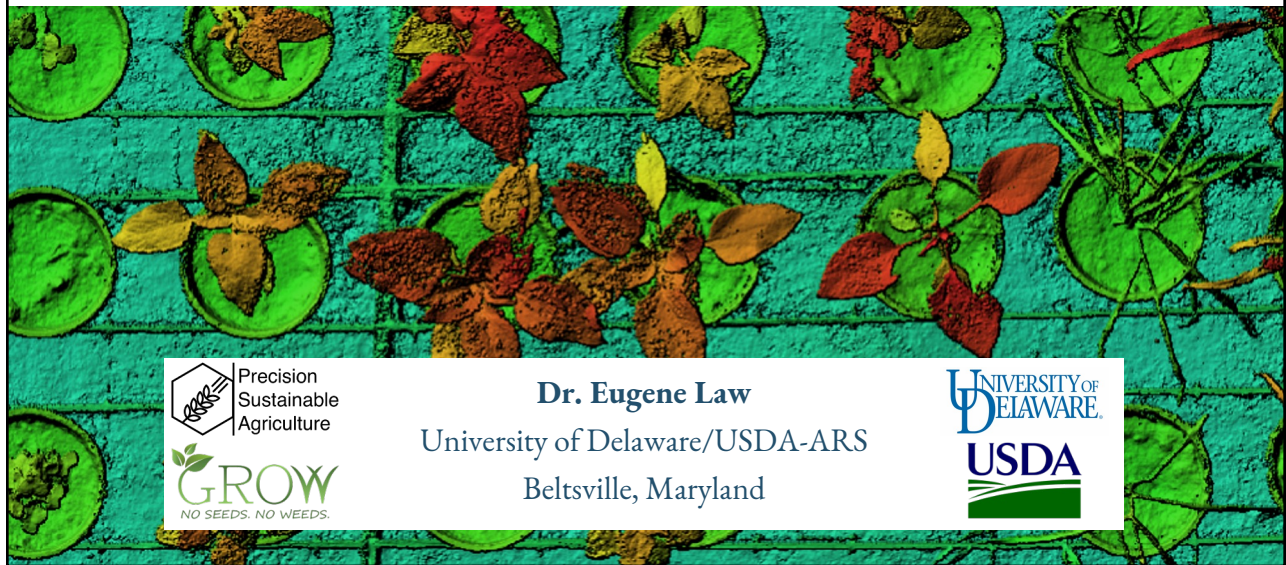


Precision Sustainable Agriculture: New Technologies for On-Farm Decision Making



1

Feed the World in the Face of Numerous Destabilizing Factors

- Changing climates
- Competing water demands
- Pest resistance to chemicals
- Declining soil and water quality



2

Climate Smart Farming

Sustainable Agriculture (regenerative and resilient)

- Cover crops and perennials
- Reduced tillage
- Crop rotation/diversity
- Agroforestry
- Integrated Pest Management
- Crop/livestock systems
- Breeding

3

Climate Smart Farming

Precision Agriculture (site specific and adaptive)

