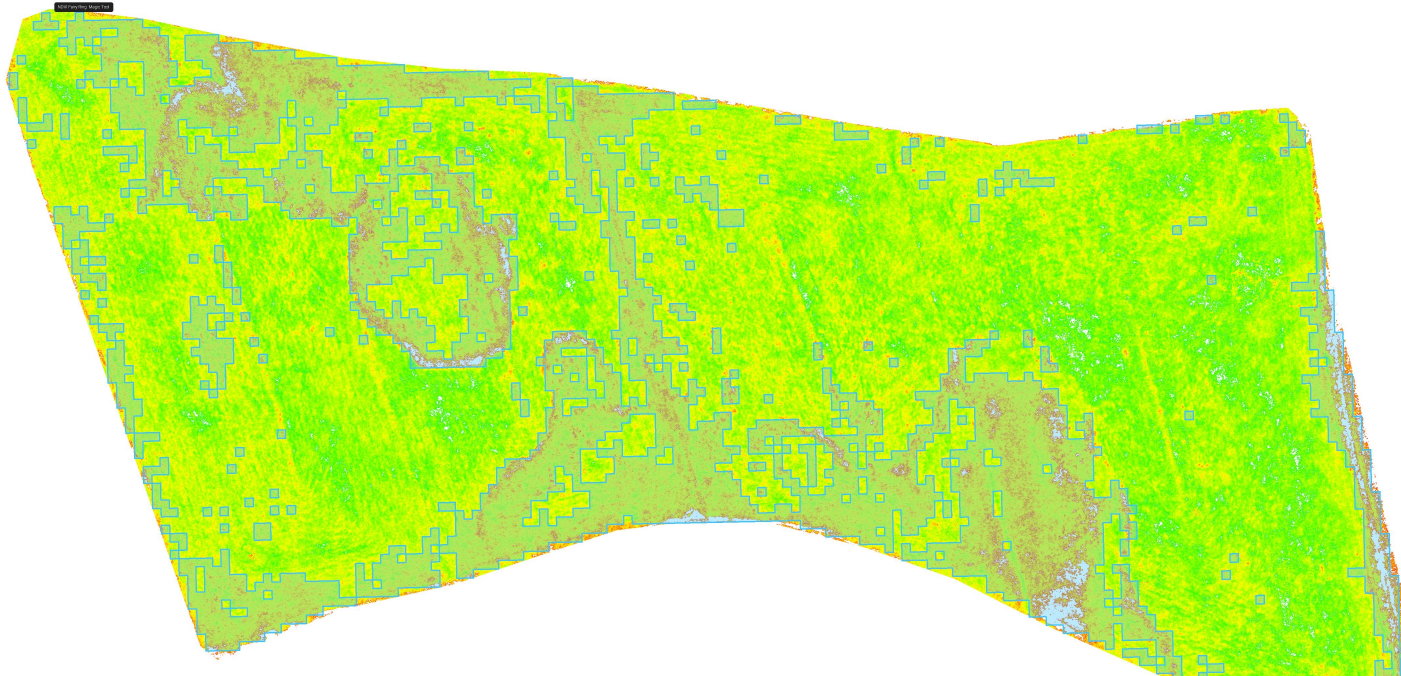


The Future of Cranberry Farming: Harnessing Drone Technology for Precision Agriculture



