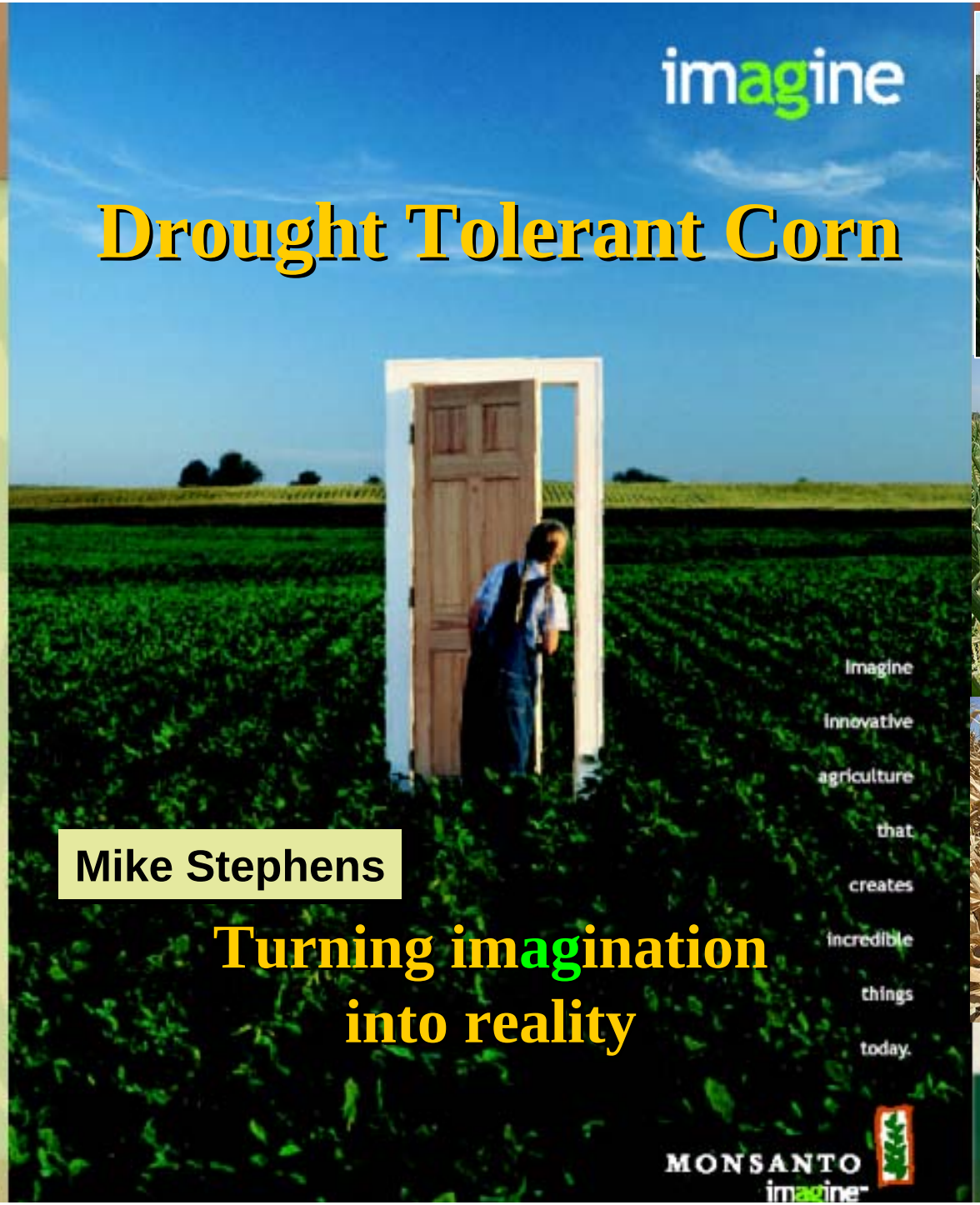
Drought Tolerant Corn



Mike Stephens

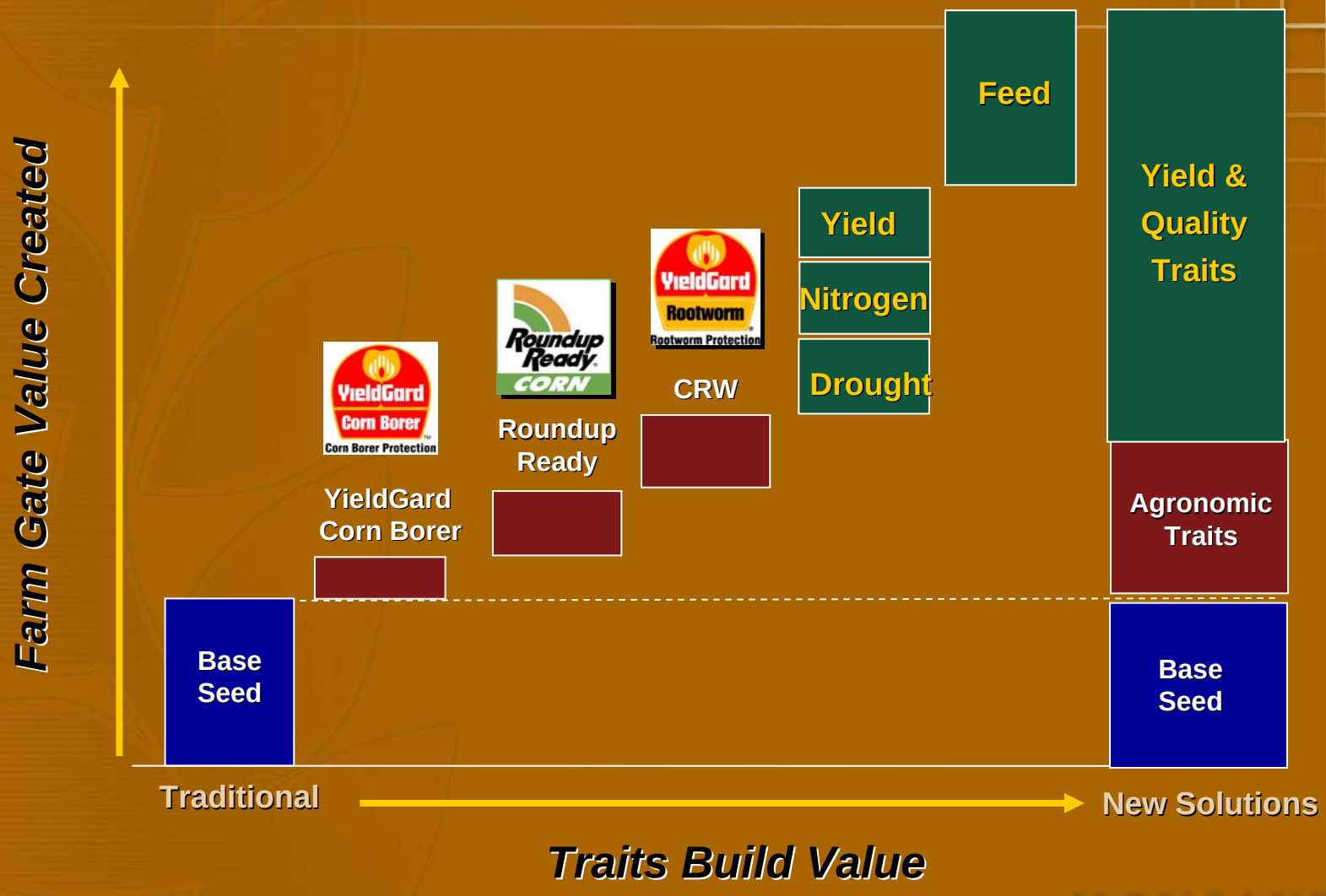
Turning imagination into reality

Topics

- Product Concepts
- Example of Progress – Corn
- Summary - discussion

