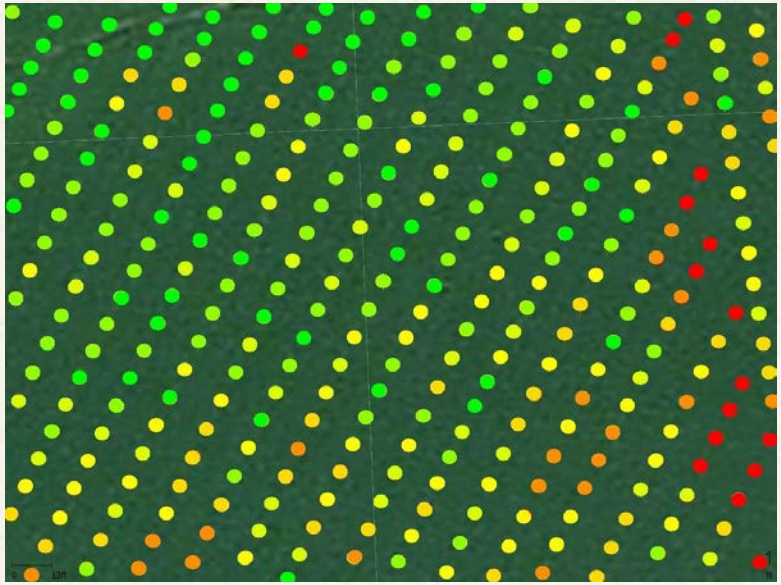
EXTENSION

Extension is a Division of the Institute of Agriculture and Natural Resources at the University of Nebraska-Lincoln cooperating with the Counties and the United States Department of Agriculture.

Connect the Dots: Improving Yield Data, Understanding My Map, and Making Decisions



Nathan Mueller
PhD CCA

Cropping Systems Educator for Dodge & Washington Counties

EXTENSION

Overview

- Yield Data Quality – Remove Bad Dots
- Imagery – Explain Some Dots
- Soil Map Unit vs. Soil EC – Need More Dots
- Connect the Dots
  - Create management zones
  - Create prescriptions
  - Create profitability maps
- Verify You Connected the Dots Right
  - On-Farm Research Network
  - Precision Ag Data Management Workshops

Dodge County, NE

croptechcafe.org/connectthedots

Get this presentation

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Yield Data Quality: Remove Bad Dots

Dot 1

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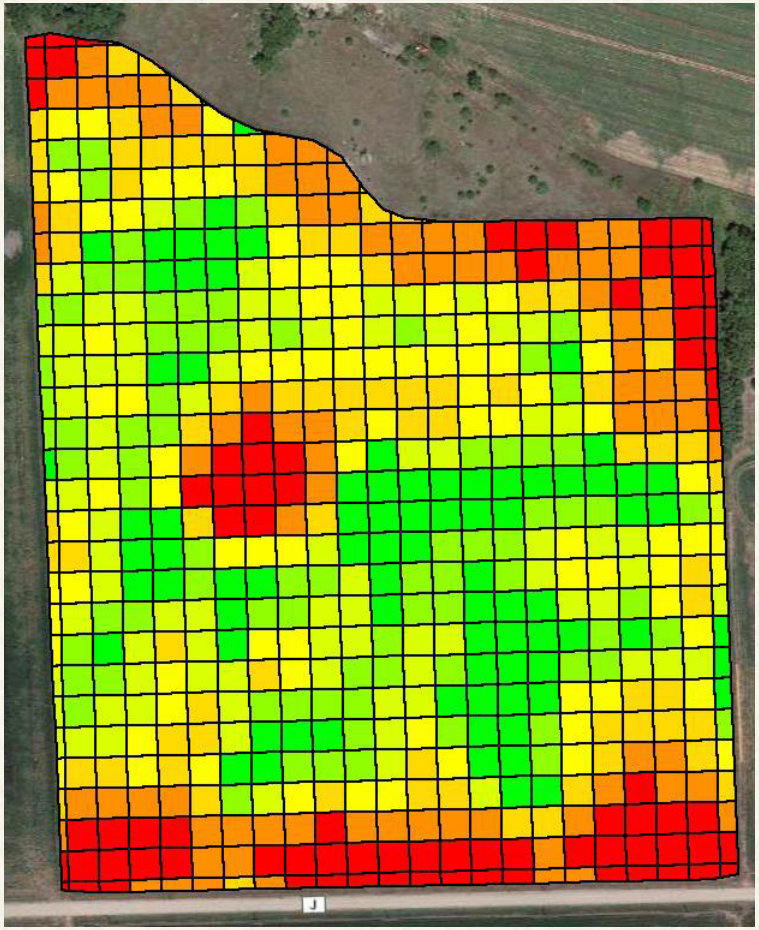
How Important is Yield Data Quality?

Most valuable data gathered each year

- Yield data is used to:
  - Develop fertilizer recommendations
  - Develop management zones
  - Assess hybrid/variety performance
  - Evaluating product performance
  - Assess profitability
- So…. Do you want to make these decision using bad yield data?

Normalized multi-year yield



EXTENSION

Impact of keeping the BAD dots

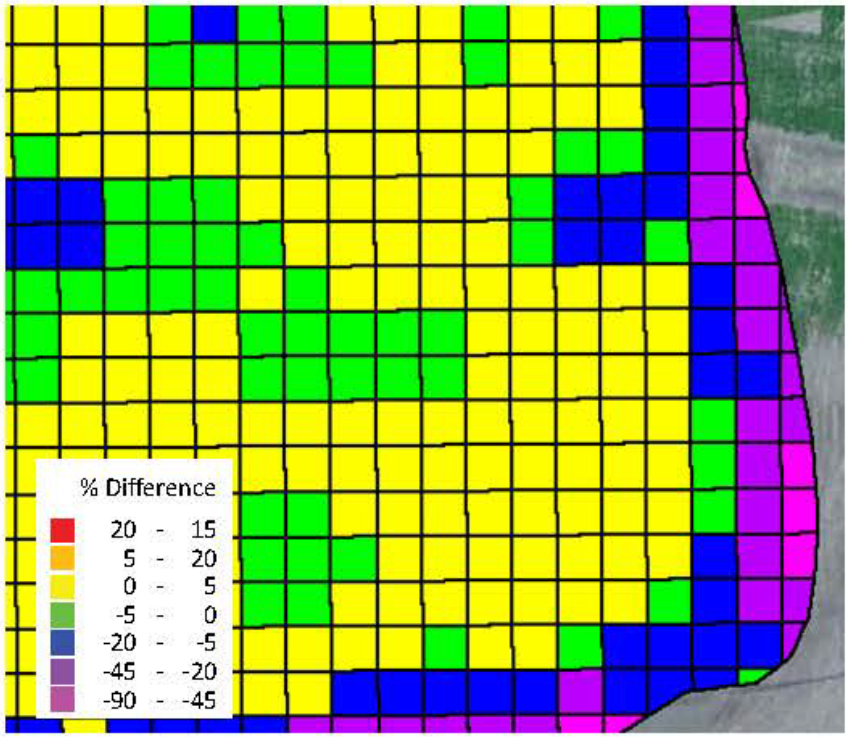


Figure 7: Differences (in %) between clean and raw gridded (50 ft square) yield data (raw grid data subtracted from clean grid data divided by clean grid data).

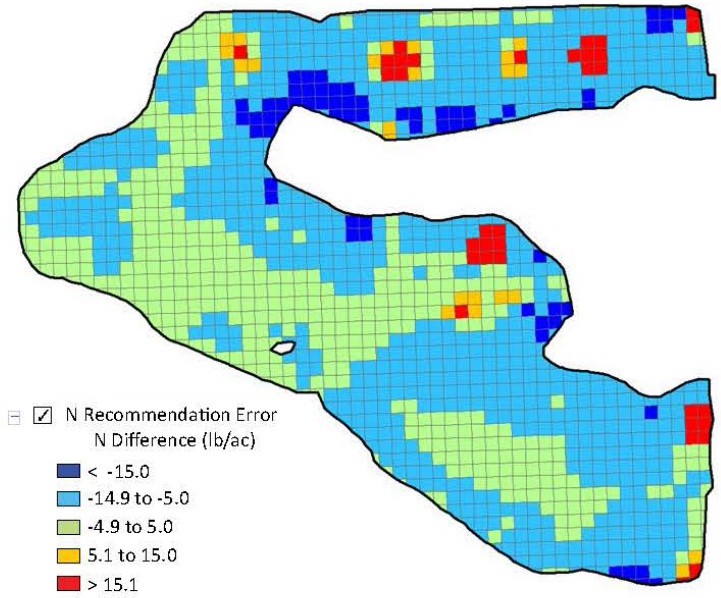
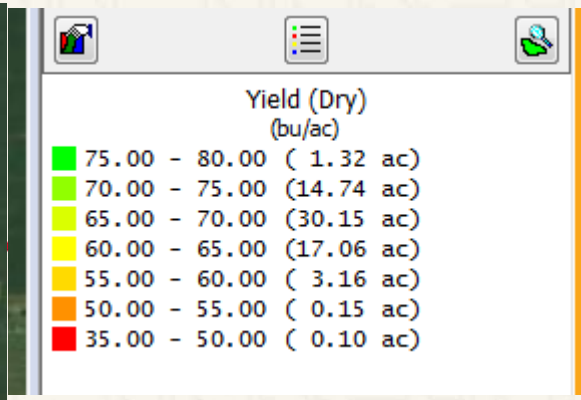


Figure 12: Map (50 ft grid) showing the potential differences in a N prescription map when using raw yield data versus cleaned yield data. In many instances, predictions of N can exceed 15 lb/ac.

N EXTENSION



- Yield at 13%
- On Same Yield Ranges (colors)

- Raw Data
- vs.
- Cleaned Data

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Institute of Agriculture and Natural Resources
EC2005

Improving Yield Map Quality by Reducing Errors through Yield Data File Post-Processing

Joe D. Luck, Extension Specialist, Precision Agriculture Engineer
Nathan Mueller, Extension Educator
John P. Fulton, Associate Professor, The Ohio State University

Introduction

Yield monitor data is certainly one of the most valuable pieces of information that is gathered throughout the year. It can allow producers to estimate profitability, evaluate management decisions, and develop recommendations for the upcoming year. If this information is to be used to its fullest potential, ensuring that the yield data represents accurate estimates of crop performance is critical. However, yield monitor data typically contains some errors. While errors are generally a very small percentage of the data gathered, they can influence the final results.

Common physically-measured errors include:

1. Header cut-width (or harvest width)
2. Header position
3. Lag time (or flow delay) settings
4. Travel distance measurements

Soon after yield monitoring systems became commercially available, researchers quickly began to develop methods to improve the quality of those datasets. Different procedures (some real-time and others post-harvest) were developed as early as the late 1990s to solve many of these issues.

The goal of this publication is to help end users understand why post-processing or "cleaning" yield data may be important for their operations by showing examples of common errors and providing suggested best management practices (BMPs) for reducing them within their datasets.

A list of abbreviations used in this article are: Best management practices (BMPs), file format for files using comma-separated values (.csv), farm management information systems (FMIS), global position systems (GPS), inverse distance weighted (IDW), kriging (KRG), prescription (Rx), file format for files using text (.txt), Spatial Management Software (SMS), and United States Department of Agriculture (USDA).

