Soybean Yield Potential

Setting the Foundation for Yield Success

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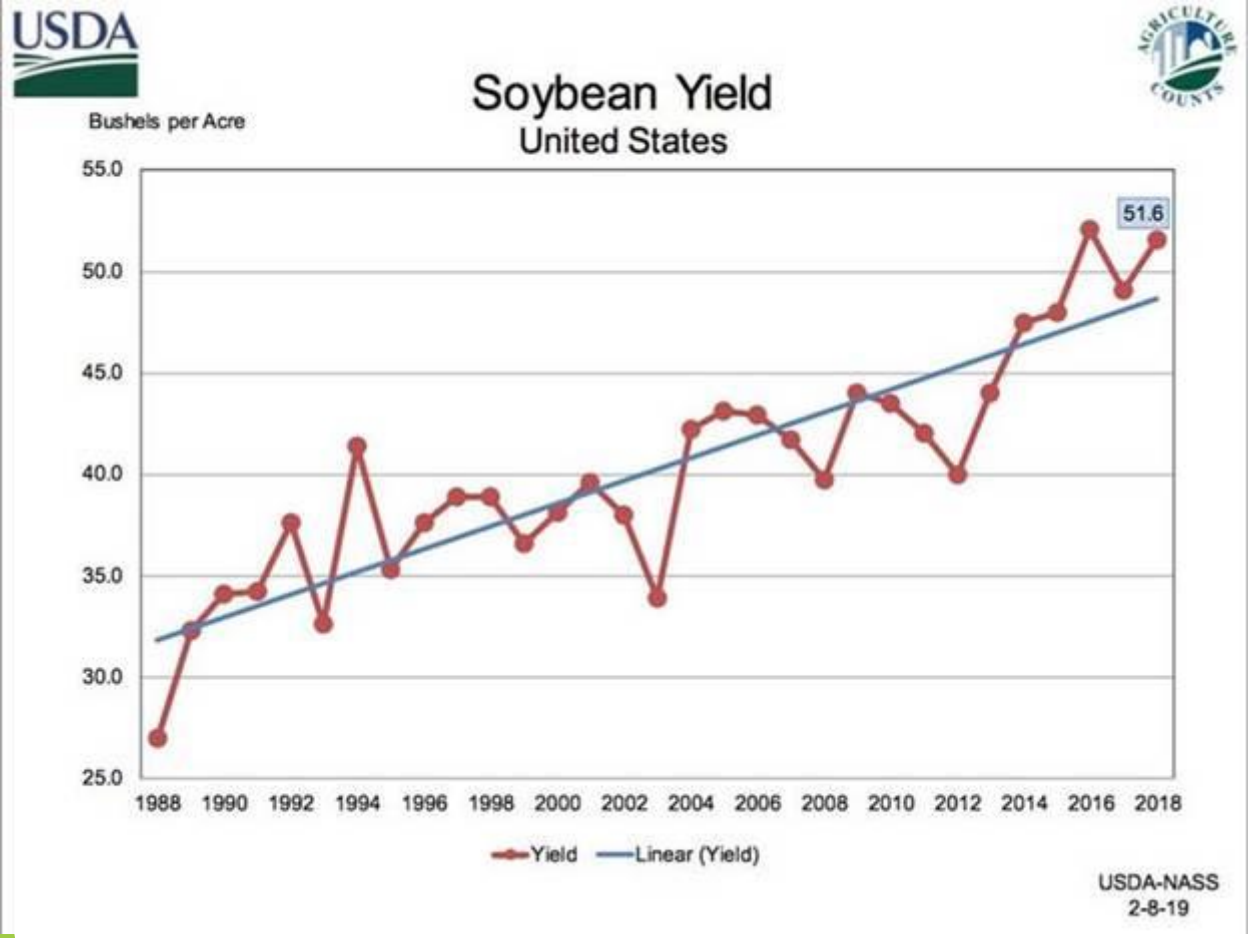
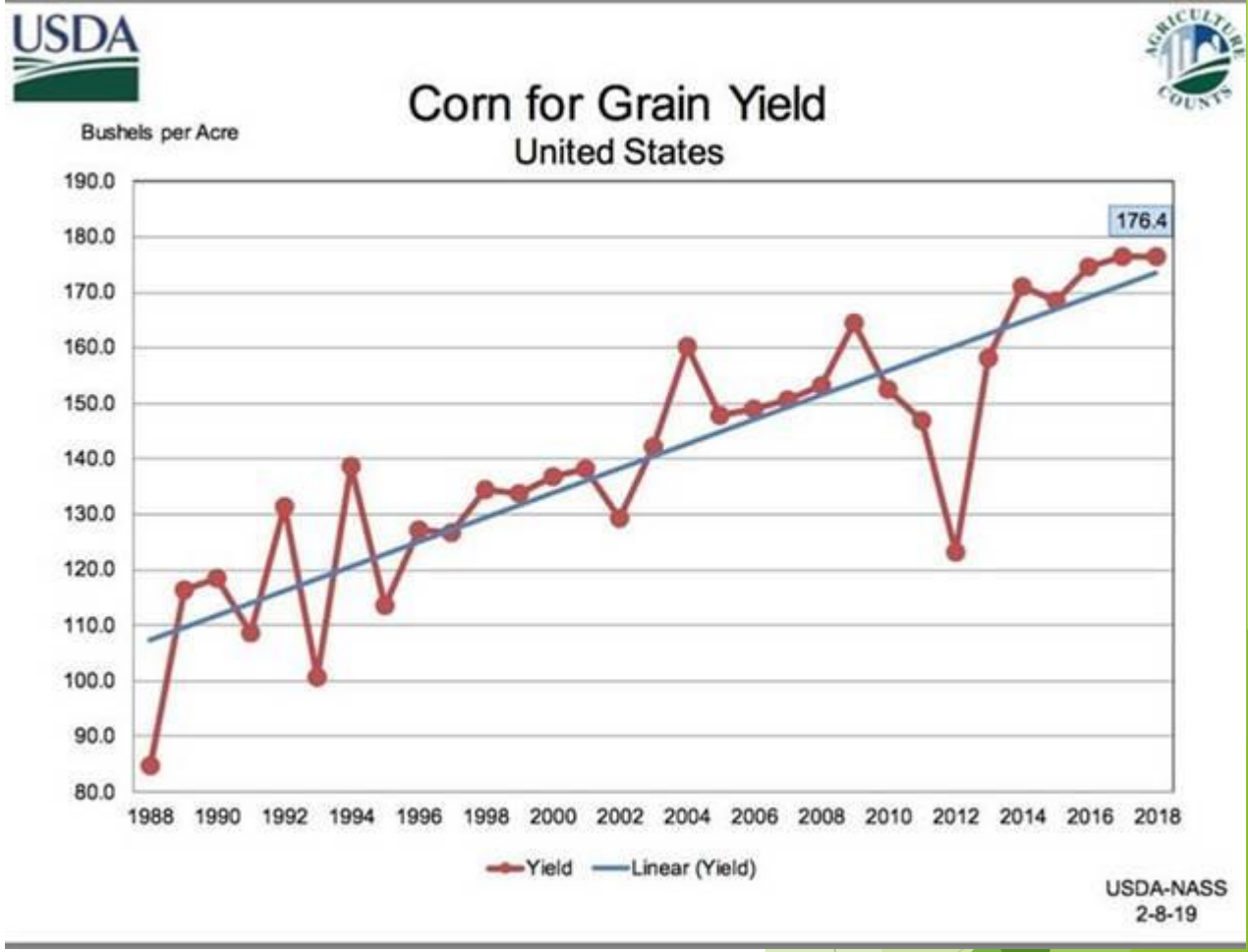
