

UConn Extension's 2023 Vegetable  
& Small Fruit Growers' Conference  
Jan. 04, 2023, Hartford, CT

**UConn**

COLLEGE OF AGRICULTURE,  
HEALTH AND NATURAL  
RESOURCES



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# Drone Imaging to Monitor Potato Leafhopper Damage in the Field

# Integrated Pest Management - IPM



Food and Agriculture  
Organization of the  
United Nations

**IPM** means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

FAO [2020]



Agricultural  
Research  
Service

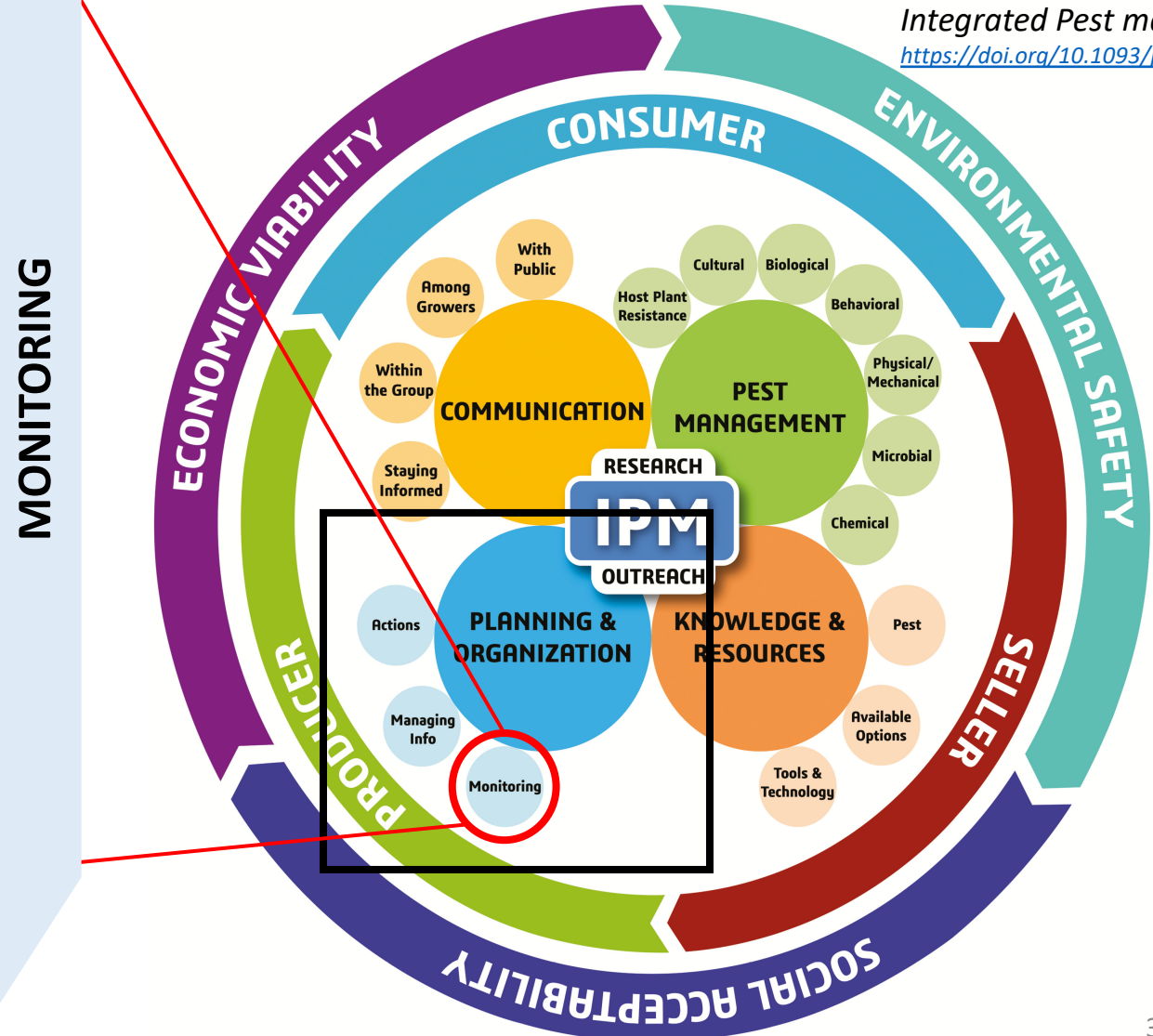
**IPM** is a sustainable, science-based, decision-making process that combines biological, cultural, physical, and chemical tools to identify, manage, and reduce risk from pests and pest management tools and strategies in a way that minimizes overall economic, health, and environmental risks.

USDA-ARS [2018]

- **Regularly monitoring** the fields for pest infestation and spread is a basic step in crop protection.
- **Early detection** in many cases can help address the pest situation by low-cost spot treatment or removal of pests or infected/infested plant material.
- When pest infestations continue to grow, regular monitoring is necessary to **assess the damage** and determine the time to initiate **farm-wide control**.
- Monitoring is also important to **avoid calendar-based pesticide applications** especially at lower pest populations that do not warrant treatments.

## The New Integrated Pest Management Paradigm for the Modern Age

Dara, [2019]. *Journal of Integrated Pest management*,  
<https://doi.org/10.1093/jipm/pmz010>



# Observations

- Regularly monitoring the fields for pest infestation and spread is basic to crop protection.
- Early detection in many cases can help address the pest situation with low-cost spot treatment or removal of pest or infected/infested plants.
- When pests are continuing to grow, regular monitoring is needed to assess the damage and determine the time to initiate farm-wide control.
- Monitoring is also important to avoid calendar-based pesticide applications especially at lower pest populations that do not warrant treatments.

