Silver Anniversary Lecture
Evolution of Yield Monitors in the Last 25 Years

Paul Jasa, Nebraska Extension

Yield monitor data collection, best practices for utilizing harvest data…

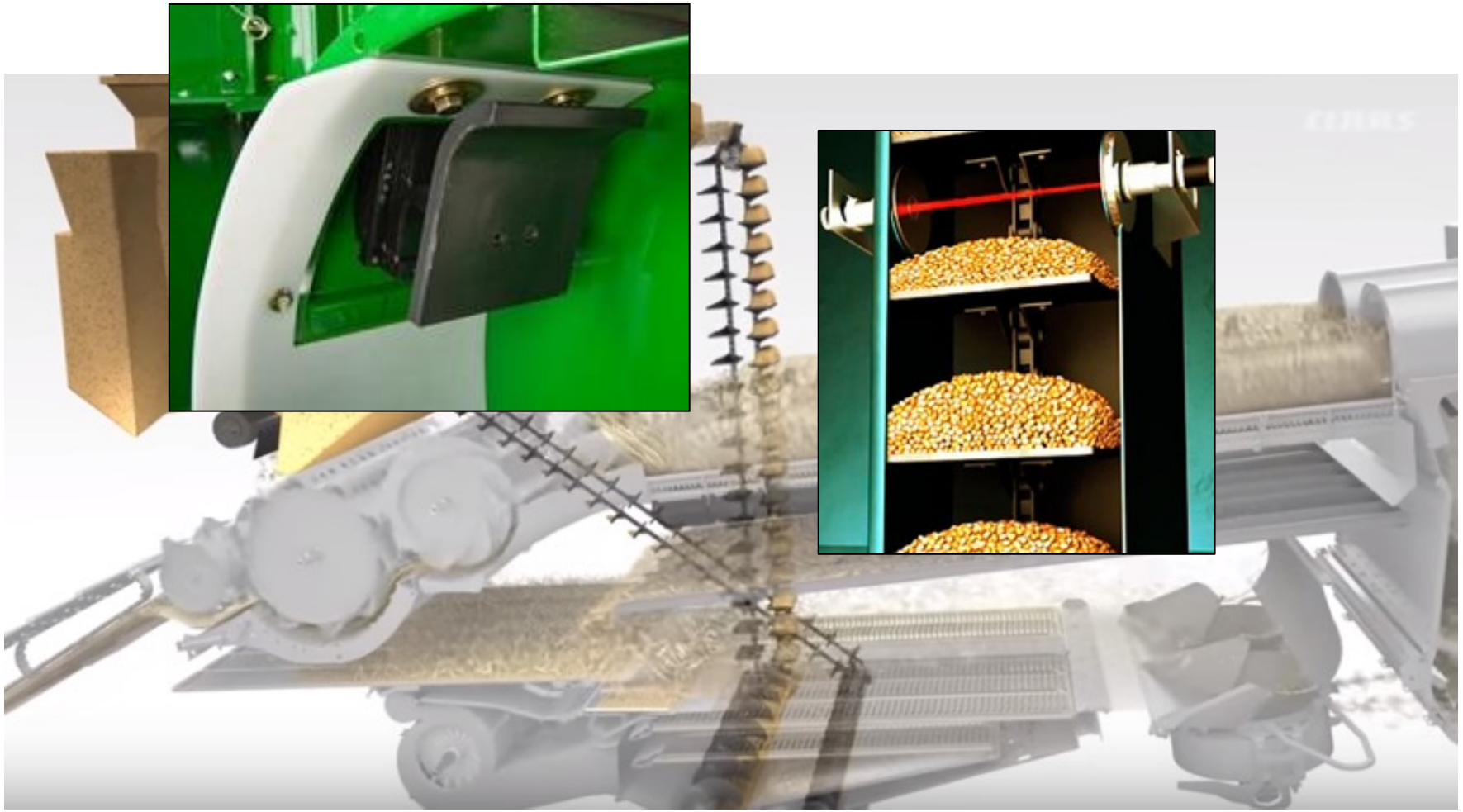
Dr. Joe D. Luck
Professor, Biological Systems Engineering
Associate Director, Eastern NE Research, Extension & Education Center

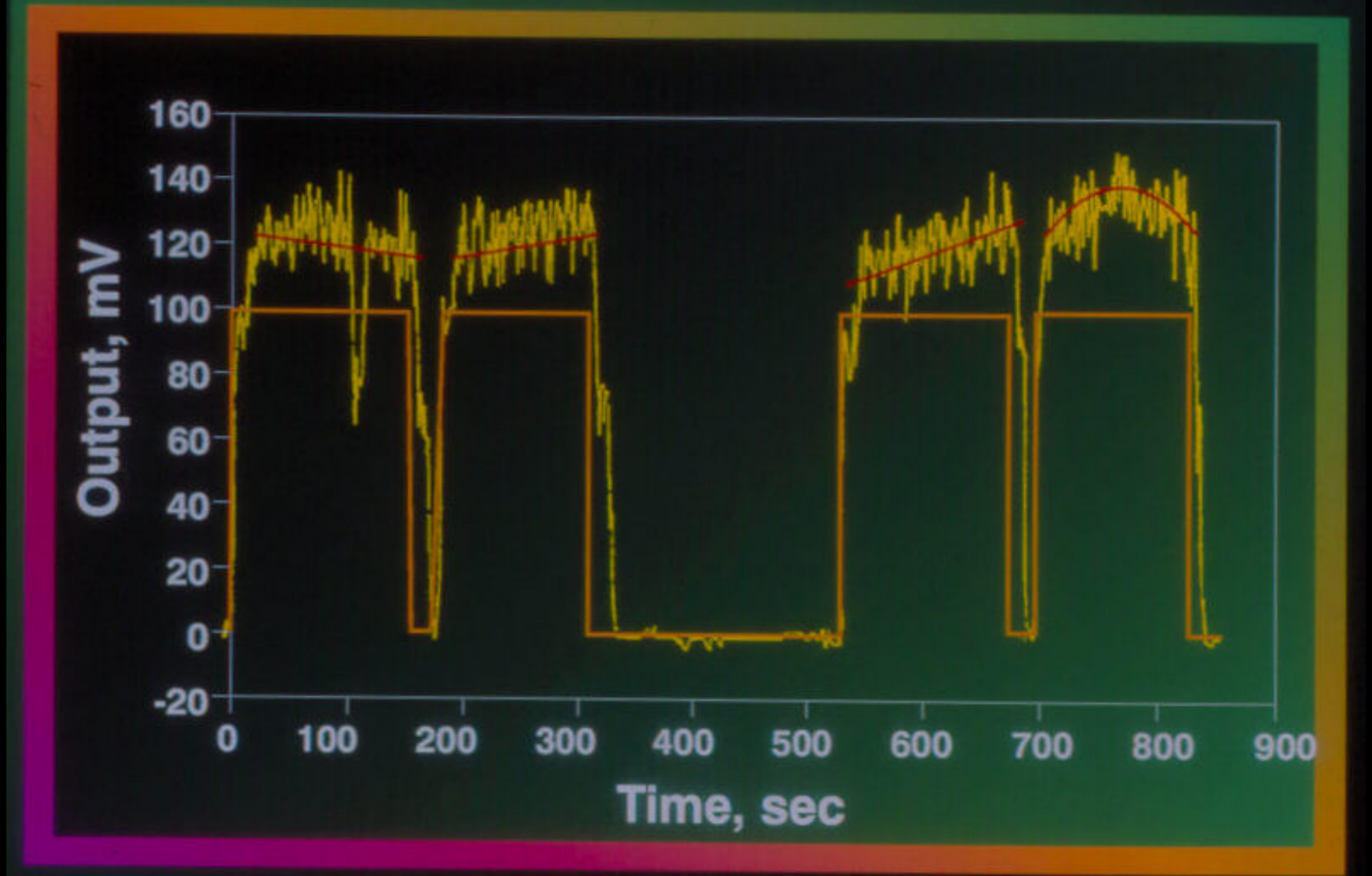
NEBRASKA EXTENSION
DIGITAL AGRICULTURE

University of Nebraska Lincoln

Flow of grain through modern combines can take many paths…

- The most important component is the mass flow (impact plate) or grain volume sensor that measures either force on plate or volume of grain on paddles…
- Lag time from cut crop to flow sensor will adjust yield data point location, but may not reflect exactly that area




160
140
120
100
80
60
40
20
0
-20
Output, mV
0
100
200
300
400
500
600
700
800
900
Time, sec

Yield Monitoring/Mapping with DGPS

Flow Sensor Data

Moisture Sensor Data

Scouting Flags

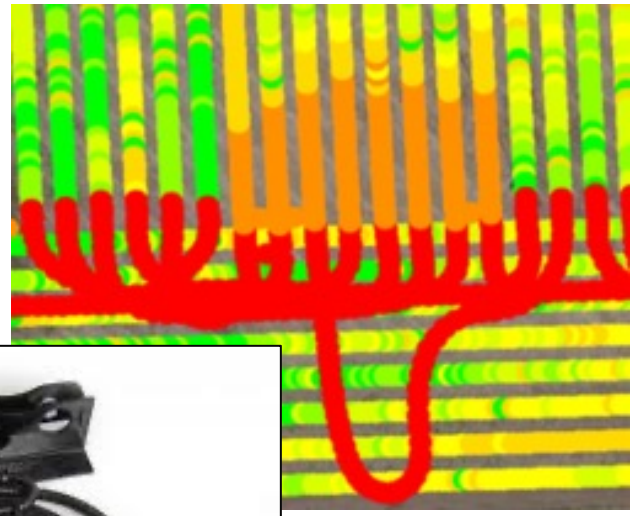
→ Position Data

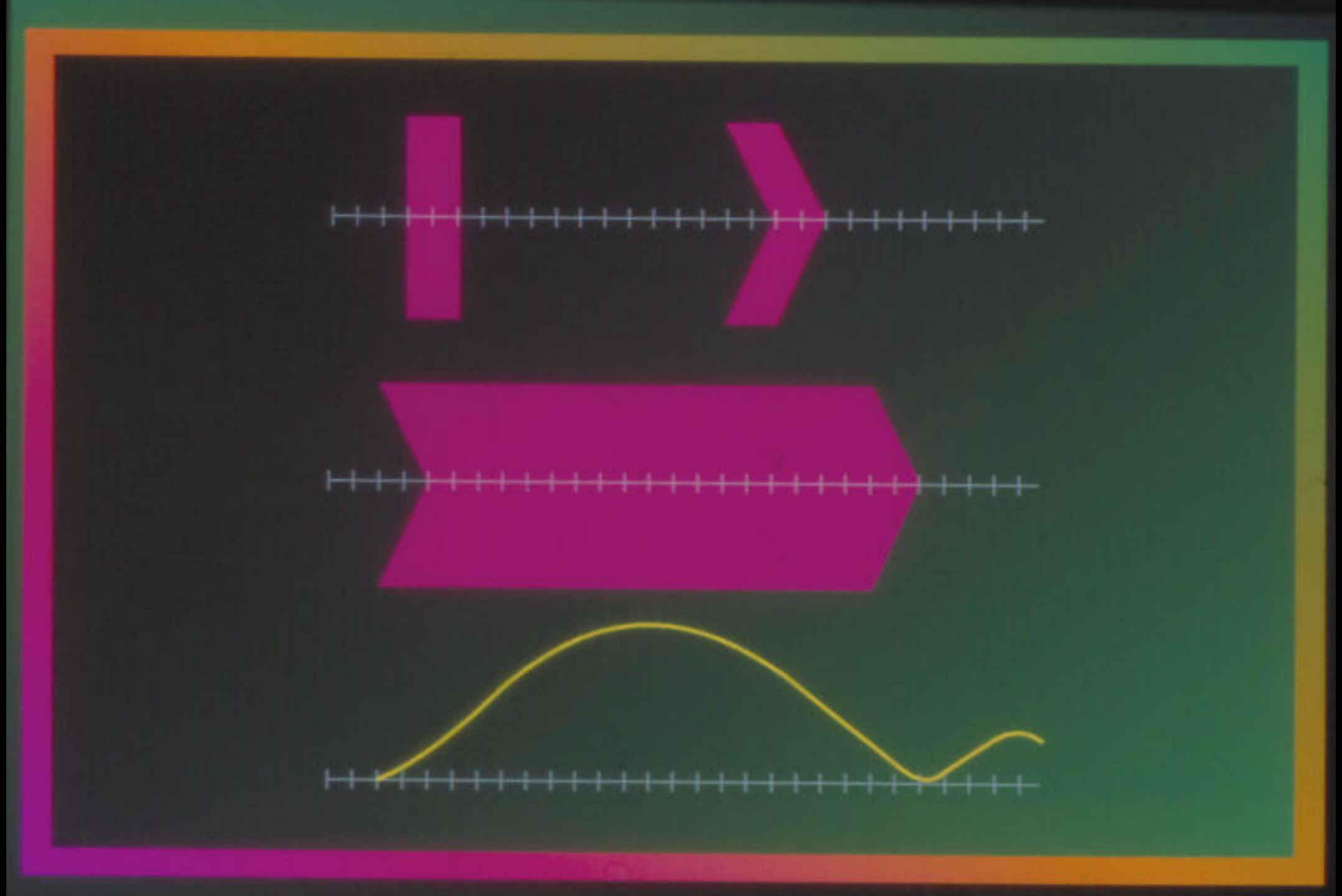

Ag Leader Technology
F187: R5C L1: DG
YIELD 102 bu/ac
MOISTURE [auto man] 10.9 %
SWATH width rows 6 rows
WEIGHT 16892 lbs
Harvesting: WHEAT AREA ON
FIELD LOAD SHOW MAP OPTIONS


