Update on Drone Technology — Where Are We Today?

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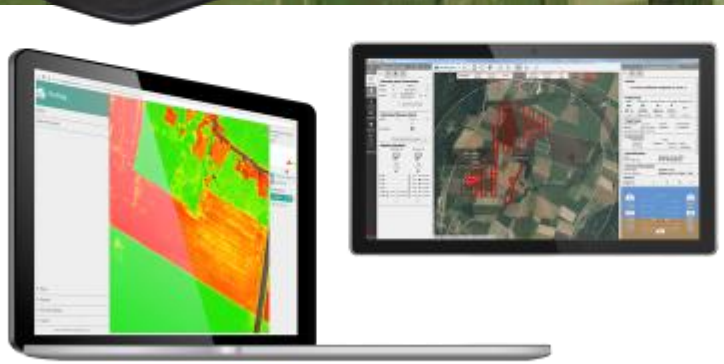
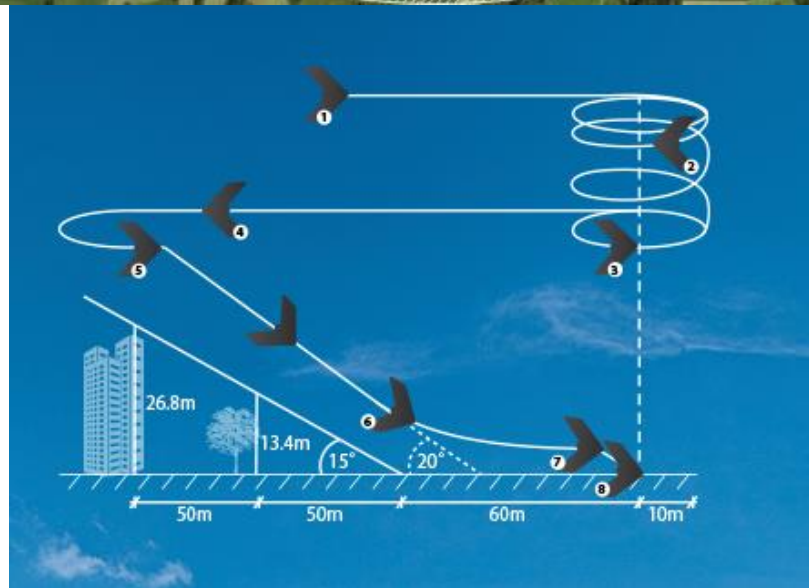
UNIVERSITY OF MISSOURI
MU Extension
an equal opportunity/ADA institution

Update of Drone Technology

- Drone Technology
- Image Processing / Analysis

The eBee SQ has a flight time of up to 55 minutes allowing to cover areas of up to 500 acres in a single flight.





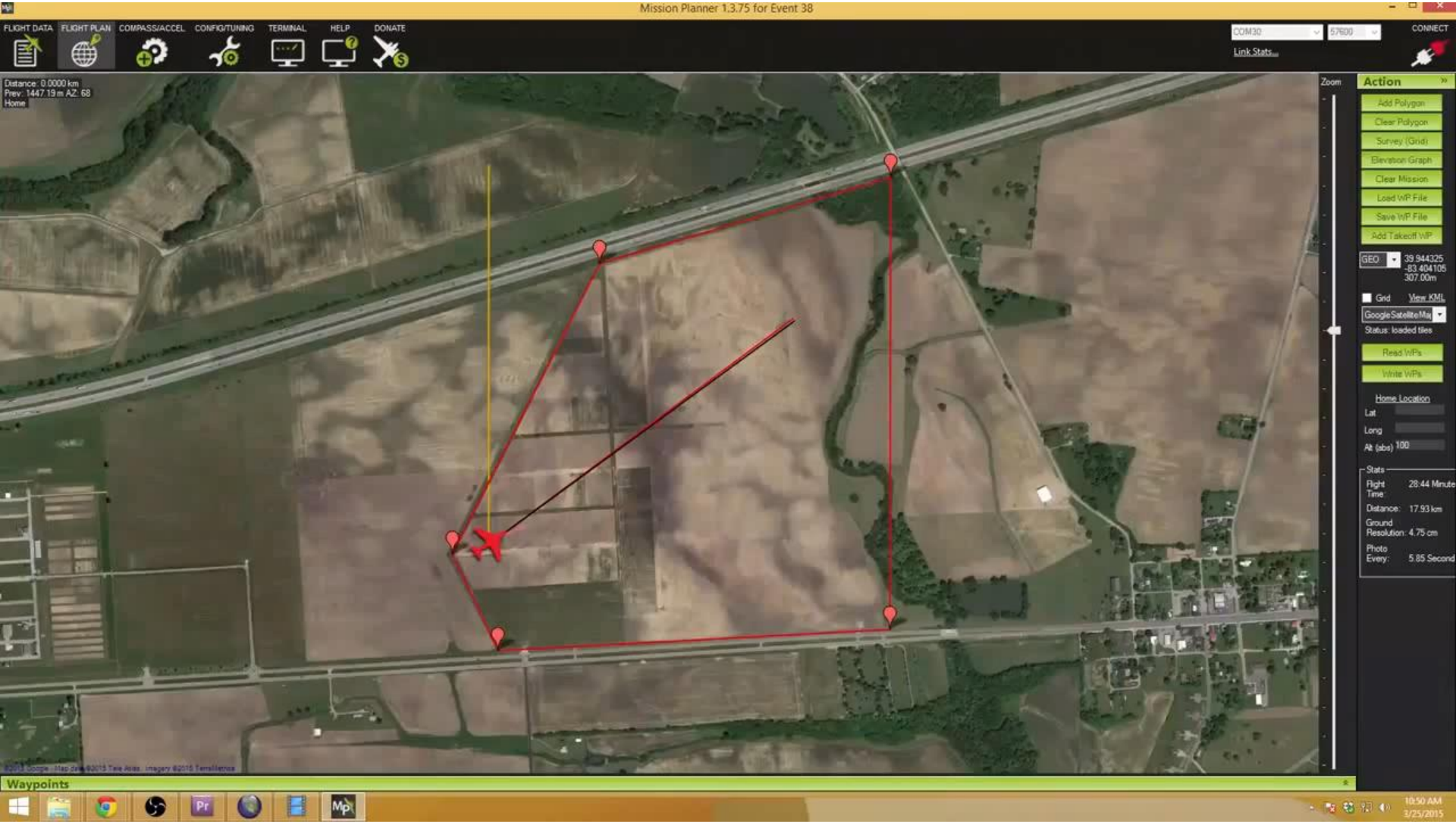
Parrot – eBee SQ - $12,000

Flight time 60 minutes

Scout Drone – Event38 - $3,096.00

https://event38.com/product/scout-drone/

120cm Wingspan, 56cm Length (47 x 22 inches)
1.37kg -weight

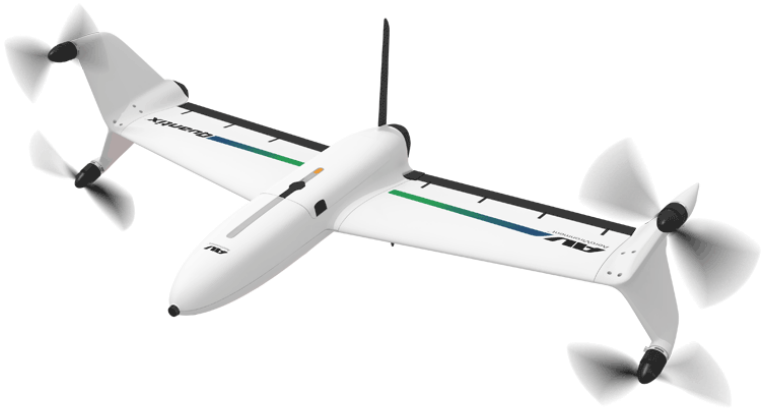

Mission Planner 1.3.75 for Event 38
FLIGHT DATA
FLIGHT PLAN
COMPASS/ACCEL
CONFIG/TUNING
TERMINAL
HELP
DONATE
COM30
57600
CONNECT
Link Stats...
Distance: 0.0000 km
Prev: 1447.19 m AZ: 68
Home
Zoom
Action
Add Polygon
Clear Polygon
Survey (Grid)
Elevation Graph
Clear Mission
Load WP File
Save WP File
Add Takeoff WP
GEO
39.944325
-83.404105
307.00m
Grid
View KML
GoogleSatelliteMap
Status: loaded tiles
Read WPs
Write WPs
Home Location
Lat
Long
Alt (abs) 100
Stats
Flight Time: 28:44 Minute
Distance: 17.93 km
Ground Resolution: 4.75 cm
Photo Every: 5.85 Second
Waypoints
10:50 AM
3/25/2015

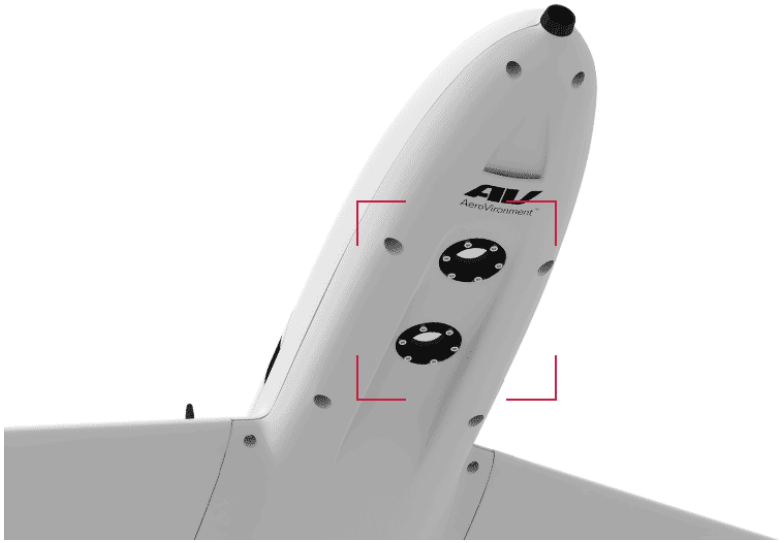
FireFLY6 PRO

$6,700

- Wingspan: 60" (1524mm)
- Length: 32.6" (828mm)
- Weight: 8.4-9.9lbs (3.8-4.5kg)
- Flight Time: 40-50min with payload*

Quantix - AeroVironment





$16,500.00

Action Drone, Inc. - AD2 AG

$3,869.00 - $7,077.00

Up to 45 minute flight time

Totally Autonomous Drone

American Robotics, an industrial drone developer specializing in agricultural automation, has unveiled its flagship product Scout. It is a self-charging, self-managing drone system capable of autonomously carrying out daily scouting missions.

DJI – The Main Source

Phantom 4 Pro or 4 ProV2 - $2300 / $2800

Matrice 100 - $6000

Inspire 2 - $5200

Newer Compact Drones from DJI

DJI – Mavic Pro - $1,439

DJI – Spark - $600

DJI – Mavic Air - $1105

JUST RELEASED DJI MAVIC PRO 2 - $2,099.00

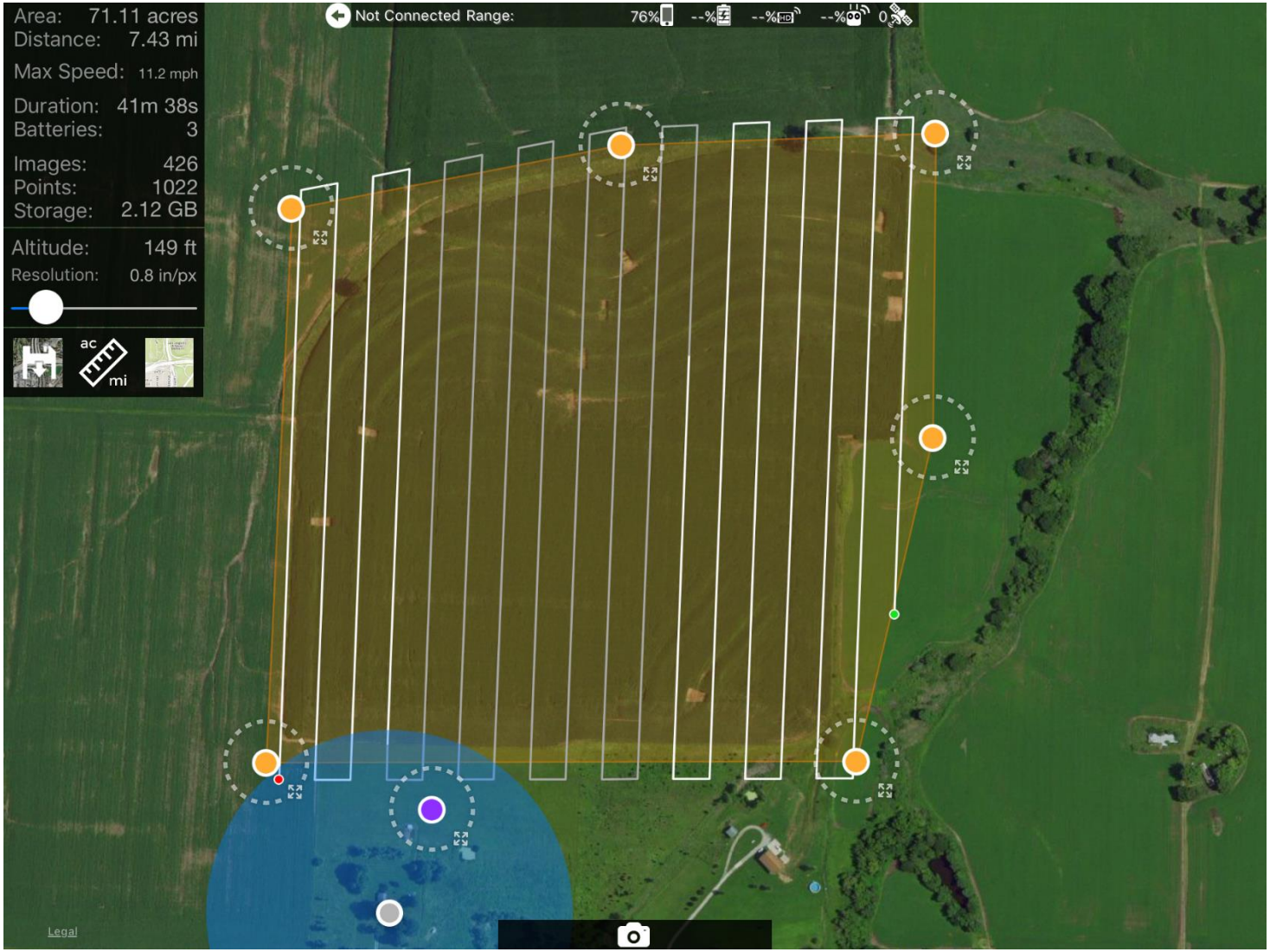
Corn –
Cover Crop Plots
- Image Captured
on June 23, 2014