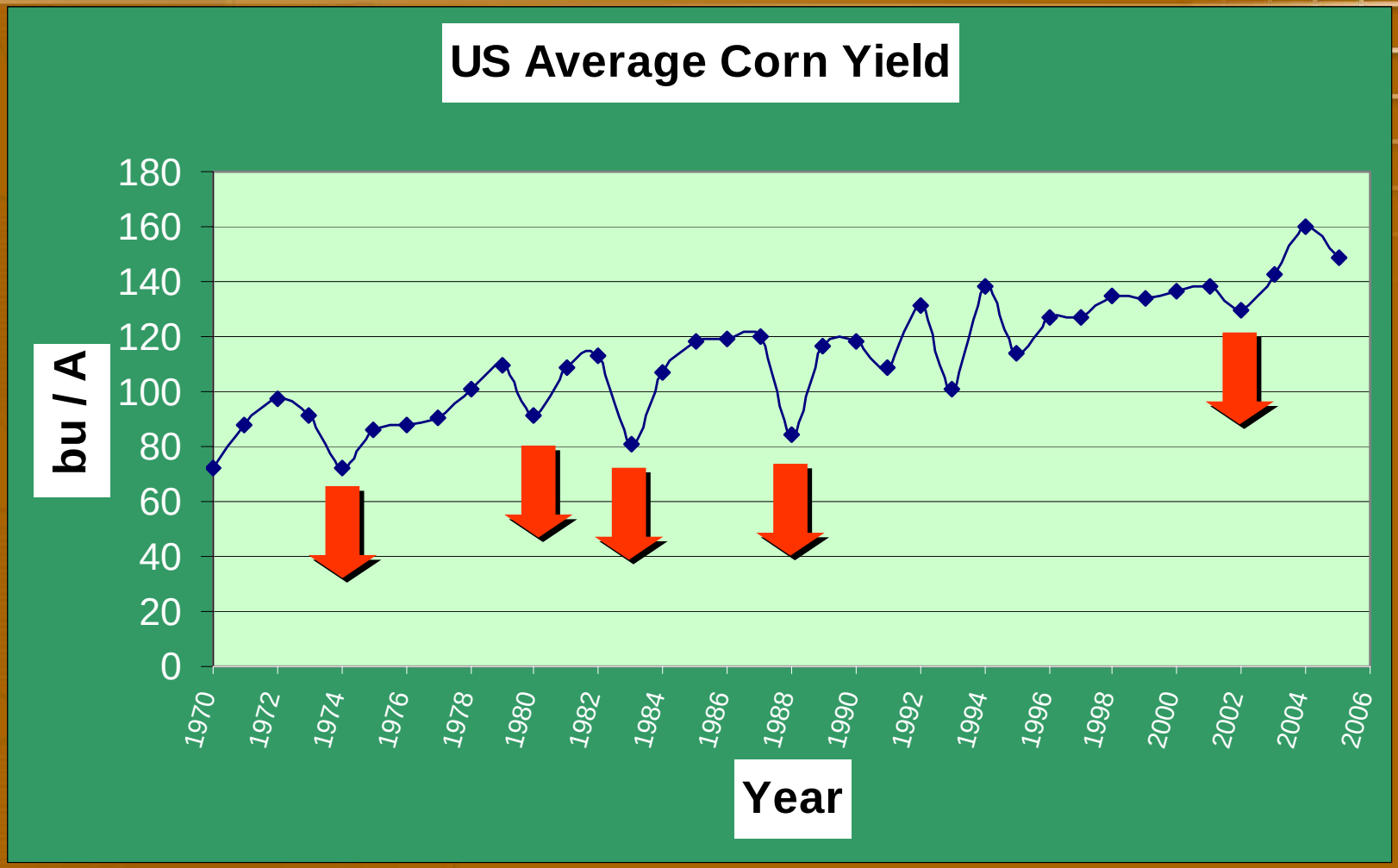
MONSANTO

New Biotech Yield Traits in the Pipeline Will Continue To Add Value To Corn



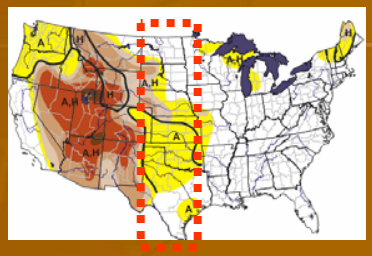
MONSANTO

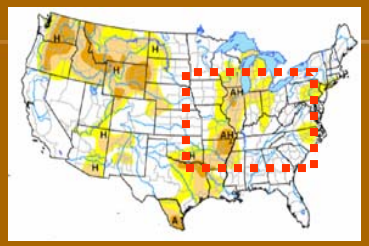
Increasing Yield Stability / Consistency



