PROGRESS ON USING REMOTE FOR CROP MANAGEMENT

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REMOTE SENSING

Fundamentals

Wavelengths and Bands

Sources of Remote Sensing

Selection Criteria

Field Studies

Identification of Anomalies

REMOTE SENSING
Definition

The acquisition of information about a surface of an object without contacting the object

REMOTE SENSING FUNDAMENTALS

System senses the energy reflected from an object or surface

Passive Remote Sensing

• Source of waves – sun

• System senses sun's rays reflected from the surface being evaluated

Active Remote Sensing

• System provides source of energy of a specific wavelength e.g. radar

• System senses energy reflected from the object

Wavelengths and Bands

Electromagnetic range – 0.300 to 3.000 micrometers (um)

Ultraviolet – less than 0.400 um

Visible – 0.400 to 0.700 um

Blue – 0.400 to 0.500 um

Green – 0.500 to 0.600 um

Red – 0.600 to 0.700 um

Near Infrared – 0.700 to 3.000 um

Thermal Infrared – 3.000 to 14.000 um

Sources of Data

Satellites*

Low Flying Manned Aircraft*

Model Airplanes

Ground transport equipment*

*Used in this study

Performance Criteria

Spectral Resolution

      Number of bands

            From 3 to 120 bands

            Should have at least four

      Width of the bands

            Narrow

            Wide

Spatial Resolution

      Area represented by each pixel

      Depends the purpose of the data

Temporal Resolution

      Bare soil

      Rapid plant growth

Ikonos Satellite Data(*u*m)
(Used in 2001 and 2002)

Visible Range

Wavelength	0.445-0.516	0.506-0.595	0.632-0.698
Color	Blue	Green	Red

Near Infrared   0.757-0.853

Panchromatic   0.450-0.900

Spatial Resolution: 1 to 4 meters

3di LLC(*um*-middle of 0.010 *u*m band) (Used in 2001)

Visible Range

Wavelength	0.530	0.554	0.580	0.605	0.634
(5 bands)	0.649	0.675			

Near Infrared	0.700	0.725	0.750	0.780	0.800
(5 bands)	0.824	0.850	0.880		

Spatial Resolution: 1 meter

Precision Aviation(*um*)
(Used in 2002)

