Optimizing Field Sampling

Potato Remote Sensing Conference

University of Wisconsin – Madison

11/14/2017

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Black Gold FARMS

BLACK GOLD FARMS HISTORY

- Black Gold Farms started in 1928 – Forest River, ND
- Business Started with Potatoes and Registered Black Angus Cattle
- Headquarters – Grand Forks, ND
- Fourth Generation Farm
- 1986: First Year
- 11 Farms in 11 States

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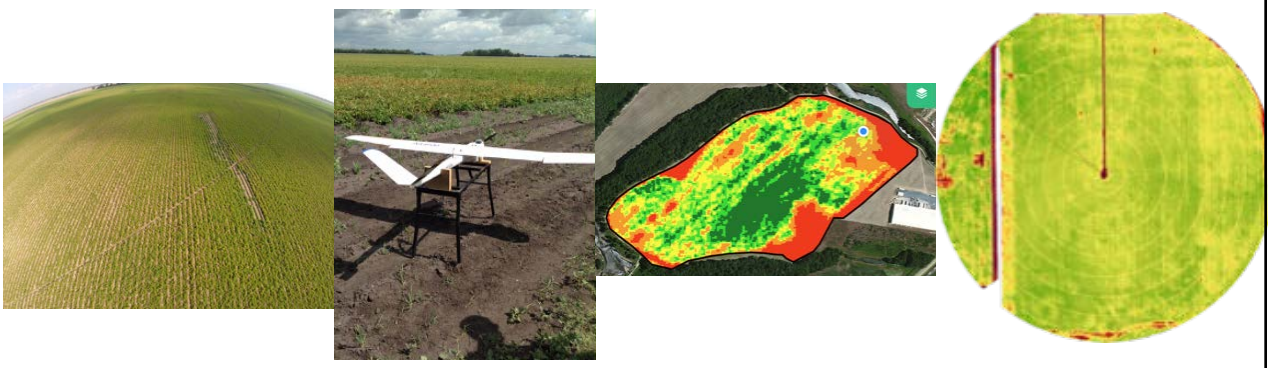
Our History with Remote Sensing



2014 2015 2016 2017

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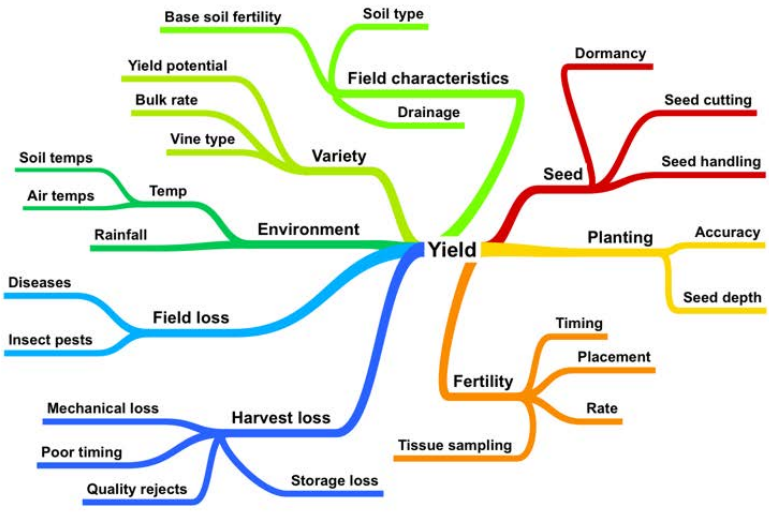
Yield in Potatoes



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Yield Sampling

- Accurate yield sampling is important
  - Provides estimates to sales and customers
  - Provides information for storage managers to store the best potatoes
- Accurate yield sampling is difficult
  - How/where/when to sample
  - Labor-intensive
  - Potatoes are heavy…..

