

Science For A Better Life

Pollinator (Bees) Protection: The Role of Stewardship in Seed Treatments

TPSA Annual Conference, Boise, Idaho

Presented by: Iain Kelly, February 08, 2012

Outline

- Seed Treatment Overview
- Bee Health Status
- Causes of Declining Bee Health
- Bees and Neonicotinoids (seeds)
- Role of Stewardship
- Conclusions

Seed Treatment Overview

Seed Treatment Overview

- Seed treatment technology has been under development since the early 1900's
- Seed treatment and GMO technology are the most focused ways to deliver plant protection products
- Seed treatment offers extensive grower benefits
- Seed treatment offers considerable environmental benefits

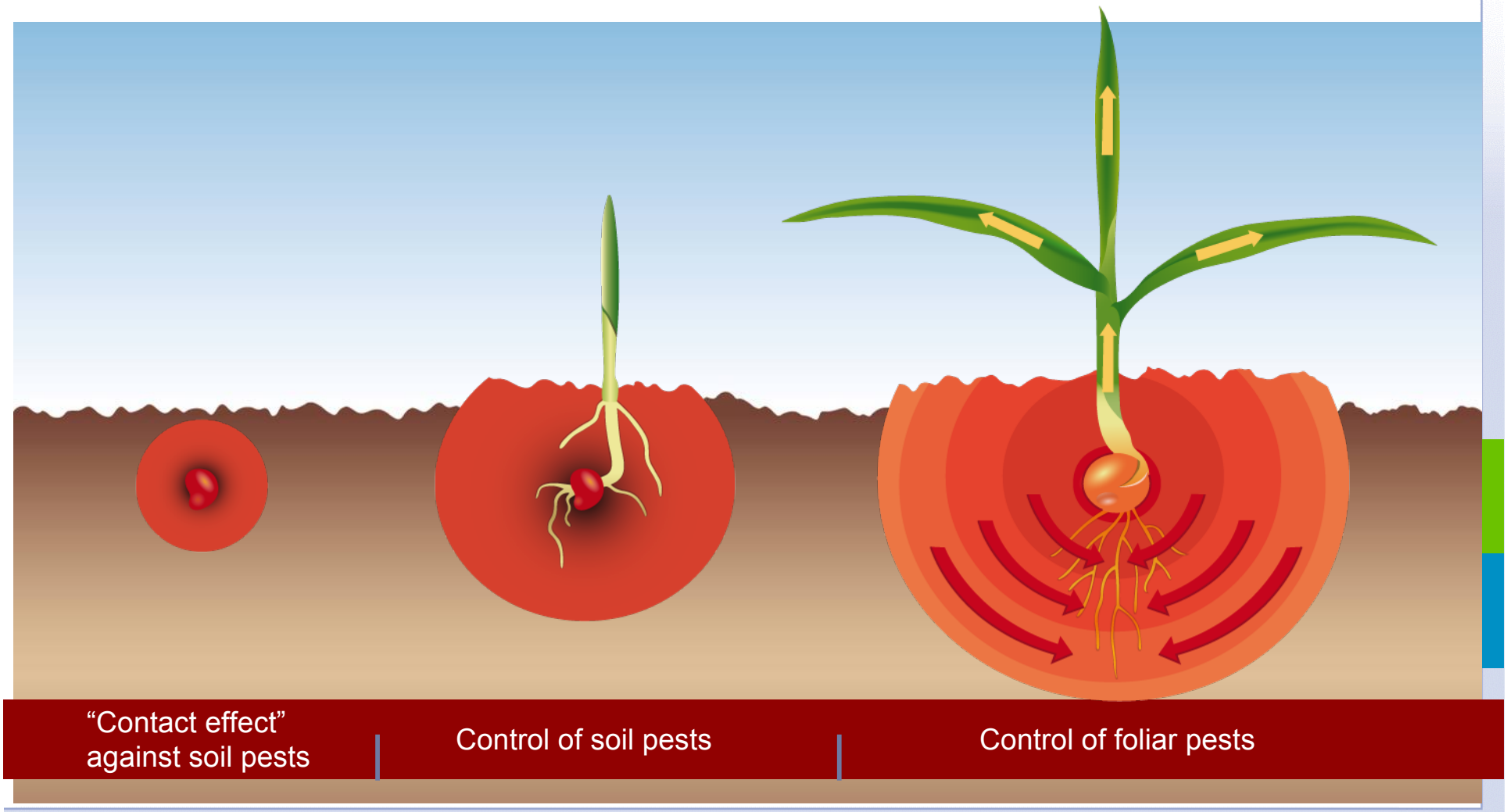
Seed Treatment across the years: dipping technique, around 1930