Could easily be
Captured with a
DJI Spark Drone

Capture Images via Autonomous Flight

Mosaic of 215 images taken on March 21, 2016 – flying at 80 meters – 60 acres

Map Pilot for DJI App - $9.99



Area: 24.36 hect
Distance: 10.42 km
Max Speed: 2.9 m/s
Duration: 63m 27s
Batteries: 2
Images: 299
Points: 717
Storage: 1.49 GB
Altitude: 100 m
Resolution: 4.3 cm/px
ha
km

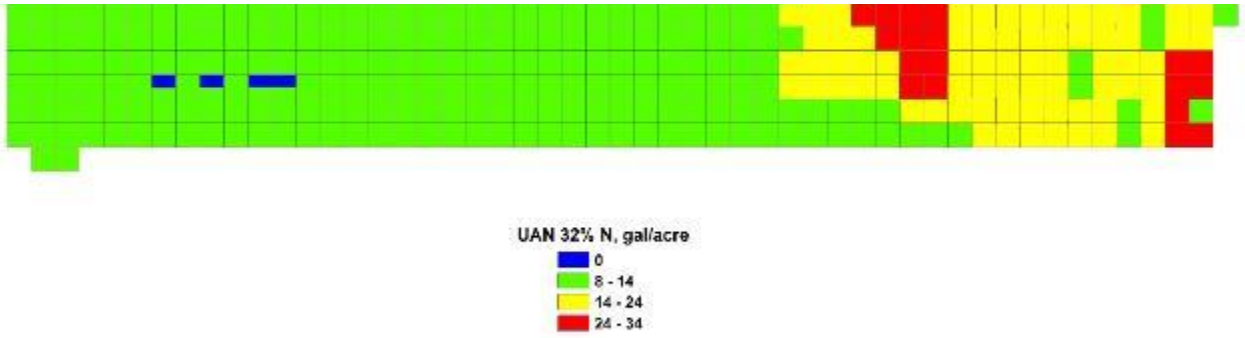
Connected Range: 1m @ 225° 76% 21% 100% 100% 11

Dist Flown: 4.1 km
Speed: 0.4 m/s
Altitude AGL: 0.0 m
Motion Blur: 0.1 cm
Images: 301
Storage: 1.54 GB
Flight Time: 16:47
No time limit
Remaining Time
This Mission: 00:00

Legal

Turning Drone Image into N Application Map

utilizing NVisionAG



Turning Drone Image into N Application Map

utilizing NVisionAG

Treatment	Sidedress N Rate – lbs/acre	Corn Yield – bu/acre
Producer	40	207
Nvision	48	209
OptRx	48	206

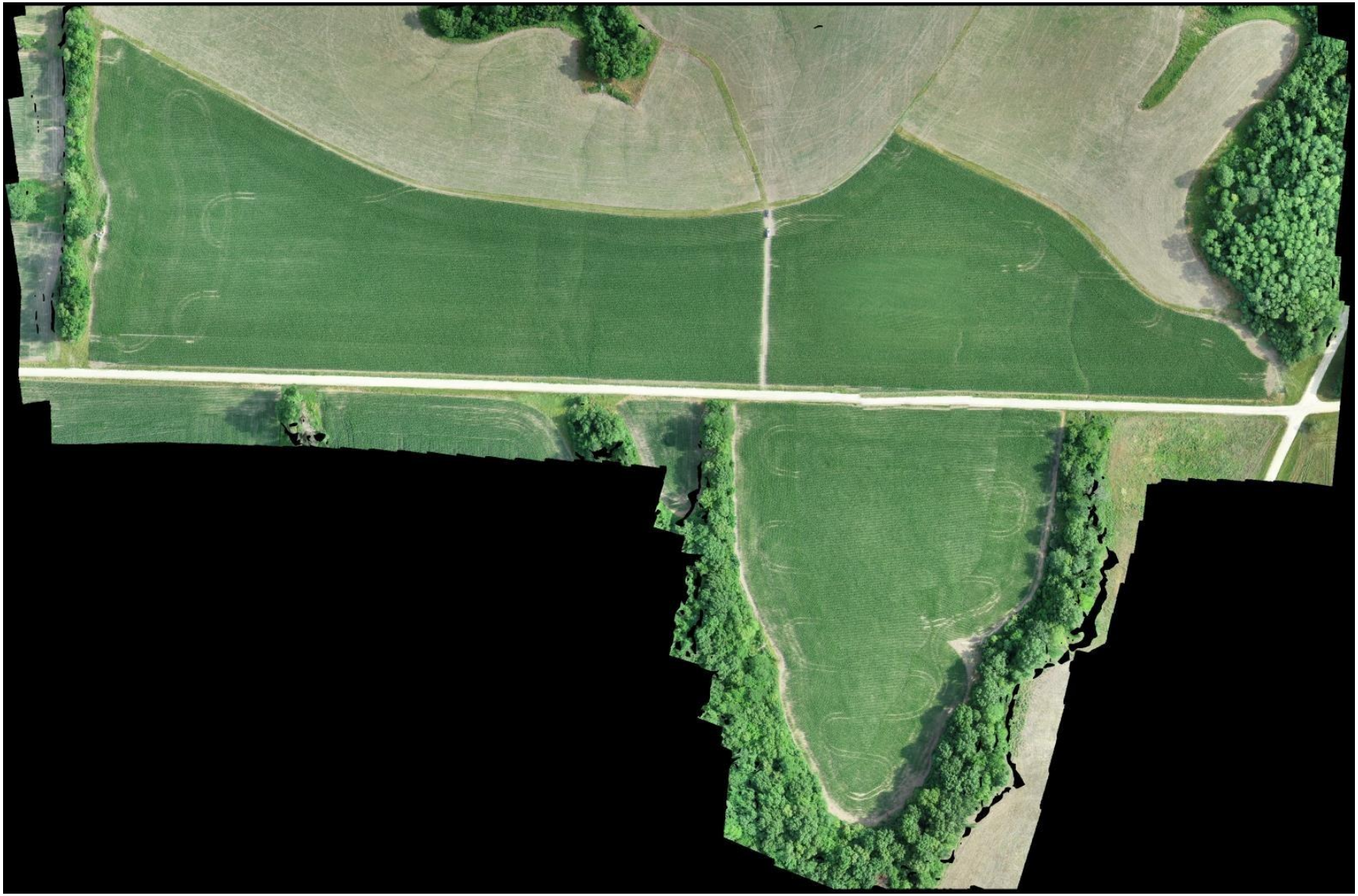
UPDATE ON
CHARITON COUNTY DEMO FARM
NITROGEN TRIALS
MU STRIP TRIAL PROGRAM

Kent Shannon

Extension Ag Engineer – University of Missouri Extension

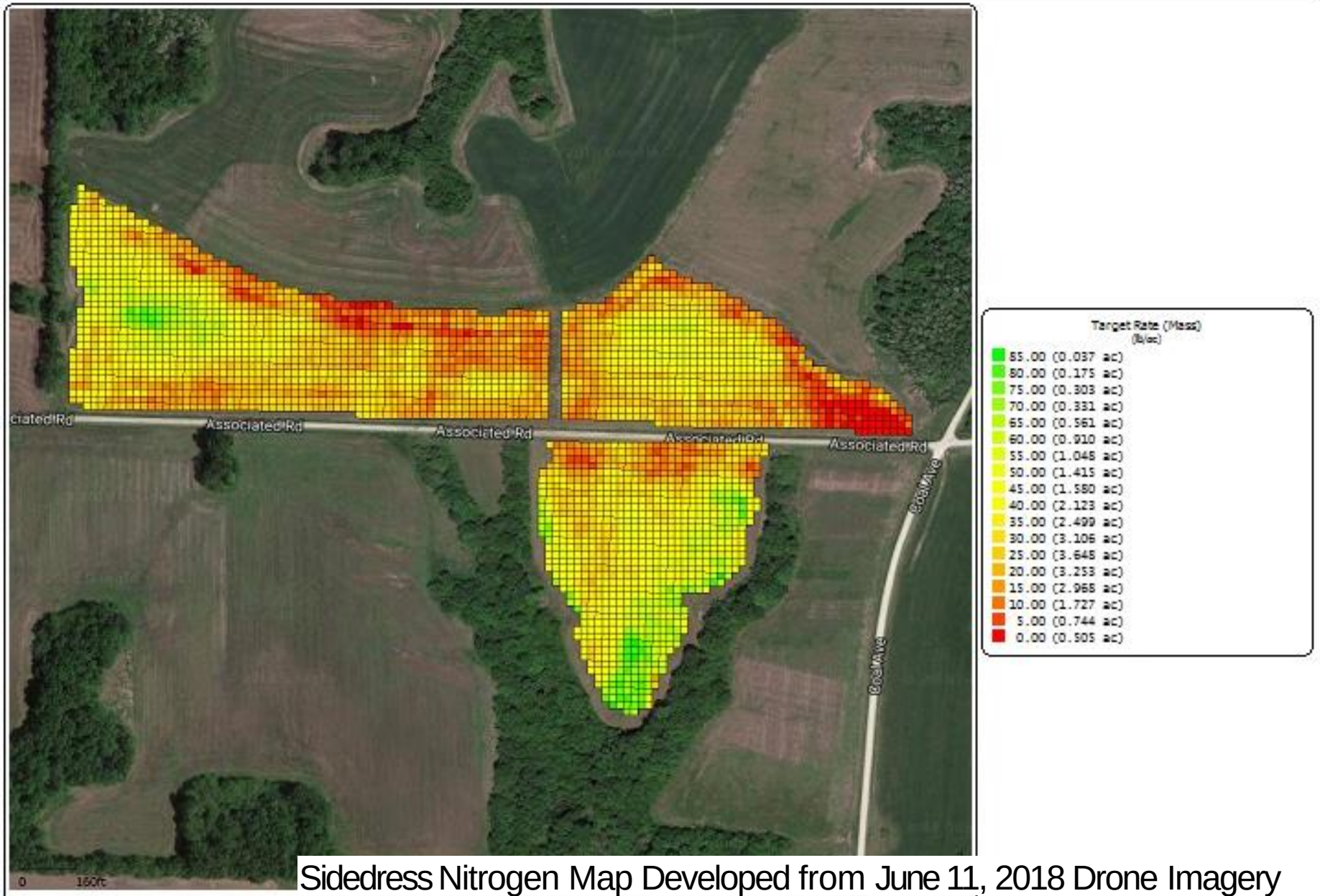
Boone County

Drone Imagery from April 23, 2018 taken at 100 m AGL



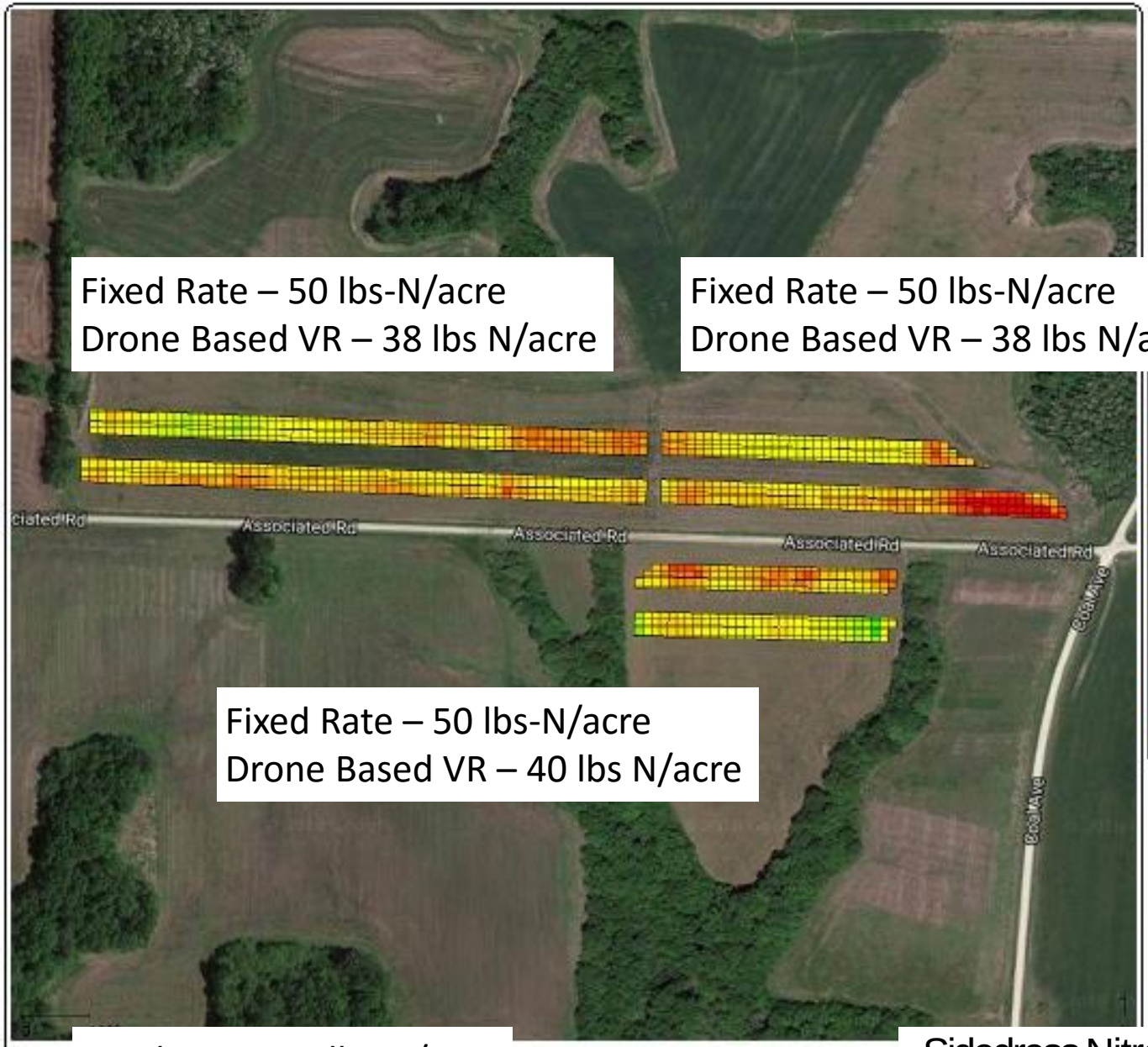
Drone Imagery from June 11, 2018 taken at 75 m AGL