Giverson Mupambi

North American Cranberry Convection, March 25-26, 2024

UMass
Cranberry
Station

Research
& Extension



Major steps in the agricultural revolution

Breakthroughs in Agriculture

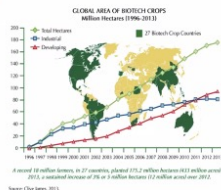
1900s Mechanization



1950s Fertilizer and chemicals



1990s Biotechnology



2010s Data Science



- Robots
- Satellites
- Big Data
- Drones
- Sensors
- Omics
- Microbiomes

Drone technology in cranberry production

1. Remote sensing

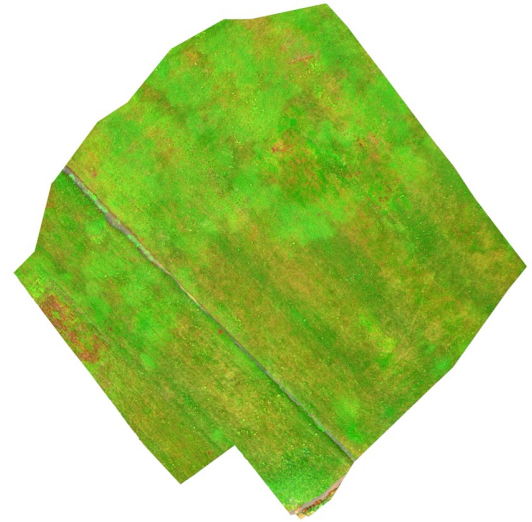
- Monitor the health and growth of cranberry vines
- Analyzing visual and spectral data obtained from airborne sensors
- The biggest challenge with spectral data is the lack of cranberry-specific indices
- Data collected still needs ground truthing.

2. Aerial applications

- Apply inputs with increased precision and site-specific applications, allowing inputs to go further

Type of camera/sensor

- RGB camera (visible range): Monitoring, scouting
- Multispectral: Plant stress, nutrition, diseases, weeds
- Thermal: Frost, irrigation
- Hyperspectral: Plant stress, nutrition, diseases

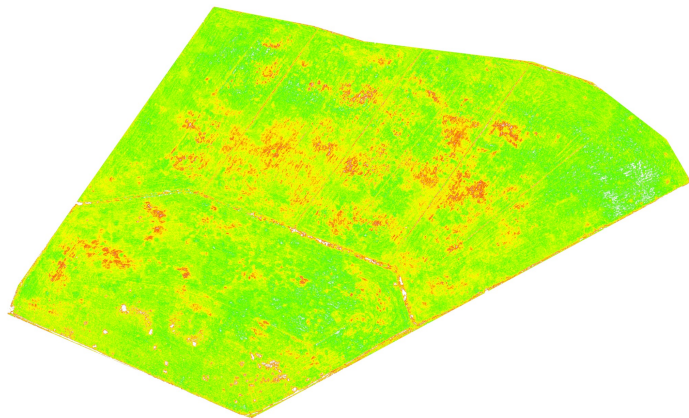


- Collects data within the visible light (400~700nm)
- Scouting and monitoring: insect damage, upright dieback

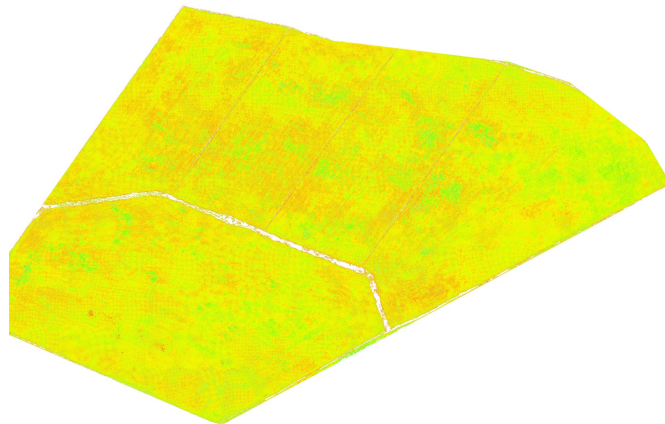


- Collects data within specific wavelengths
- Calculate vegetation indices like NDVI, NDRE, GNDVI

- Vegetation indices are spectral calculations of two or more bands of light that highlights vegetative properties
- Useful tool for analyzing trends in plant health, stress etc..



