Agronomic Management for Optimizing Corn Yields

Larry Hendrickson
John Deere Technology Innovation Center

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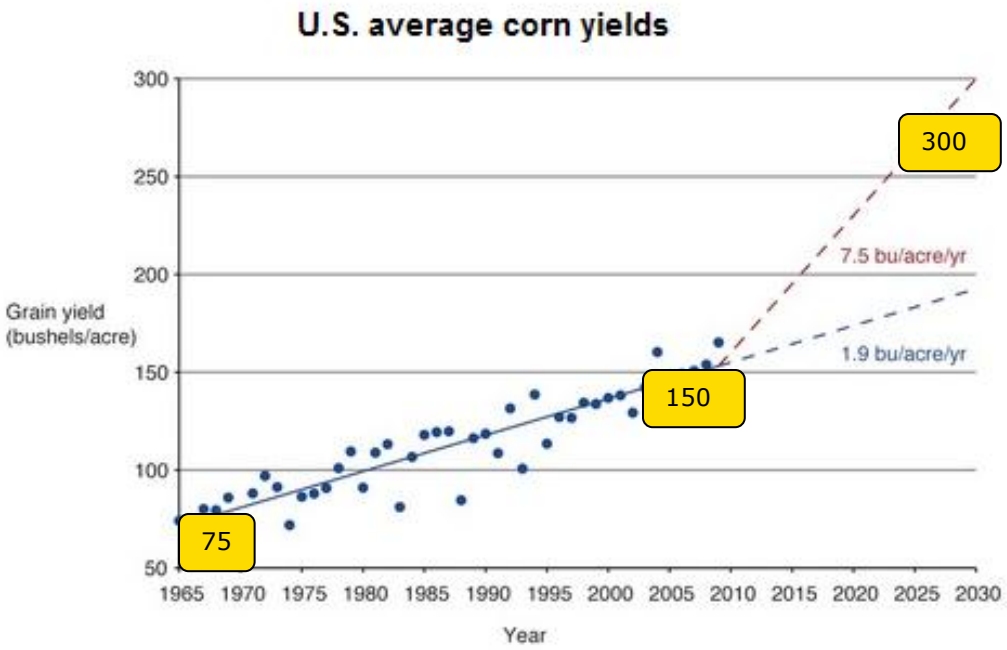
Agronomic Challenge

John Deere has produced new products that are bigger, wider, faster to increase productivity

Need to switch from bu/operator to bu/acre

With challenge to raise yields, we also need to focus on products that more consistently satisfy plants' requirements. Plants are our real customers



Summarize some John Deere initiatives to understand opportunities for improved equipment and technology

With high crop and land prices, our customers can't leave yield in the field

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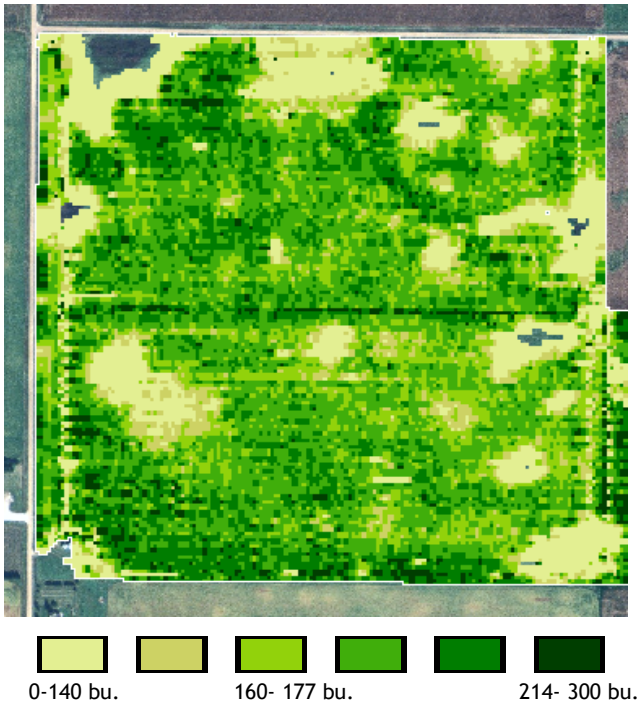
Critical Agronomic Concepts

- Seed industry and annual weather determine yield potential for each field, but only some of this is realized

- Considerable crop variability
  - Localized (plant level)
  - Topography induced

- Can we bring the entire field up to its yield potential?