Why Post-Processing (or Cleaning) Yield Data is Important

At the time yield data collection became mainstream, many farm management information systems (FMIS), including software comparable to Ag Leader's SMS or John Deere's Apex, were difficult to use for most customers. Most users would generate yield maps for viewing; however further analysis using the data was not widespread. Many prescription (Rx) maps were generated by manually creating zones that didn't require a high level of accuracy when viewing yield maps. General trends across a field were considered when generating these management zones on such maps.

eld map (A) and contour-based yield map (B) using clean data points from Figure 2.

ng grid- and contour-based maps created from raw and clean yield data.

nt Yield (bu/ac)	*Raw Yield Data Grid Map (bu/ac)*	*Clean Yield Data Grid Map (bu/ac)*	*Raw Yield Data Contour Map (bu/ac)*	*Clean Yield Data Contour Map (bu/ac)*
)	31.2	36.9	32.2	38.0
.0	60.3	61.0	56.4	60.3
7	51.7	53.0	51.6	52.8
(bu)	1,660 (bu)	1,701 (bu)	1,653 (bu)	1,693 (bu)

nto either grids or zones
eas within the field. This
tween raw and cleaned
mary of minimum, maxi-
om the raw and clean yield
l and contour). The field
roximately 30 ac in size.

values may not be alarm-
s between a gridded yield
w errors more clearly. *Fig-*
ng a grid map of raw yield
an data. In most locations,
estimates, cleaning the
es higher. *Figure 5* also
es were regularly off by
eld estimates were high,
ot over-estimated in the

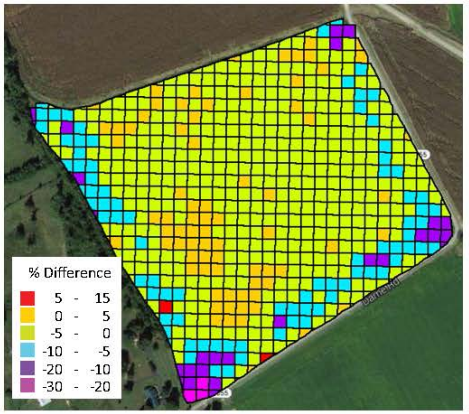
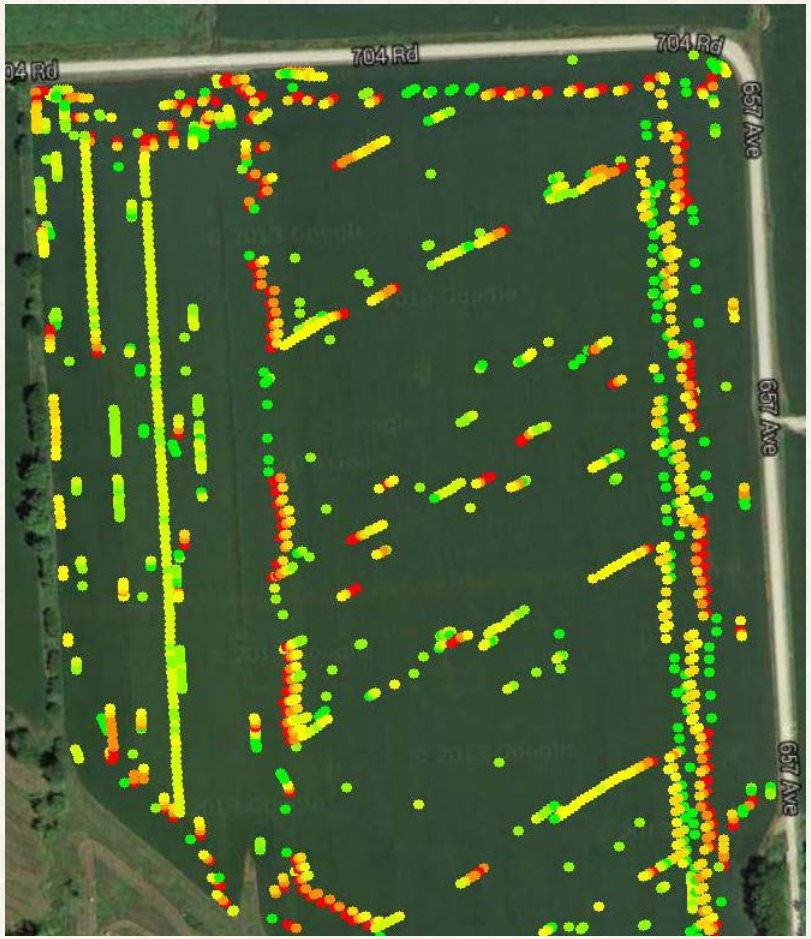


Figure 5: Differences (%) between clean and raw gridded yield data (raw grid data subtracted from clean grid data divided by clean grid data).

Common Errors in Yield Data

- Examples in our data set
  - Header cut-width/overlap
  - Flow delay
  - Drastic velocity changes
- Others
  - Header up/down

Removed Yield Data Points



USDA Yield Editor 2.0.7

- Import Ag Leader Adanced or Greenstar text file formats

Table 1. ***Required*** data fields in ***bold*** for emulating AgLeader advanced file format.

1) Longitude	***decimal degress, negative in W hemisphere***
2) Latitude	***decimal degrees, negative in S hemisphere***
3) Flow	***pounds per second***
4) GPSTime	seconds
5) Logged Interval	***seconds***
6) Distance	***inches***
7) Swath	***inches***
8) Moisture	percent wet basis
9) Header Status	unitless, 1 = harvesting, 0 = not harvesting
10) Pass Number	***unitless, generally +1 each header up/down cycle***

Filter Types in Yield Editor - Delays

- Delays
  - Flow
  - Moisture
  - Start Pass
  - End Pass

- A positive value – grain moved backwards in time
- A negative value – grain moved forward in time

Filter Types in Yield Editor - Velocity

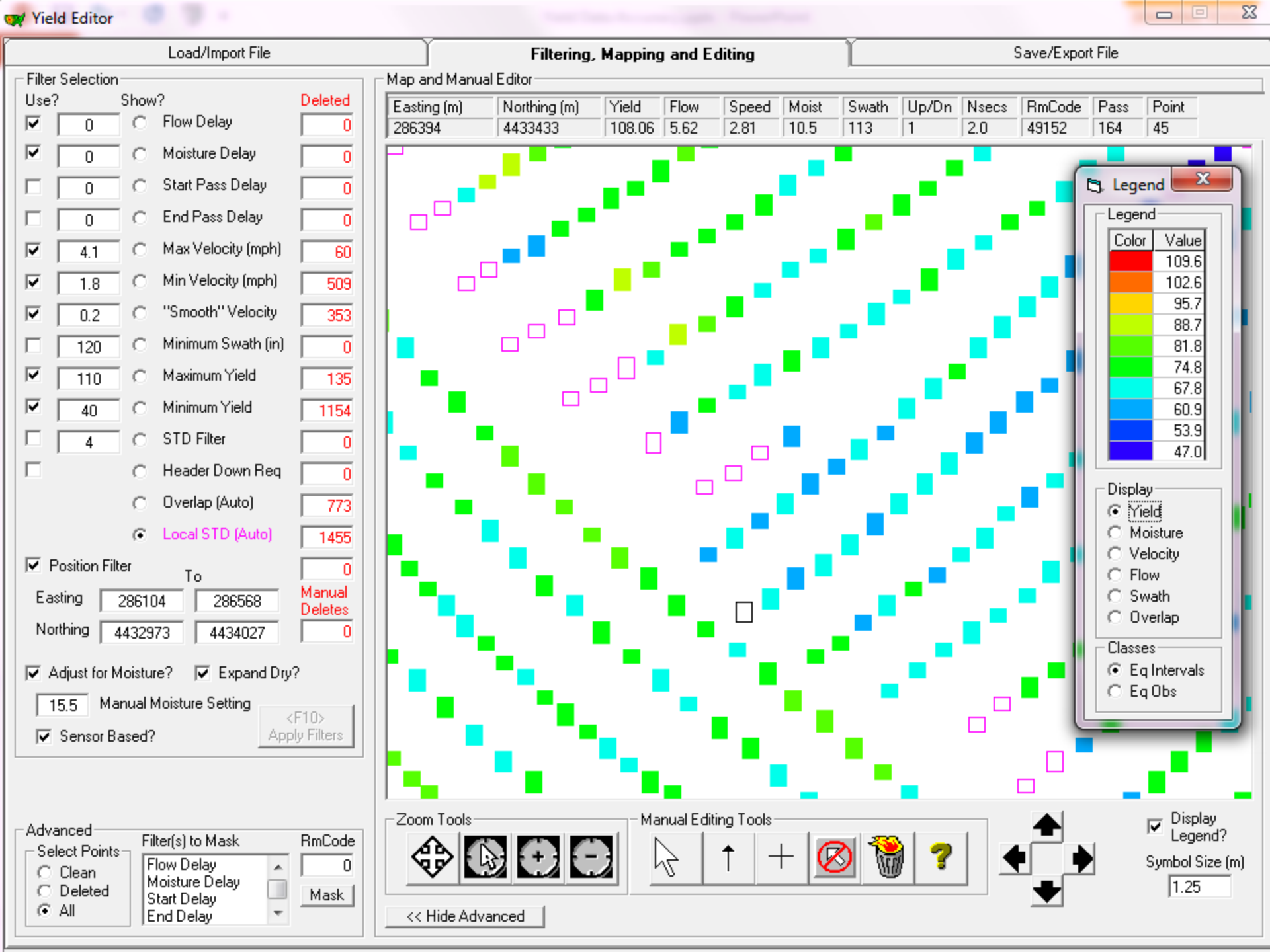
- Velocity
  - Max (mph)
  - Min (mph)
  - Smooth (mph)

- Example of smooth velocity (point-to-point in transect)
  - 4.0 mph down to 3.1 mph (>0.2 smooth vel)
  - 0.2 or 20% of 4 mph is 0.8 mph decrease or increase

Filter Types in Yield Editor - STD

- Standard Deviation (STD) Filters
  - “Fieldwide” STD
  - Local STD (Auto) – # of header widths

- Local Standard Deviation Example (bu/ac)
  - 50, 55, 60, 65, 55, 60, 60, 65, 50, 200 = Average = 72
  - $(50-72)^2 + (55-72)^2$… Sum of Squares
  - Square root of the Sum of Squares/(n-1) = STD = 15
  - 3 STD = 45 bu/ac,
  - 27 to 117 bu/ac


Yield Editor
Load/Import File
Filtering, Mapping and Editing
Save/Export File
Filter Selection
Use?
Show?
Deleted
Flow Delay
Moisture Delay
Start Pass Delay
End Pass Delay
Max Velocity (mph)
Min Velocity (mph)
"Smooth" Velocity
Minimum Swath (in)
Maximum Yield
Minimum Yield
STD Filter
Header Down Req
Overlap (Auto)
Local STD (Auto)
Position Filter
To
Easting
Northing
Manual Deletes
Adjust for Moisture?
Expand Dry?
Manual Moisture Setting
Sensor Based?
<F10> Apply Filters
Map and Manual Editor
Easting (m)
Northing (m)
Yield
Flow
Speed
Moist
Swath
Up/Dn
Nsecs
RmCode
Pass
Point
Legend
Color
Value
Display
Yield
Moisture
Velocity
Flow
Swath
Overlap
Classes
Eq Intervals
Eq Obs
Advanced
Select Points
Clean
Deleted
All
Filter(s) to Mask
Flow Delay
Moisture Delay
Start Delay
End Delay
RmCode
Mask
Zoom Tools
Manual Editing Tools
Display Legend?
Symbol Size (m)
<< Hide Advanced

Filter Types in Yield Editor

- Overlap (auto)
- Effective at removing overlapped data points on field harvested by one combine
- Assuming GPS data is good
- Multiple combines in the same field could be an extra issue to deal with

Filter Types in Yield Editor - Overlap

- Overlap (auto)