Normalized Difference Vegetation Index (NDVI)

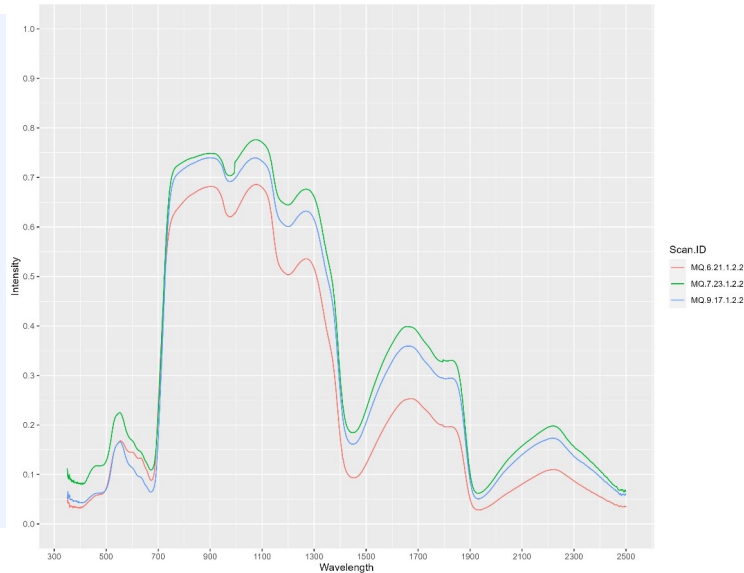


Normalized Difference Red Edge (NDRE)



Applications derived from temperature differences

- Frost monitoring:
 - ✓ Check frost irrigation efficiency
 - ✓ Mapping cold spots for siting temp sensors
- Irrigation monitoring
- Evaporative cooling



- Hundreds of narrow bands
- Identification and quantification of surface properties, as well as inferring biological and chemical processes

Integrated:

Mavic 3M, Phantom 4 Pro



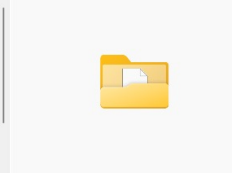
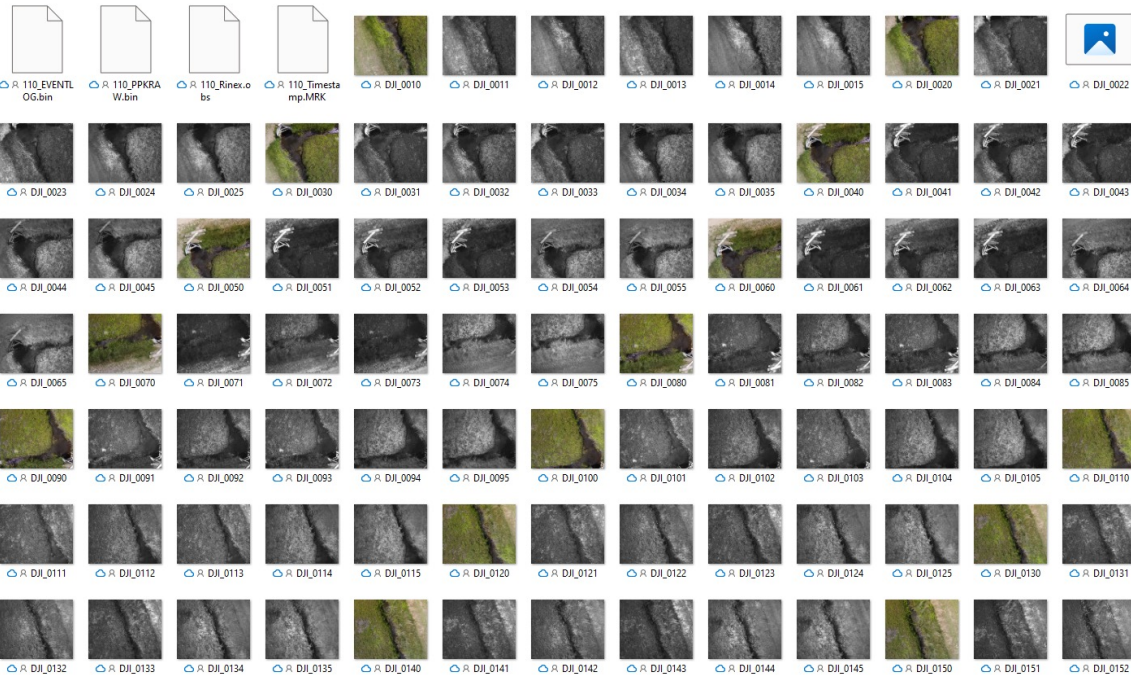
Multi-purpose:

Matrice 300 RTK, 100



Photogrammetry software

RGB Blue Green Red R/Edge Near Infrared



110FLAN (556 items)

Select a single file to get more information and share your cloud content.

Photogrammetry software

- Software designed to gather crucial farm operational data.
- Ideal software can be used in the field or the office, is accurate,
- Generates agricultural prescription maps, and is easy to export the results.



DJI SMARTFARM WEB



Application 1: Putnam Scale damage

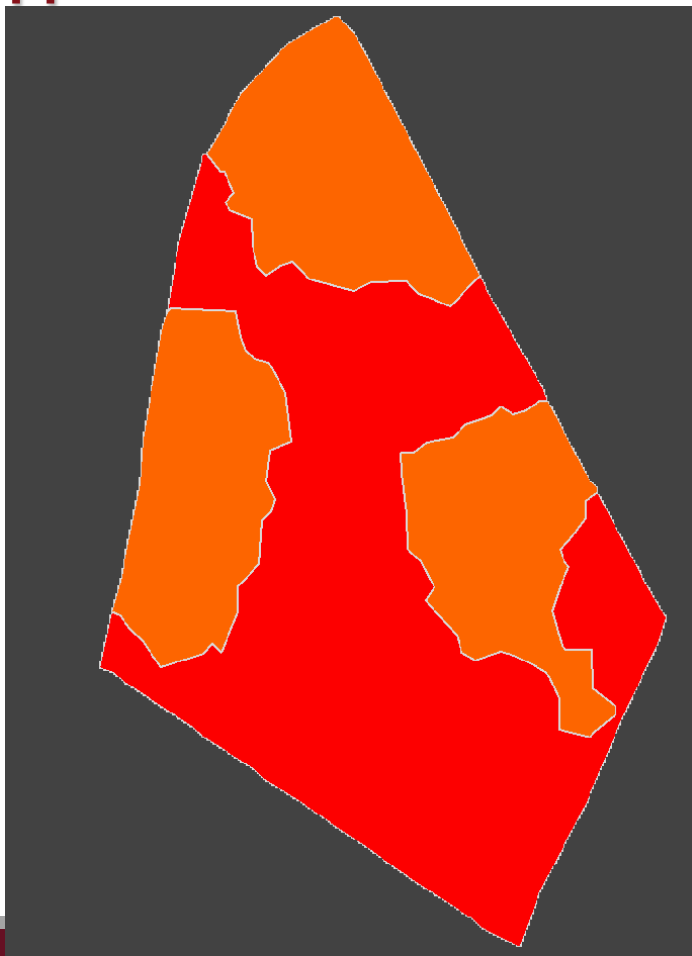


2023 May

September 2022

1. Building a database tracking progress over years and effectiveness of treatments
2. Set thresholds for triggering action