DANGER

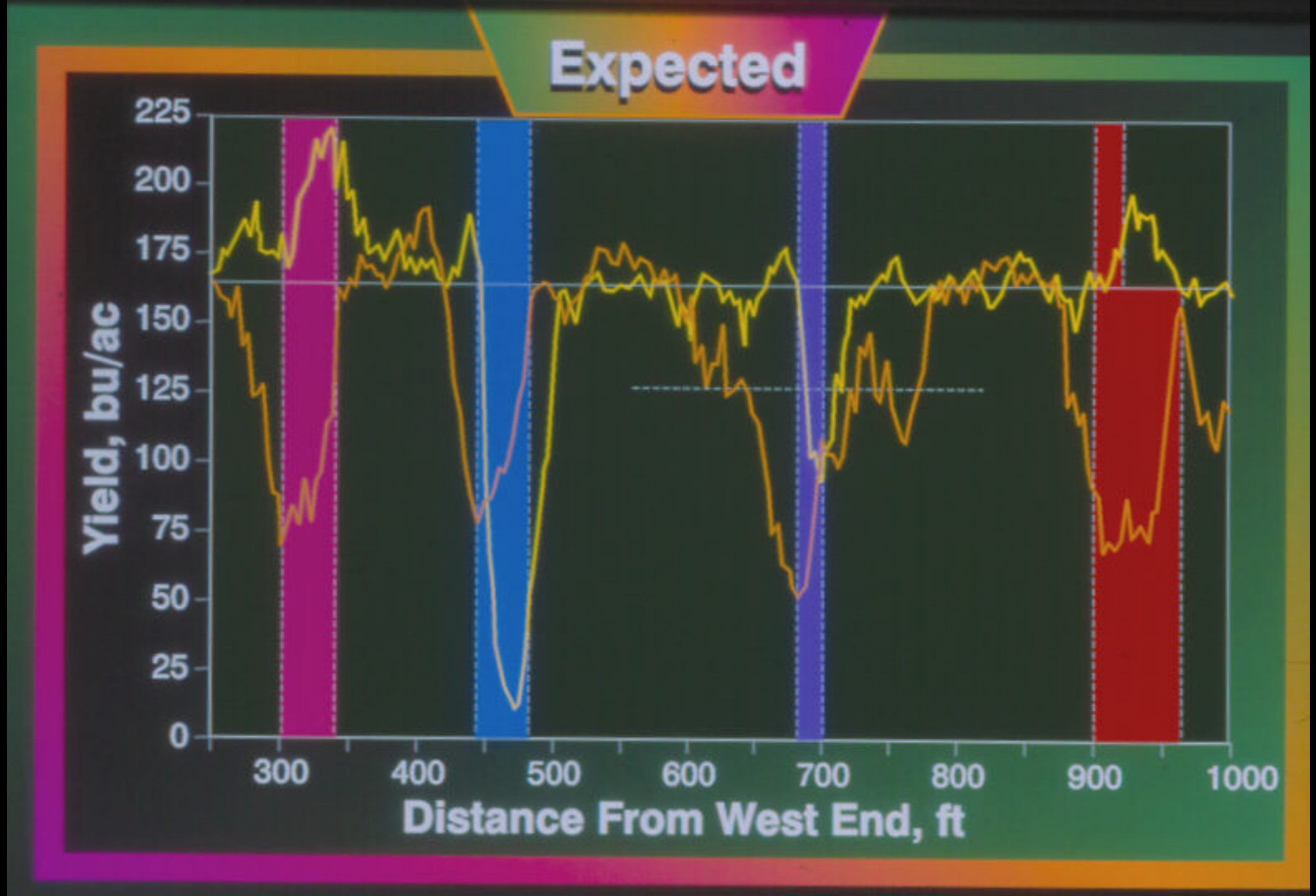
Other important sensors…

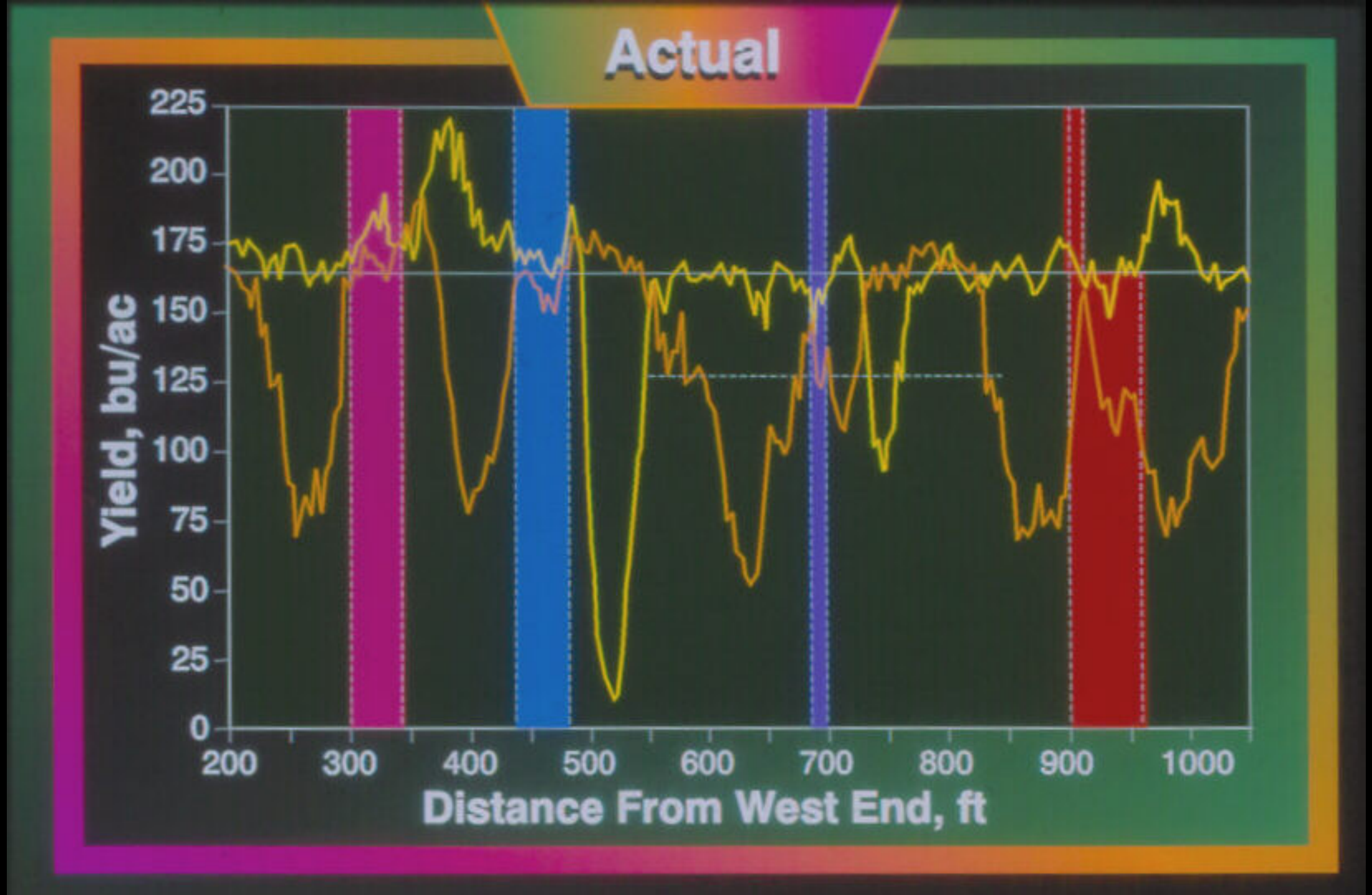
- Moisture sensors generally provide accurate data between 9-25% moisture (or so)
- Critical for assessing marketable grain
- Header height sensors monitor when crop is being harvested…check for successful operation and try to raise/lower header appropriately
- Can lead to errors in total acres, yield estimates, etc.

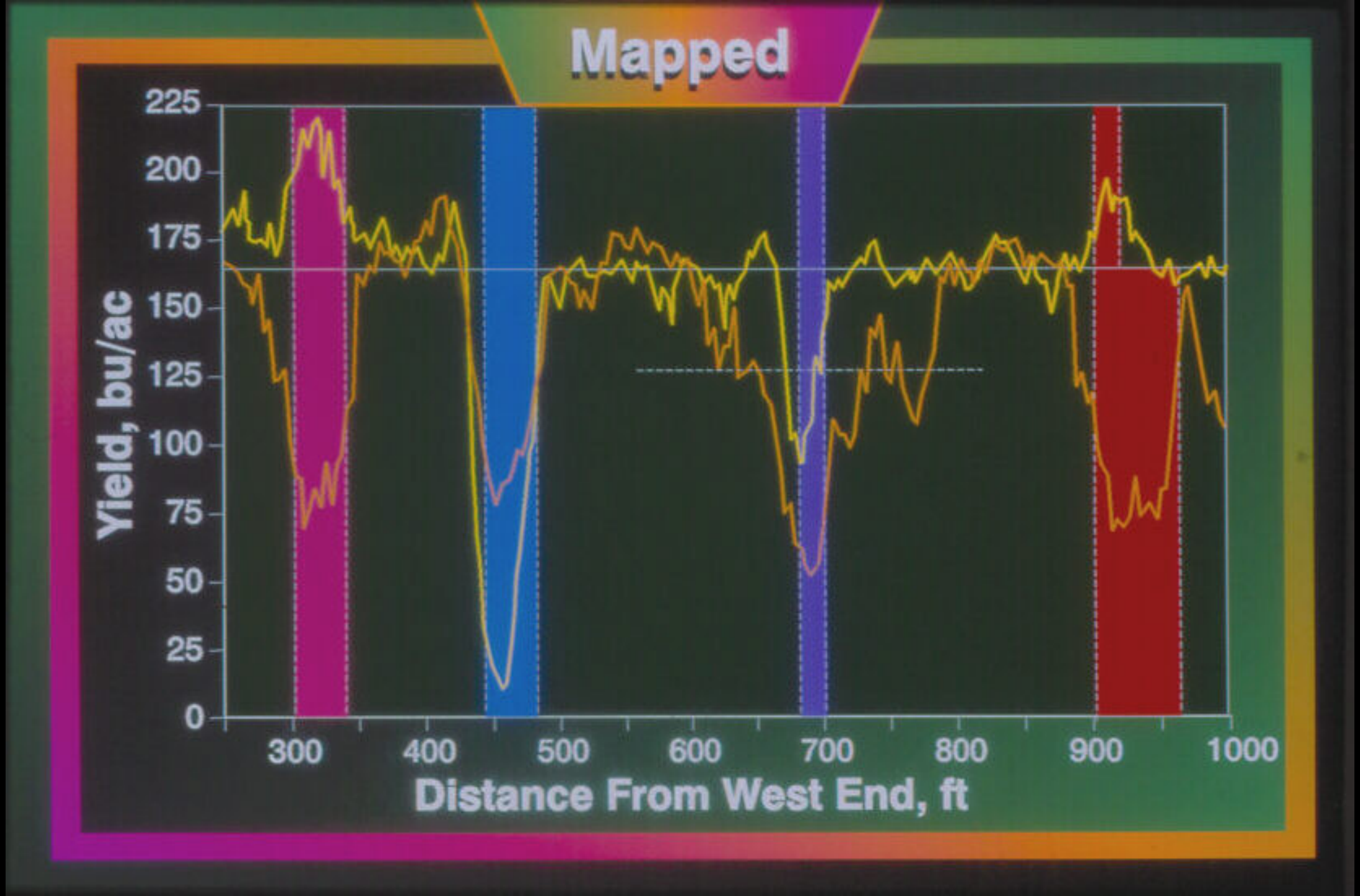





LEANER
M2
ALLIS-CHALMERS

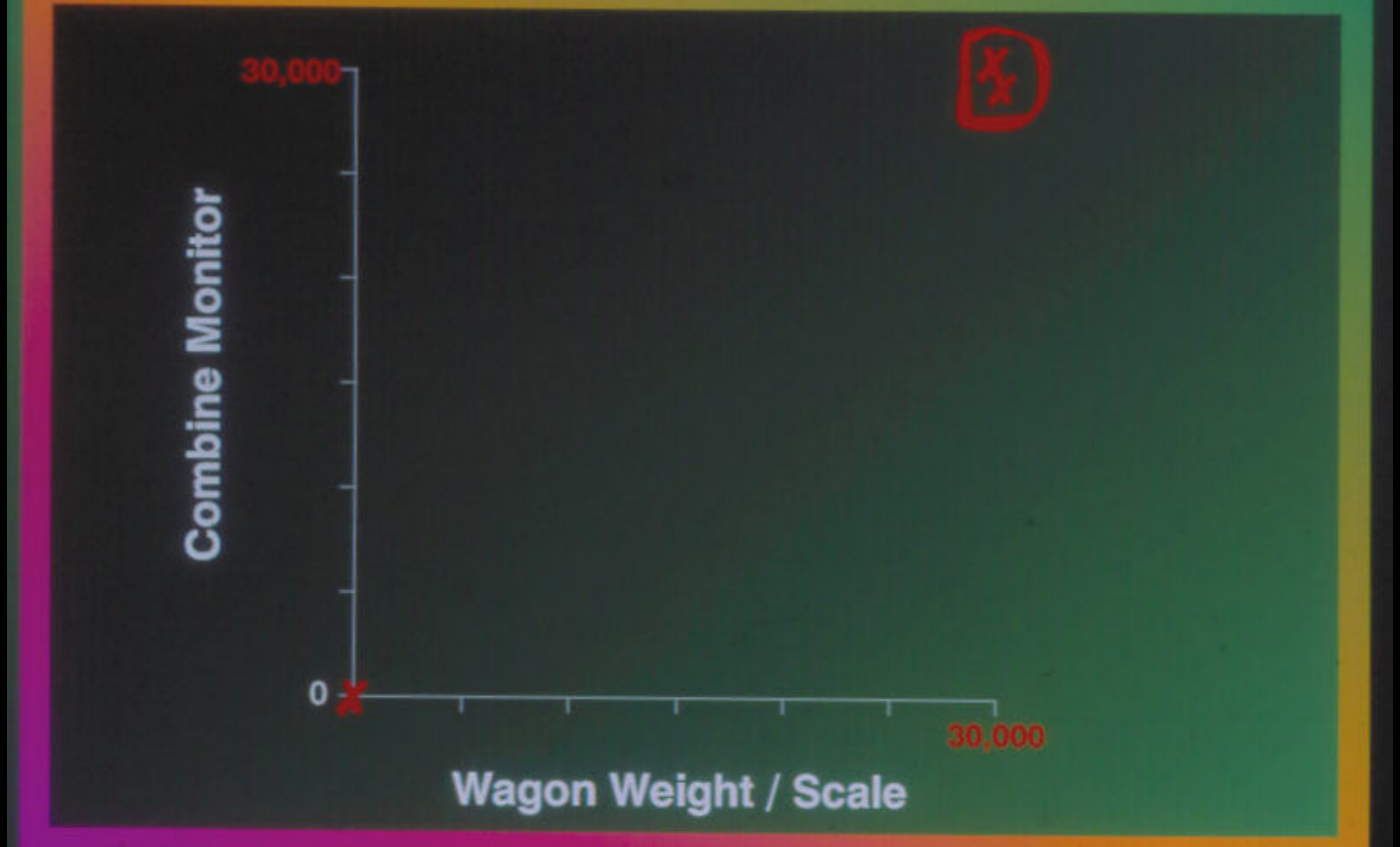

Expected
225
200
175
150
125
100
75
50
25
0
Yield, bu/ac
300
400
500
600
700
800
900
1000
Distance From West End, ft

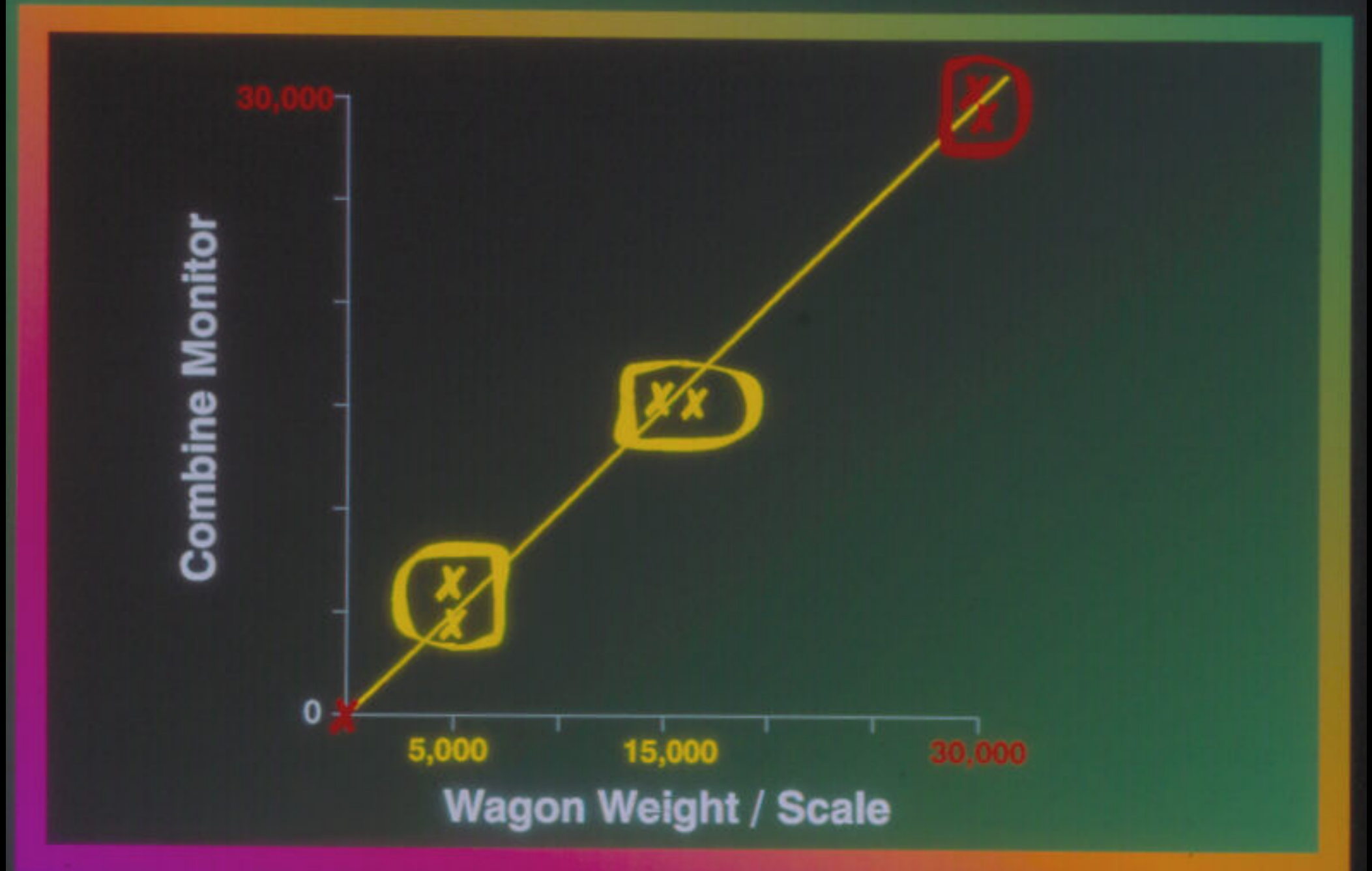

Actual
225
200
175
150
125
100
75
50
25
0
Yield, bu/ac
200
300
400
500
600
700
800
900
1000
Distance From West End, ft


Mapped
225
200
175
150
125
100
75
50
25
0
Yield, bu/ac
300
400
500
600
700
800
900
1000
Distance From West End, ft

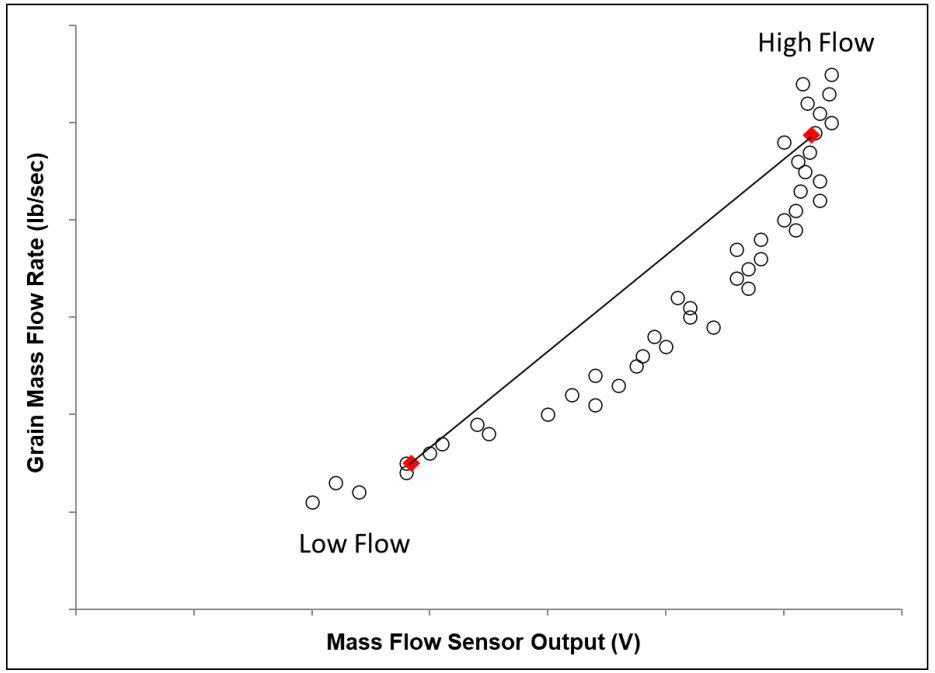
- Calibration must be conducted properly according to manufacturer specifications
- During every season (can be adjusted later in software if necessary)
- Different crops need their own calibration
- Different test weight and moisture content may also require their own calibration
- Expectations from low to high?
- Must maintain stability
- Harvest loads 3,000 to 5,000 lb