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Yield Sampling Difficulty

- Extrapolating a large volume from a small sample
- Variation complicates estimation
  - Between potato plants
  - Between competitors (weeds)
  - Non-uniform fertility
  - Non-uniform pest control
- Objective: Make informed decisions on where to sample

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Current Method
“Improved” Method
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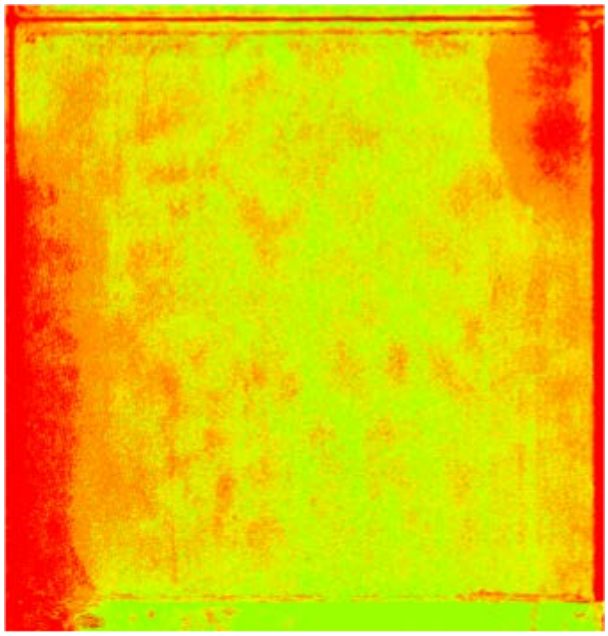
2015 Drone Use
Forest River, ND
Hovet Field
August 2015

Trial Purpose

- Identify practical applications of drone use using spectral imagery (RGB, NDVI and NIR).
- Flight was conducted on the Hovet field south of Grand Forks, ND on 08/17/15.
- Flight data was reviewed and yield and QC samples were taken on 08/28/15.
  - Correlate yield and/or other characteristics to data received from the drone flight.

Spectral – NDVI (Near Infrared)

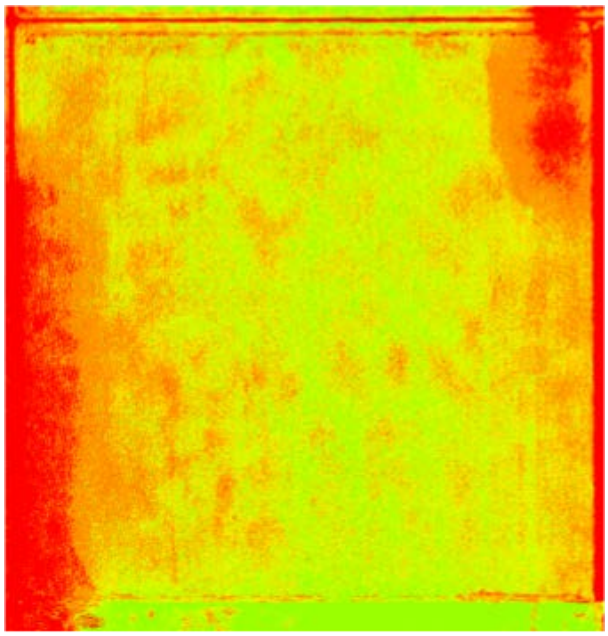


Colors correlate to NDVI values (red = low and green = high)

The breakdown of % area of the field for each color:

Red = 10.8%
Orange 1 = 23.4%
Orange 2 = 25.2%
Yellow = 25.5%
Green = 16.1%

Sampling



We sampled locations in red, green and orange 2 locations.

Data collected included:

Number of Tubers
Estimated Yield
Number of Plants
Number of Stems
Vine Rating
% Incidence of Growth Cracks
Scab Rating

Visual

Green **Orange** **Red**

No readily discernible differences in some areas, though some "green" sample locations were greener/healthier than others but some red areas were actually quite healthy looking.