Drone Based N Application 2018 - All Fields



Sidedress Nitrogen Map Developed from June 11, 2018 Drone Imagery

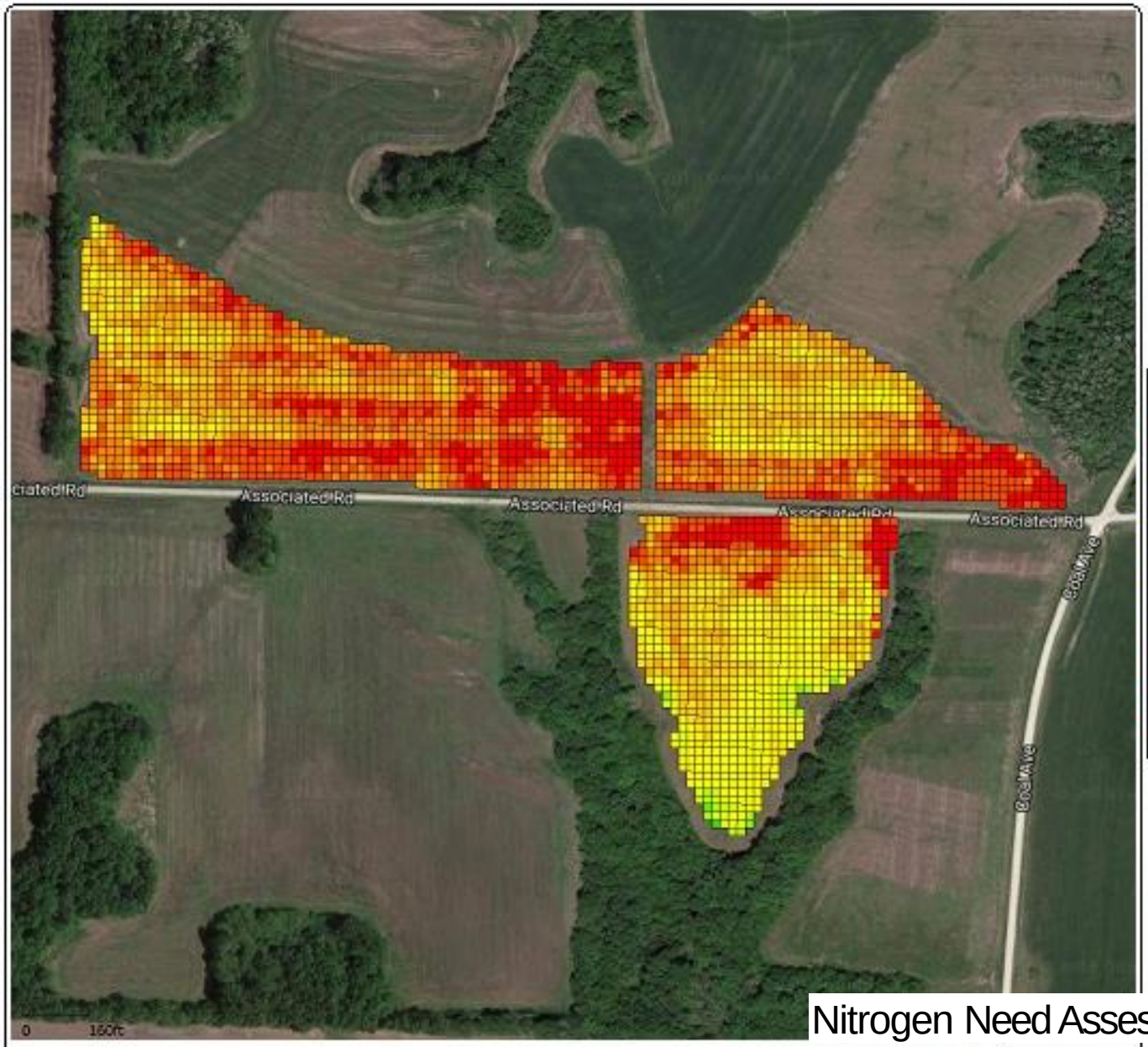
Drone Based N Application 2018 - All Fields



Sidedress Nitrogen Treatments Made

Drone Imagery from June 29, 2018 taken at 100 m AGL

Drone Based N Need Assessment 2018 - All Fields



Target Rate (Mass)
(lb/ac)

75.00	(0.009 ac)
65.00	(0.009 ac)
60.00	(0.037 ac)
55.00	(0.064 ac)
50.00	(0.119 ac)
45.00	(0.202 ac)
40.00	(0.487 ac)
35.00	(0.772 ac)
30.00	(1.525 ac)
25.00	(2.196 ac)
20.00	(3.666 ac)
15.00	(4.521 ac)
10.00	(4.999 ac)
5.00	(5.017 ac)
0.00	(3.308 ac)

Nitrogen Need Assessment on June 29

Grain Harvest 2018 - All Fields(CORN)

Yield (Dry)
(bu/ac)

155.63	- 235.30	(0.00	ac)
142.87	- 155.63	(0.00	ac)
131.66	- 142.87	(0.00	ac)
119.52	- 131.66	(0.00	ac)
97.52	- 119.52	(0.00	ac)
67.45	- 97.52	(0.00	ac)
2.07	- 67.45	(0.00	ac)

Grain Harvest 2018 - All Fields(CORN)

What Drone Should I Use?