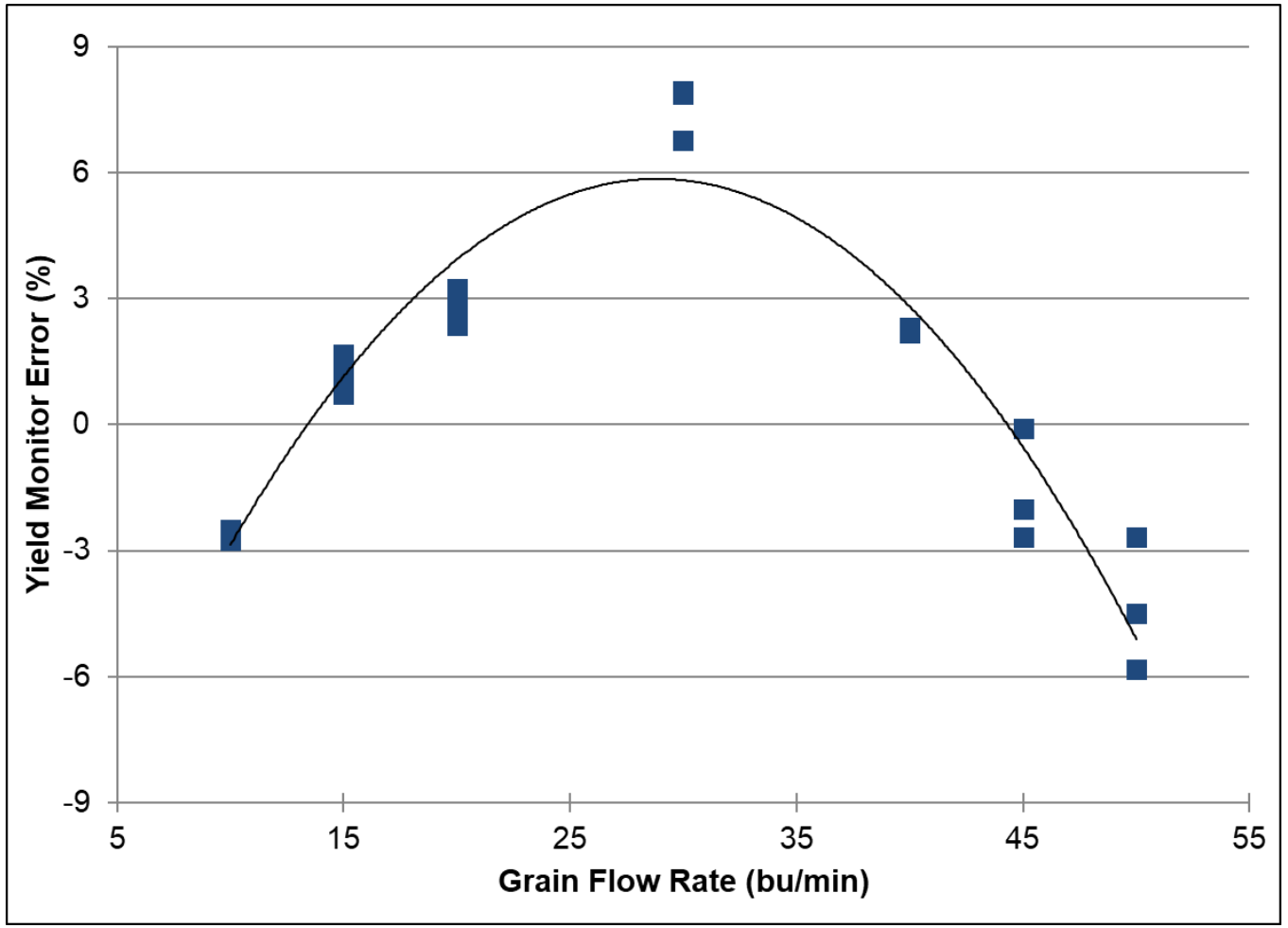

CASE INTERNATIONAL
1680


30,000
Combine Monitor
0
30,000
Wagon Weight / Scale


30,000
Combine Monitor
0
5,000
15,000
30,000
Wagon Weight / Scale

- Two point calibration errors





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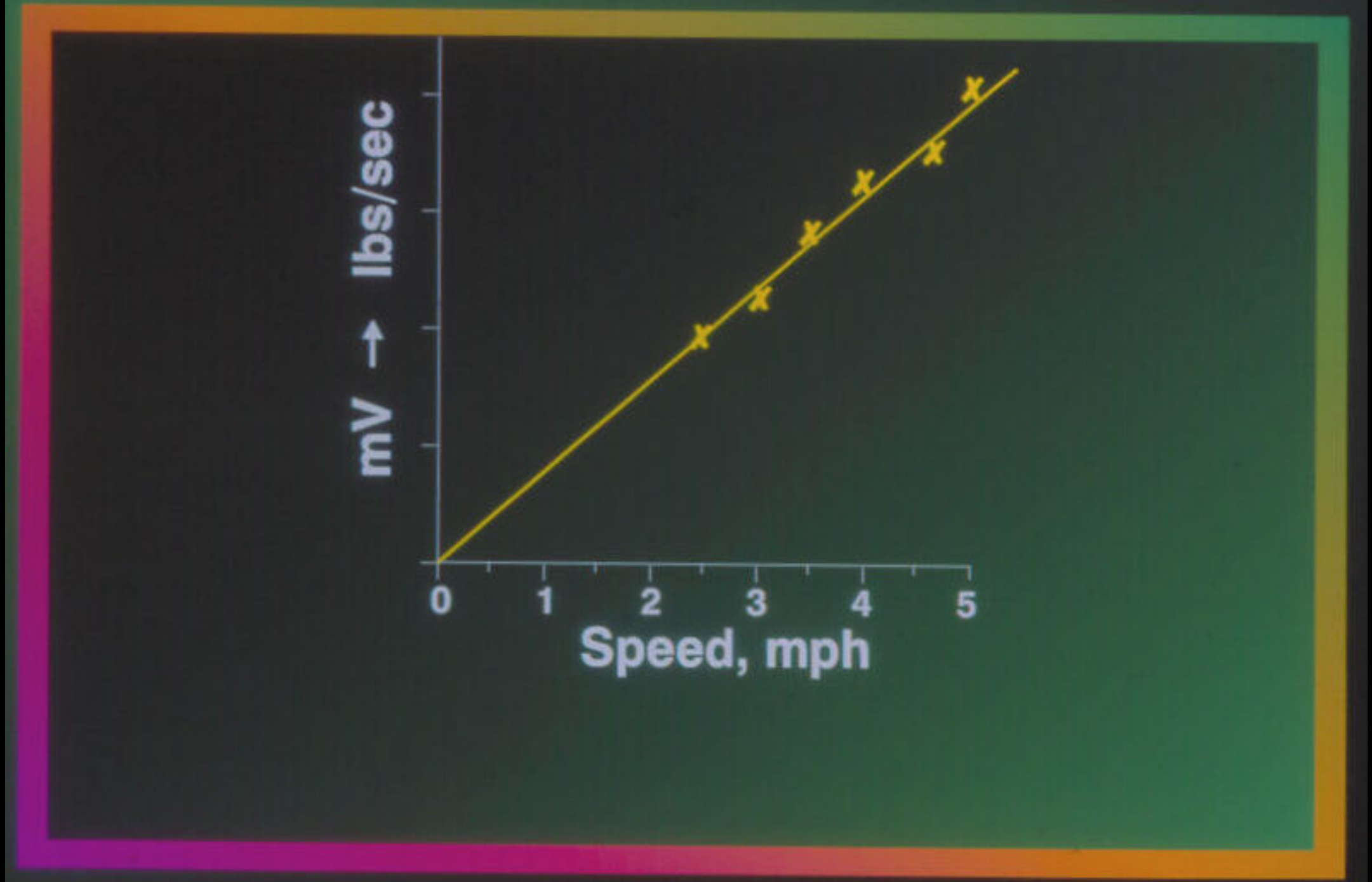
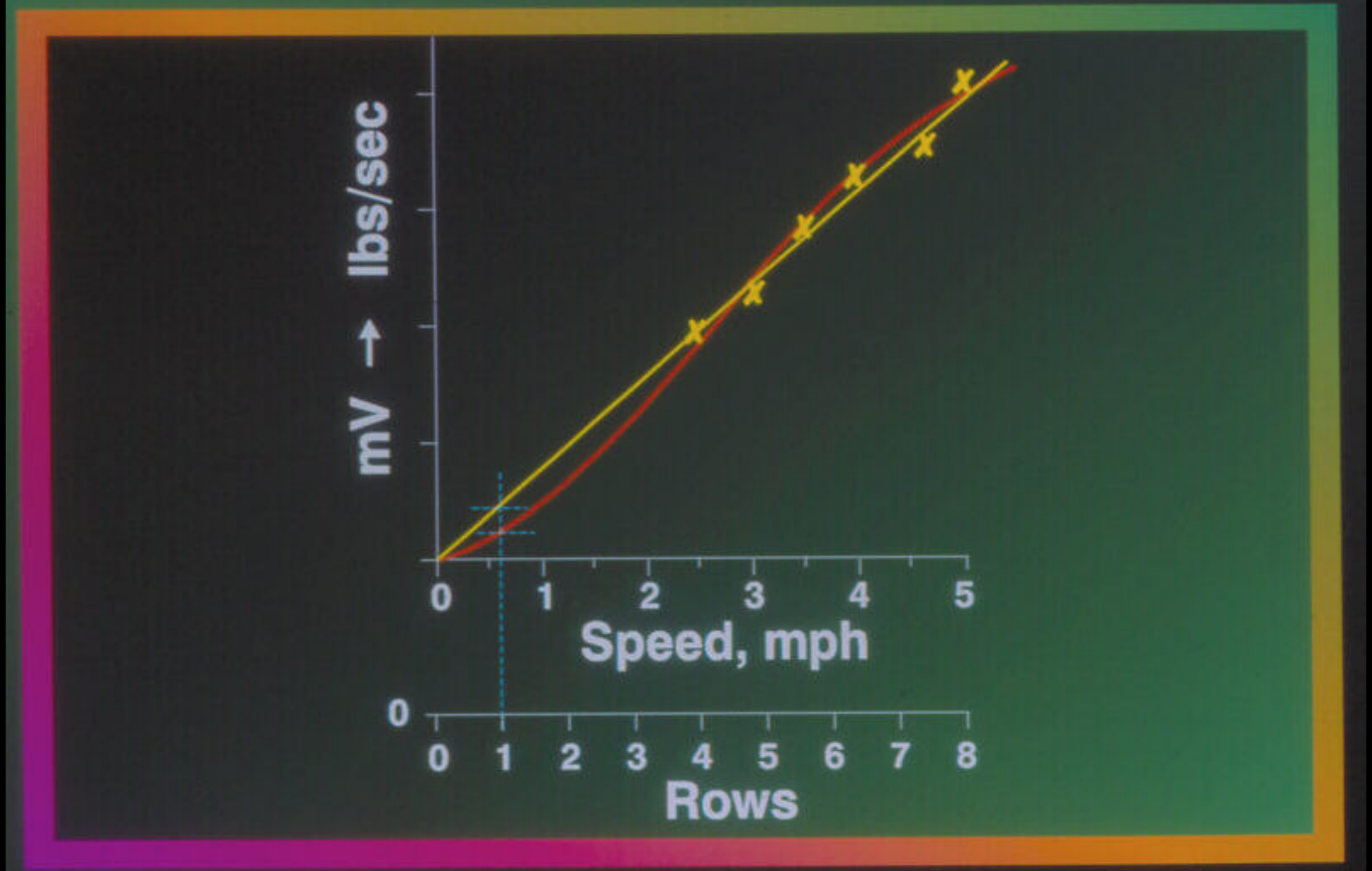
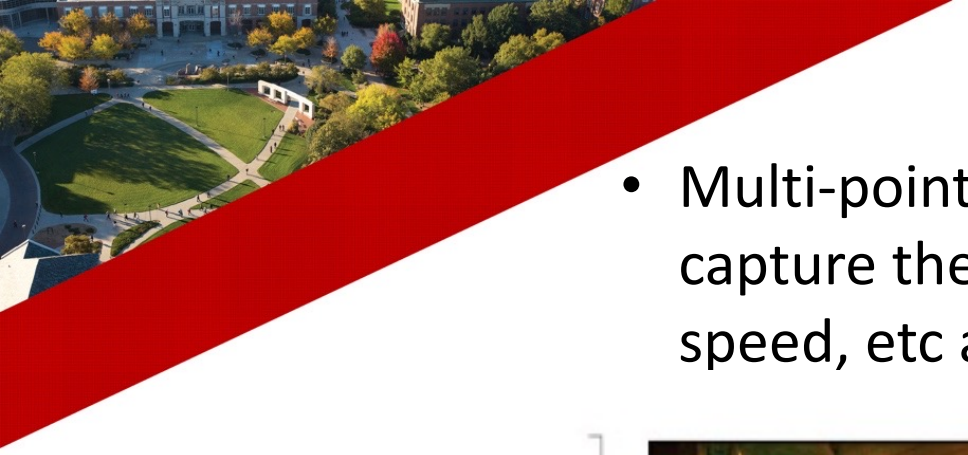
Example Calibration loads with varying speed or swath width

	Ld1	Ld2	Ld3	Ld4	Ld5	Ld5
Speed (mph)	5.0	4.5	4.0	3.5	3.0	2.5

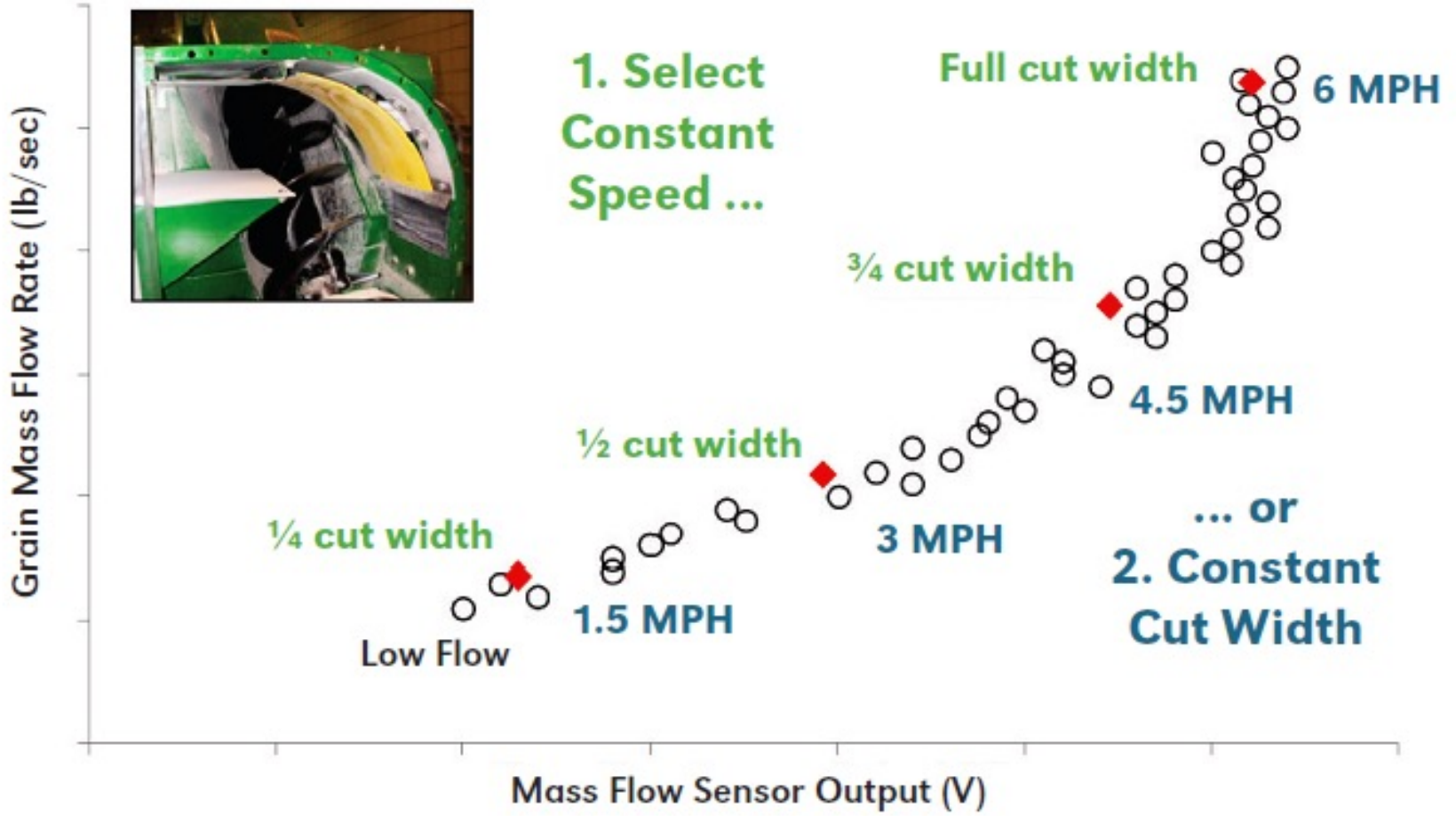

mV → lbs/sec
0
1
2
3
4
5
Speed, mph

Row	Mass lbs/sec	Distance inches	lbs/ft of row	Yield bu/ac
8	7.56	143	0.16	48.3
7	7.03	145	0.17	50.5
1	2.62	179	0.35	106.8


mV → lbs/sec
0
1
2
3
4
5
Speed, mph
0
0
1
2
3
4
5
6
7
8
Rows



- Multi-point calibrations tend to provide the best data…try to capture the ranges of flow (think about how crop yield, travel speed, etc affect flow) as you create this calibration for each crop…



△ Marker Type A
□ Marker Type B
○ Marker Type C
✕ Marker Type D
223.4 - 197.2 Bu0.5 Ac
197.2 - 188.4 Bu0.6 Ac
188.4 - 179.2 Bu0.7 Ac
179.2 - 159.2 Bu0.9 Ac
159.2 - 126.2 Bu1.0 Ac