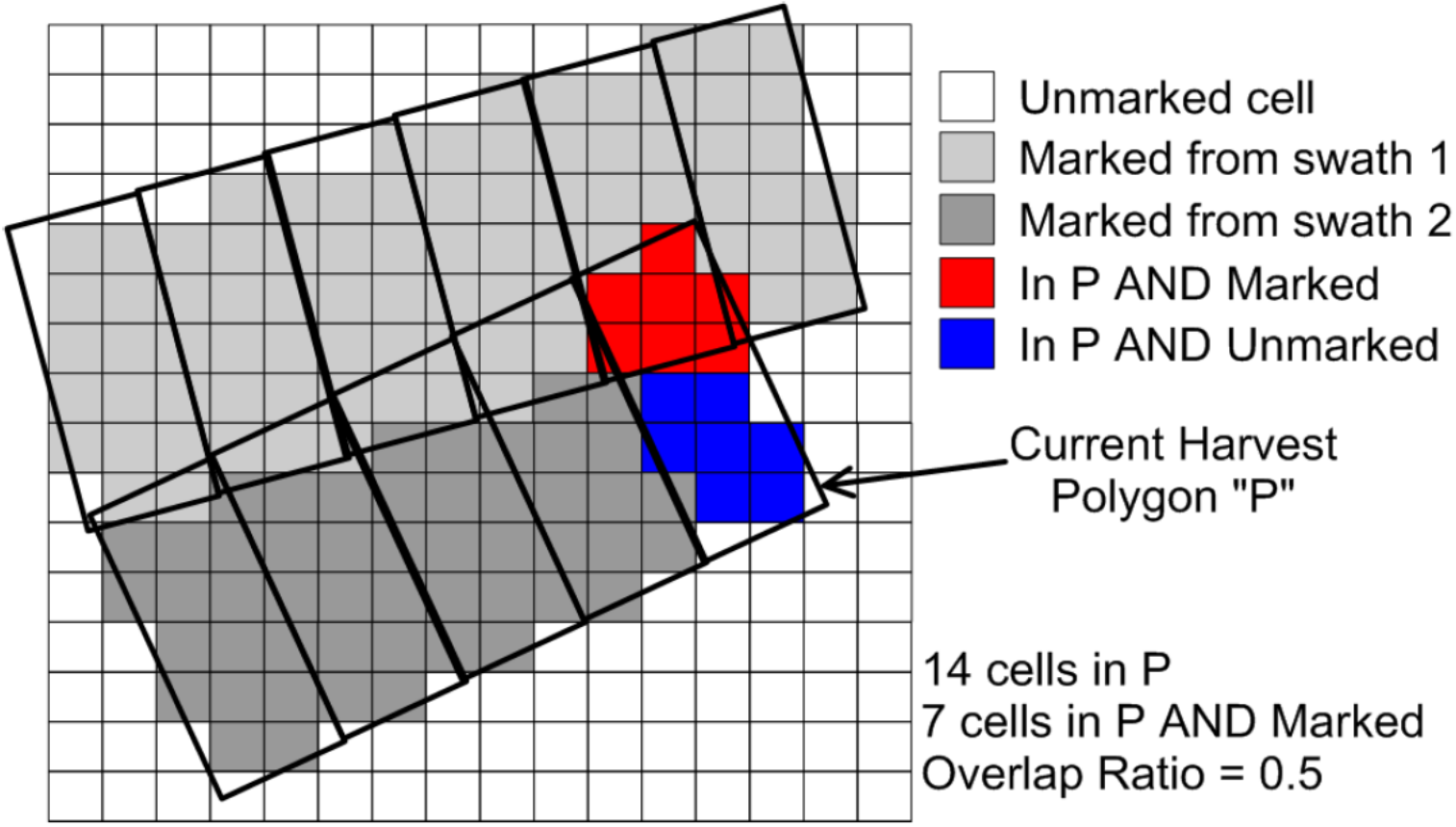
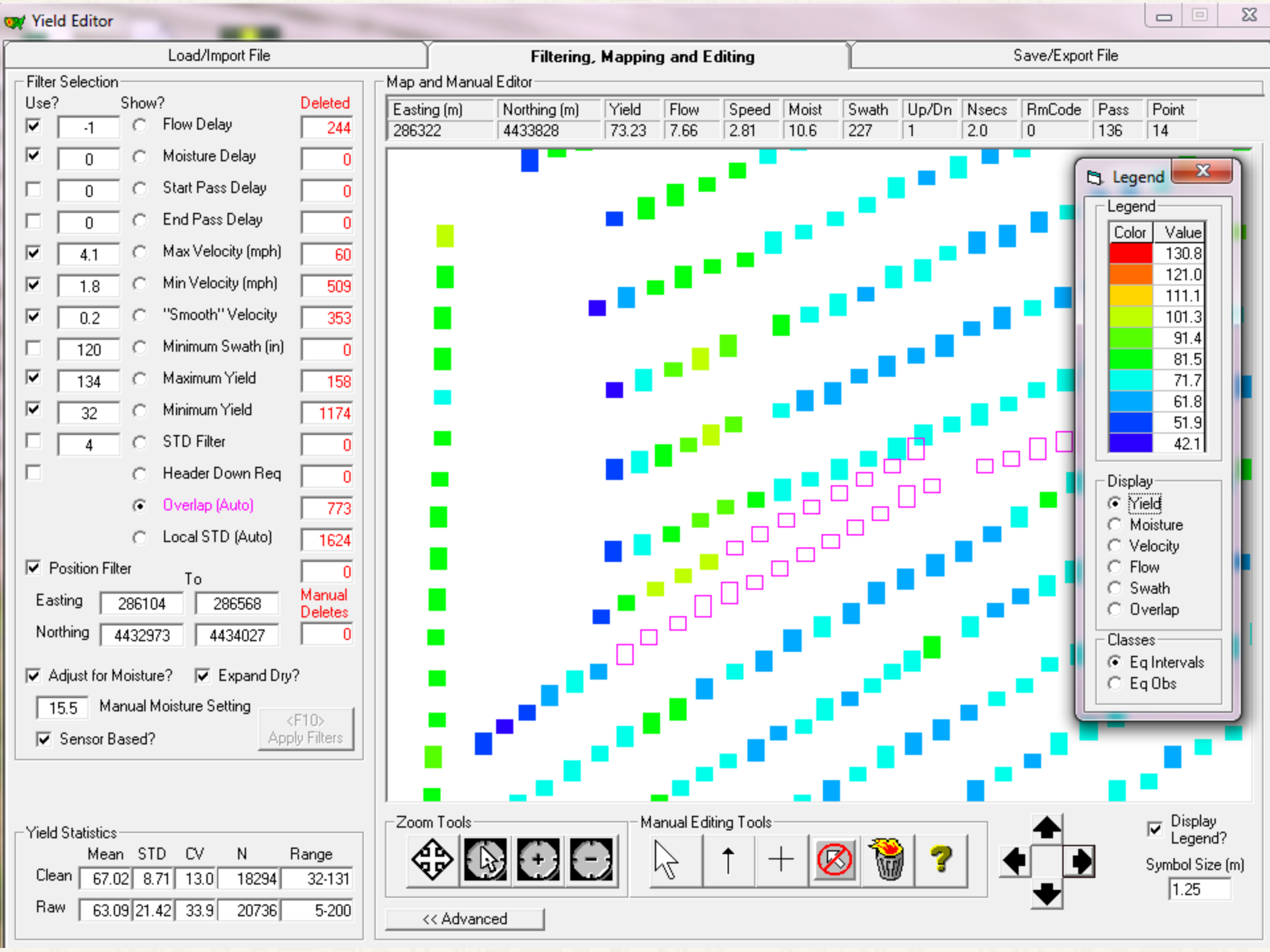


Figure 6. Illustration of the bitmap method by Han et al. (1997) for removal of overlapped areas.


Yield Editor
Load/Import File
Filtering, Mapping and Editing
Save/Export File
Filter Selection
Use?
Show?
Deleted
-1
Flow Delay
244
0
Moisture Delay
0
0
Start Pass Delay
0
0
End Pass Delay
0
4.1
Max Velocity (mph)
60
1.8
Min Velocity (mph)
509
0.2
"Smooth" Velocity
353
120
Minimum Swath (in)
0
134
Maximum Yield
158
32
Minimum Yield
1174
4
STD Filter
0
Header Down Req
0
Overlap (Auto)
773
Local STD (Auto)
1624
Position Filter
0
To
Easting
286104
286568
Manual Deletes
Northing
4432973
4434027
0
Adjust for Moisture?
Expand Dry?
15.5
Manual Moisture Setting
Sensor Based?
<F10> Apply Filters
Yield Statistics
Mean
STD
CV
N
Range
Clean
67.02
8.71
13.0
18294
32-131
Raw
63.09
21.42
33.9
20736
5-200
Map and Manual Editor
Easting (m)
Northing (m)
Yield
Flow
Speed
Moist
Swath
Up/Dn
Nsecs
RmCode
Pass
Point
286322
4433828
73.23
7.66
2.81
10.6
227
1
2.0
0
136
14
Legend
Legend
Color
Value
130.8
121.0
111.1
101.3
91.4
81.5
71.7
61.8
51.9
42.1
Display
Yield
Moisture
Velocity
Flow
Swath
Overlap
Classes
Eq Intervals
Eq Obs
Zoom Tools
Manual Editing Tools
Display Legend?
Symbol Size (m)
1.25
<< Advanced

Filter Types in Yield Editor - Others

- Others
  - Header Down Req
  - Position
- Moisture (not a filter, just an adjustment option)

Aerial Imagery – Explain Some Dots

Dot 2

EXTENSION

Sources of Aerial Imagery

- USDA Geospatial Gateway
  - Free, available online
  - Georeferenced
  - More than aerial imagery
- USGS Earth Explorer
  - Free, available online
- Many other sources
  - Google Earth
  - Sat Shot
  - Terra Server
  - Many more service providers

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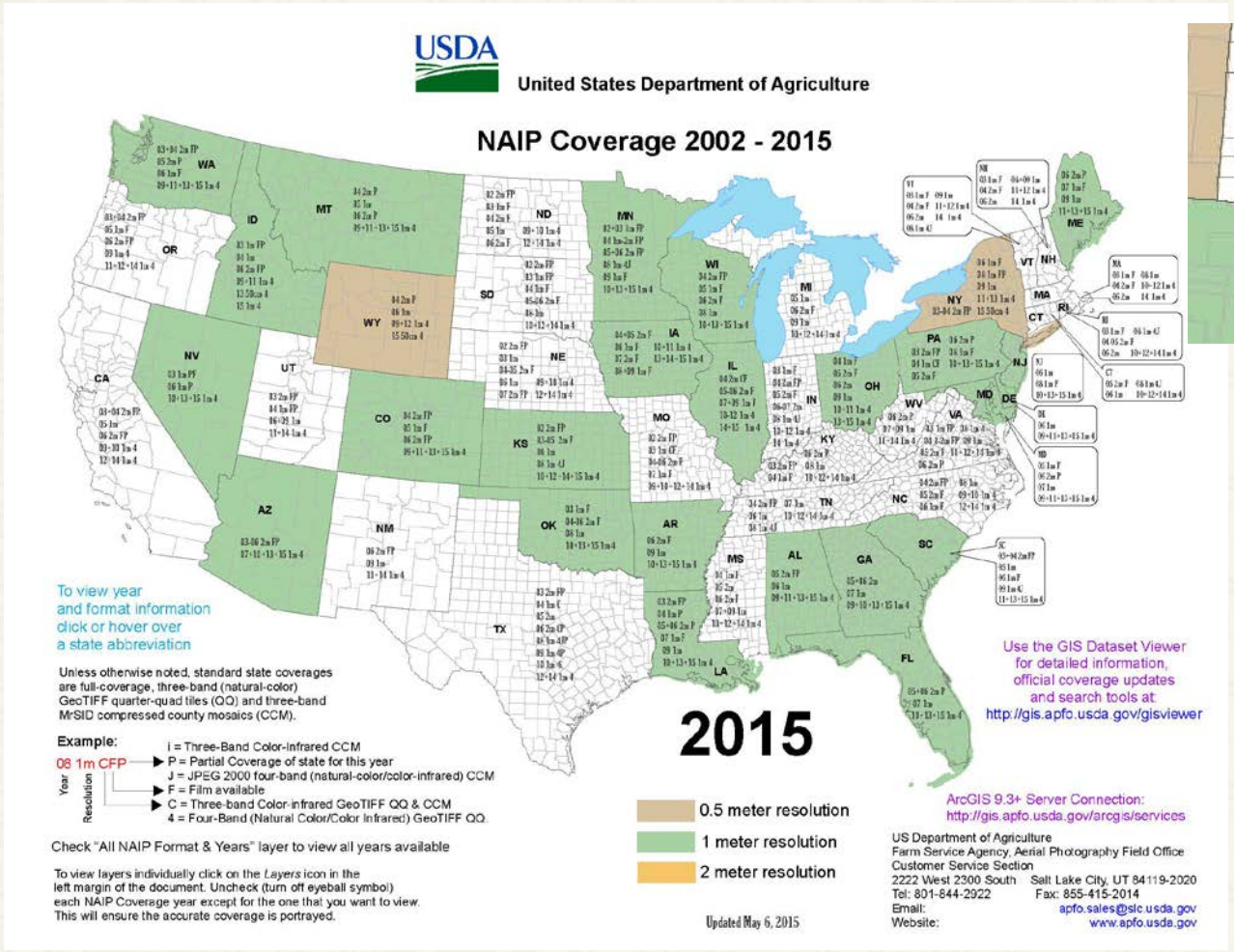
USDA Geospatial Gateway

