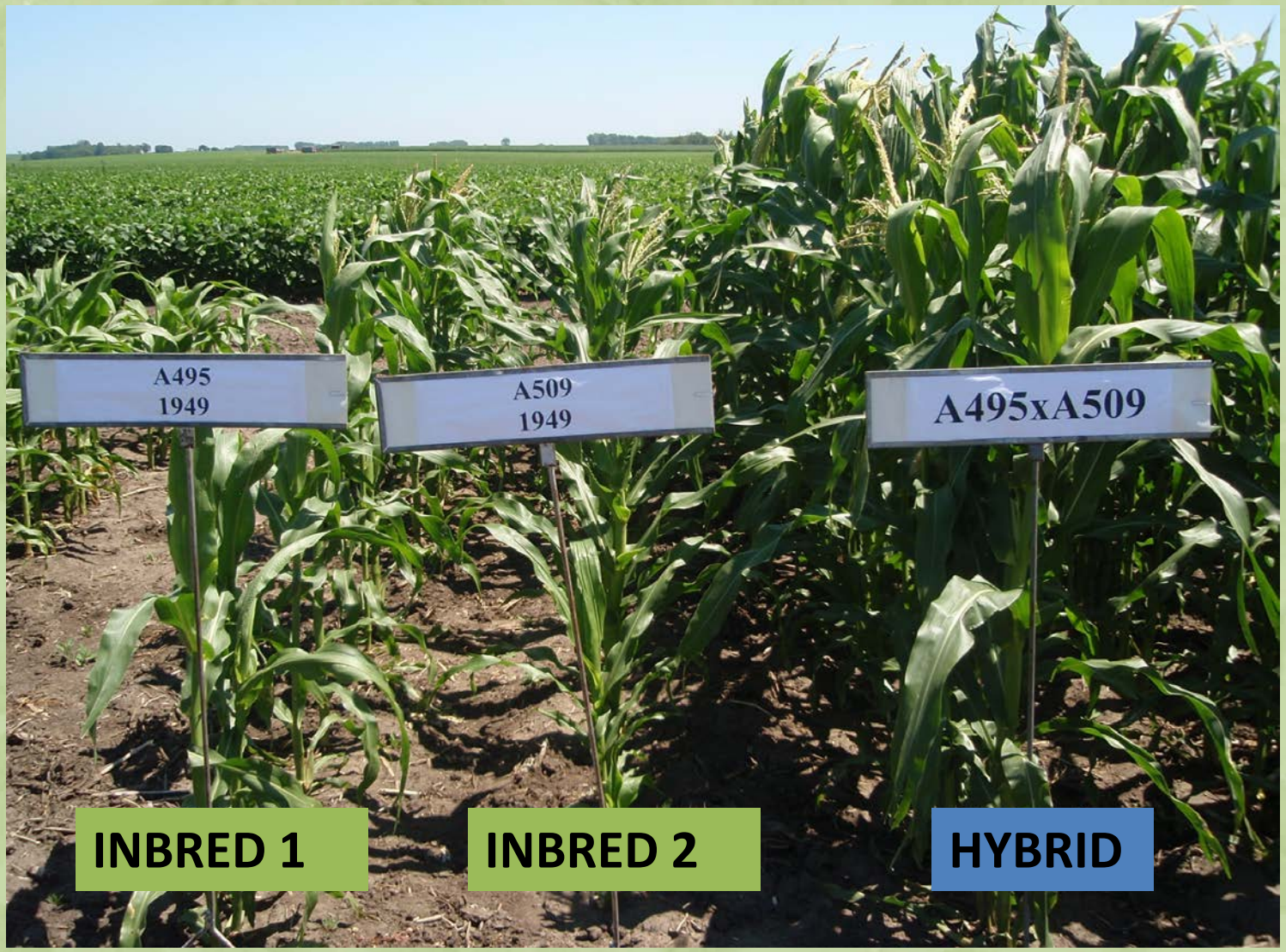
Organic Definition of GMO

- Breeding using “Excluded Methods”
  - Cell fusion, microencapsulation and macroencapsulation
  - Recombinant DNA technology = gene deletion, gene doubling, changing the positions of genes, and introducing a foreign gene (transgene)

Traditional Hybrids ARE Allowed



GMOs – Prohibited in Organic Agriculture

- Cannot plant GMO crop seed
- Cannot use GMO inputs
  - Legume inoculants
  - Biocontrol insecticides
  - Growth hormones (livestock)
- Verify non-GMO status of products before use

GMOs during Transition

- No prohibited substances, including GMOs
- Non-GMO premium possible in some crops

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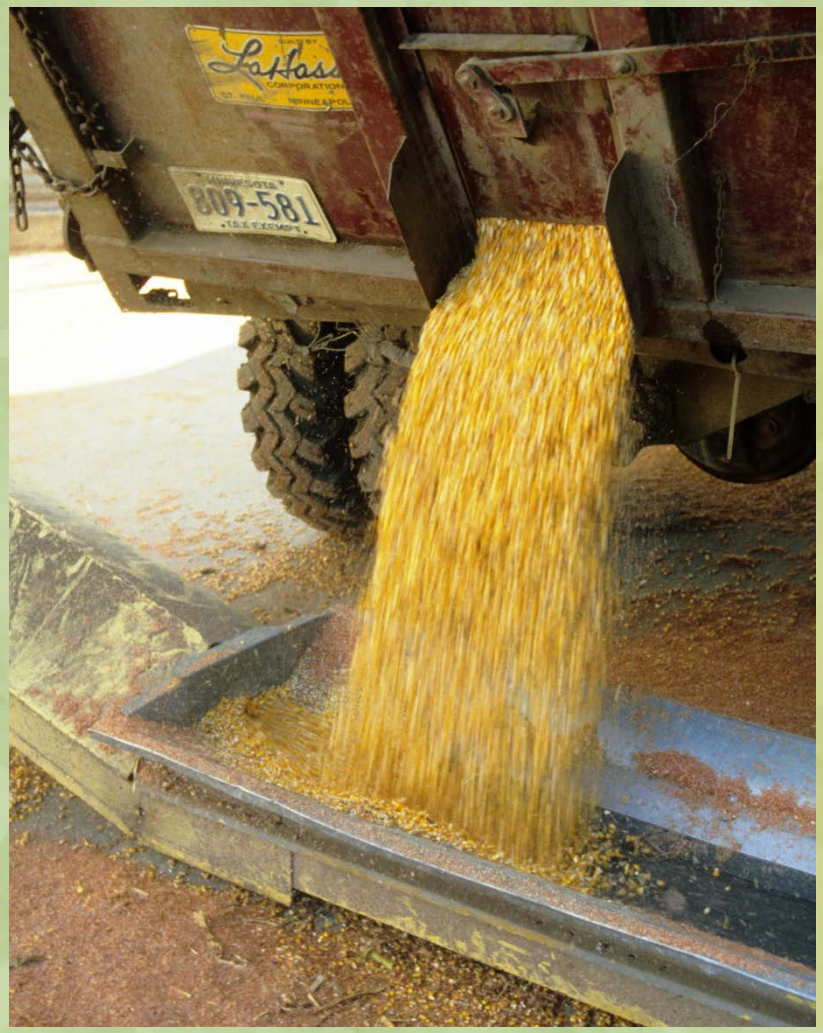
GMO Contamination



