Use of UAVs with multispectral sensors in agronomy

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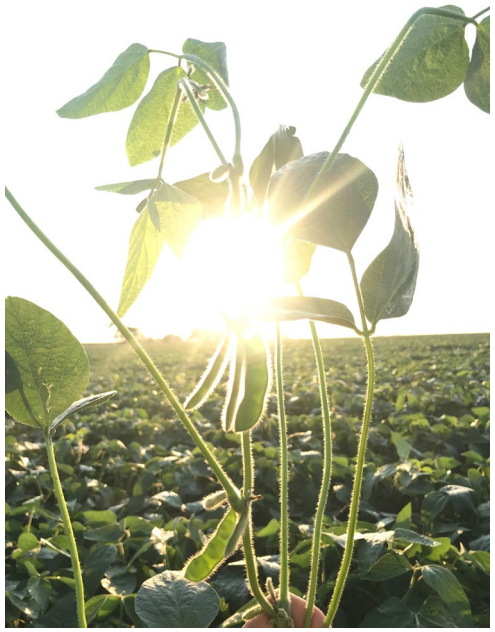
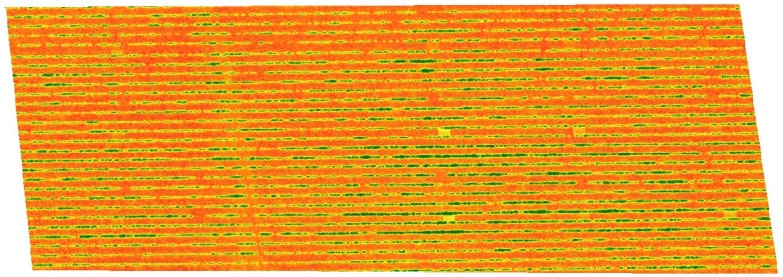
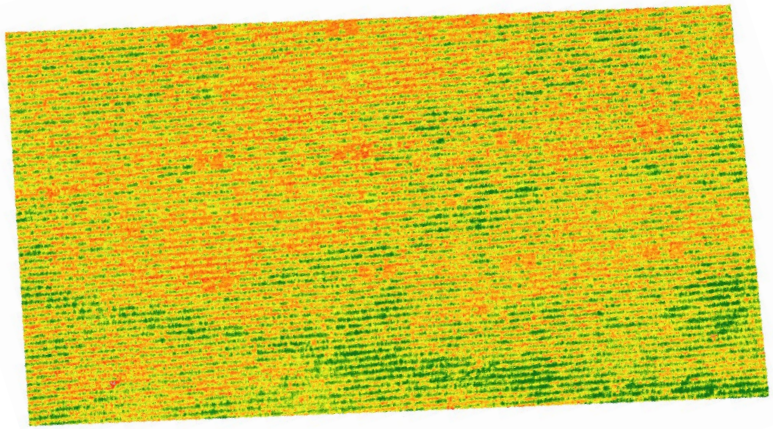
December 12, 2023







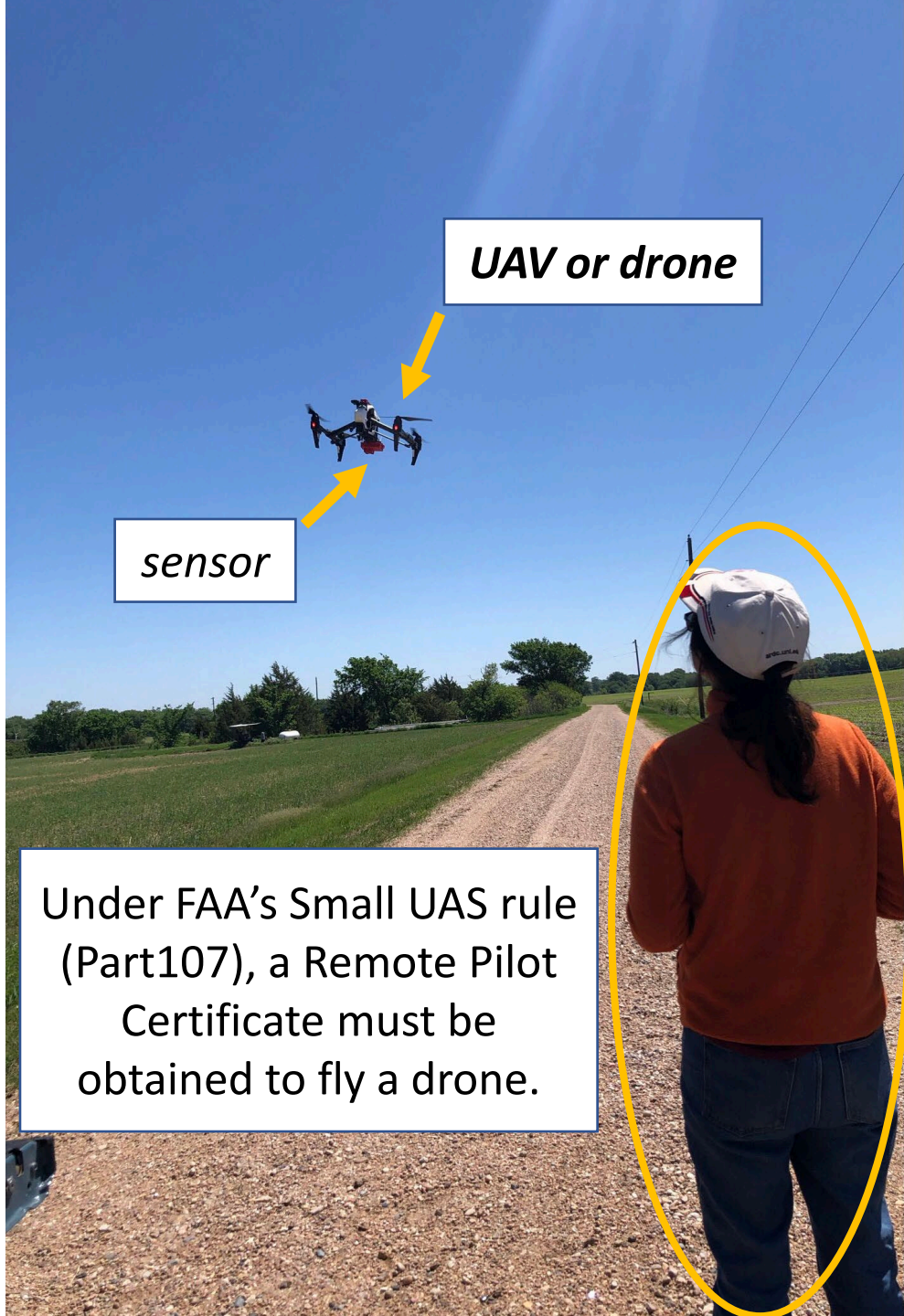
Outline

- UAVs and sensors in agronomy
- **Applications of UAVs+sensors in agronomy research**
  - **Nutrient status (e.g., nitrogen status in soybean) – PhD research**
  - Crop management assessment
  - Plant count
  - Crop height estimate
  - Crop biomass monitoring
  - Crop yield prediction
  - Disease/insect monitoring
  - Water status assessment
  - Varietal development

