



# 2005 North Central American Society of Agronomy

**“Climbing Above the Yield Plateau”**

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# Outline

- Soybean Yield Trends
  - Historical trends
- Research Strategies
  - Historical perspective
  - Marker-Assisted Selection (MAS)
  - Biotech approaches to yield enhancement
  - Research on new diseases and pests
  - Maximizing soybean yield potential

# Yield Perspectives

- Yield is the most important trait for soybean producers
- Reliability of yield performance from year to year is crucial to build and maintain customer satisfaction
- Key defensive traits are required to ensure realization of yield potential
- Accurate characterization of varieties is critical to aid varietal selection and proper positioning on the farm

# Yield Perspectives

- Yield increases based on genetic improvements continue to be made by US soybean breeders (~0.4 bu/acre/year)
- Increasing incidence of diseases and pests and recent droughts have prevented the realization of full yield potential in some regions

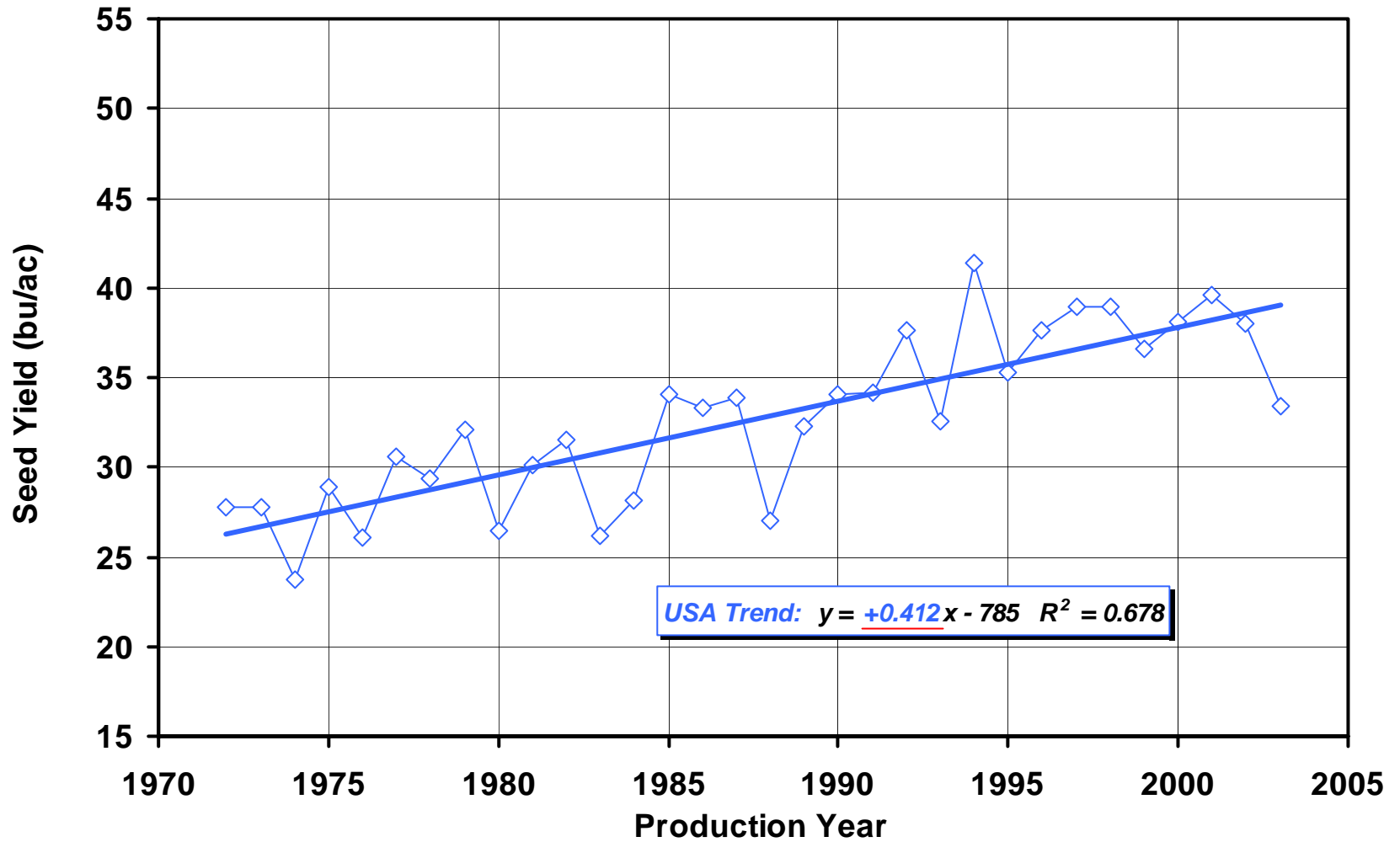


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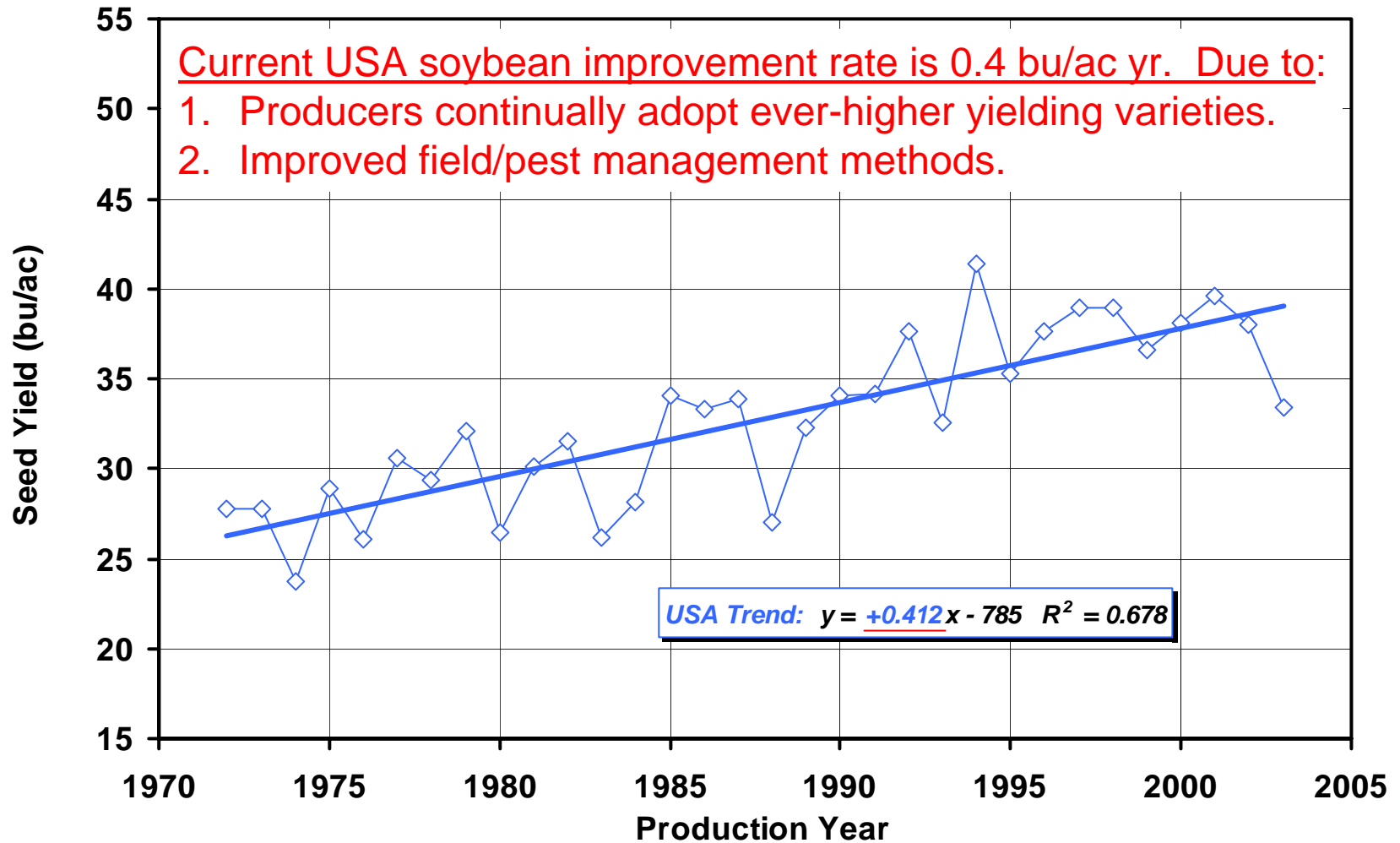
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# USA Soybean Yield Trend (1970 –2003)

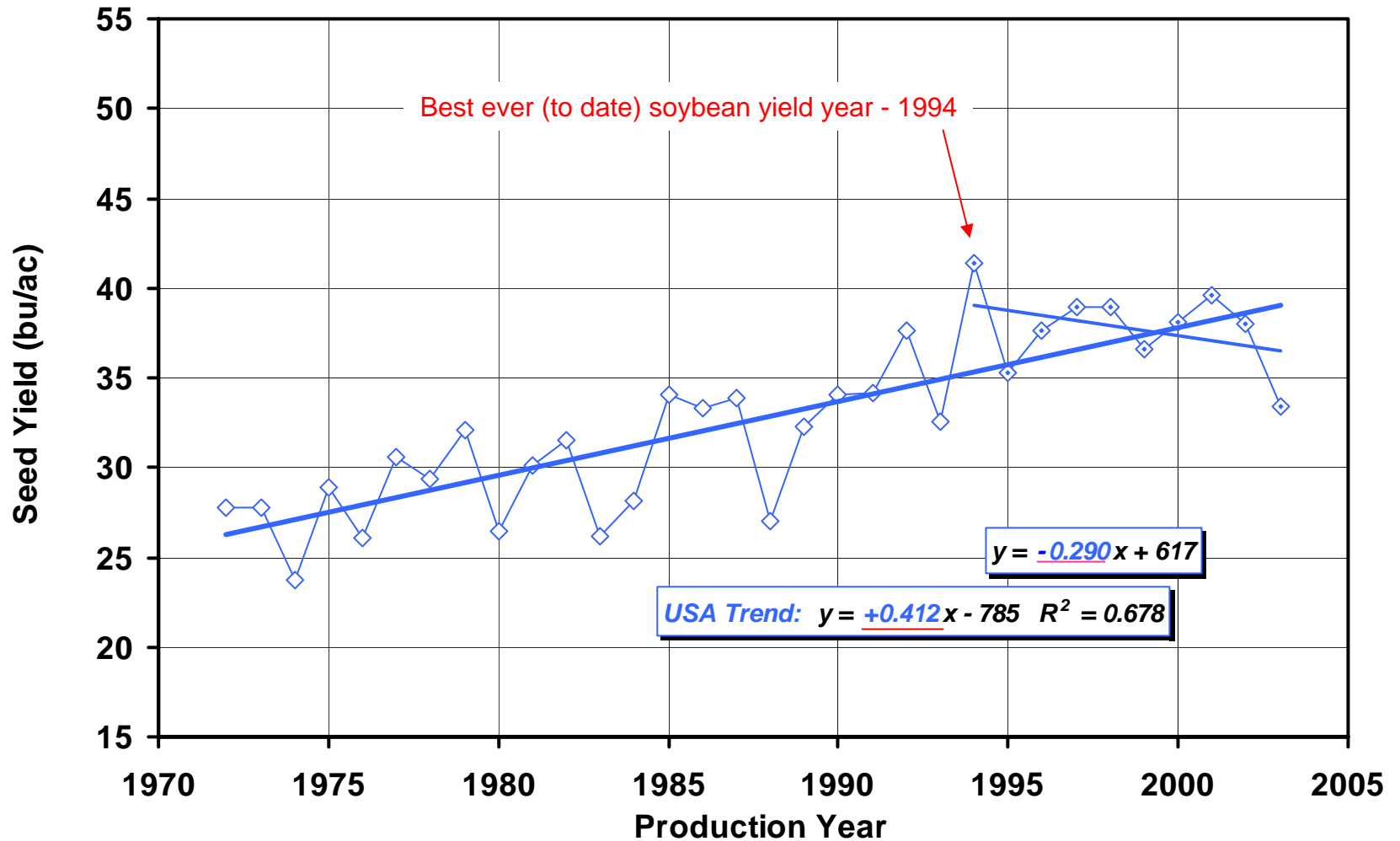


Source: Jim Specht, University of Nebraska, Data from National Agricultural Statistics Service