DJI Phantom 3 Professional

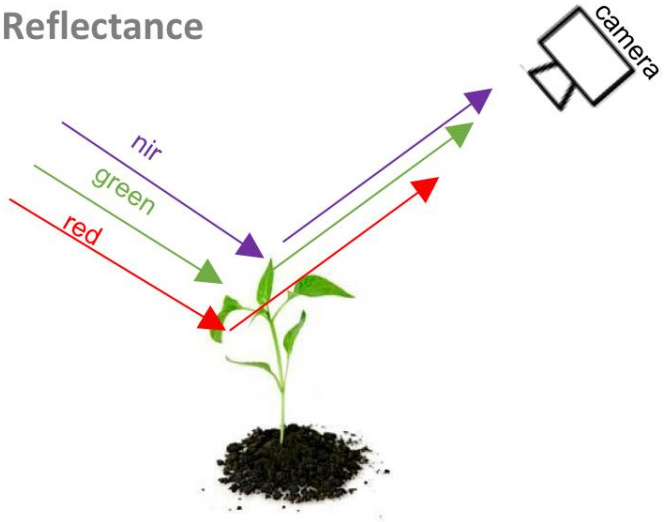
DJI Phantom 4 Pro

DJI Inspire 1 v2.0

DJI Mavic Pro

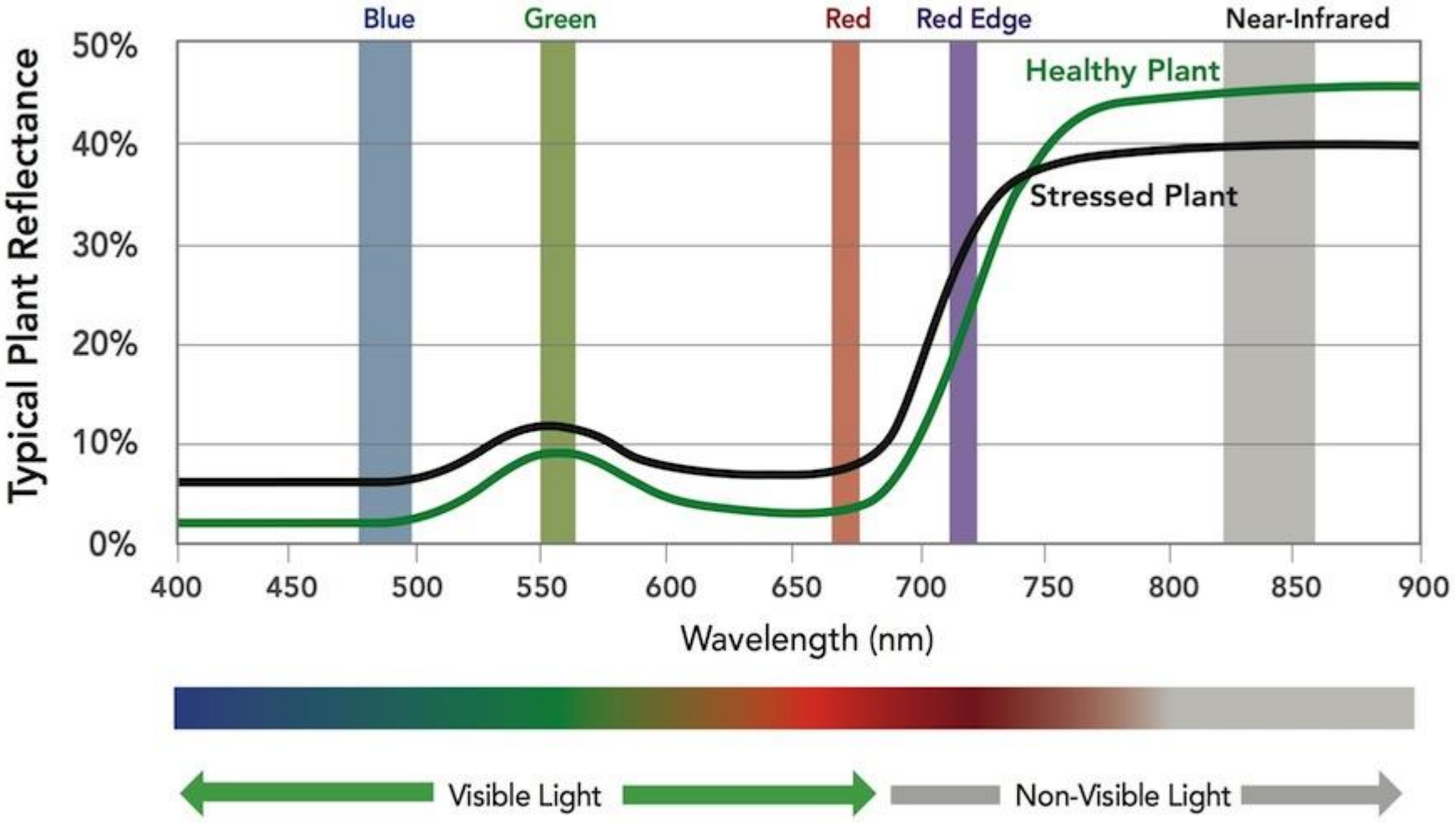
Reflectance

From Images to **Reflectance**

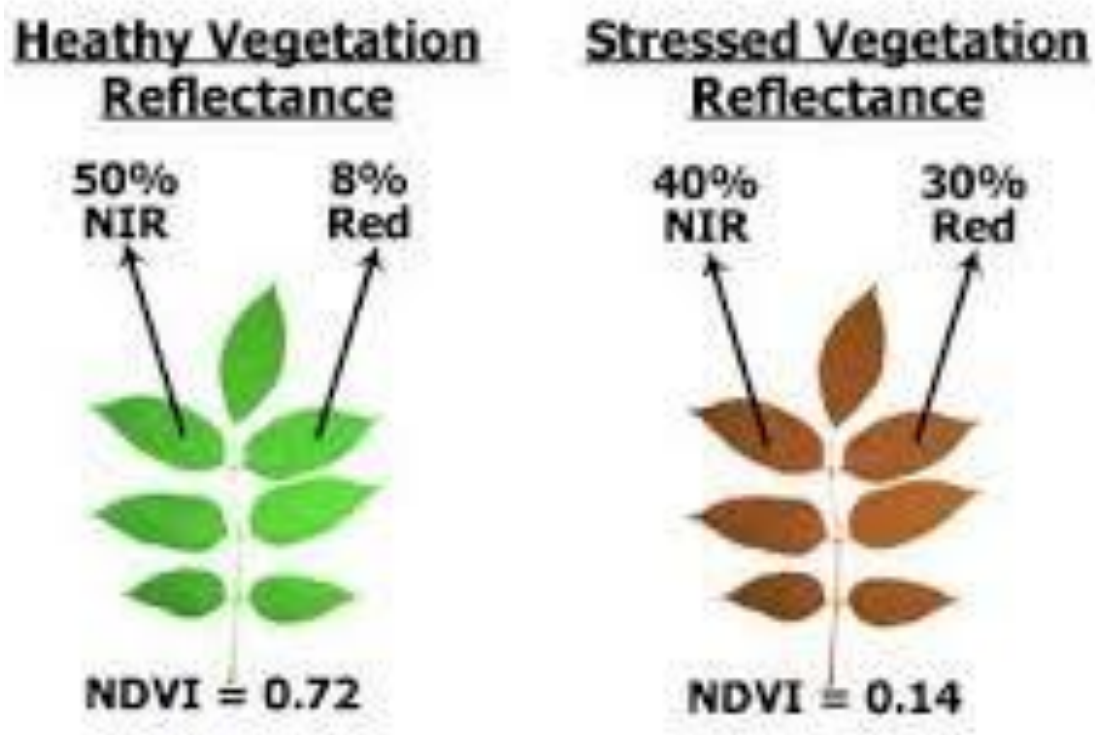


PIX4D
simply powerful

Electromagnetic Spectrum

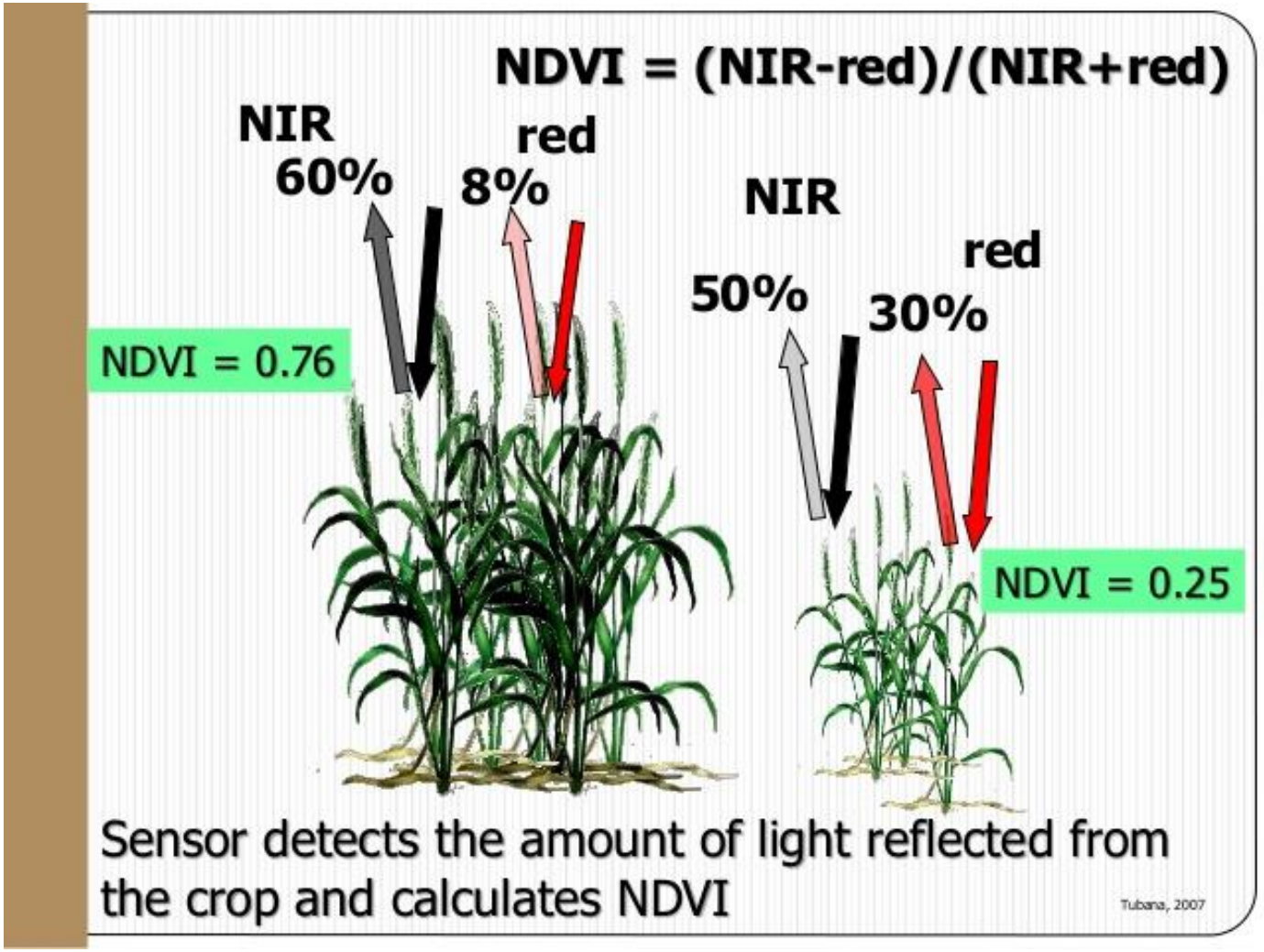


NDVI – Normalized Difference Vegetative Index



$$NDVI = \frac{NIR - Red}{NIR + Red}$$

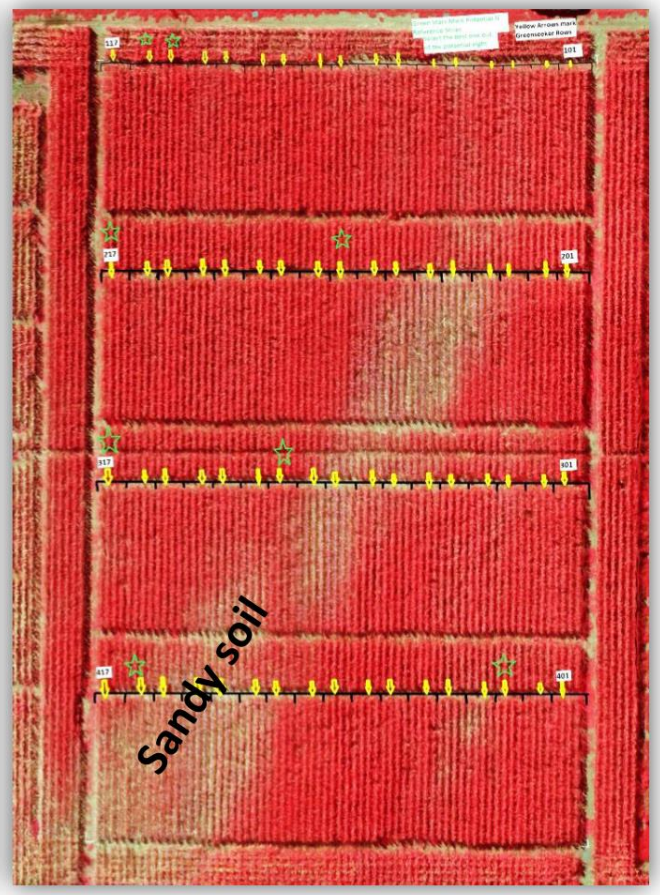
NDVI – Normalized Difference Vegetative Index



Comparing sUAS with Modified NDVI cameras Values to GreenSeeker NDVI Values

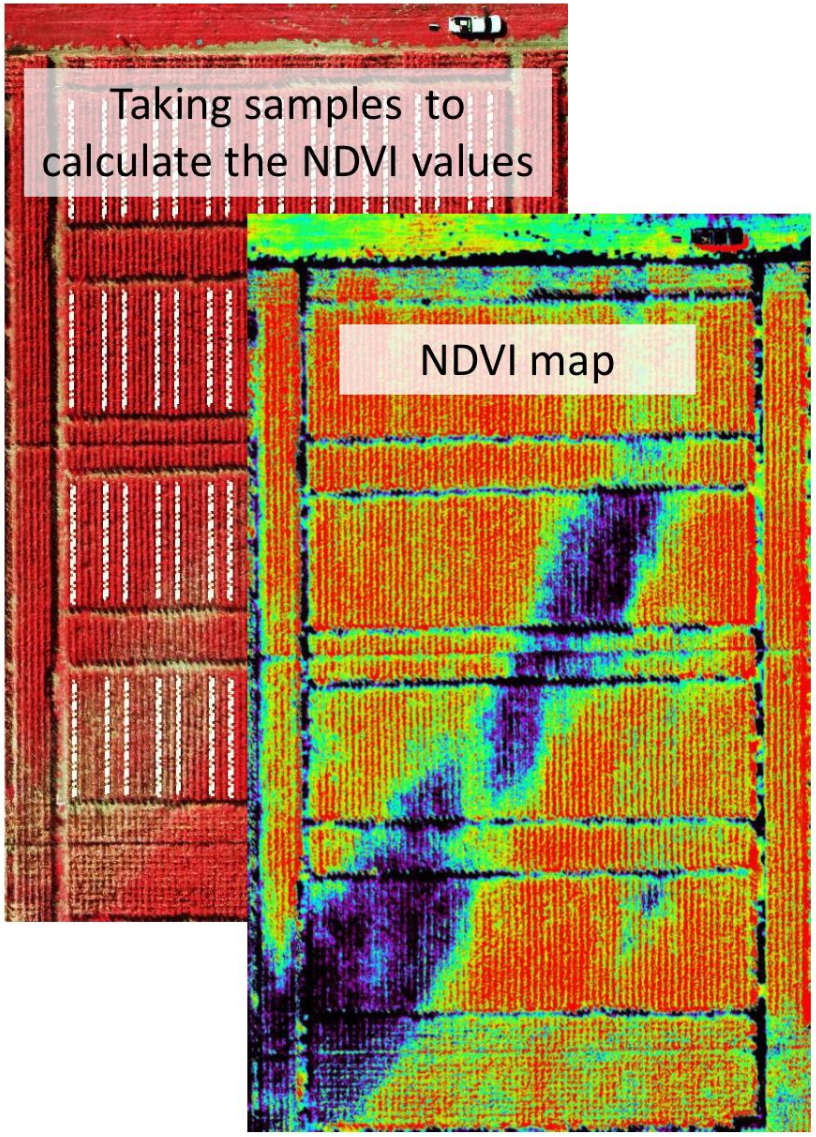
Collecting color infrared imagery using Hexcopter and Canon T4i NDVI camera

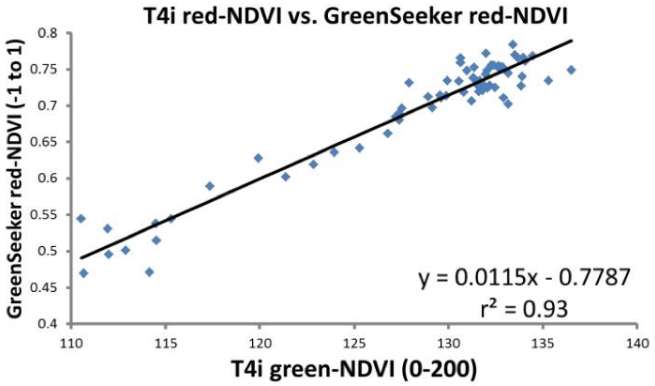
Collecting NDVI data using the Trimble® GreenSeeker® crop sensing system

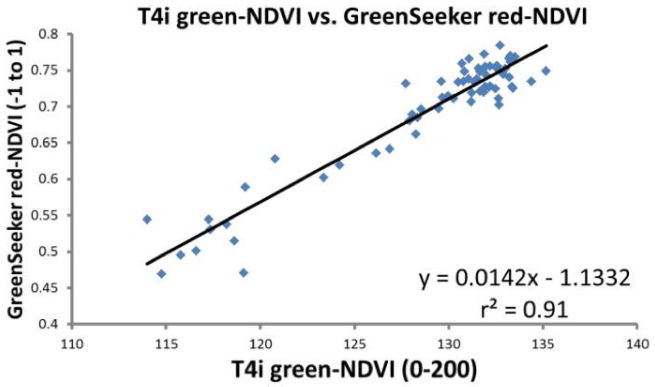


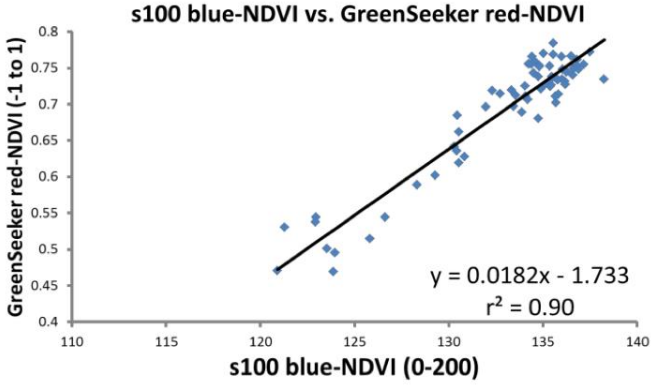
Yellow Arrows: GreenSeeker Row
Green Stars: N Reference Strips