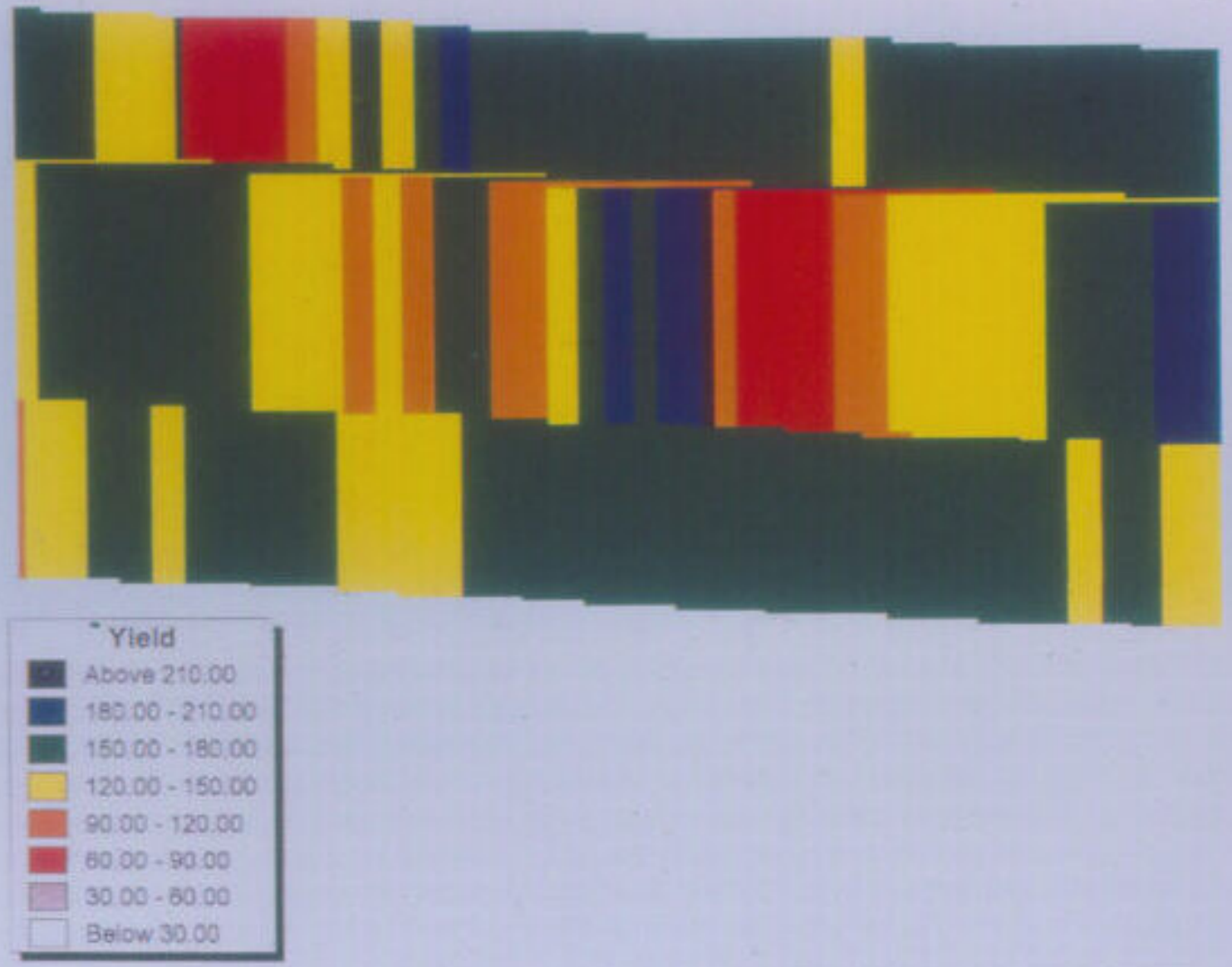
Example Calibration loads with varying speed or swath width

	Ld1	Ld2	Ld3	Ld4	Ld5	Ld5
Speed (mph)	5.0	4.5	4.0	3.5	3.0	2.5
Width (rows)	6	5	4	3	2	1

Yield Monitor Calibration

Load 1	Load 2	Load 3	Load 4	Load 5	Load 6
600 bu/hr	900 bu/hr	1200 bu/hr	1500 bu/hr	**1800** bu/hr	2100 bu/hr
Improved calibration loads for a variety of flow rates					


YIELD MONITOR 2000


Yield
Above 210.00
180.00 - 210.00
150.00 - 180.00
120.00 - 150.00
90.00 - 120.00
60.00 - 90.00
30.00 - 60.00
Below 30.00


450
400
350
300
250
200
150
100
50
0
2.75 mph
bu/A
1150
1175
1200
1225
1250
1275
1300
Distance from West End, ft

Yield Monitor Accuracy at Reduced Flow Rates

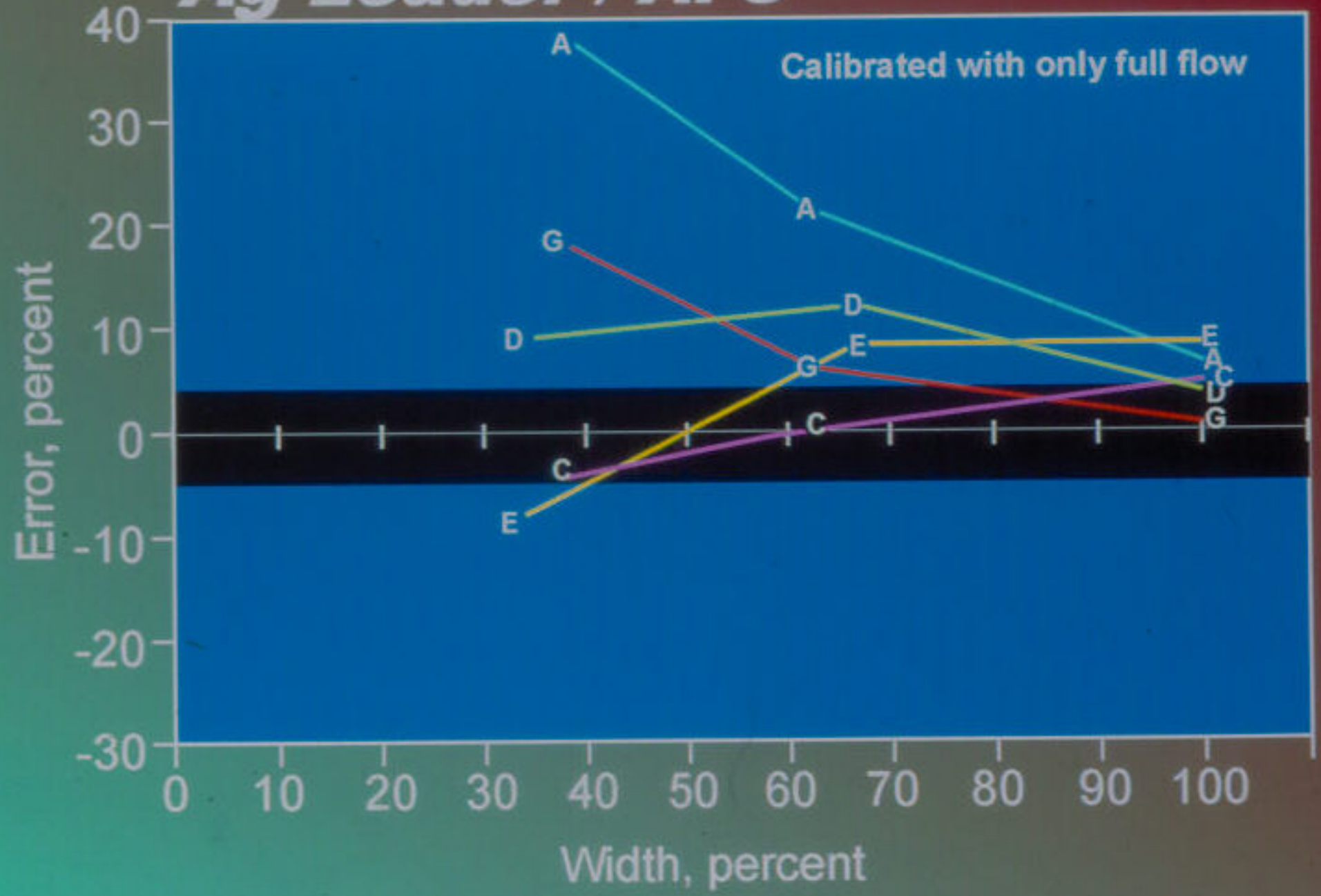
Paul Jasa
Robert Grisso
JoAnn Wilcox

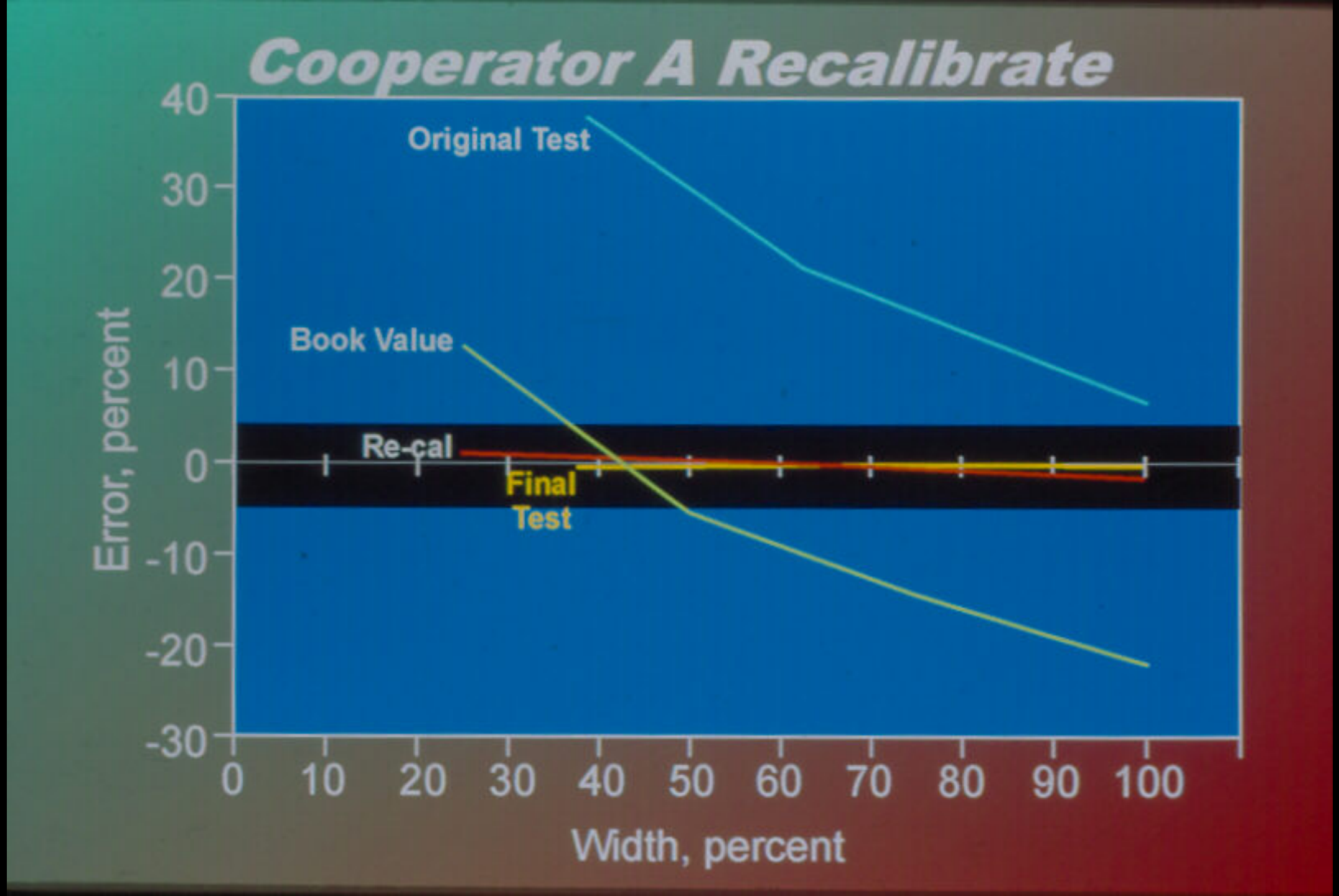
University of Nebraska

Successful Farming Magazine

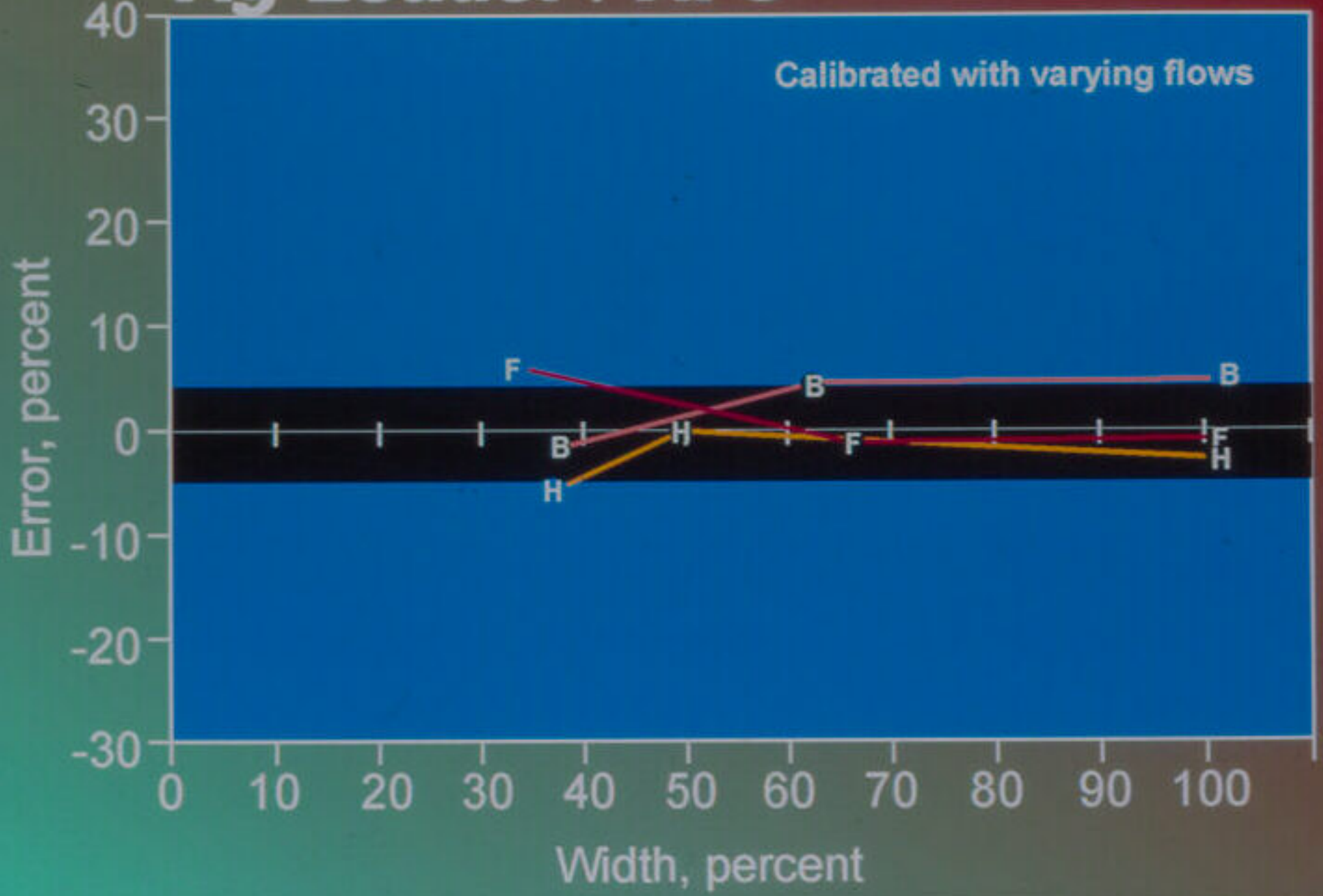

CASE INTERNATIONAL

Ag Leader / AFS




Cooperator A Recalibrate
Original Test
Book Value
Re-cal
Final
Test
Error, percent
40
30
20
10
0
-10
-20
-30
0
10
20
30
40
50
60
70
80
90
100
Width, percent

Ag Leader / AFS



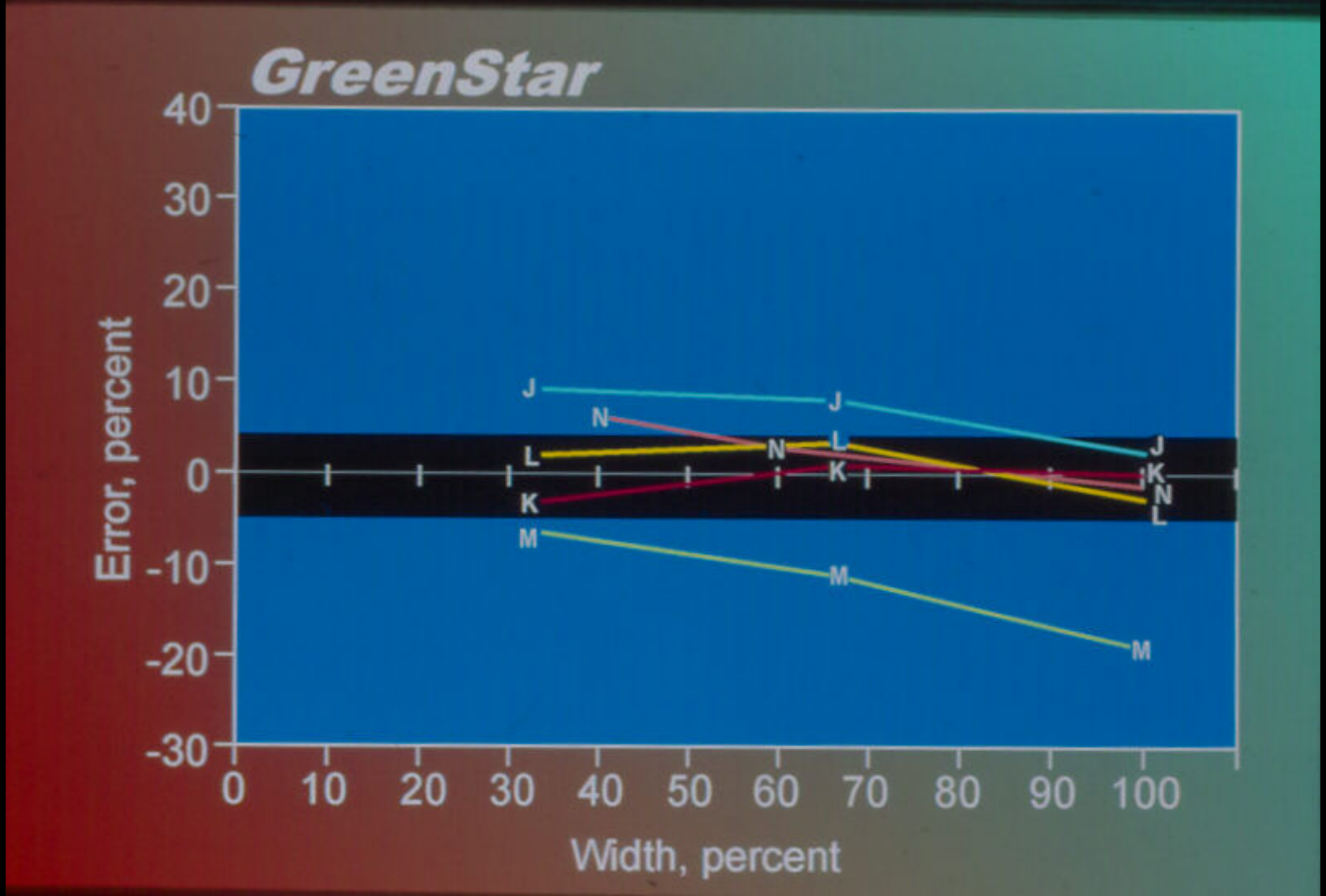
Mode	Irrigated	Irr & Dry
Normal	3.3	4.5
Fast	4.3	2.3
Slow	11.8	-2.1
Average	5.8	1.6
2 Rows	12.6	


Ag Leader Technology
YIELD MONITOR 2000
LIGHT
CLOCK
STOP HEIGHT
SETUP
MEM
YES
NO
FIELD
LOAD
ROWS
ROW SPACE
SWATH
F5→KIEFER W L57→U4C DG
0 LB
0.0 AV B/A
GRAIN
MOIST
WEIGHT
WET GRAIN
DRY GRAIN
SPEED
AREA
DIST
DATE/ TIME
INST YIELD
AVG YIELD
FLOW
TEMP


Irrigated
Irrigated & Dryland
Plot only
C - value
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100
Percent?