UAVs and sensors in agronomy

Unmanned Aerial System (UAS) are *air vehicles(unmanned aerial vehicles (UAVs) or drones)* and *associated equipment (ground-based controller, sensor, software)* that do not carry a human operator but instead are **REMOTELY PILOTED or FLY AUTONOMOUSLY.**

Source: https//www.trade.gov/unmanned-aircraft-systems



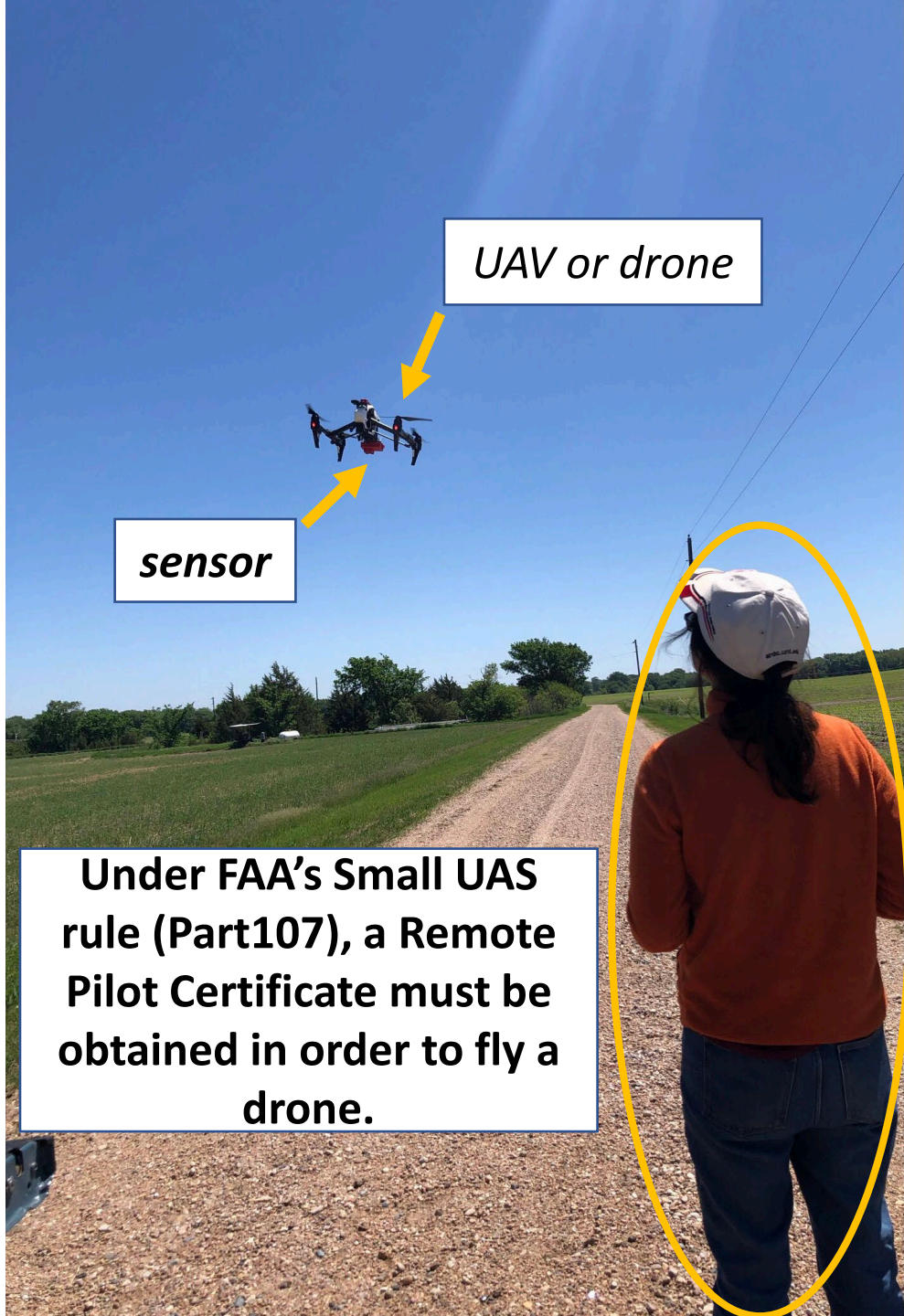
UAVs and sensors in agronomy

RGB camera (~$1,200)

Multispectral camera (~$8,000)

Thermal camera (~$12,000)

Hyperpectral camera (~$50,000)