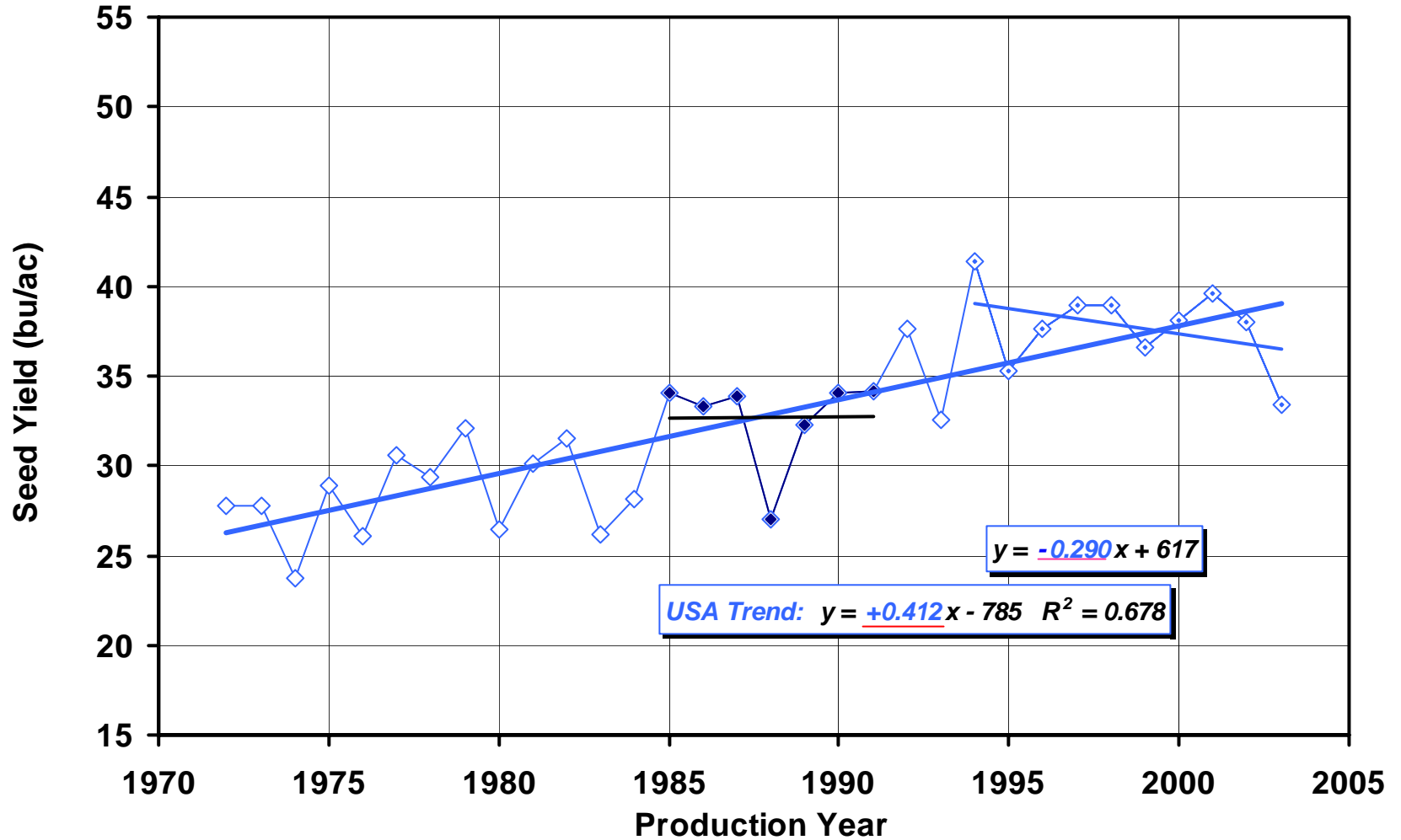
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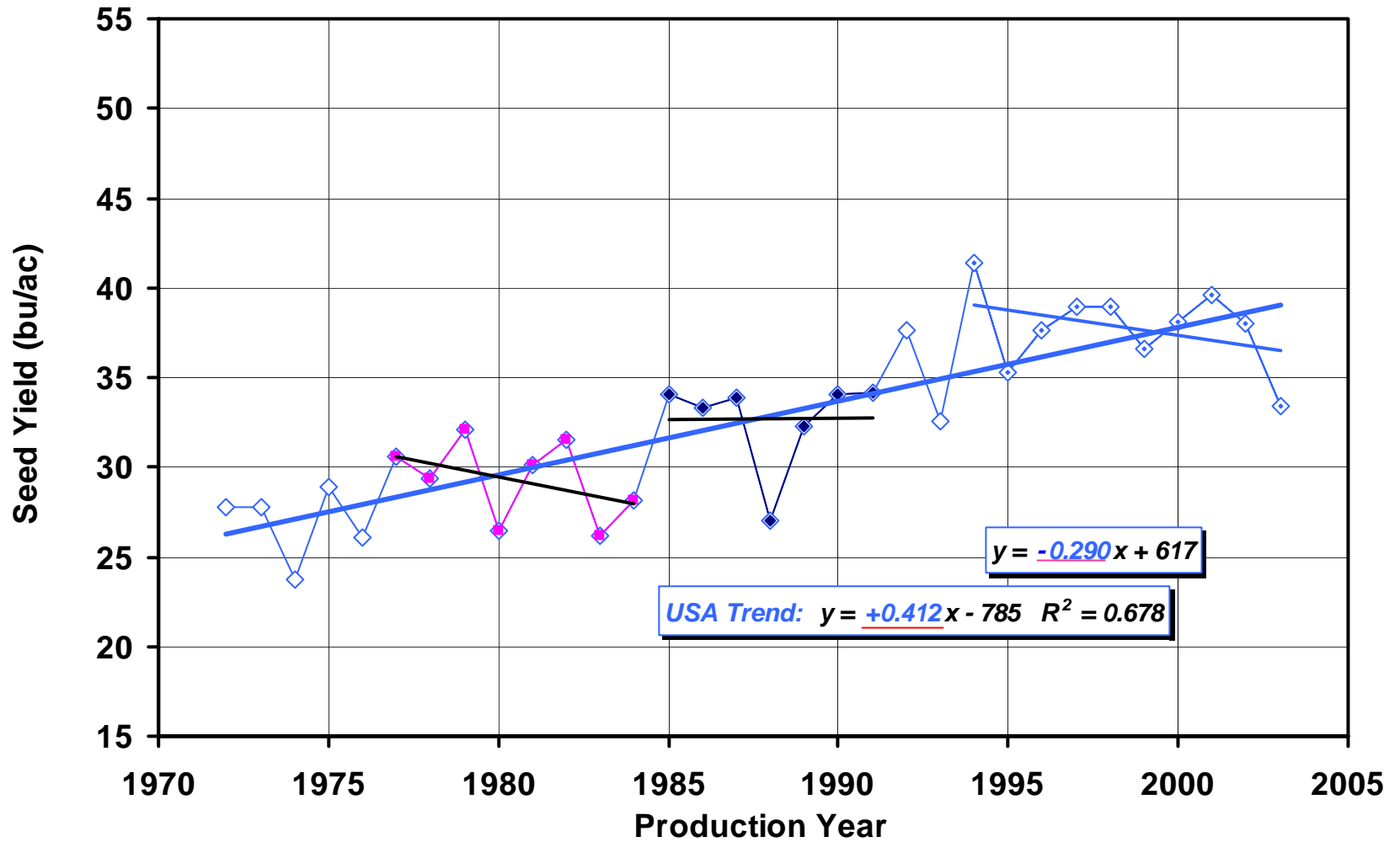
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Source: Jim Specht, University of Nebraska, Data from National Agricultural Statistics Service