- This would accelerate yield improvement and reduce our environmental footprint



Plant to Plant Variability

- What causes this plant variability?
  - Seeds are identical
  - Uniform soil properties over short distances
  - Do our field operations contribute to this variability?
- Can we improve our equipment and technology to reduce this variability?

Proximity to N Fertilizer Bands

Table 5. Corn response to preplant banded UAN application and RTK-guided corn row placement at Wanatah, 2006-2008†

Starter Fertilizer?	Preplant N rate and Placement	Stand 4 weeks	Plant Height	Harvest Moisture	Yield @ 15.5%
		ppa	in	%	bu/A
None	0 pre-plant UAN	33449ab‡	22.4bc	21.6d	200.9ab
	50 lbs on row	31972b	22.0c	21.9bcd	202.2ab
	50 lbs 5 inches	33694a	23.1abc	21.6d	203.7a
	50 lbs 10 inches	34326a	24.2a	21.5d	202.9ab
	100 lbs on row	28092c	20.3d	22.5ab	183.0c
	100 lbs 5 inches	33523ab	22.2c	21.8bcd	200.2ab
	100 lbs 10 inches	34000a	24.0a	21.5d	202.8ab
	200 lbs on row	20852d	16.0e	23.0a	143.4d
	200 lbs 5 inches	33791a	22.0c	22.4abc	193.6b
	200 lbs 10 inches	34018a	23.9ab	21.8cd	201.3ab

All treatments received a total of 200N, so above differences were only due to placement

Found similar yield impact on 2 of 3 sites over 3 years. Other site was affected much less.

From Vyn and West, 2009

2510H Applicator

2510H Applicator

- High Speed—10 mph
- NH_3 or UAN
- 4.5” Depth Coulters
- Clearance allows application to 30” corn
- Makes sidedress a more viable option for many growers

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Implement Guidance

Offers potential to target planting to fertilizer bands, tillage strips, and previous crop rows

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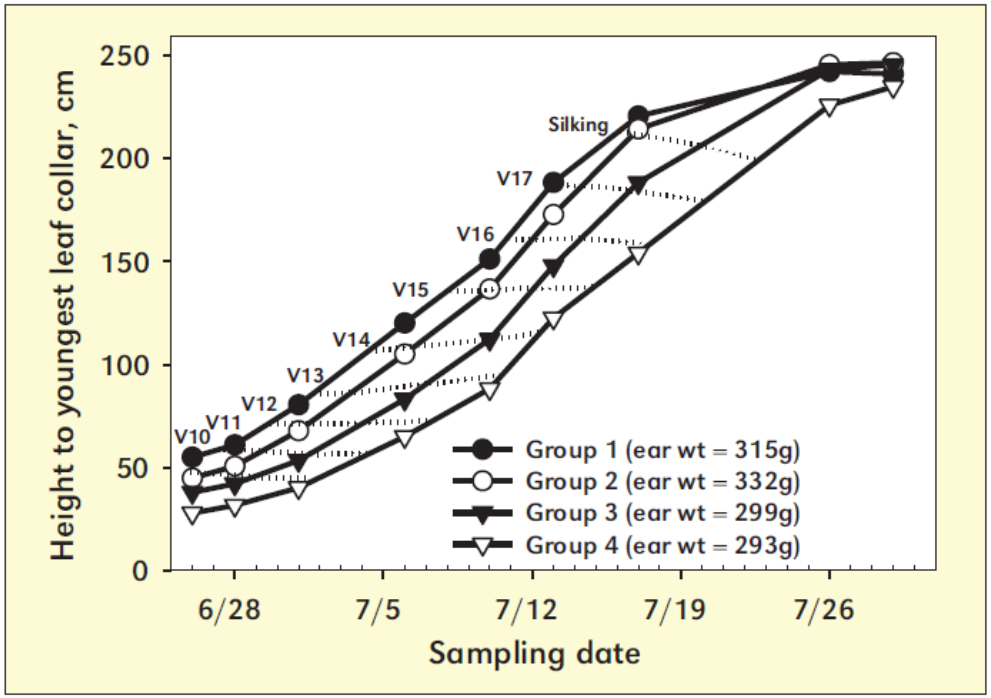
Purdue study

- Comparing NH3 bands applied diagonally vs. applied 6” from seed rows
- Evaluating yield response and plant variability as impacted by proximity to NH3 bands
- Results from first year available and will be published later

Positive Response to Nearby Nitrogen Bands

Corn plants show when their roots first reach bands created by injection of anhydrous ammonia.