Comparing sUAS with Modified NDVI cameras Values to GreenSeeker NDVI Values

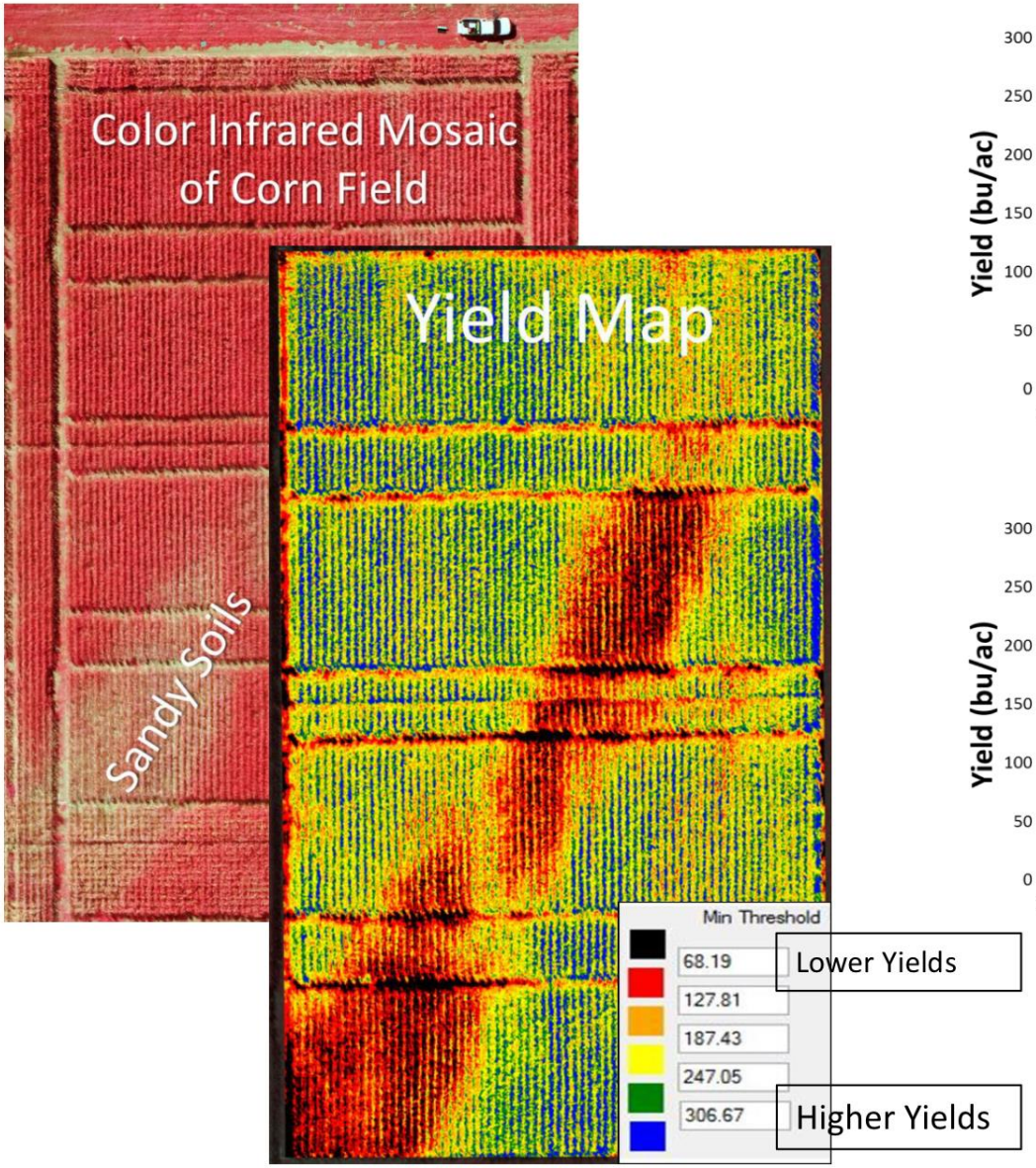


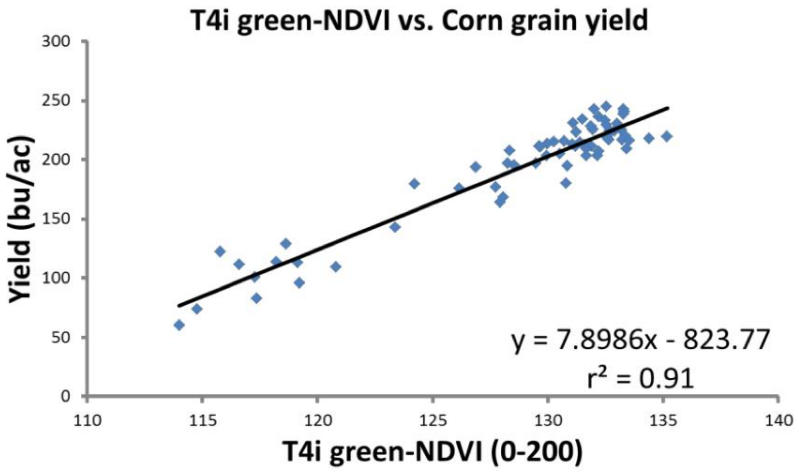


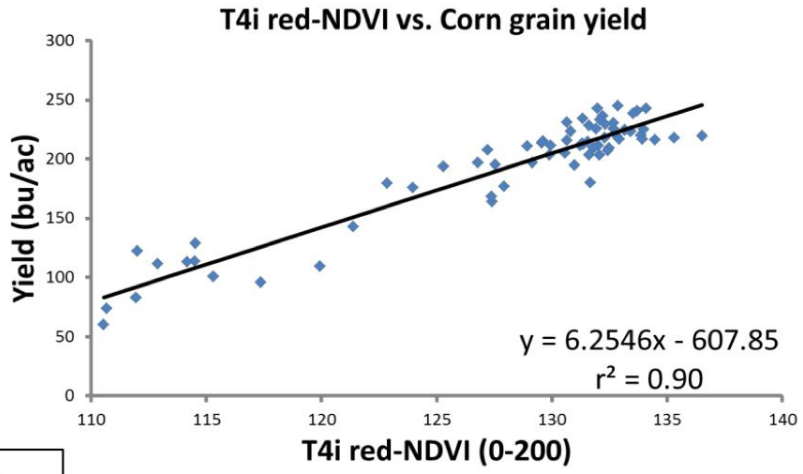




Using sUAS Imagery and AgPixel to Model Corn Yields







Drones / Sensor Technology

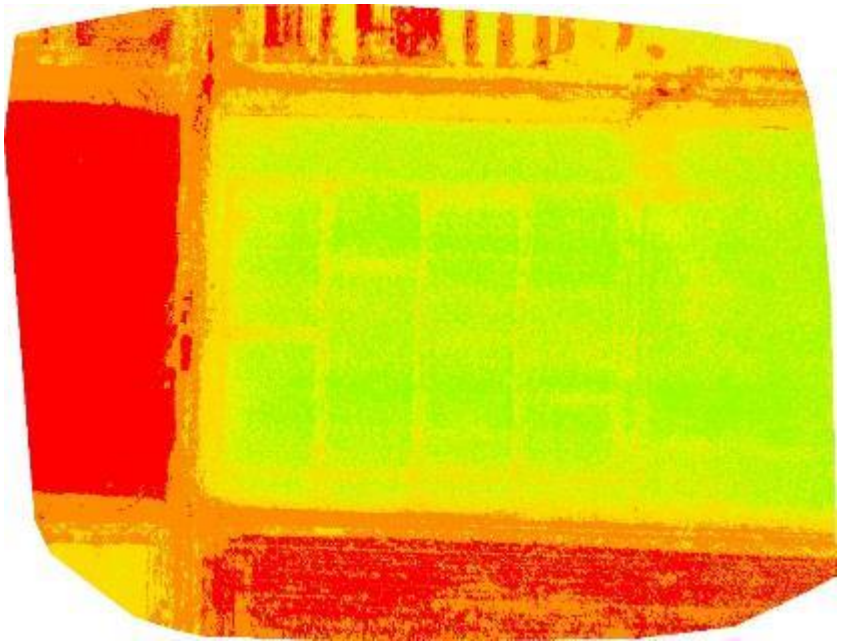
Red and NIR
Bands for NDVI

$2,949 upgrade
to a DJI P4Pro

sentera

DJI Phantom 4 with Sentera Single NIR Sensor and Standard RGB Camera

Drones / Sensor Technology



From DJI Phantom 3 with Sentera Single NIR Sensor and Standard RGB Camera

Parrot Sequoia

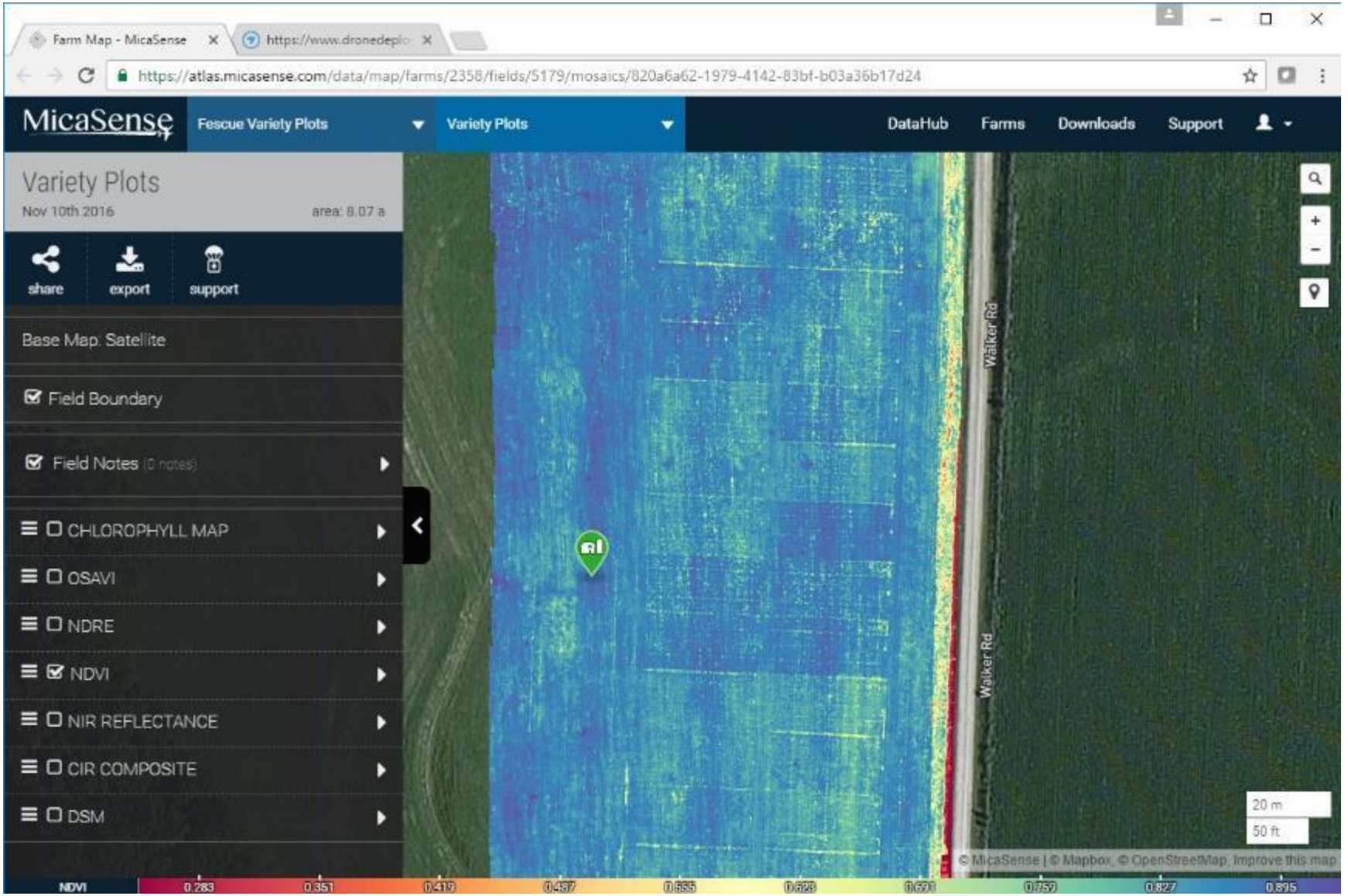
Sunlight
Sensor

4 Band Sensor
Green, Red, Red-Edge, NIR

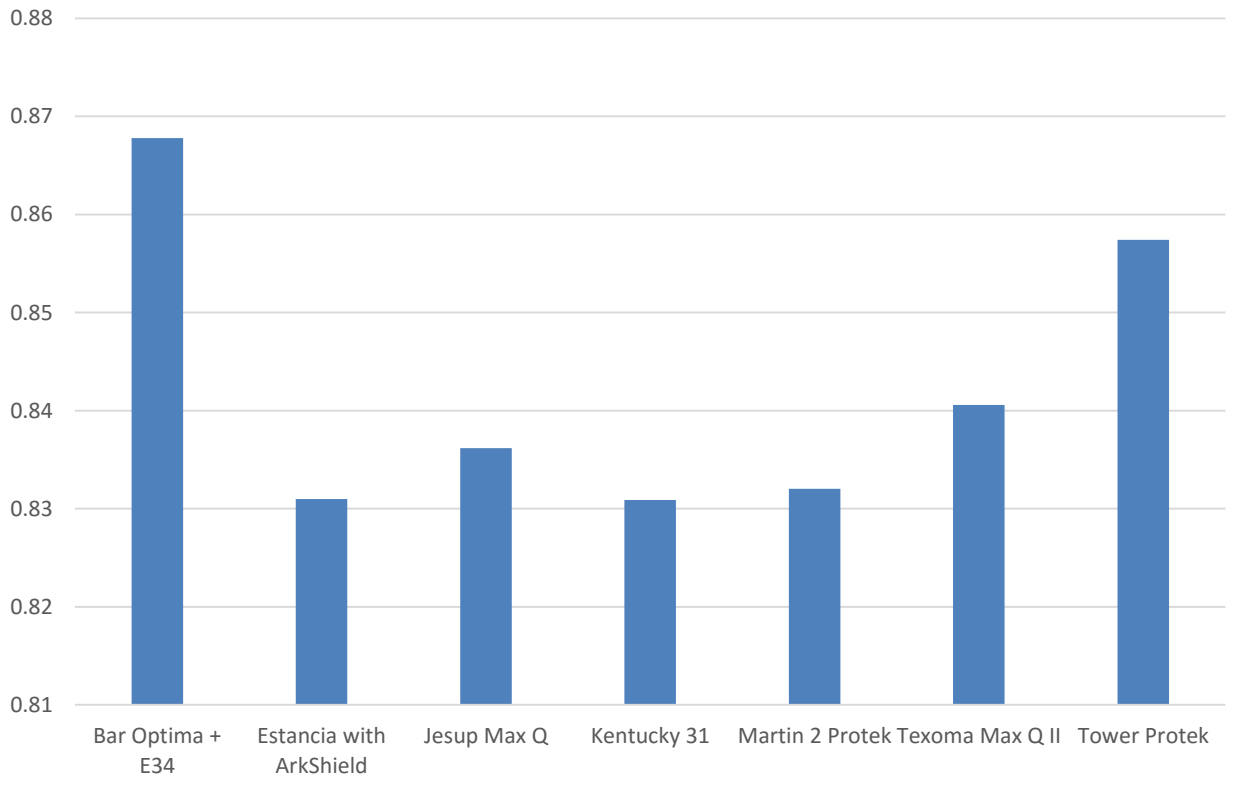
Parrot
Agriculture

$3500.00

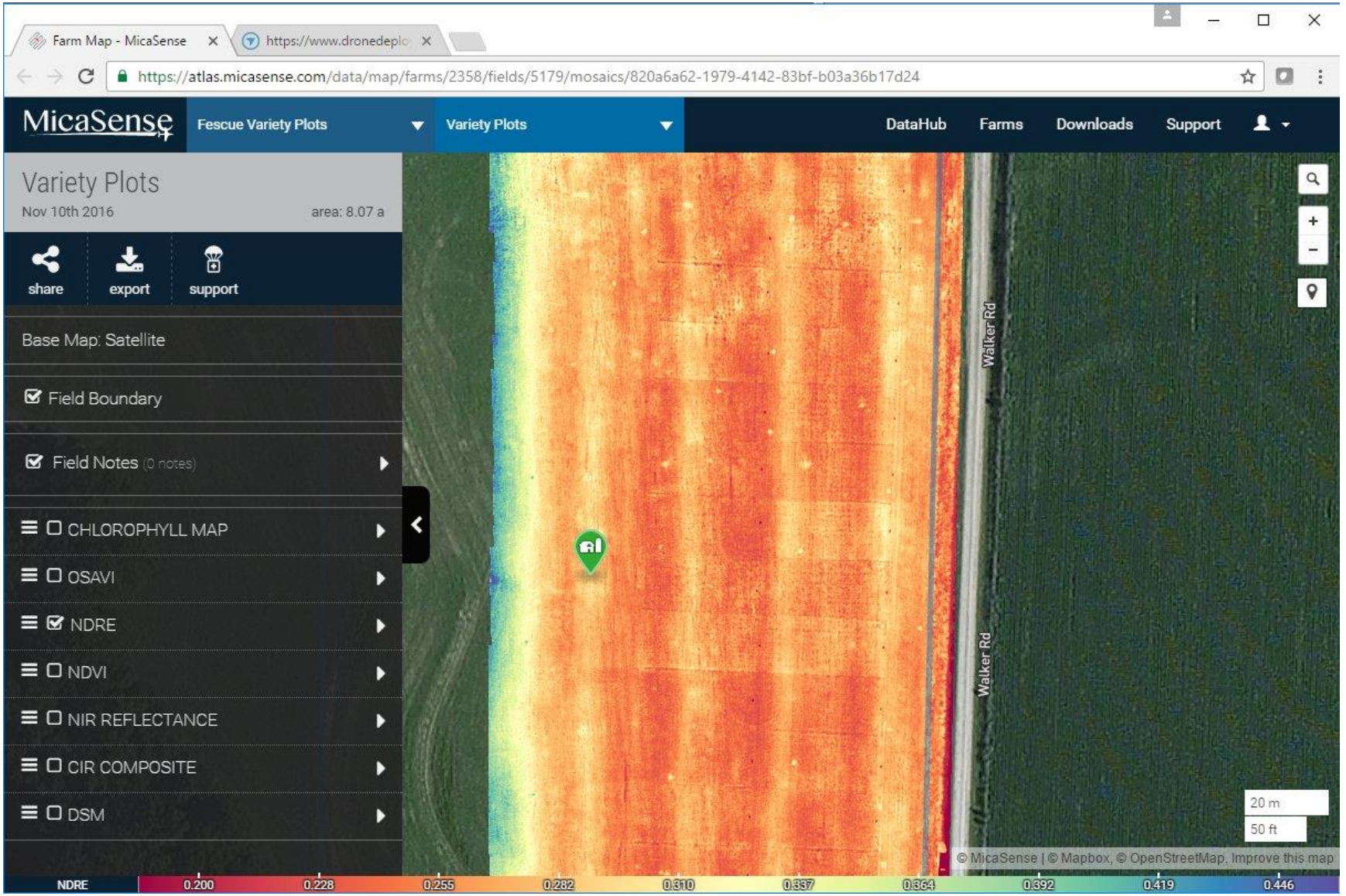
NDVI from Sequoia Sensor