A. Planting stock
B. Pollen drift
C. Volunteer plants
D. Equipment

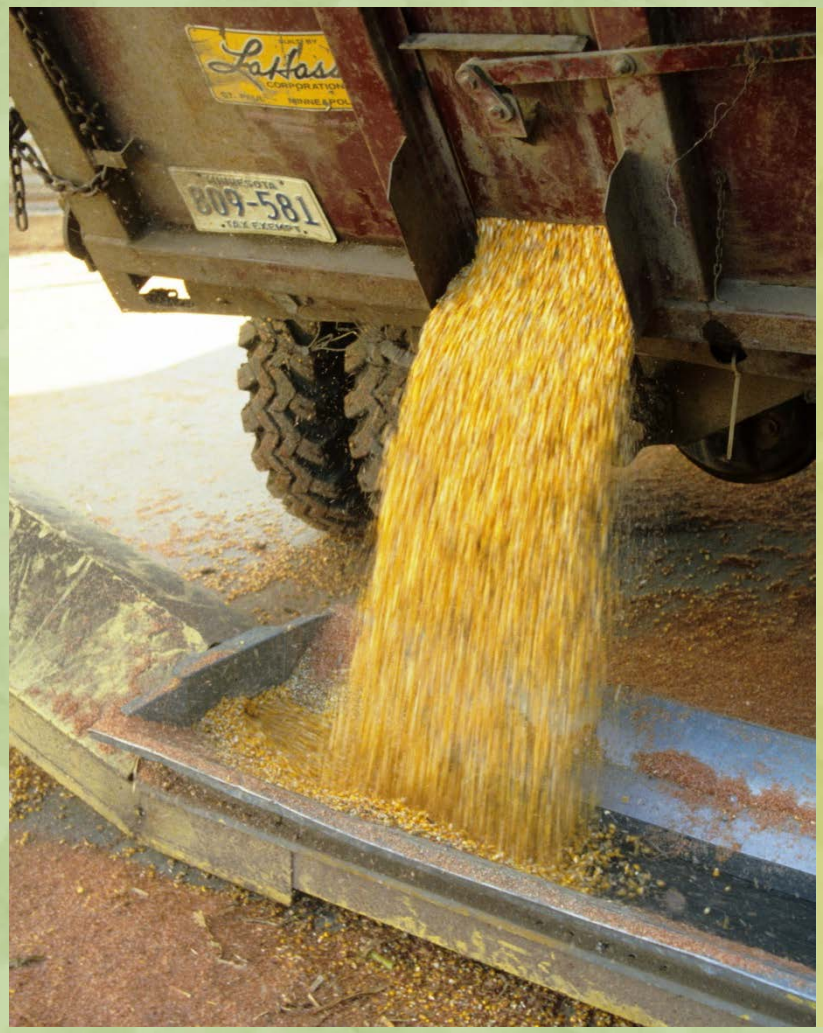
Planting Stock

- Avoid use of contaminated seed
- Can be from supplier or saved seed

Seed Suppliers

Ask for GMO test results from seed supplier prior to purchase

GMO Contamination



A. Planting stock
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What Traits Make Crops Susceptible to GMO Pollen Drift?

1. Same species or relation to a GMO crop
2. Grown in proximity to GMO counterpart
3. Breeding system where outcrossing likely (cross-pollinating)

Insect-pollinated

Wind-pollinated

Crops Susceptible to Pollen Drift

- Alfalfa
- Canola
- Sugarbeet
- Corn
- **NOT soybean**

Alfalfa and GMO Drift

- Bigger risk in seed production regions
- Usually not an issue in hay production

Sugarbeet and GMO Drift

- Only a concern in seed production regions

Canola and GMO Drift

- Concern in canola-growing regions
- Canola GMO pollen can also cross with related weeds