Zhang et al. (2010)



Growing perspective that applying nutrients using #/acre methods often doesn't satisfy individual plants

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Internal Studies

- Field studies with steerable planter and steerable 2510H
- Comparing offsets of 0, 5, 15 inches from NH3 band
- NH3 band applied 2 weeks before, 2 days before, and 2 weeks after planting
- Results currently being analyzed

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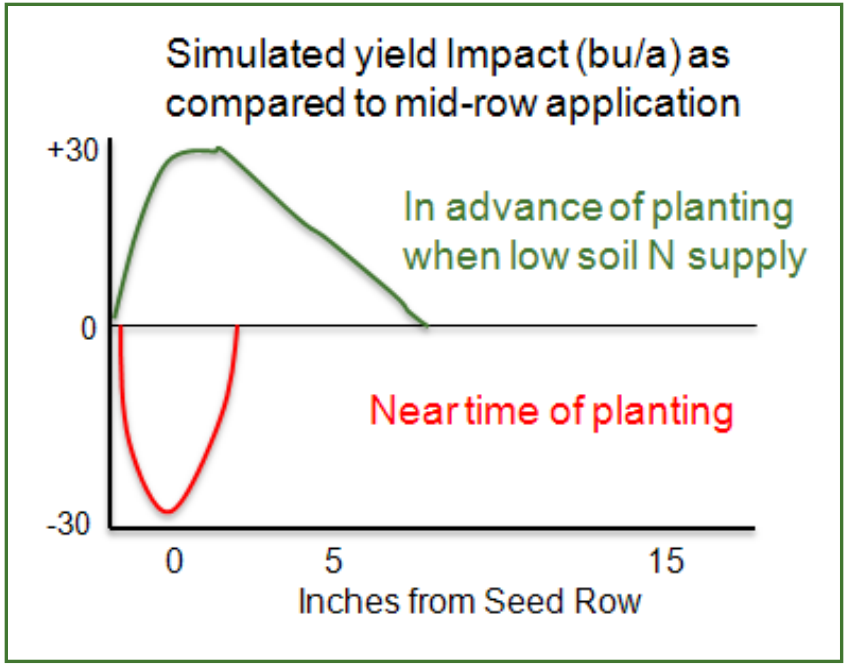
Observations about Impact of NH3 Band Placement

Very large yield differences due to N proximity in some fields

Optimum placement likely depends upon when nitrogen is applied

- Potential phytotoxicity
- Early season access to corn seedlings

Placement likely adds additional complexity and new opportunities for N management



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Fertilizer Distribution from a Breeding Perspective

Proximity to banded N fertilizer is an important consideration

- Probably more important when overall N fertility is limiting (wet springs, corn/corn)
- Resultant plant growth patterns more apparent when fertilizer is banded
- Likely makes field evaluation of NUE traits more difficult

Can we assume that broadcast fertilizer will reduce plant variability?

- Some reports showing that soil levels of P, K vary over short distances
- Broadcast application likely not superior if we need to ensure even distribution to each individual plant
- Likely need to think about applying g/plant rather than lbs/acre

What can you do to provide a more consistent environment for each seed in your selection and evaluation programs?

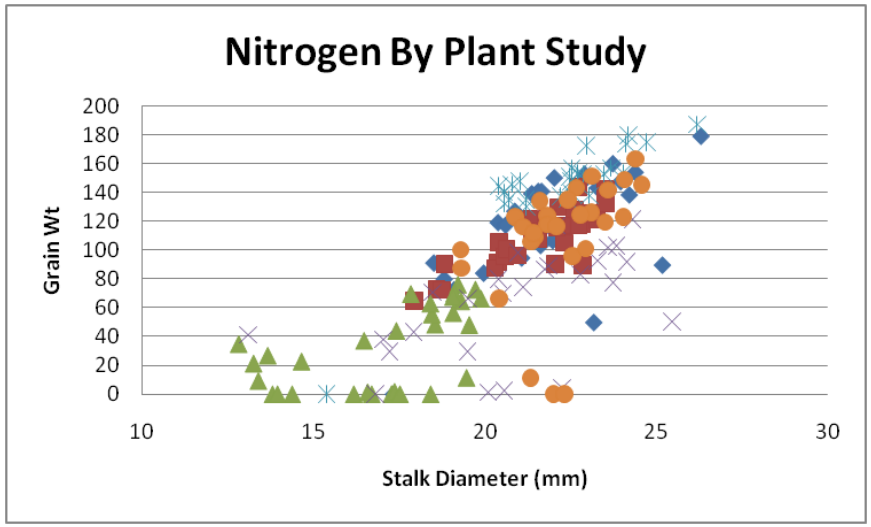
Accurate Guidance Across Field Operations