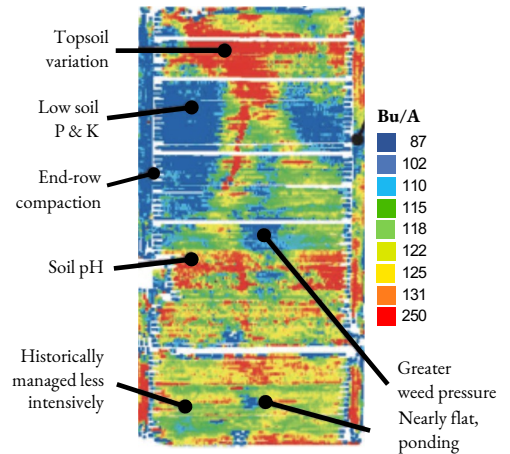
Blue River

4

Precision Sustainable Agricultural is Knowledge Intensive



**High spatial variability
(drainage issues)**



**Corn Grain Yield
USDA-ARS, Centralia, MO**

5

Translational Pipelines

Realm of science



Realm of practice



6

Translational Pipelines Require Transdisciplinary Teams

Realm of science

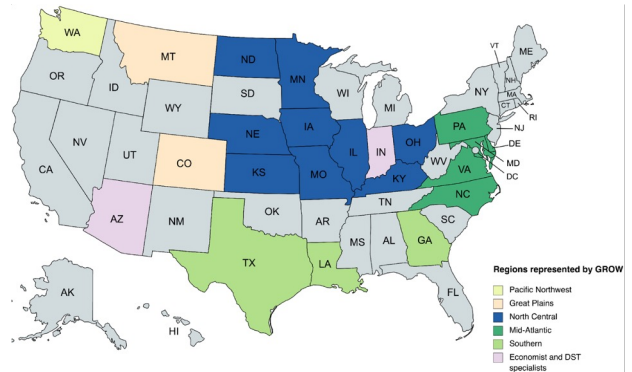
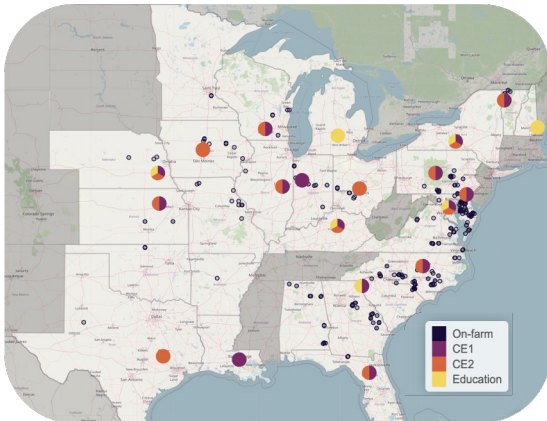
operationalize and commercialize →

Realm of practice

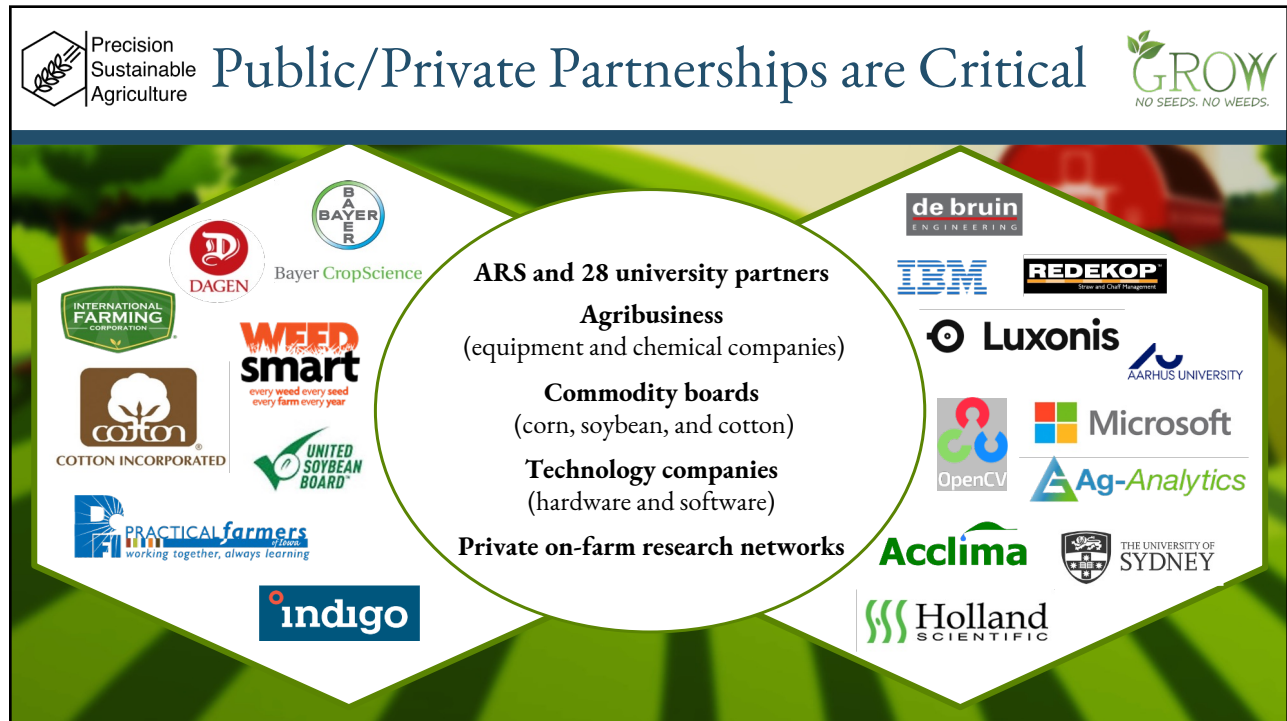


7

Precision Sustainable Agriculture and GROW Networks: *Transdisciplinary Research & Translational Pipelines*