Corn and GMO Drift

- Crop of most concern
- Widely grown
- Likely to be tested for GMOs

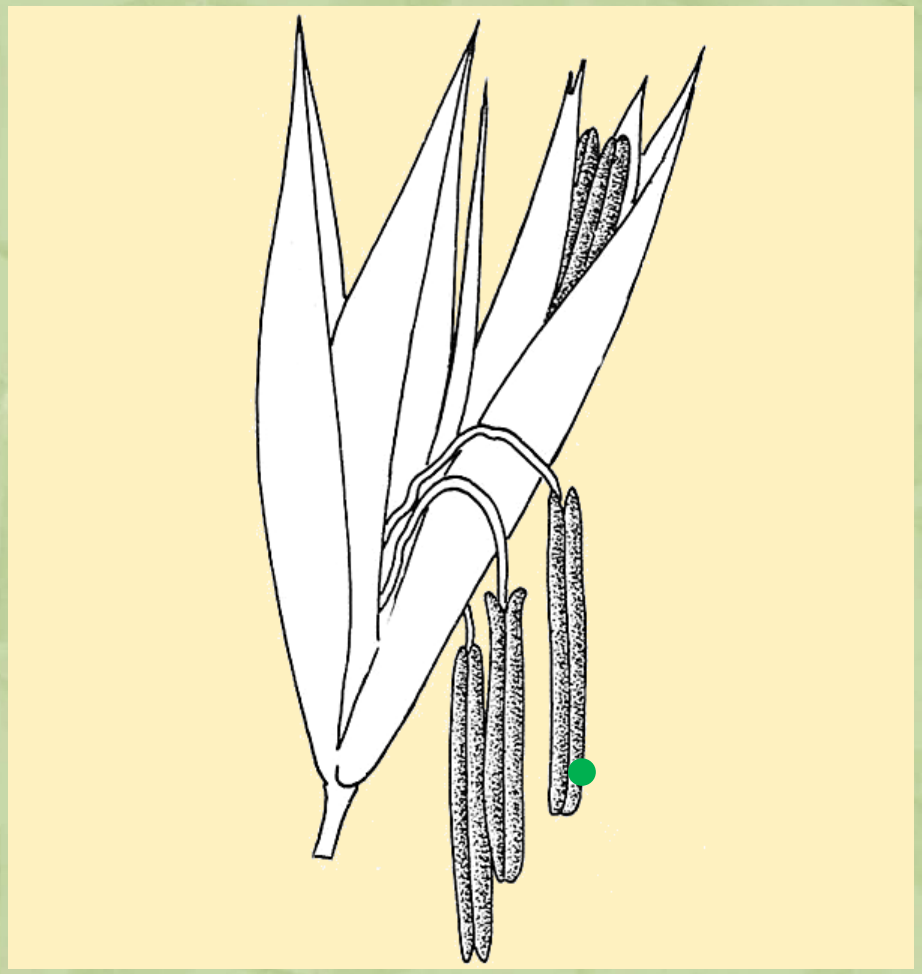
Corn Reproduction

www.allaboutcorn.umn.edu

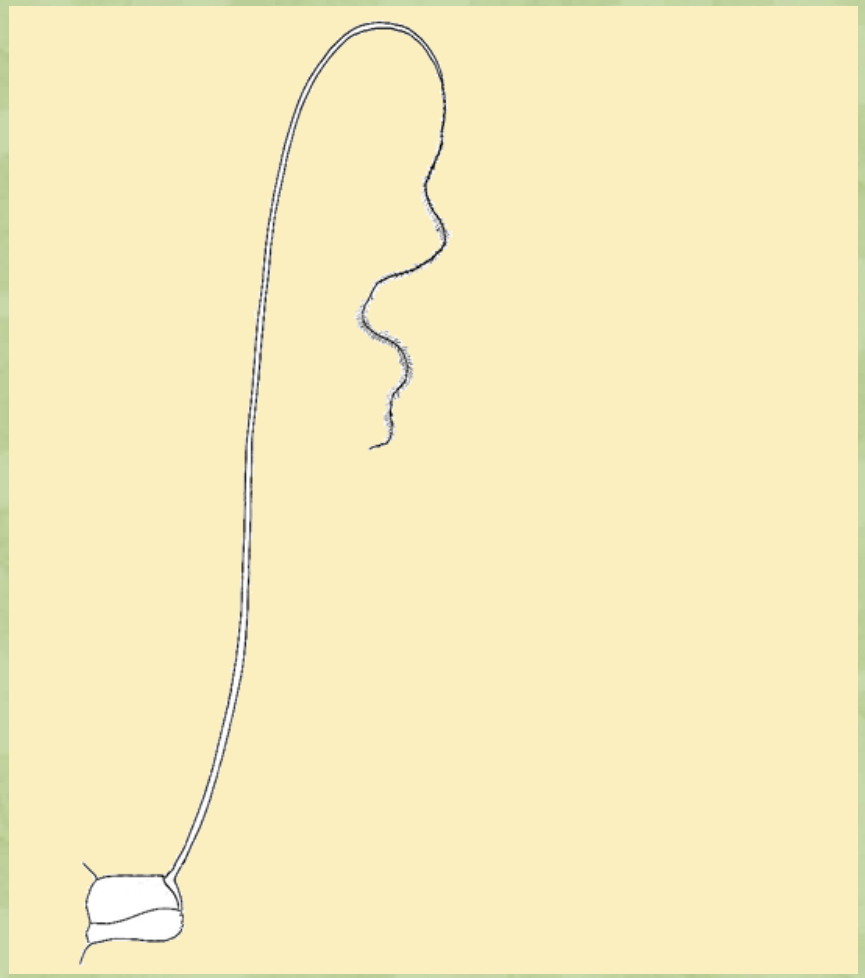
Pollen

Pollen emerges from anthers on tassels

Pollination



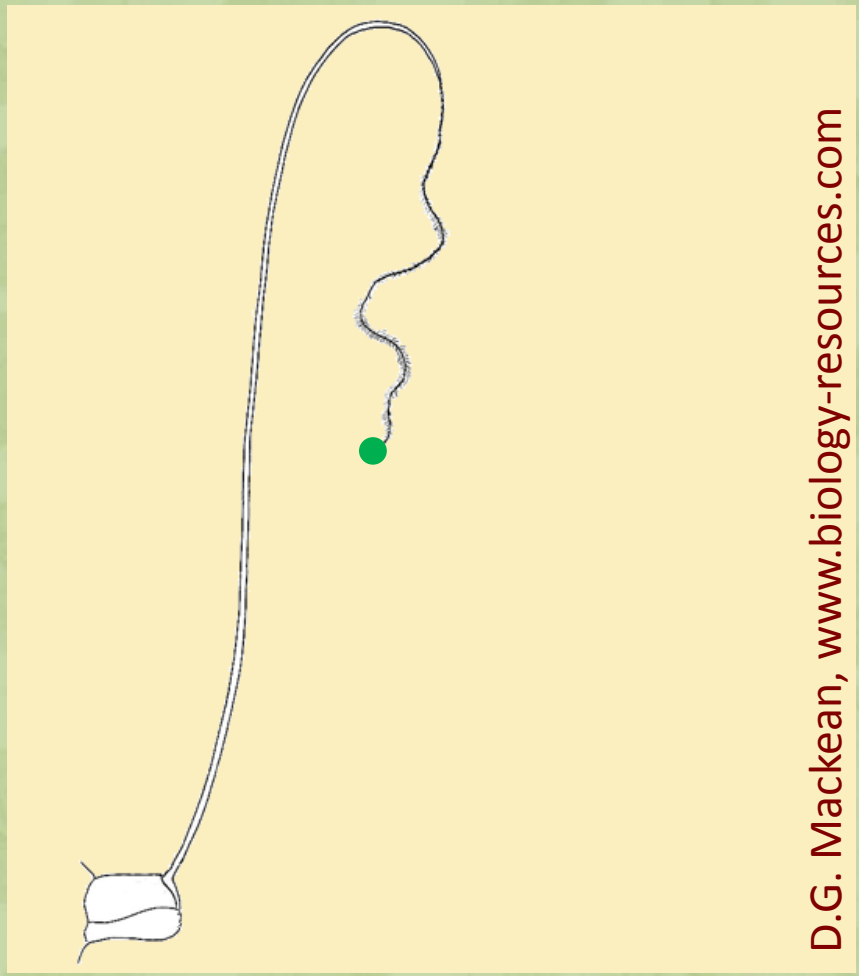
D.G. Mackean, www.biology-resources.com



