Overview of Seed Treatment Technology and Stewardship

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Outline

- What are seed treatments and why do farmers use them?
- How do you know if seed treatments work? What data are available?
- How are seed treatments regulated? What do the EPA pollinator risk assessments tell us about seed treatments?

What are seed treatments? What goes in a recipe?

Dye/Colorant
Seeds need to be colored by law so that they don't enter the food chain.

Polymer/Binder
Adheres active ingredients to the seed, controls release. Improves appearance, plantability and handling.

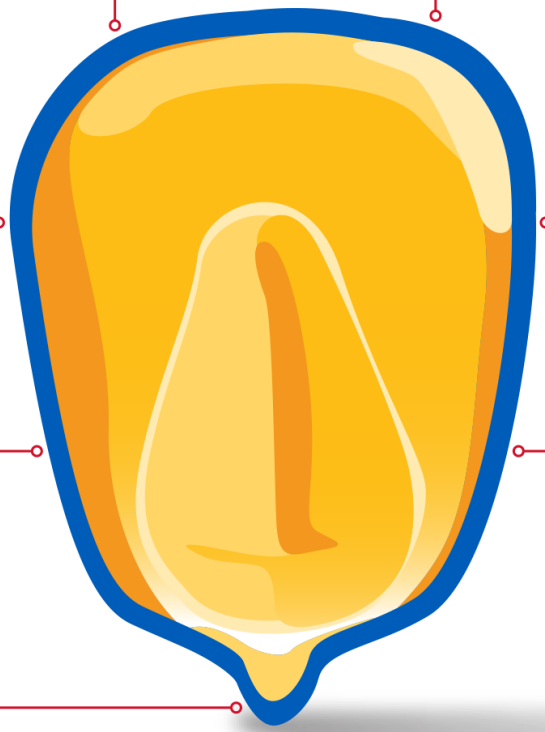
Biologicals
Enhance germination and vigor, and opportunities for pest and disease control.

Inoculants
Enhance nitrogen fixation.

Nematicides
Protection from nematode damage during early stages of plant growth.

Insecticides
Protection from insect damage during storage, in the soil and/or during early stages of growth (post emergence).

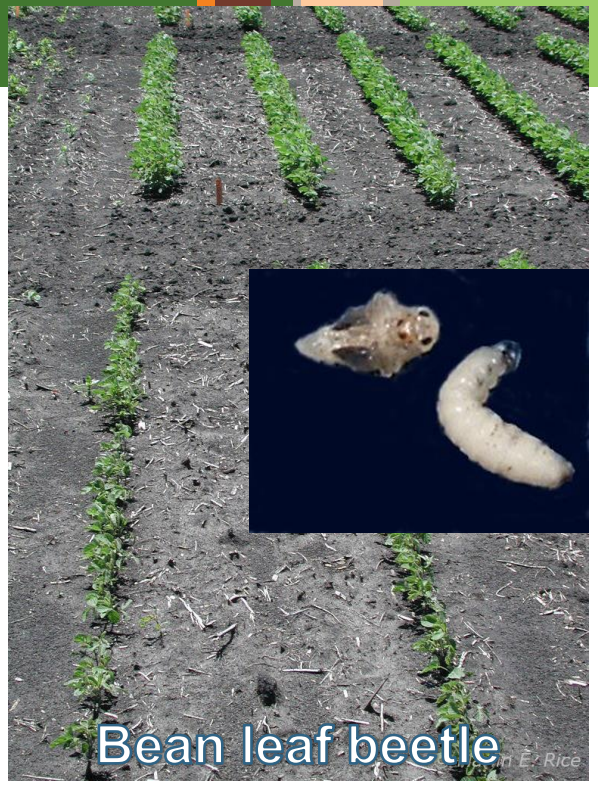
Fungicides
Protection from disease damage during storage, in the soil and during growth of the plant.

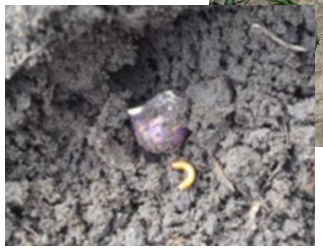


Why do farmers use seed treatments?

- Planting early
- Ease of handling and use, safety
- Integrated Pest Management
  - "Rescue" treatments are not an option for some pests
- Seedling/stand establishment and vigor
- Prevent disease transmission (seed, soil or vector-borne)
- Prevent predation/feeding on seed and seedling
- Yield benefits

- Examples of early season pests and diseases:
  - Corn: Black cutworm, wireworm, "white grubs," seed corn maggot, "seedling blights" (*Pythium*, *Fusarium*, *Rhizoctonia)*
  - Soybean: bean leaf beetle, seed corn maggot, "seedling blights" (*Phytophthora*, *Pythium*, *Fusarium*, *Rhizoctonia)*