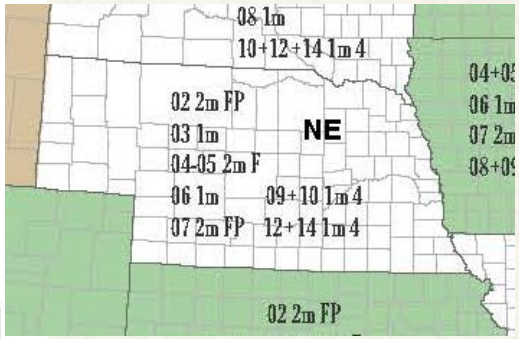
- Contains National Agriculture Imagery Program imagery
- Order content by county or specified area
- Example:
  - Nebraska 2016
  - Resolution: 0.6 meter

https://gdg.sc.egov.usda.gov/

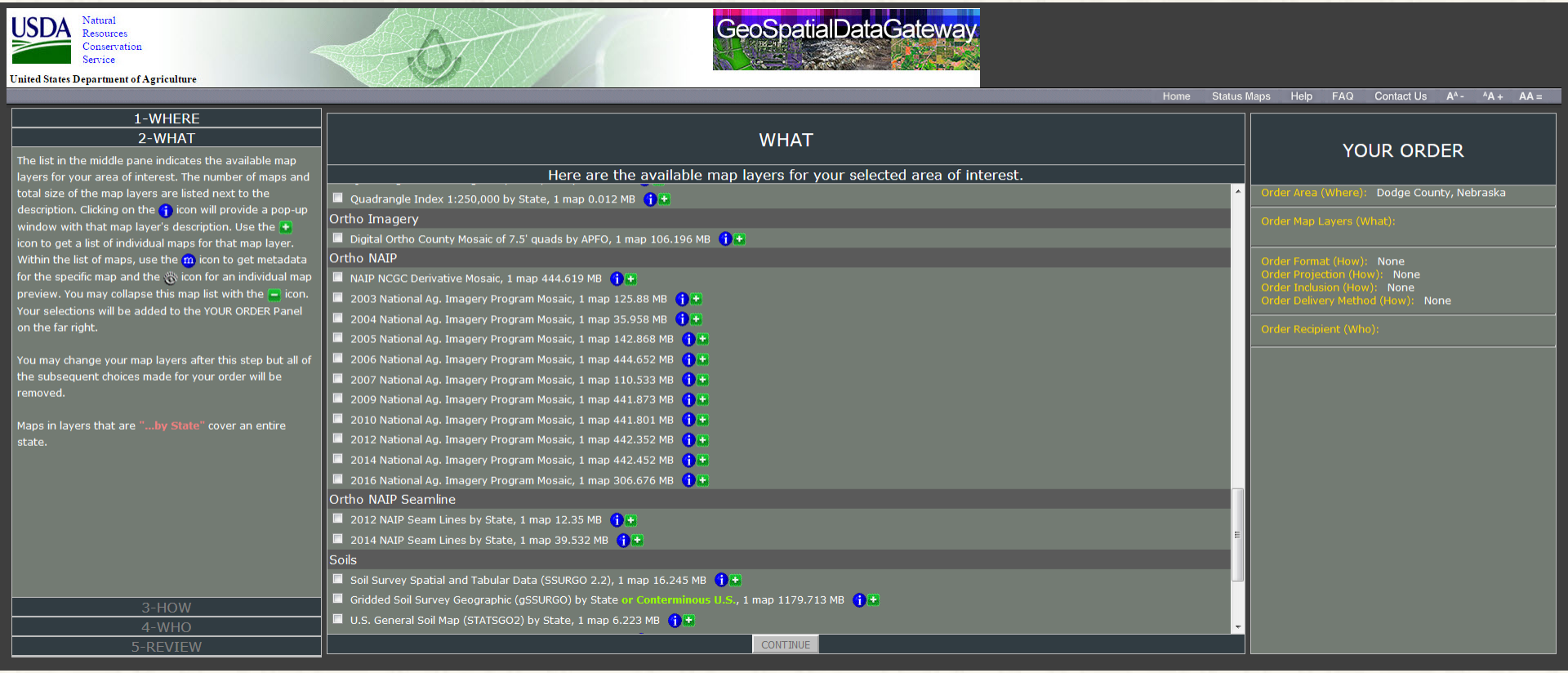
N EXTENSION

NAIP Coverage

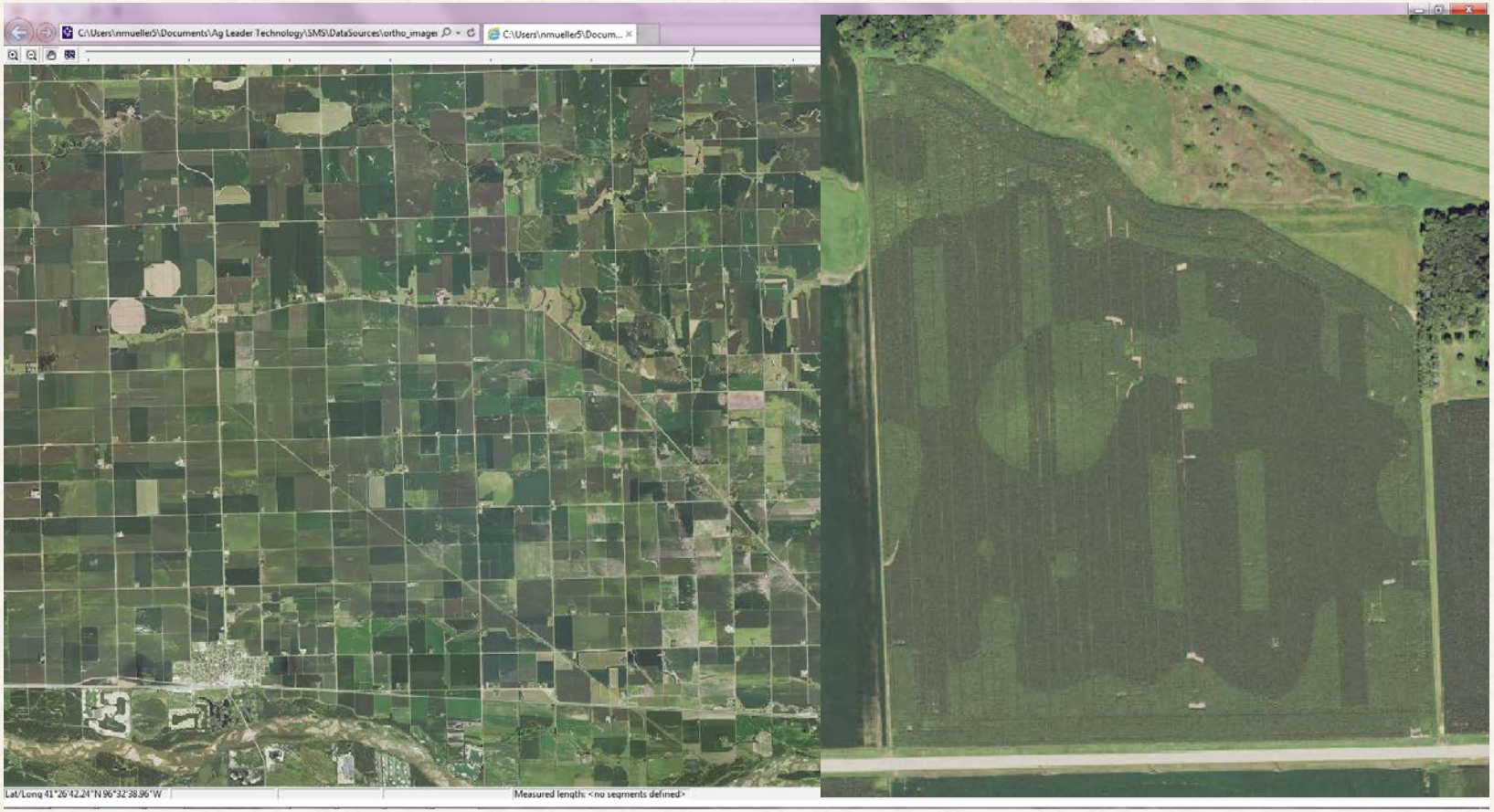




Orth NAIP Mosaics for Dodge County



2016 NAIP Mosiac – Dodge County



LizardTech ExpressView Browser Plug-in