Two sensing systems

Multispectral	0.560	0.660	0.830
	Green	Red	Near Infrared

Hyperspectral   120 bands

0.471 to 0.828

0.003 increments

Spatial Resolution: 1 meter for both

Field Studies

Seven production fields 1997 - 2002

     40 to 105 acres

     Silt Loam Soil

     North of Madison

     Corn – soybean rotation

Data collected

     Remote sensing data

     Combine yield monitor

     Grid soil sampling – one acre grids

     Plant data – population and plant height

Ikonos
Satellite
Data

Panchromatic –
0.450 – 0.900

Spatial Res. –
    1 meter

Date: May 2,
2002
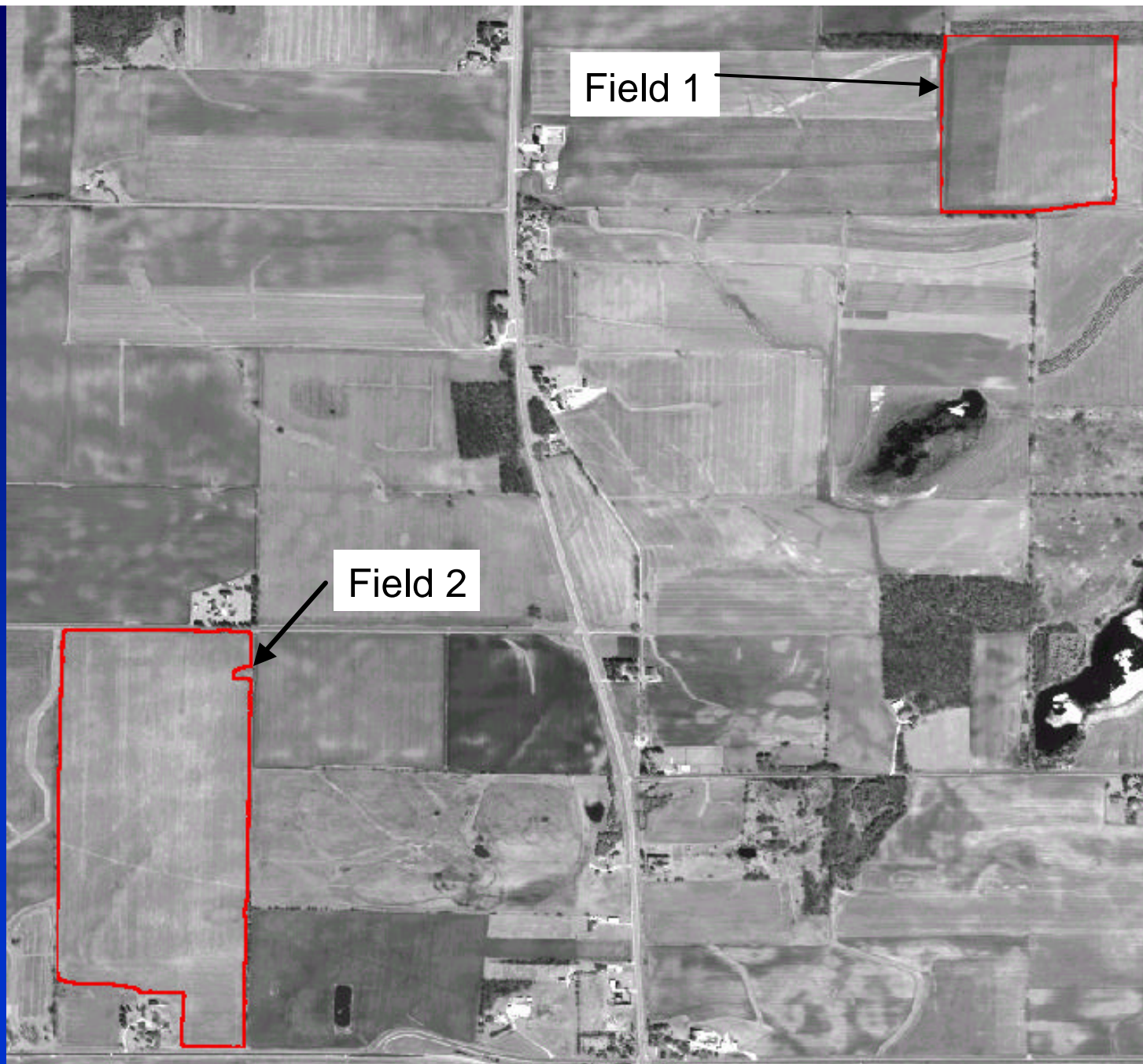
Field 1

Field 2

IKONOS Satellite Digital Image

Bare Soil
Date: 5/30/01

Pancromatic Image
Reflectance Value

High : 810

Low : 484

Field Boundary

Wavelengths
Pancromatic Band: 525 nm - 929 nm

Spatial Resolution: 1 meter
Area: 44.9 acres
Scale: 1:3,600

N
W   E
S

89°19'3"W 89°19'0"W 89°18'57"W 89°18'54"W 89°18'51"W 89°18'48"W

43°21'30"N
43°21'27"N
43°21'24"N
43°21'21"N
43°21'18"N
43°21'15"N

400   200   0   400   800   1,200   Feet
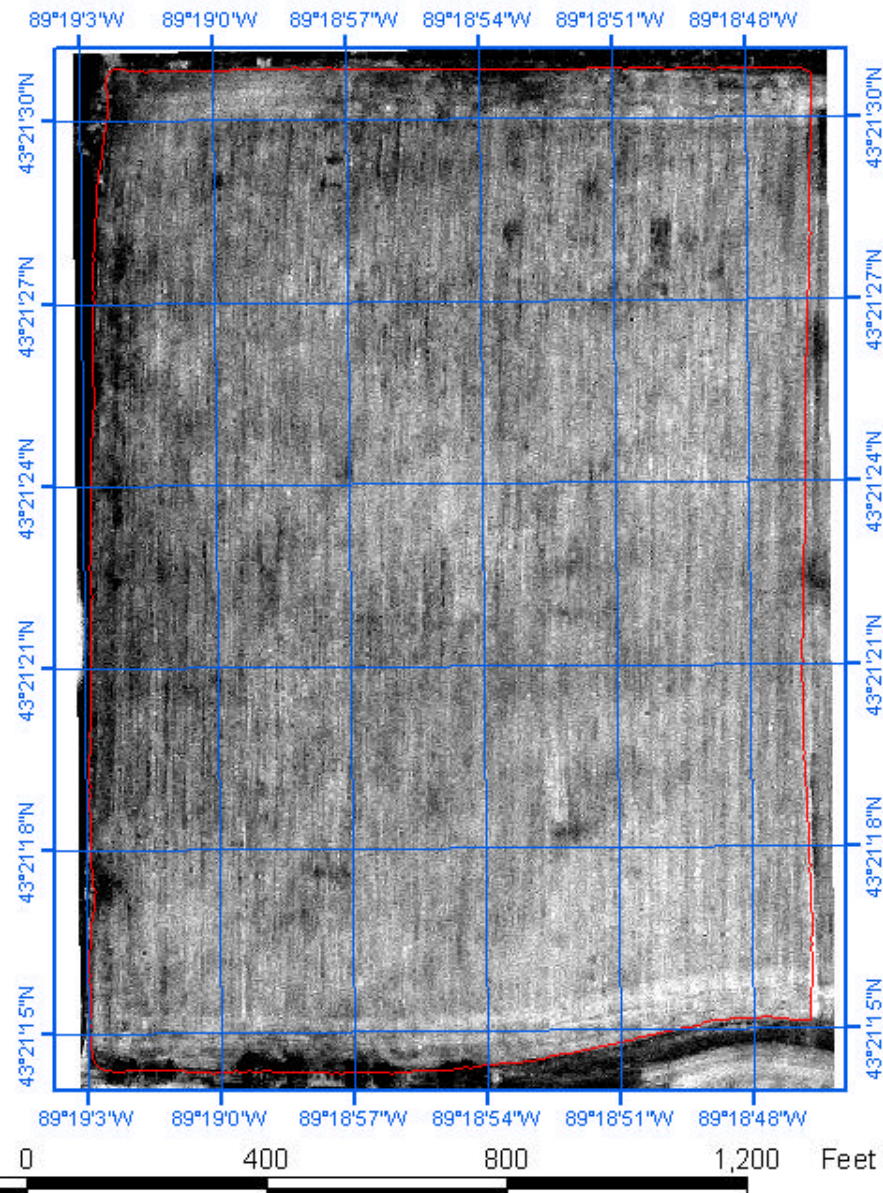
IKONOS Satellite Digital Image

Crop: Soybeans
Date: 8/29/01

Pancromatic Image
Reflectance Value

High : 518

Low : 0

Field Boundary

Wavelengths
Pancromatic Band: 525 nm - 929 nm

Spatial Resolution: 1 meter
Area: 44.9 acres
Scale: 1:3,600

| 400 | 200 | 0 | 400 | 800 | 1,200 | Feet |
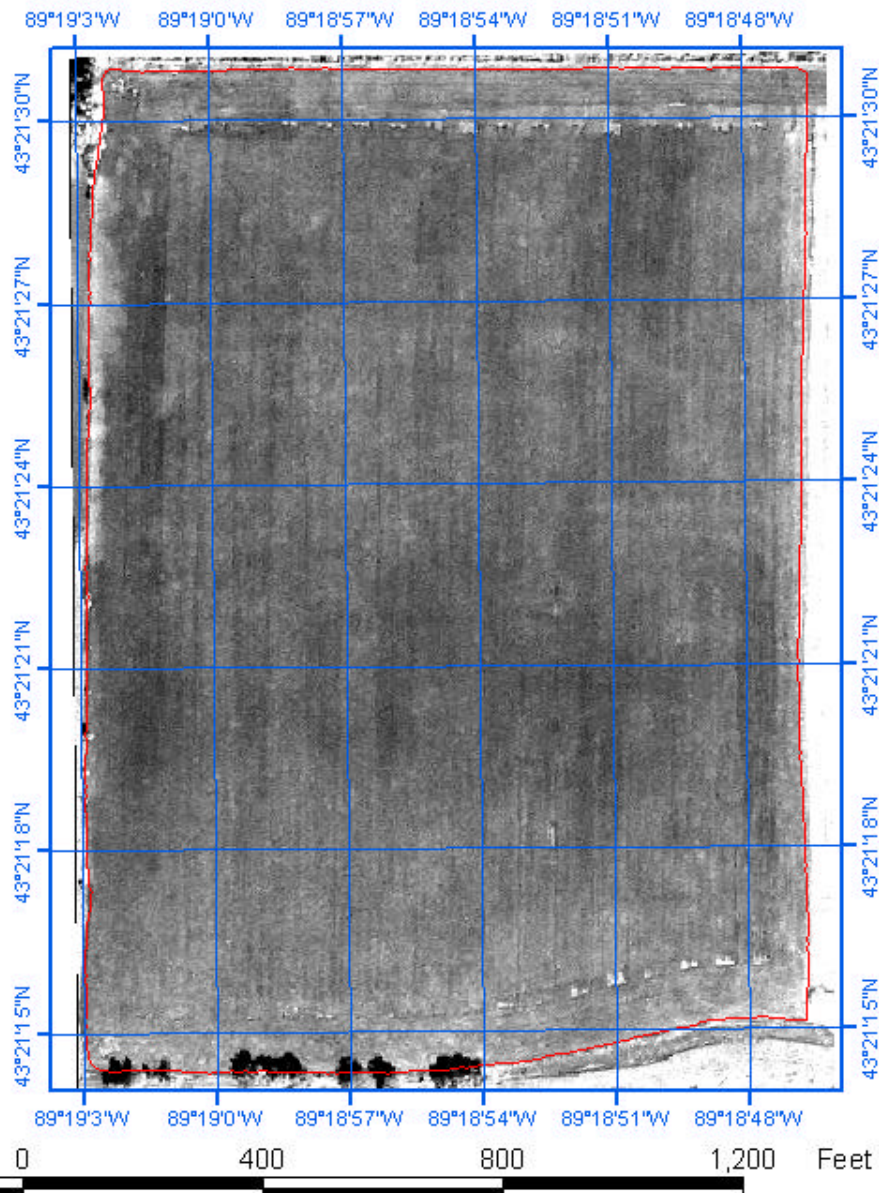
IKONOS Satellite Digital Image