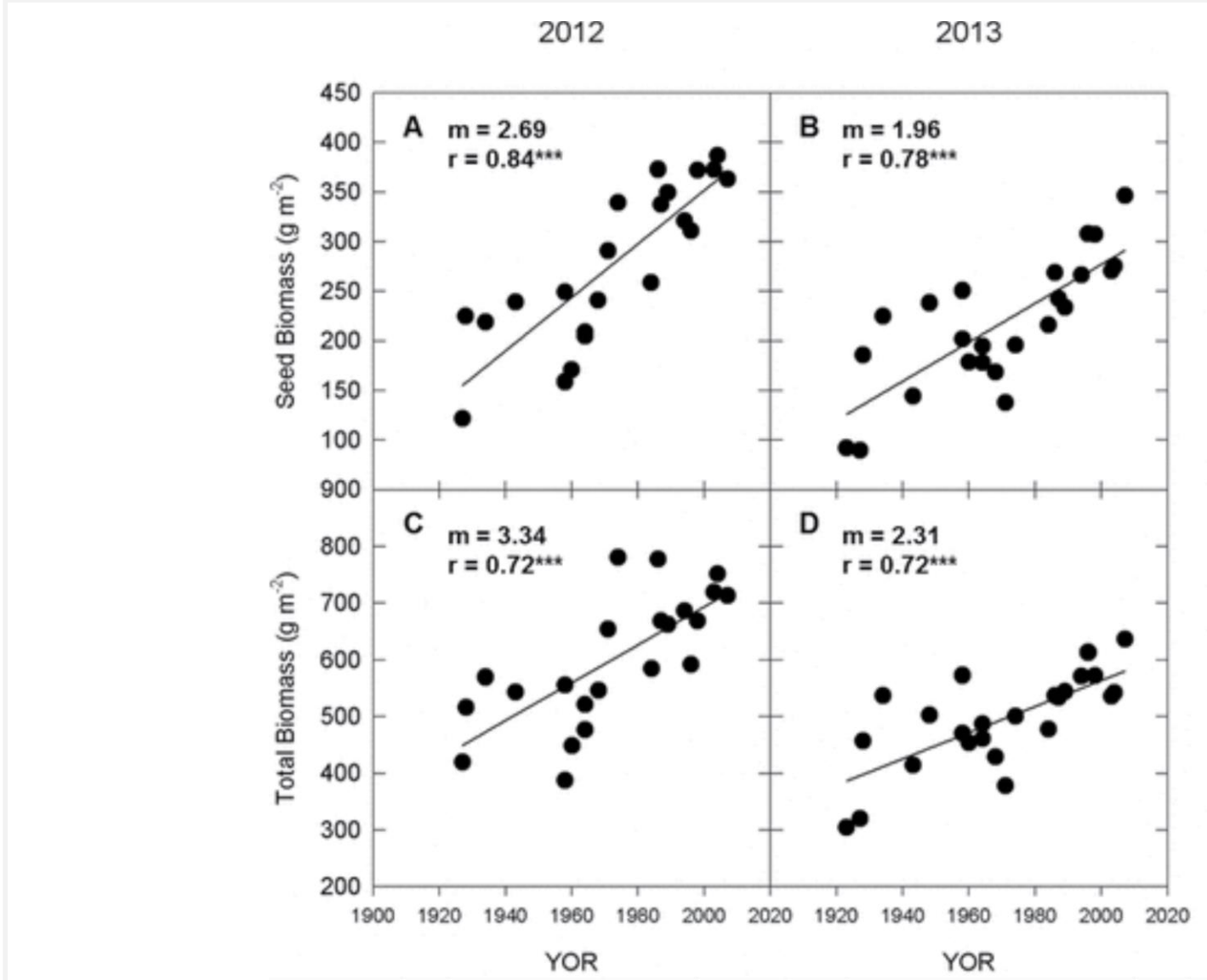
Genetic Yield Potential of Soybeans