Applications of UAVs+sensors in agronomy research

- **Nutrient status (e.g., nitrogen status in soybean)**
- Crop management assessment
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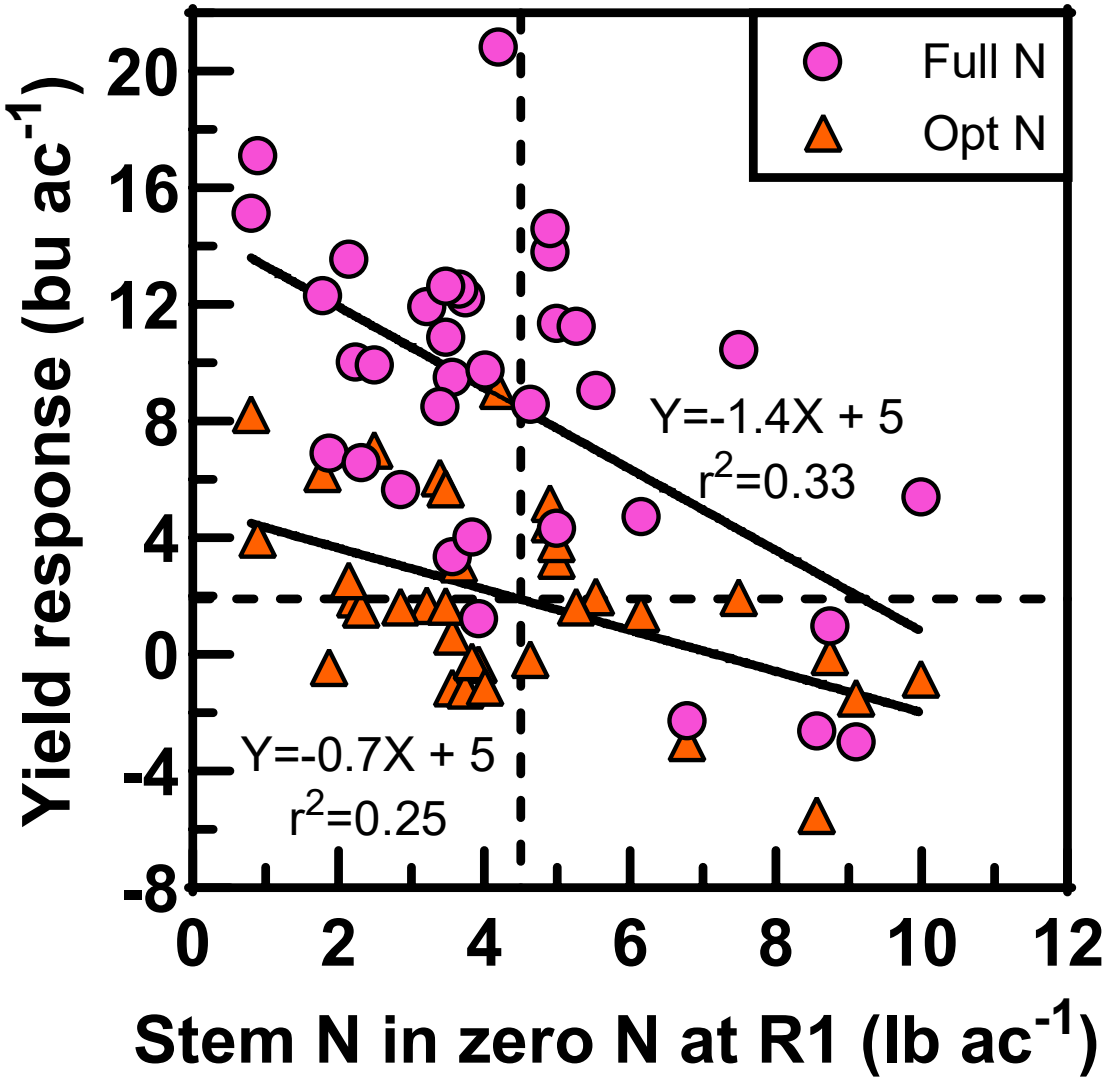
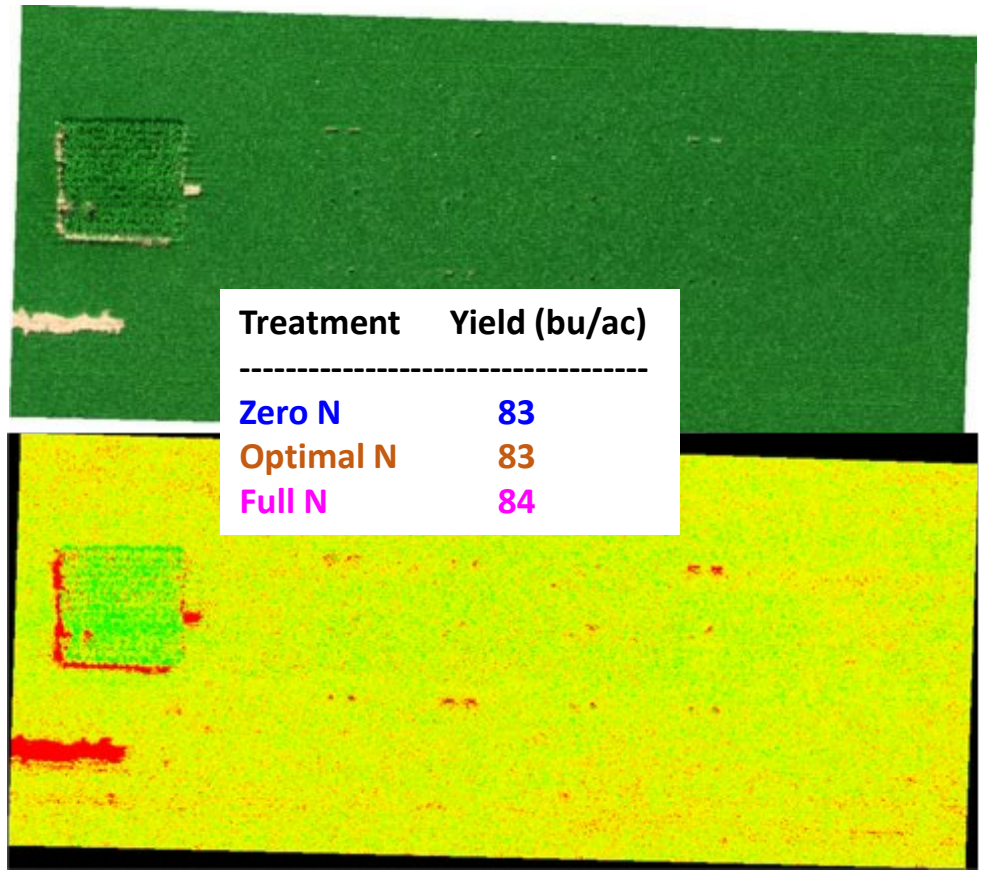
Nutrient status evaluation

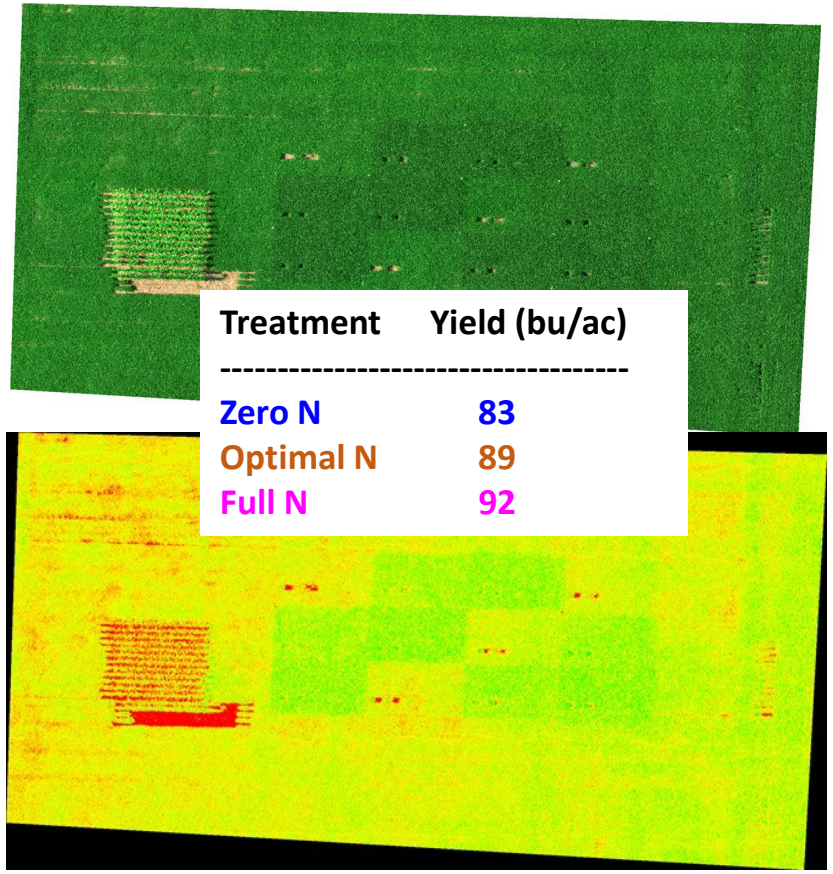


The lower the N content in the stems at R1, the higher the yield difference at harvest.

The information presented are preliminary results and part of a PhD dissertation in progress.

Nutrient status evaluation





Source: Thompson (unpublished)

Soybean fields with nitrogen limitation could potentially be identified early in the season (start of pod or R3 stage).