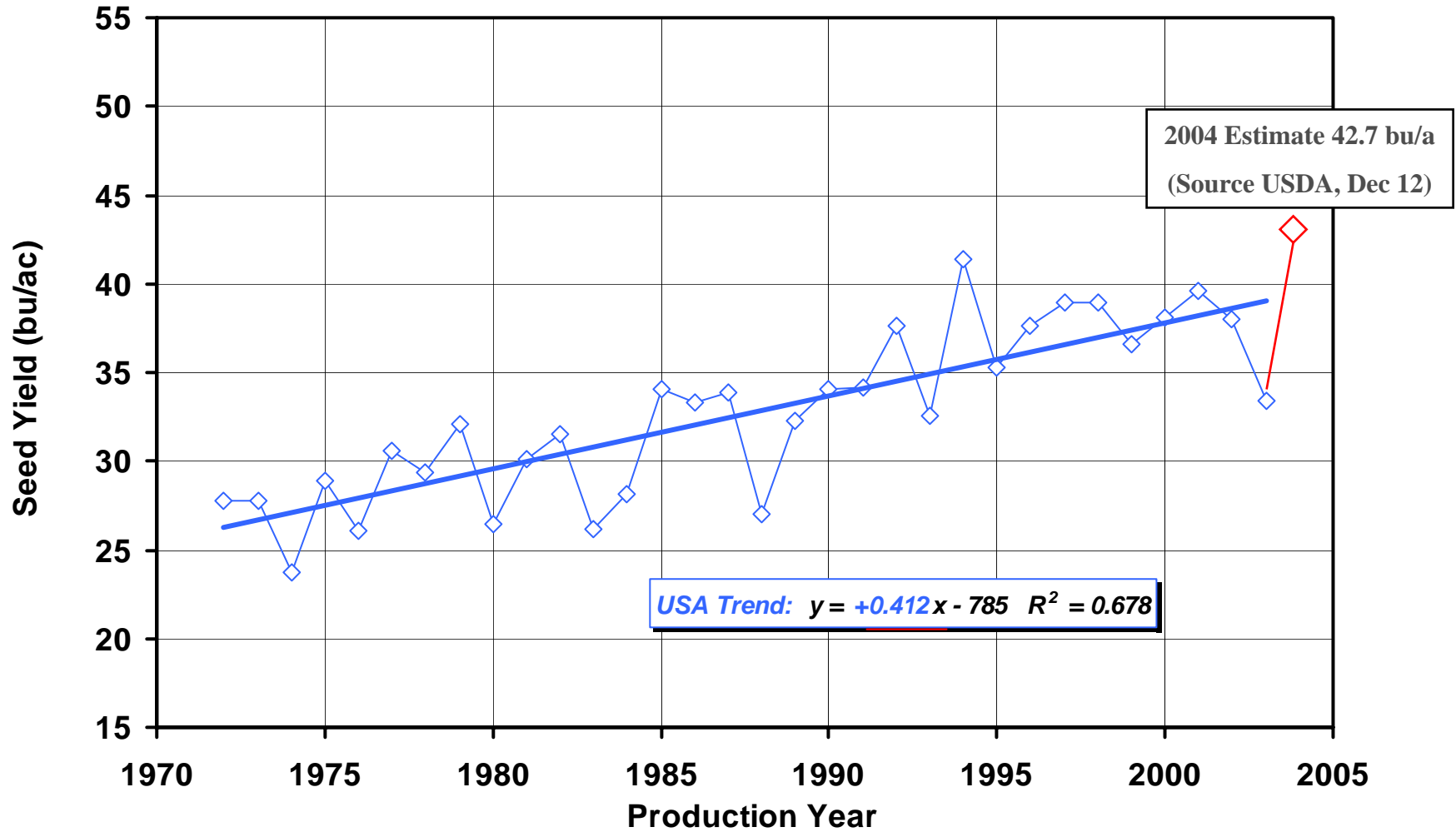


# USA Soybean Yield Trend (1970 –2003)



Source: Jim Specht, University of Nebraska, Data from National Agricultural Statistics Service

# USA Soybean Yield Trend (1970 –2004)



Source: Jim Specht, University of Nebraska, Data from National Agricultural Statistics Service

# Historical Yield Improvement Strategies

- Cross high-yielding parental lines
- Evaluate large numbers of experimental lines derived from the parental crosses
- Commercialize the best experimental lines based on wide-area yield performance
- Rate of yield improvement (about 0.4 bu/year)



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# Yield Testing Strategies - Today

- Yield testing
  - Over 1 million research yield test plots planted annually by Pioneer soybean researchers in North America
  - Use marker-assisted selection (MAS) to front-end load yield trials with experimental lines that possess disease/pest traits customers need
- On-farm comparison trials
  - More than 10,000 plots planted on customer and sales rep farms
  - Improves our ability to position varieties