NDVI and
Novel Endophyte Fescue Varieties



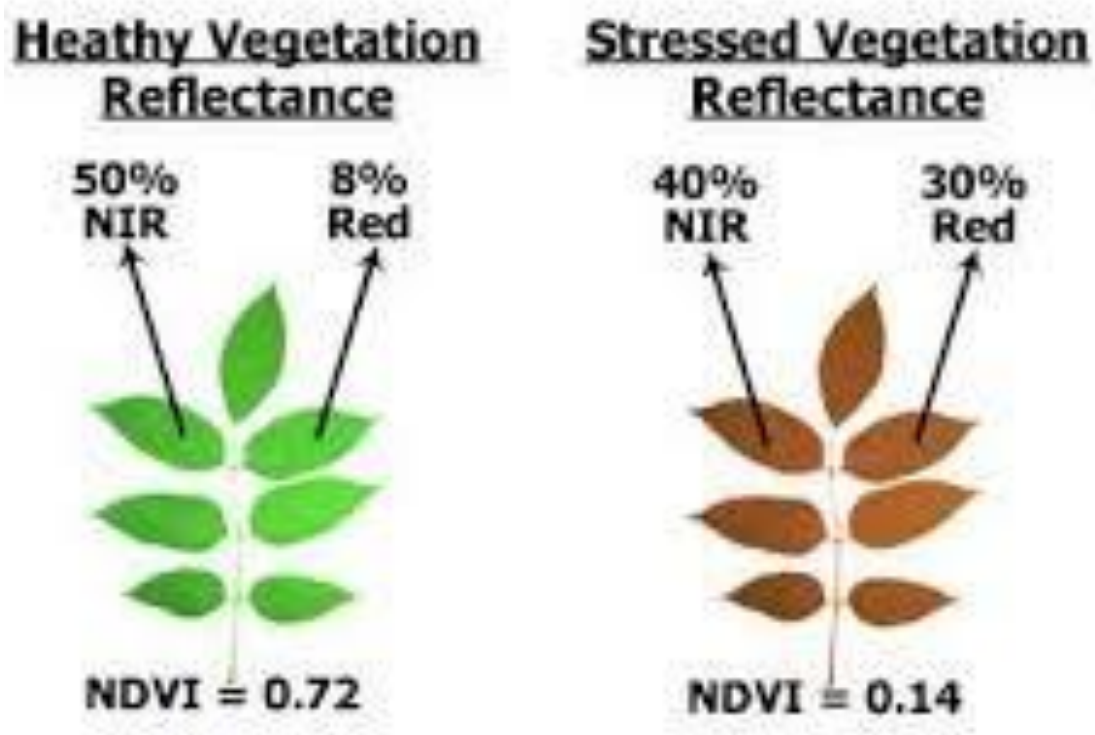
NDRE from Sequoia Sensor



Corn Nitrogen Strip Trial

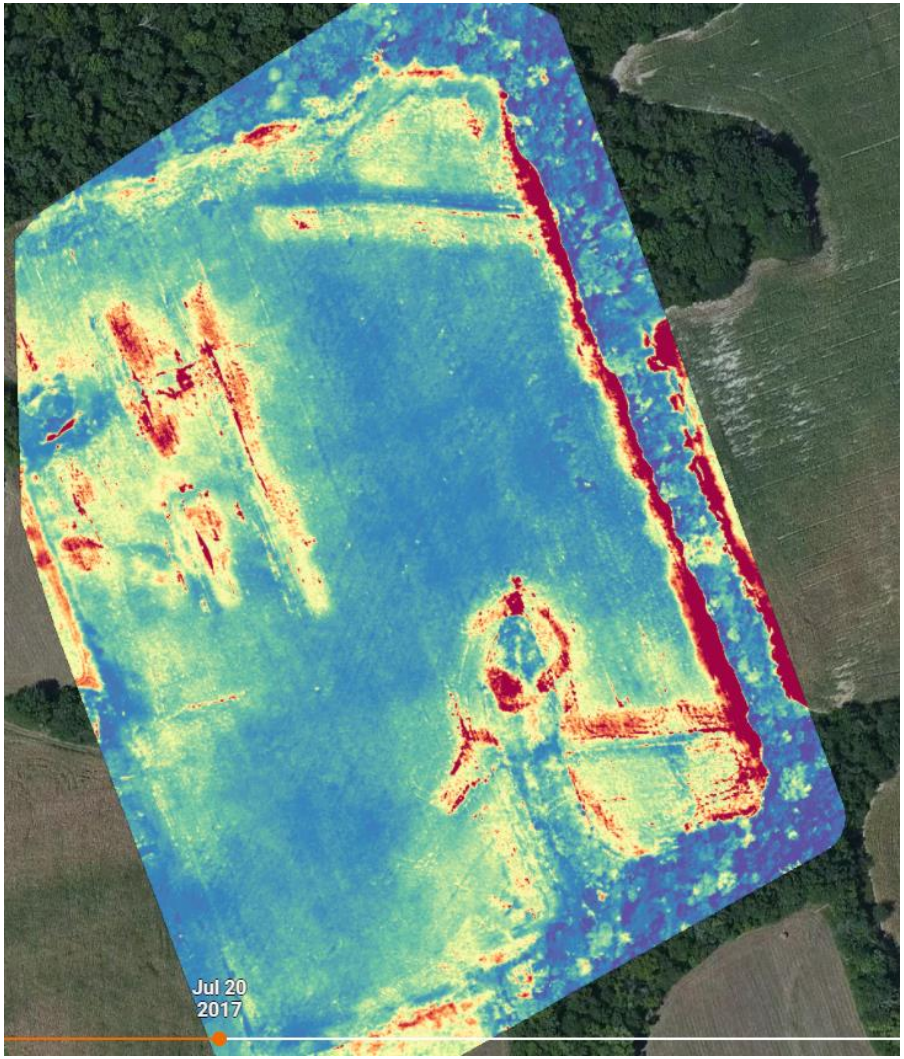
129 Images 7/20/17
Nitrogen Dates
4/18 60 lbs. & 0 lbs.
6/13 140 lbs. & 200 lbs.

NDVI – Normalized Difference Vegetative Index



$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Corn Nitrogen Strip Trial



NDVI on 7/20/17, derived from Parrot Sequoia
Nitrogen Dates
4/18 60 lbs. & 0 lbs.
6/13 140 lbs. & 200 lbs.

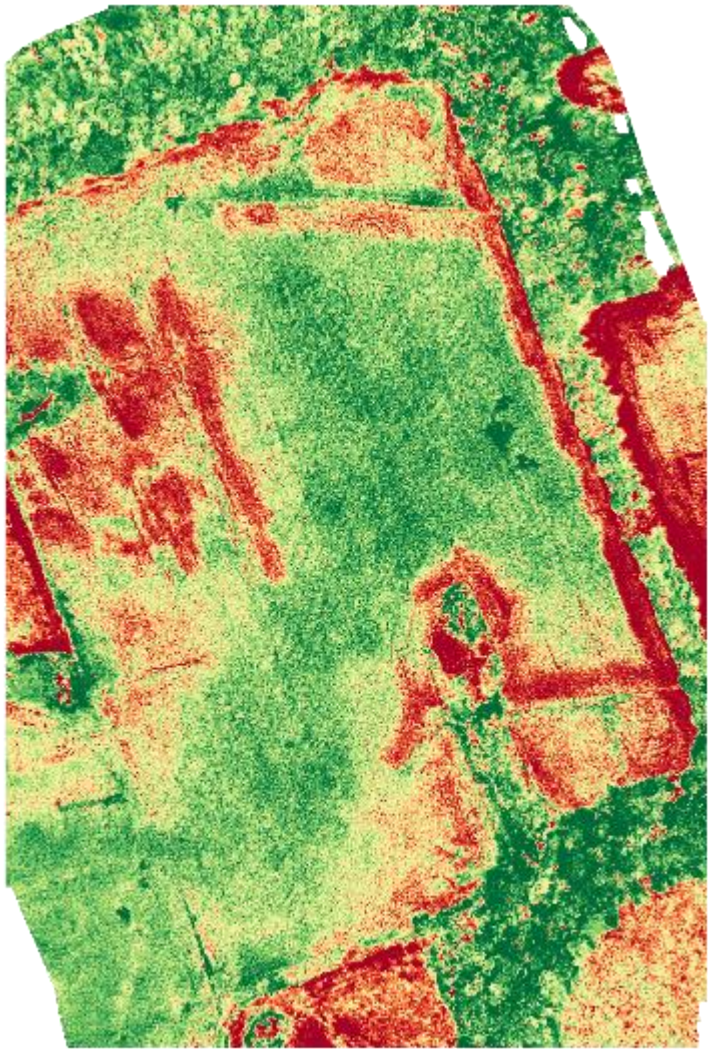
VARI -

Visible Atmospheric Resistant Index (VARI), developed at the University of Nebraska uses the formula

$$VARI = \frac{R_{GREEN} - R_{RED}}{R_{GREEN} + R_{RED} - R_{BLUE}}$$

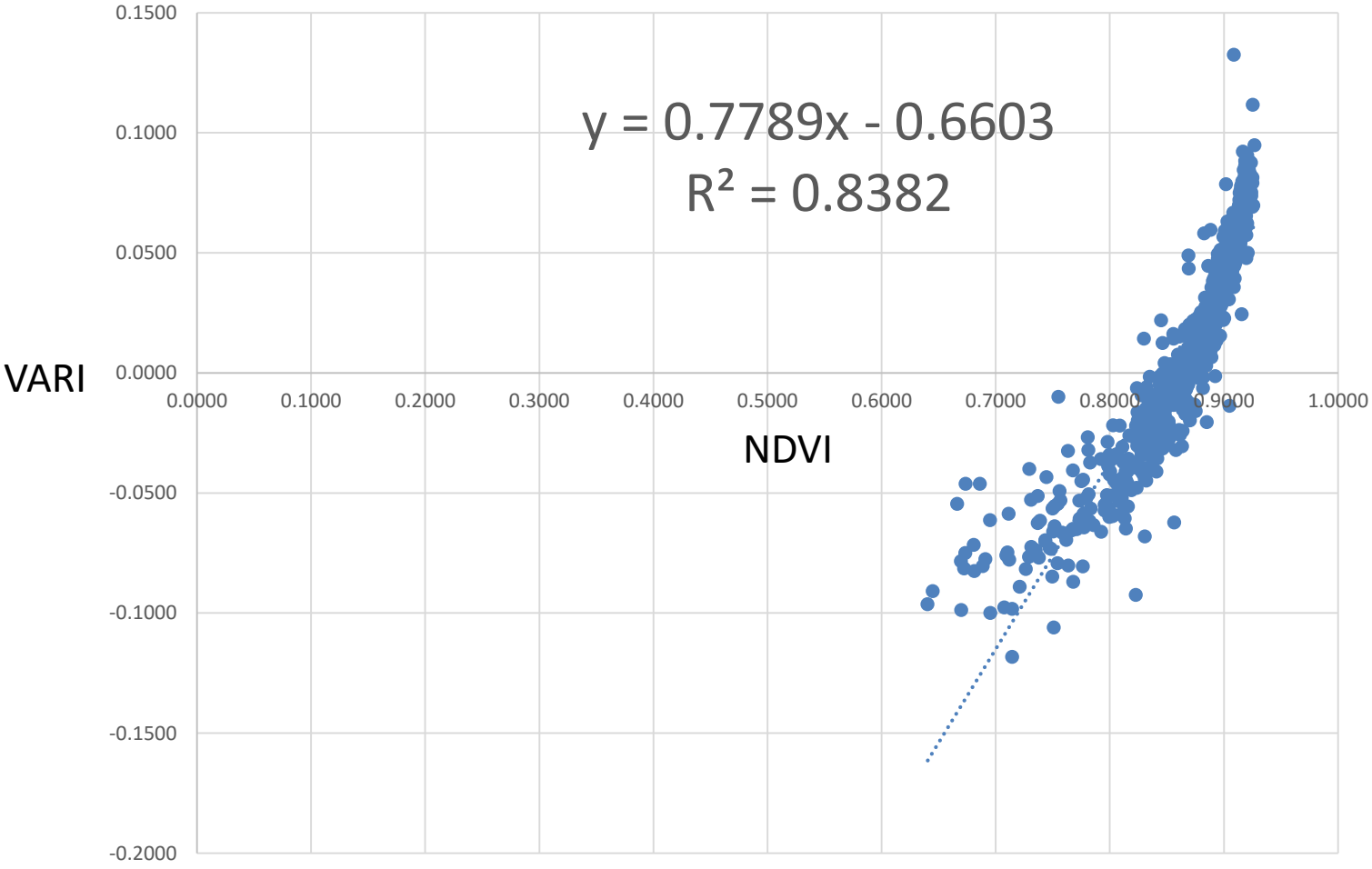
This is the index utilized by Drone Deploy for their Plant Health Image