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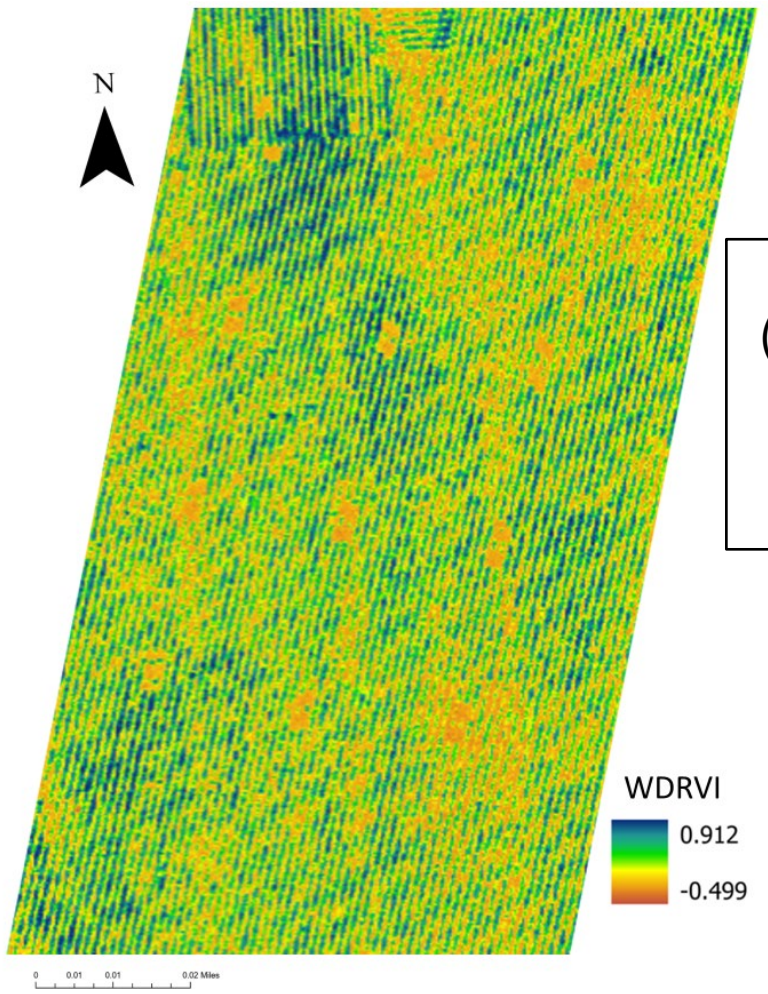
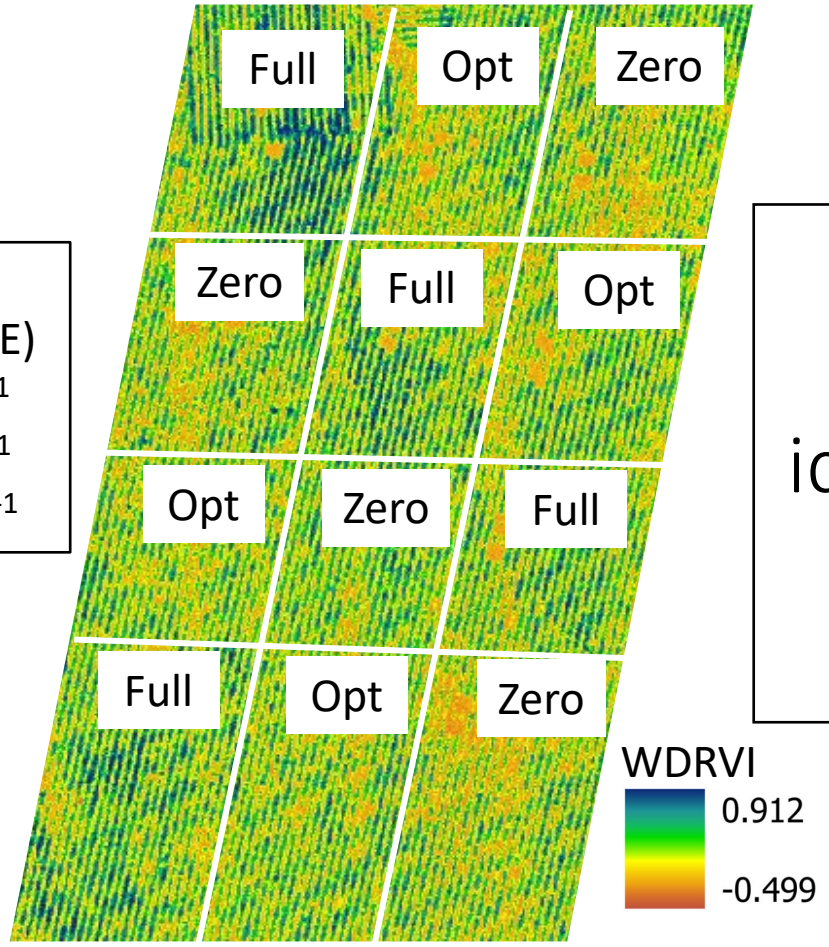
Nitrogen status evaluation (at flowering)



Field location
(R-NS, Mead, NE)
Full: 82 bu ac^{-1}
Opt: 71 bu ac^{-1}
Zero: 68 bu ac^{-1}



The limitation could be identified as early as flowering stage.

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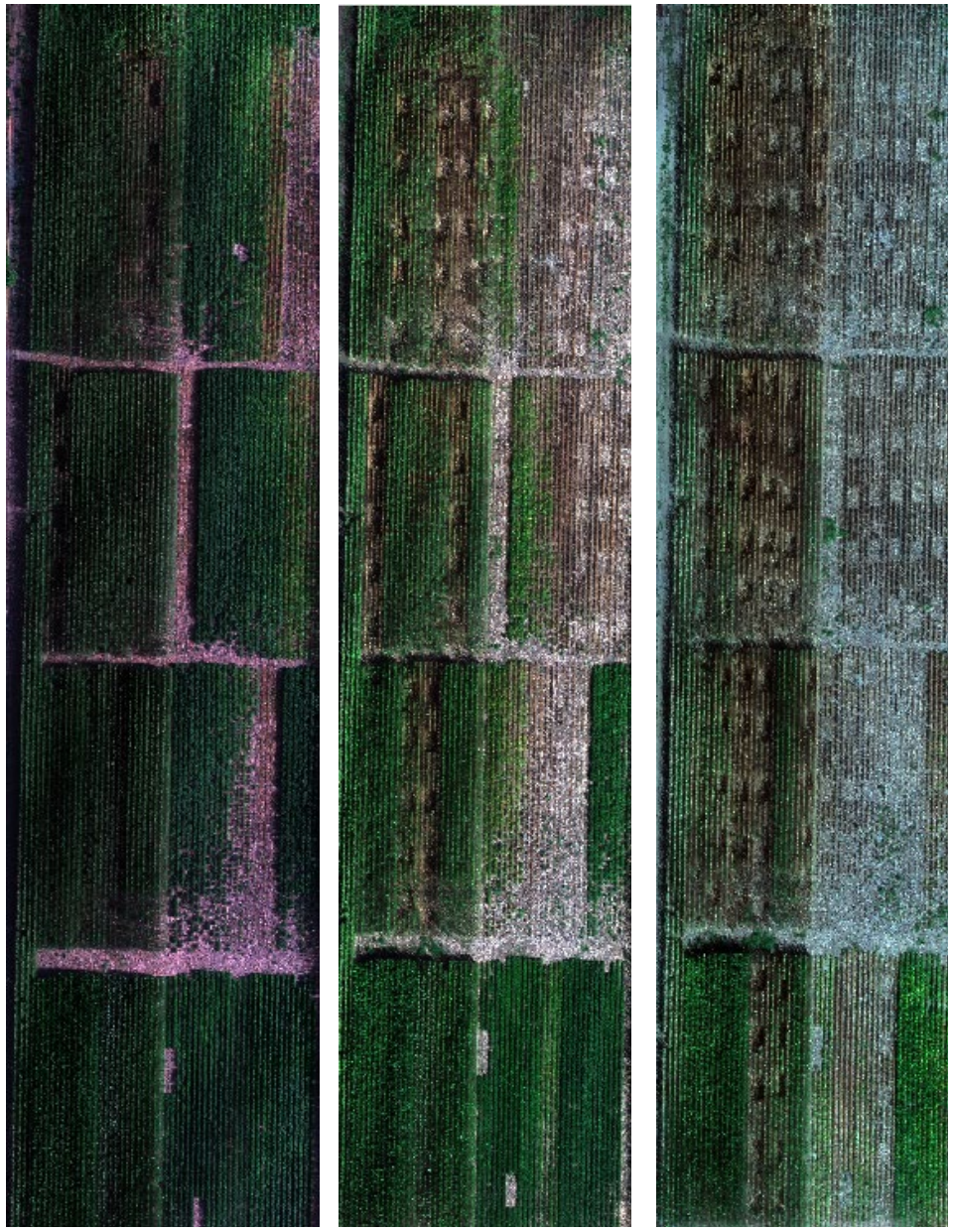