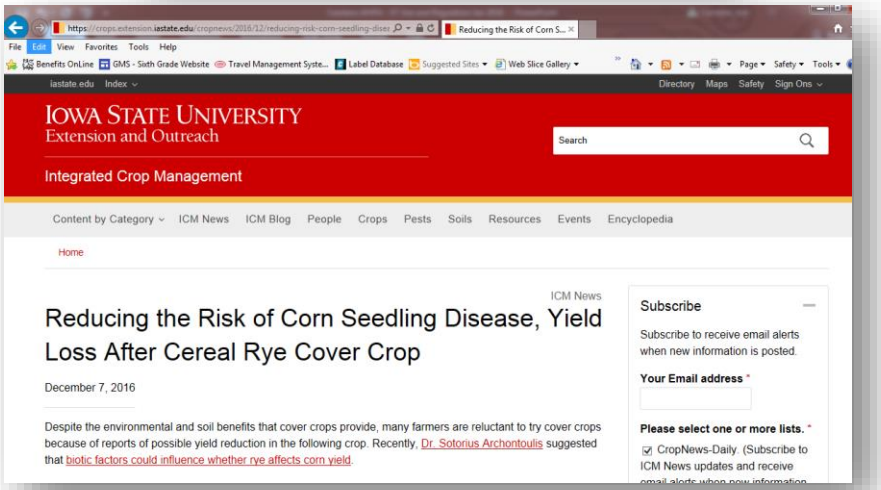


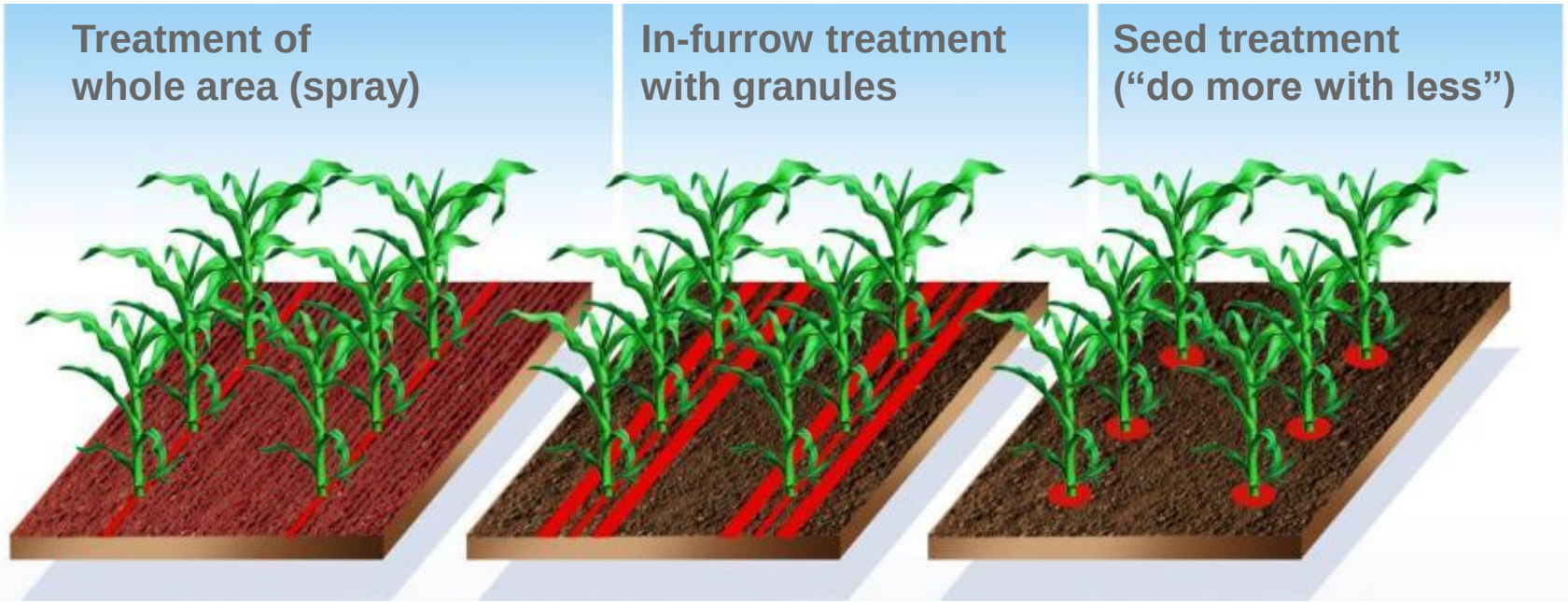


Source: A. Goggi, Iowa State University. 2011. Evolution, purpose and advantages of seed treatments. Seed Congress of Americas

Factors that influence early season pest and disease pressure

- Soil type
- Soil moisture, drainage and irrigation
- Planting date
- Planting density/seeding rate
- Manure application on-field or nearby
- Cover crop history
- Tillage type
- Prior cropping history
- Weed pressure
- Neighboring crops/plants
- Genetics of hybrid/variety
- Pest/disease history





- 1% of a field is treated compared to broadcast spray

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How do we decide what to offer?

Seed treatments undergo thorough evaluation before being commercialized

P Plantability: Does it plant as well as or better than our current product(s)?

A Application: Does it adhere to the seed well (e.g. polymer usage)?

S Stewardship: Is it a sustainable solution for our customers?

S Seed Safety: Does it affect germination?

E Efficacy: Does it perform?

R Regulatory: Is it in compliance?