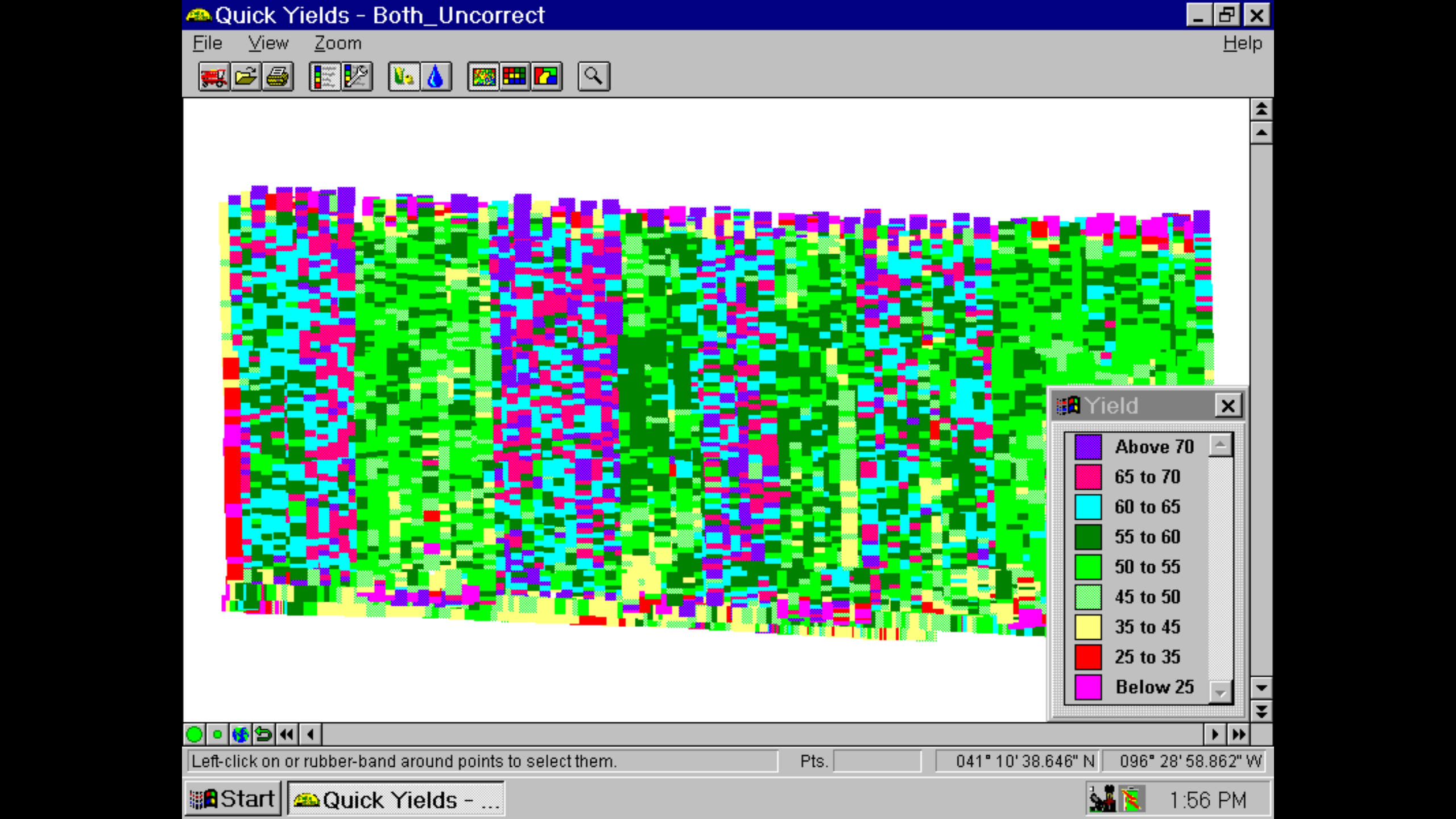
Mode	Irrigated	Irr & Dry	New Box	Farmer
Normal	3.3	4.5	0.3	1.8
Fast	4.3	2.3	0.1	-0.2
Slow	11.8	-2.1	-0.4	1.8
Average	5.8	1.6	0.0	1.1
2 Rows	12.6			-45.0

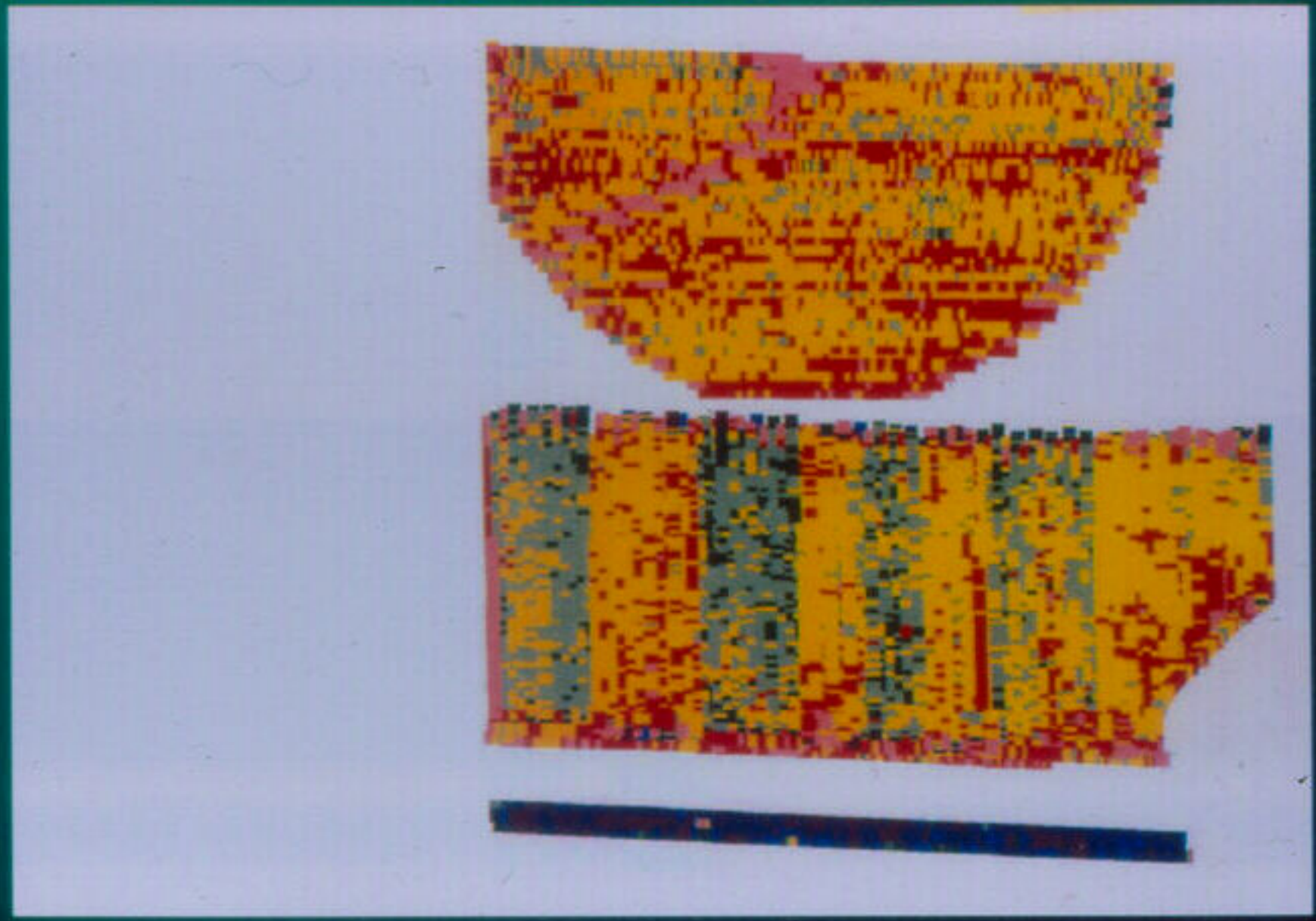

JOHN DEERE
9400
643


GreenStar
40
30
20
10
0
-10
-20
-30
Error, percent
0
10
20
30
40
50
60
70
80
90
100
Width, percent
J
J
J
N
N
L
L
L
K
K
K
M
M
M

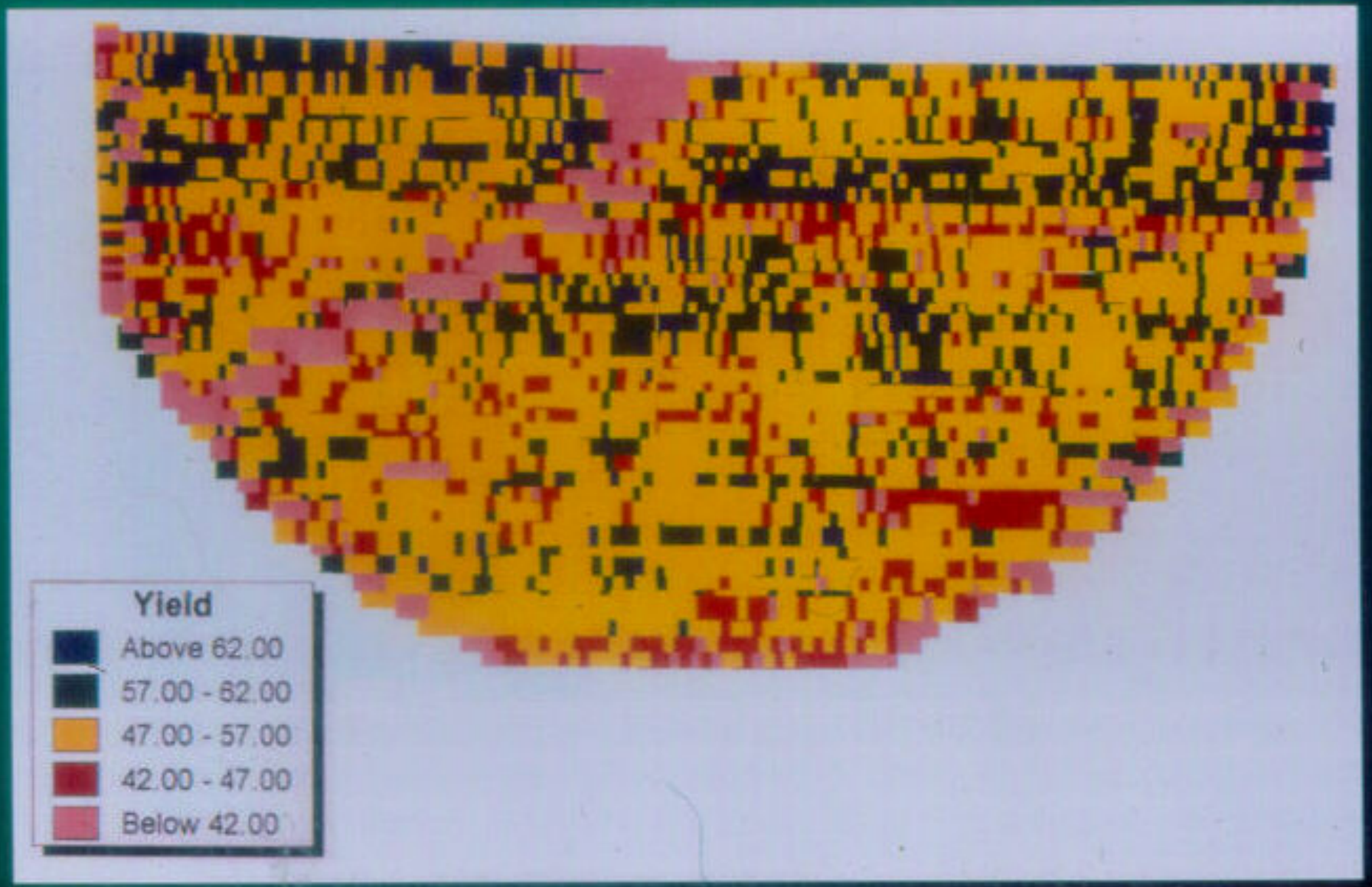

Garst
Garst

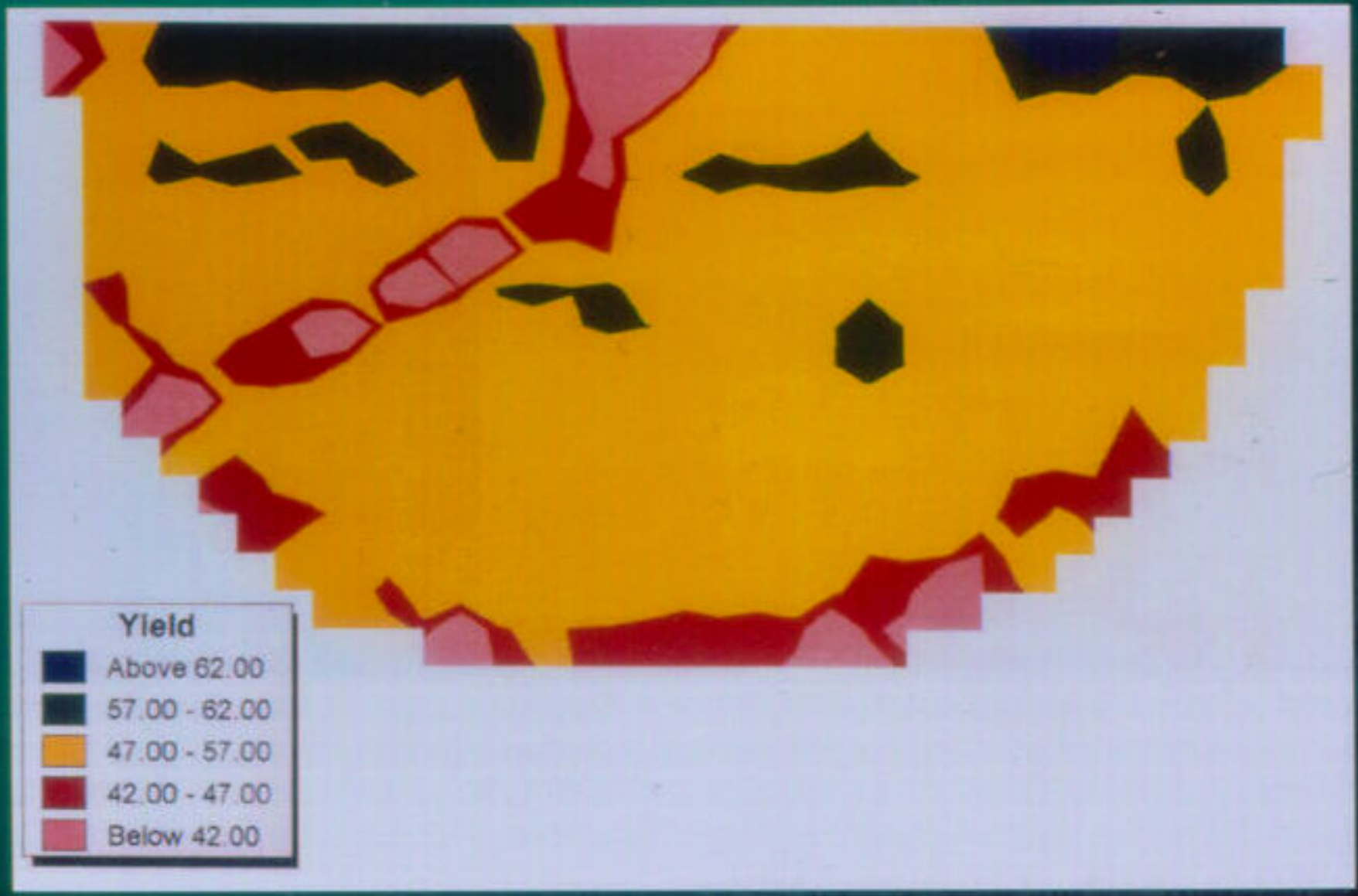
Case - IH Combine	Weigh Wagon	Percent Error
8,269	8,220	0.6
6,209	6,140	1.1
4,287	4,200	2.1
4,275	4,200	2.1
9,087	9,100	-0.1
10,450	10,460	0
42,585	42,320	0.6