Pollen grain transferred to silk of another plant

Fertilization

- Pollen unites with ovule
- Fertilized ovule forms corn kernel



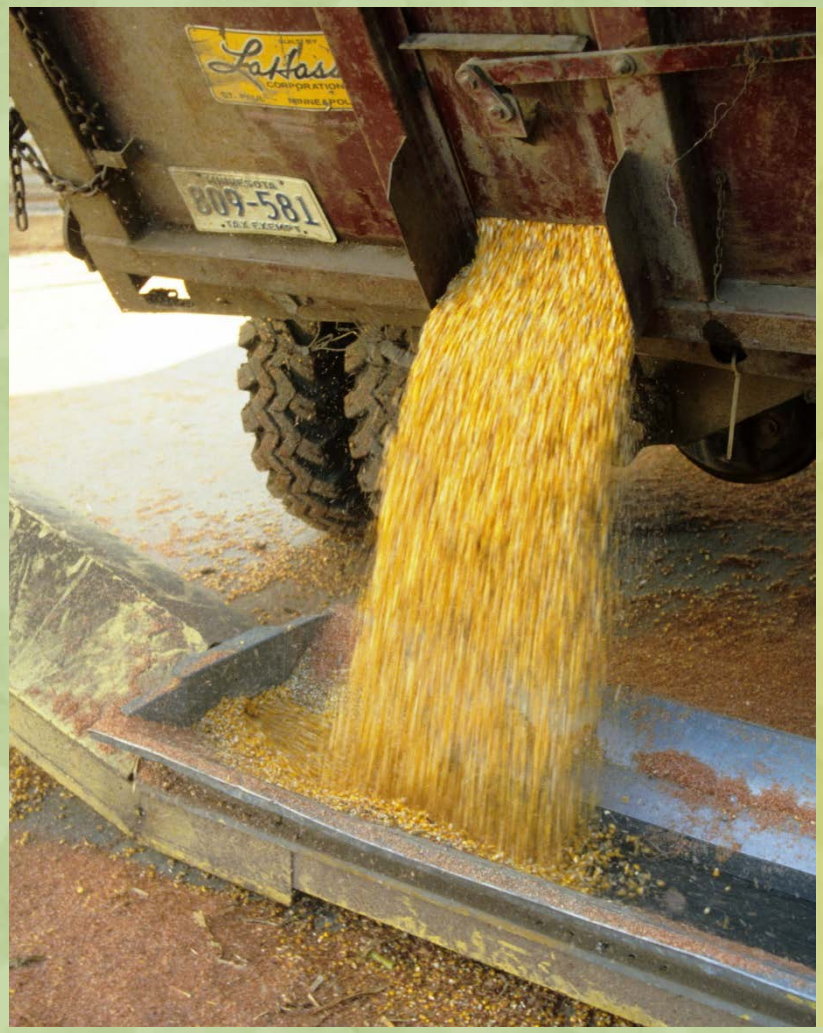
Kernel Development

GMO corn

Non-GMO corn

Kernels with GMO parent will be GMO

GMO Contamination



A. Planting stock

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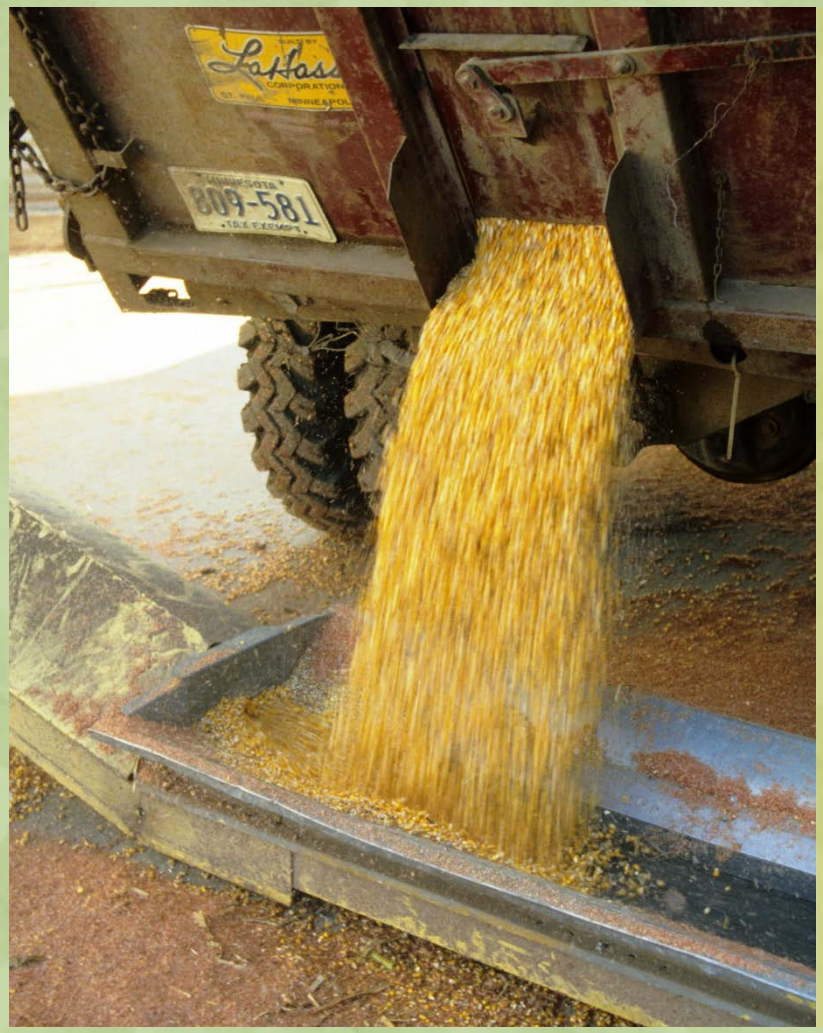
Volunteer plants