MONSANTO

Drought Tolerant Corn - Potential Product Concepts

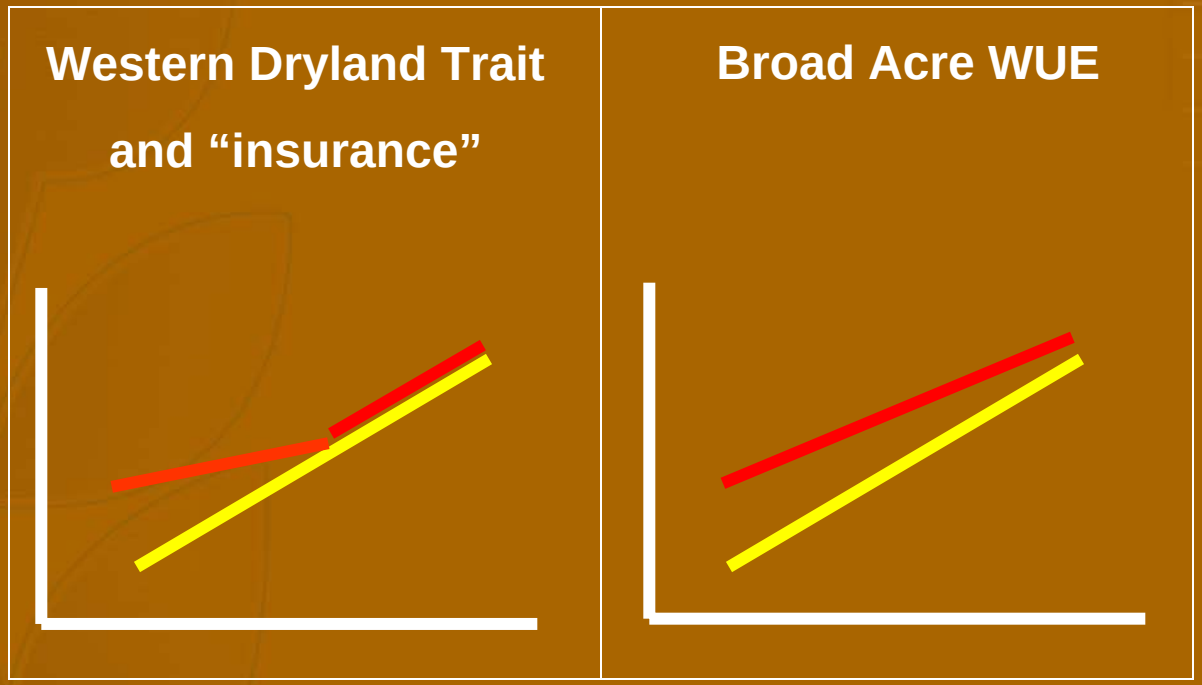




Product Concept	**Consistent Drought Stress Western US Dryland**	**Drought "Insurance"**	**Reduced Irrigation Costs**	**Broad Acre WUE**
Market	**KS, NE, TX, CO, SD**	**Central, E and S. corn belt**	**KS, NE, TX, CO**	**All corn acres**
	Opportunity for more crop choices for growers	**More reliable / consistent yields**	**Protect Aquifer water levels / reduce fuel consumption needed to pump water**	**Most corn experiences periodic water stress which limits yield**