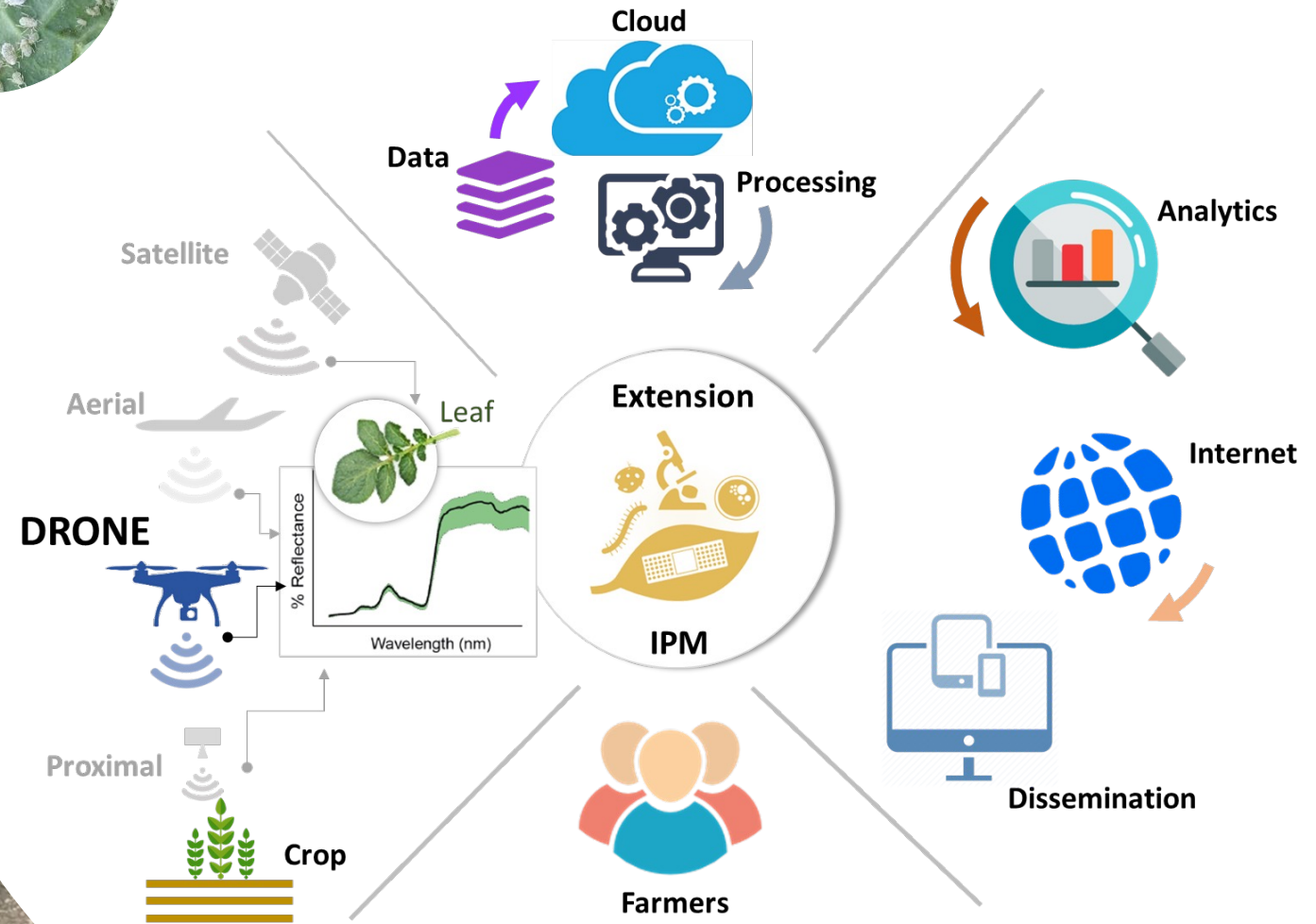
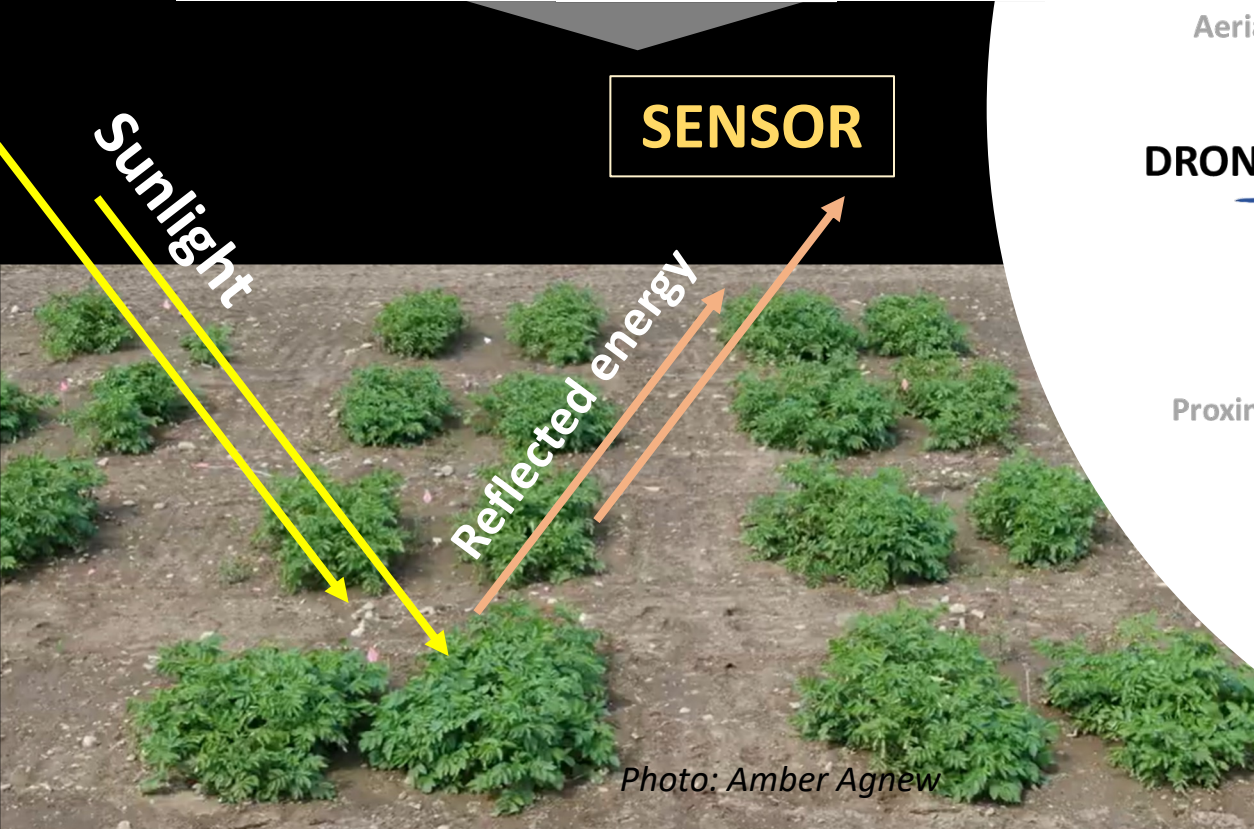
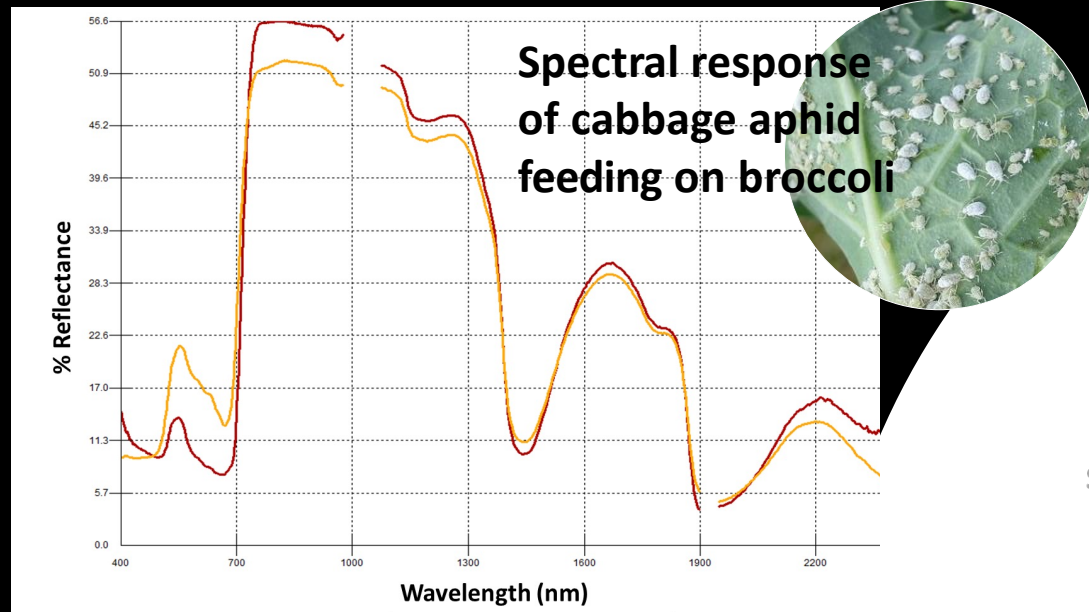