Evolution of Seed Treatment

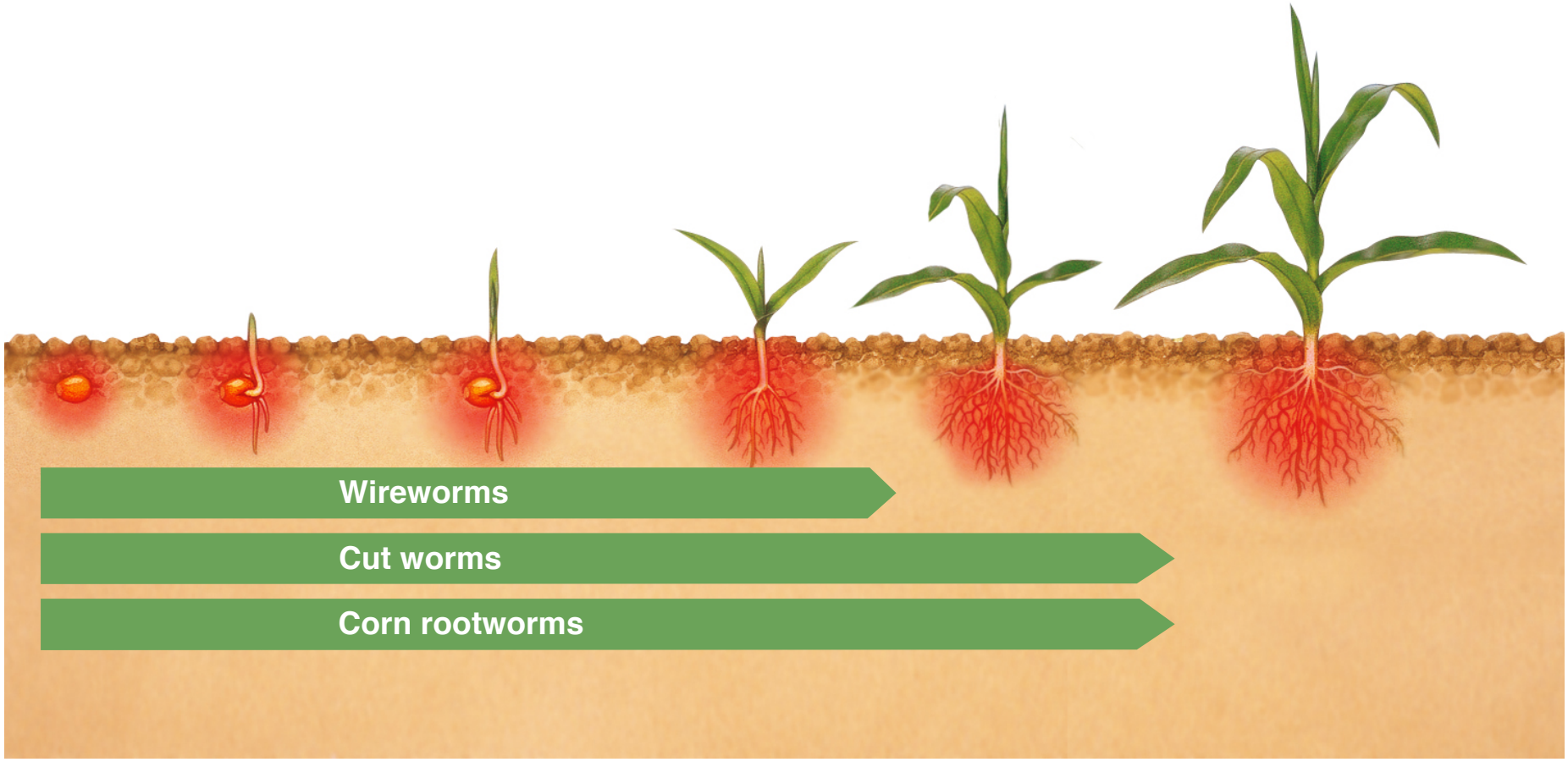
Seed borne	Soil borne	Foliar	Nematode Protection	Application Technology	
Prior to 1980s	1980s	1990 - 2005	2000 - Current	2000- Current	
Primarily seed disinfection	**Seedling protection**	**Plant protection**	**Improved root health**	**In-Plant Handling, Dust Abrasion, Plantability**	**Delivery systems**
Prior to 1980: Dependence on contact fungicides such as captan and thiram and mercury based products. Use of systemics fungicides such as carboxin and chloroneb in the late 1970s.	**1980s** Introduction of low rate highly effective systemic fungicides, e.g., (triadimenol, metalaxyl . First seed treatment herbicide safener developed.	**Early 1990s**: systemic insecticides (**Gaucho®** - imidaclopriid). **2005:** new generations systemic insecticicide (**Poncho** – clothianidin) **Significant Yield Increases**	**2000 – Current** Introduction of first seed treatments that provide protection against nematodes. Abamectin from Syngenta **VOTiVO** (biological) from Bayer CropScience	**Application technology becomes more important** •More seed treatment usage on high value transgenic seed •More product being applied. •Product retention •Handling •Plantability	Adoption of new seed treatment technology has lead to the development of innovative new seed treatment application equipment and coating technology. **New round of Seed Treatment innovation**

Innovation

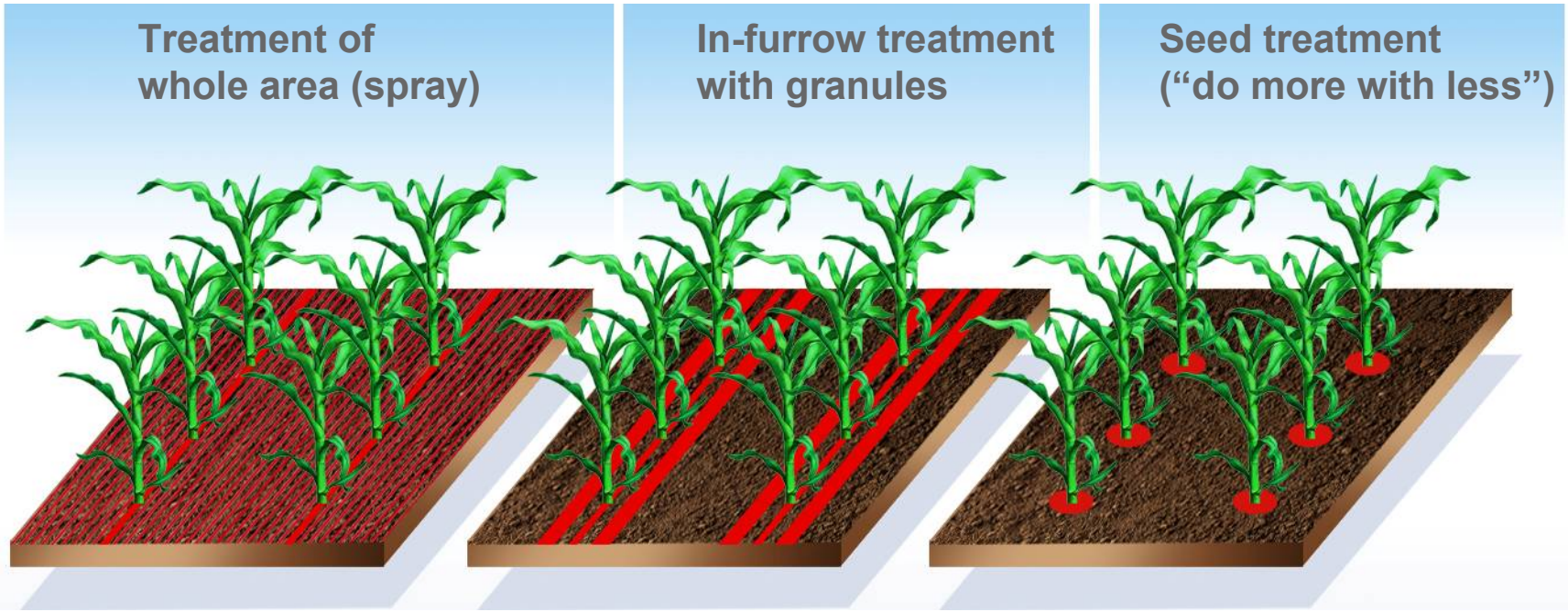
Seed Treatment Benefits
1. Targeted application below surface