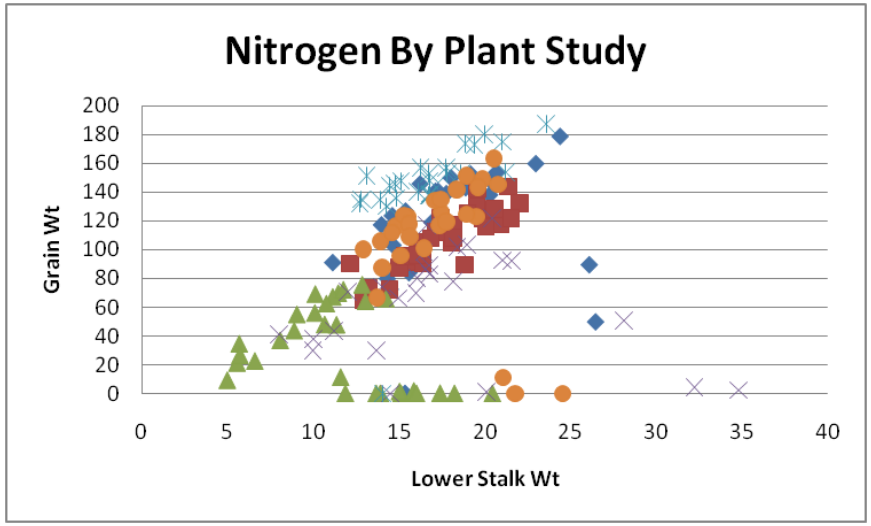
- More corn following corn
- Higher yields means more plant residue
- Residue is more resistant to decomposition over winter

- Would consistent planting in relationship to previous plant rows reduce variability?
- Might this be beneficial from a disease perspective?

Individual Plant Characterization

- Preliminary project with Emerson Nafziger to explore impact of N fertilizer placed near individual plants
- Plants responded as might be expected.
- Strong relationship between ear yield and stalk diameter and weight
- Project with Tony Grift to explore potential stalk sensor
- Rapid phenotyping tool?





Topography often dictates yield potential

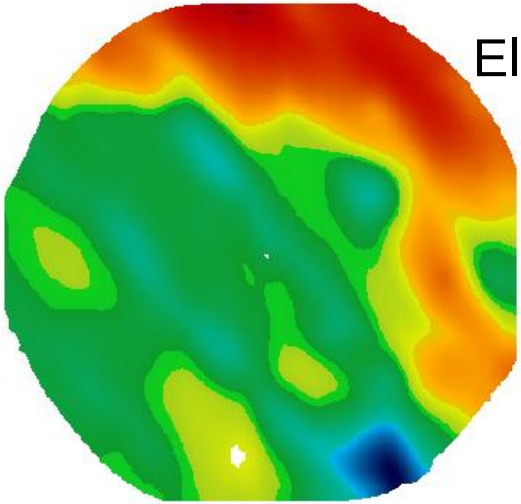
We have observed that crop yields are consistently related to topography, supporting a conclusion that water is the most important factor controlling crop yields

Landscape patterns create large differences in soil moisture patterns

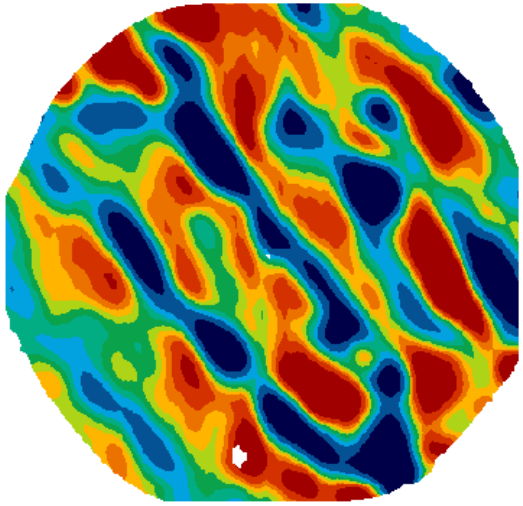
- Soil moisture during operations
- Available moisture supply