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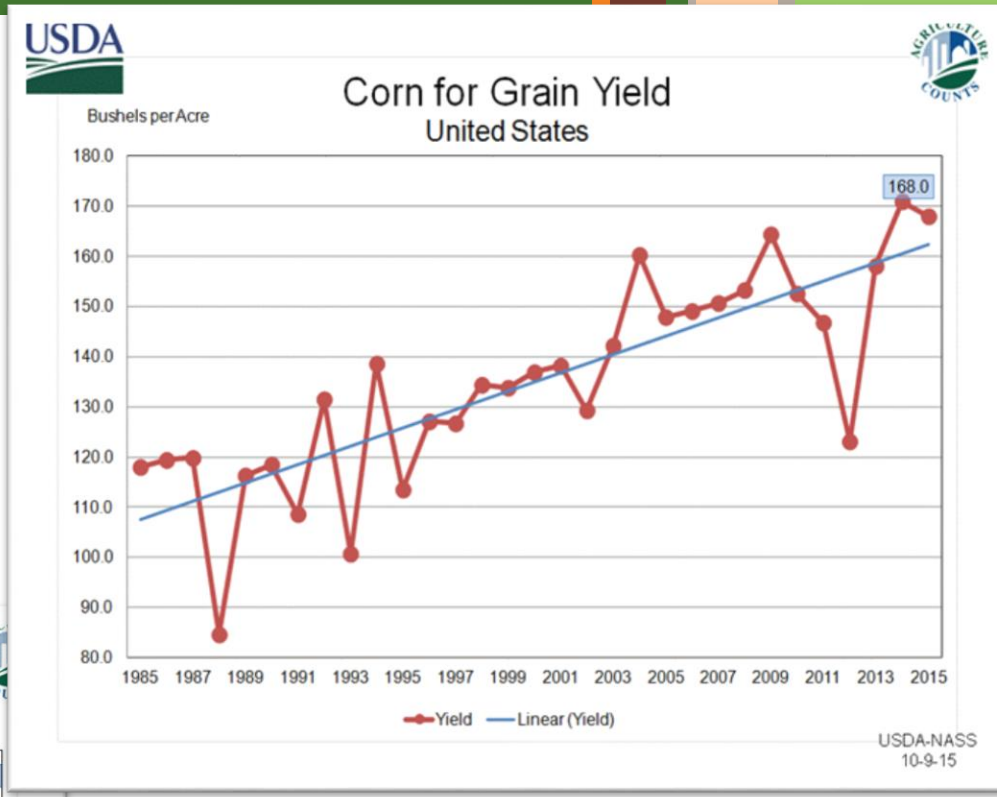
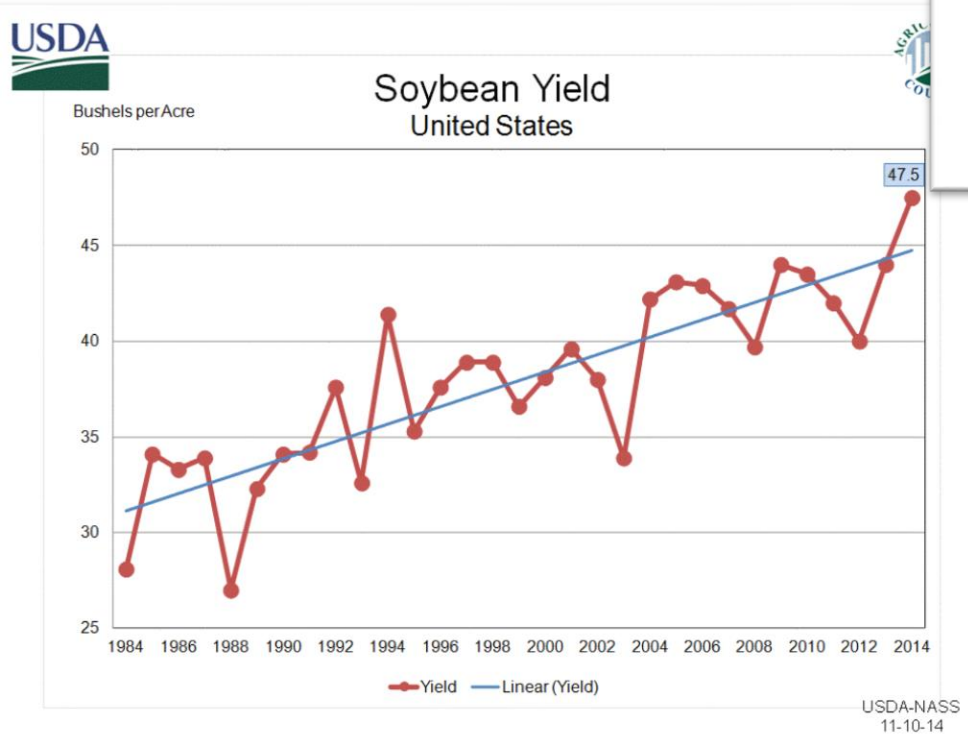
What yield improvement is important to a farmer?

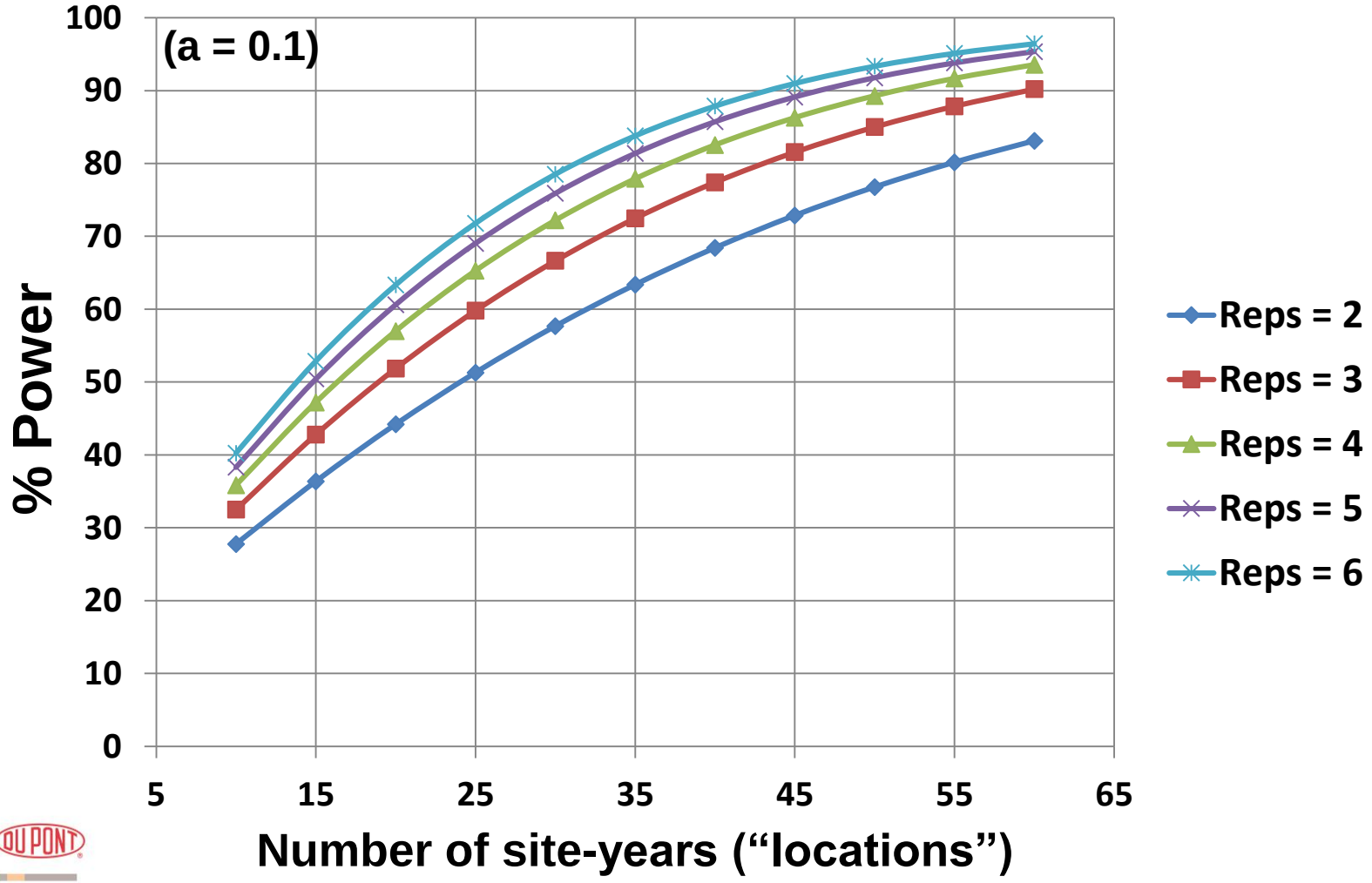
- 2 bu/acre for corn
- 0.5 bu/acre for soybeans