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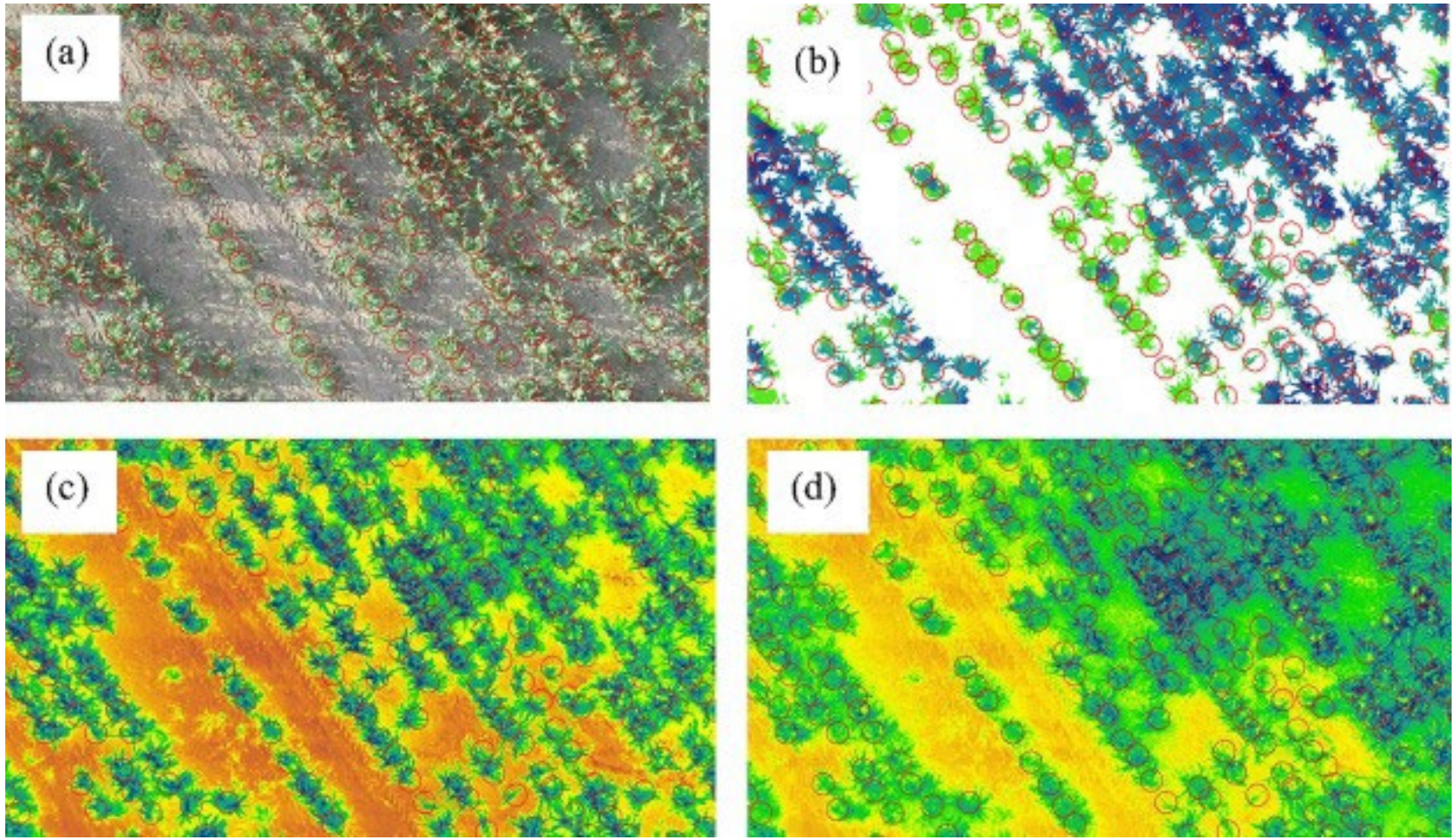
Crop management assessment

Planting date x maturity group x plant population in corn and soybean.