8



9

Spatial Data and Management Complexity

On-farm and research stations

LIVING LABORATORIES

IoT EVERYWHERE

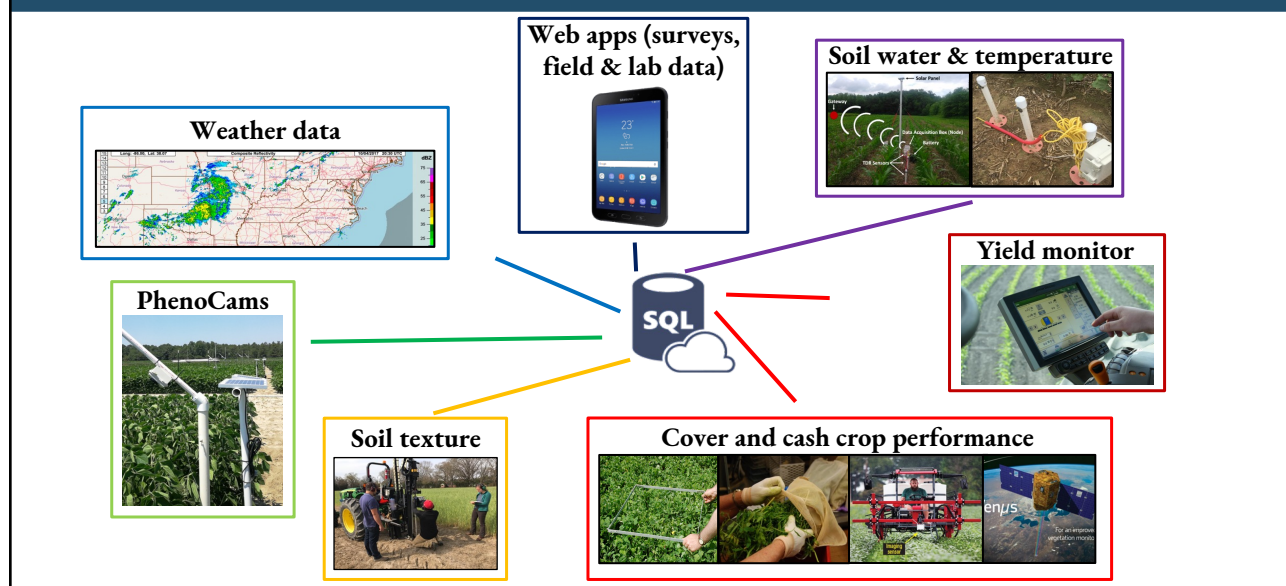
SOIL SENSORS

PLANT SENSORS

PHENO 'STRESS' CAMS

10

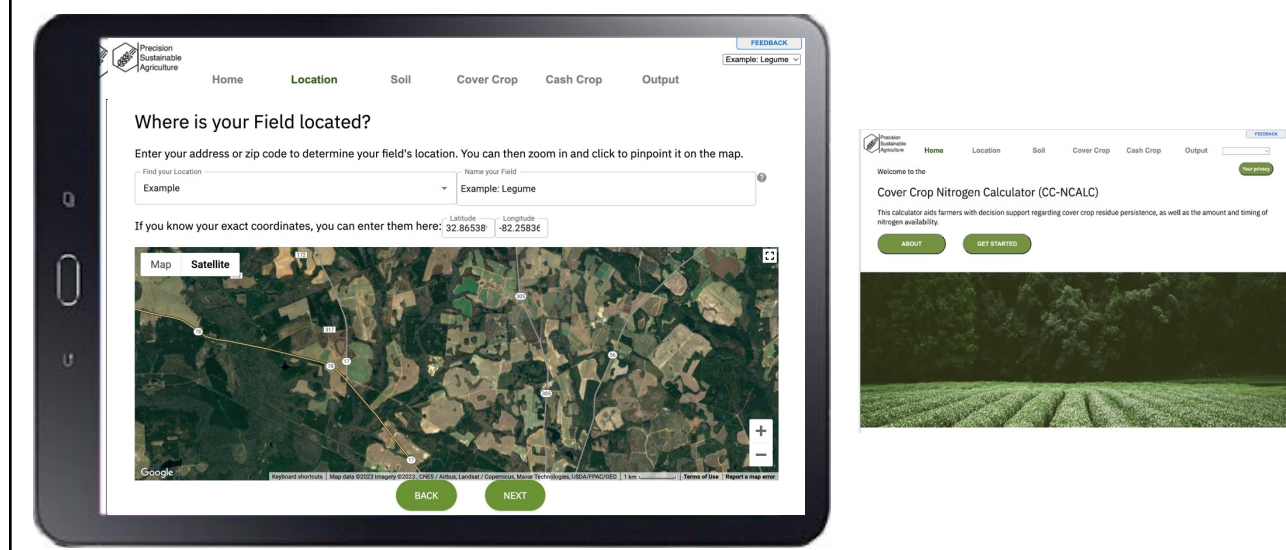
Actionable Data: highly structured databases, tools, and real-time API access