Corn Nitrogen Strip Trial

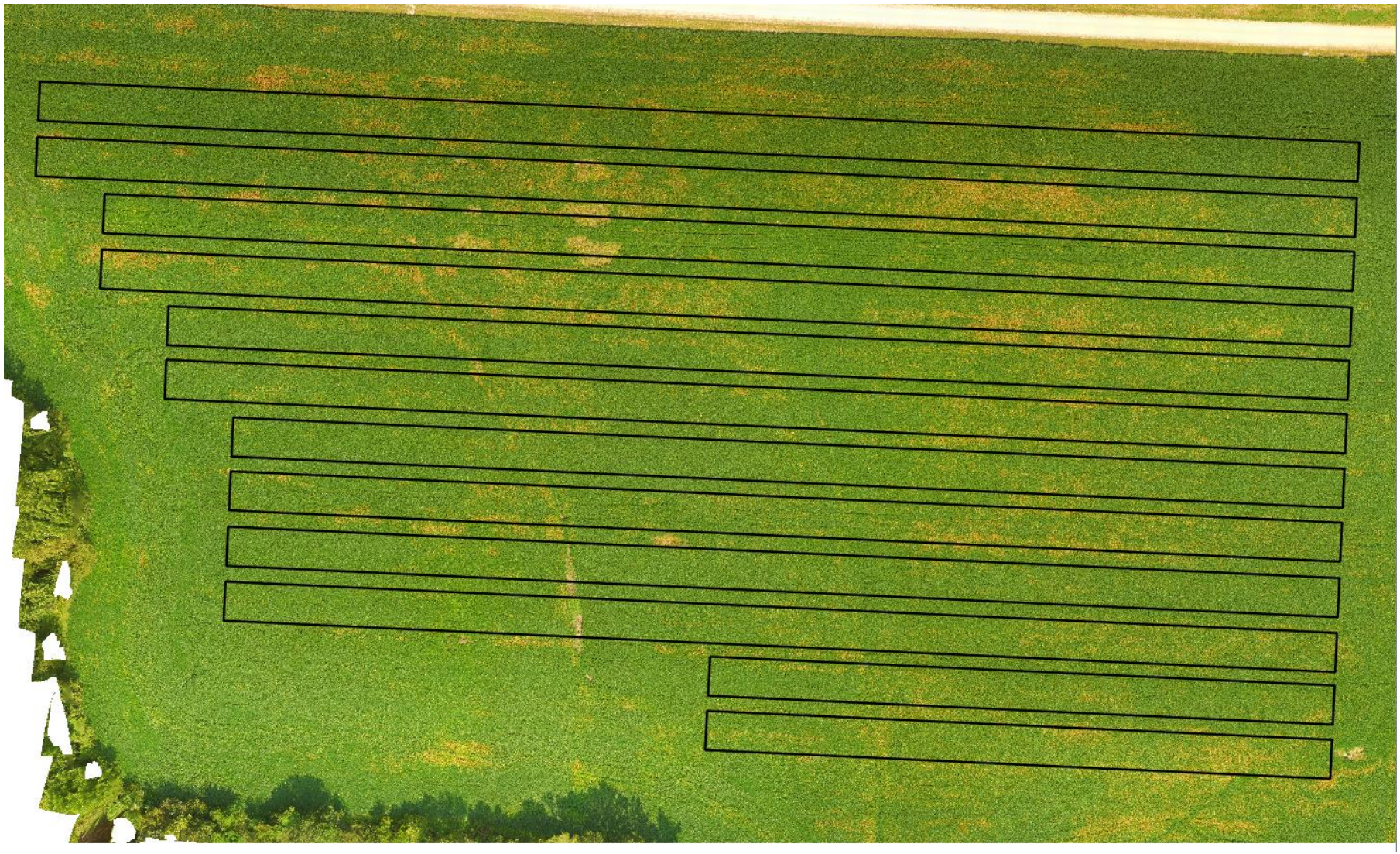


Plant Health (VARI) on 7/20/17, derived from Drone Deploy
Nitrogen Dates
4/18 60 lbs. & 0 lbs.
6/13 140 lbs. & 200 lbs.