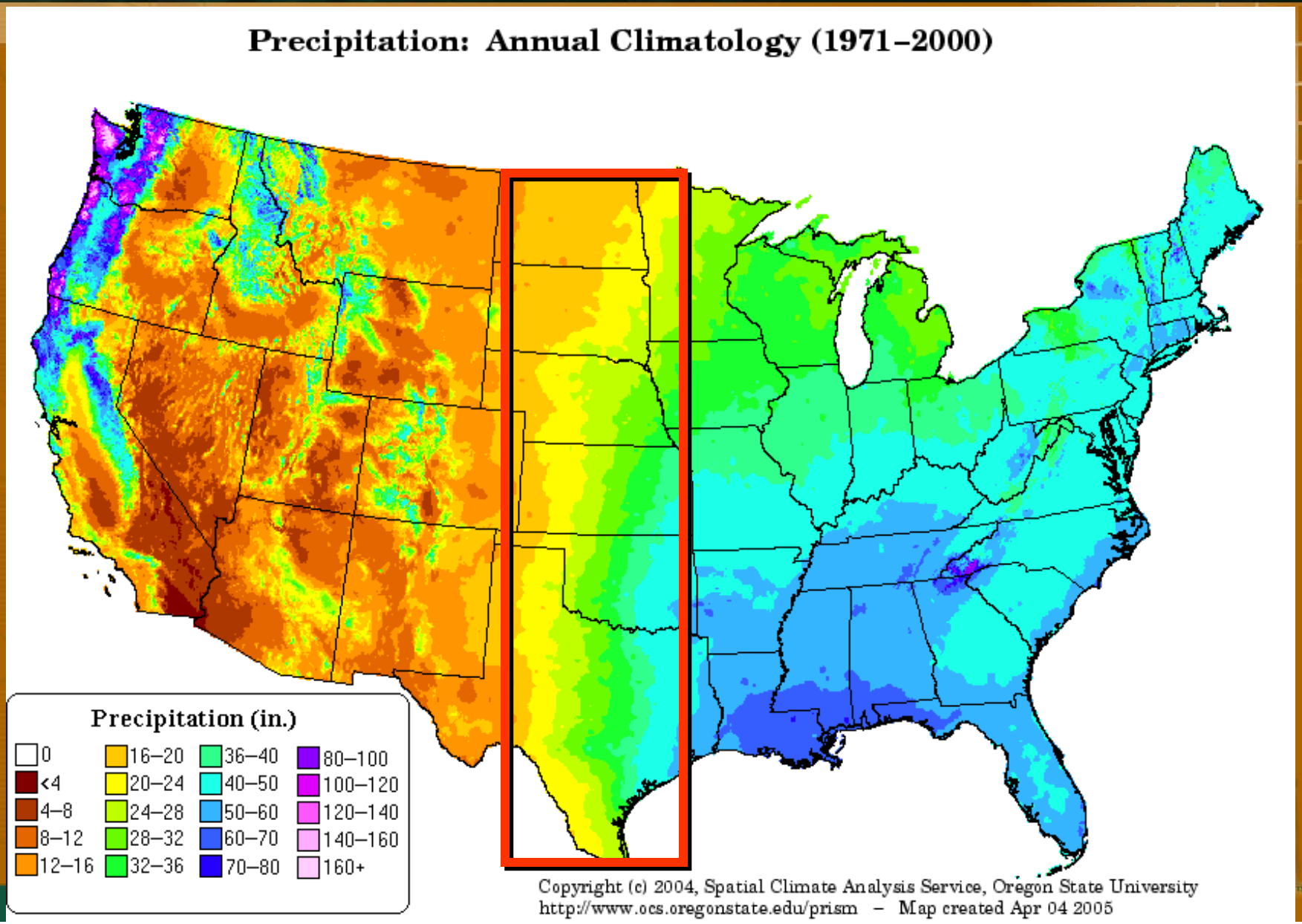
MONSANTO

Drought / WUE Product Concepts



MONSANTO

Annual precipitation in western plains can be 25-60% of the central corn belt



Traits that improve water utilization will make more productive use of water and potentially reduce irrigation costs

Irrigation is responsible for 70% of water withdrawn

Drought traits may eventually mitigate the effects of:

Depletion of aquifers

- Ogallala depleted at 1 - 5 ft / year. Affects river levels & increases conflict between users.

Increasing restrictions on wells

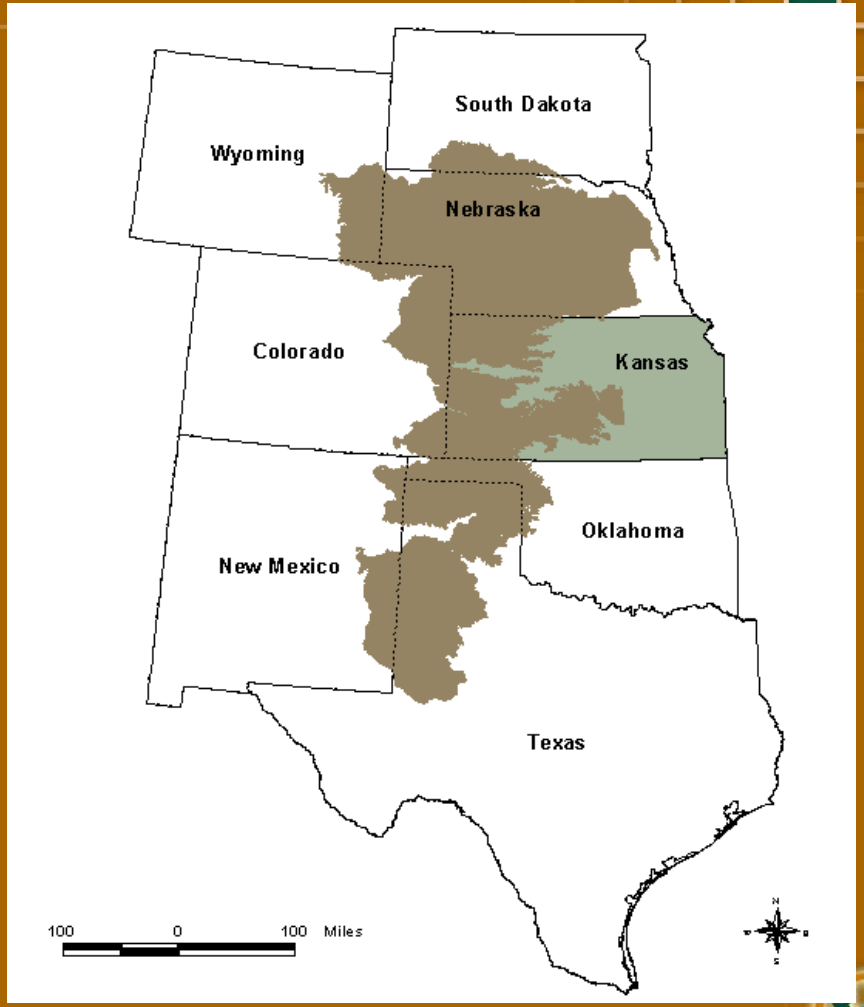
- Reduces volume and quality of water available

Higher pumping costs lower margin

- Deeper wells require higher pumping costs and fuel costs are higher.

Resulting in changes in farming practices

- More conservation measures (tilling, irrigation).
- Movement from irrigated corn to other crops