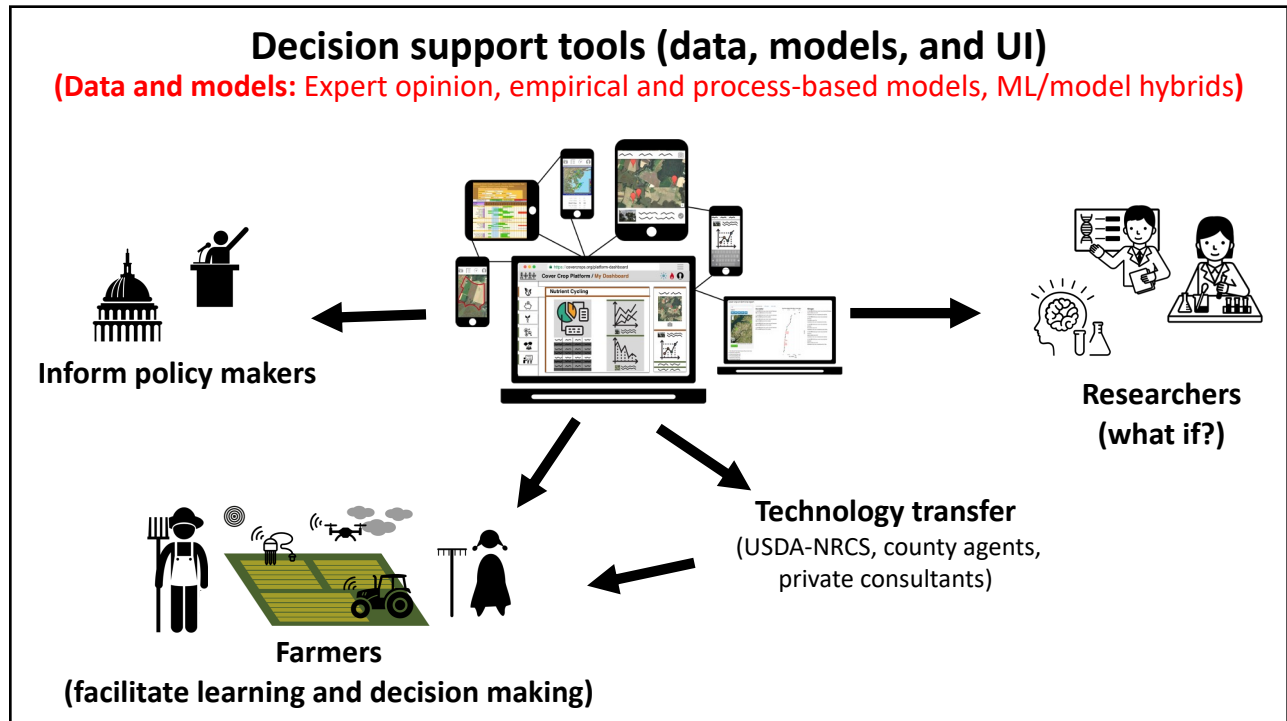
11

Web-based Decision Support Tools