## The New Integrated Pest Management Paradigm for the Modern Age

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# Remote Sensing Technology & IPM



# Drones in Action



**UConn OVPR-REP Grant**

*Green bean  
Broccoli*



**Multistate Hatch Fund**

*Green bean*



**Northeastern  
IPM Center Grant**

*Potato*



**Multistate Hatch Fund**

*Green bean*

2018

2020

2022

2024

2026

First *proof-of-concept*  
study on spectral  
imaging to identify  
insect damage

*Apple, Peach  
Grape, Blueberry*

**USDA Specialty Crop Block Grant**



*In-review proposals*

**Operational Applications**





# Potato Leafhopper (PLH)

- Potato leafhopper (*Empoasca fabae* (Harris)) attacks several key crops: alfalfa, beans, potato, soybeans, hops
- Feeding causes “hopperburn” due to leaf cell laceration and injection of enzymes into leaf tissues.
- Leaf tips and margins wilt, curl and turn yellow eventually dying
- Yield reduction can exceed 50% under large PLH infestations

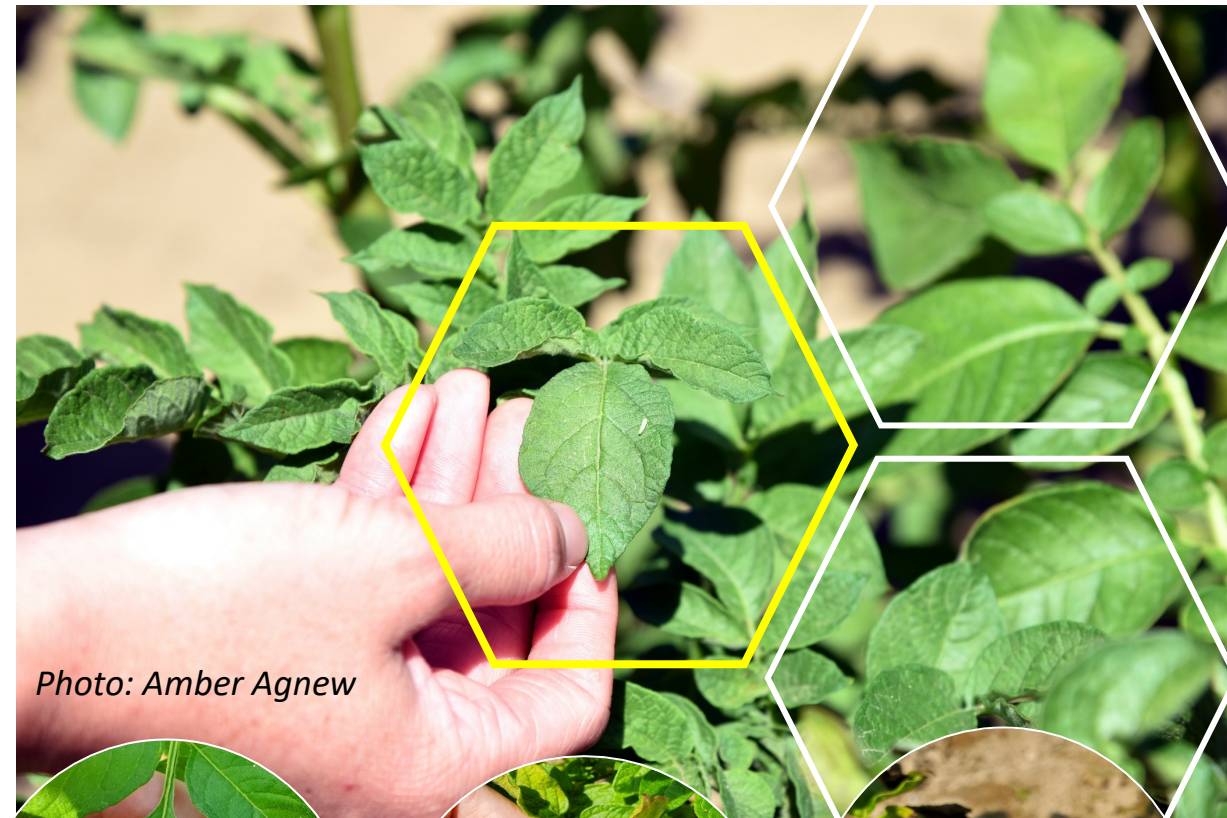


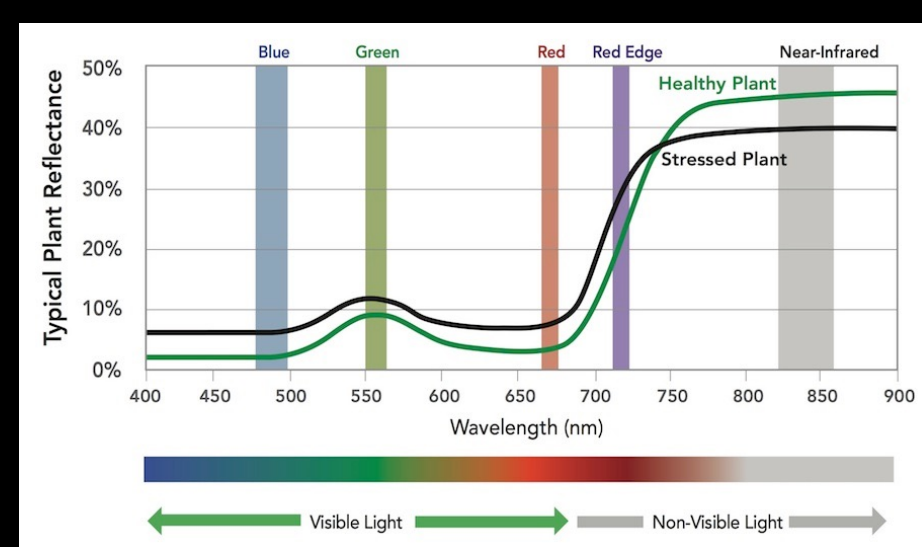
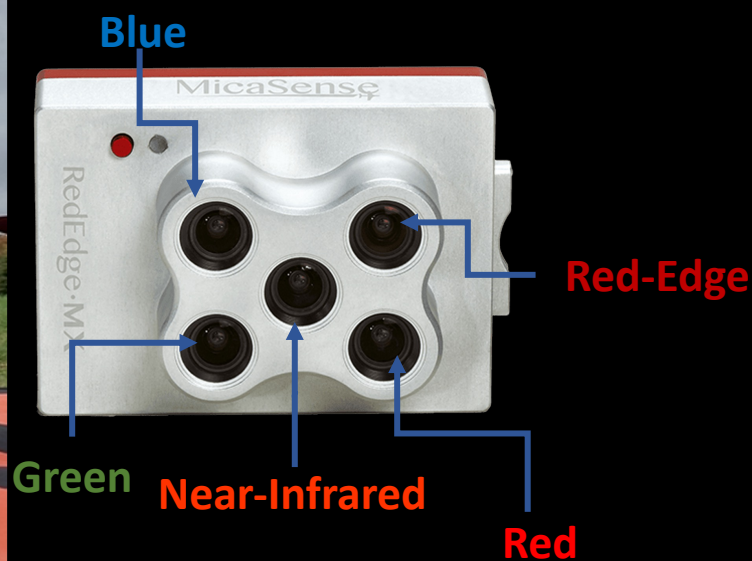
Photo: Amber Agnew



**PLH damage progression in potato**



# MicaSense RedEdge-MX Sensor





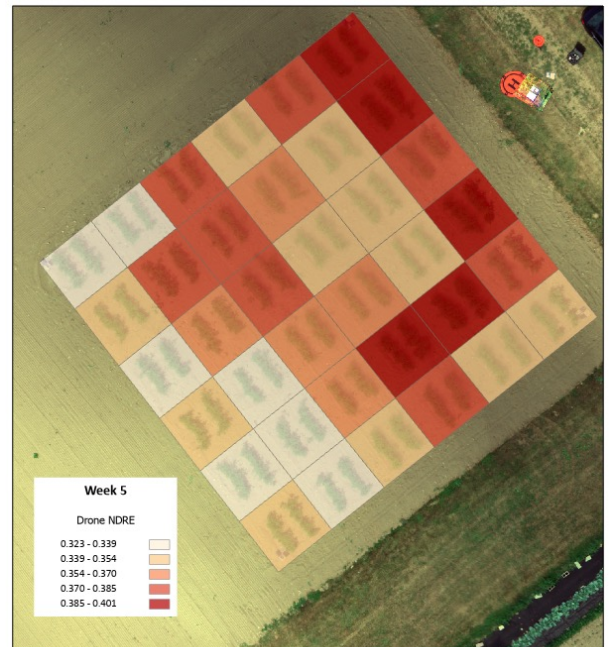
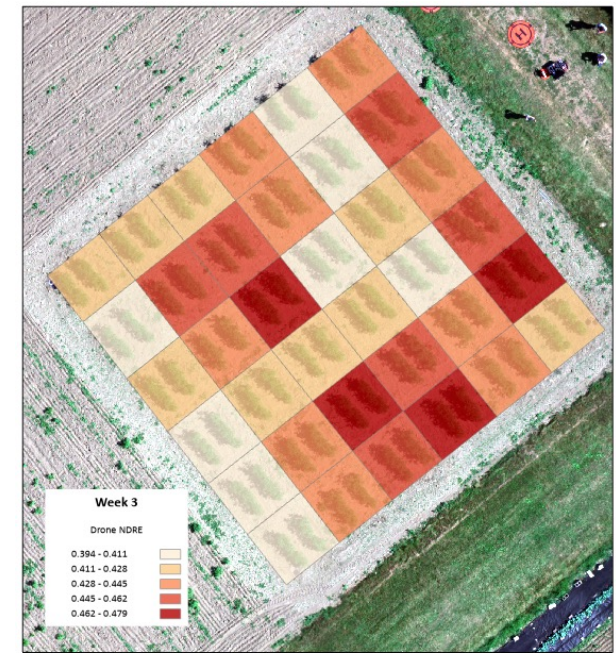
# Response of drone-imagery derived vegetation indices