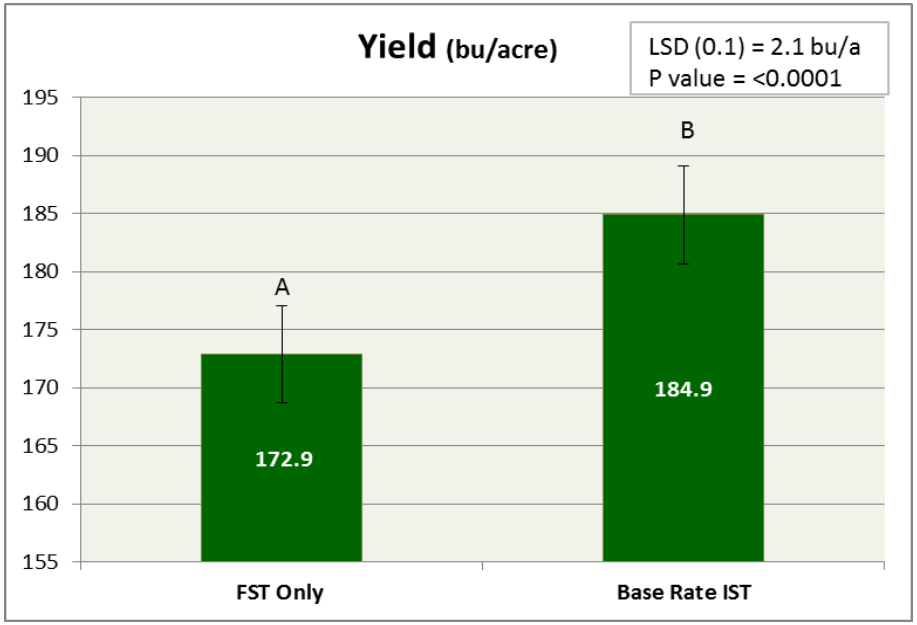


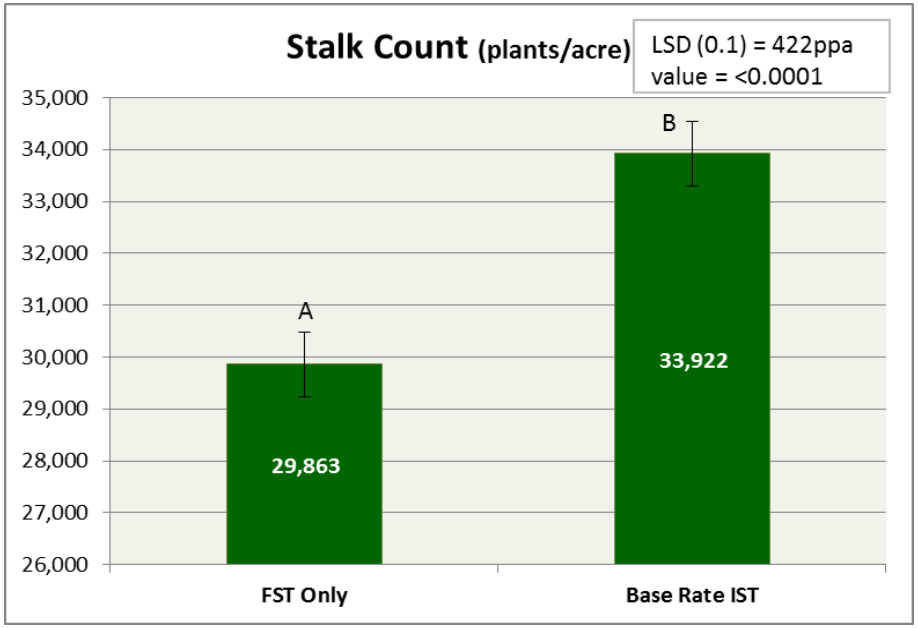
Trial considerations – early planting, power analysis

EXAMPLE: Detecting a yield difference of <u>>0.8 bu/acre</u> for an experimental soybean seed treatment



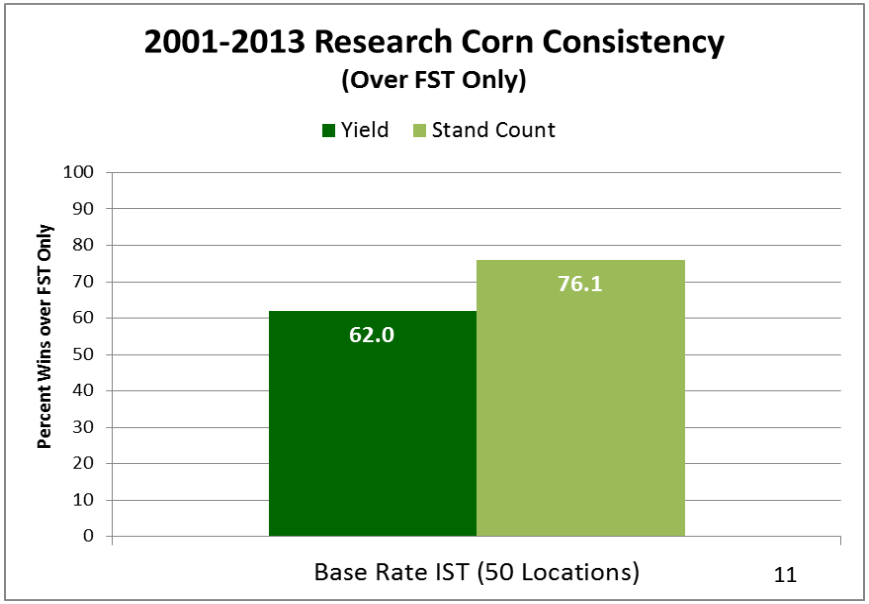
Corn Seed Treatment – Average Insect Pressure