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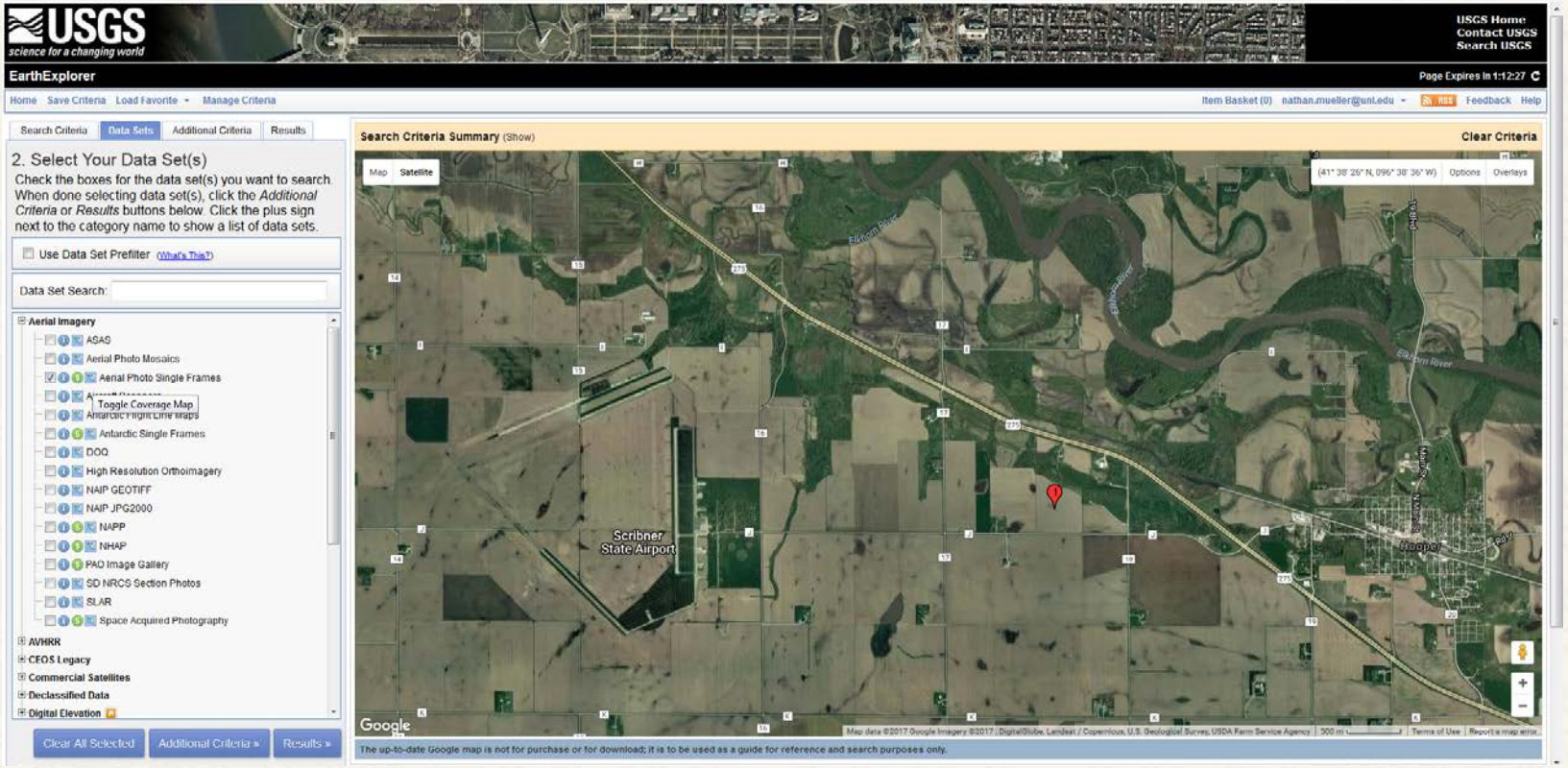
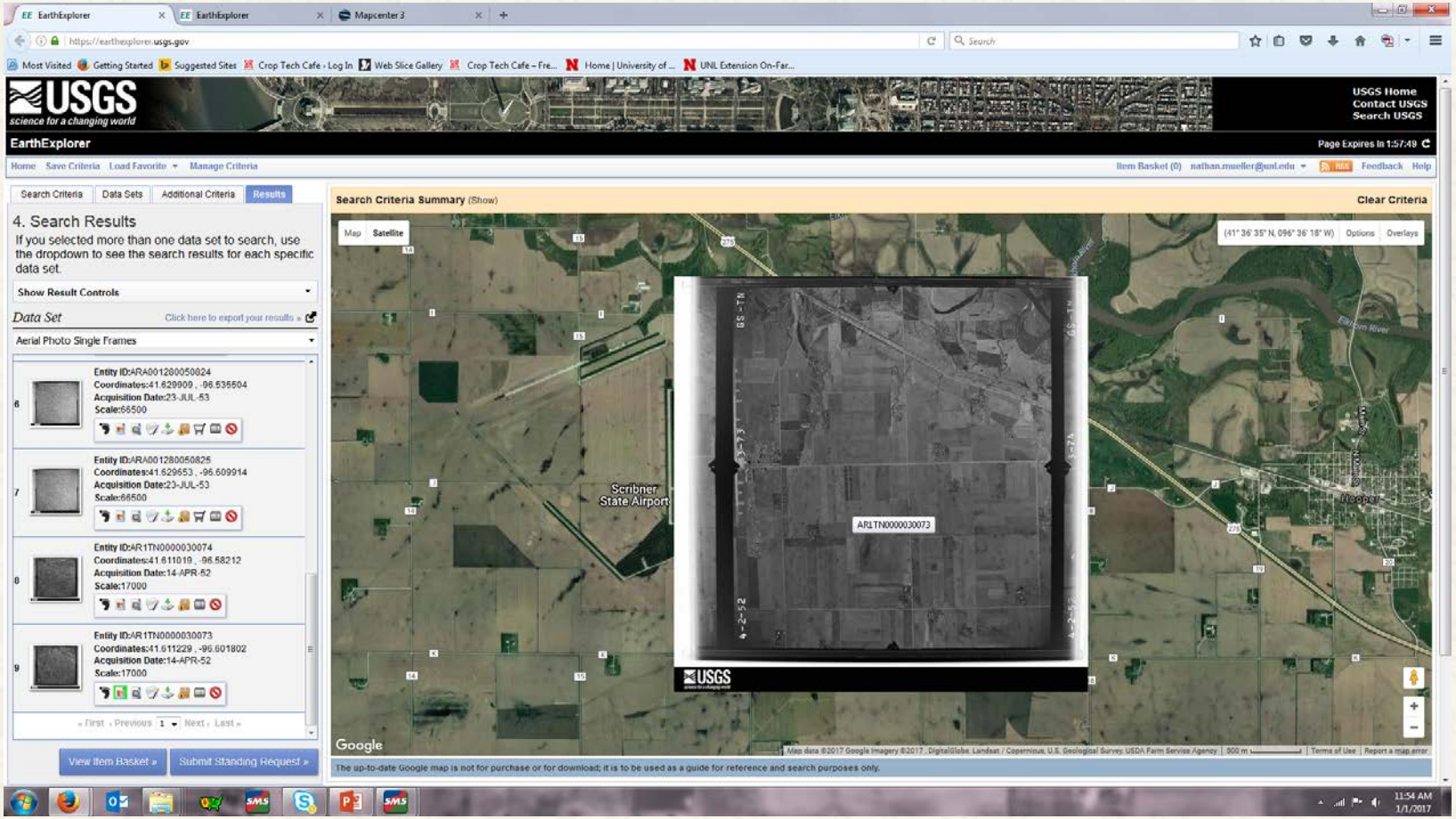
USGS EarthExplorer

https://earthexplorer.usgs.gov/



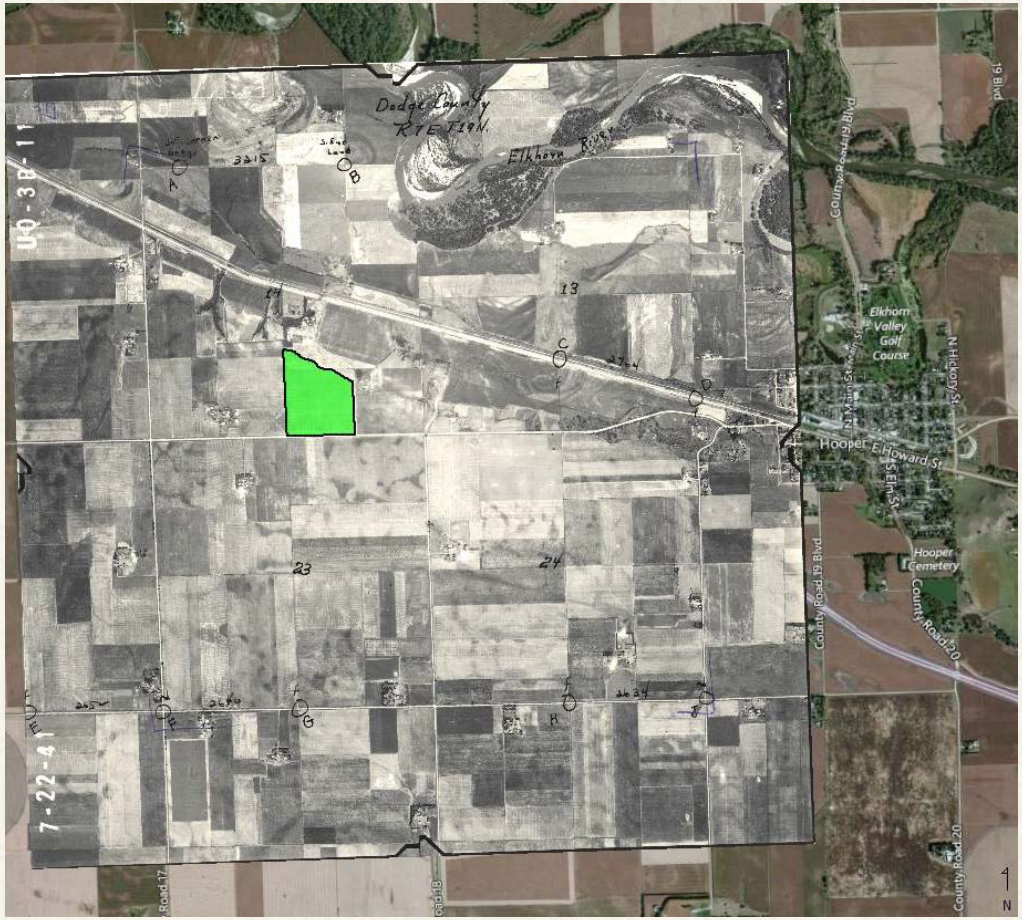
Some Historical Imagery Available



Nebraska Maps and More Store

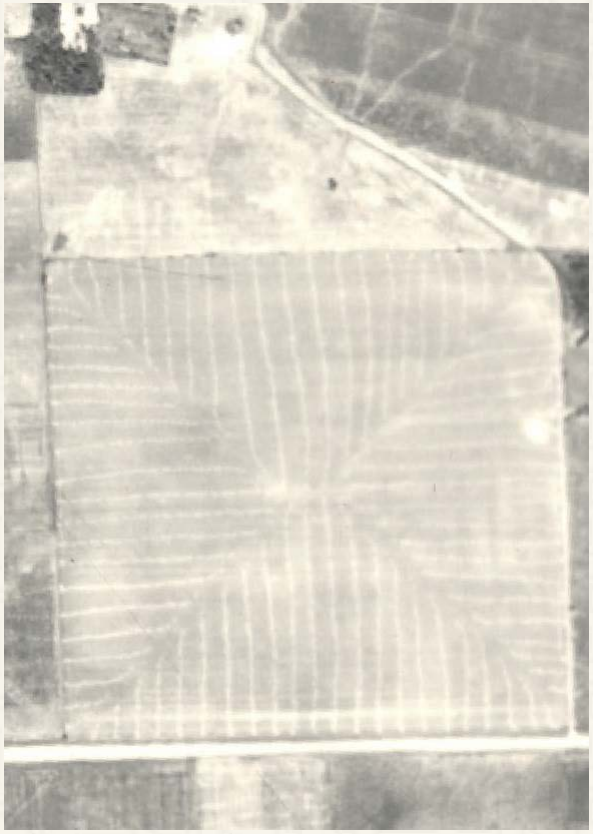
http://nebraskamaps.unl.edu/productcart/pc/home.asp

- UNL East Campus
- 101 Hardin Hall, 3310 Holdrege Street, Lincoln, NE 68583-0961
- 402-472-3471
- snrsales@unl.edu