## Normalized difference red-edge index (NDRE)

$$NDRE = (NIR - RedEdge) / (NIR + RedEdge)$$



Plot design, Summer 2022

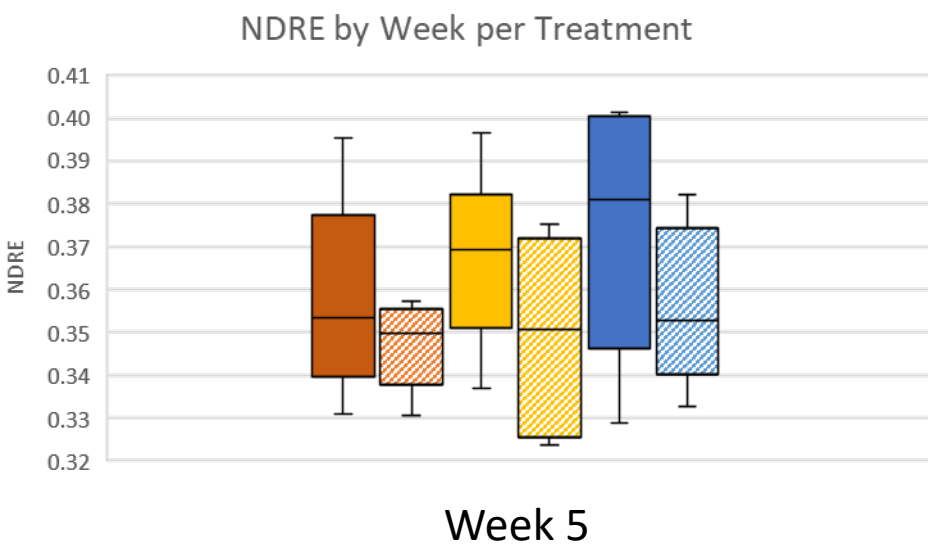
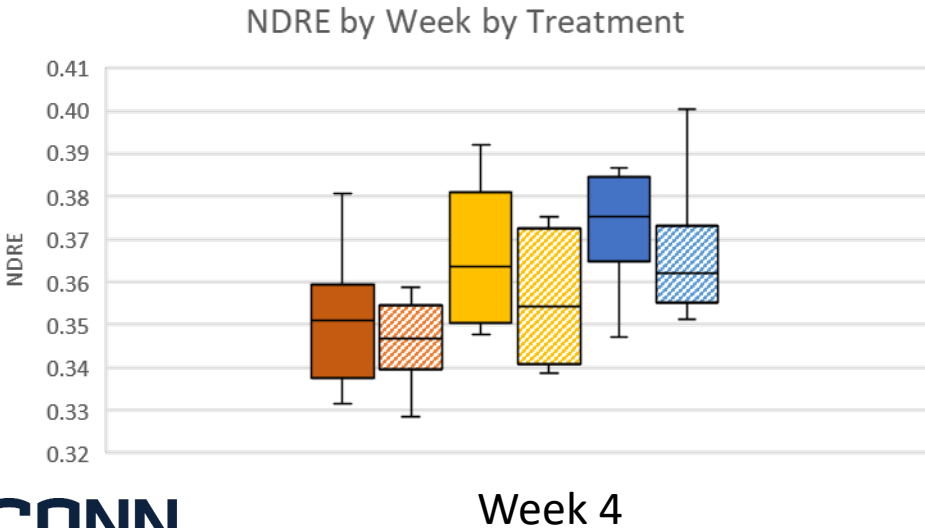
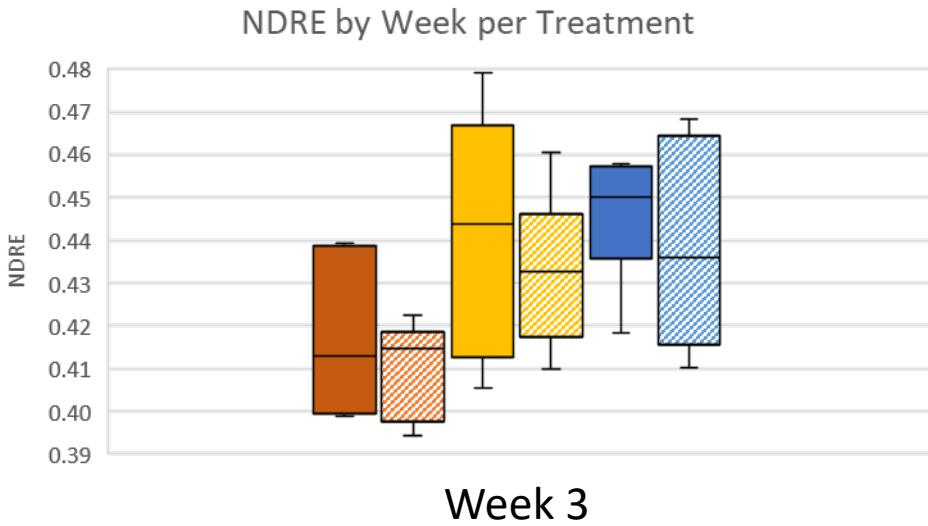
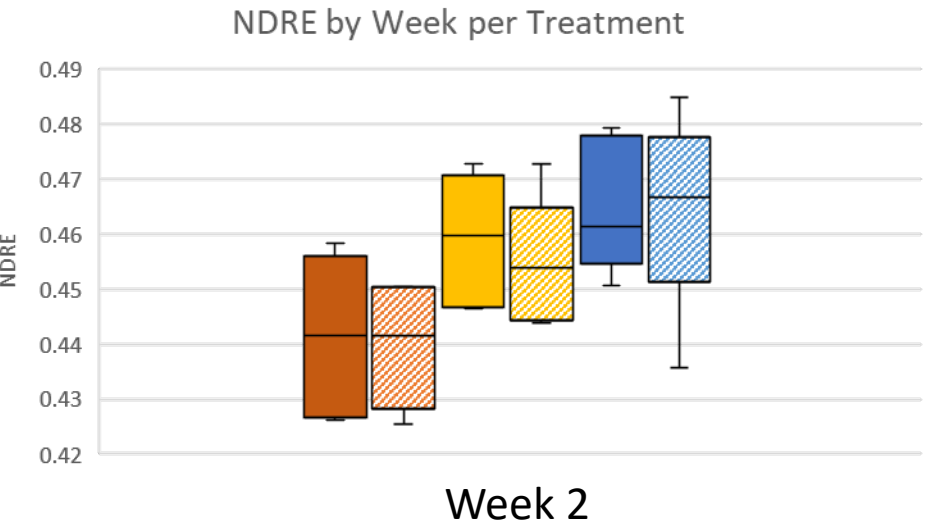