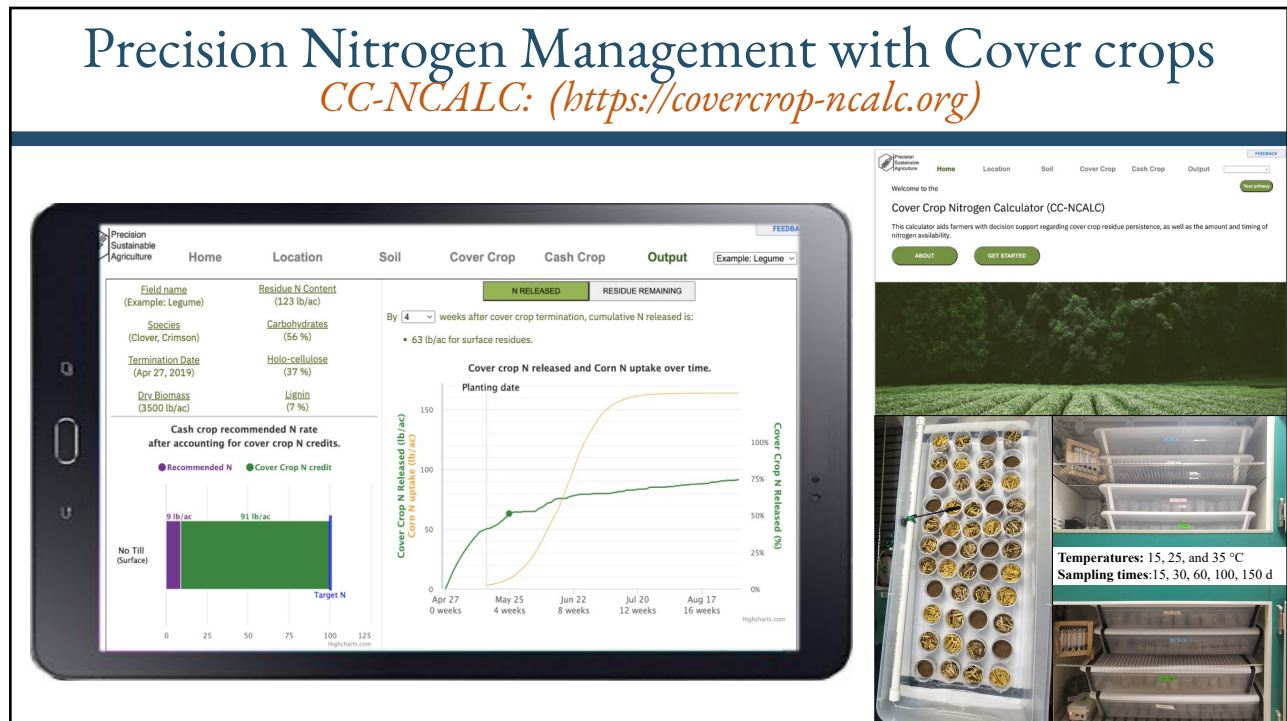
Real-Time Decision Making and Long-term Planning