Seed Treatment Benefits
2. Protection for the Seed and the Plant



Seed Treatment Benefits
3. Reduction in Rates and Treated Area



Average application rate g active ingredient / ha:

10x 5x 1x

Treated area in m^2:

10,000 500 58

Seed Treatment Benefits
4. Environmental and Human Safety

Reduced spray drift

Reduced exposure to non-target species

Reduced run off

Reduced worker exposure

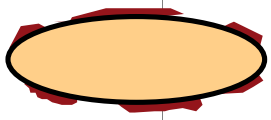
Reduced exposure to preople

Reduced food residues

Seed Treatment Benefits
5. Flexibility and Innovation

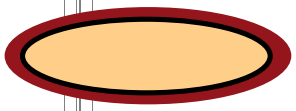
Improved plantability, reduced dust release, targeted delivery

Definitions of main application technologies:



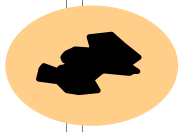
SEED DRESSING

- Application via conventional application machinery
- Simple use (e.g. cereals)



FILM COATING

- Application of a uniform layer which completely covers the seed without changing its shape (e.g. vegetables)
- Can be co-applied with fungicides and insecticides



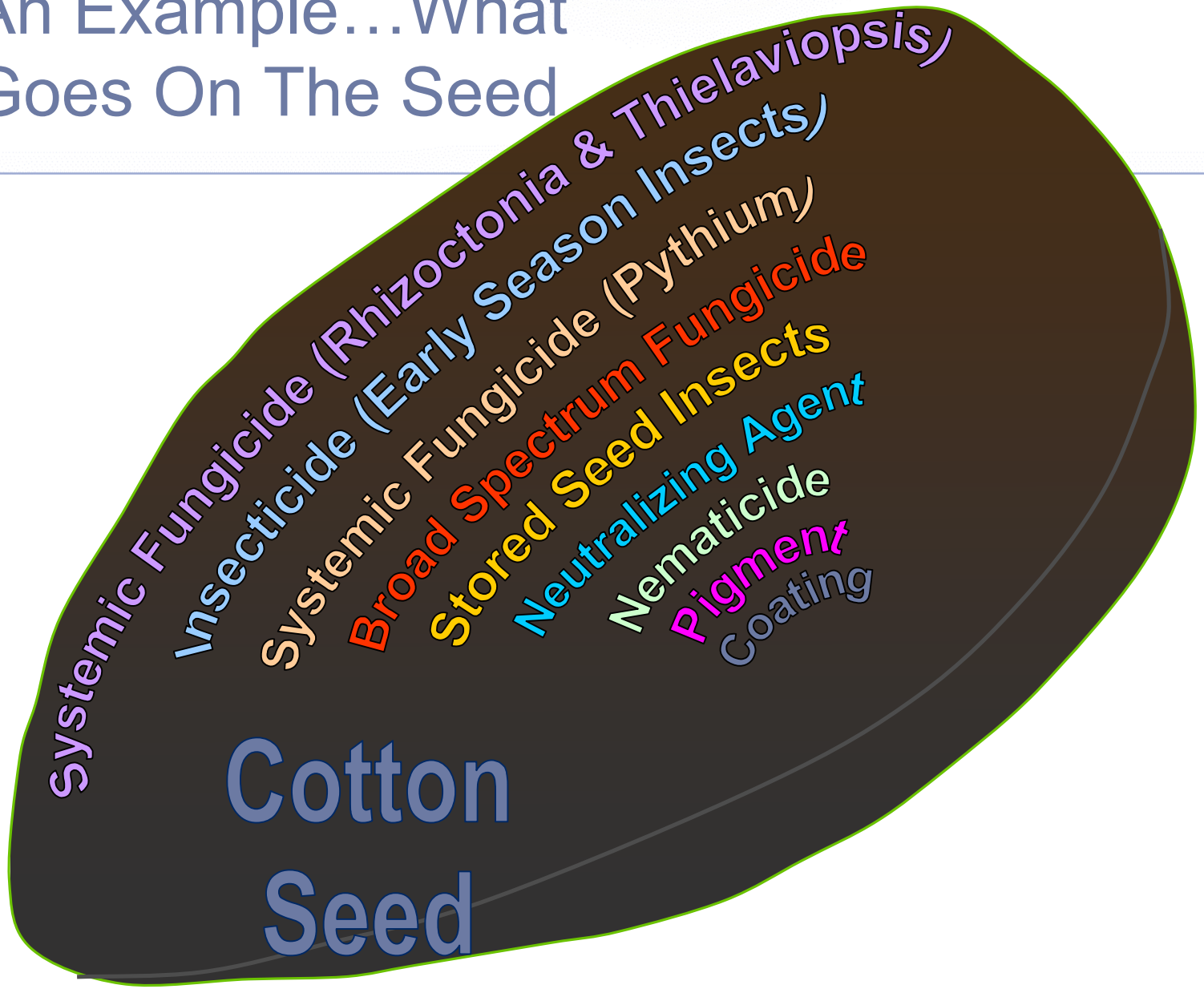
PELLETING

- Application of a uniform layer which completely covers the seed and changes its shape (e.g. sugar beet)
- Fungicides and insecticides can be incorporated

MULTILAYER COATING

- Highly sophisticated method allowing sequential application of multilayer materials
- Including incorporation of fungicides and insecticides