Crop: Soybeans
Date: 8/29/01

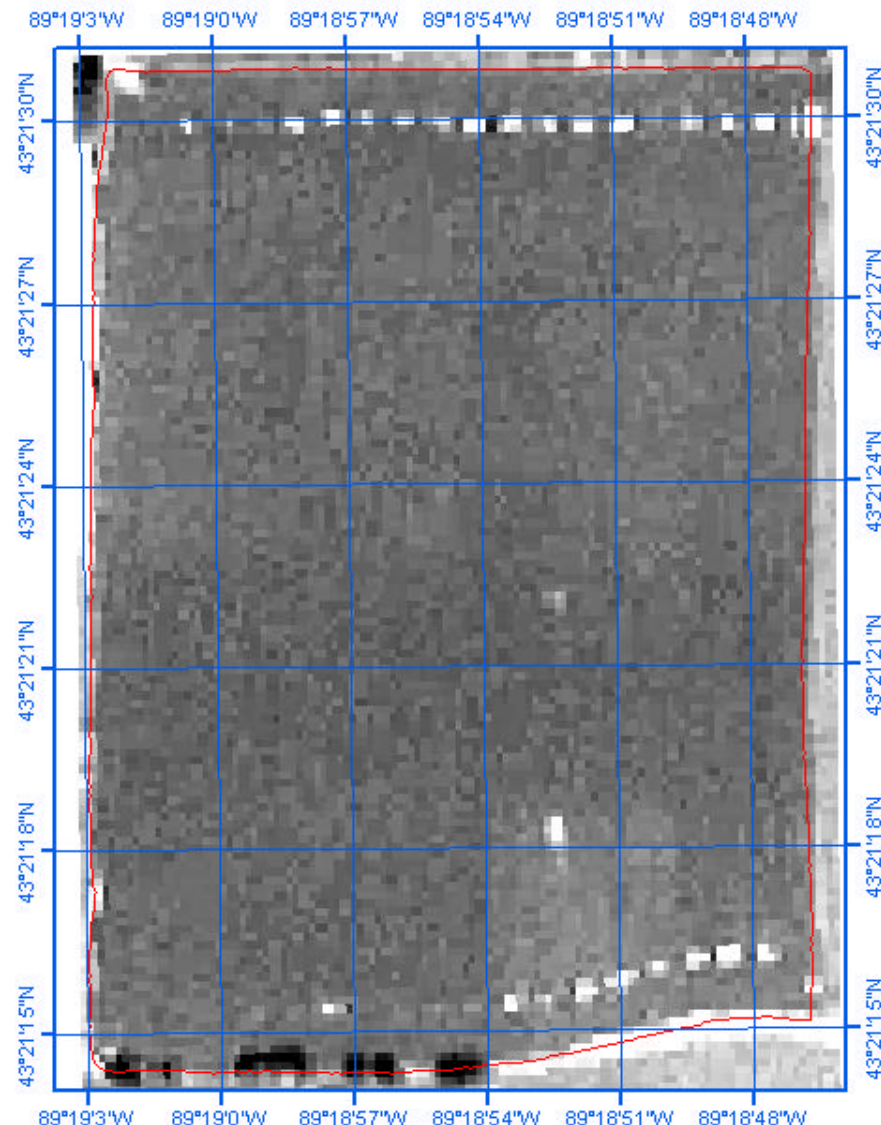**Red Band Image**
Reflectance Value

High : 396

Low : 95

Field Boundary

Wavelengths
Near IR Band: 632 nm - 698 nm

Spatial Resolution: 4 meters
Area: 44.9 acres
Scale: 1:3,600

400 200 0 400 800 1,200 Feet

Field A

Field Size – 45 Acres

Crop – Soybeans

3di LLC data

Date – August 20, 2001
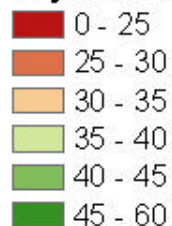
Drill skips

Missing Data

Low yielding

Yield Map

Crop: Soybeans

Soybean Yield (bu/acre)
- 0 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 60

Average: 34.3
Std. dev.: 8.6

Area: 44.9 acres
Sample pts/acre: 164.3
Scale: 1:3,600
Analysis gride cell size: 5 ft
Interpolation type: Spline w/tension
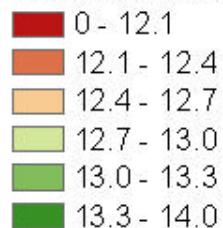

89°19'3"W 89°19'0"W 89°18'57"W 89°18'54"W 89°18'51"W 89°18'48"W

43°21'30"N 43°21'27"N 43°21'24"N 43°21'21"N 43°21'18"N 43°21'15"N

N
W   E
S

400   200   0   400   800   1,200   Feet
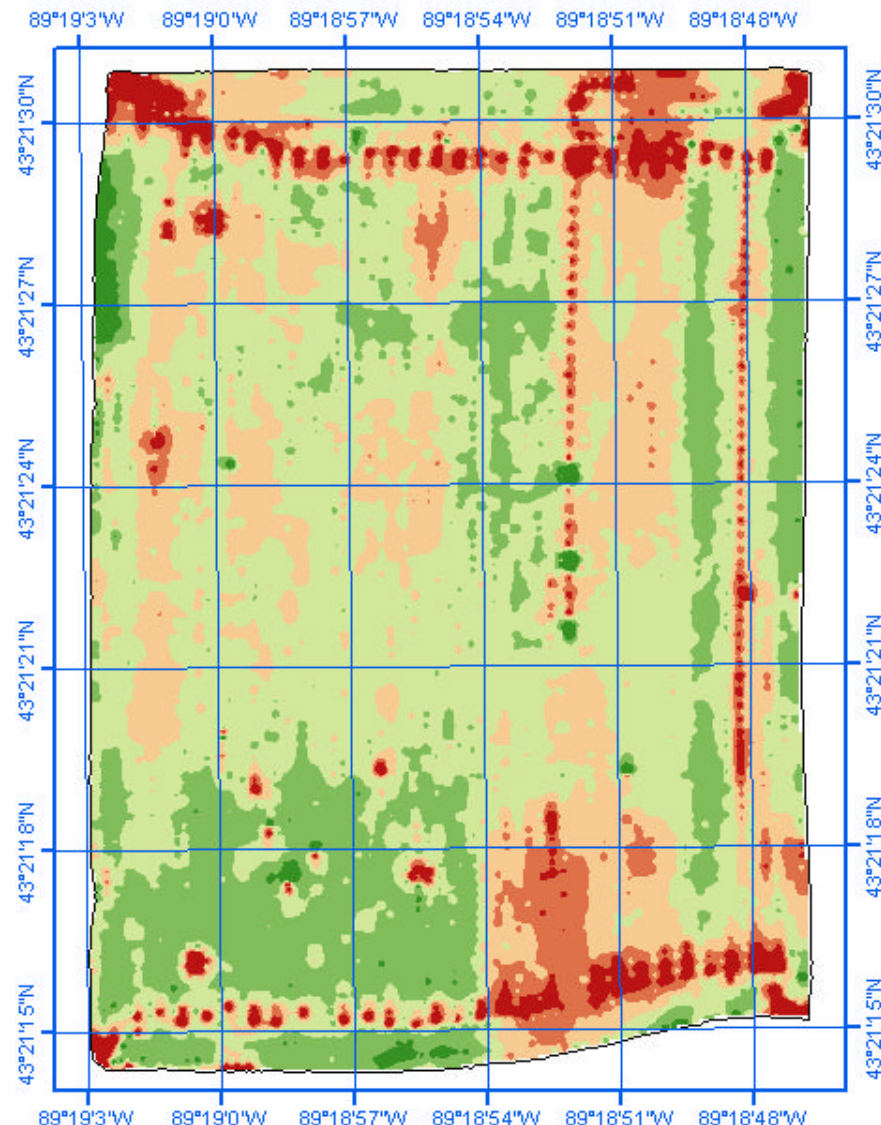
Moisture Map