12

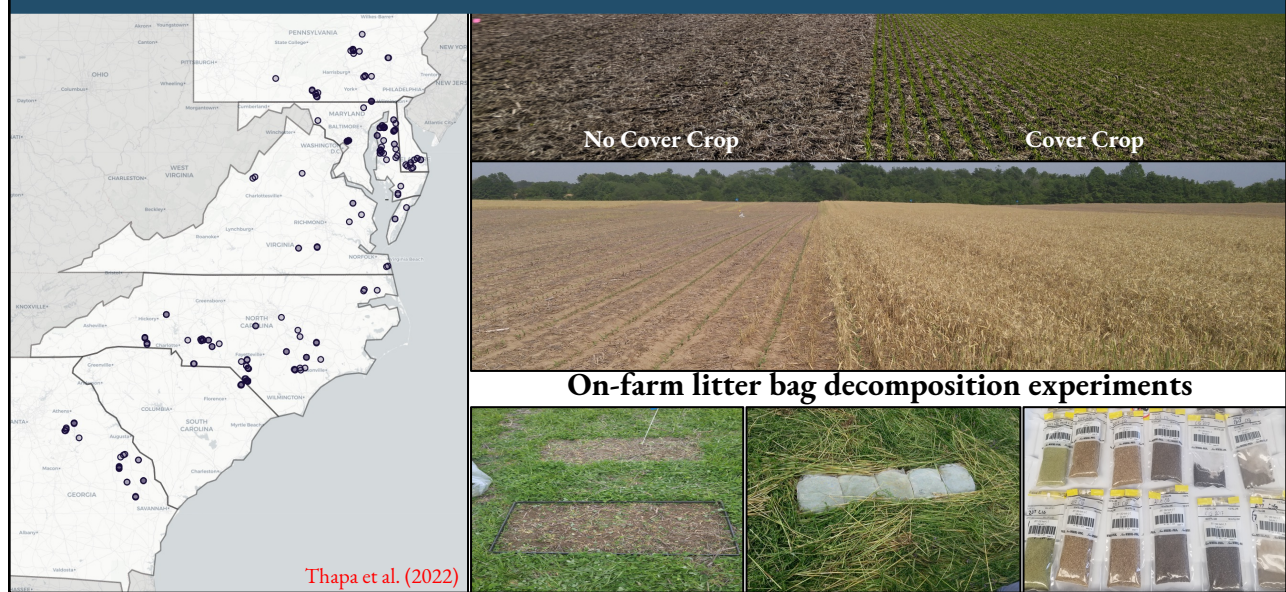


13



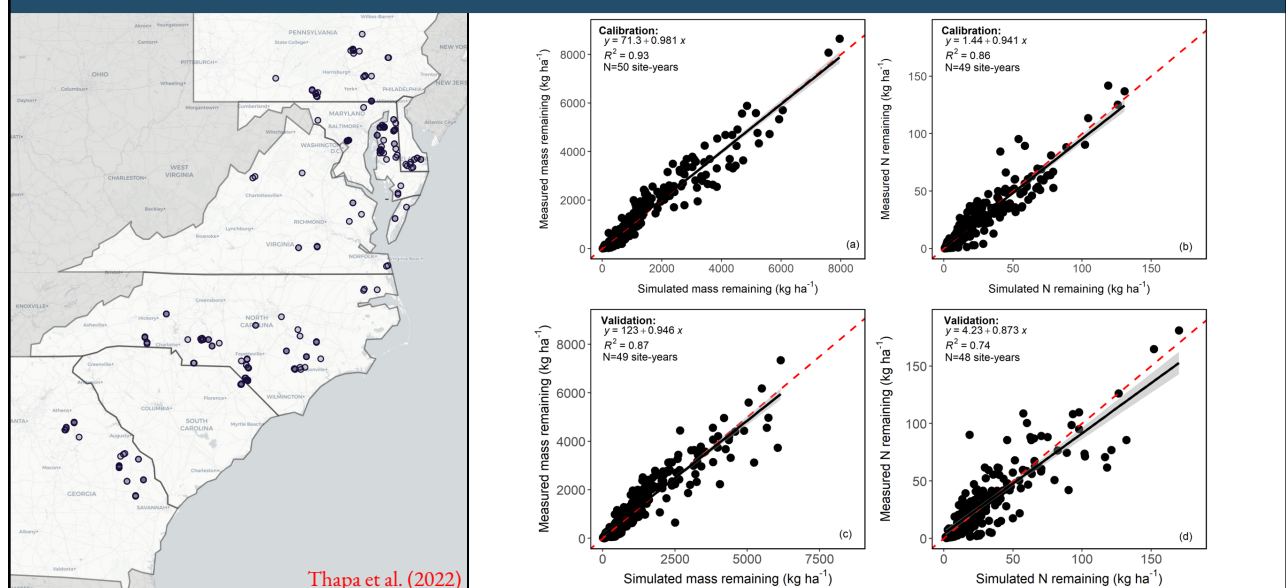
14

Regional Assessment of Cover Crop Residue Decomposition and N Release



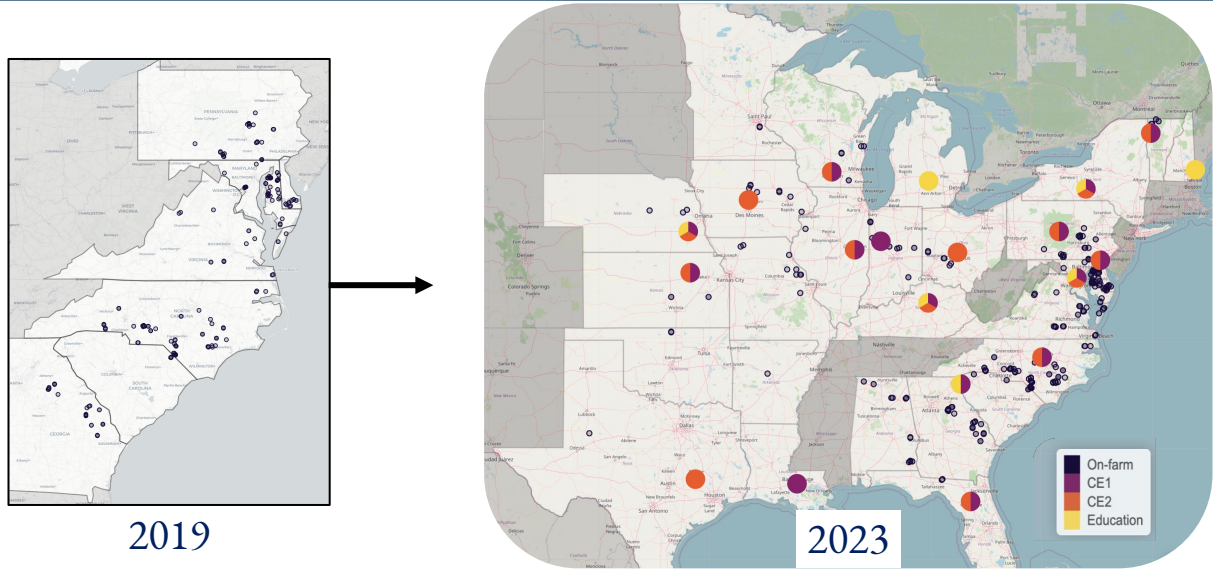