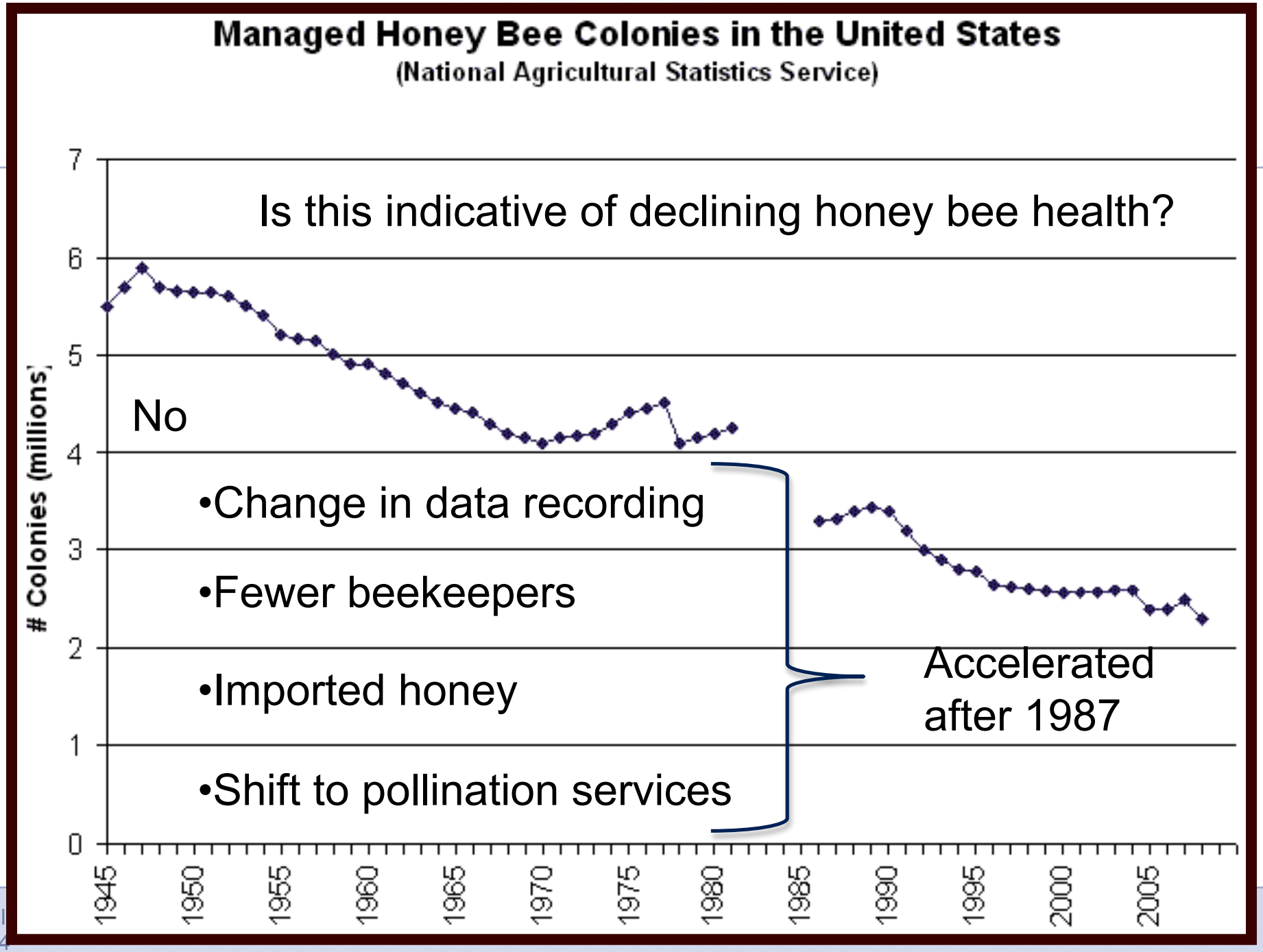
An Example…What Goes On The Seed

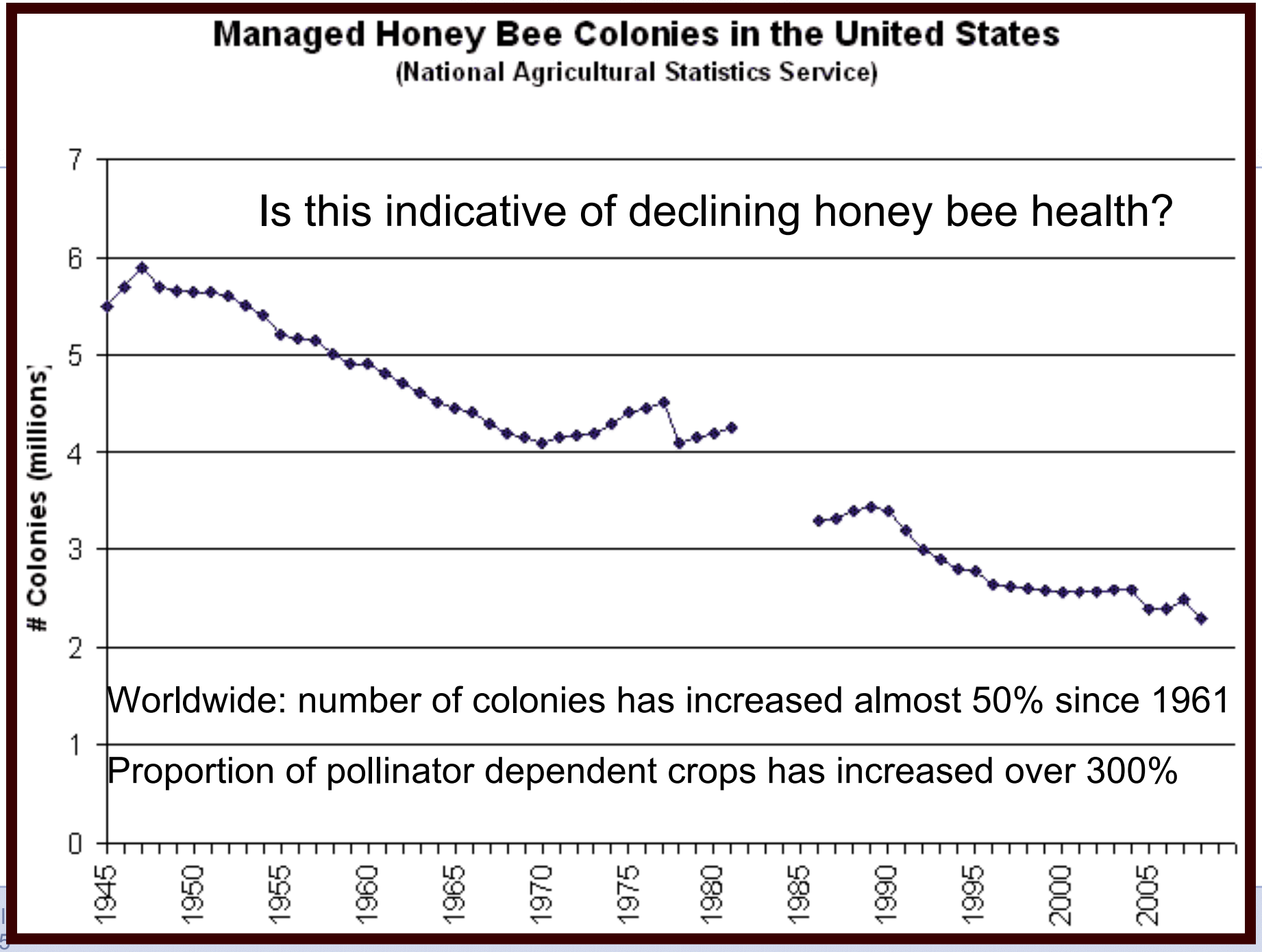


Bee Health Status

Honey Bees: The Sparkplug of Agriculture

- Number of species of bees = 20,000+
  - Number of species of of Apis = 7
    - Number of subspecies of A. mellifera = 28
- Brought to North America early 1600s
- Global movement


Managed Honey Bee Colonies in the United States
(National Agricultural Statistics Service)
Is this indicative of declining honey bee health?
No
•Change in data recording
•Fewer beekeepers
•Imported honey
•Shift to pollination services
Accelerated after 1987
Colonies (millions)
0
1
2
3
4
5
6
7
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

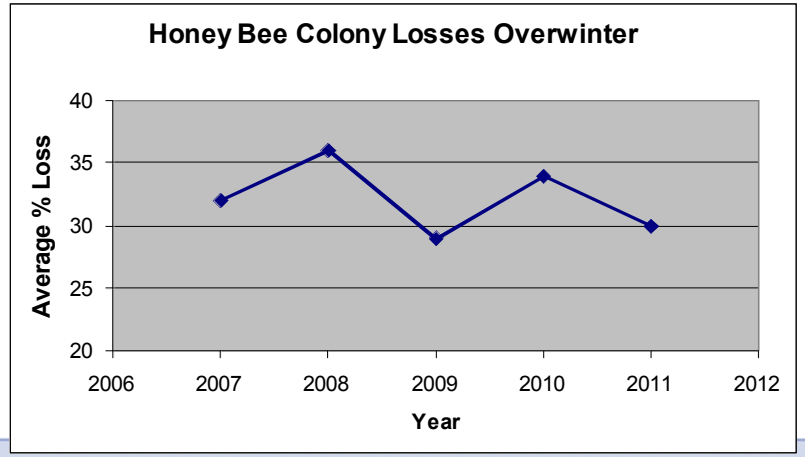

Managed Honey Bee Colonies in the United States
(National Agricultural Statistics Service)
Is this indicative of declining honey bee health?
Colonies (millions)
7
6
5
4
3
2
1
0
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Worldwide: number of colonies has increased almost 50% since 1961
Proportion of pollinator dependent crops has increased over 300%


HONEY & HIVE PRODUCTS
Traditional Honey Bee Industry


POLLINATION
Increasingly important to Honey Bee Industry
Almonds require approximately 1.6 million colonies

Status of Honey Bee Health

- Is honey bee health declining? - YES!
  - Historical winter losses = 10-15%
  - Current average reported losses = 30-40%
  - Losses up to 100% in some apiaries
  - Almost all colonies are showing health issues
- Is this a global issue?
  - More significant in Northern Hemisphere