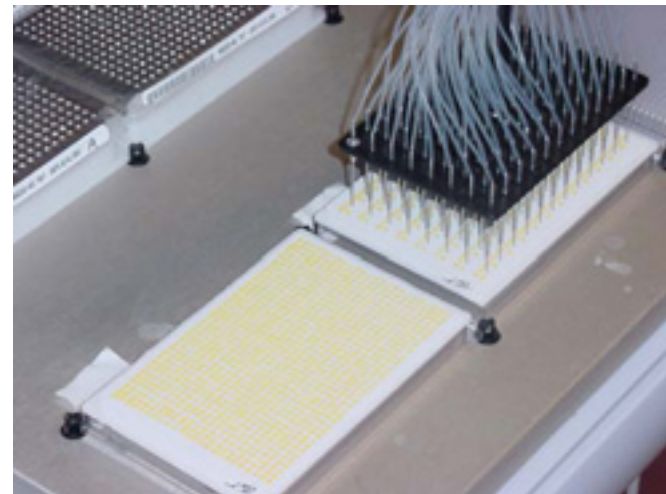
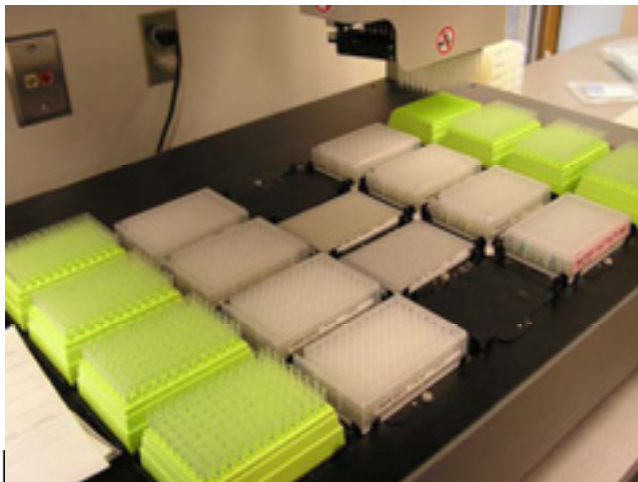
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# Genetic Fingerprinting

- Ensure the presence of key defensive traits prior to yield testing (Marker-Assisted Selection)
- Identify genes governing yield potential and discover untapped sources of yield potential in exotic germplasm
- Map disease/pest resistance genes



# SCN Resistance: Marker Approach



- A patented technique developed by Pioneer
  - biotechnology
  - robotics
  - information management
- Gene mapping used to identify the location of SCN resistance genes on specific chromosomes
- Marker-assisted selection to confirm the presence of these genes in experimental varieties
- Requires only a leaf tissue sample; no nematodes required
- Can be used in off-season nurseries
- Rate of Genetic Gain = 2X Historical Rate of Gain







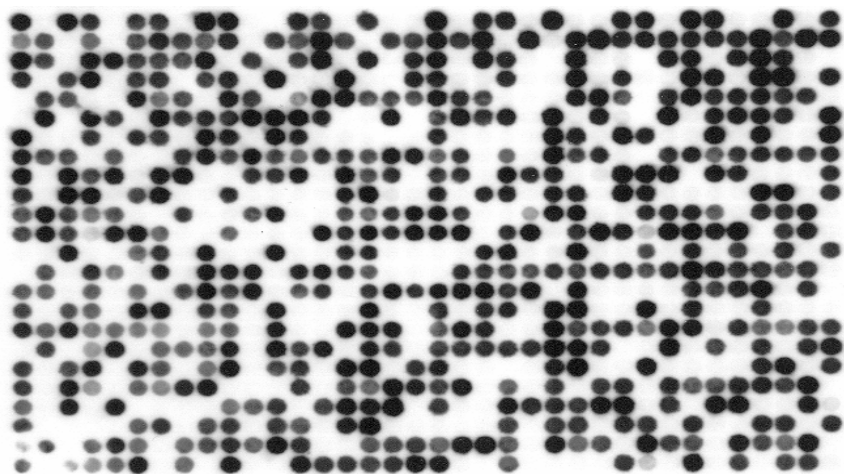
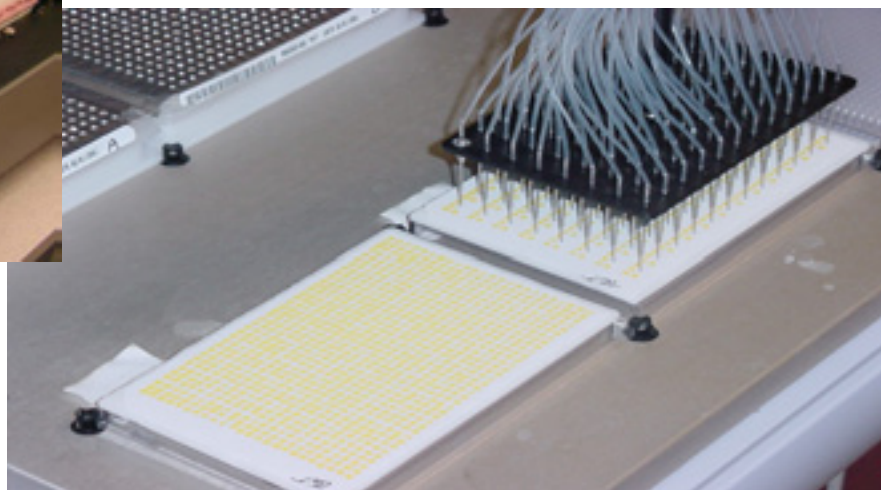
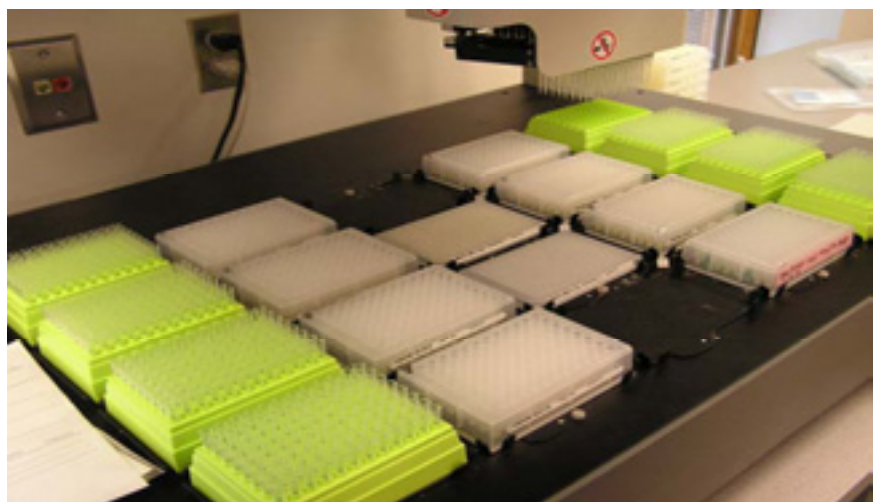