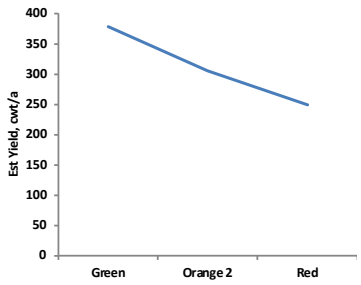
Results

		Mean	P-Value	Sign. @ 10%
Tubers (Number)	Green	45.6	0.731	No
	Orange	42.0		
	Red	41.7		
Yield (cwt/a)	Green	378.4	0.074	Yes
	Orange	306.6		
	Red	249.3		
Plants (Number)	Green	6.6	0.385	No
	Orange	7.5		
	Red	6.8		
Stems (Number)	Green	29.8	0.603	No
	Orange	30.8		
	Red	27.0		
Vine Rating (0-10)	Green	5.0	0.231	No
	Orange	4.3		
	Red	3.5		
Growth Crack (%)	Green	19.3%	0.026	Yes
	Orange	14.7%		
	Red	5.9%		
Scab Rating (0-10)	Green	3.8	0.648	No
	Orange	3.8		
	Red	4.3		

We found significant correlation in two measured metrics: estimated yield and occurrence of growth cracks.

Yield was positively correlated with NDVI and % growth cracks was negatively correlated with NDVI.

Yield



	Est Yield/Acre	% NDVI Value	Acre/NDVI Group	Est Volume
Green	378.4	10.8%	16.0	6048
Yellow	342.5	23.4%	34.6	11861
Orange 2	306.6	25.2%	37.3	11435
Orange 1	278.0	25.5%	37.7	10492
Red	249.3	16.1%	23.8	5940
Total			148.0	45777
			Weighted Yield	309
			Adjusted Yield	263
			Last Est Yield Dig	345
			Adjusted Yield	293

Based on test dig to NDVI estimate difference, there is a potential 30 cwt/a difference in yield estimates or 4,440 cwt of potatoes

Key Learning: Good information, very slow delivery

2016 Satellite Work Rhodesdale, MD

5/26/2016 6/19/2016 7/14/2016 8/12/2016

We were not successful in trialing in 2016. Dickeya!

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2017 Satellite Work Rhodesdale, MD

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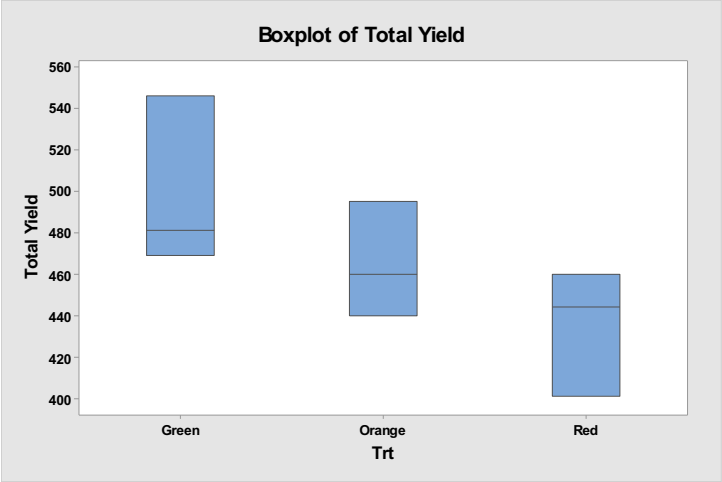
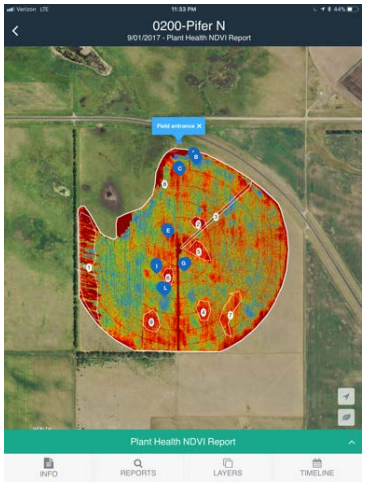
2017 Satellite Yield Results



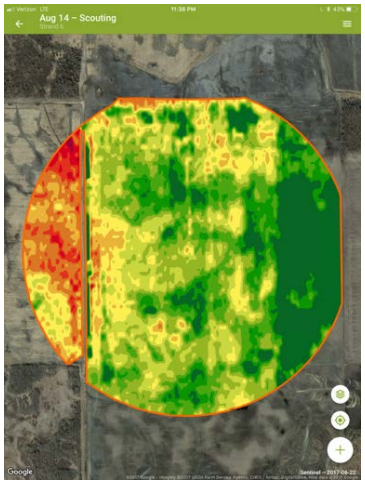
P = 0.147

Despite a clear trend, we lacked significant differences between the values.