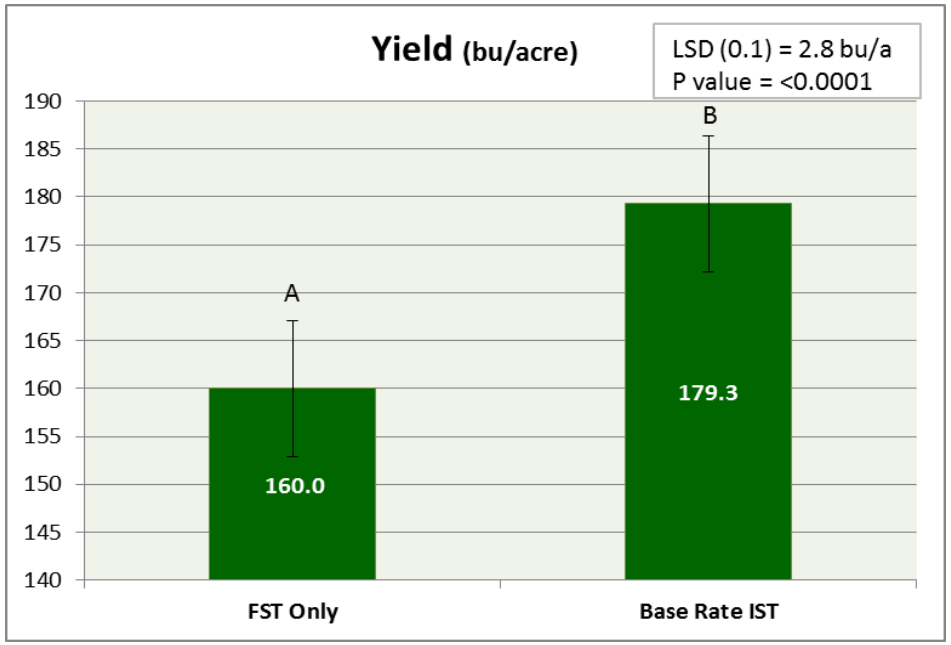


Yield protection: 12 bu/acre grain 11% silage

- Research studies from 2001 to 2013
- 50 locations and >10 years
- Average insect pressure including: wireworm, white grub, seedcorn maggot & corn rootworm
- Base rate IST is the recommended for early season pests

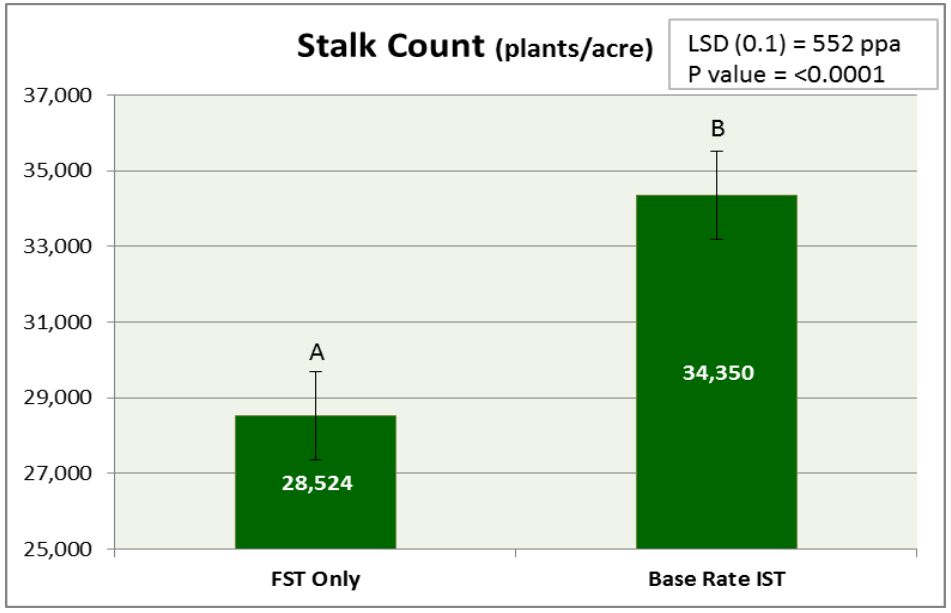


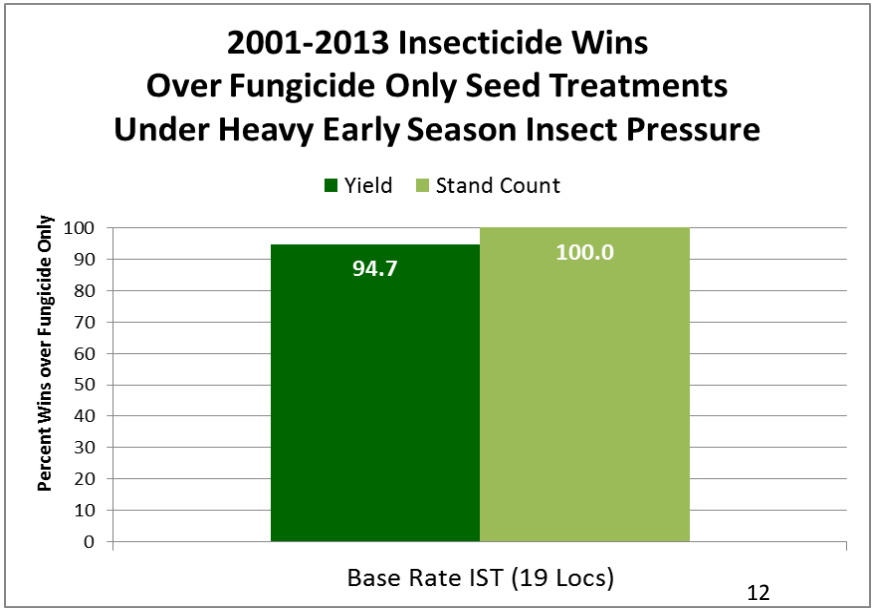
Corn Seed Treatment—Heavy Insect Pressure