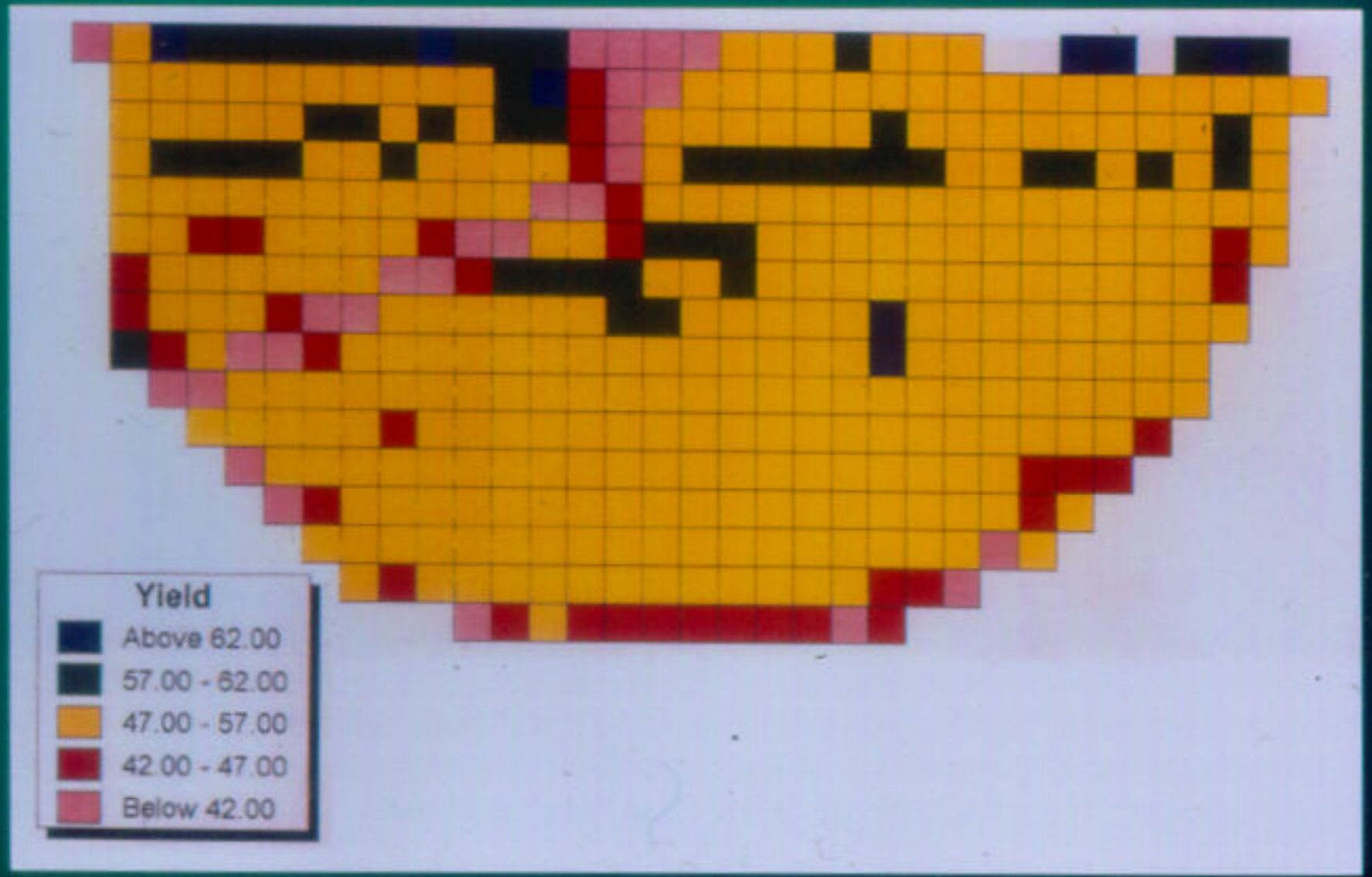

Quick Yields - Both_Uncorrect
File
View
Zoom
Help
Yield
Above 70
65 to 70
60 to 65
55 to 60
50 to 55
45 to 50
35 to 45
25 to 35
Below 25
Left-click on or rubber-band around points to select them.
Pts.
041° 10' 38.646" N
096° 28' 58.862" W
Start
Quick Yields - ...
1:56 PM



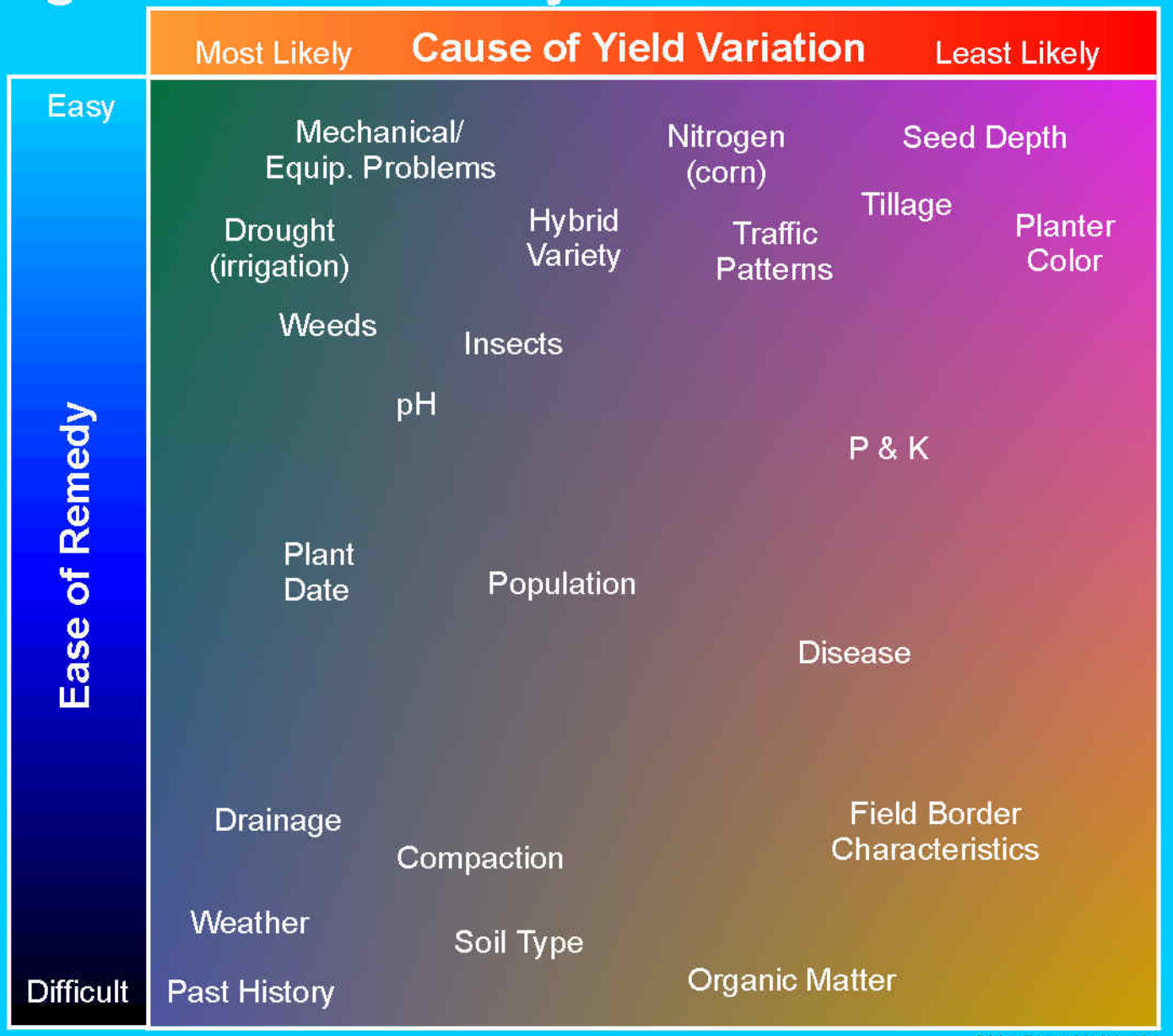
John Deere Combine	Weigh Wagon	Percent Error
7,984	5,980	34
4,896	4,040	21
5,277	4,120	28
5,258	4,140	27
5,057	4,200	20
5,190	4,220	23
5,187	4,220	23
5,086	4,240	20
9,315	7,960	17
6,136	5,040	24
59,386	48,160	23