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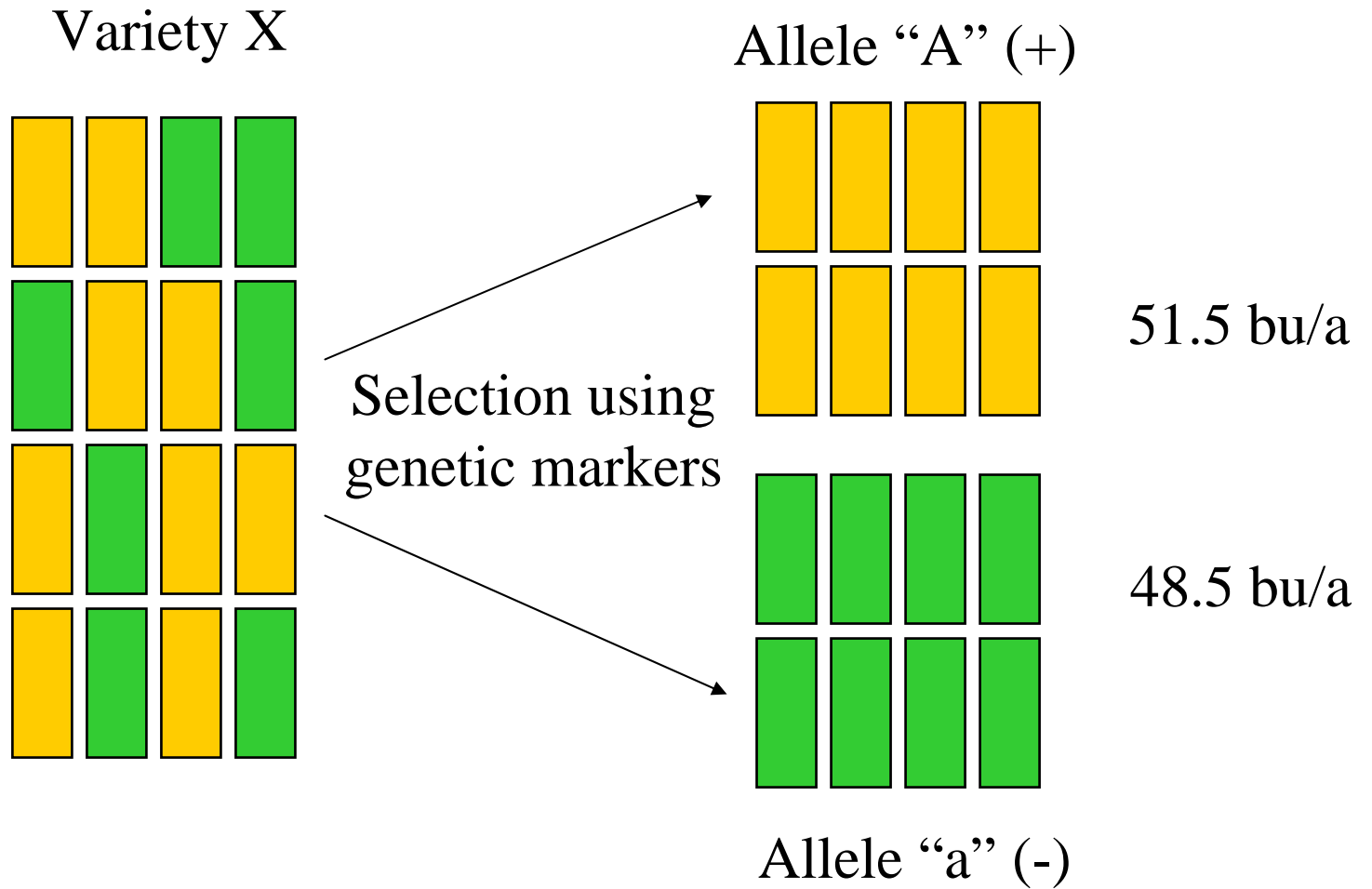


# Biotech Approaches to Yield

- Genetic fingerprinting (molecular markers) to track yield genes
- Transgenic approaches to enhance yield potential and/or stability
- Genomics to understand gene function and interactions



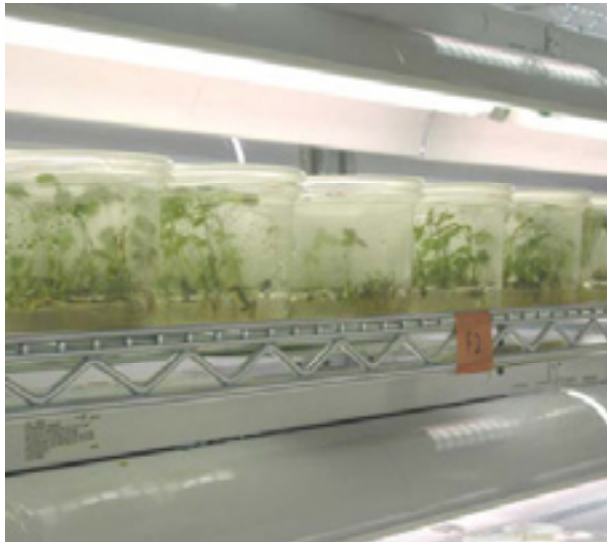
# Selecting for Yield Genes





# Transgenic Approaches

- Improve the efficiency of photosynthesis – “source”
- Improve the yield “sink”
- Improve resistance to drought, heat, insects and diseases