Crop: Soybeans

Percent Moisture of Grain

- 0 - 12.1
- 12.1 - 12.4
- 12.4 - 12.7
- 12.7 - 13.0
- 13.0 - 13.3
- 13.3 - 14.0

Average: 12.5
Std. dev.: 0.3
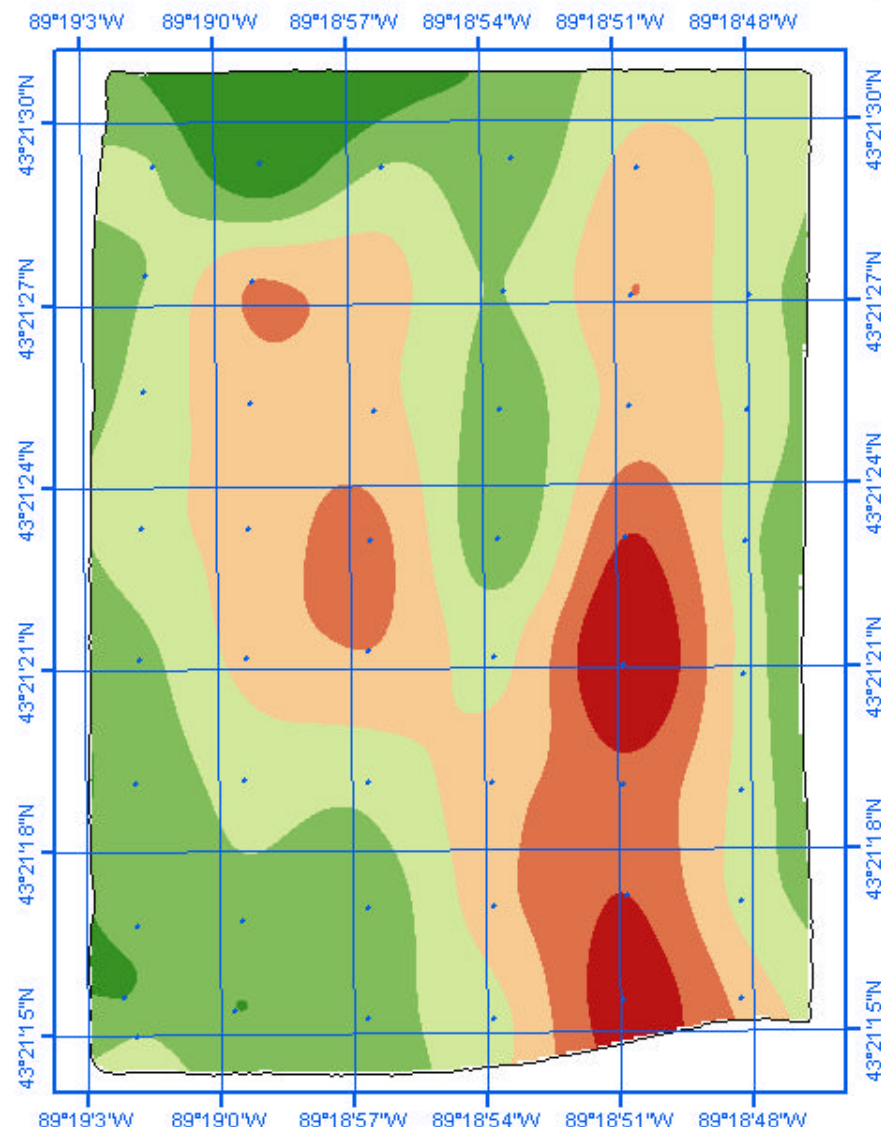
Area: 44.9 acres
Sample pts/acre: 164.3
Scale: 1:3,600
Analysis gride cell size: 5 ft
Interpolation type: Spline w/tension

N
W E
S

400   200   0   400   800   1,200   Feet
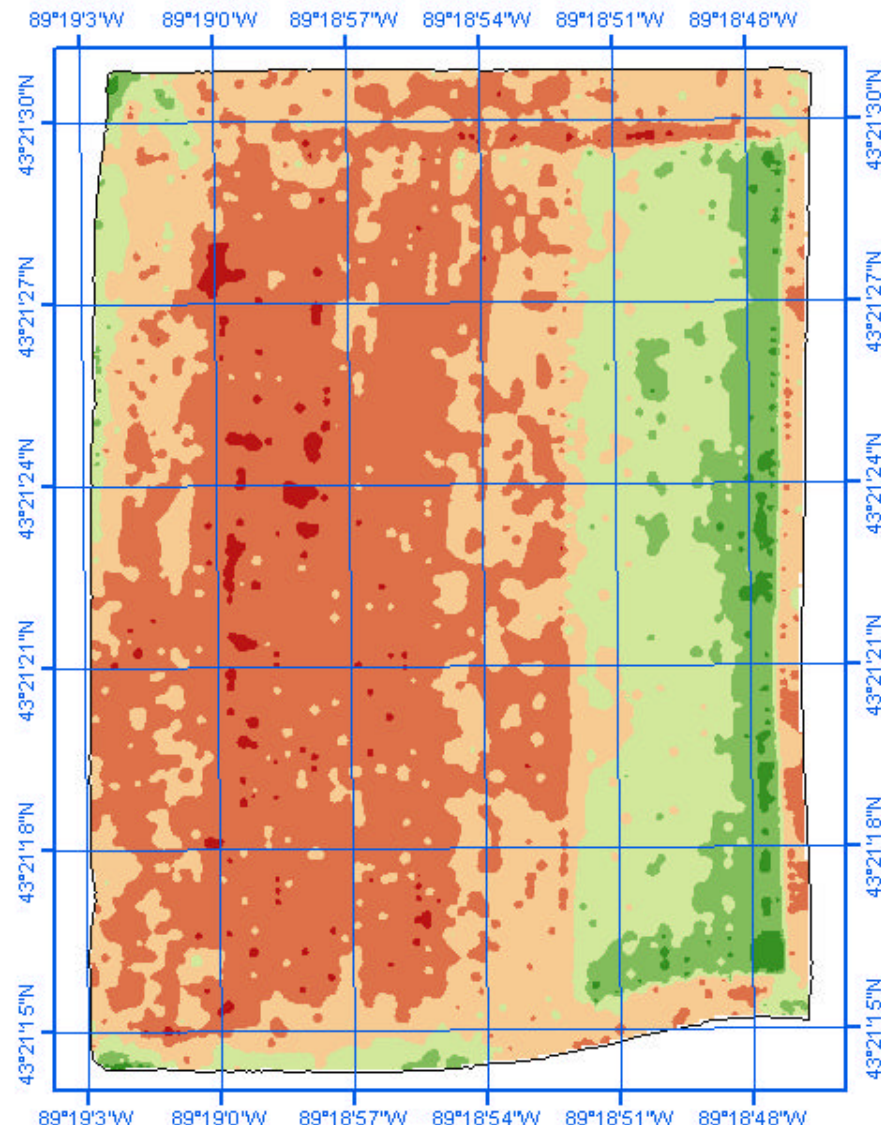
Date: 1999
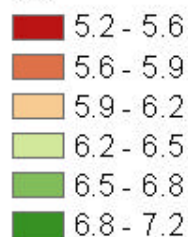
Ph
- 5.2 - 5.6
- 5.6 - 5.9
- 5.9 - 6.2
- 6.2 - 6.5
- 6.5 - 6.8
- 6.8 - 7.2
- • Sample Points