- Inadvertently planted seed
- Harvested with intended crop
- May include feral plants in ditches and hedgerows

GMO Contamination



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Equipment Contamination

GMO seed can be remnants in harvest, transport, or storage equipment

Equipment Contamination

- Biggest risk in:
  - Split operations using same equipment
  - Borrowing equipment or hiring custom operators
  - Transportation

Preventing GMO Contamination

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Value of organic crops loss from presence of GMOs--certified and exempt organic farms

2011 through 2014

Geographic area	Number of farms	Value of loss	Average value of loss per farm
United States	92	$6,108,322	$66,395
Iowa	8	$33,840	$4,239
Minnesota	3	$82,440	$27,480
North Dakota	1	not reported	not reported
South Dakota	2	not reported	not reported
Wisconsin	6	not reported	not reported

Source: USDA. Census of Agriculture, 2014 Organic Survey

Consequences of Contamination

- NO loss of certification if correct practices are followed
- USDA Organic Rule is process-based

Consequences of Contamination

- Loss of organic premium
- No uniform standard or legal requirement
  - Buyer policies
  - Importer policies

Recourse and Compensation?

- No official legal stance on liability for lost revenue due to GMO contamination
- Organic farmers currently bear full burden

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Protecting Your Product

A. Know the practices in your supply chain
B. Avoid cross-pollination
C. Monitor

Know Your Supply Chain

Purchasing Non-GMO Seed

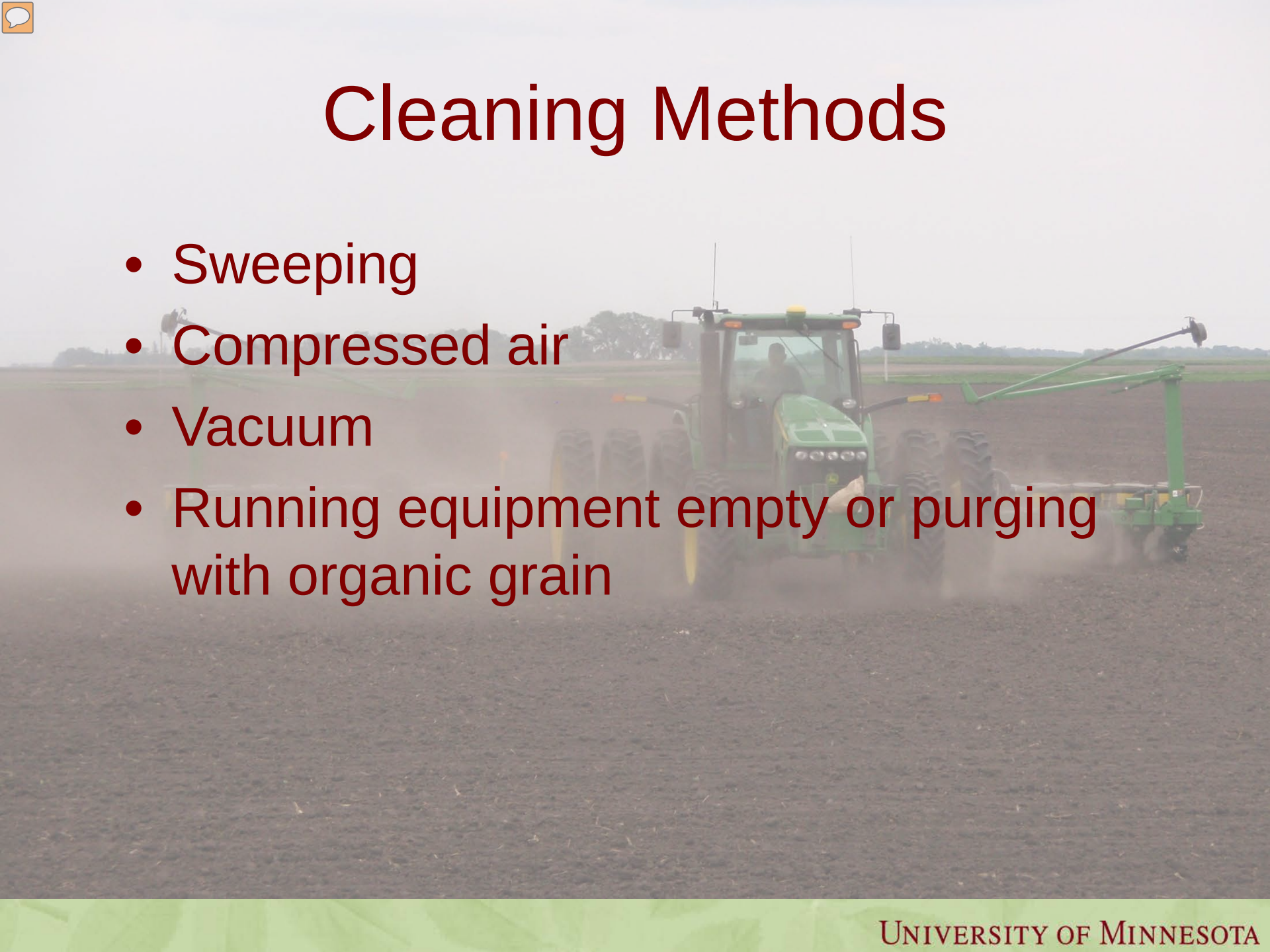
- Use organic seed if commercially available
- Non-organic seed (in transition)
  - Obtain test results
  - Consider third-party non-GMO certified seed

Clean Equipment and Storage

- Your equipment (planters, combines, grain wagons, etc.)
- Custom work equipment
- Grain bins
- Transport equipment (grain carts, semis, augers, elevators, legs, etc.)