Yield protection: 19 bu/acre grain 17% silage

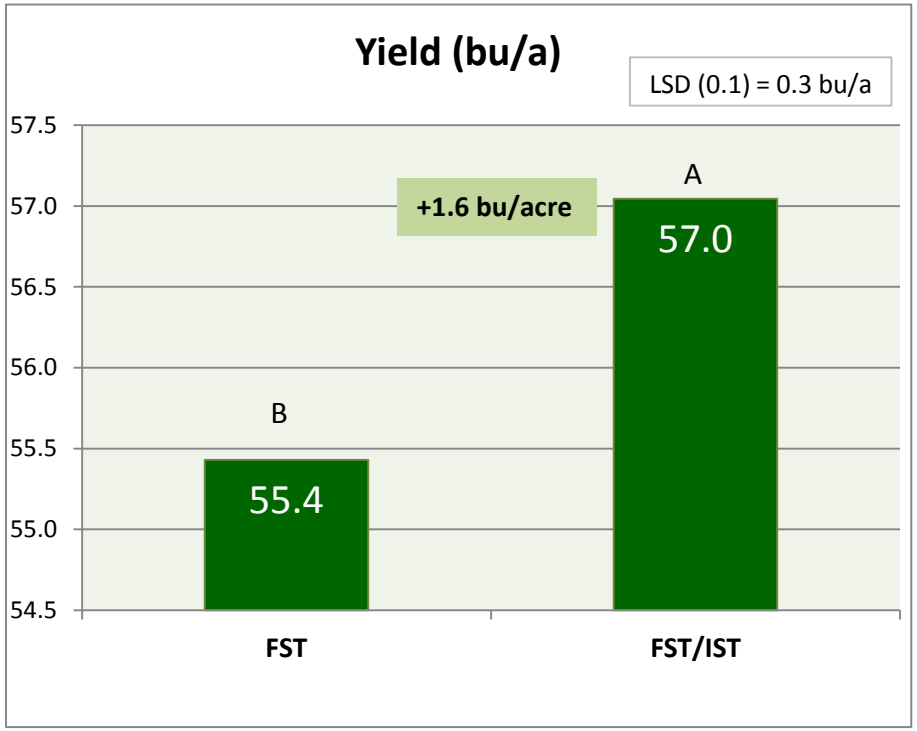
- Research studies from 2001 to 2013
- 19 locations and >10 years
- Heavy early season insect pressure including:
  - wireworm, white grub, seedcorn maggot



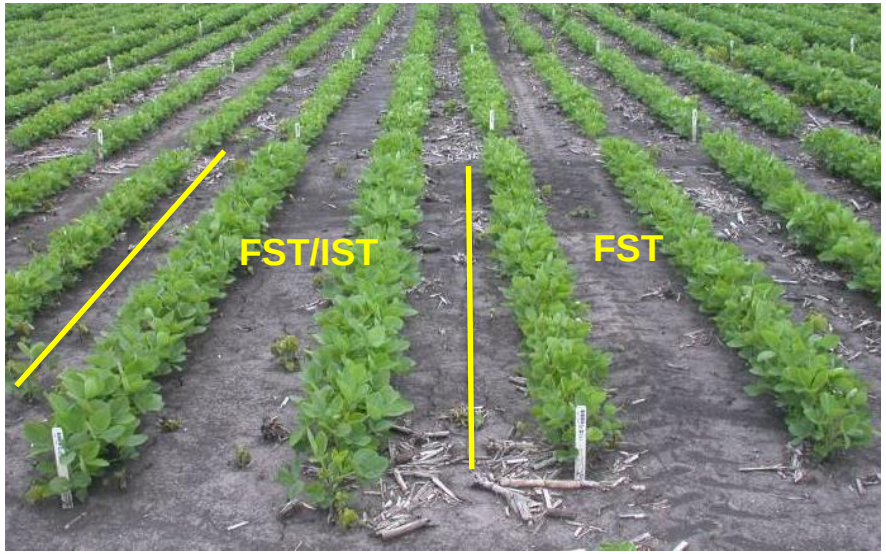


Soybean Seed Treatment – Insecticide Seed Treatment Benefit

1.6 bu/acre yield protection from IST over FST
Percent Wins for IST = 79.7%



- Data from 2004 - 2014
- Pioneer Soybean Research
- 59 replicated research locations
- Average insect pressure



10 Years of trials show IST consistently improves:

Yield

Stand count

Vigor

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Agronomic benefits analyses – Why do some claim ‘no benefit’?

- Study design for yield trials
  - Replication
  - Seeding rates and economics for farmers
  - Planting dates
- Benefits beyond yield
- Entomology
  - Ease of monitoring early season vs later season pests
  - Grad student availability, funding and experience
  - “Secondary” pests

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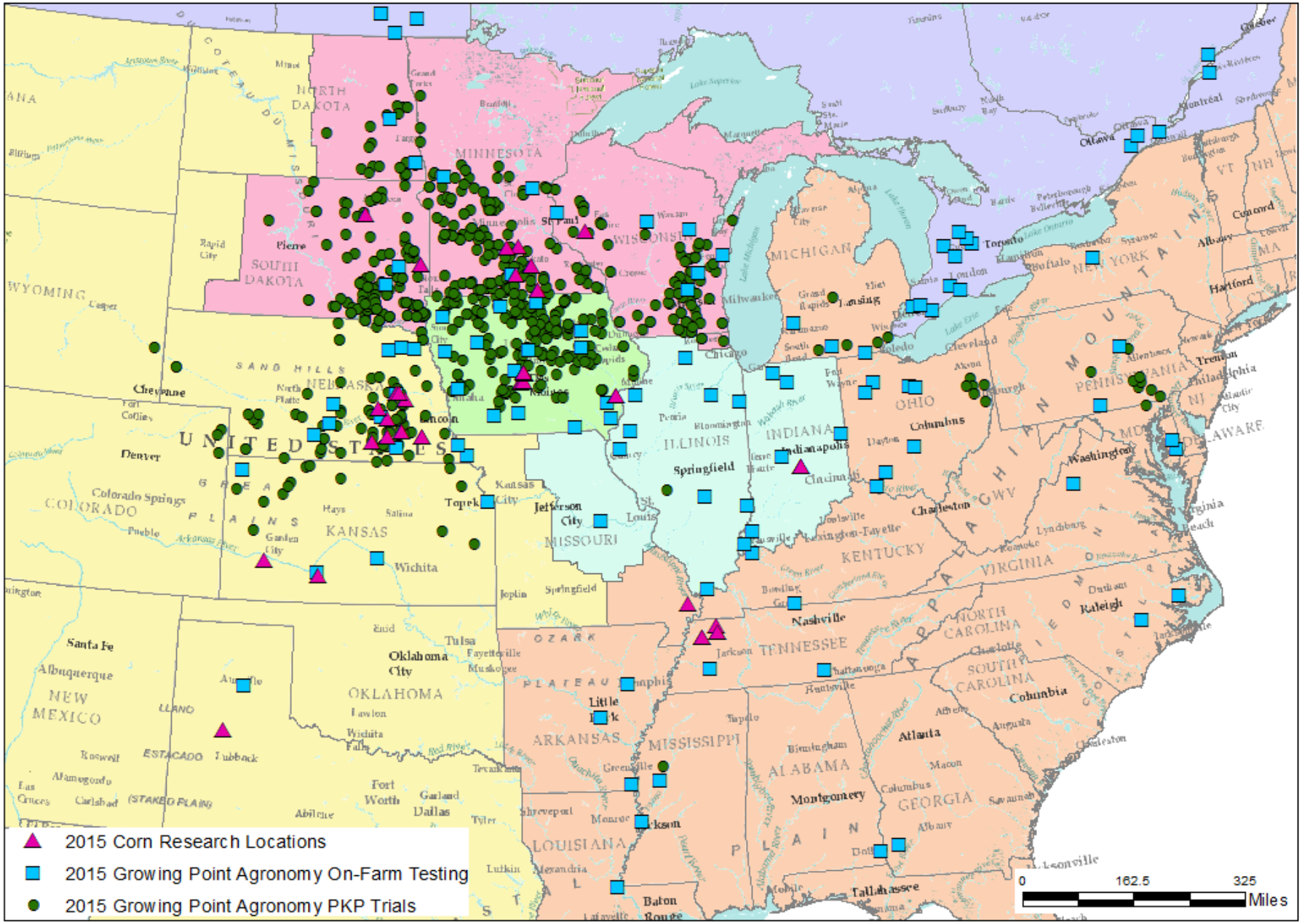
2015 PPST plus Lumivia Seed Treatment Agronomy Testing - North America