Average: 6.3
Std. Dev.: 0.4

Area: 44.9 acres
Sample pts/acre: 1.07
Scale: 1:3,600
Analysis gride cell size: 5 ft
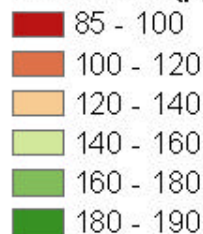Interpolation type: Spline w/tension

Printed: 9/06/02

400   200   0   400   800   1,200   Feet

Franz1-1999
Soil Potassium Map

Date: 1999

Potassium (ppm)

- 85 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 190
- · Sample Points

Average: 127.9
Std. Dev.: 24.8

Area: 44.9 acres
Sample pts/acre: 1.07
Scale: 1:3,600
Analysis gride cell size: 5 ft
Interpolation type: Spline w/tension

Printed: 9/06/02

400 200 0 400 800 1,200 Feet
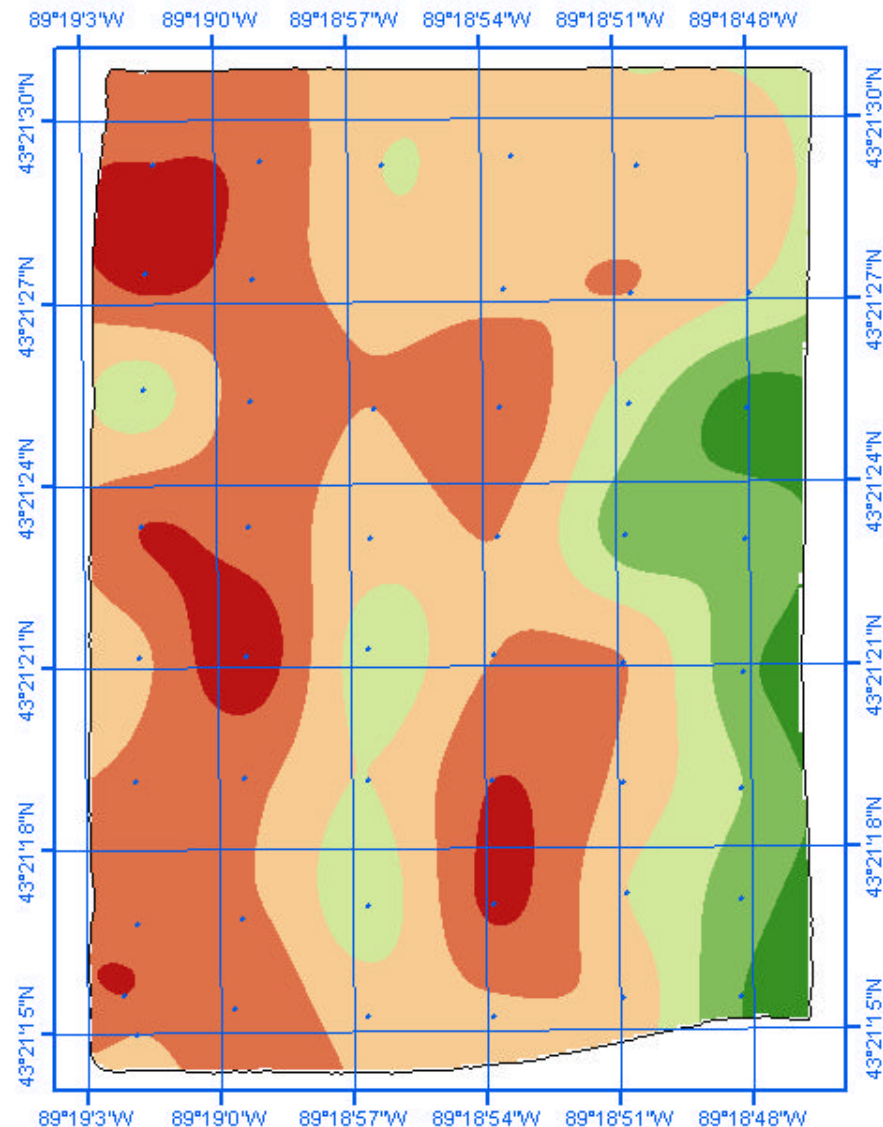
Ikonos Satellite Data