  - Southern Hemisphere
    - Australia (no Varroa mite)
    - Africanized Honey Bees



Causes of Declining Bee Health

The Beekeepers View

Honey Bee Colony Losses in the U.S., winter 2009-2010*
(2010 – 2011 results similar)

- Responding beekeepers attributed their losses to
  - Starvation 32%
  - Weather 29%
  - Weak colonies in the Fall 14%
  - Mites 12%
  - Poor queens 10%
  - Only 5% of beekeepers attributed Colony Collapse Disorder (CCD) as the major cause

*http://ento.psu.edu/news/2010/losses-2009-10. Dennis van Engelsdorp, Jerry Hayes, Dewey Caron, and Jeff Pettis.

A Word about CCD

Colony Collapse Disorder (CCD):

- Specific set of symptoms
  - Adult worker bees abandon the hive
  - Queen and brood left behind
  - No dead bees

- Symptoms occur in only a small percent of colony loss cases
  - No single causative agent identified
  - Adequate monitoring could identify alternate cause in many cases

The Scientific View

Bacteria

FL → CA → FL → PA → ME → NY → PA → FL

Pests and predators

Fungi

Other factors:
hive management, food, water, toxins, shelter, weather, varroacide resistance

Viruses

The Public View
Confusing Media Coverage

grist 21 April 2011

"His [Dr Jeff Pettis] research shows that neonicotinoids, from pre-coated seeds or treated crops, ooze out through the nectar, pollen, and water of plants like cotton and corn. Honeybees and other natural pollinators eat it, and even undetectable amounts most likely weaken their immune systems and make them susceptible to harmful pathogens they would be able to fight off when healthy."