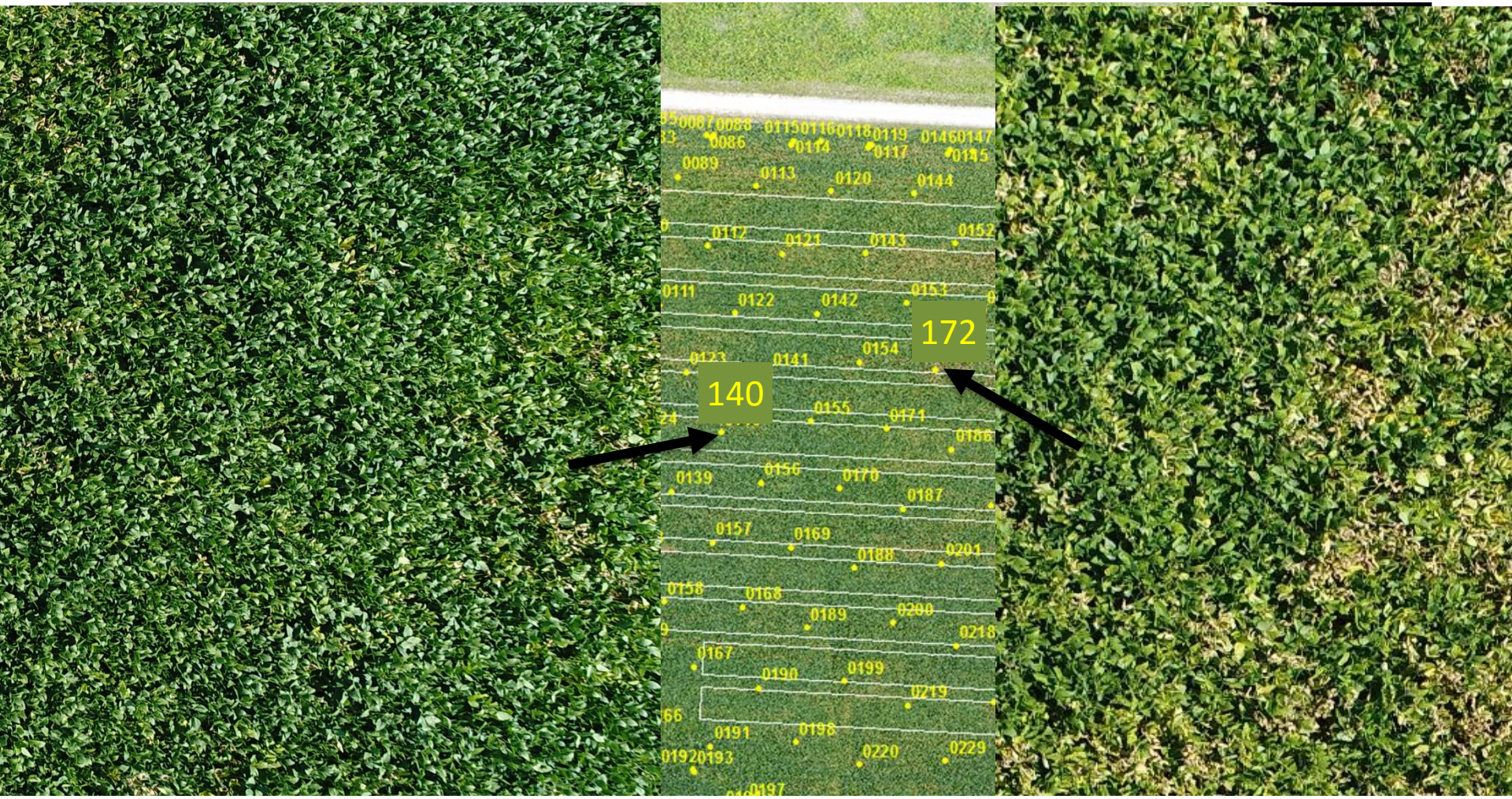
Comparing VARI vs NDVI



Soybeans – Sudden Death Syndrome

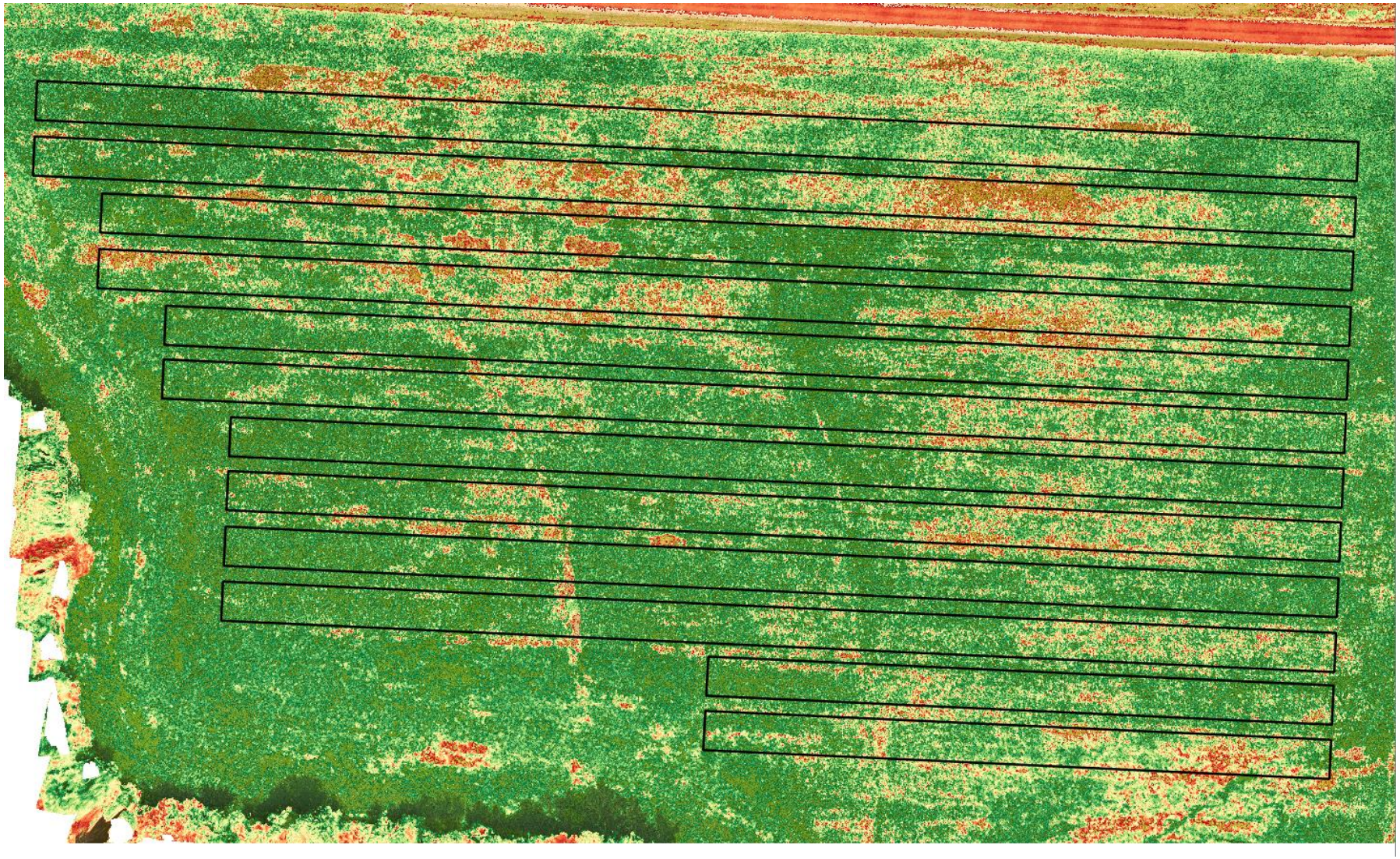


Detailed Photos to Verify

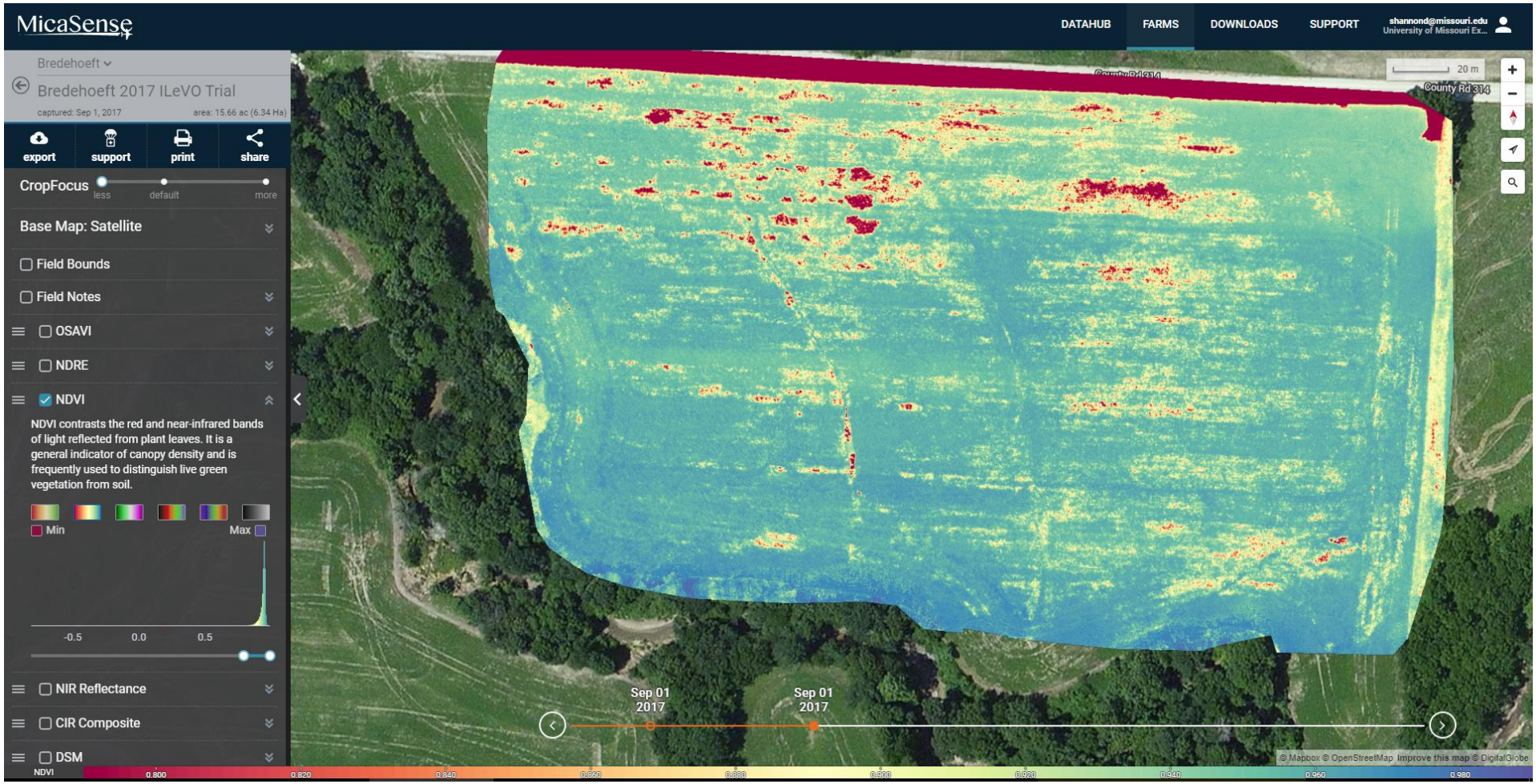


Flying to Waypoints for Detailed Photos

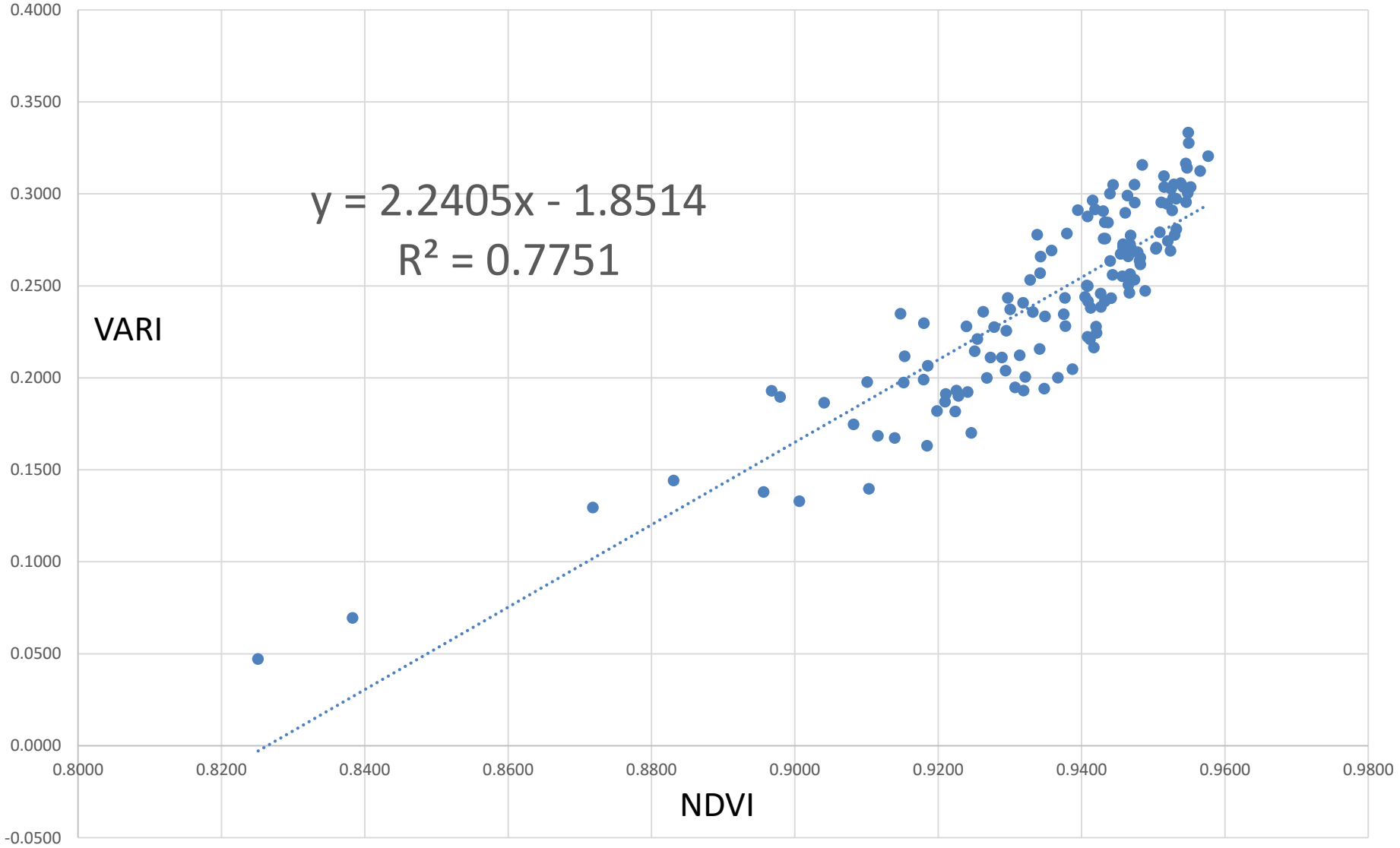
Soybeans – Sudden Death Syndrome



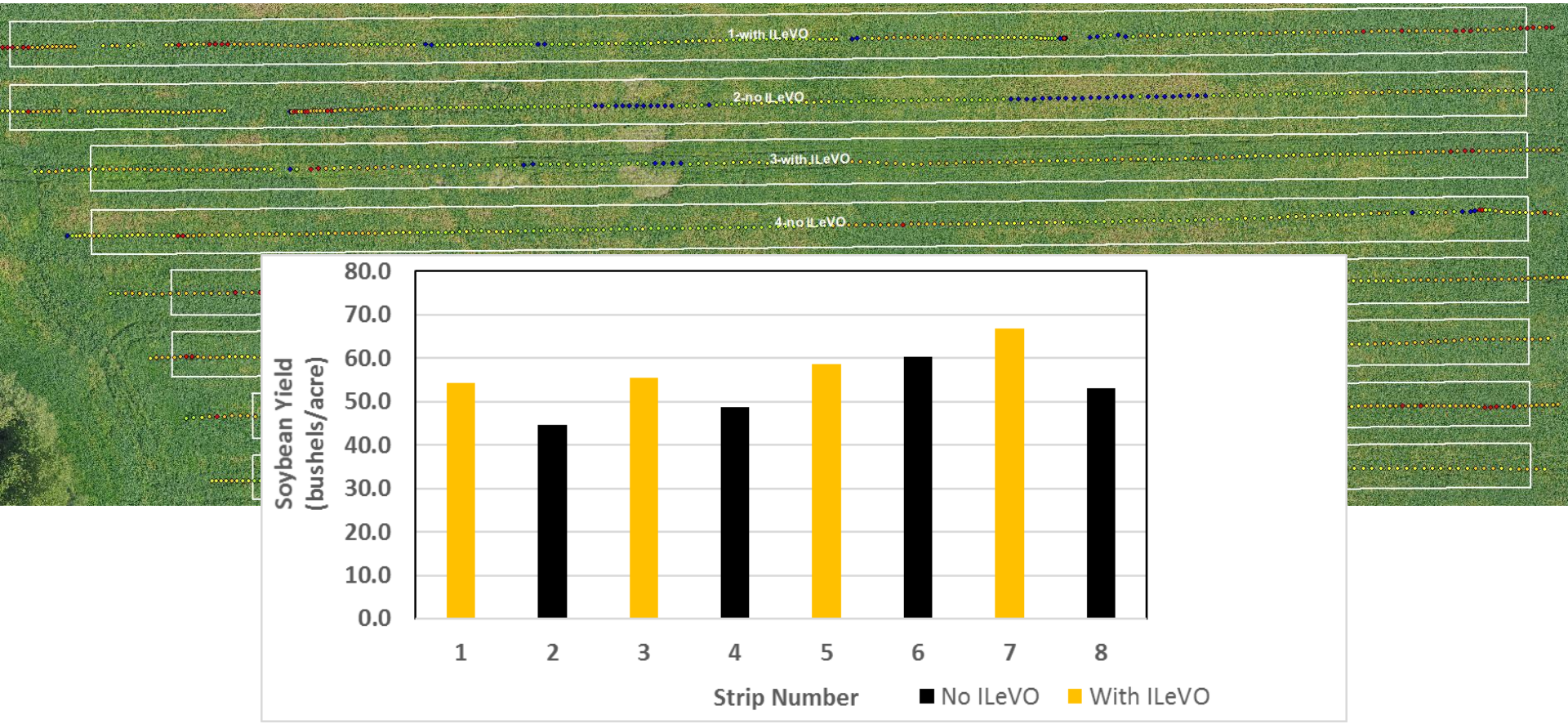
Soybeans – Sudden Death Syndrome



Comparing VARI vs NDVI



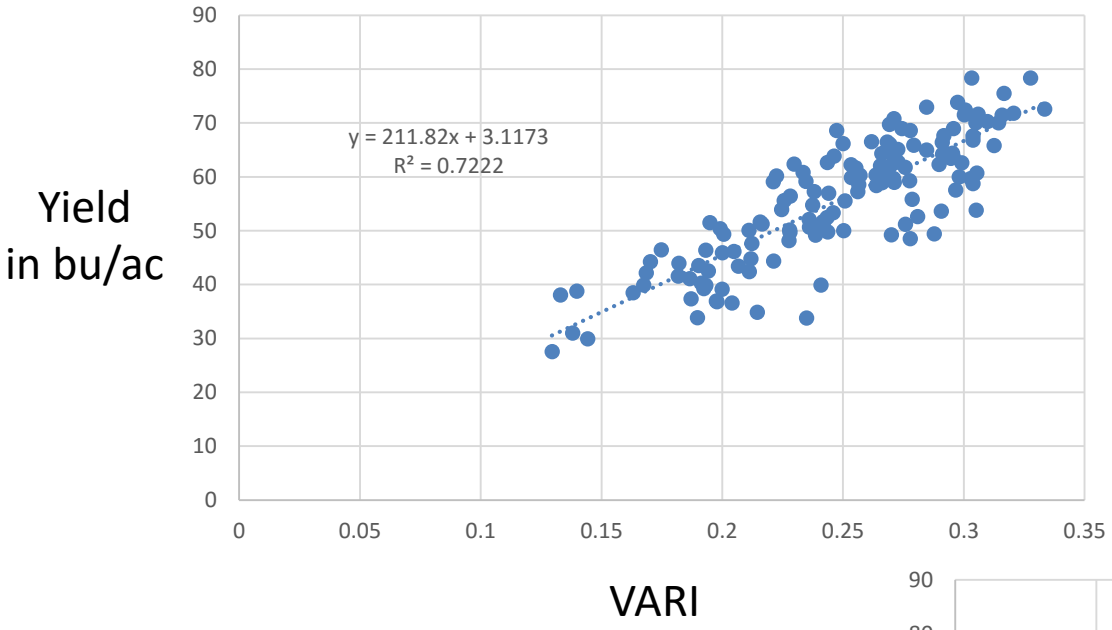
Comparing Imagery to Yield

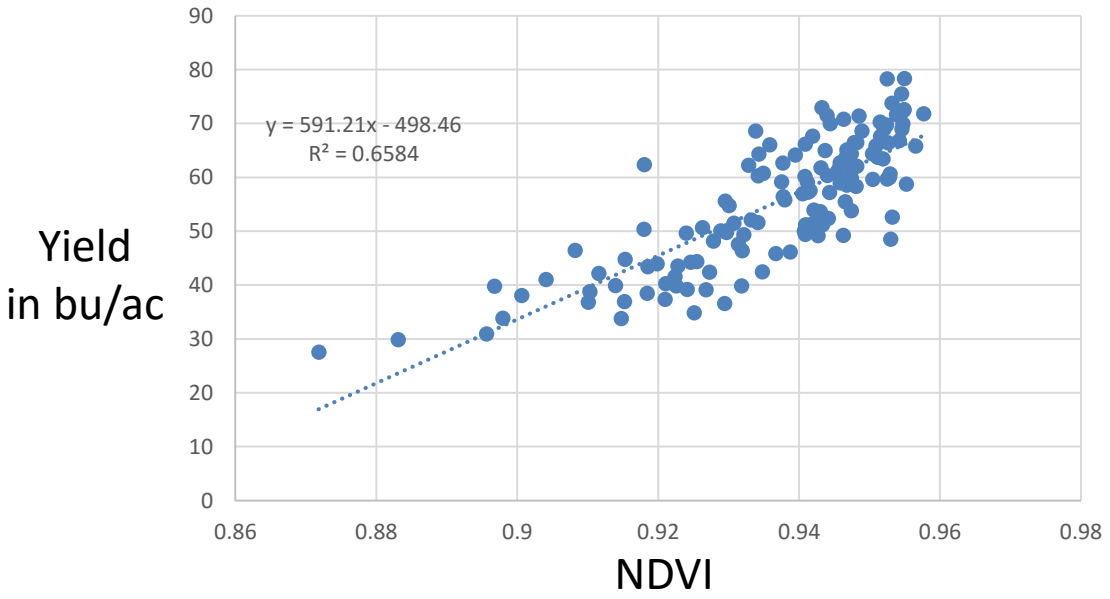


Mean yield for all strips was 55.5 bu/A (58.8 bu/A with ILeVO; 51.7 bu/A without).

Strip	1	2	3	4	5	6	7	8
ILeVO?	Yes	No	Yes	No	Yes	No	Yes	No
Yield (bu/A)	54	45	55	49	59	60	67	53

Comparing Imagery to Yield





Update of Drone Technology

- Drone Technology
- Image Processing / Analysis

UNIVERSITY OF MISSOURI

MU Extension

an equal opportunity/access/affirmative action/
pro-disabled and veteran employer

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