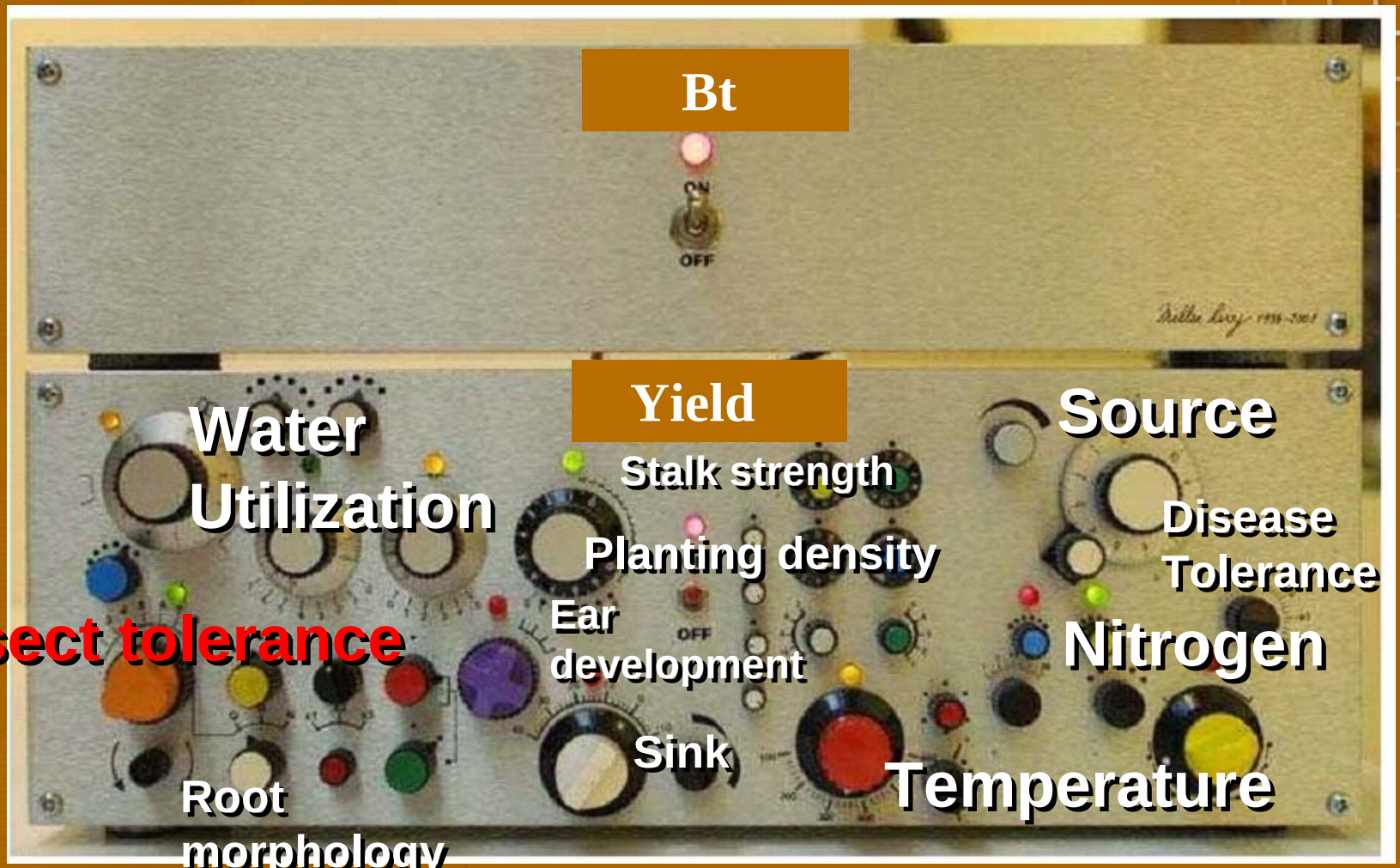


MONSANTO

- Product Concepts
- **Example of Progress – Corn**
- Summary - discussion

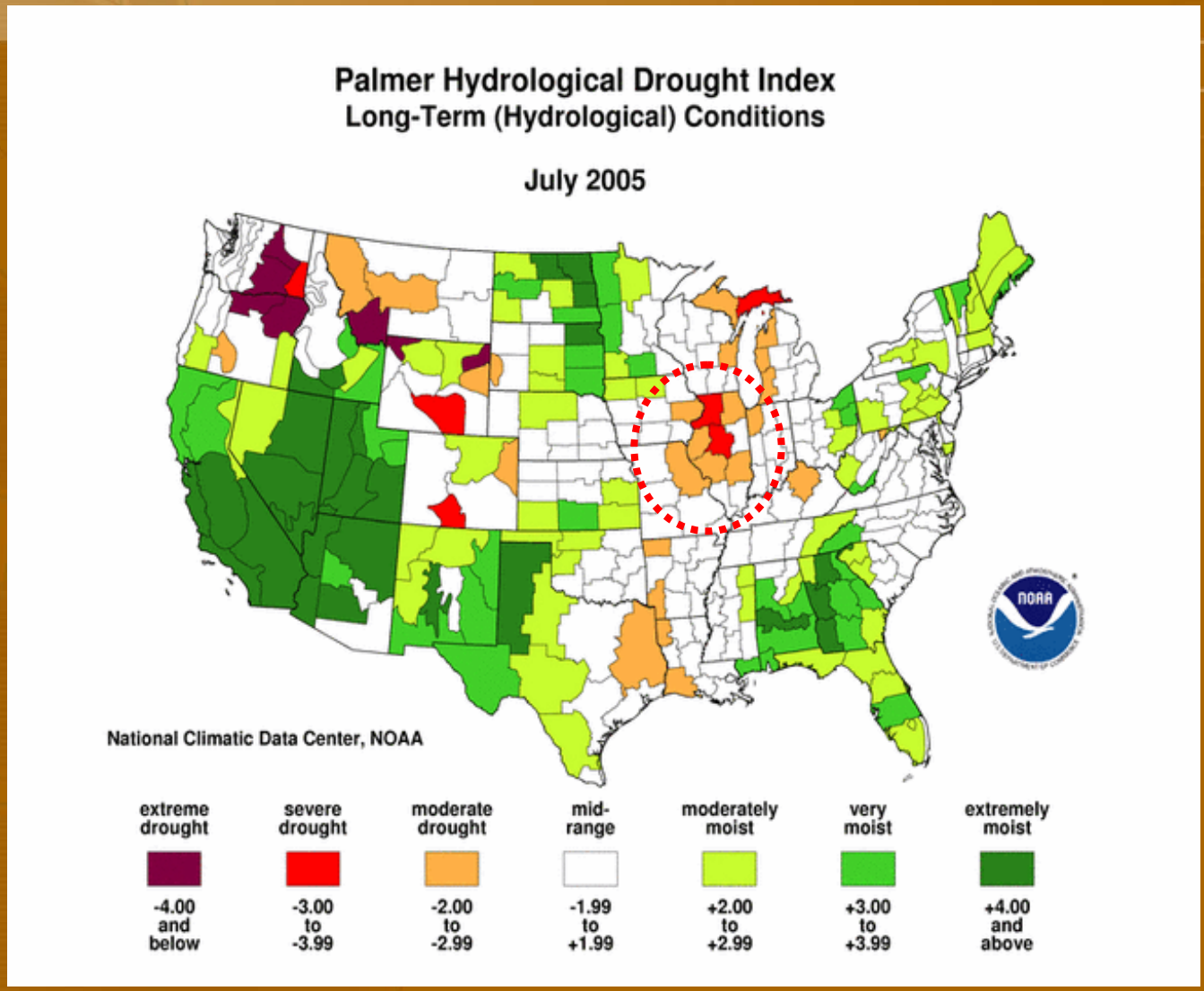
MONSANTO

Yield is a complex quantitative trait but individual components affecting yield can be modified using single genes