Yield
Above 62.00
57.00 - 62.00
47.00 - 57.00
42.00 - 47.00
Below 42.00

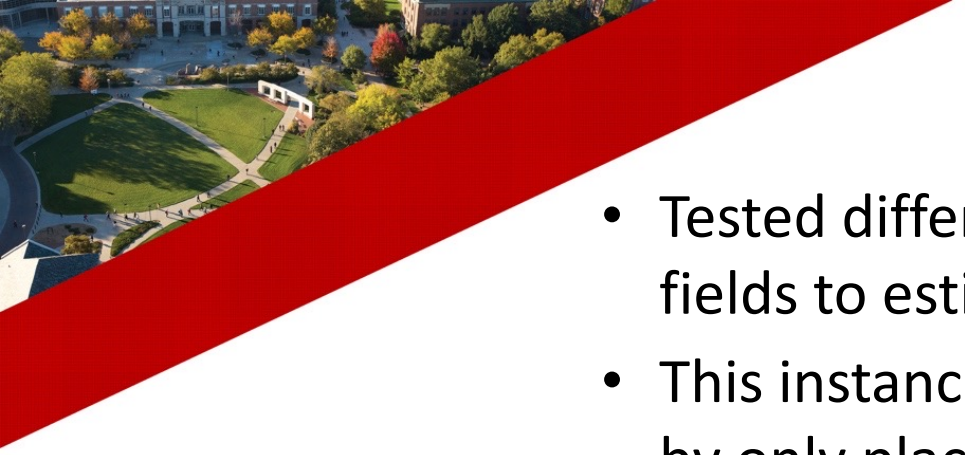

Yield
Above 62.00
57.00 - 62.00
47.00 - 57.00
42.00 - 47.00
Below 42.00


Yield
Above 62.00
57.00 - 62.00
47.00 - 57.00
42.00 - 47.00
Below 42.00

Ranking of Yield Variability Factors and Ease of Remedy

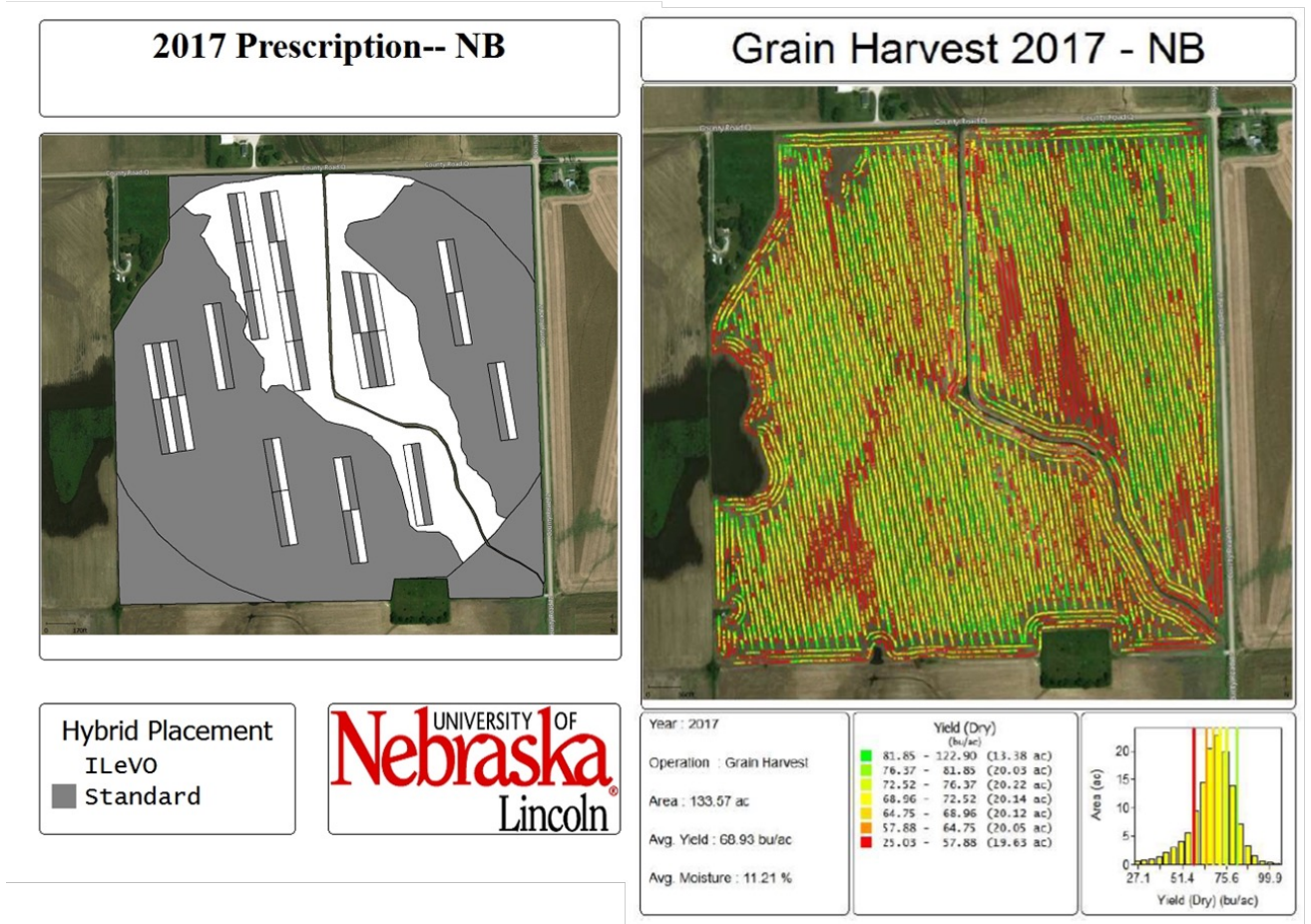


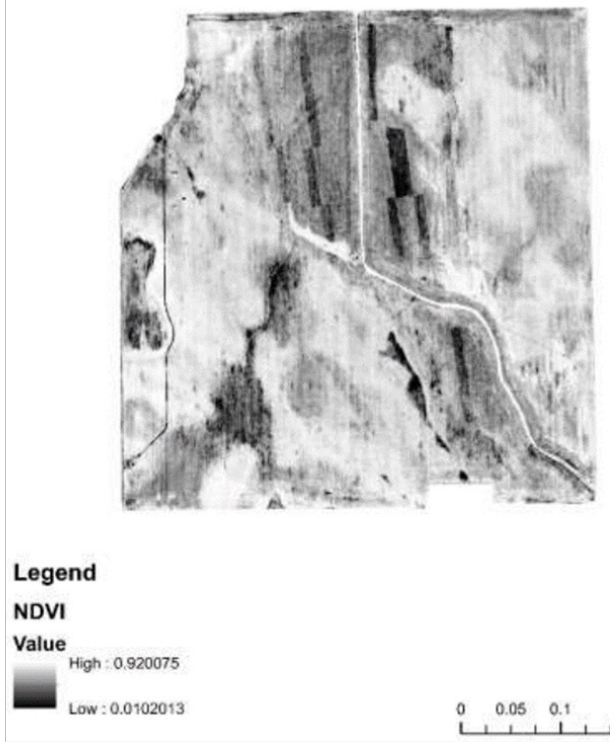
Ohio State University

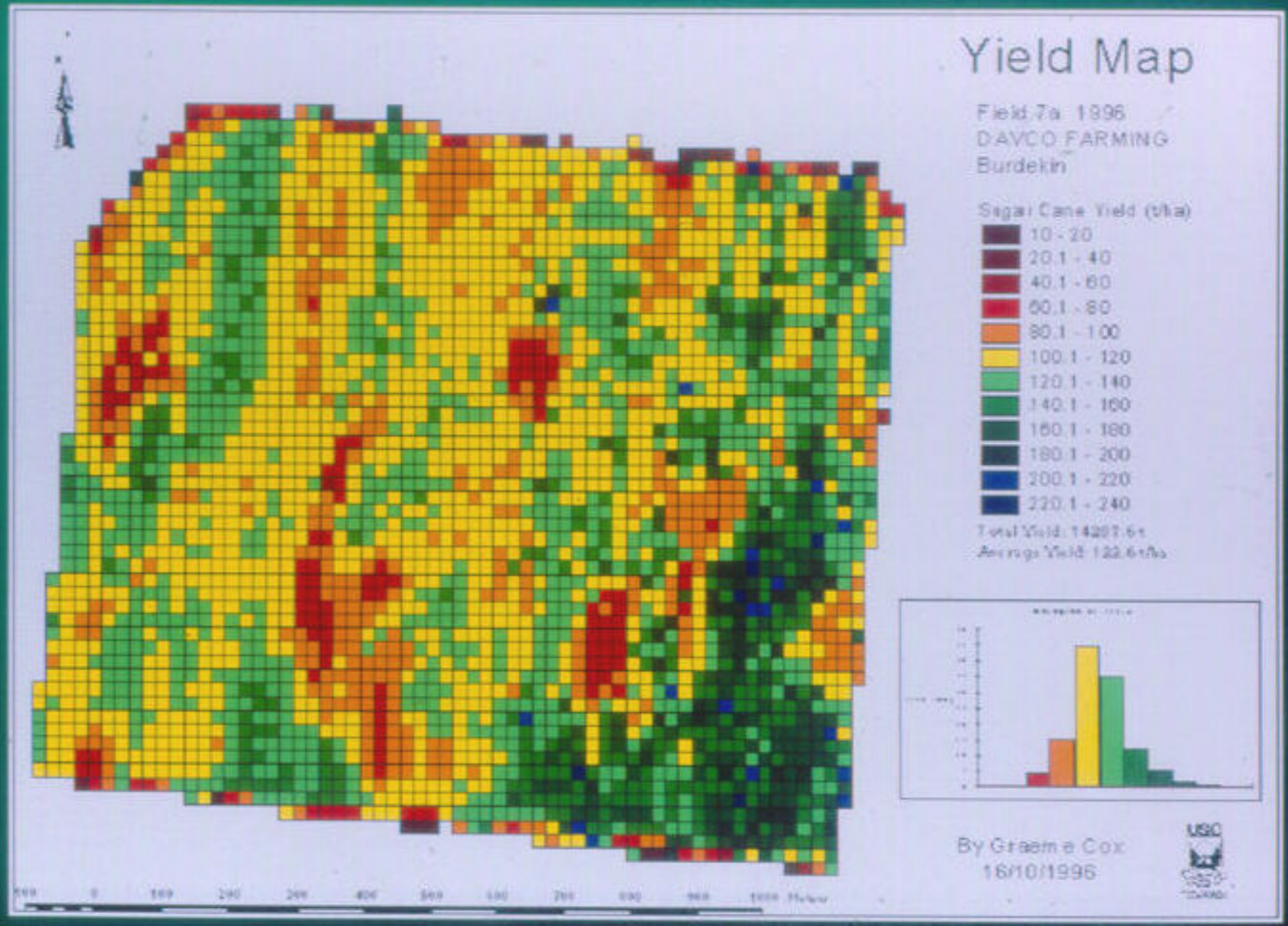


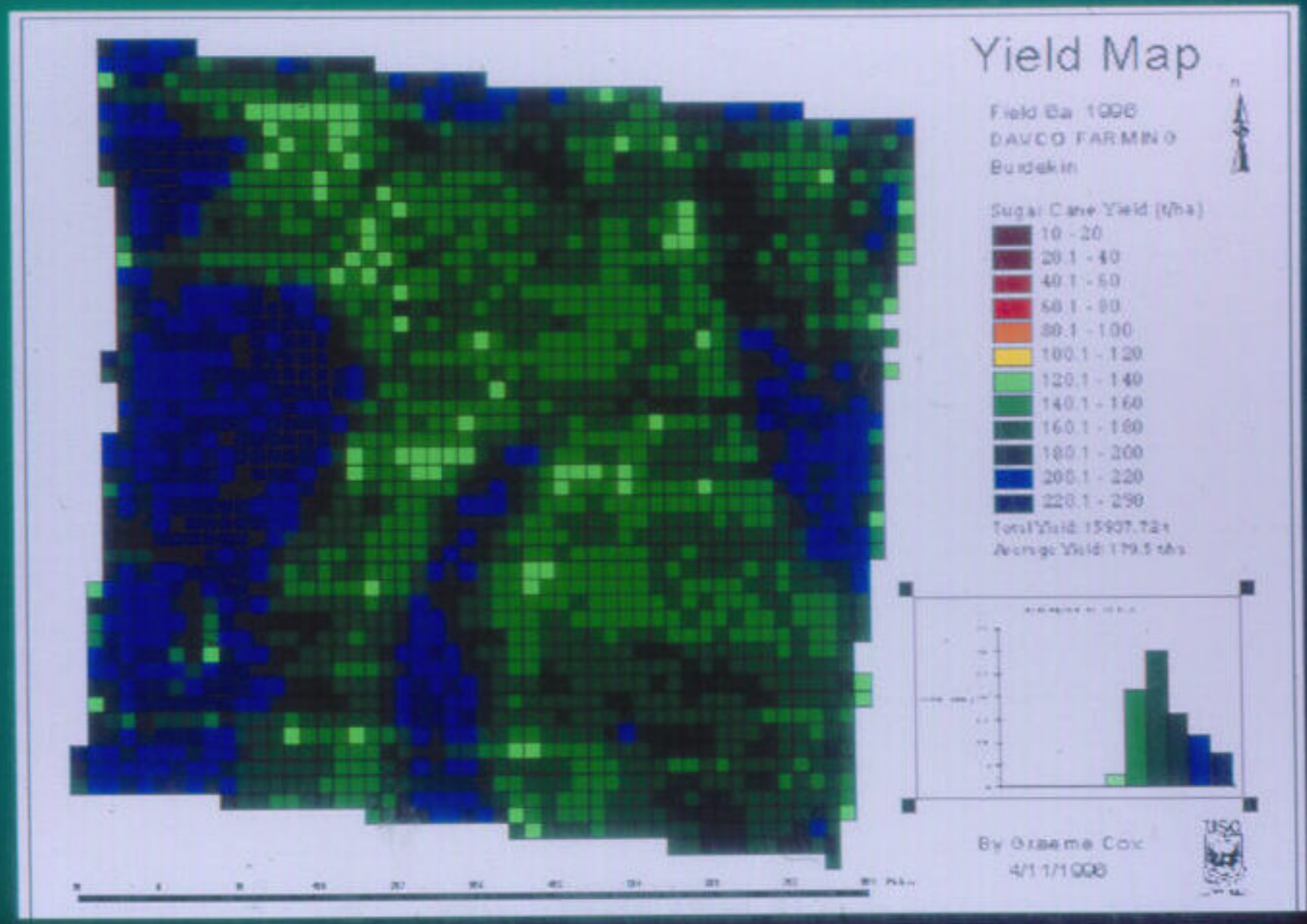
Utilizing yield monitor data…

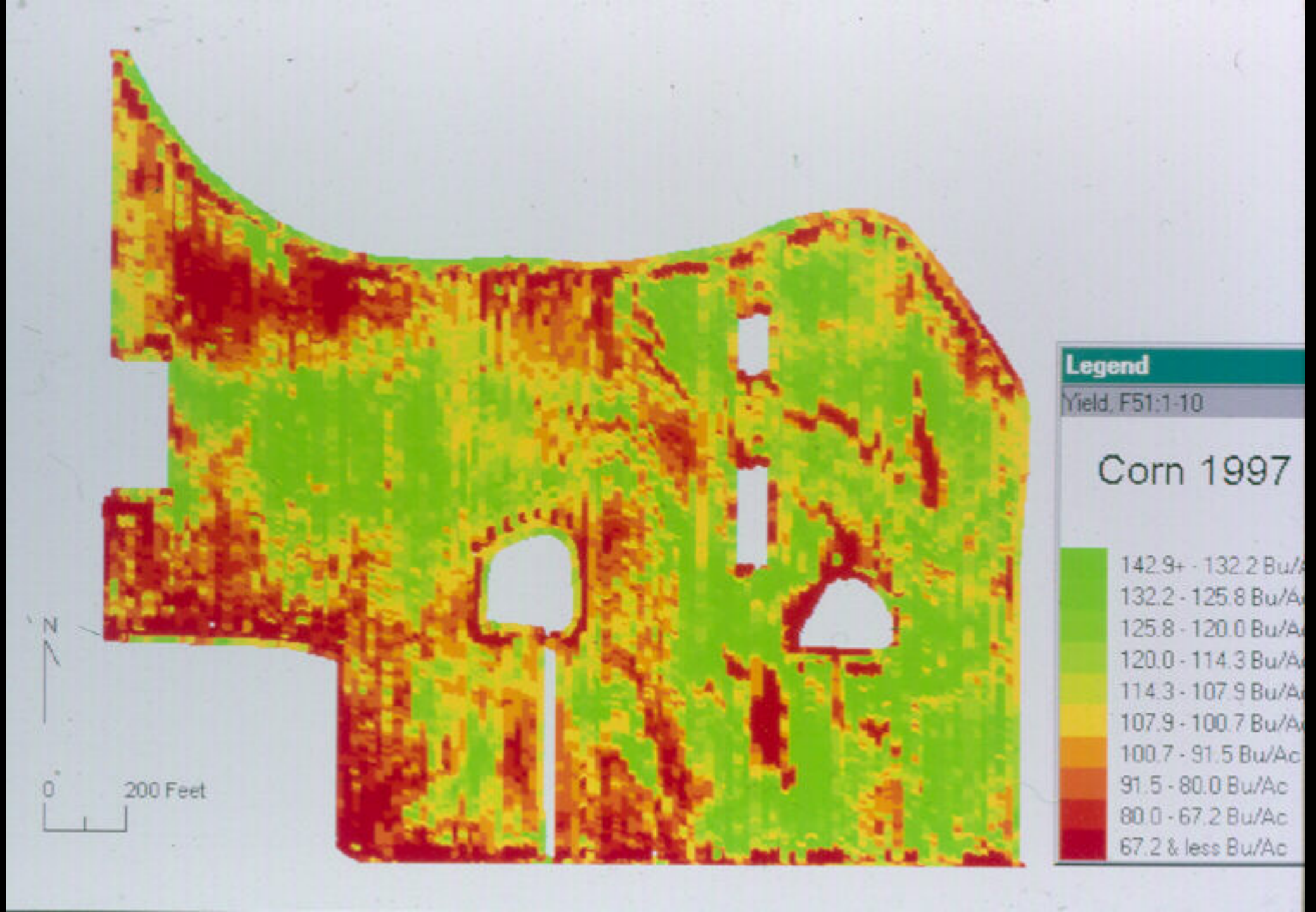
- Tested different seed treatments (Ilevo for SDS treatment) across fields to estimate a site-specific approach via multi-hybrid planters
- This instance could have resulted in $80/ac improved profitability by only placing the treatment where needed

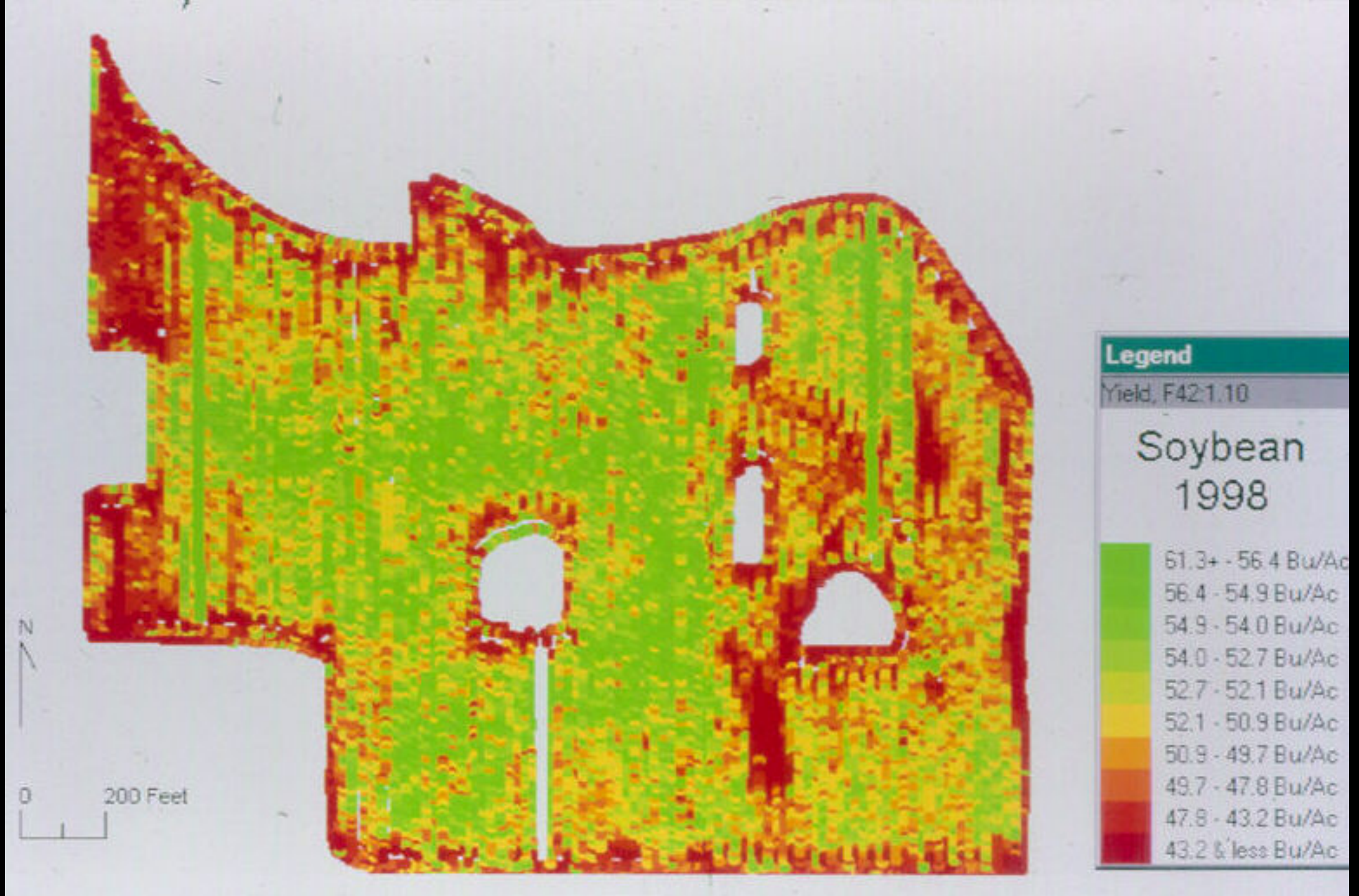


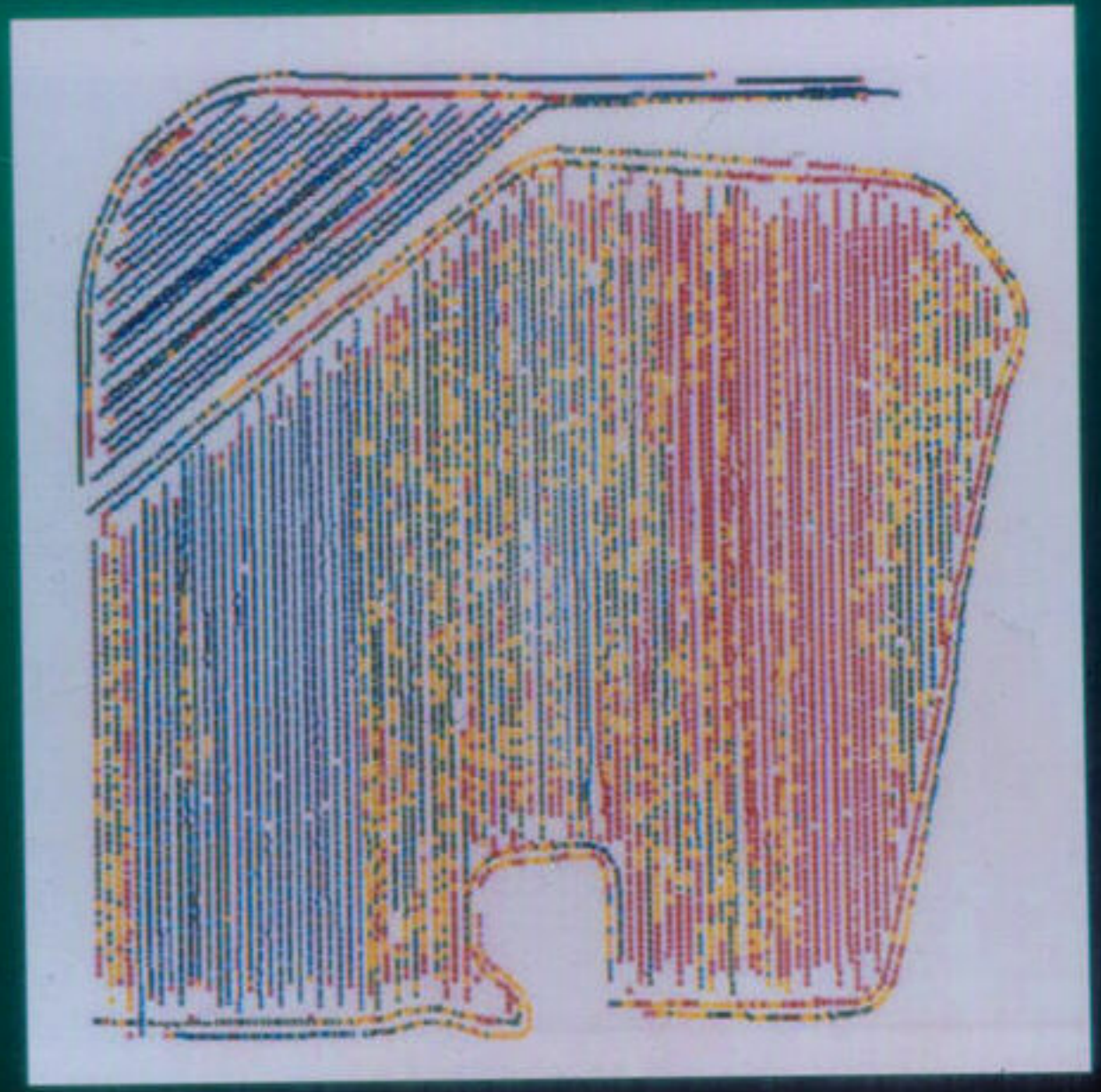



Yield Map
Field 7a 1996
DAVCO FARMING
Burdekin
Sugar Cane Yield (t/ha)
10 - 20
20.1 - 40
40.1 - 60
60.1 - 80
80.1 - 100
100.1 - 120
120.1 - 140
140.1 - 160
160.1 - 180
180.1 - 200
200.1 - 220
220.1 - 240
By Graeme Cox
16/10/1996
USC


Yield Map
Field 6a 1998
DAVCO FARMING
Burdekin
Sugar Cane Yield (t/ha)
10 - 20
20.1 - 40
40.1 - 60
60.1 - 80
80.1 - 100
100.1 - 120
120.1 - 140
140.1 - 160
160.1 - 180
180.1 - 200
200.1 - 220
220.1 - 290
By Graeme Cox
4/11/1998

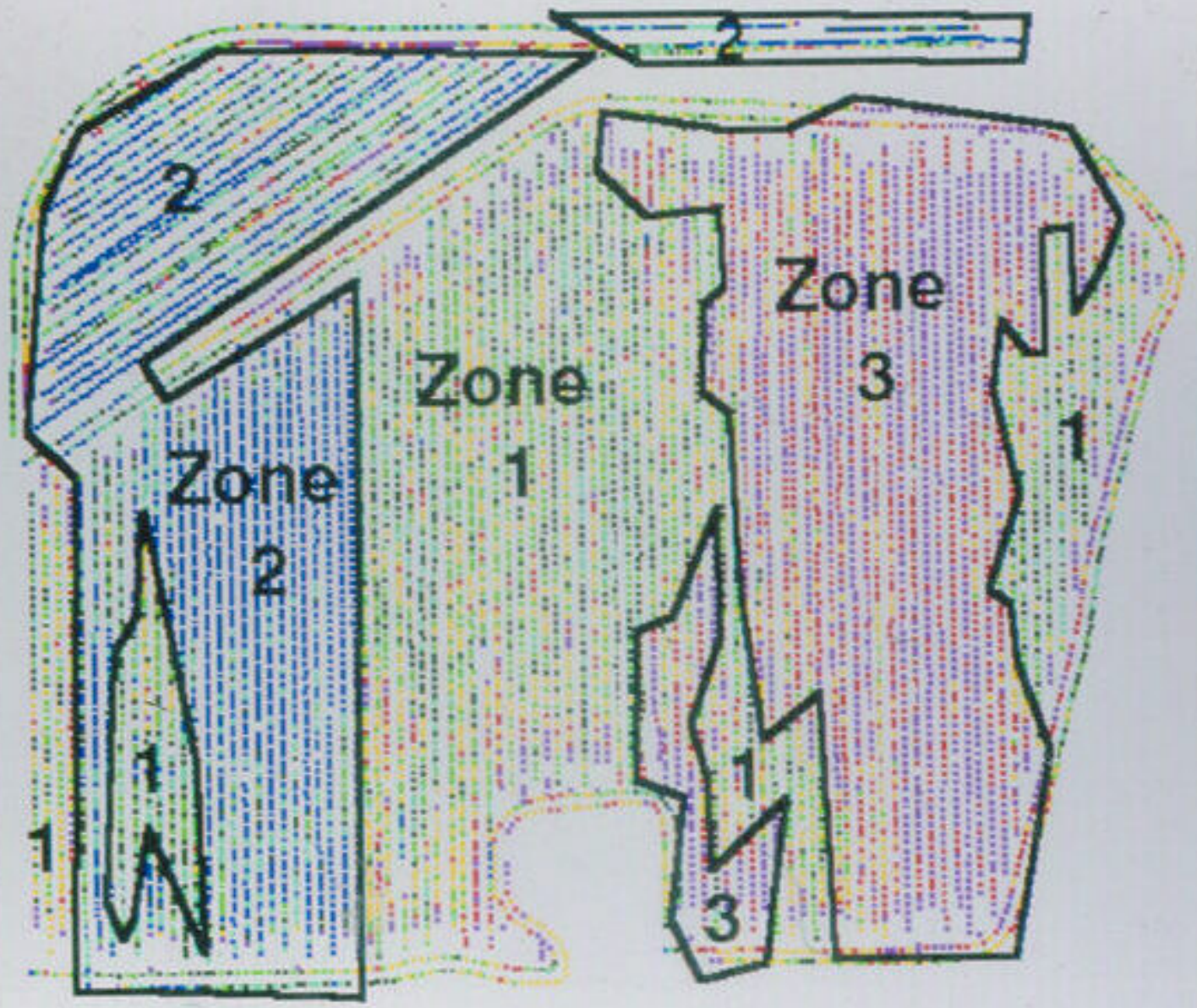

Legend
Yield, F51:1-10
Corn 1997
142.9+ - 132.2 Bu/A
132.2 - 125.8 Bu/Ac
125.8 - 120.0 Bu/Ac
120.0 - 114.3 Bu/Ac
114.3 - 107.9 Bu/Ac
107.9 - 100.7 Bu/Ac
100.7 - 91.5 Bu/Ac
91.5 - 80.0 Bu/Ac
80.0 - 67.2 Bu/Ac
67.2 & less Bu/Ac
N
0
200 Feet