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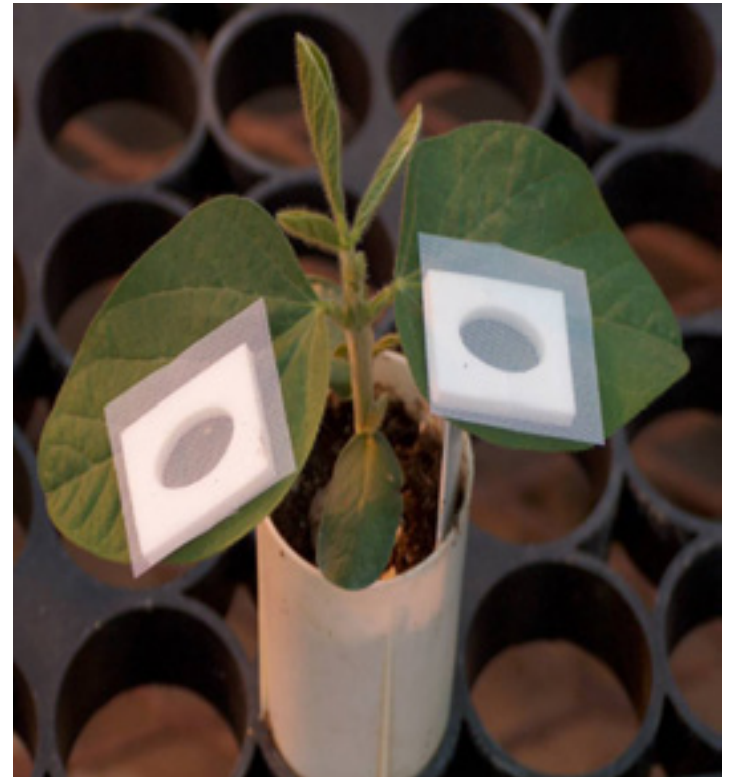
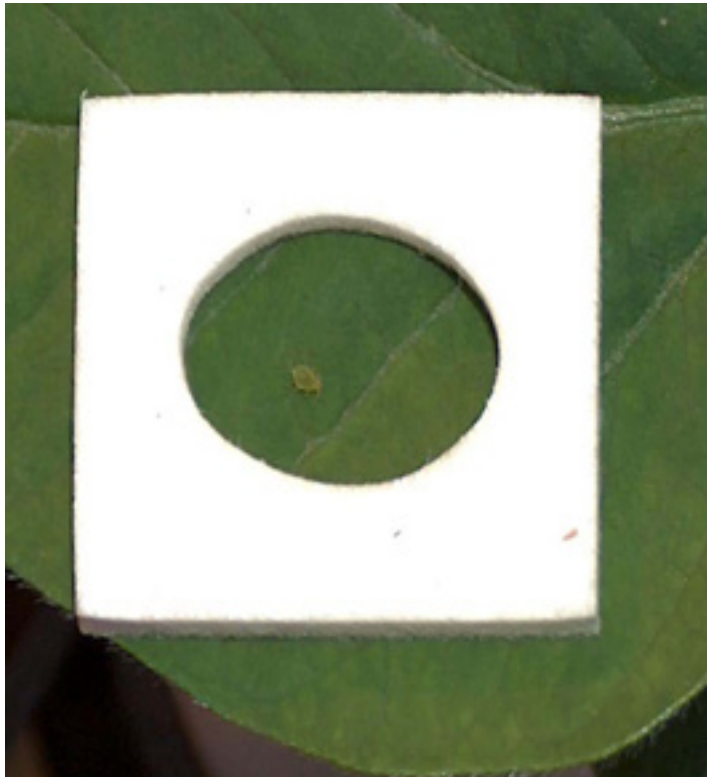
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# Chinese Soybean Aphid



# Aphid Screening

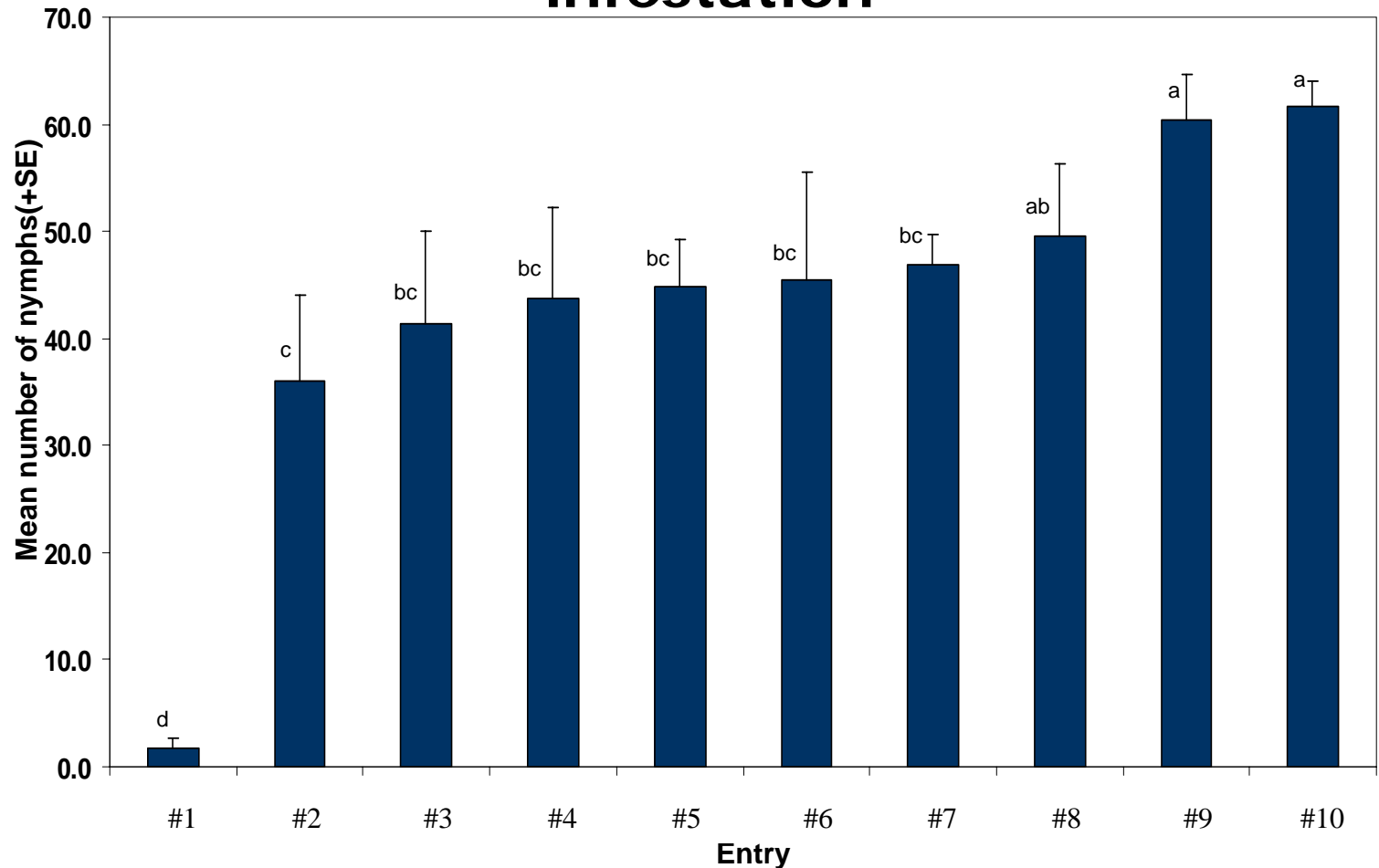


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# Reproduction of *Aphis glycines* on 10 soybean entries after seven days of infestation



Bars with the same letter are not significantly different ( $P < 0.05$ , Tukey's test).