Agnew [unpublished]



# Based on **drone** data:

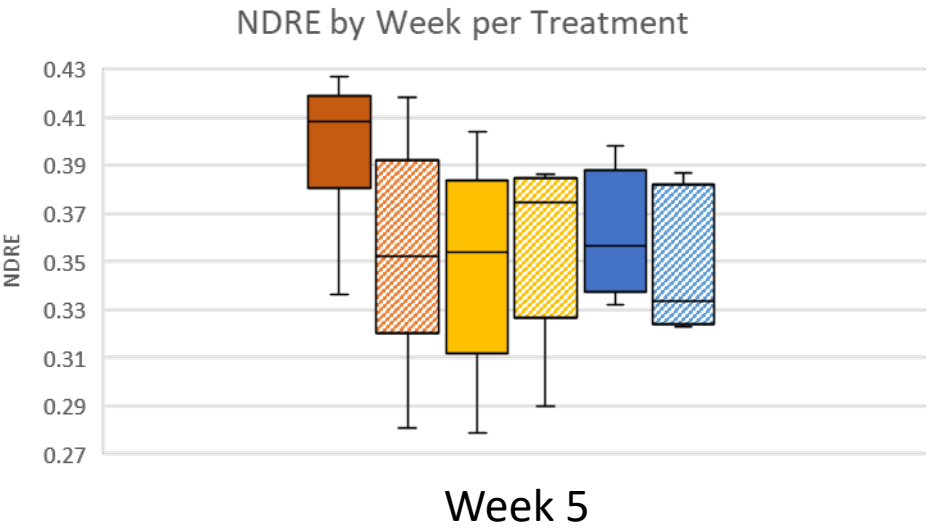
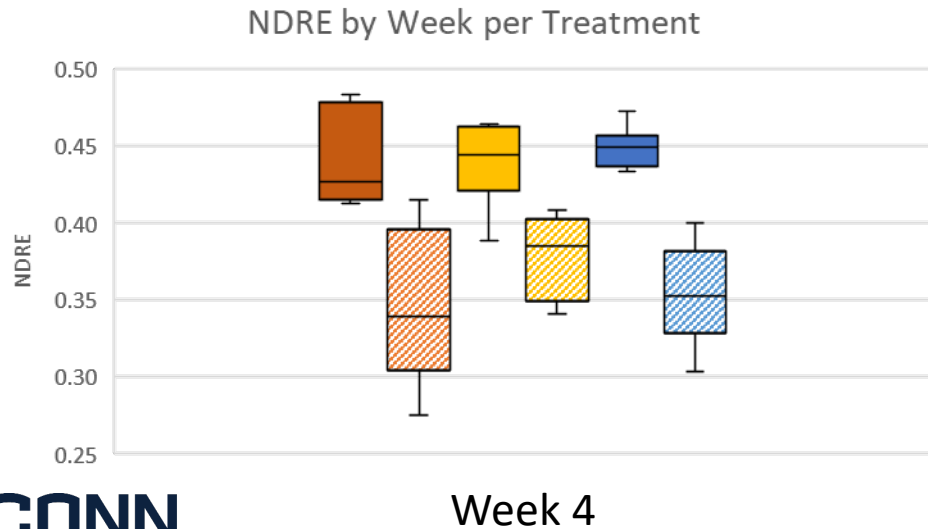
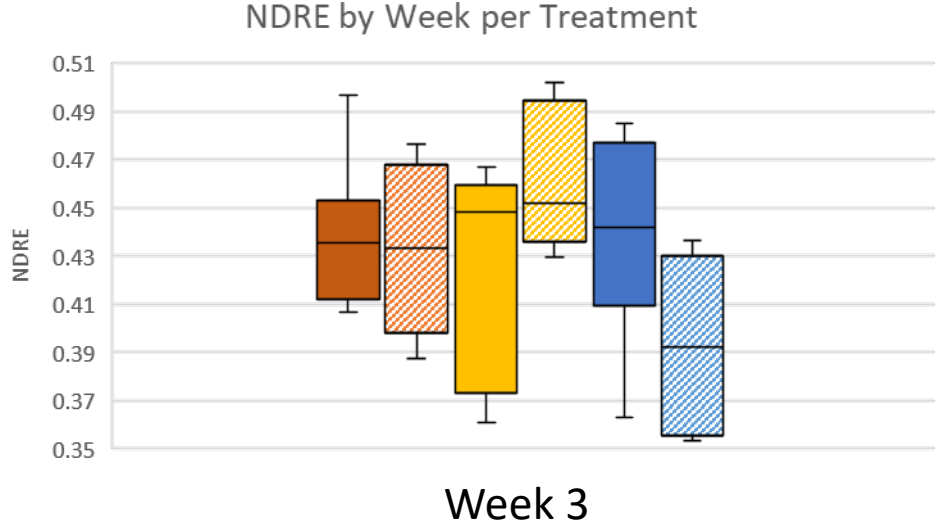
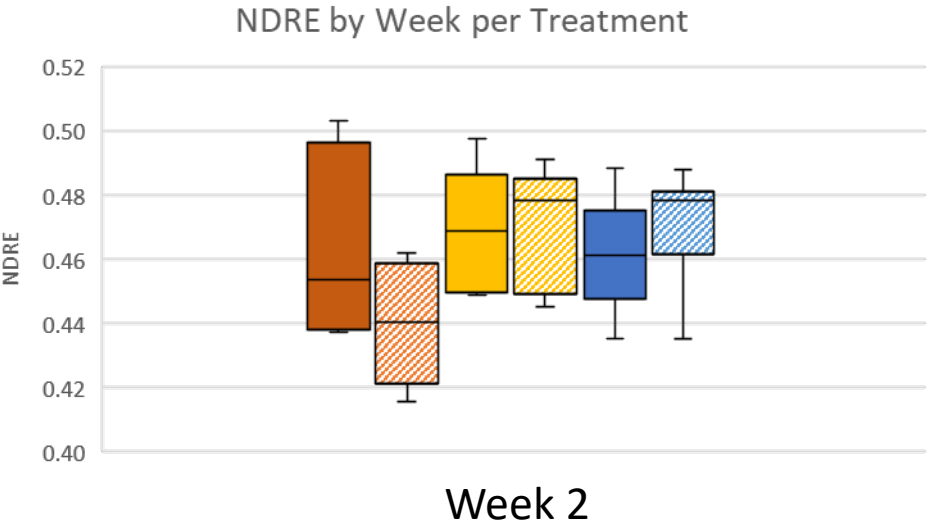
## *Normalized difference red-edge index (NDRE)*