- The components of soybean yield are…
  - Plants, pods/plant, seeds/pod & seed weight
  - Seeds/acre X weight/seed = Lbs/acre/60 = YIELD
- How high can we go?
  - Current yield record 171 bu/acre
  - 2018 US average of 51.6 bu/acre (2nd highest ever)
  - 2018 Illinois state average 65 bu/acre (new Record)
- Have soybean yields increased?
  - Breeding or management?
  - Have soybean yield gains kept pace with corn?
- Soybean plants are “source limited”
  - Soybean plants are unable to “feed” all the yield potential they hold





Notice how similar the slopes of these lines are.
Since 1988 trend line yield has increased 53% for soybean and 61% for corn
In 1988 corn trend line yield was 3.4X soybean and today it is 3.6X.



From: Historical gains in soybean (Glycine max Merr.) seed yield are driven by linear increases in light interception, energy conversion, and partitioning efficiencies

J Exp Bot. 2014;65(12):3311-3321. doi:10.1093/jxb/eru187

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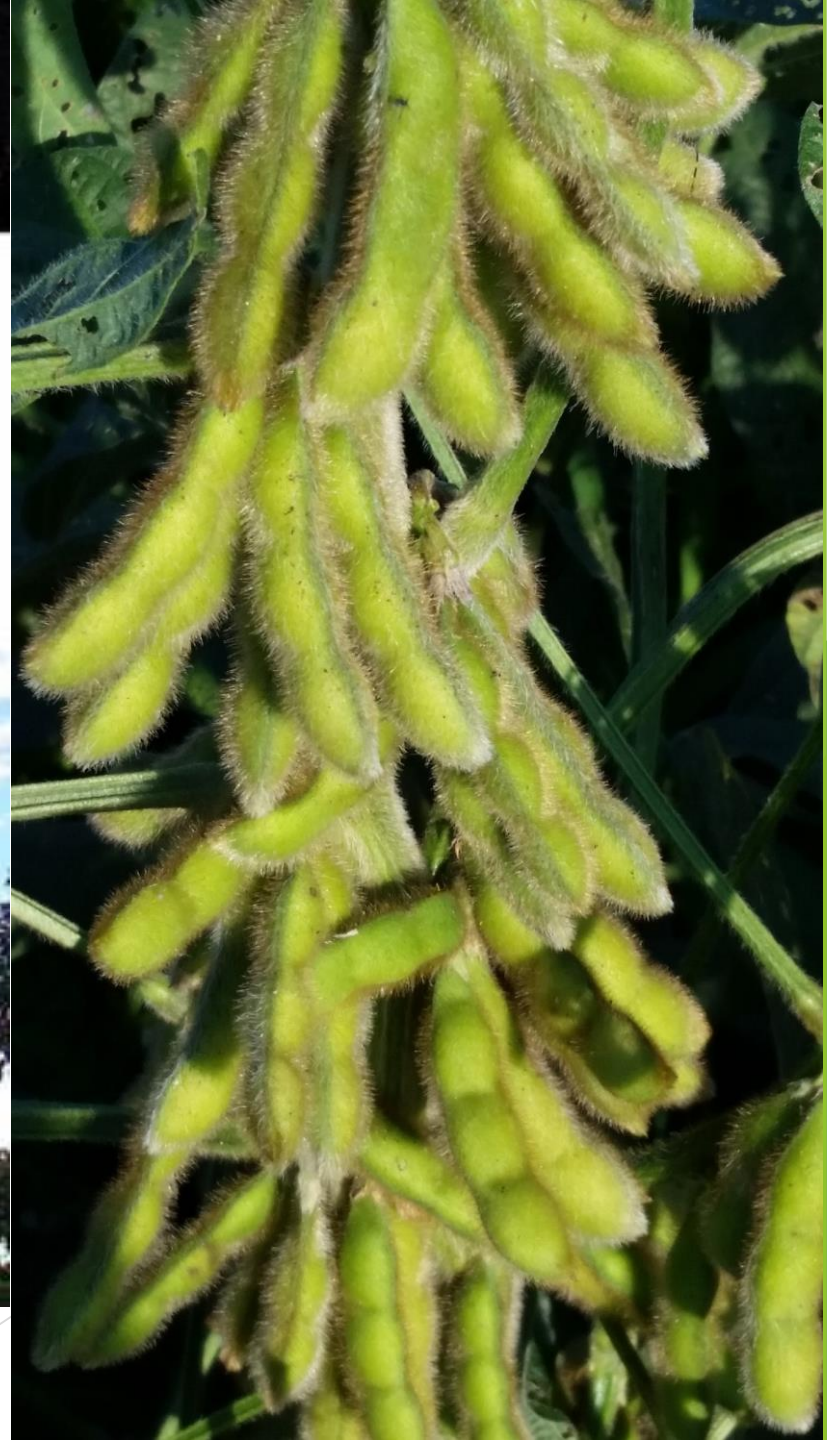


Case Study From Monmouth

- Individual soybean plant
  - Given unlimited space, sunlight, moisture & nutrients
  - How much yield was produced?
- 0.4417 lbs grain from a single plant
  - What does this equate to?
- Making the following assumptions…
  - 2800 seeds/lb
  - Average of 2.6 seeds/pod
  - = 476 pods/plant
- If you could produce 130,000 such plants per acre…

Genetics or Management?