MONSANTO

Commercial Biotech traits already reduce risk during dry growing conditions



Palmer Hydrological Drought Index

MONSANTO

Protecting roots - protects yield

2005 Drought Conditions U.S. Corn Belt

In Severe Drought

YieldGard® Plus

*16.6 bu/A**

Advantage

over YieldGard Corn Borer
with Soil Insecticides

In Moderate Drought

YieldGard Plus

*11.5 bu/A**

Advantage

over YieldGard Corn Borer
with Soil Insecticides

Approximately 25% of growers in the drought-stricken regions of IL experienced >30 bu/A advantage with YieldGard corn borer + YieldGard Corn rootworm versus YieldGard Corn Borer + Soil Insecticides.*

U.S. Corn Belt Summary

*10.9 bu/A***

Advantage with YieldGard Plus
vs Conventional Hybrids with Soil Insecticides

YieldGard Plus
Maximum Insect Protection

** Source: 195 field trial head-to-head comparisons; grower on-farm and Monsanto trials, 2005.

* Source: 231 severe drought zone field trials; 278 moderate drought zone field trials.

Using Functional Genomics to Identify Lead Genes for Drought Tolerance

Current revenue re-invested in development of future traits

- **High Throughput Greenhouse & Field Screens**
- **Detailed Physiology Trials**
- **Controlled Drought Field Yield Trials**
- **Multiple Location & Germplasm Yield Trials**

MONSANTO

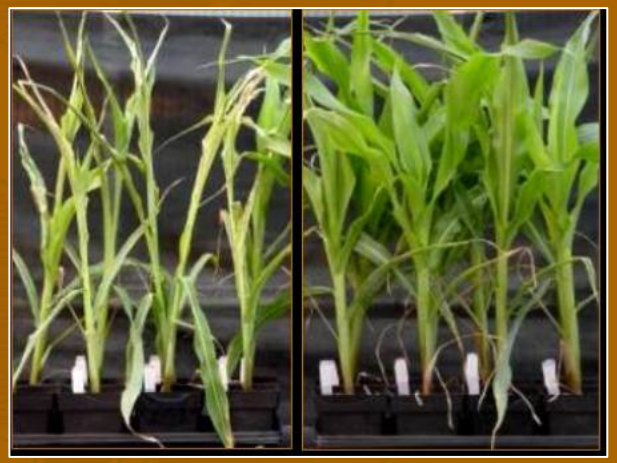
Drought Stress Tolerance in Model plants

Arabidopsis

Rice

Drought Tolerant Crops Demonstrated in Greenhouse and Field

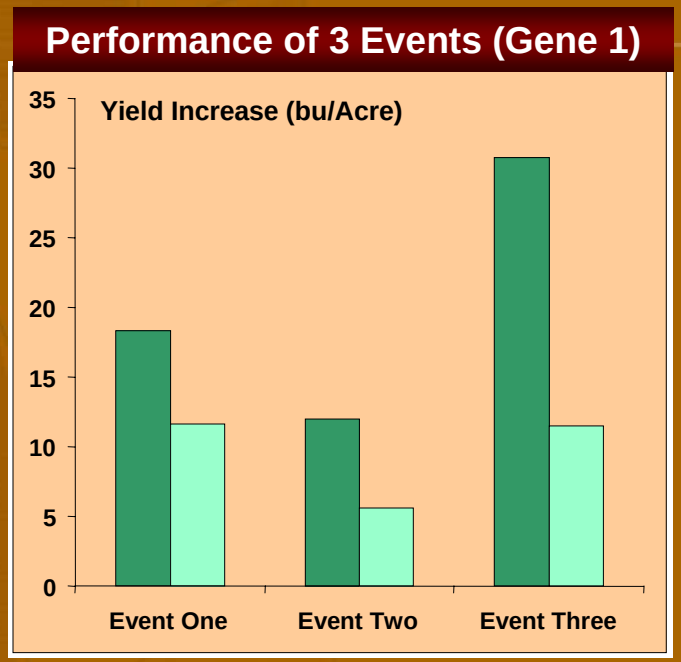
2003

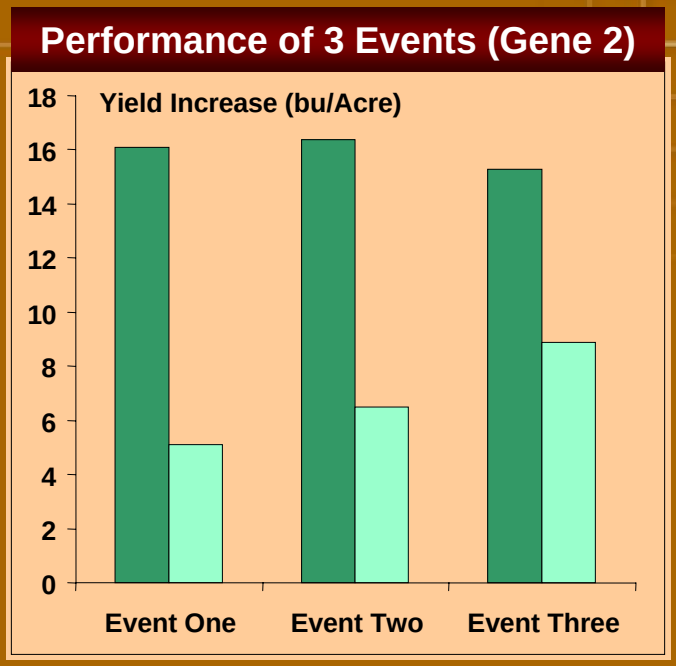


MONSANTO

2004 - Quantitative Results From Field Tests

Relative to isogenic check





Hybrid background A

Hybrid background B

- More kernels per ear and more ears harvested.
- Benefit is real
- May vary with environment & germplasm