15

Regional Assessment of Cover Crop Residue Decomposition and N Release



16

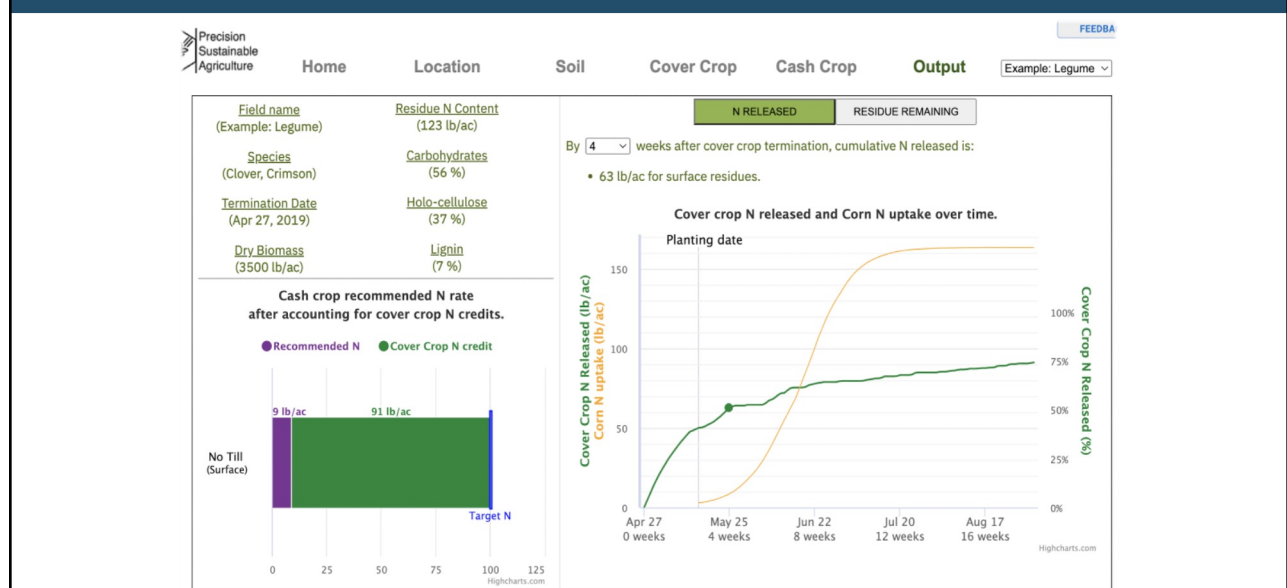
Regional Assessment of Cover Crop Residue Decomposition and N Release