Channel 4 News 4 April 2011

"The lab study certainly seemed very clear that low levels of pesticides were impacting on honey bee health. But when we look in the field we don't see the same results. Even when colonies that were exposed to low levels we're not seeing outbreaks of the gut parasite pathogen that we saw in the lab," said Dr Jeff Pettis of the US Agricultural Research Service.

http://www.grist.org/industrial-agriculture/2011-04-21-usda-bee-scientist-pesticide-research-pettis

http://www.channel4.com/news/bee-decline-not-caused-by-pesticides

Science vs. Perception

Belief that because insecticides are toxic to insects they must be affecting colony health

- Toxicity DOES NOT equal risk
- Risk = Hazard (Toxicity) x Exposure

Key Concepts

- The *toxicity* of a pesticide remains constant regardless of its use
- The *exposure* to a pesticide is dependent on the conditions surrounding its use
- The *risk* associated with using a pesticide can only be reduced *(mitigated)* by decreasing the potential for exposure

Bee Health and Neonicotinoid Seed Treatment

The major class of seed treatment insecticides has been alleged to be a factor in declining bee health

Neonicotinoid Seed Treatments

Benefits to agriculture or risk to bees?

Importance of Neonicotinoids ST

A total of 147 million USA acres are planted with neonicotinoid-treated seeds.

2010 Seed Treatment**	
	% of Total Acres Planted with Treated Seeds
CROP	Total Neonicotinoids (Clothianidin, Imidacloprid, Thiamethoxam)
CANOLA	100%
CEREALS	42%
CORN	94%
COTTON	42%
RICE	51%
SORGHUM	75%
SOYBEANS	32%
SUGAR BEETS	65%

* *CTN 2010 Seed Treatment Market Report.

Value of Neonicotinoids to Corn Growers

- Most (94%) seed corn in the U.S. is treated with neonicotinoids
- Yield increase of 6 to 14 bushels per acre
- Value to the U.S. economy: $2 - $5 billion
- 3.3 million production acres required to replace the lost yields

Neonicotinoids and Bees - France

1992 Imidacloprid approved for use in France

1995 Claims that there may be a relationship between bee mortality and the use of imidacloprid

1999 Imidacloprid use on sunflowers suspended

2004 Imidacloprid use on maize suspended

2007 - French food safety authority (AFSSA) reports that bee losses are due to a multitude of factors

French Minister of Agriculture admits that identical bee deaths seen in regions where imidacloprid had not been applied

2008 AFSSA reports of no statistical correlation between bee deaths and imidacloprid residues in pollen

2009 New AFSSA study identifies the *Varroa* mite as the main cause of bee death. Confirms that it is not possible to confirm that pesticides play any direct or indirect role in bee mortality

2009 French regulators start to approve neonicotinoids uses again

Neonicotinoids and Bees - Canada

- Virtually all canola seed used in hybrid seed production is treated a neonicotinoid (thiamethoxam or clothianidin)
- Commercial beekeepers bring large numbers of bees to the canola fields each year for pollination
- No effect on bee colony health has been reported by these beekeepers due to this production process

Neonicotinoids and Bees - Canada

Overwintering losses (%) in Canada [1]

Province	2007	2008	2009	2010
British Columbia	23	38	24	24
***Vancouver Is.*[2]**	--	*43*	*40*	*73*
Alberta	31	44	44	18
Saskatchewan	24	26	25	21
Manitoba	27	28	30	26
Ontario	37	33	31	22
Quebec	30	19	32	22
Nova Scotia	20	18	29	42
New Brunswick	59	29	43	20
PEI	29	36	40	17
Canada	**29**	**35**	**34**	**21**

[1]From CAPA annual reports, 2007 - 2010
[2]Vancouver Island info included in British Columbia average, not Canada average

National long term average: approx. 15%

High losses do not correlate with seed insecticide use

Neonicotinoid and Bees - Field Studies

2000 Study 1: Scott-Dupree (U. of Guelph) and Spivak (U. of Minnesota)

- Evaluated: brood development, foraging activity, mortality and honey yield.
- Findings: No adverse effects

2007 Study 2: Cutler and Scott-Dupree (U. of Guelph)*

- Similar to previous study, but with longer study duration.
- Evaluated: brood development, mortality, worker longevity, weight gain and honey yield.
- Findings: No adverse effects

Conclusion: Risk is minimal under real field conditions

*J Econ Entomol. 100(3):765-772 (2007)

Neonicotinoids and Bees - U.S.

- EPA (Feb 2011)[1] commented on claims related to bee health and clothianidin, that the Agency is:

  "…not aware of any data that reasonably demonstrates that bee colonies are subject to elevated losses due to chronic exposure to this pesticide."

- U. of Georgia[2] (Sept. 2011) reported on the Managed Pollinator CAP:
  - 17-member consortium of university and federal bee labs
  - $4.1 million, 4 Year Budget
  - Conclusions from Final Year (2011 -2012)
    - The importance of Varroa is increasingly clear
    - Close proximity of colonies to agricultural lands generally predicts poor bee health
      - Relationship is not necessarily associated with pesticide residues
      - Chief risk is more likely to be old chemistries
      - Not the newer neonicotinoid systemics

[1] http://www.epa.gov/opp00001/about/intheworks/clothianidin-response-letter.pdf
[2] http://www.ent.uga.edu/bees/documents/GBL-Sept2011.pdf

The Role of Stewardship

If Neonicotinoids are Not the Cause of Declining Bee Health Why is Stewardship Important?