This soil moisture pattern then drives differences in crop establishment, development rates, and duration of grain fill

Landscape Position (LSP) Zones for Nebraska field

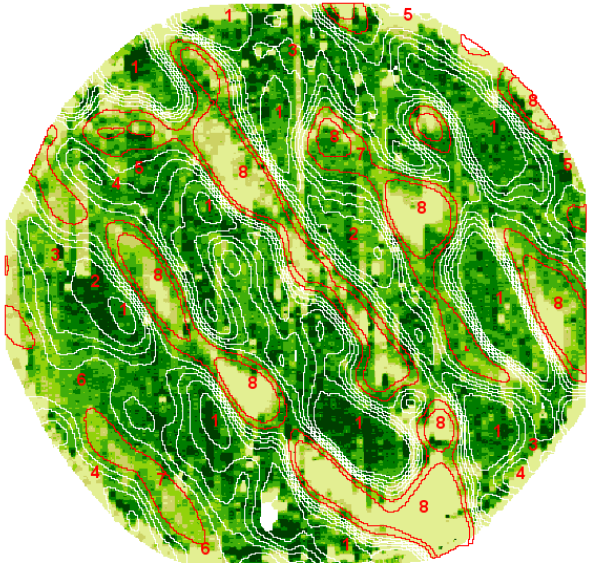


Elevation



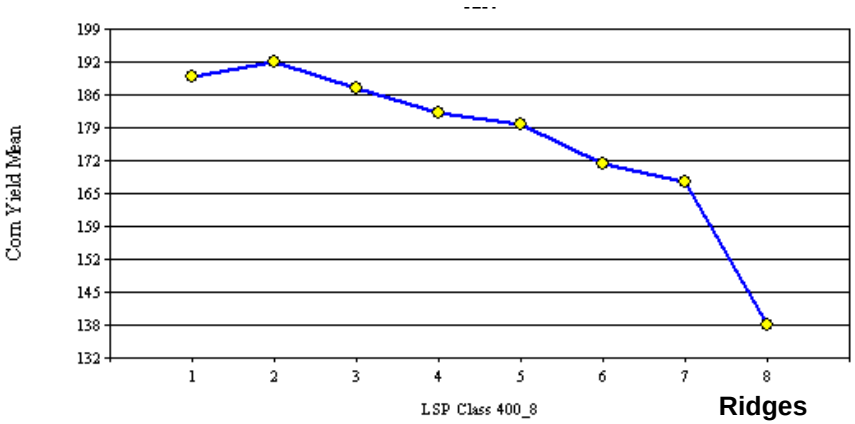
LSP Zones

- Depression
-
-
- Sideslope
-
-
-
- Ridge



Corn Yield

- Minimum to 80.00
- 80.00 to 120.00
- 120.00 to 150.00
- 150.00 to 180.00
- 180.00 to 200.00
- 200.00 to 220.00
- 220.00 to Maximum