Panchromatic – 0.450 – 0.900

Spatial Res. – 1 meter

Date: May 2, 2002

Ikonos Satellite Data

Panchromatic – 0.450 – 0.900

Spatial Res. –
   1 meter
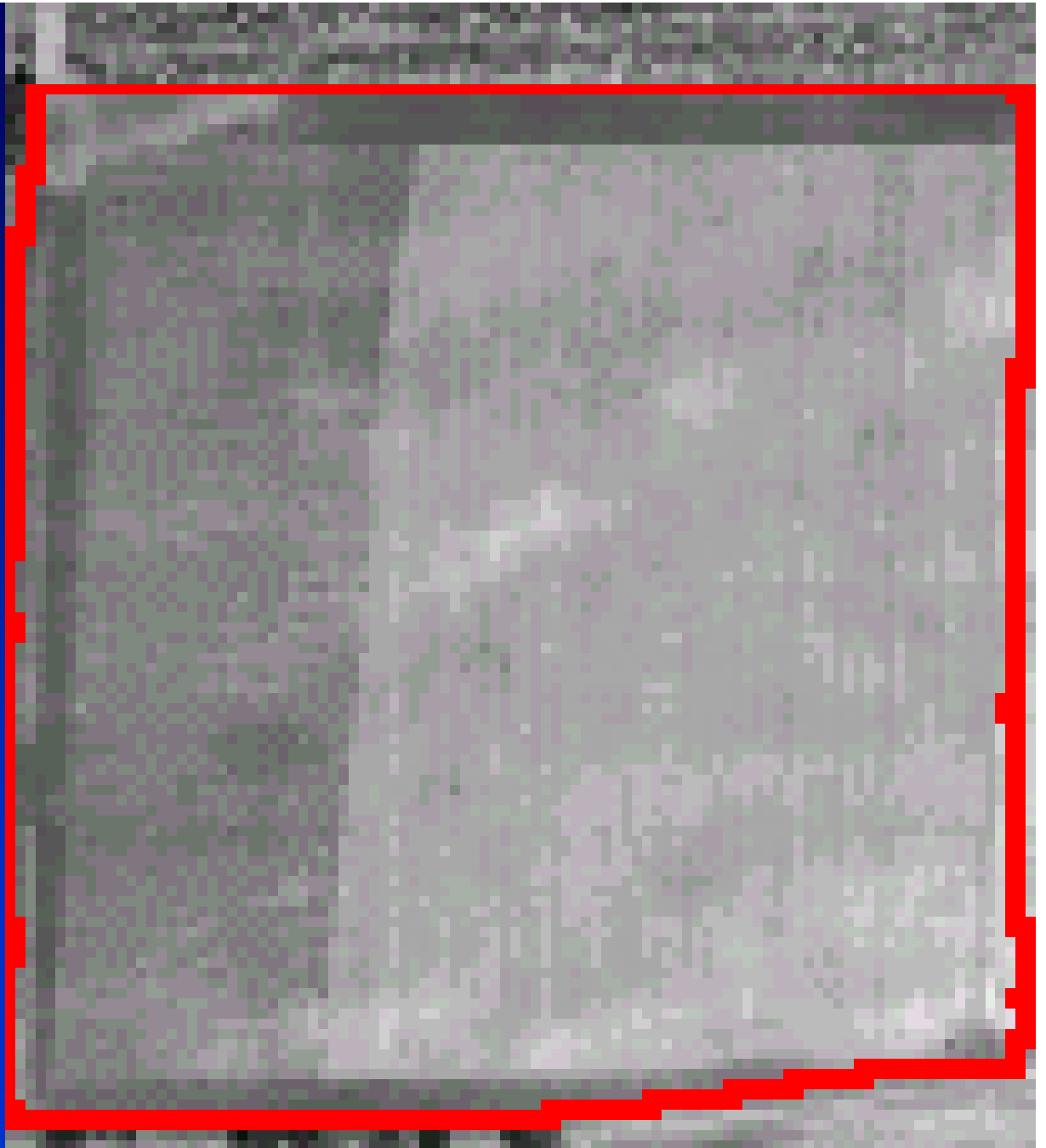
Date: May 2, 2002