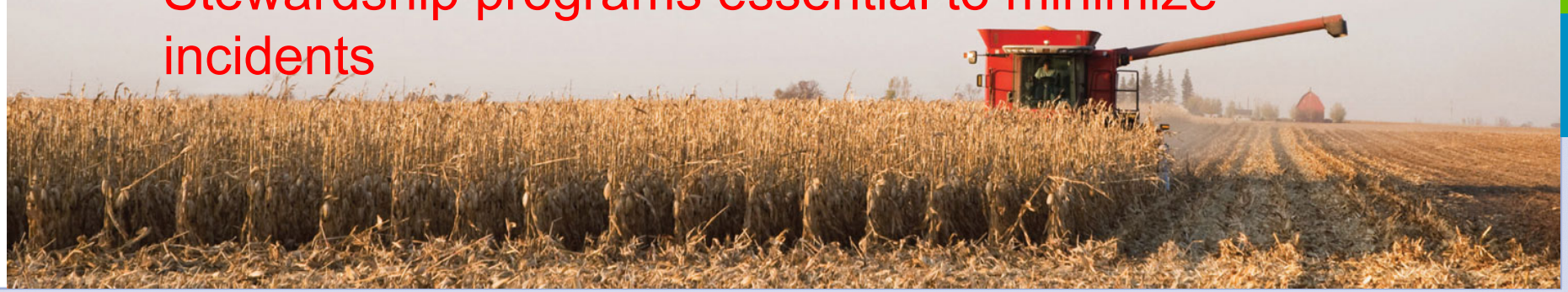
Acute versus Chronic Risk

- Data shows that neonicotinoids are not the cause of declining bee health
- But ACUTE incidents do occur and lead to increased public concern e.g. April 2008: 11,500 bee colonies suffered losses in Upper Rhine Valley in Germany:
  - For some seed batches, the application quality and use of film coatings was substandard leading to higher dust levels
  - Most of the pneumatic vacuum planters used in the Upper Rhine Valley exhaust the emissions upward or to the side.
  - Later than normal planting window
  - Small field sizes (≤10 acres) in close proximity to flowering crops (canola)
  - Dry weather and windy conditions led to dust drift

Acute Risk– U.S. Agriculture

- In 2010, **one** incident in USA involving a few hives (acute effect only) for >86-million acres of neonicotinoid-treated corn planted.
- In 2011, no recorded incidents despite a wet spring conducive to flowering weeds in fields (possibly one in Northern IN)
- This extremely low incidence attributed to:
  - Agronomic landscape
    - large fields; herbicide usage; lack of intensive flowering crops immediately adjacent to planting)
  - Appropriate seed coating

Stewardship programs essential to minimize incidents



Components of a successful seed treatment stewardship program

- All aspects of the process requires appropriate stewardship
  - Treatment of seed
  - Testing of seed
  - Seed treatment equipment
  - Labeling of seed bag tags
  - Transport of treated seeds
  - Planting
  - Disposal

Stewardship in Seed Treatment

Factors influencing seed treatment quality

Seed material
- Purity
- Calibration/sizing
- Dust properties

Equipment
- Type (batch/continuous)
- Monitor treatment process
- Dosing system (vol./weight)
- Operator safety

Quality of Seed Treatment

Product formulation
- Concentrated
- Stable
- Good adhesive properties
- Safe to seed

Slurry recipe
- Liquid volume
- Film coatings
- Colorants
- Miscibility

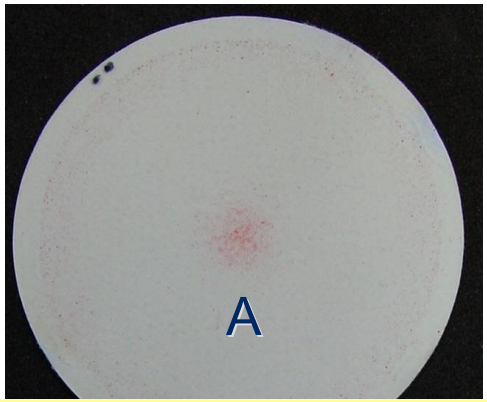
Quality control
- Dust abrasion
- Loading analysis
- Seed-to-seed distribution
- Plantability