Description	Treatment
No Nitrogen Without Potato Leafhoppers	NoFert_NoPLH
No Nitrogen With Potato Leafhoppers	NoFert_PLH
Low Nitrogen Without Potato Leafhoppers	LowN_NoPLH
Low Nitrogen With Potato Leafhoppers	LowN_PLH
Standard Nitrogen Without Potato Leafhoppers	StdN_NoPLH
Standard Nitrogen With Potato Leafhoppers	StdN_PLH

Agnew [unpublished]

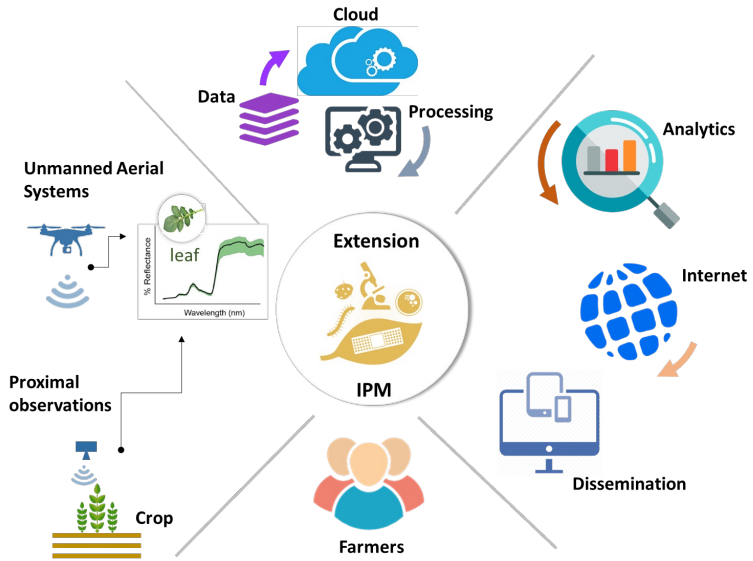
Based on **in-situ** spectral data:  
*Normalized difference red-edge index (NDRE)*



Description	Treatment
No Nitrogen Without Potato Leafhoppers	NoFert_NoPLH
No Nitrogen With Potato Leafhoppers	NoFert_PLH
Low Nitrogen Without Potato Leafhoppers	LowN_NoPLH
Low Nitrogen With Potato Leafhoppers	LowN_PLH
Standard Nitrogen Without Potato Leafhoppers	StdN_NoPLH
Standard Nitrogen With Potato Leafhoppers	StdN_PLH

Agnew [unpublished]





To develop an operational nutrient monitoring system for Connecticut's tree fruit orchards