Field A

Multispectral-3 bands

Field size – 45 acres
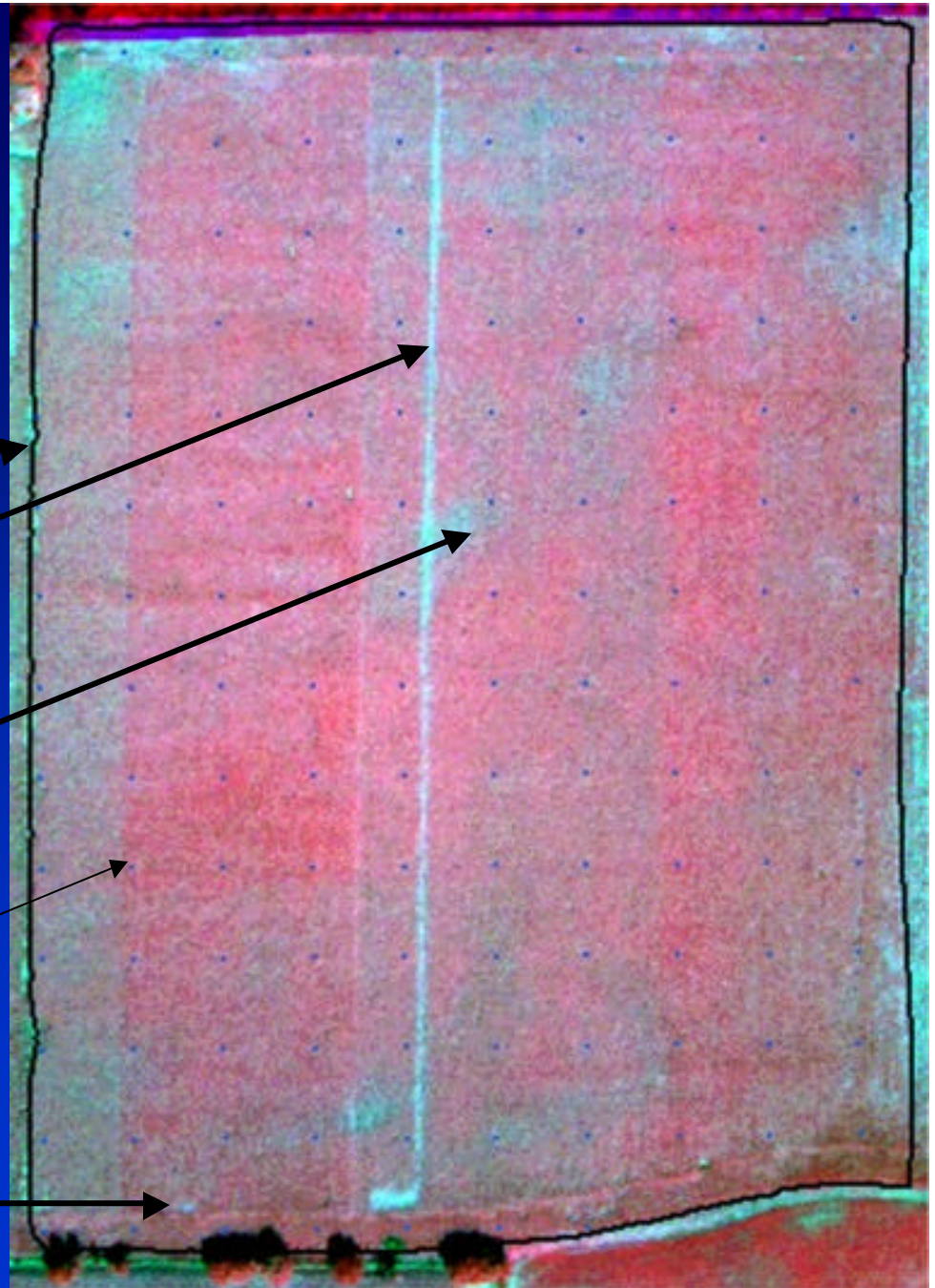
Crop – corn

Date – August 25, 2002

Border

Sprayer skip

Weed pressure
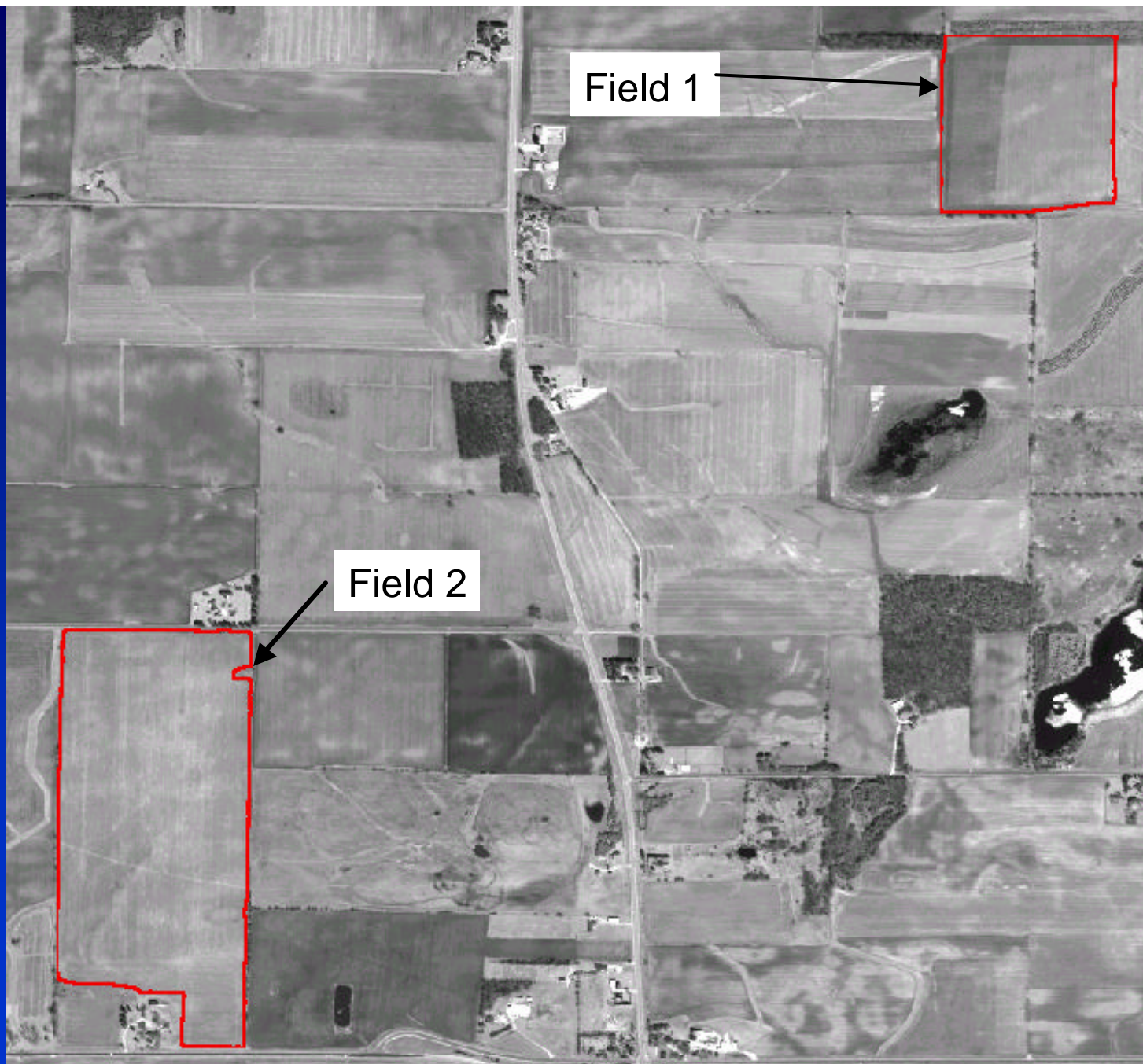
Tillage Difference

Planter skips

Ikonos
Satellite
Data

Panchromatic –
0.450 – 0.900

Spatial Res. –
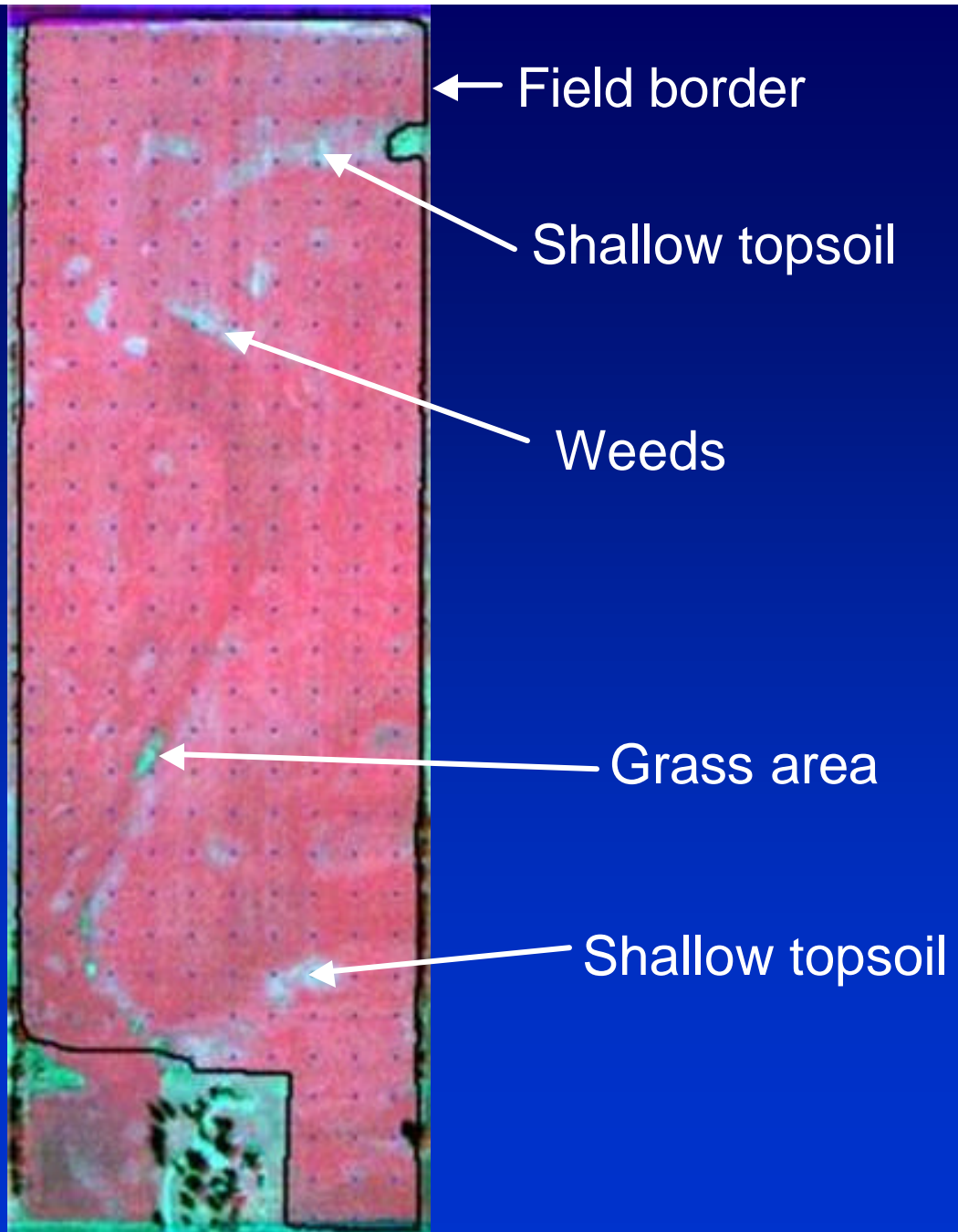1 meter

Date: May 2,
2002

Field 1

Field 2

Field 2
Multispectral
Field size 106 acres
Soybeans
Spatial Resolution – 1 meter
Sept. 2, 2002