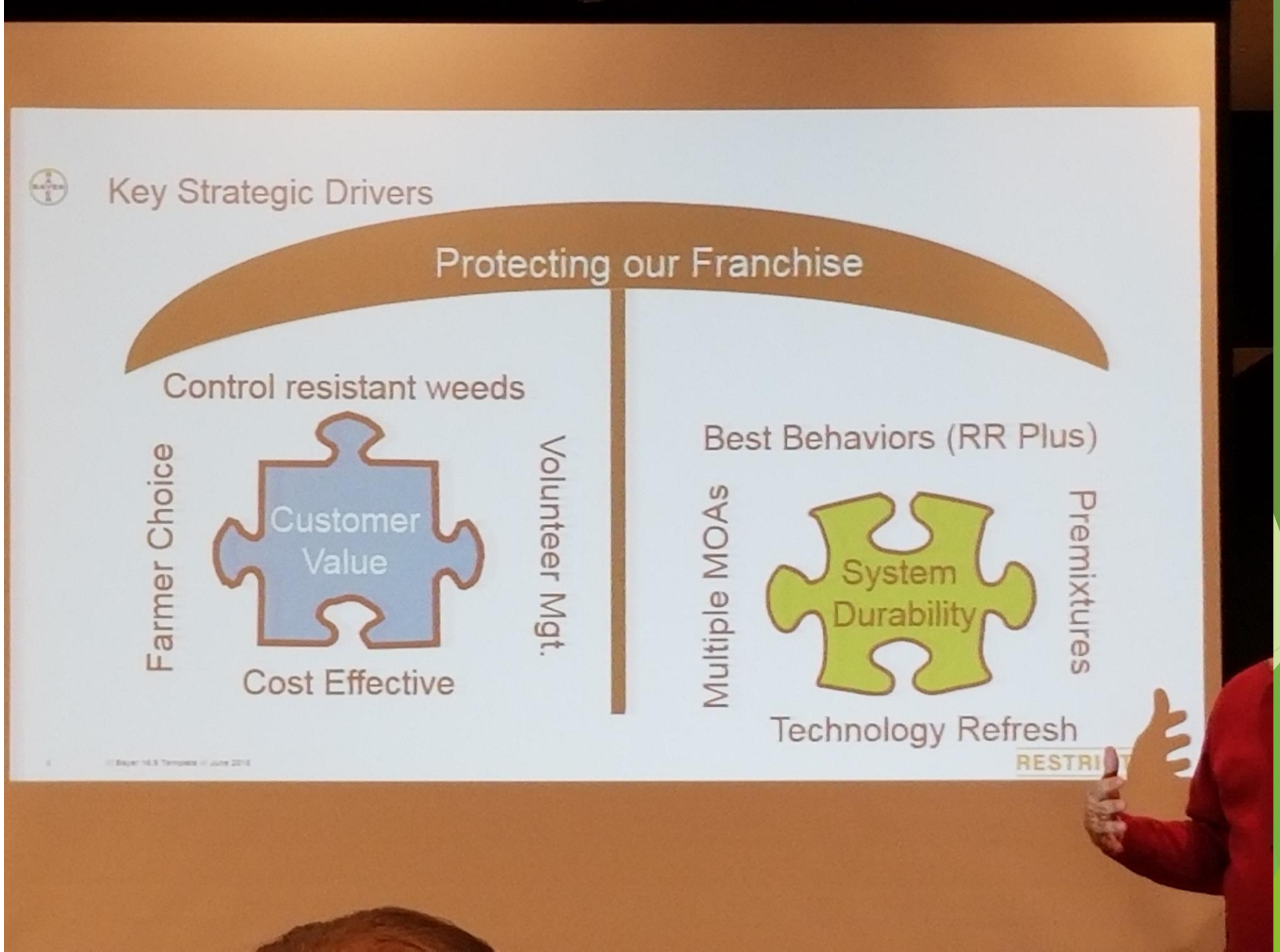
- Every product on the market today can yield > 100 bu/acre
- Matching genetics to the environment is important
  - Some varieties excel more in high yield environments
- Disease resistance key feature of “maintaining” yield potential
  - Nematodes and diseases can be major yield limiting factors
- Knowing responsiveness of genetics to management is tricky