Source: Kansas State University



# Asian Soybean Rust



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**FAST RUSTING**

**SLOW RUSTING**



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# MATO GROSSO

1. Harvesting

3. Vegetating

2. Pod filling

Extended period of sowing makes rust control difficult

Tapurah, Mato Grosso, Feb. 23, 2004



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# Maximizing Genetic Yield Potential

- Yield Expectation
- Field History
  - Diseases
  - Pests (Aphids, SCN, etc.)
- Product Selection
  - Maturity
  - Herbicide Resistance
  - Disease and/or Pest Resistance Traits
  - Agronomic Traits
- Increased Management of Pests
- Select a “Package of Products” to reduce risk



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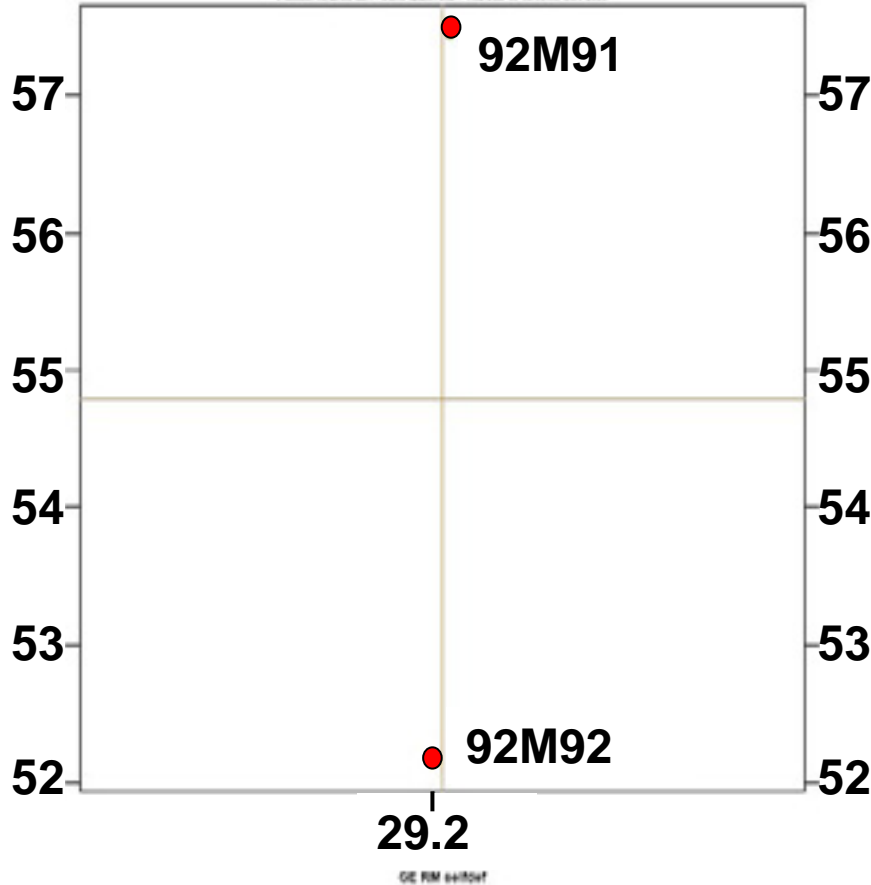
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# 92M91 vs. 92M92

## No SCN

Experiment: 92M91 vs. 92M92 0-99 SCN - 2004 - 48 LOCs

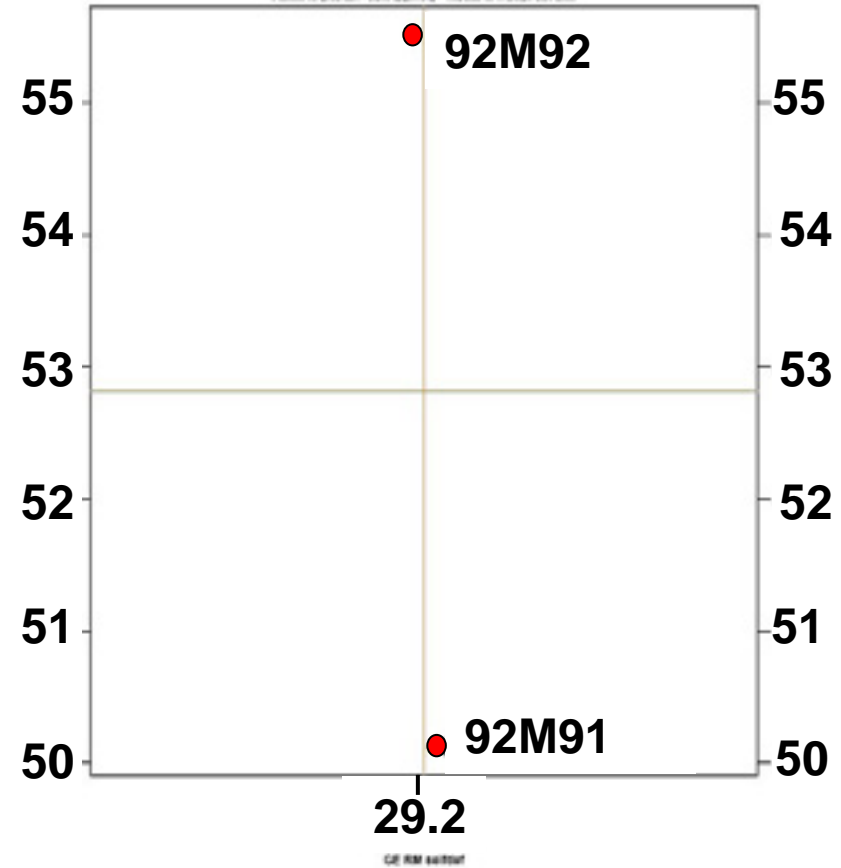
Power 92-Bred 921 - CONFIDENTIAL - The Jan 11 16:16:43 CST 2005



## High SCN

Experiment: 92M91 vs. 92M92 4000+ SCN - 2004 - 10 LOCs

Power 92-Bred 921 - CONFIDENTIAL - The Jan 11 17:16:24 CST 2005





# White Mold Damage

Wellman, IA – 8/24/04



93M11

WHD = 6

Competitor

WHD = ???

AUG 24 2004

# Sudden Death Syndrome Damage

Keota, IA 8-24-04

Competitor

SDS = ???



93M50

SDS = 6



93B68

SDS = 6

AUG 25 2004

# Take Home Messages

- We continue to seek new strategies to add to soybean performance, minimize grower risk, and add value
- Yield improvement will remain a primary focus of our research efforts
- We are confident that the application of biotechnology tools will increase the rate of yield improvement in soybeans
- We are working diligently to develop varieties that will handle key disease and pest challenges facing growers today and in the future
- Teamwork Across Disciplines