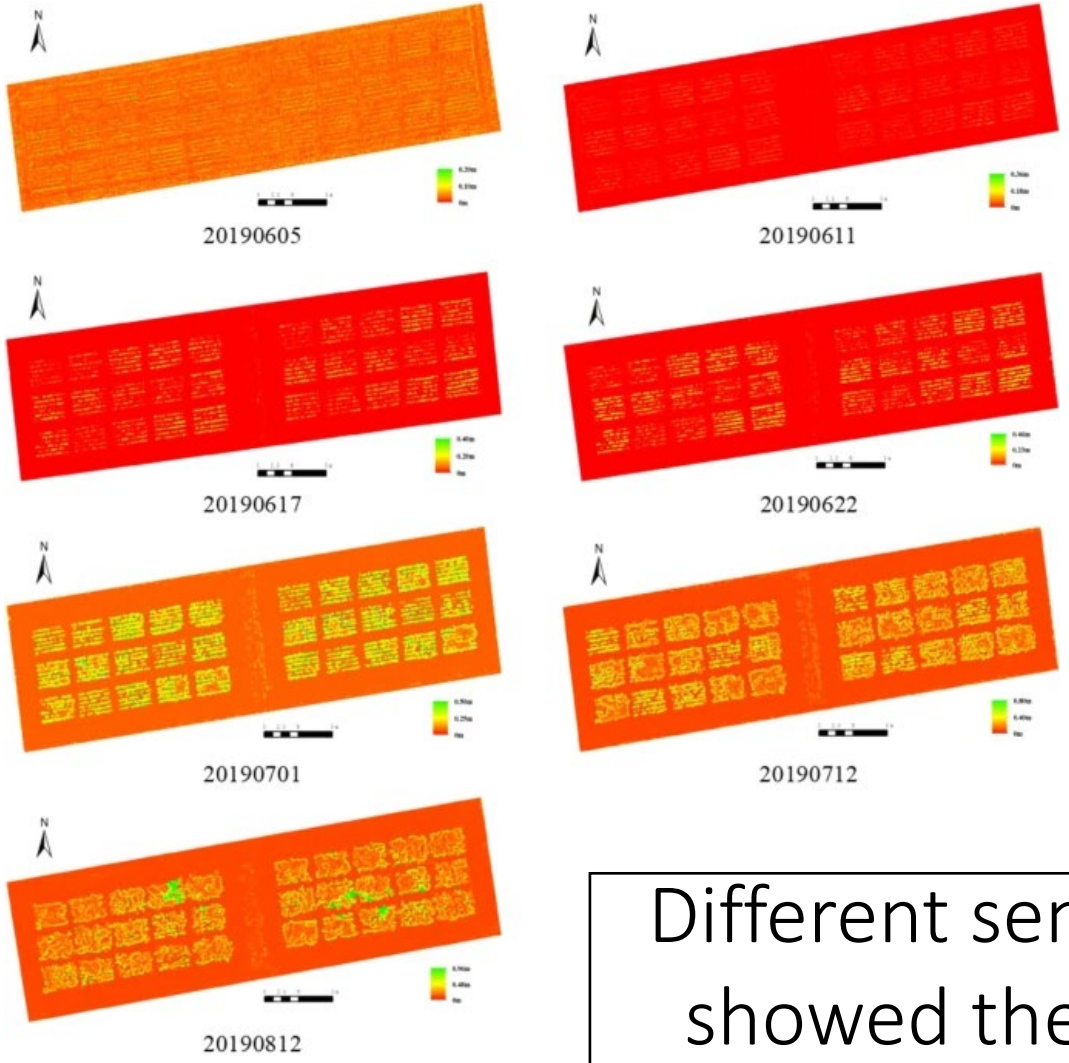
Plant count

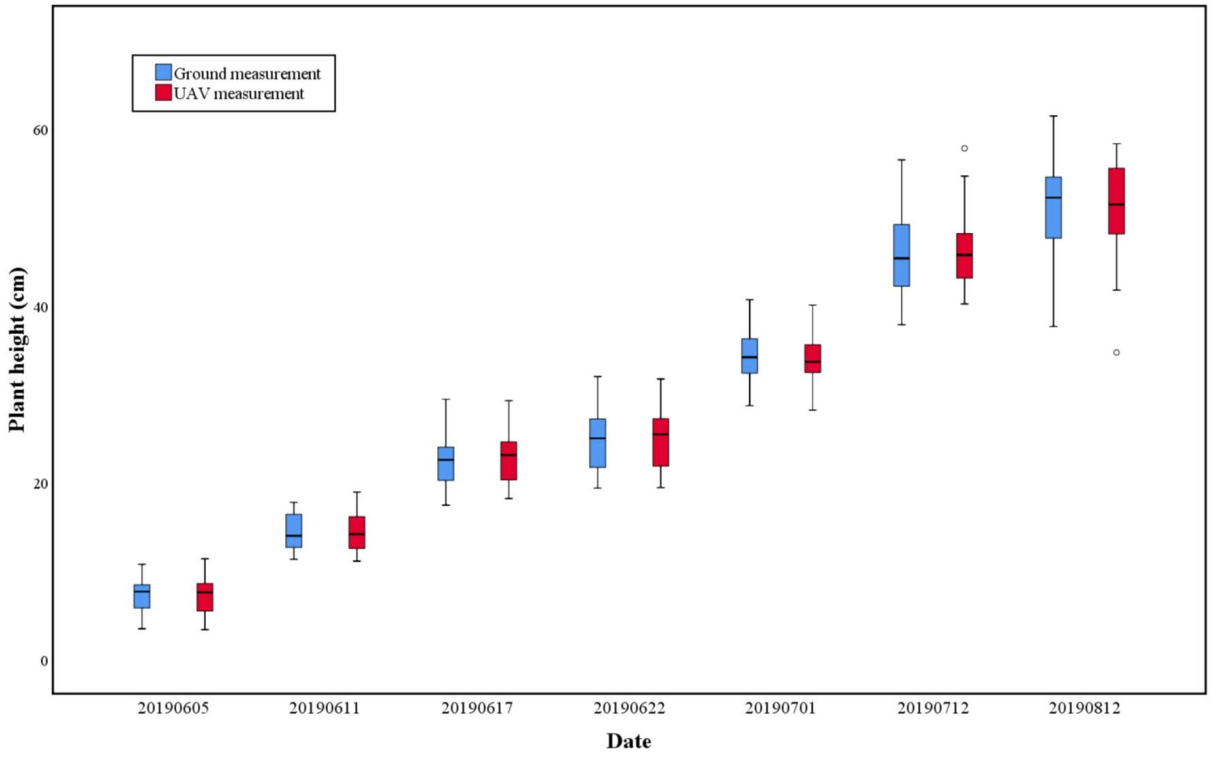


Source: Xiao et al. (2023)

The number of corn plants was estimated from an RGB image using a model that automatically counts corn plants.

Crop height estimate





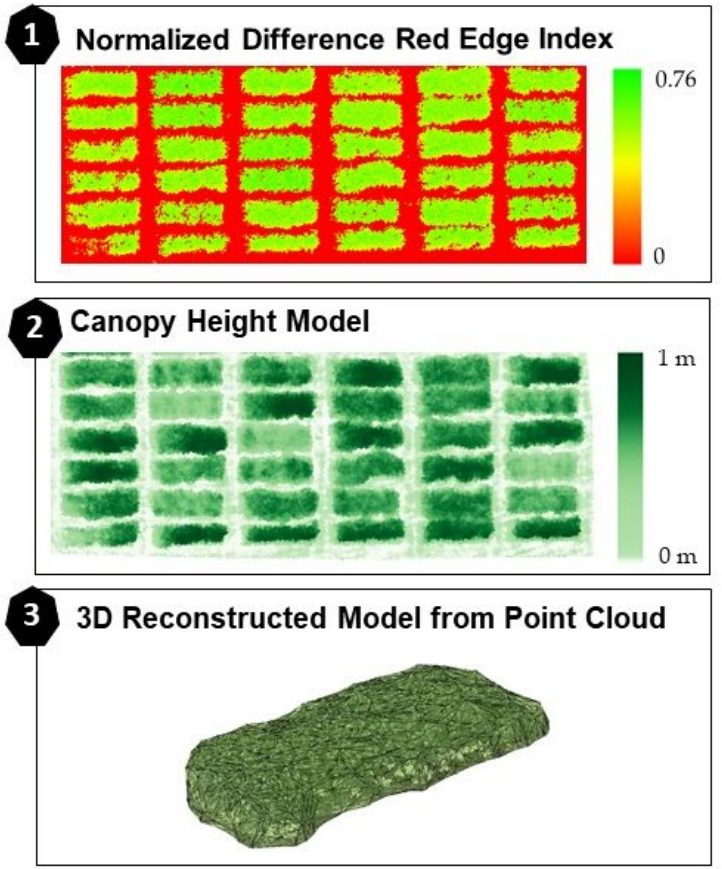
Source: Ji et al. (2022)

Different sensors were explored and RGB imagery showed the highest effectiveness on estimating plant height in Faba beans.