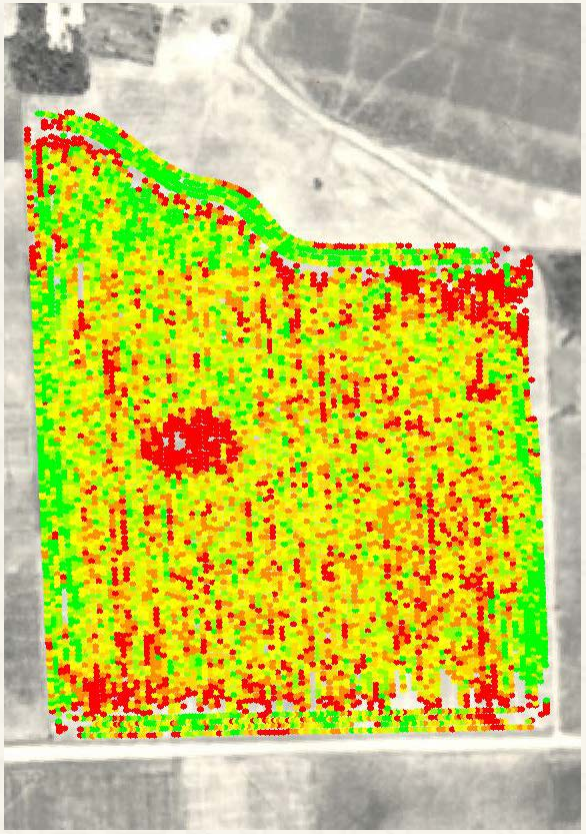


Utilizing Imagery in SMS

2016 Imagery/Boundary

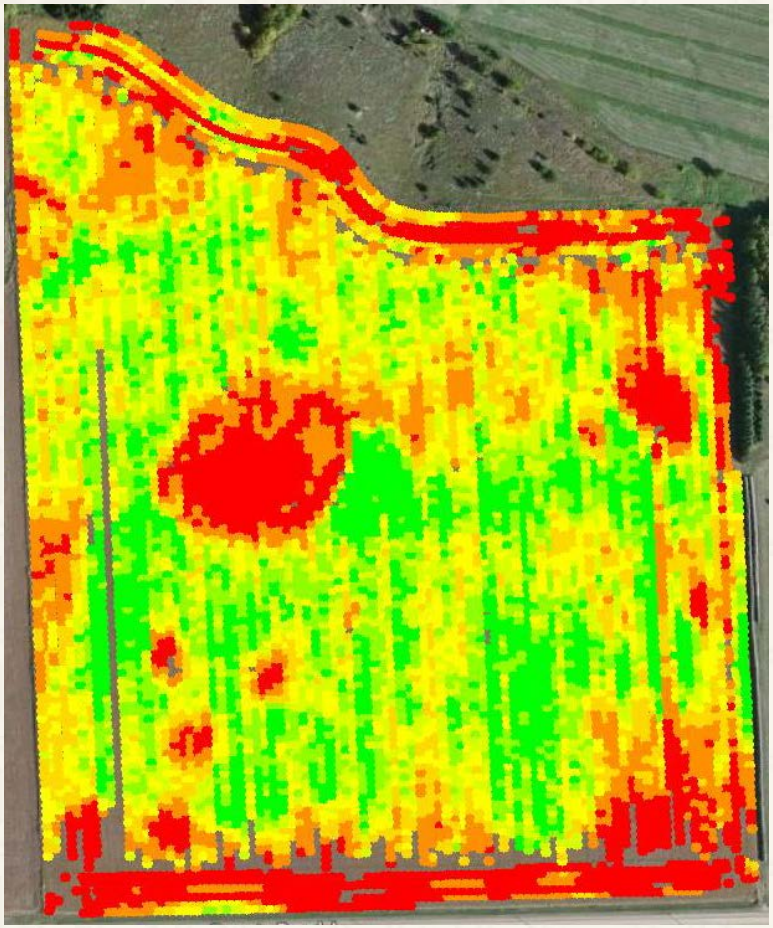


1941 Historical Imagery

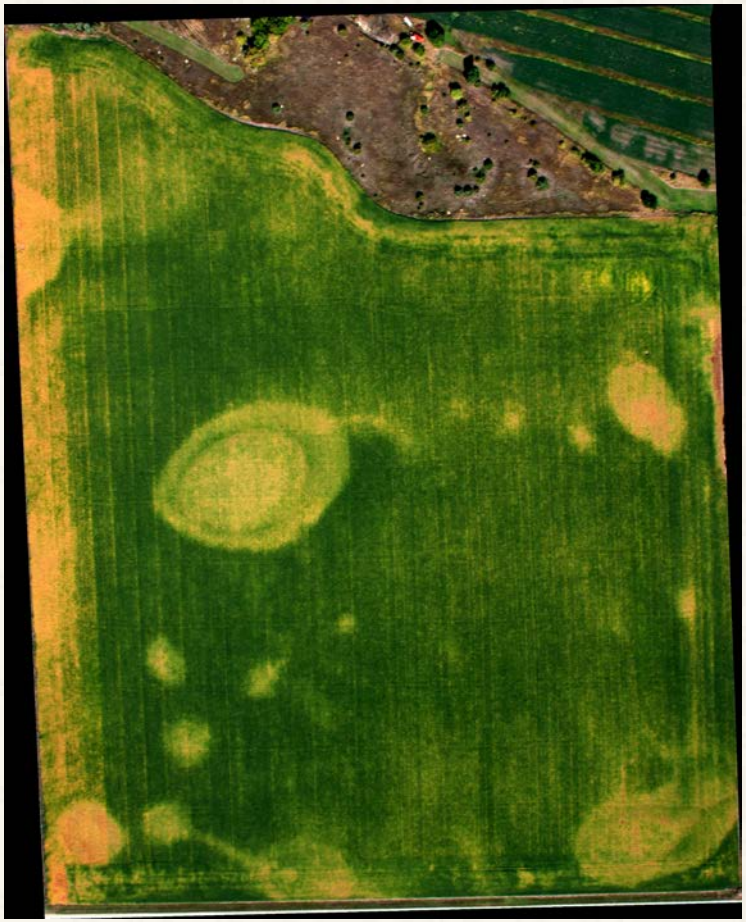


2014 Yield Data

Capture Differentiation - Timeliness



2012 Corn Yield Map - Drought



2013 Aerial Image –
Soybeans, Flash Drought

Resolution

USDA NAIP Mosiac – 0.6 m

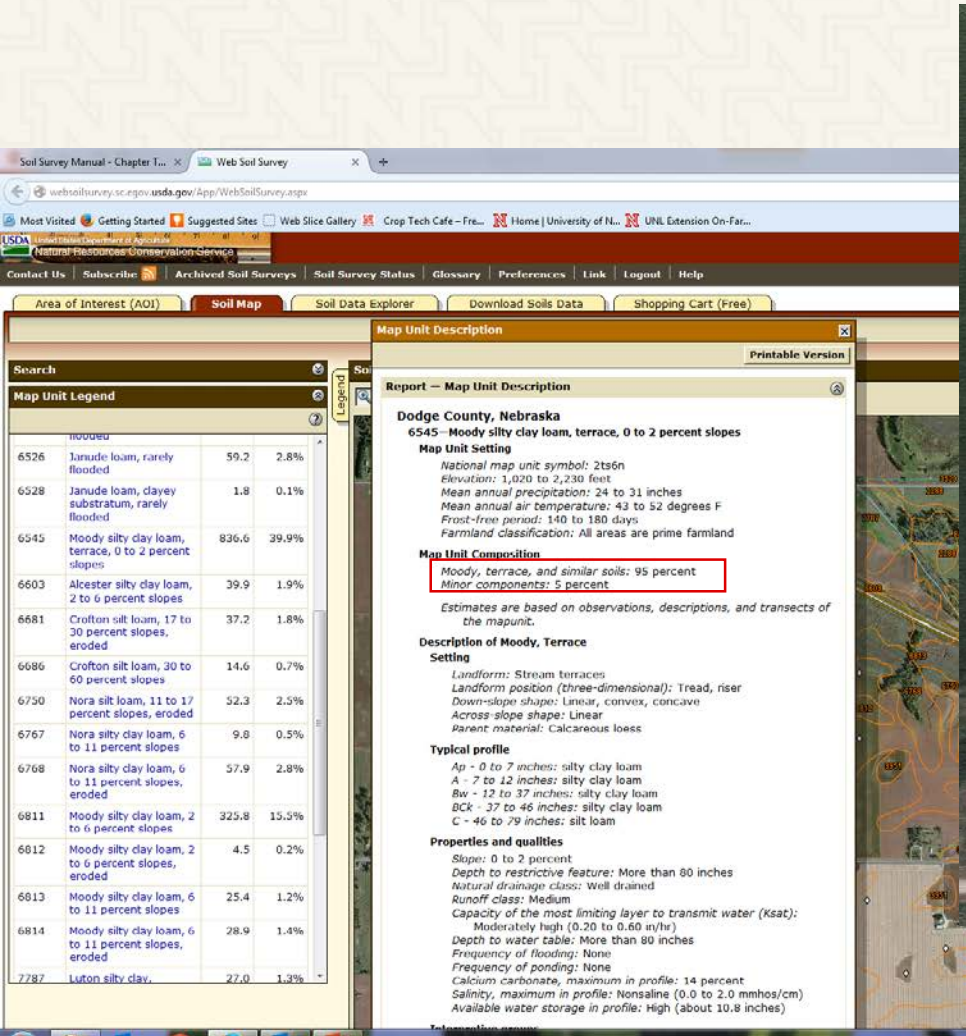
UAV Imagery

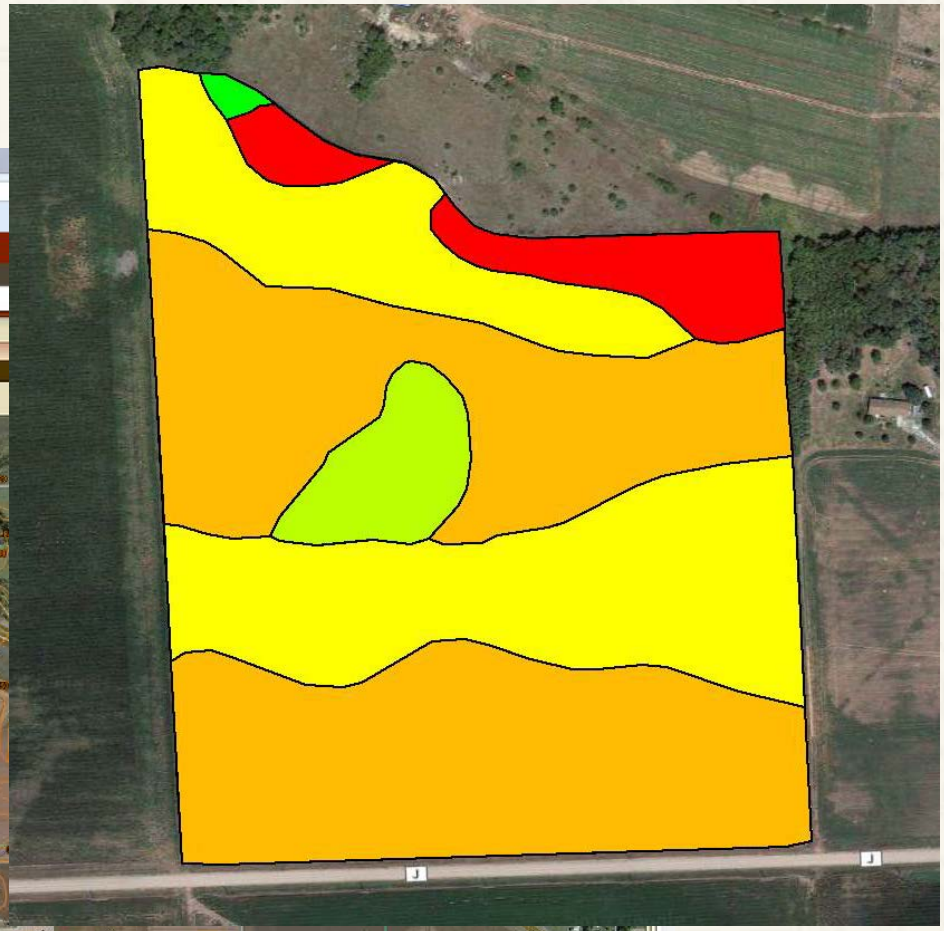
Soil Map Unit vs. Soil EC – More Dots

Dot 3

EXTENSION

Soil Map Unit





EXTENSION

Soil Electrical Conductivity Mapping

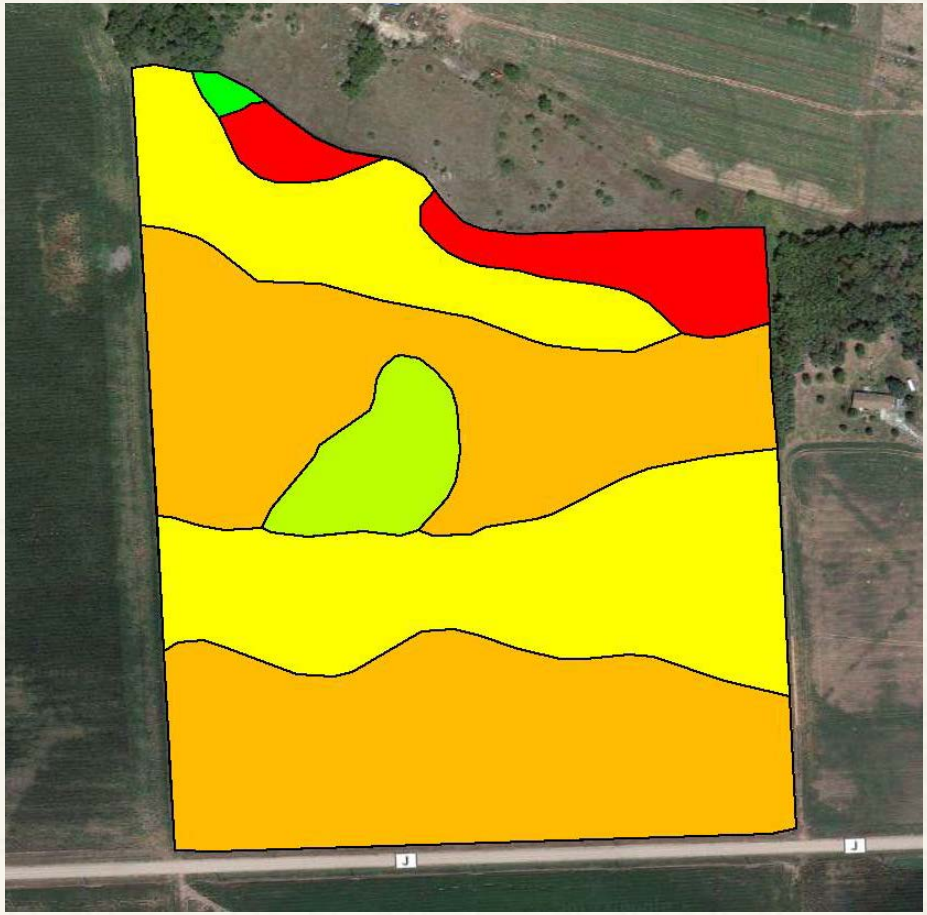
- Electrical conductivity is the ability of a material to transmit an electrical current (Often express as mS/m).
  - Sand (low)
  - Silt
  - Clay
  - Saline soils (high)

- Methods for measuring soil conductivity
  - Veris platform uses coulters (contact)
  - Electromagnetic sleds (non-contact)

- Delineate ¼ acre inclusions versus 2.5 to 4 acre inclusions

Photo Credit: Aaron Nelson

Comparing Data Layers



1979 Soil Map

IDW Deep EC Map

Comparing Data Layers

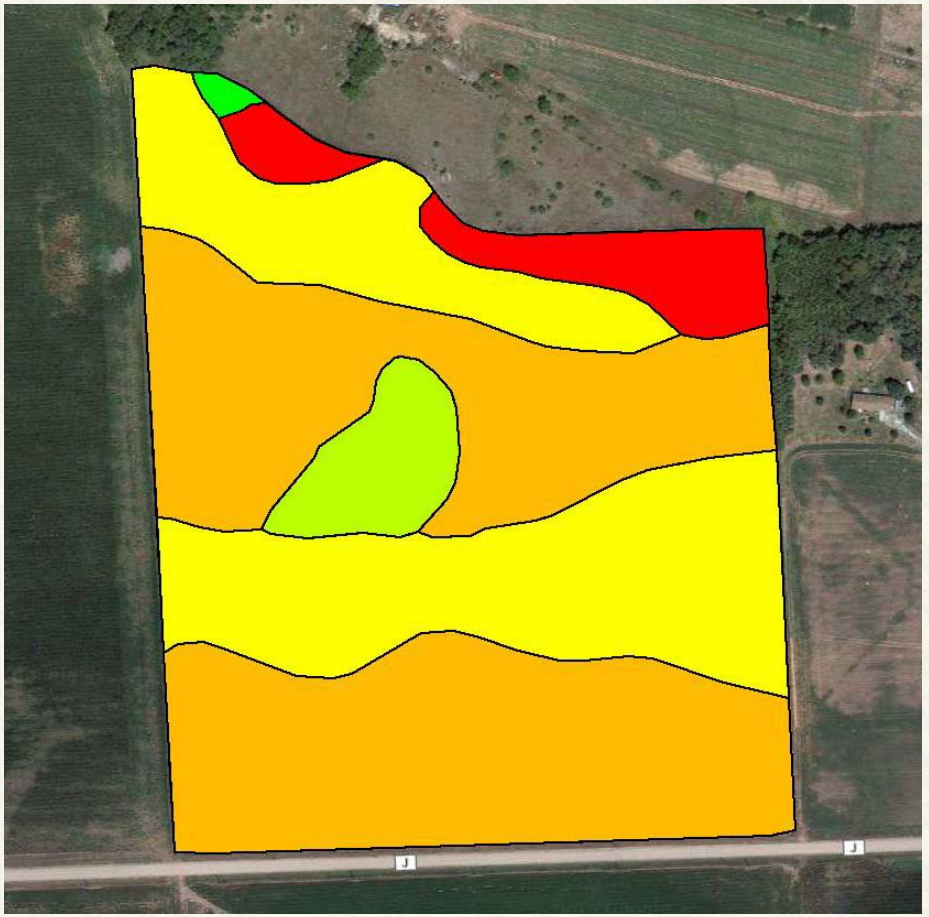
2012 Yield Map

2014 EC Map

EXTENSION