2017 Drone Work ND, MI, IN

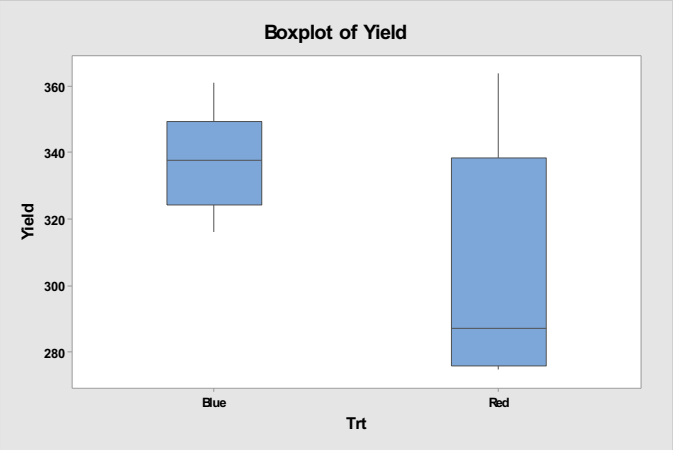


Aker



Mavrx

2017 Drone Yield Results



P = 0.058

Despite messy data, we had significant differences between the values.

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Yield Sampling Recap

Year	Type	Yield Diff?
2015	Drone	Significant
2016	Satellite	Not Significant
2017	Satellite	Not Significant
2017	Drone	Significant

Could the type of imagery technology influence our yield estimation?

A problem of scale??

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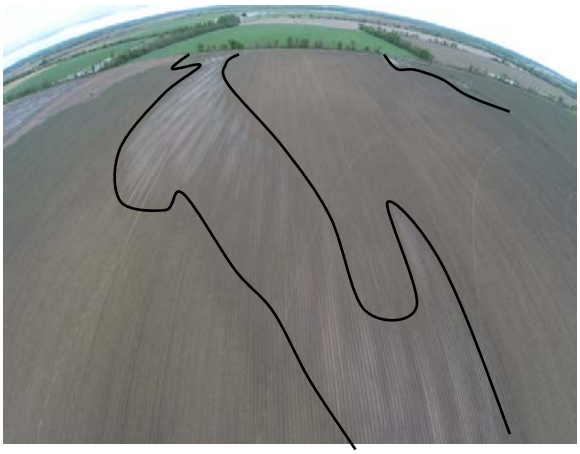
Lessons regarding practical use of imagery

1. Data handling → Information

- Goal is information
- Private use of drones is costly
- Lots of low cost commercial options



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Lessons regarding practical use of imagery

2. Scale is likely important for certain circumstances

- Early season evaluation
- Potato may require more data to make inferences

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Lessons regarding practical use of imagery

3. Timing and number of imagery events is critical depending on what you want to accomplish

- Early season evaluation of stands?
- Mid season evaluation of fertility?
- Late season evaluation of yield?