Defend Against These Yield Robbers…

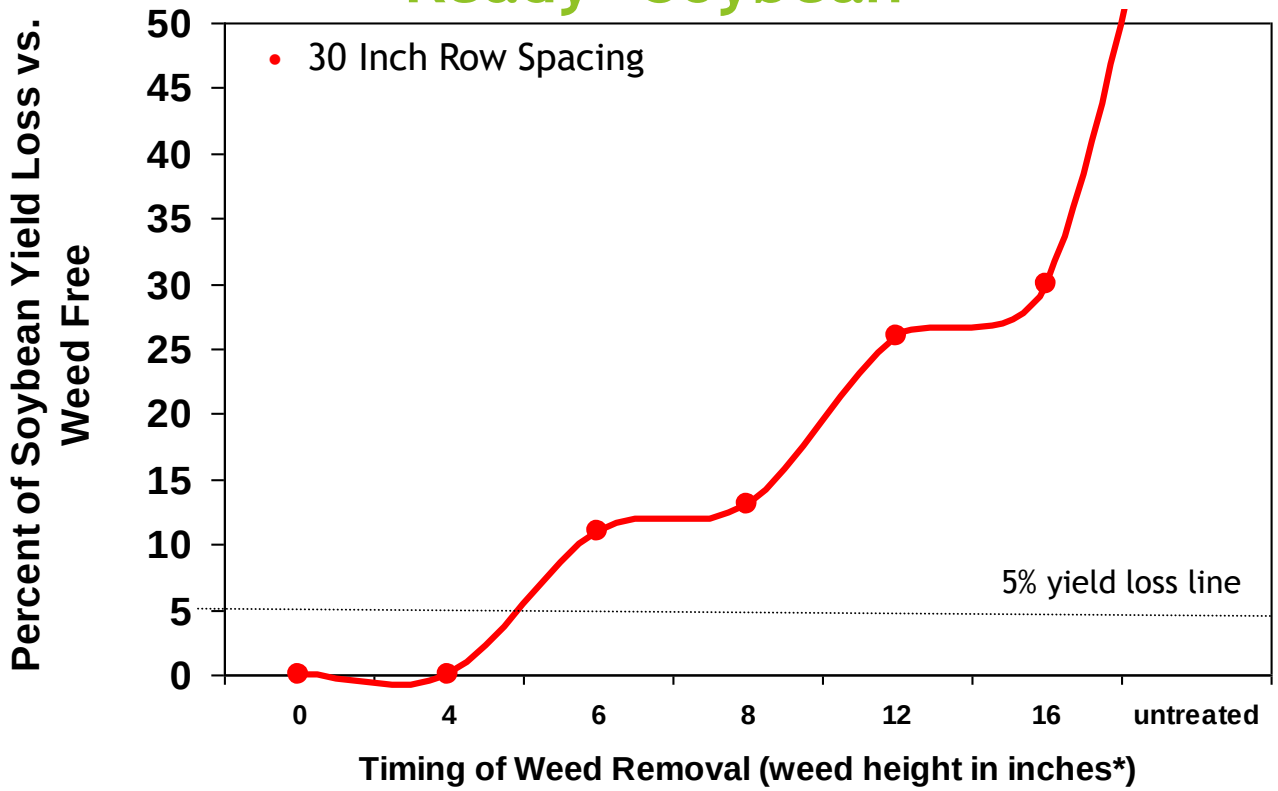
- Weeds
  - Timely, Effective, Affordable, Responsible weed management strategies
- Diseases
  - Seedling, root, foliar
  - Rare to have high yielding unhealthy soybeans
- Nematodes
  - Academic surveys indicate #1 yield robbing pest in soybeans nationally
- Insects
  - BLB, Jap. Beetle, aphids, stink bugs, green clover worm, grass hoppers, others
- Environmental Stresses
  - Moisture, Temperature, Sunlight, Compaction, Drainage
  - Each stress is a multiplier that makes all other stresses more damaging

Weed Management

- Use residuals and multiple effective Modes of Action
- Prevent as much germination as possible to reduce pressure on POST products
- Control weeds early POST (within 30 days of planting)
- Make sure PRE and POST residuals are overlapping
- Scout fields for escapes 7-10 days after POST application
- Follow ALL product labels
- Weed control will never be as simple/cheap again as it was 10-15 years ago
- Goal should be for effective, economical and sustainable systems


Key Strategic Drivers
Protecting our Franchise
Control resistant weeds
Farmer Choice
Customer Value
Volunteer Mgt.
Cost Effective
Best Behaviors (RR Plus)
Multiple MOAs
System Durability
Premixtures
Technology Refresh

Cost of Delaying Weed Control in Roundup Ready® Soybean



**Weed heights converted from metric measurements of 5, 10, 15, 20, and 30 to 35 cm. Location was Urbana, IL, 2001 and 2002.*

Weed	Plants/ft^2
giant foxtail	
6.3 morningglory	1.2
waterhemp	1.1

- **Approximately 2-3% yield loss for every inch of weed height after weeds exceed 4 inches**
- **It can often take 3-4 days for most weeds to grow 1 inch**
- **For every inch of weed growth above 4 inches, it costs approximately 1.5 bushel (~$14.25), which can equal approximately $4.07/acre per day.**
  - ***Calculations based on 60 bushel/acre yields, 2.5% yield loss for every inch of weed height after weeds exceed 4 inches, and 3.5 days for 1 inch of weed growth.***

Source: Kamienski, C. 2003. Masters thesis: Effect of postemergence glyphosate application timing on weed control and grain yield in glyphosate-resistant soybean. University of Illinois.