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Seed Treatment Regulation

1. Seed treatment product regulation – e.g., FIFRA
2. Pesticide application
3. Federal Seed Act

Pesticide Registration Overview

- Scientifically demonstrate that it:
  - Does not cause unreasonable effects to human health and the environment
  - Is effective against target pests (weeds, insects, disease)

- Pesticide registration is needed for:
  - Active Ingredients (e.g., clothianidin)
  - Finished products (formulations)
  - Every country of sales, manufacturing and seed treating
  - Each specific use (crop protected, pest controlled, use rate)

- Detailed data requirements and application processes are different in different countries

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Questions a pesticide registrant has to answer:

- Product identification
  - What are the properties of this new product?
  - Do you have the tools to measure it?
- Product efficacy
  - How does it work? On which targets?
  - What is the use rate?
- Exposure
  - How does it breakdown in the environment? plant tissue?
  - Where does it go in the soil, air, water, food chain?
- Safety
  - Human safety
  - Repeat same question for fish, birds, bees, butterflies, worms, mammals, plants, beneficial insects…
- **Can this product be used safely?**

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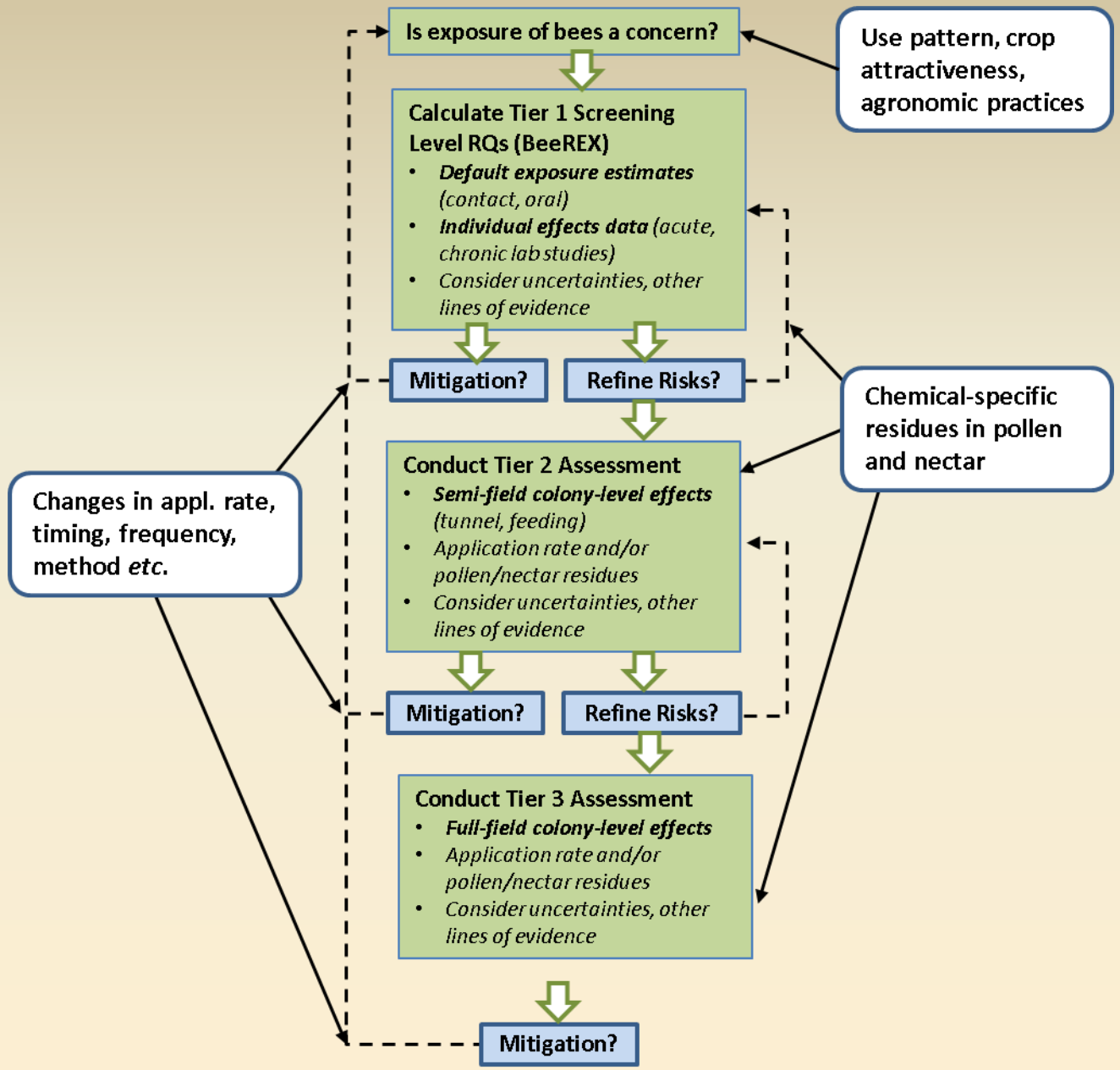
Printed OECD dossier to be submitted for one application