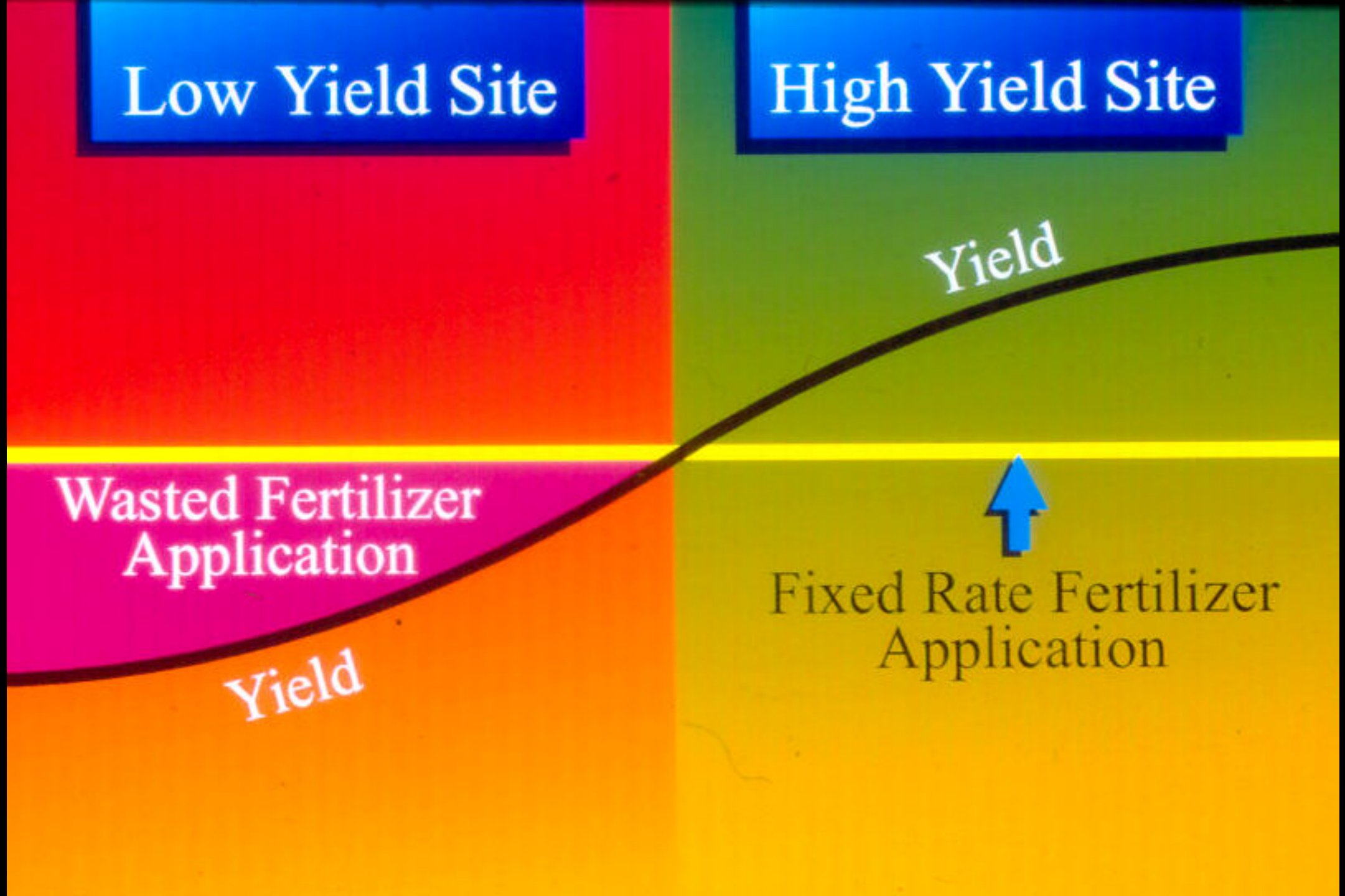

Legend
Yield, F42:1.10
Soybean
1998
61.3+ - 56.4 Bu/Ac
56.4 - 54.9 Bu/Ac
54.9 - 54.0 Bu/Ac
54.0 - 52.7 Bu/Ac
52.7 - 52.1 Bu/Ac
52.1 - 50.9 Bu/Ac
50.9 - 49.7 Bu/Ac
49.7 - 47.8 Bu/Ac
47.8 - 43.2 Bu/Ac
43.2 & less Bu/Ac
N
0
200 Feet

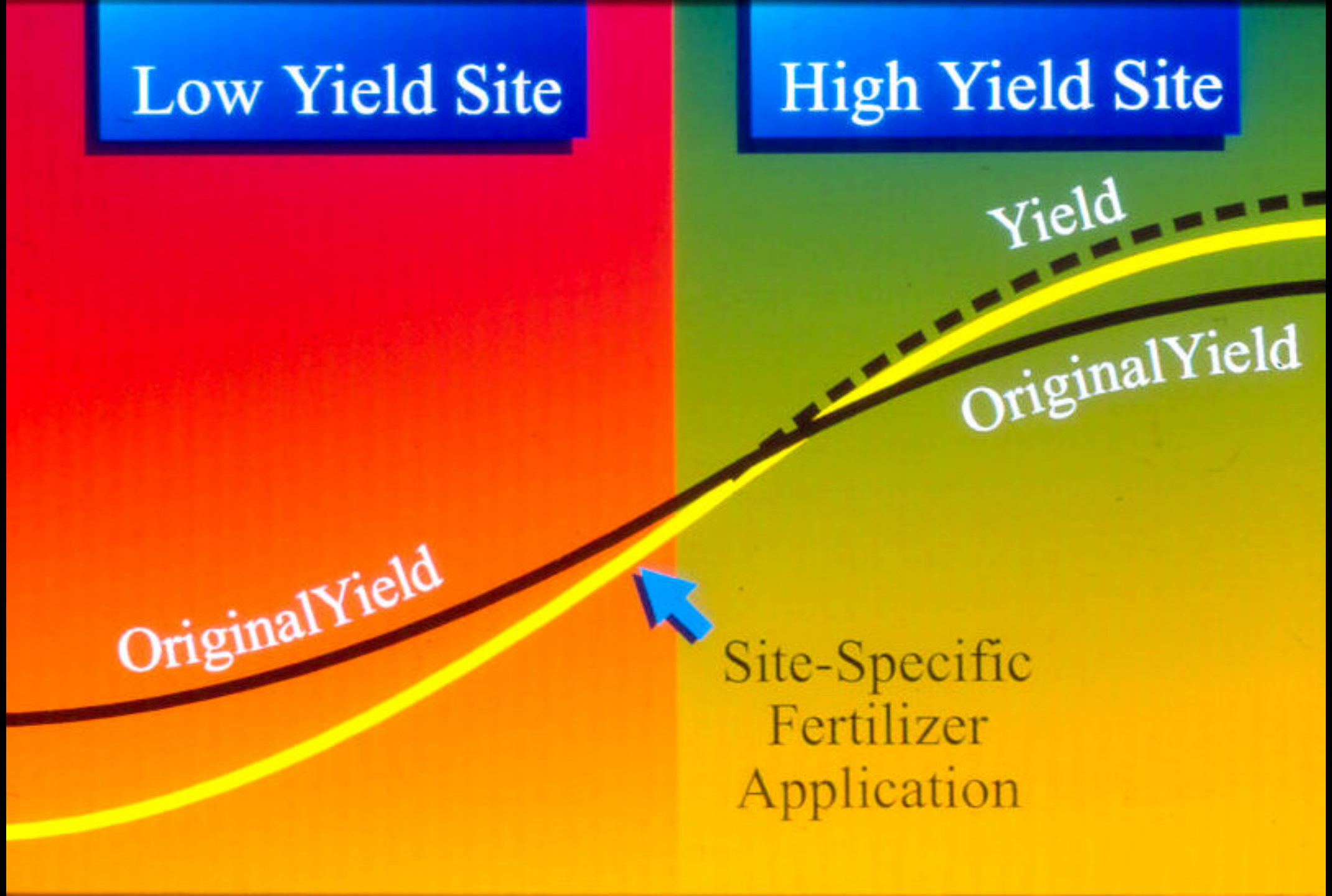


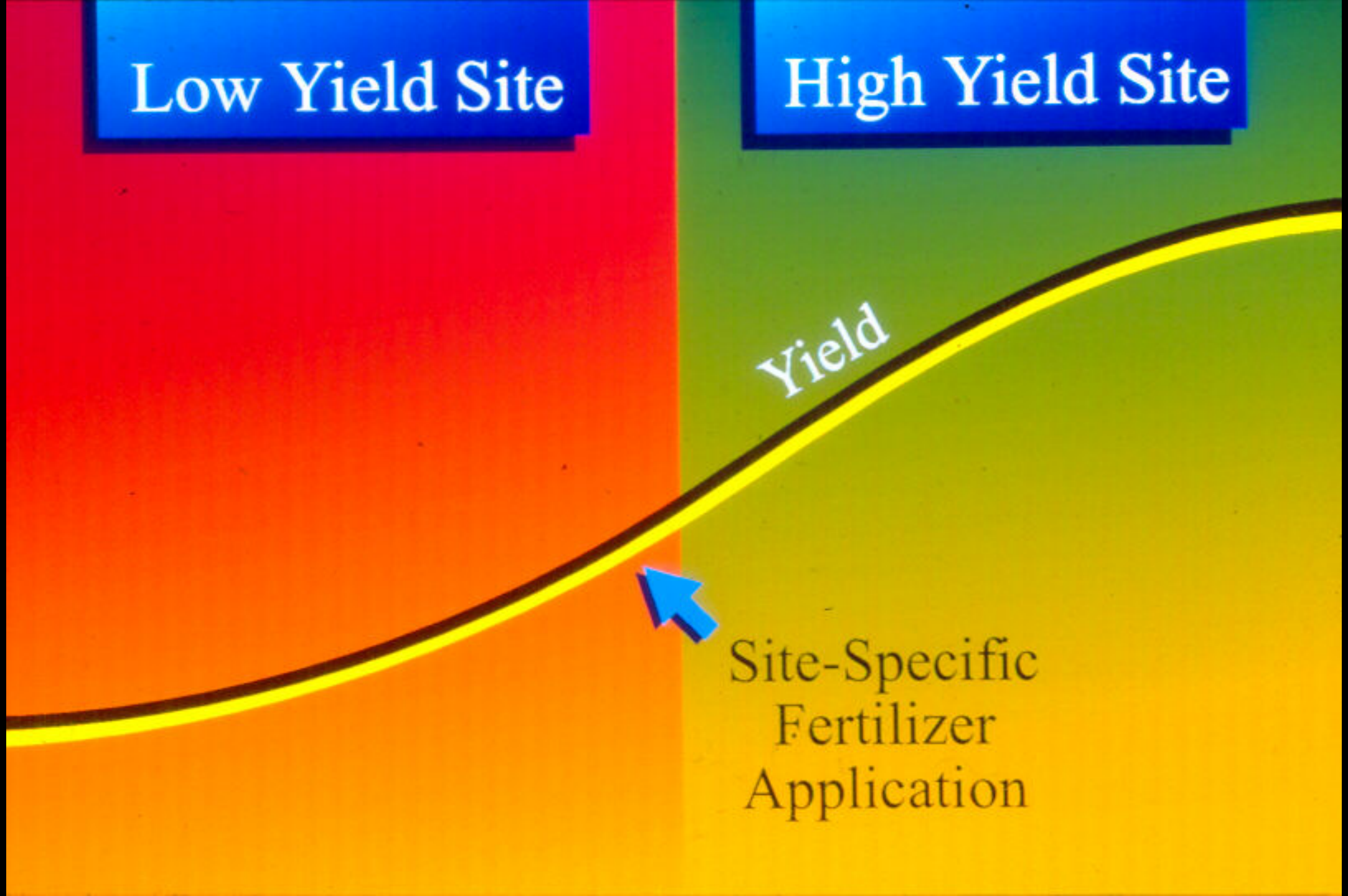
Recognizing Patterns

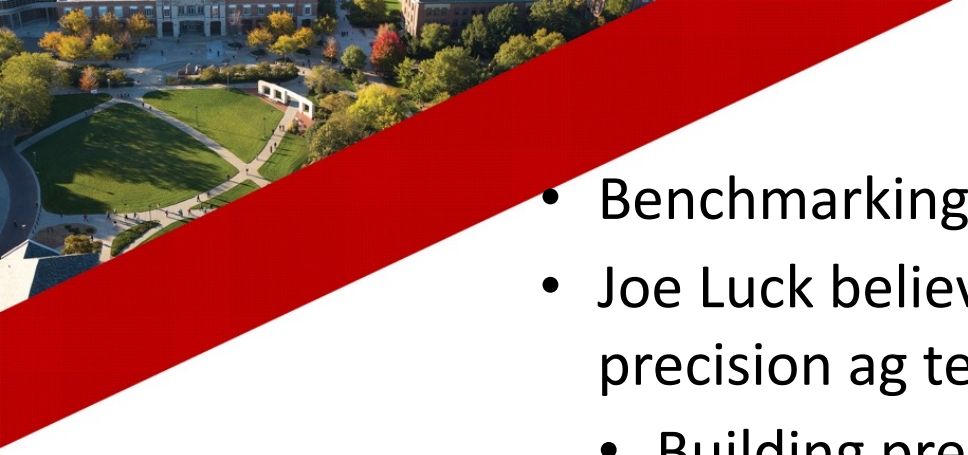
Straight Line Patterns		Irregular Patterns	
With Direction	At an Angle	Irregular Line	Irregular Patch
Planting date	Tillage (NH3)	Topography	Soil type
Variety	Tile lines	Herbicide drift	Weeds
Compaction	Previous fields	Insect movement	Insects
Sprayer skip	Manure	Waterways	Disease
Straw or chaff distribution	Pipelines	Border effects	Drainage


2
2
Zone
2
Zone
1
Zone
3
1
1
1
1
3


Low Yield Site
High Yield Site
Yield
Wasted Fertilizer Application
Yield
Fixed Rate Fertilizer Application

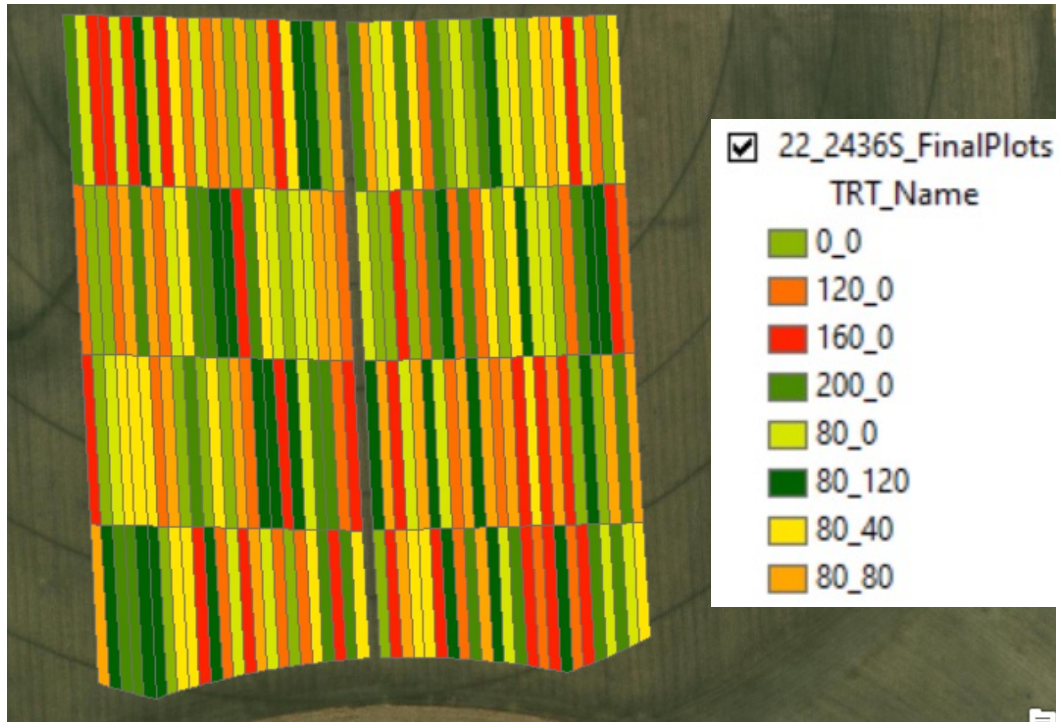

Low Yield Site
High Yield Site
Yield
OriginalYield
OriginalYield
Site-Specific
Fertilizer
Application


Low Yield Site
High Yield Site
Yield
Site-Specific
Fertilizer
Application



Utilizing yield monitor data…

- Benchmarking spatial variability by and extremely useful application
- Joe Luck believes that on-farm research can be facilitated using precision ag technologies and yield monitor data:
  - Building prescriptions for applying different rates/products
  - Validate with as-applied data if possible
  - Design plots at ~250 feet in length to ensure transitions



- Field had 8 different N rate/timing treatments
- Application rates are validated with as-applied data
- Yield data are post-processed and averaged within each plot
- Advanced FMIS systems can provide similar information or basic GIS software can be used as well

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