Weed Examples

COMMON WATERHEMP
Amaranthus rudis

SEEDS/PLANT
250K

SITE OF ACTION	2 ALS INHIBITORS	4 SYNTHETIC AUXINS	5 PHOTOSYSTEM II INHIBITORS	9 EPSP SYNTHASE INHIBITOR	14 PPO INHIBITORS	27 HPPD INHIBITORS
PRODUCT EXAMPLES (Trade Name®)						
KNOWN RESISTANCE						

EXAMPLE OF GOOD WEED MANAGEMENT SYSTEM

ROUNDUP READY 2 XTEND® SOYBEANS*

Soybean

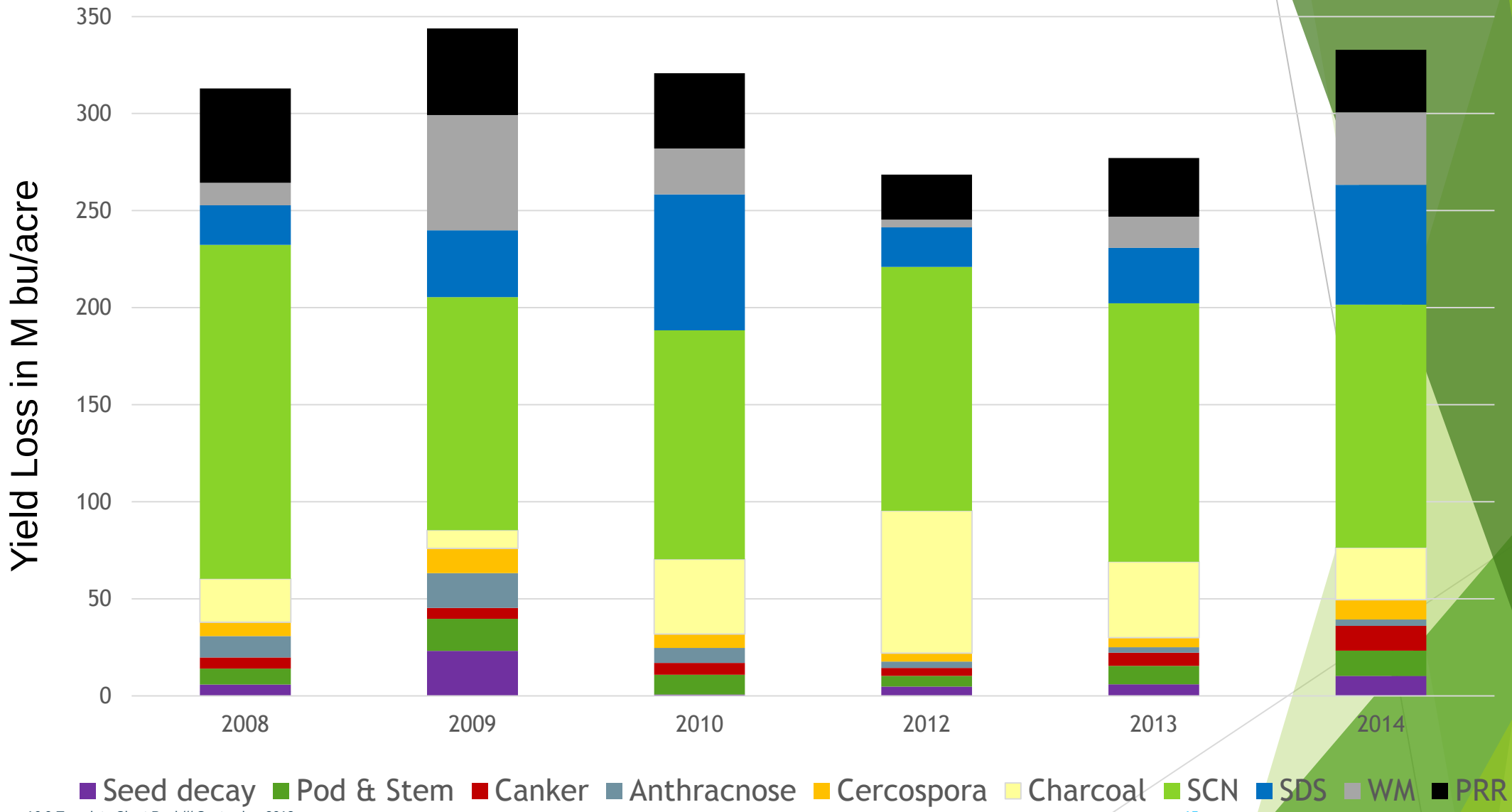
TIMING	PRACTICE	EXAMPLE RECOMMENDATION**
Before Planting	Burndown or Start Clean with Tillage	Roundup PowerMAX® Herbicide (32 oz) + XtendiMax® herbicide with VaporGrip® Technology (22-44 oz) + labeled Drift Reducing Adjuvant (DRA)
At Planting	Pre	Valor® SX Herbicide (2 oz), Valor® XLT Herbicide (3 oz), Fierce® Herbicide (3 oz) or Warrant® Herbicide (3-4 pt) + metribuzin (0.25 lb)
Post 1 Over-the-top	Post 1 < 4" weeds and within 20-30 days after PRE Application	Roundup PowerMAX® Herbicide (32 oz) + XtendiMax® herbicide with VaporGrip® Technology (22 oz) + labeled DRA Warrant® Herbicide (3-4 pt) or Warrant® Ultra Herbicide (50 oz)
Post 2 Over-the-top	Post 2 Prior to R6 growth stage	Cobra® Herbicide (10 oz) + COC (1% v/v) to control any weed escapes prior to R6