Comparing Data Layers

2012 Yield Map



1979 Soil Map

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So what?

- Improving the resolution of soil maps allows for:
  - Helping guide soil sampling for VR lime and fertilizer applications
  - Developing variable-rate seeding
  - Multi-hybrid planting
  - Multi-seed treatment or VR seed treatment
  - VR soil applied herbicide applications

Application Rates

	BROADCAST RATE PER ACRE*	
SOIL TEXTURAL GROUP	WARRANT (quarts) Less than 3% Organic Matter	WARRANT (quarts) 3% or More Organic Matter
Coarse	1.5 to 2.0	2.0
Medium	1.5 to 2.75	2.0 to 2.75
Fine	1.5 to 2.75	2.75 to 3.0

*Use the higher rate in the range for areas of heavy weed infestation.

Connect the Dots: Management zones, prescriptions, & profitability maps

Dot 4

EXTENSION

Creating an equation for profitability

- Factors
  - Yield
  - Price
  - Production cost
  - Spatially variability
- Things to consider
  - Raw or cleaned yield
  - Conditional statements

Creating an equation in SMS

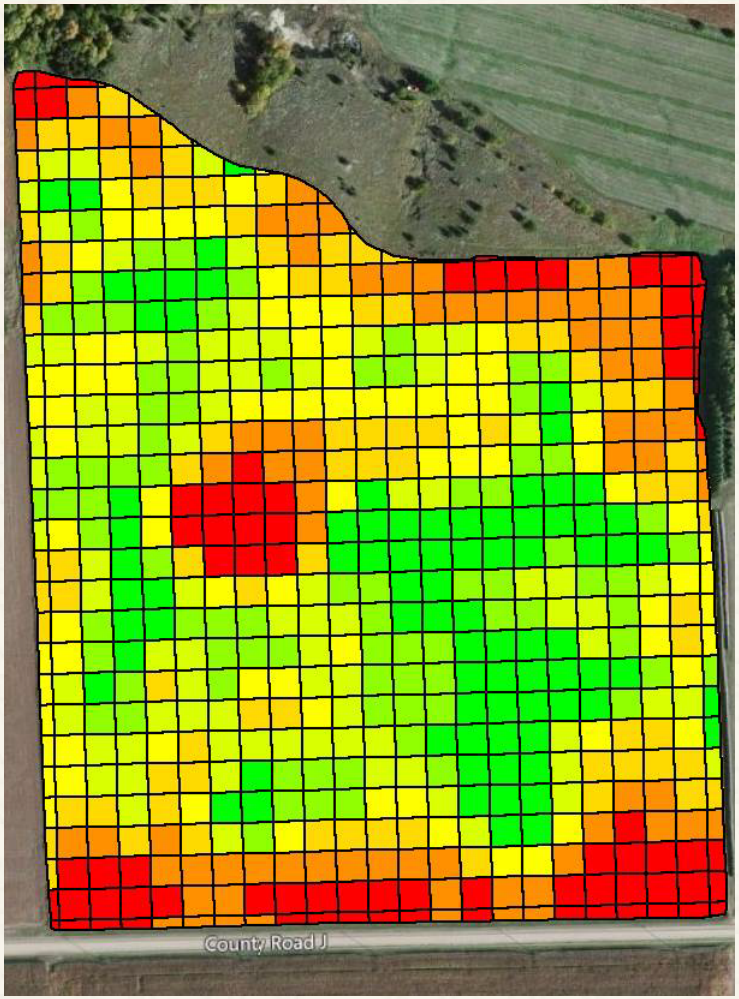
If ([Yield (Dry)(bu/ac)] > 0.00) Then

Begin

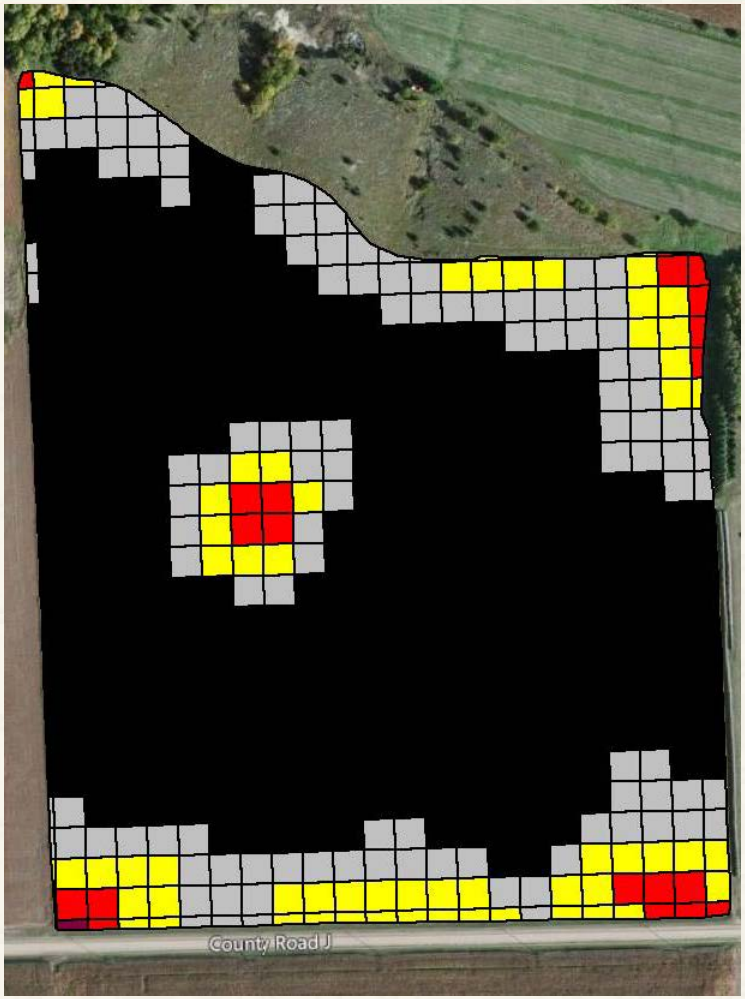
RESULT= ([Yield (Dry)(bu/ac)] * [Corn Price]) - [Production Cost]