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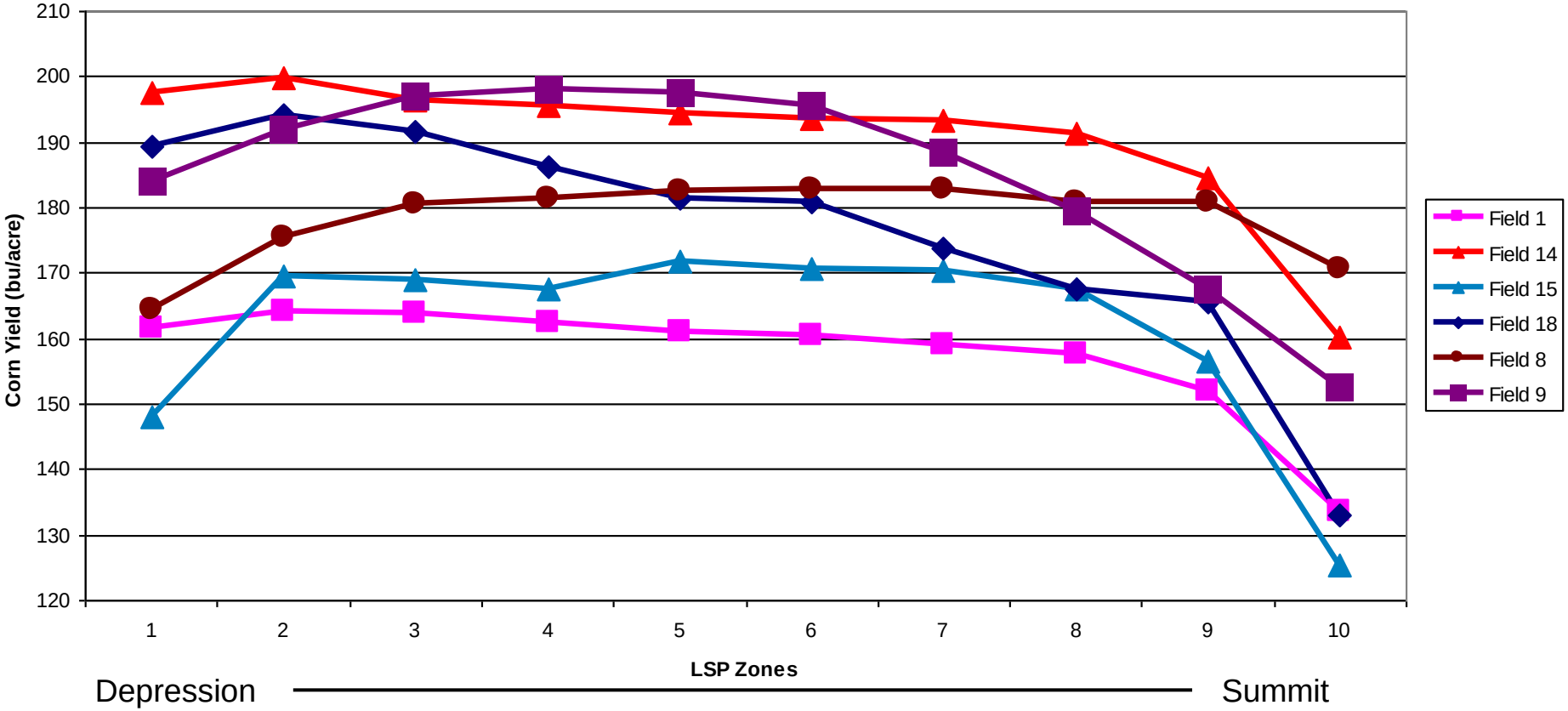
Yield variability related to LSP—Across Nebraska fields



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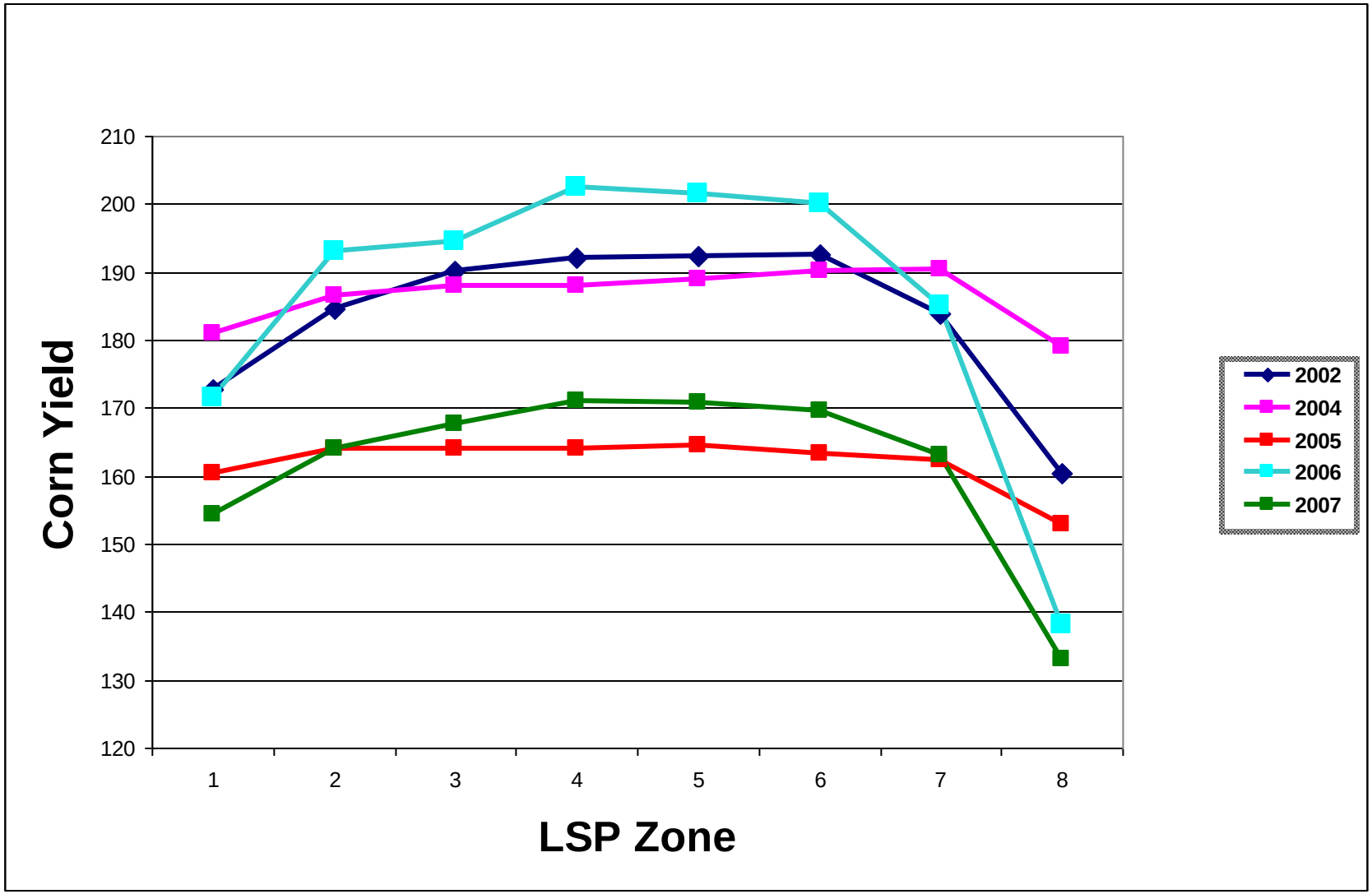
Yield variability related to LSP—Across years on NE field