optimized products

customized solutions

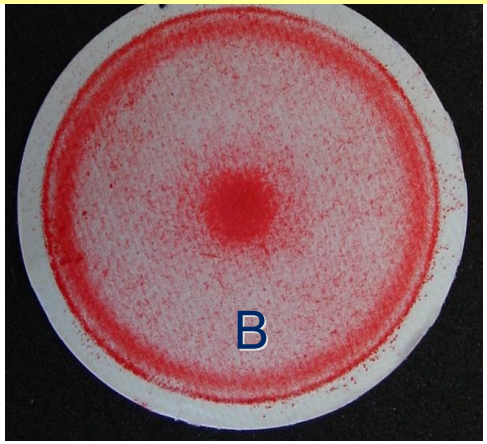
Standard Test for Dust-Abrasion

Heubach Test

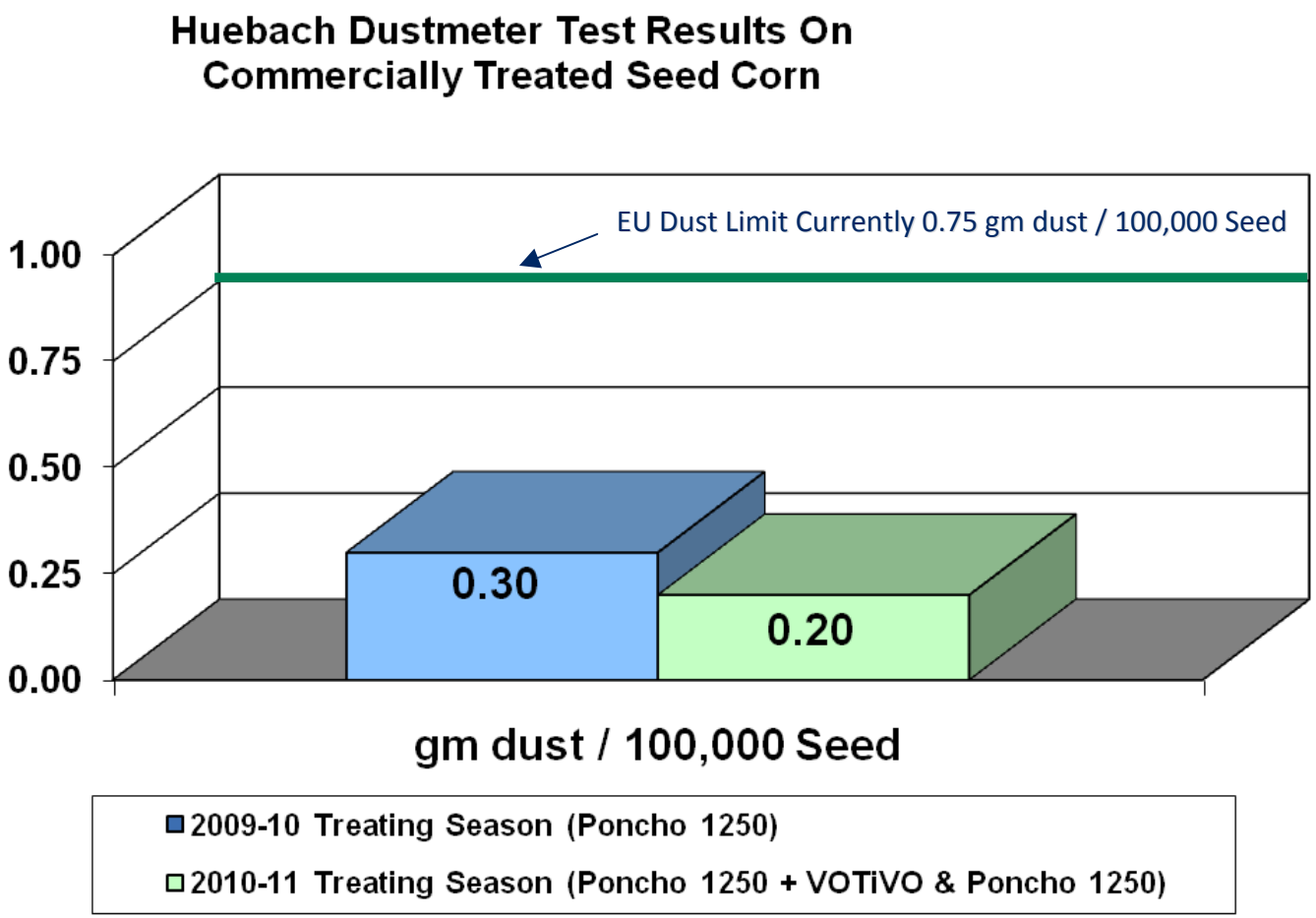


A: Good ST quality sample (BCS recommended recipe)

B: Bad ST quality sample from affected area in SW-Germany



Heubach Dust-Off Results
Seed Finisher Coating on Dust Attrition of Corn



Seed Treatment Stewardship
Appropriate Equipment

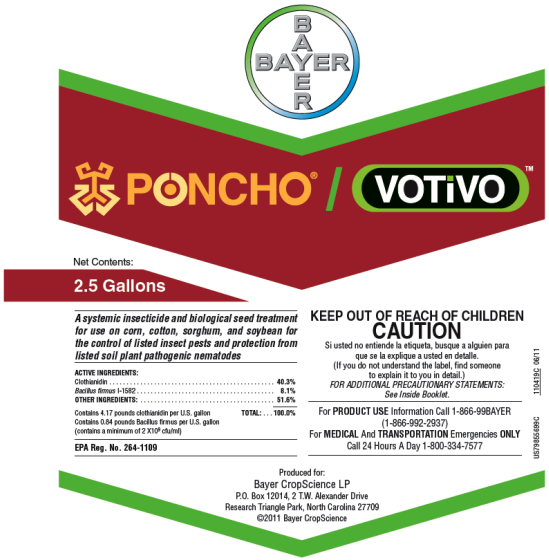
- With On Demand™, growers can have greater assurance that seed treatments are being applied correctly, consistently, and according to labeled rates
- A closed system that includes pre-loaded bulk chemical kegs, eliminating inaccuracies caused by traditional hand mixing
- Reduced environmental and human exposure
  - Less exposure to the formulator
  - Produce only required amounts

Stewardship in Seed Treatment

Labeling of Seed Bag Tags

For your own safety and to protect the environment, the following precautions must be observed:

- Do not use treated seed for human or animal consumption or for processing.
- Keep out of reach of children, livestock and wildlife.
- Store under appropriate conditions
- Signal Word (i.e. Caution)
- Wear protective clothing and gloves. Avoid contact with skin and respiratory tract during seed handling and equipment cleaning.
- Do not reuse empty seed bags for other purposes than storing the original treated seed
- Plant-back intervals / grazing restrictions
- Appropriate contacts In the event of overexposure, e.g.
  - Bayer CropScience Product Emergency Number (800-334-7577)



Stewardship in Seed Treatment

Storage and Transport of Treated Seed

Treated seeds must be protected against damage

- Avoid mechanical damage to treated seed
- The storage area must:
  - Have sufficient lighting and ventilation
  - Storage area should be dry and secure
- Seeds must be transported in a way that none are spilled on the highway/ground
- If spills occur, treated seed should be properly disposed of to prevent exposure to humans or the environment
- Appropriate contacts In the event of spills, accidents or emergencies, e.g.
  - Bayer CropScience Product Emergency Number (800-334-7577)

Stewardship in Seed Treatment
Before Planting

Before Planting

- When opening seed containers and during filling or emptying of the planting machine, avoid dust exposure.
- Avoid loading dust from the bottom of the seed container into the planting machine.
- Follow planter manufacturer recommendations for use of talc or graphite.

Stewardship in Seed Treatment

At Planting

At planting:

- Avoid off-site movement of dust from treated seeds during planting. Be aware of wind speed and direction.
- To protect birds and mammals, treated seeds must be incorporated into the soil at proper planting depth, in particular at row ends and field corners.
- Be aware of the presence of flowering crops in or adjacent to the field which could attract pollinators. Take appropriate precautions by following best management practices.

Stewardship in Seed Treatment

Seed Bag Storage or Disposal

After planting:

- Ensure that any left over treated seed is returned to the original containers
- Do not reuse empty seed containers for other purposes than storing original treated seed
- Dispose of empty bags or seed bins according to regulations and container return policies
- Cover all treated seeds in the field by incorporating into the soil at proper planting depth, in particular at row ends and field corners

Conclusions

- Seed treatment is an invaluable tool in modern agriculture with many beneficial attributes
- The assumption by many individuals that pesticides, including seed treatments, are the cause of declining bee health is not supported by the science
- Bee health is declining due to multiple factors
- Good stewardship is essential to protecting seed treatments as valuable crop protection tools
- Industry is committed to working with beekeepers, growers, government agencies and other stakeholders to improve bee health


Thank You!
Questions?