Belltown Hill Orchards, Glastonbury, CT. Summer 2022, Drone deployment



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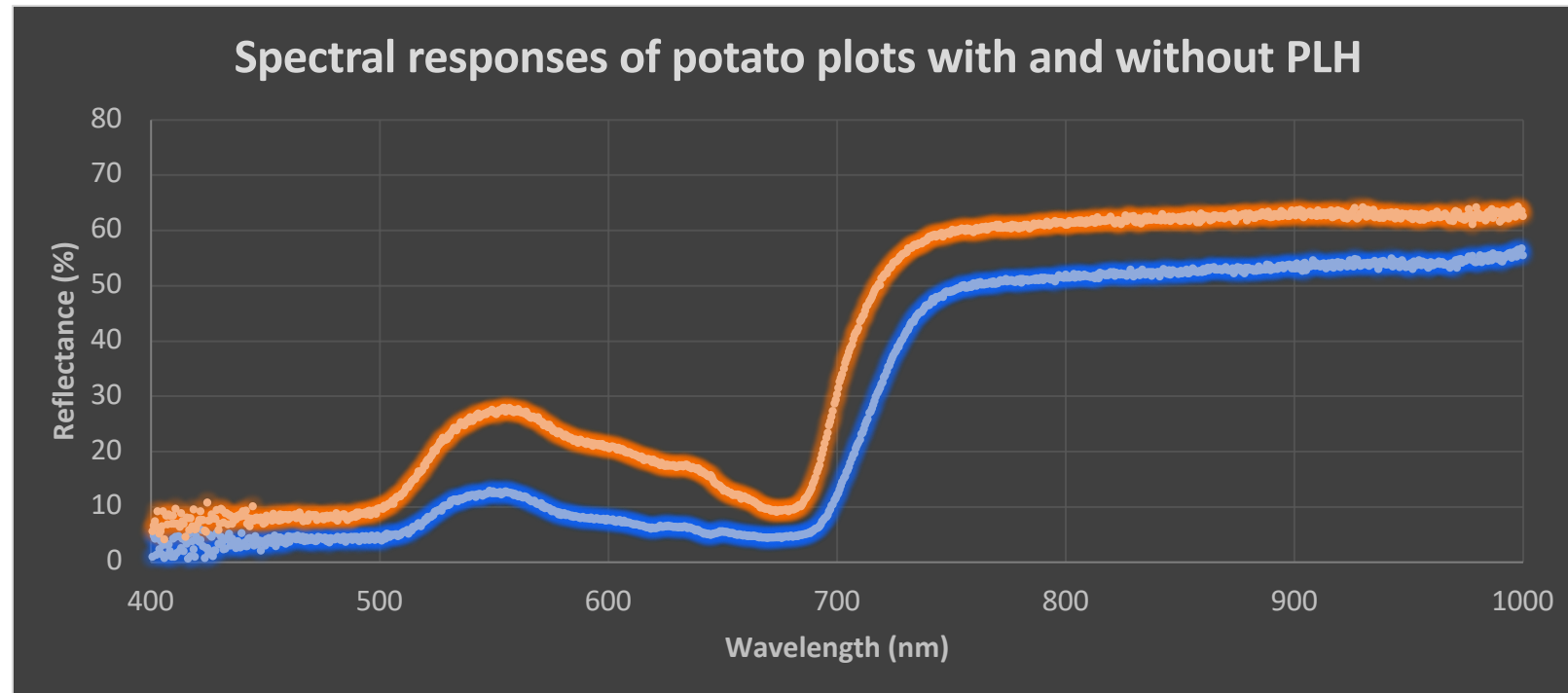


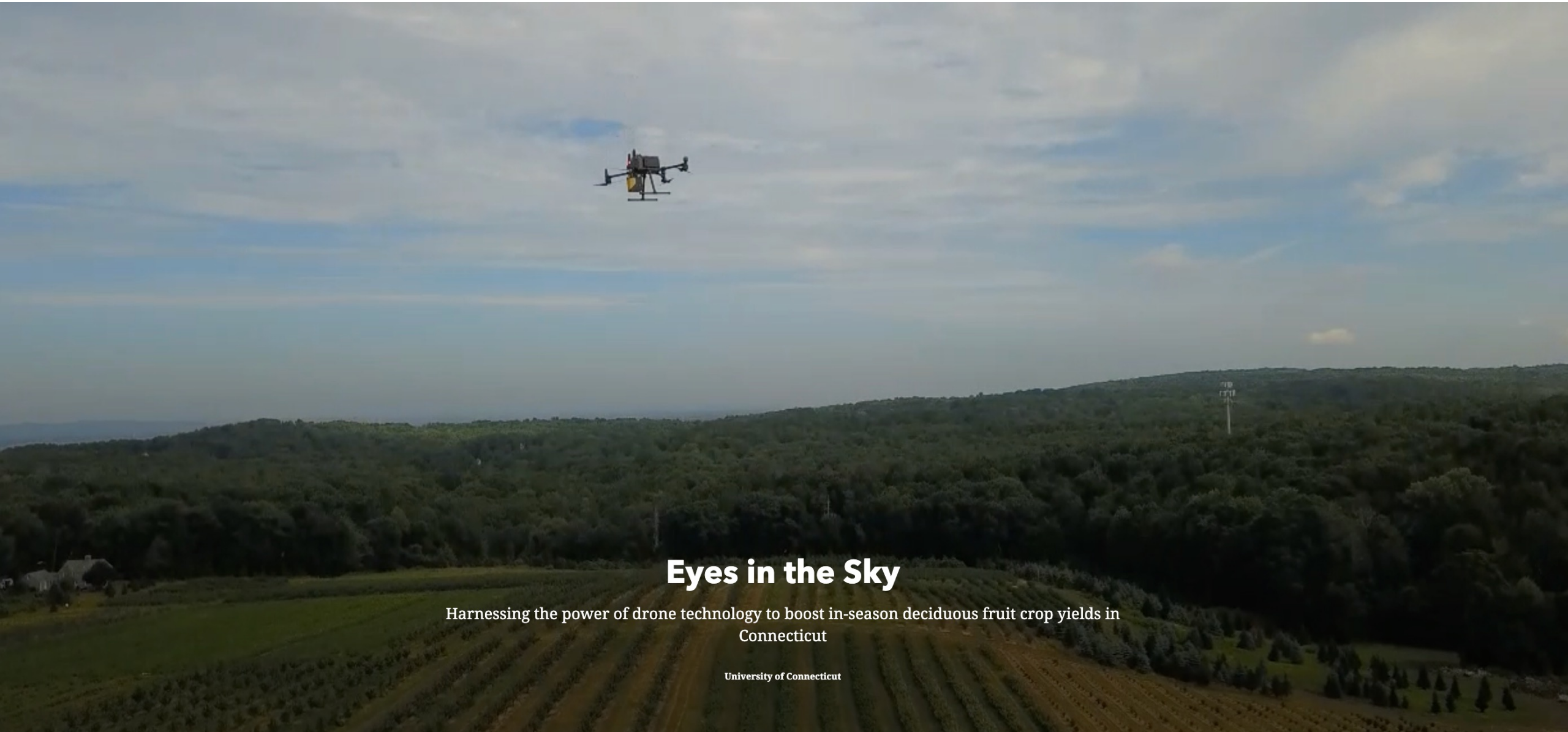
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## Eyes in the Sky

Harnessing the power of drone technology to boost in-season deciduous fruit crop yields in Connecticut

University of Connecticut

<https://storymaps.arcgis.com/stories/1da6df61b62b484fa40b7a3854c79e82>