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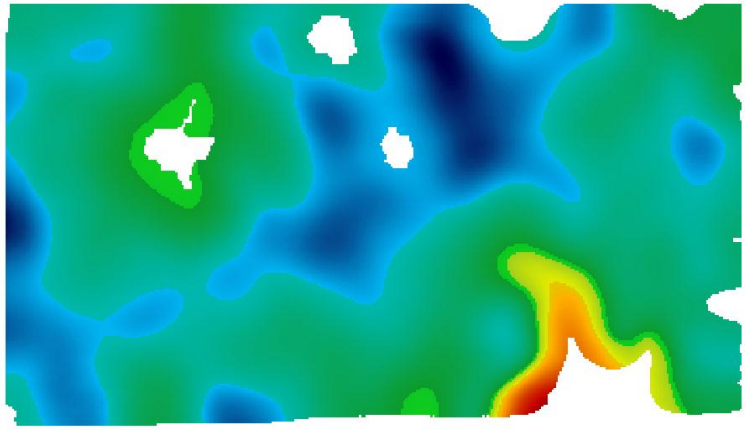
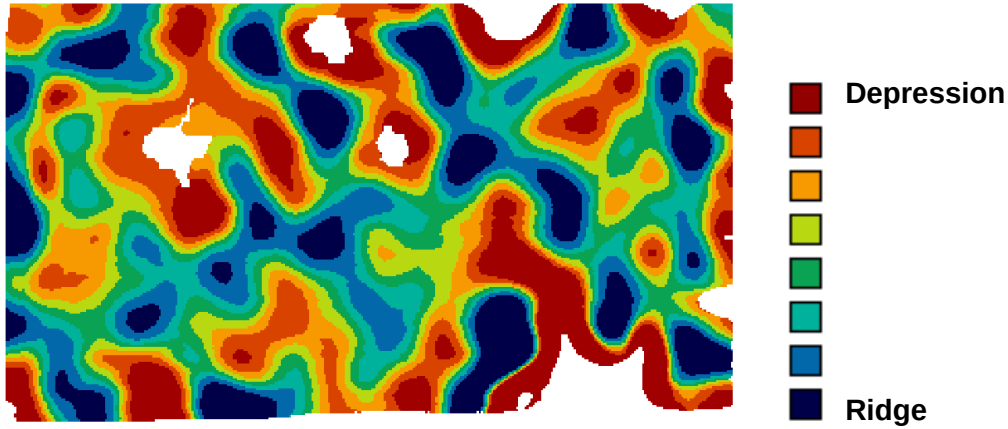
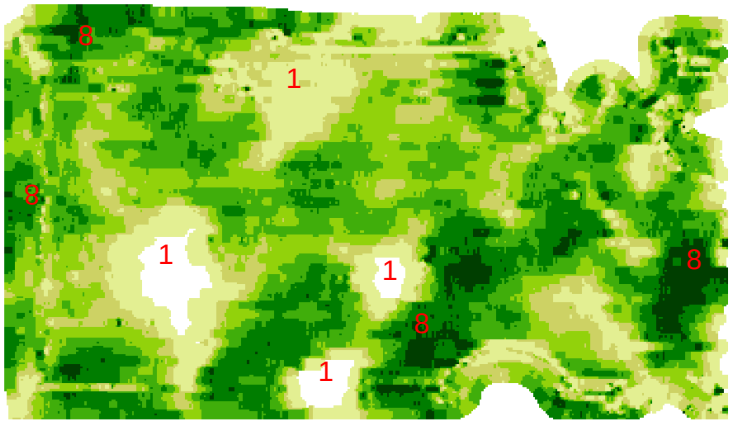
Landscape Position (LSP) Zones for Iowa Field