Cleaning Methods

- Sweeping
- Compressed air
- Vacuum
- Running equipment empty or purging with organic grain



Clean Equipment and Storage

- Record cleaning and storage procedures
- Save all documents
  - Own equipment
  - Custom operators
- Transport
  - Clean transportation affidavits
  - Bills of lading

Know your buyers

- Find out thresholds or tolerances (none may be specified)
  - Ex. 0.9% for EU
- If selling on contract, know contract requirements regarding GMO rejection levels

Protecting Your Product

A. Know the practices in your supply chain
B. Avoid cross-pollination
C. Monitor

Know Surrounding Area

- Talk with conventional neighbors
- Monitor weeds, field edges for feral plants

Mark Your Organic Land

Separate GMO and Non-GMO Crops

Distance

Time

Separate by Distance

- Field location
- Plant buffers or windbreaks
  - Increased height can sometimes increase effectiveness

Distances Needed to Prevent Cross-Pollination

Crop	Separation distance
Corn	660 feet
Alfalfa (for forage)	1500 feet when alkali or leafcutter bees are stocked as pollinators; 0.5 mile when honeybees are stocked
Canola	660 feet from other canola, 0.25 miles from field mustard

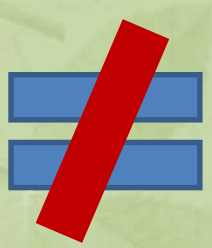
Source: USDA APHIS

Refuge Placement

- For Bt GMO crops
- Request refuge placement to serve as buffer
  - Some Bt products now use “refuge in the bag” rather than structured refuge