Field 2
Multispectral
Field size 106 acres
Soybeans
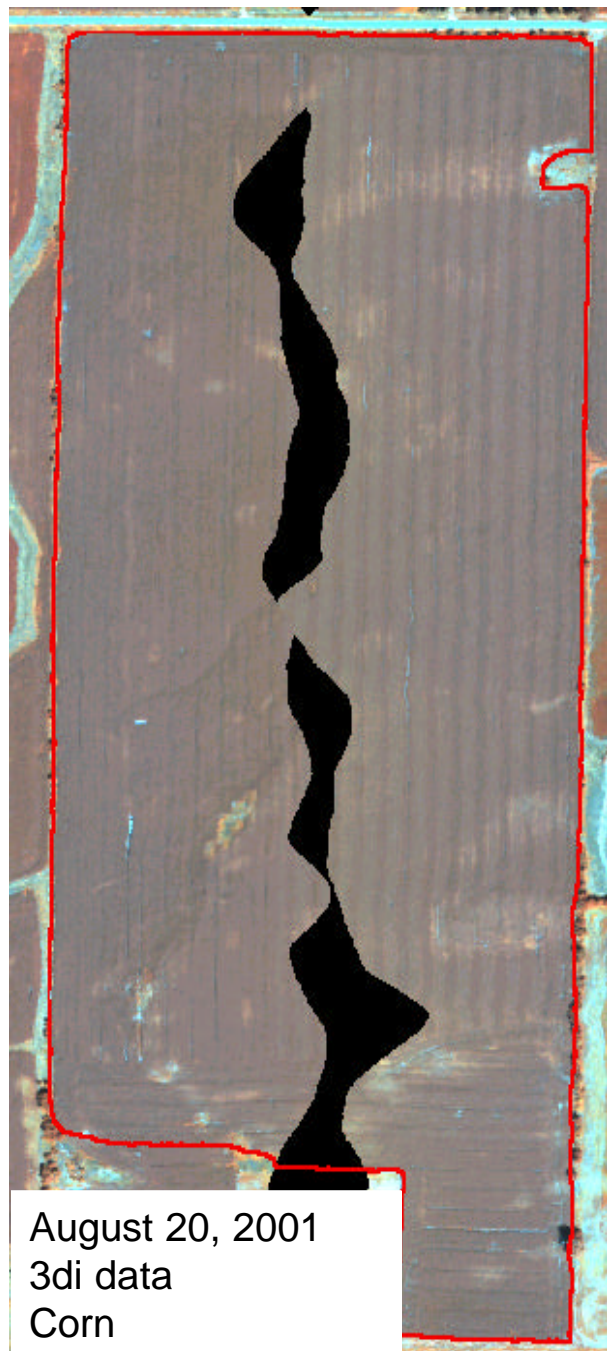Spatial Resolution –
        1 meter
Sept. 2, 2002

Field border

Shallow topsoil

Weeds

Grass area

Shallow topsoil

August 20, 2001
3di data
Corn

Sept. 9, 2002
Multispectral
Soybeans

August 20, 2001
3di data
Corn

3di data
Corn

Franz2-2001
Yield Map

Crop: Corn
Date: 2001

Yield (bu/acre)
- 0 - 100
- 100 - 125
- 125 - 150
- 150 - 175
- 175 - 200
- 200 - 225
- Field Boundary
- Grass Strip
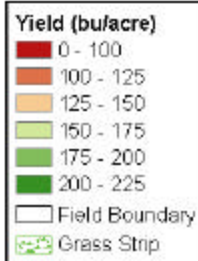
Mean: 162.1
Std. dev.: 35.8
Area: 106.0 acres
Sample pts/acre: 178.8
Scale: 1:6,000
Analysis gride cell size: 7 ft
Interpolation type: Kriging/Spherical Model

400 200 0   400   800   1,200   1,600 Feet
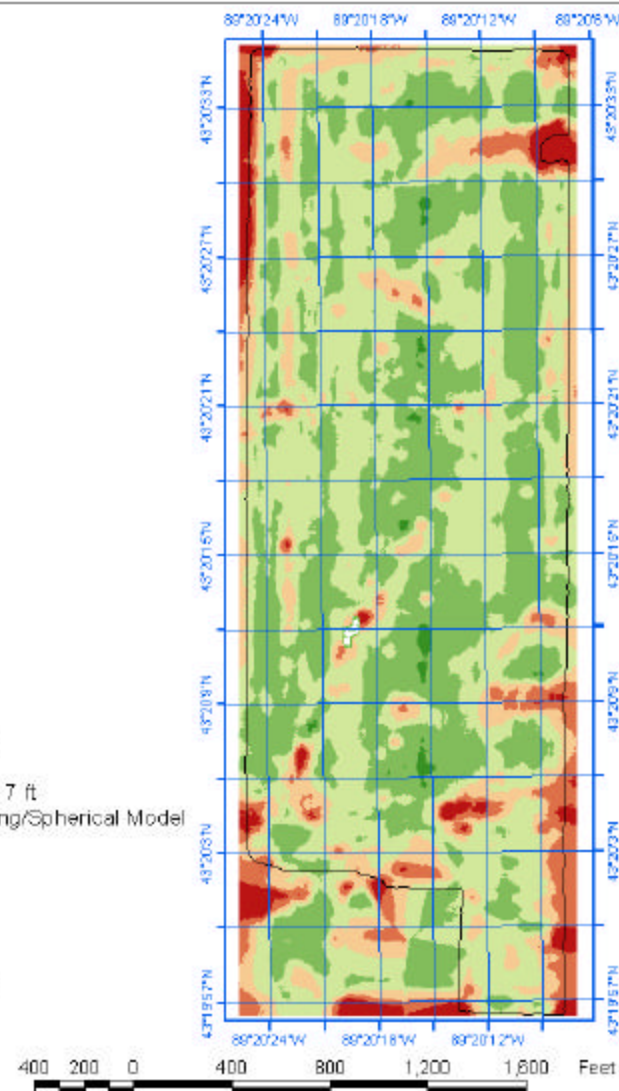
Concluding Remarks

Remote sensing provides locations of anomalies

Field scouting needed to identify causes

Consistent source of data is needed