*Check with your local dealer or representative or U.S. EPA and your state pesticide regulatory agency for the product registration status and additional restrictions in your state.
**Contact your local retailer, company representative or extension service for specific regional weed management recommendations.

Soybean Diseases

- Managed by genetic resistance and fungicides
- Can have a MAJOR impact on soybean yield
- Most agree benefits of seed treatments outweigh the costs
  - What is the limit? $20… $30… $40… more?
  - Can a seed treatment give you a 4+bu yield increase?
- Foliar fungicides are a standard practice for high yield soybeans
  - How many applications and what timing?
- What is responsible for the yield increase following multiple years of corn?
  - Disease and nematode suppression are a factor
  - Possible unknown changes in soil biology or chemistry

Yield Loss Estimates for Soybean Diseases



Data: http://extension.cropsciences.illinois.edu/fieldcrops/diseases/yield_reductions.php

The *Diaporthe* Species Complex

Diaporthe caulivora

D. phaseolorum var. caulivora

Northern Stem Canker

Southern Stem Canker

Diaporthe aspalathi

D. meridionalis

D. phaseolorum var. meridionalis

Diaporthe sojae

D. phaseolorum var. sojae

Pod & Stem Blight

Seed Decay & Zone lines

Diaporthe longicolla

Phomopsis longicolla

Soybean Insect Pest Management

- Early season insect pests
  - Seed & seedling feeders
    - Generally controlled by Neonic insecticide seed treatments
    - Spraying for BLB sometimes warranted
- Mid season insect pests
  - Largely ignored and generally thought not to impact yield
  - Many economical foliar options if needed
- Late season insect pests
  - Most acres sprayed at R3 with fungicide get insecticide as well
  - Probably situations where a later (R4-R5) application would benefit
    - Late pod feeding contributed to seed quality issues and damage in 2018
- Scouting is difficult, thresholds for multiple pests not well understood and hard to balance IPM, ROI and pushing for maximum yields.


Untreated
Acceleron F/I

The Unseen Yield Robber - Nematodes

- Generally considered to be the #1 cause of yield loss in soybeans
- Partially controlled by genetic resistance bred into >95% of commercial lines
  - Same source of resistance PI88788 used in most lines for past 30 years
  - Other, stronger “fresher” sources of resistance are known but harder to work with
  - Some evidence that SCN populations are adapting to widespread PI88788 use
- Several seed treatment products available
  - More testing needs to be done to determine broad acre benefit
  - Yield responses have been variable and slightly better than break even on average
  - Sampling in 2017 & 2018 Bayer research trials indicated lower SCN pressure
- If SCN are negatively impacting your yield there should be a benefit to using a product that will help control them
  - Encourage field scale split field trials in 2019

Environmental Stresses

- Too much or too little soil moisture during growing season
- Higher or lower than optimal temperatures during growing season
- Soil rooting environment
  - Soil conditions that negatively impact root growth & health
- Less than optimum solar radiation levels
- Environmental impacts on soil health & biology
  - Can adversely affect nodulation, nodule health and N fixation
- Environmental stresses often interact with each other and other plant stresses from diseases, insects, nutrient deficiencies, etc compounding the damage

Foundation for Maximum Yield Potential

- Germplasm
- Management
- Stress Mitigation
  - Weeds
  - Insects
  - Diseases
  - Nematodes
  - Environment

G X E X M = Yield