EPA Pollinator Risk Assessment Framework

Neonic pollinator risk assessments – EPA and PMRA Conducted under Obama administration

- EPA used data submitted by registrants, as well as public sources
- Use patterns showing most potential risk to pollinators include citrus and cotton, for example
- Seed treatment uses are generally considered a low risk for route of exposure for pollinators.
  - **"EPA concludes that any issues related to dust-off at planting can be addressed using Best Management Practices and working with the ag industry."**
- PMRA also released its benefits assessment, and concludes that use of neonicotinoid treated corn and soybean seed has value in Canada, with the levels of value varying by province and crop.

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Quality Management: Clean Seed

Clean seed = Less dust

Clean seed is better for consumers, farmers, our employees, and the environment

Deploy state-of-the-art seed conditioning and seed treatment systems

1gram

Seed Cleaning and Conditioning

Air Stream Cleaner – Separates seed from foreign material

Seed Sizing – Group seed by size/shape and removes small seed, debris and dust

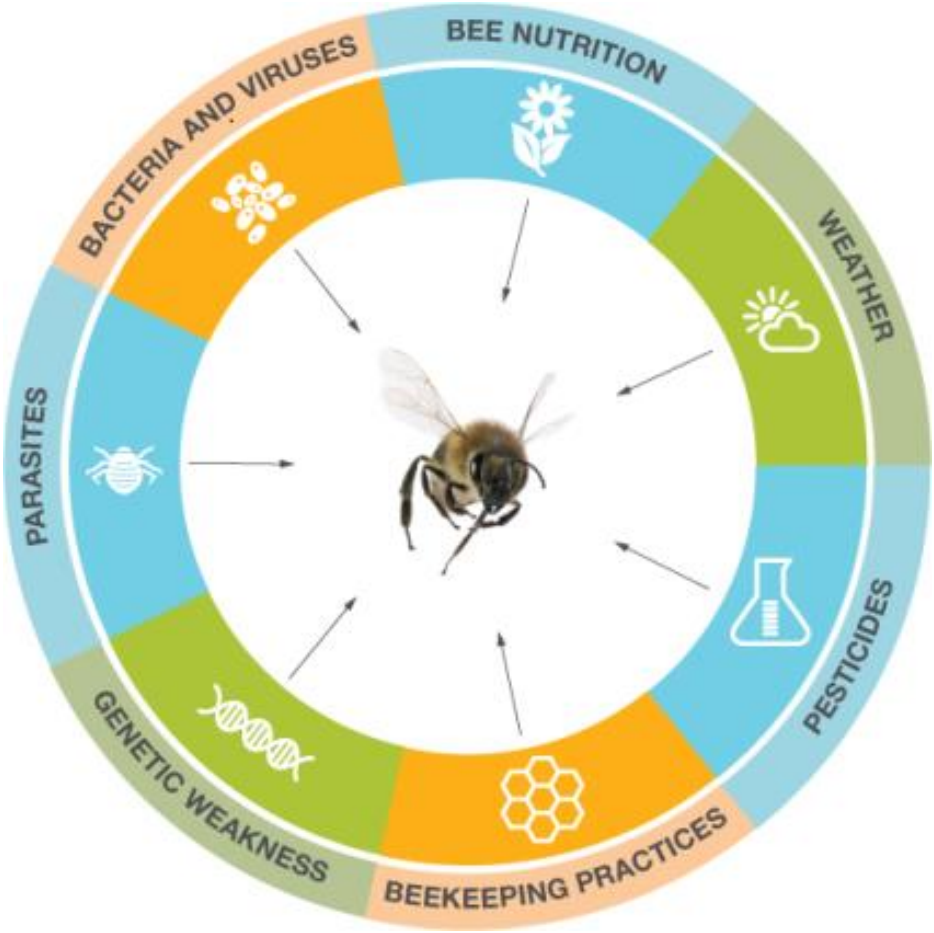
Gravity Table – Seed floats on stream of air, seed pieces and dust are removed

Seed Treating – Aspiration of seed prior to treating removing dust

Guide to Seed Treatment Stewardship

- Covers Best Management Practices for applicators and users of treated seed
- Input from farmer groups, stewardship experts, and experts in seed treatment application
- Topics covered include: Safe Use and Handling, Selection of Treatment Product, Locating Hives and Communication with Beekeepers, Planting of Treated Seed, Application, Storage and Disposal

Reality: Multiple Stressors Affecting Bee Health



Scientists are focused on the interaction of multiple factors:

- Parasites (*Varroa* mites)
- Diseases (*Nosema*, bacteria and viruses)
- Weather patterns and changing climate
- Beekeeping practices
  - Transportation stress
  - Lack of genetic diversity
  - Artificial food sources
  - Pest management within colonies
- Pesticides (used in hives and in agriculture)
- Lack of suitable habitat
- Lack of varied diet
- Queen failure

Information Sources: U.S. Department of Agriculture and U.S. Environmental Protection Agency National Honey Bee Health Stakeholder Conference Steering Committee, 2013. Report on the National Honey Bee Health Stakeholder Conference (October 2012). http://www.usda.gov/documents/ReportHoneyBeeHealth.pdf

Mao, W., Schuler, M.A., Berenbaum, M. 2013. Honey constituents up-regulate detoxification and immunity genes in the western honey bee Apis mellifera. Proc Natl Acad Sci U S A. 2013 May 28;110(22):8842-6.

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HONEY BEE HEALTH COALITION INITIATIVES

The Coalition is focusing on accelerating collective impact to improve honey bee health in four key areas.

Nutrition & Forage

We are looking at ways to improve honey bee nutrition to provide diversity in honey bee forage

Hive Management

We are making investments to understand and suppress varroa mite and virus susceptibility and developing best management practices (BMPs) for beekeepers

Crop Pest Management

We are developing crop- and product-specific best management practices and messaging

Cross Industry Collaboration

We are working across the public and private sector to coordinate on solutions that work

Summary

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Thank you