Crop biomass monitoring

Estimating Above-Ground Biomass(AGBM)

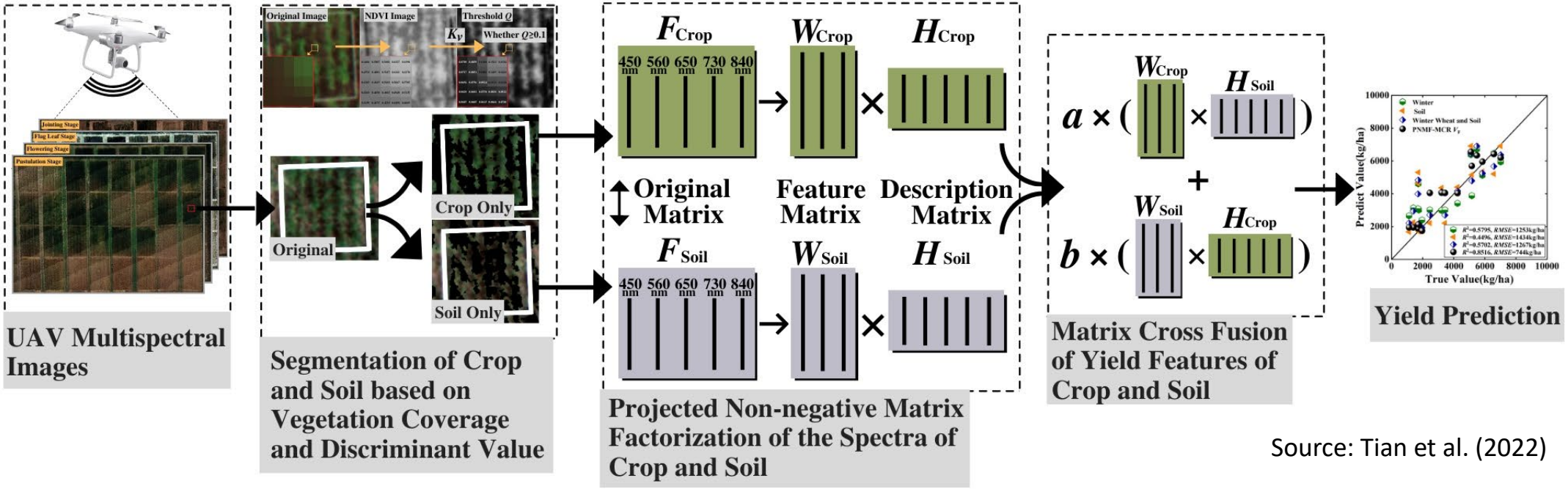
AGBM Estimation Based on Canopy Volume Extracted from UAV Data



The 3D model estimated canopy volume with high correlation with fresh above-ground biomass of forage and field peas.

Source: Sangjan et al. (2022)

Crop yield prediction



Source: Tian et al. (2022)

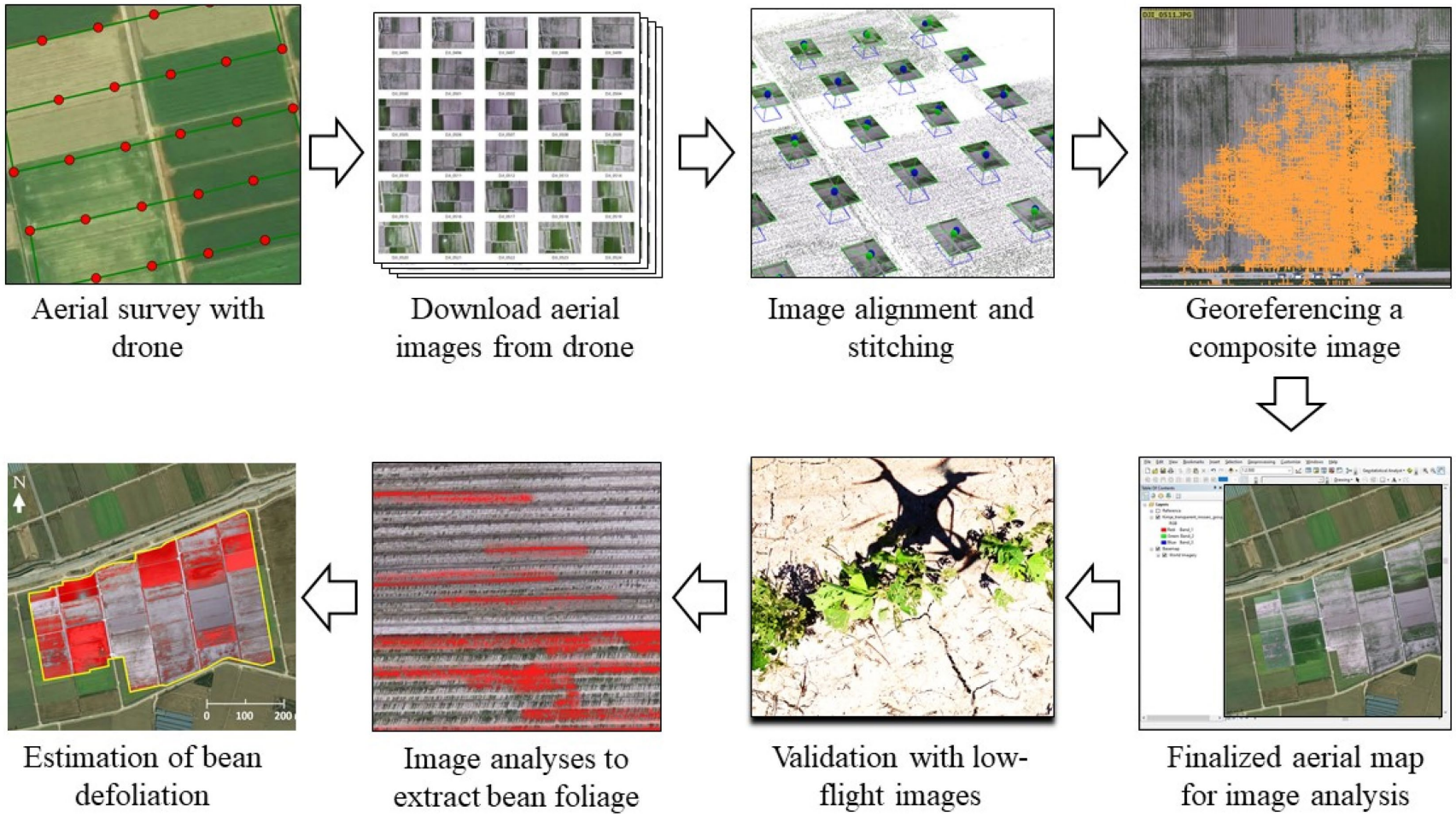
Yield was predicted at the flowering stage in winter wheat using UAV multispectral images.