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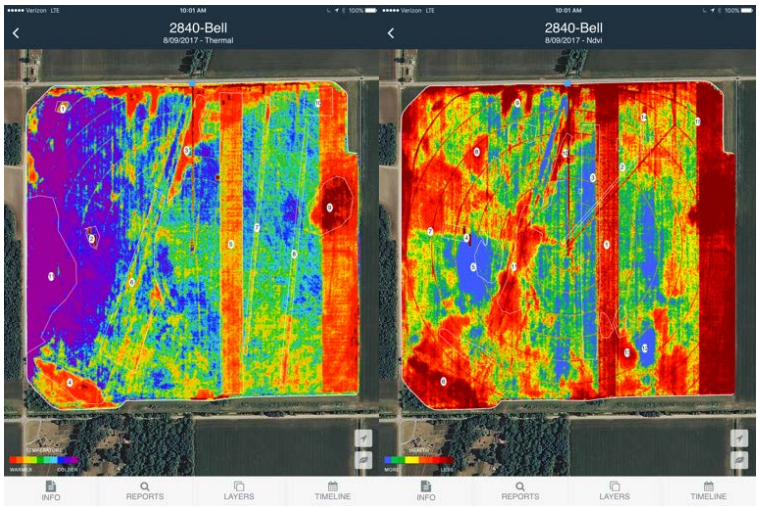
Lessons regarding practical use of imagery

4. NDVI may <u>not</u> be the best means of yield estimation

- NDVI is the most common
- Thermal?
- Certain wavelengths?



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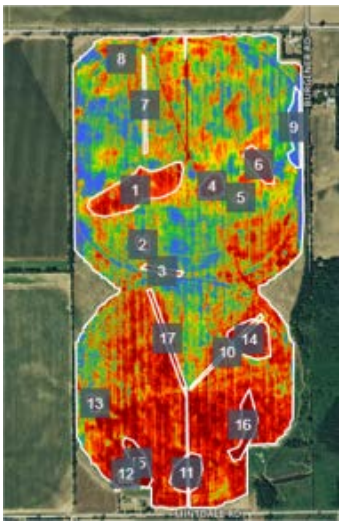
Lessons regarding practical use of imagery

5. Variation is a shared enemy

- For any attempt to evaluate yield, variation will reduce success
- But yield differences are created by variation
- ????



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Lessons regarding practical use of imagery

6. Vet your Imagery Company

- Most Ag start-ups fail in the first two years
- A lot of venture capital

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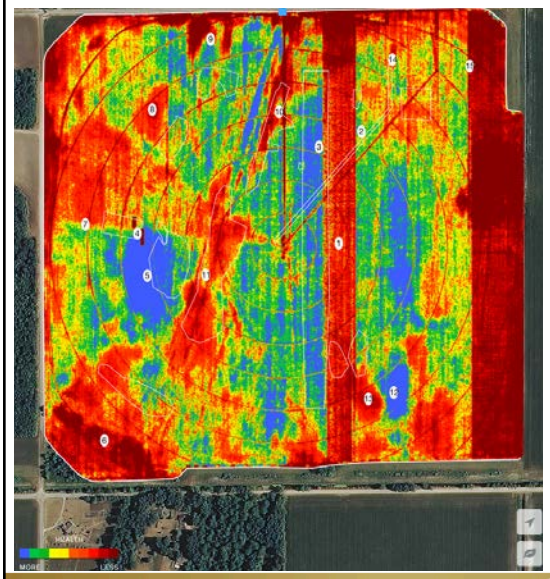
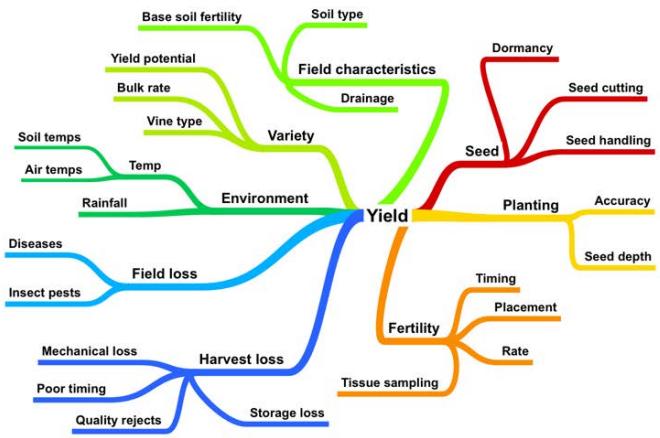
Linkedin Post

Final Thought





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