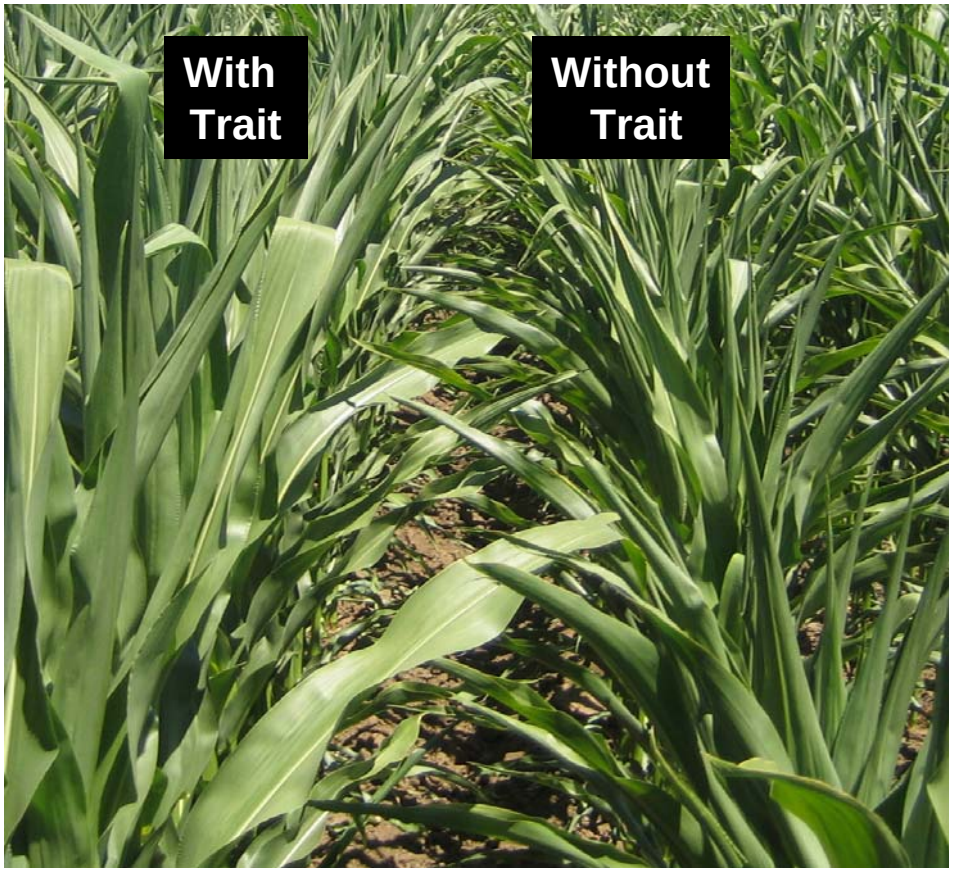
MONSANTO

Standard agronomic traits collected in yield trials:

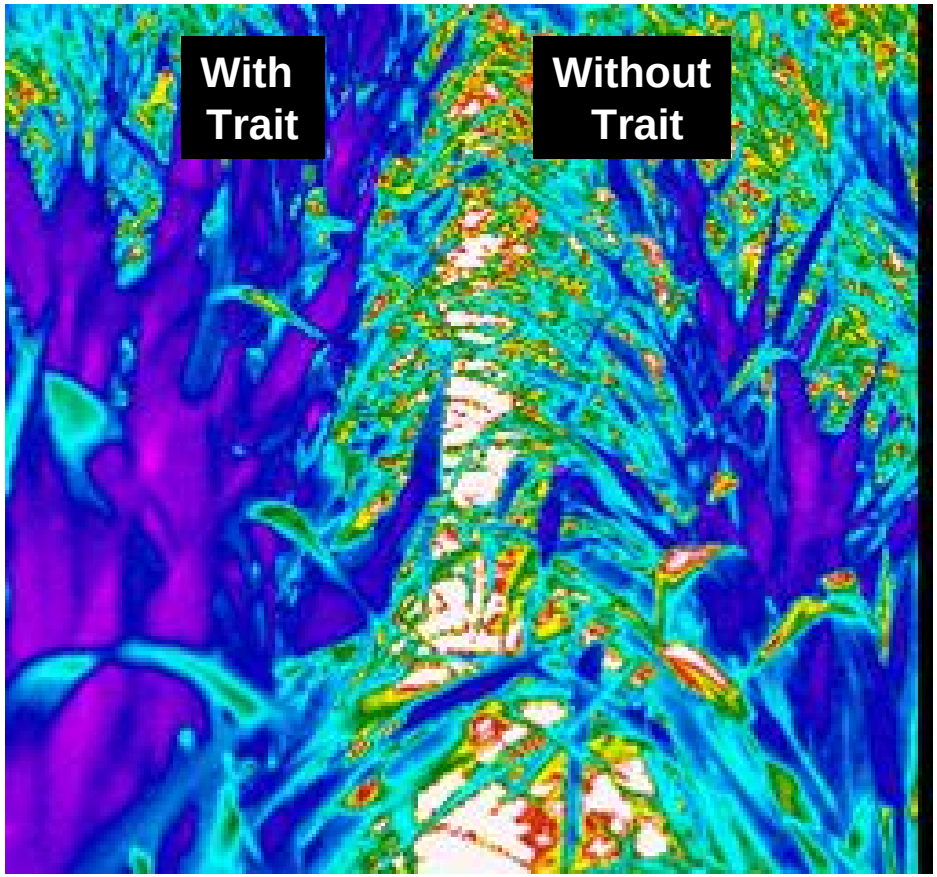
- Stand
- Greenness
- Flowering
- Plant Height
- Root & Stem Lodging
- Disease Ratings
- Grain Yield
- Grain Test Weight
- Grain Moisture
- Grain Quality Parameters