Elevation

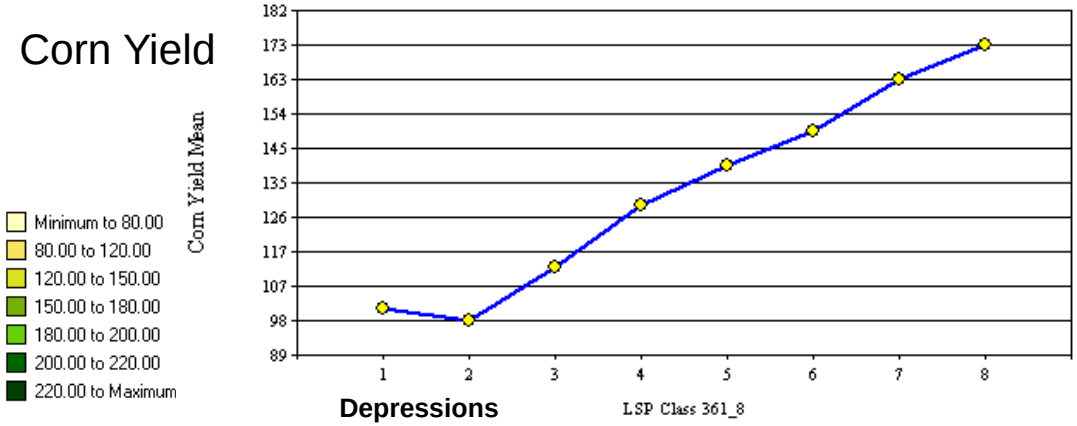


LSP Zones





Corn Yield



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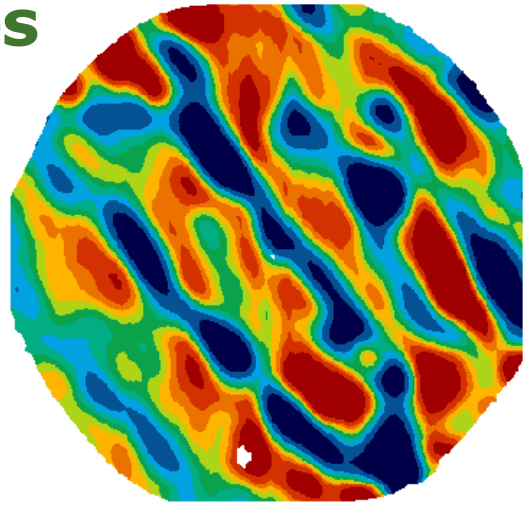
Possible applications of LSP zones



- Targeted drainage plans
- VR irrigation

- Could LSP drive seed rate, hybrid decisions?
- Could LSP improve GxExM models?
- Could LSP (soil moisture environment) be useful for genotype development projects?

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Intelligent Equipment—Next Generation of Precision Ag

Always less moisture on ridges than in lower areas

Planting:

- Optimum seed placement depth
- Required down-pressure

Residue Management and Tillage:

- Seedbed conditions
- Soil moisture control
- Erosion control on slopes

Summary

•Can we reach 300 bu/acre by paying more attention to variability?

•We need all plants to take full advantage of their genetic potential

•How can John Deere improve its equipment and technology to provide a more consistent environment to each plant?

•Can you exploit these new perspectives in your genotype development programs?

•What are opportunities for us to work together on new solutions?