Disease monitoring

Source: Gorlich et al. (2021)

Classification of *Cercospora* (fungal pathogen) Leaf Spot in sugar beet.

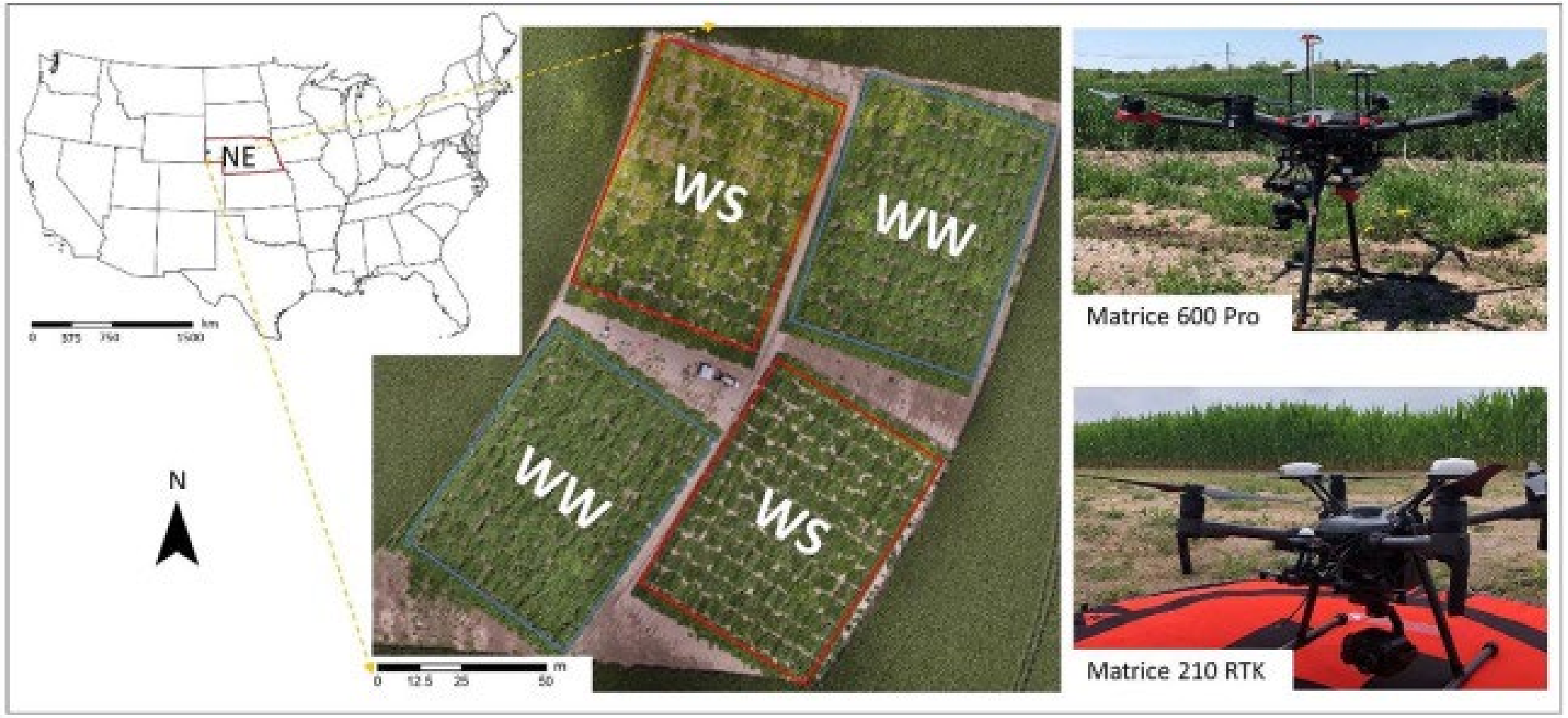
Insect monitoring



Source: Park et al. (2023)

Assessment of insect pest (Lepidoptera) outbreak in soybean.

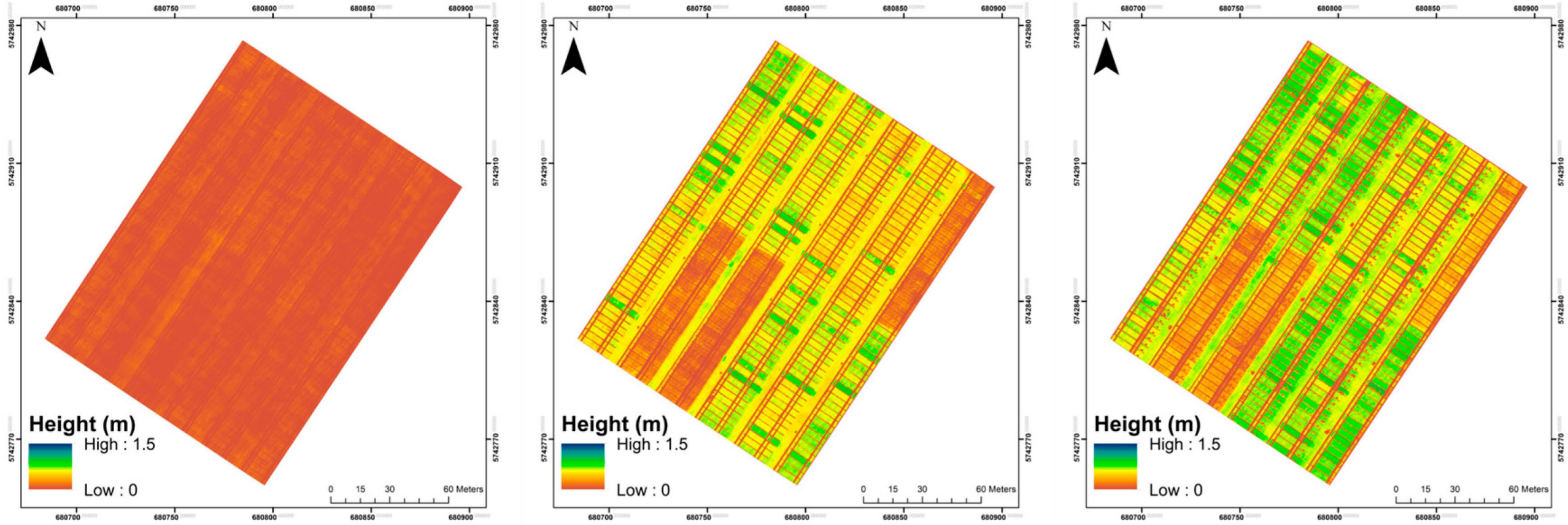
Water status assessment



Source: Li et al. (2022)

Drought tolerance assessment in sorghum.

Varietal development



Source: Holman et al. (2016)

Field phenotyping of wheat plant height.




THANK YOU!

For any further questions please email me at **lsazon2@unl.edu**

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