End

Yield and profitability map

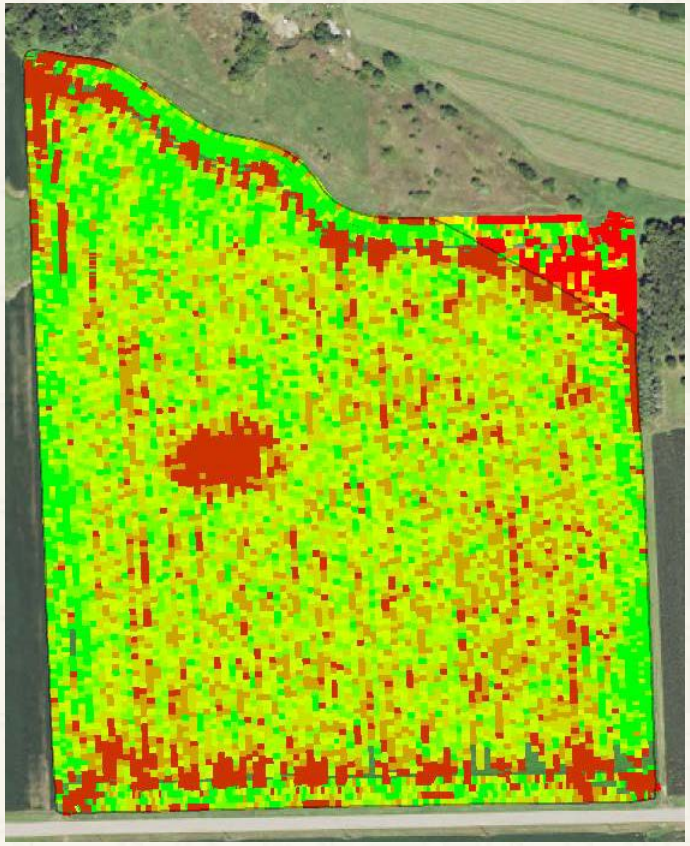


10/12/14 Corn Yield Maps



Profitability: $700/ac & $4.00/bu

Produce or Not Produce…



2014 Yield Data

2016 Imagery/Boundary

Let’s discuss these...

- Know your cost of production – accrual budget
- Run various scenarios
- Utilize precision ag software
- What action steps can be taken?

Verify You Connected the Dots Right: On-Farm Research Network & Precision Ag Data Management Workshops

Dot 5

N EXTENSION

Multi-Hybrid Planting

Multi-Hybrid Planting

Treatment	211: Yield (bu/acre)†	209: Yield (bu/acre)†	P Value
Zone 1	231 A*	233 A	0.326
Zone 2	240 A	244 A	0.062

†Bushels per acre corrected to 15.5% moisture.
*Values with the same letter are not significantly different at a 95% confidence interval.

Nebraska On-Farm Research Network

2017 Annual Results Update

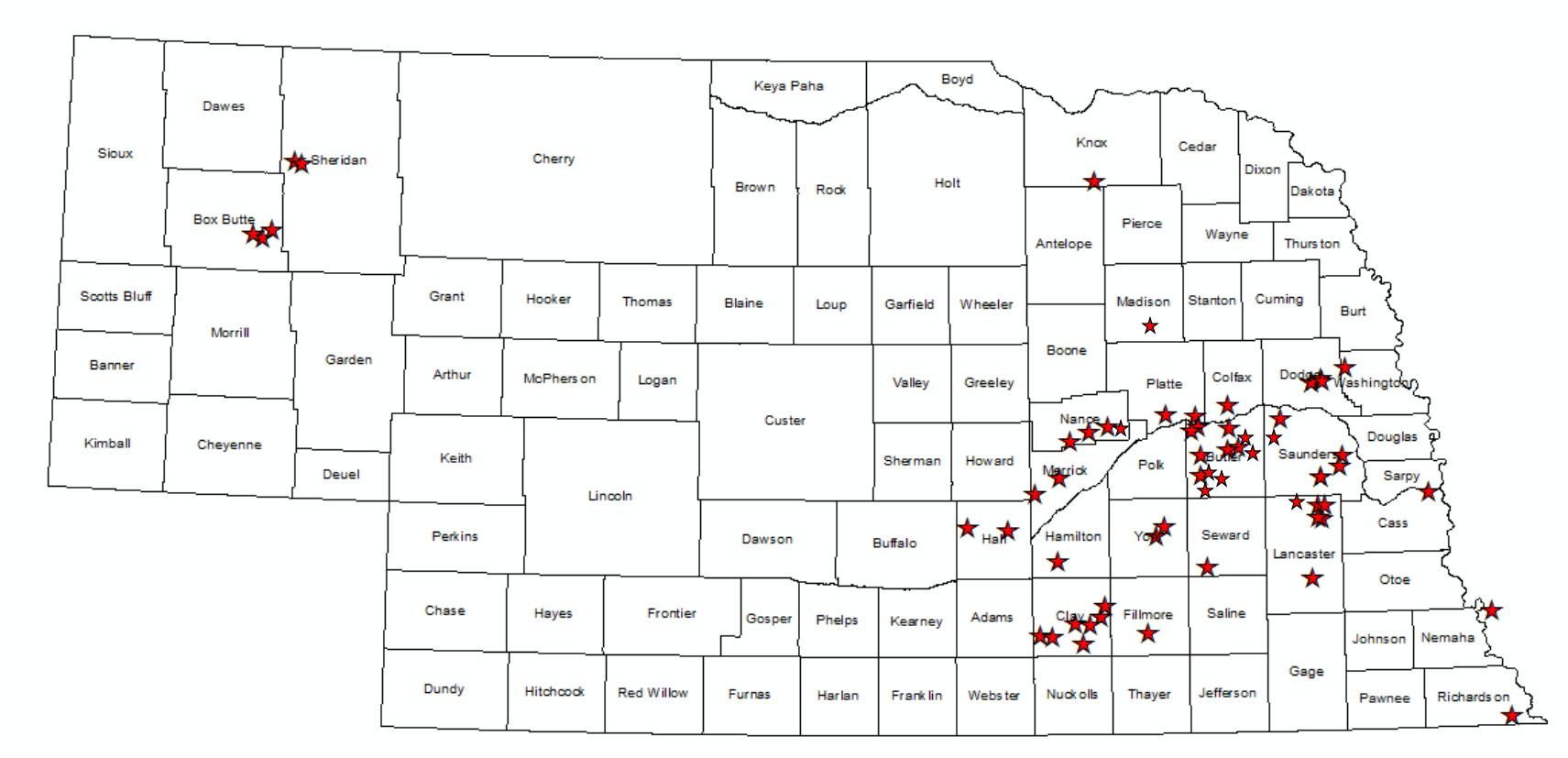
Feb. 20 | Agricultural Research and Development Center, near Mead | 9 a.m.- 4:30 p.m.
Feb. 21 | Lifelong Learning Center, Northeast Community College, Norfolk | 9 a.m.- 4:30 p.m.
Feb. 23 | West Central Research and Extension Center, North Platte | 12 noon - 4:30 p.m.
Feb. 24 | Knight Museum & Sandhills Center, Alliance | 9 a.m.- 2 p.m.
Feb. 27 | Hall County Extension Office, College Park Campus, Grand Island | 9 a.m.- 4:30 p.m.

Registration begins ½ hour prior to the start times listed above.

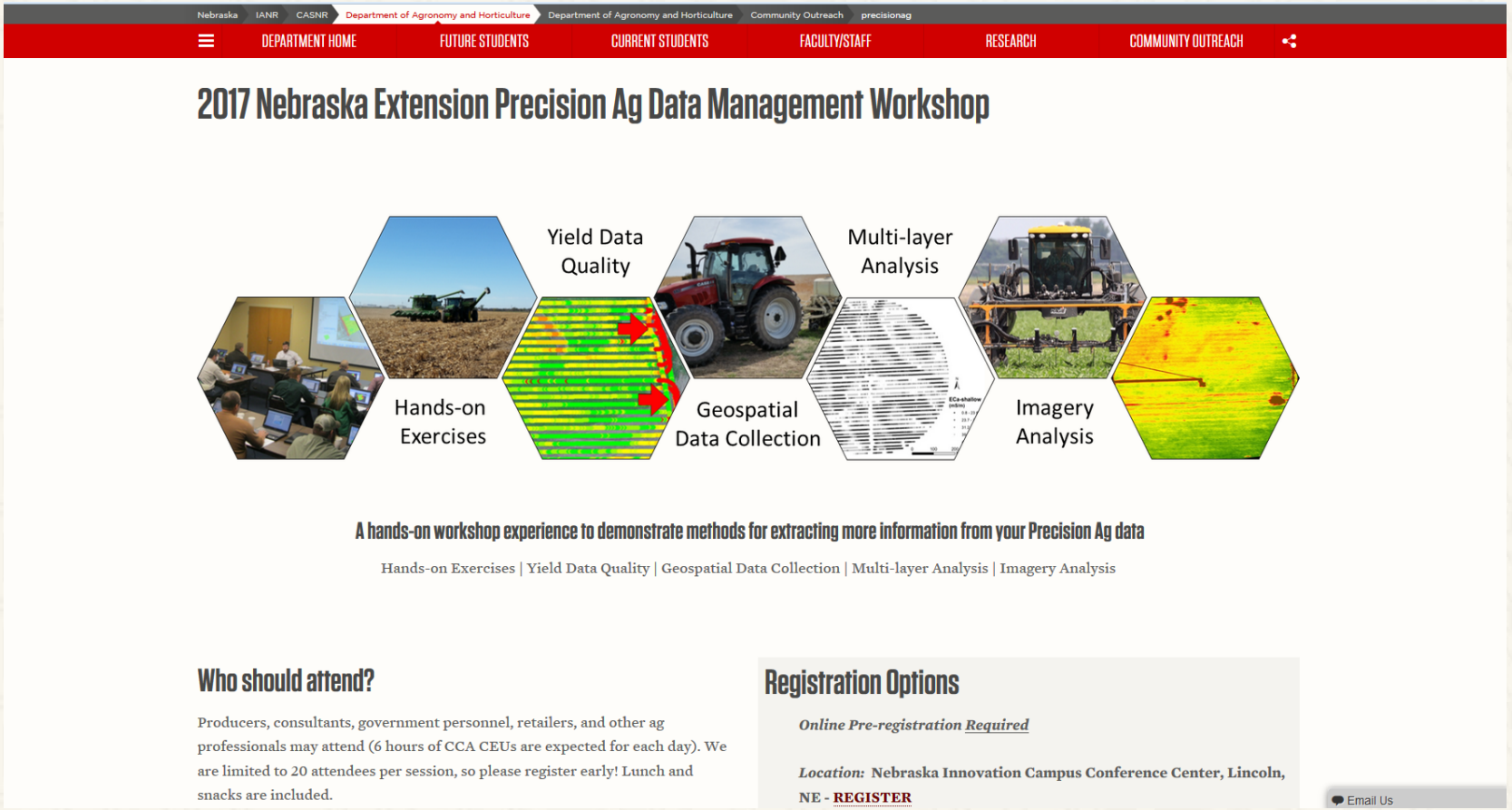
N EXTENSION
On-Farm Research

2016 Studies – 70+ studies

CROPS: Soybean, Corn, Dry Edible Beans, Field Pea, Forage Kochia, Alfalfa, Smooth Brome, Big Bluestem



agronomy.unl.edu/precisionag



Conclusions

- Yield Data Quality – Remove Bad Dots
- Imagery – Explain Some Dots
- Soil Map Unit vs. Soil EC – Need More Dots
- Connect the Dots
  - Create management zones
  - Create prescriptions
  - Create profitability maps
- Verify You Connected the Dots Right
  - On-Farm Research Network

Dodge County, NE

EXTENSION

croptechcafe.org/connectthedots

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Thank You!

EXTENSION