MONSANTO

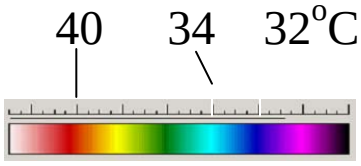
2005 - Vegetative Phenotypes Repeated



Reduced Leaf Rolling

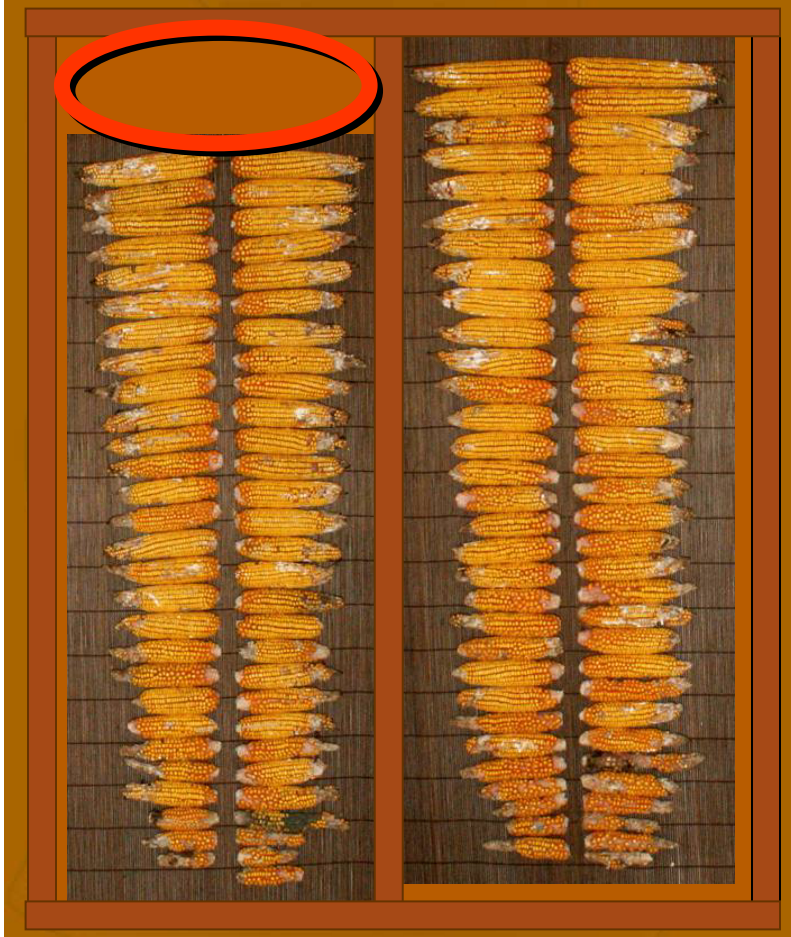


Reduced Leaf Temperature



Results from 2005 trials
Multiple leads again showed yield benefit

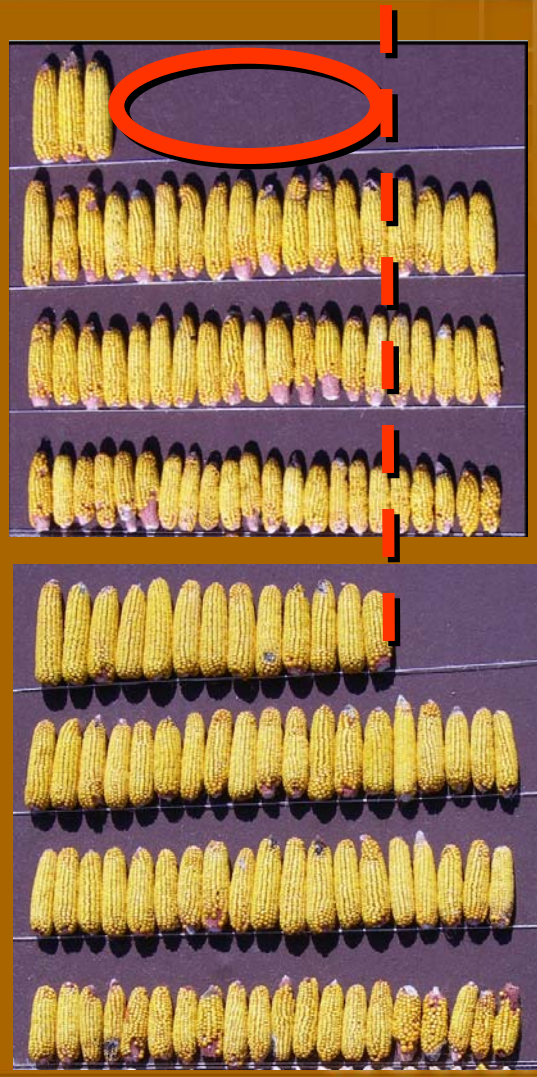
KS



Without Trait

With Trait

CA



Without Trait

With Trait

Combination of traits & germplasm will provide options & the best stress mitigation packages for growers

Breeding
for stress tolerance and Yield potential

Traits
for Stress Tolerance
(while maintaining yield potential)
-YGCB /YGRW
- Drought
- Nitrogen
- Cold

Hybrid / trait combinations
adapted for adverse growing conditions
-more stable and consistent-

MONSANTO

Summary – Drought Tolerant Corn

- **A Trait that will Reduce Risk:**
  - Drought tolerance is one of a set of traits that reduce risk for growers by mitigating the effects of abiotic and biotic stresses on crops.
- **In Development:**
  - Researchers are developing biotech traits and germplasm that will enhance yield under drought stress for corn and other important crops.
- **Multiple Benefits:**
  - Growers:
    - Improve yield consistency, profitability, potentially reduce input costs (e.g. irrigation = energy) and potentially provide growers with more crop options.
  - Provide more consistent supply of feed stocks for animals and ethanol plants
- **Combinations of Traits and Germplasm:**
  - To provide the best stress mitigation solutions these traits will need to be provided in elite adapted germplasm.

MONSANTO

imagine™