Application 1: Variable rate application



ZONATION

Zonation

Created from NDRE

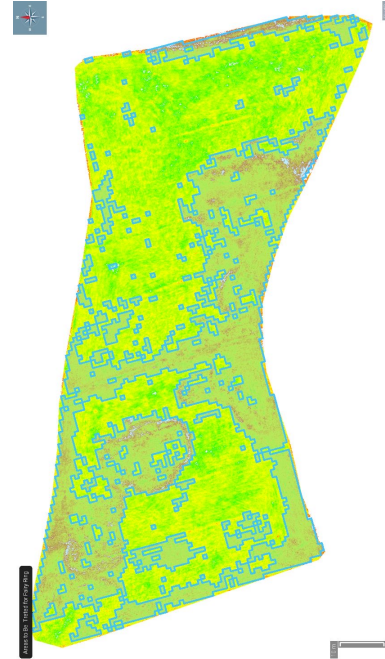
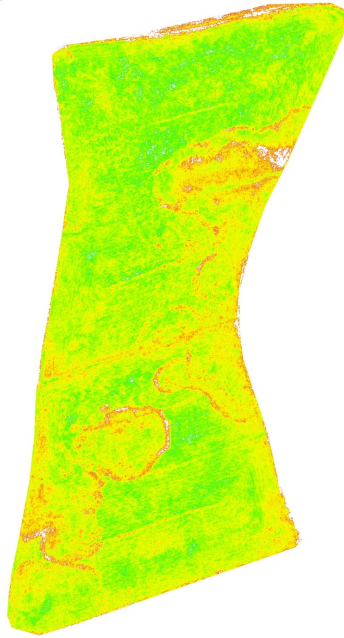
Zonation Annotations

PRESCRIPTION

Average value	Area [ha]	Rate [units/ha]	Amount [units]
0.24	0.92	50.00	46.02
0.25	0.66	20.00	13.14
Total	1.58		59.16

- Create a map for variable rate application or spot application

Application 2: Fairy Ring Damage

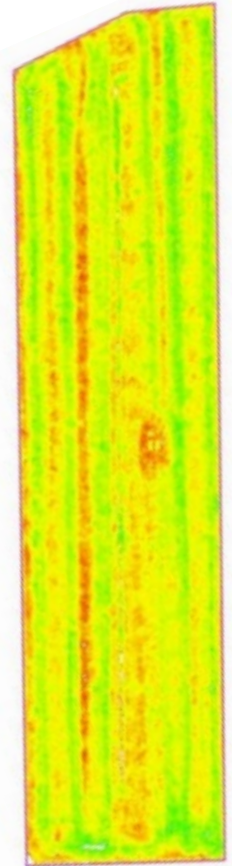


1. Orthomosaics from both RGB and multispectral cameras showed the extent of fairy ring damage
2. Use NDVI data to develop maps for spot applications

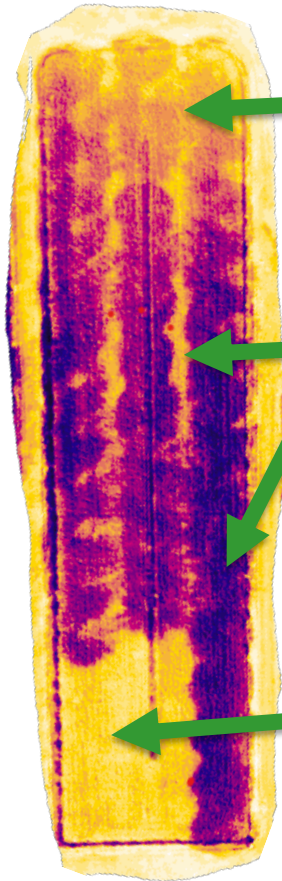
Application 3: Assessing the efficiency of cultural practices



- Efficiency fertilizer application was explored
- Based on both visible and NDVI images, the rotary spreader fertilizer application on this particular bog was shown to be uneven