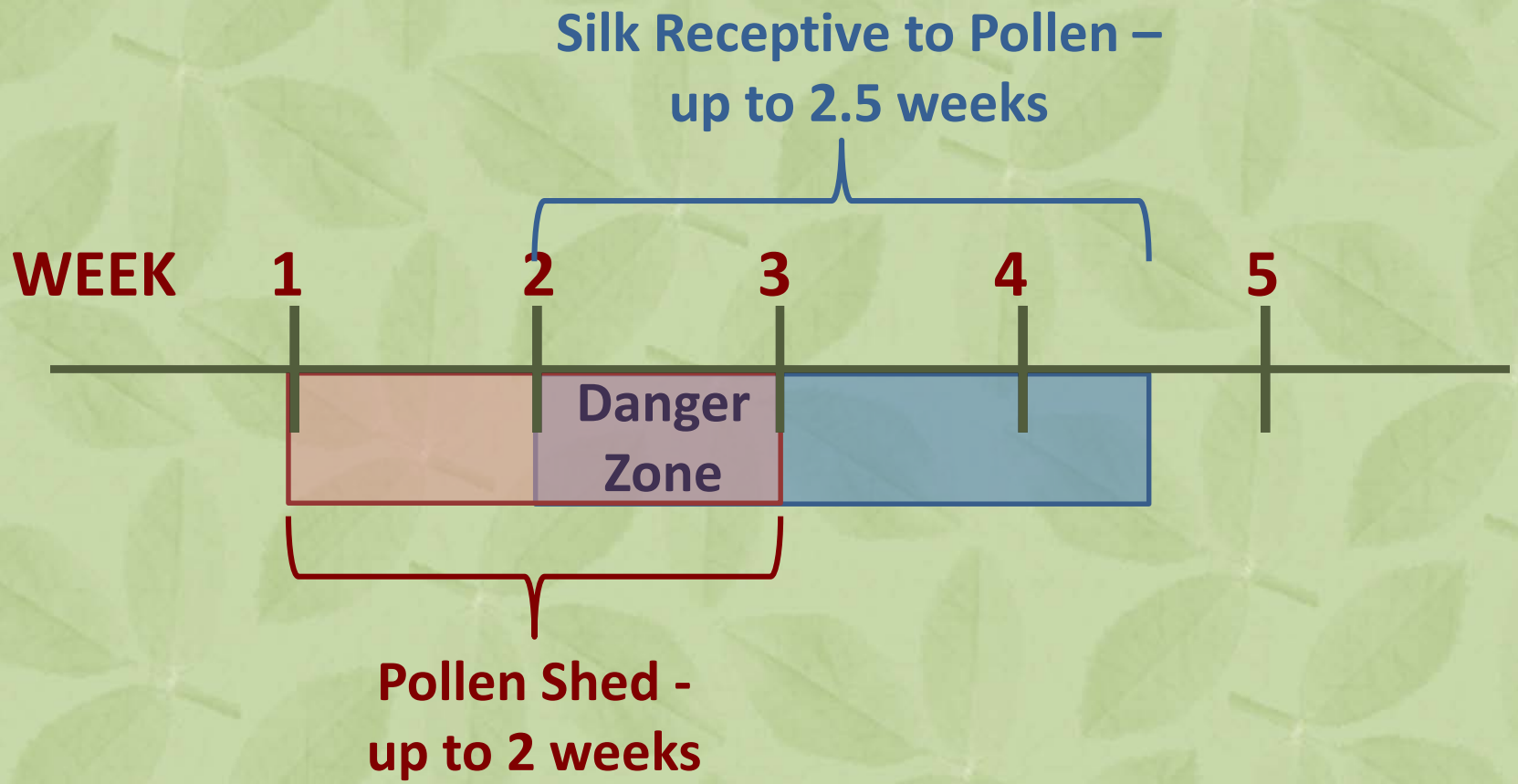
Separation by Time

GMO Pollen Shed



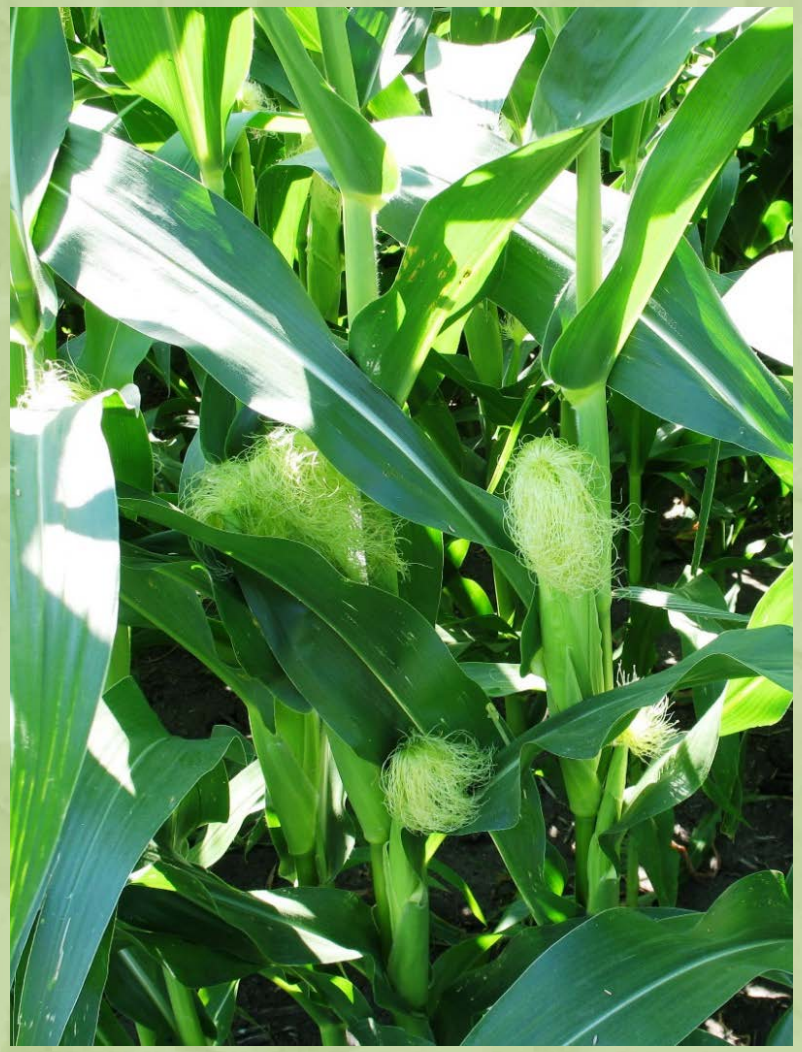
Non-GMO Silking

Separation = Minimum 1 Week, Preferably 3-4 Weeks



Options for Separation by Time

- Stagger flowering times with neighboring GMO crops
  - Different planting dates
  - Different maturities



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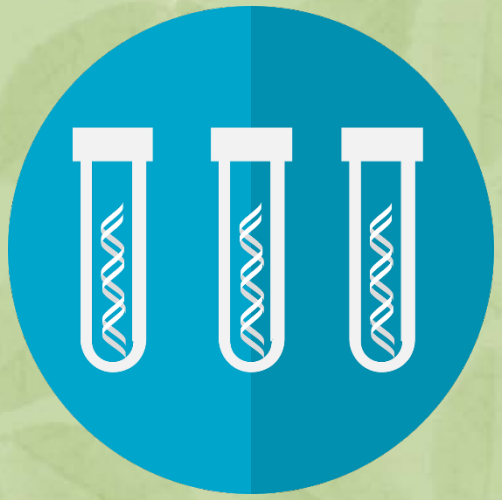
GMO testing

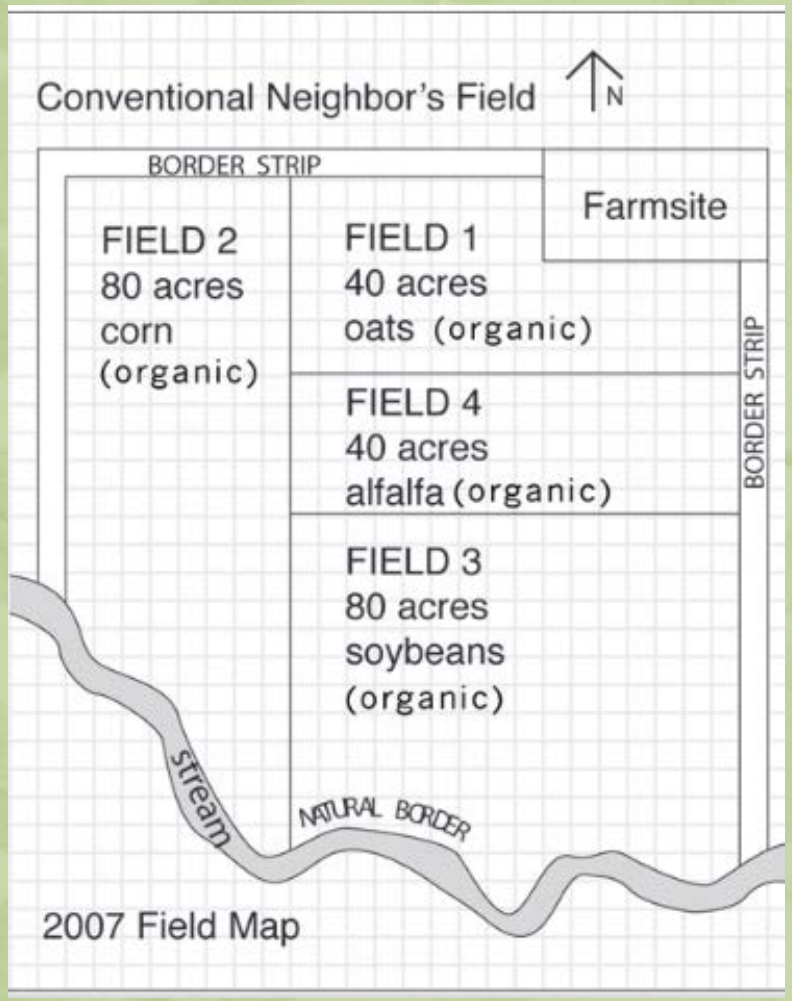
- Test strips
  - Inexpensive
  - Detect single gene of interest



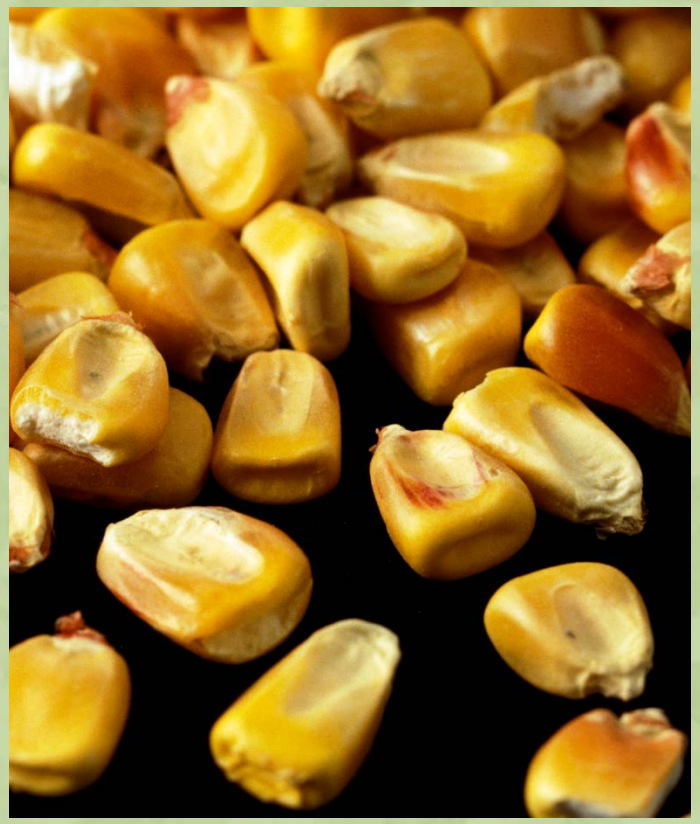
- PCR and ELISA
  - More expensive
  - Lab-based
  - Can be quantitative
  - Detect all commercially available modified genes
  - Used by buyer

Keep Complete Records

- Seed or crop test results
- Production practices
- Seed and input sources
- Equipment cleaning
- Planting records
- Field maps showing buffer zones



Take Samples



- Collect your own samples
  - High- and low-risk parts of field
  - Independently test
- Could help determine how contamination occurred
- Possible to mitigate effects
- Save samples

Non-GMO verification programs

- For seed:
  - Non-GMO Verification Project
  - Safe Seed Pledge
- For crops
  - Non-GMO Verification Project

What to Do if GMOs Are Found

- Request a second test to confirm GMO contamination
- May need to sell crop as conventional

What to Do if GMOs Are Found

- If you suspect pollen drift was a source of contamination

  AND

- GMO crop is registered as a pesticide (e.g. Bt corn)
- Consider contacting state ag department regarding pesticide trespass

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General Resources

- GMO Contamination Prevention: What does it Take? – University of Minnesota
- GMO Contamination webinar – eXtension
- Farmers' Guide to GMOs – Farmers' Legal Action Group (FLAG)
- Coexistence Resources – USDA
- Minimum Separation Distance Guidelines – APHIS
- List of GMO Testing Labs – NonGMO project
- Sample Equipment Cleaning Log – CCOF
- Search for Permitted Materials – Organic Materials Review Institute

Keep Updated on Current GMOs

Lists of current GMOs on the market:

- Non-GMO Sourcebook
- GMO Answers

Status of permit requests for new GMO releases:

- Aphis

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References

Conventional and Non-GMO Policy. Blue River Hybrids Organic Seed, Ames, IA. http://www.blueriverorgseed.com/resources/conventional-non-gmo-policy/144

McEvoy, M. 2011. Policy Memo 11-13: Genetically Modified Organisms. USDA AMS, Washington, DC. https://www.ams.usda.gov/sites/default/files/media/OrganicGMOPolicy.pdf

McEvoy, M. 2012. National Organic Program: Genetically Modified Organism (GMO). USDA AMS, Washington, DC. https://www.ams.usda.gov/sites/default/files/media/GMO%20Policy%20Training%202012.pdf

Moncada, K., C. Sheaffer, J. Coulter, J. Lamb, J. Sackett, and A. Jacobson. 2014. All About Corn: Corn Breeding 3. University of Minnesota, St. Paul, MN. http://www.allaboutcorn.umn.edu/lessons/corn-breeding

Monson, D. 2006. GMOs in agricultural inputs pose risks to organic, non-GMO farms. The Organic and Non-GMO Report, Fairfield, IA. http://www.non-gmoreport.com/articles/may06/gmo_risks_for_organic_farms.php

Neilsen, B. 2016. Silk Development and Emergence in Corn. Purdue University Corny News Network, West Lafayette, IN. https://www.agry.purdue.edu/ext/corn/news/timeless/Silks.html

References (cont.)

Neilsen, B. 2016. Tassel Emergence and Pollen Shed. Purdue University Corny News Network, West Lafayette, IN. https://www.agry.purdue.edu/ext/corn/news/timeless/tassels.html

Organic Seed Growers and Trade Association. 2016. GMO Corn Contamination 101. OSGATA, Washington, ME. http://www.osgata.org/2016/gmo-corn-contamination-101/

Riddle, J. 2004. The Inspector's Notebook #2: Protecting the Integrity of Organic Grains During Harvest. Rodale Institute, Kutztown, PA. http://newfarm.rodaleinstitute.org/columns/inspector/2004/0804/081704.shtml

Riddle, J. 2012. GMO Contamination Prevention: What Does It Take? UMN Southwest Research and Outreach Center, Lamberton, MN. http://www.demeter-usa.org/downloads/GMO-Contamination-Prevention.pdf

Riddle, J. 2015. GMO Contamination: What's an Organic Farmer To Do?. eXtension. http://articles.extension.org/pages/33163/gmo-contamination:-whats-an-organic-farmer-to-do-webinar

USDA. 2016. 2012 Census of Agriculture: Organic Survey (2014). USDA NASS, Washington, DC. http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Organics/ORGANICS.pdf