Application 3: Irrigation monitoring



1. Pressure is uneven

2. Coverage is not uniform, dry spaces between rows.

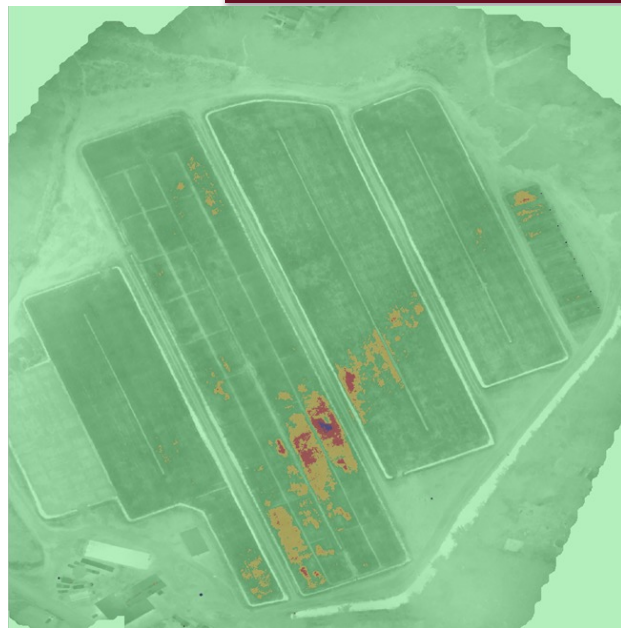
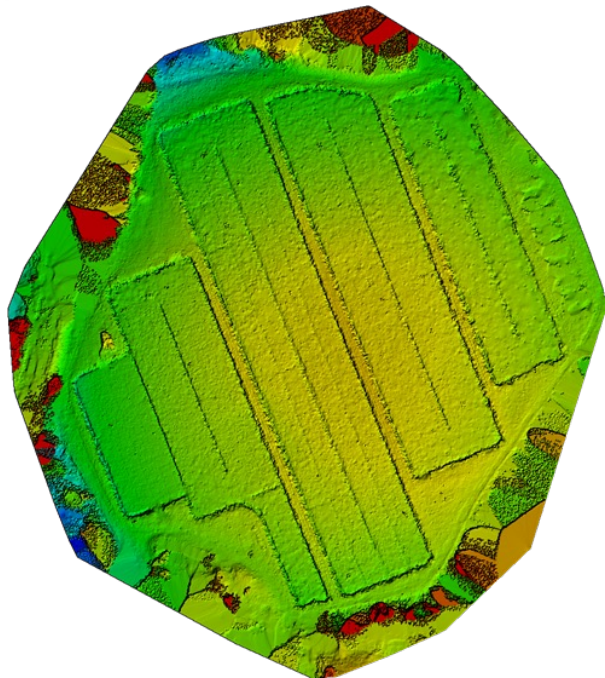
3. Heads are blocked

**Implications for chemigation,
frost protection, productivity**

Application 4: Improving placement of temperate sensors



- Long-wave infrared (thermal) imaging
- Mapping cold spots on a multiple cranberry bog system that is controlled by one frost temperature sensor.



Digital elevation model (left) and thermal image orthomosaic (right) in greyscale of a cranberry bog system. The dark spots on the thermal image represent the coldest spots

Granular Payload



Liquid Payload

Leading Edge Aerial Technologie ©



Granular Fertilizers

Liquid fertilizers, Pesticides (aerial label)

Advantages:

- RTK precision
- Variable rate applications
- Spot applications



2023: Observational study in conjunction with a grower collaborator

- 104 acres of fertilizer
- 100 acres herbicides

Ryan Wicks, *University of Massachusetts Amherst*

Follow

Giverson Mupambi, *University of Massachusetts - Amherst*

Follow

Publication Date

2023

Preflight Checklist



UMassAmherst

Cranberry Station

Ryan Wicks¹ and Giverson Mupambi²

¹UMassAir, University of Massachusetts Amherst, Amherst, MA, USA

²UMass Cranberry Station, University of Massachusetts Amherst, East Wareham, MA, USA

Version 2, September 2023

Permissions and legality, flight plan review, weather conditions, systems checks, launch preparations, and post-flight actions.

https://scholarworks.umass.edu/cranberry_factsheets/52/

- CCCGA for funding the pilot study
- Ryan Wicks
- Staff and faculty at Cranberry Station



Email: gmupambi@umass.edu

Phone: (508) 970-7638