17

Precision Nitrogen Management with Cover crops

CC-NCALC: (<https://covercrop-ncalc.org>)



18

Ongoing Tool Calibration

Cover crop treatments:

- cereal rye, legume, rye/legume, fallow

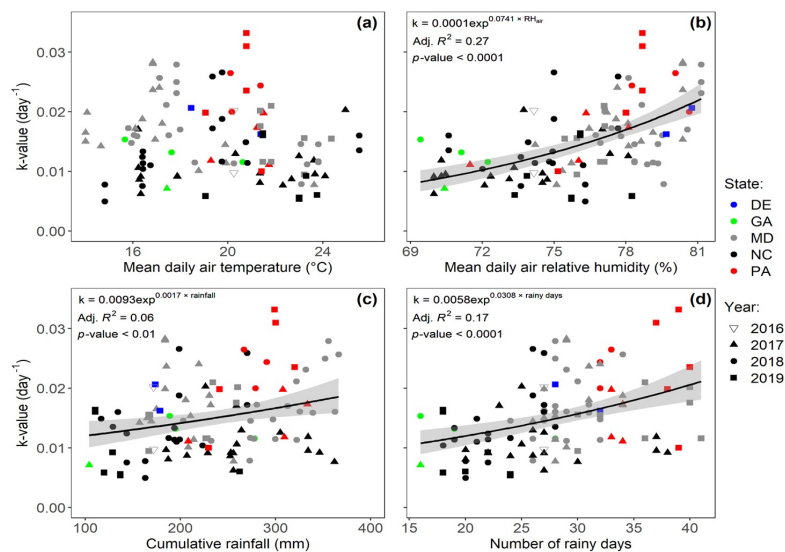
Nitrogen rates

- 0, 45, 90, 179, 269, and 358 lb ac⁻¹



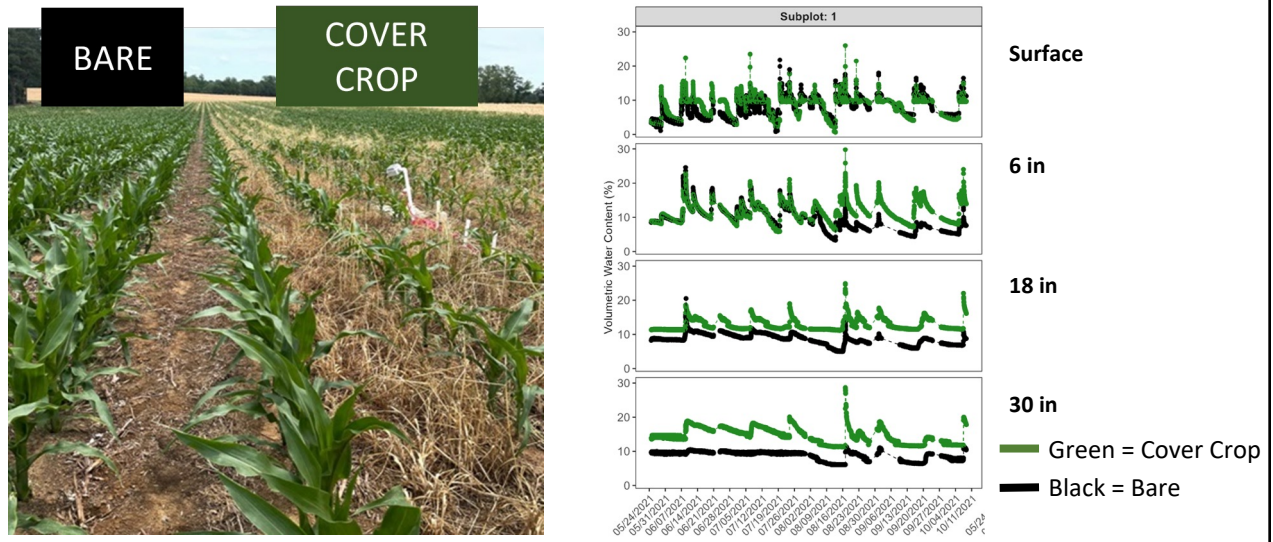
19

Climatic Control on Decomposition Rates



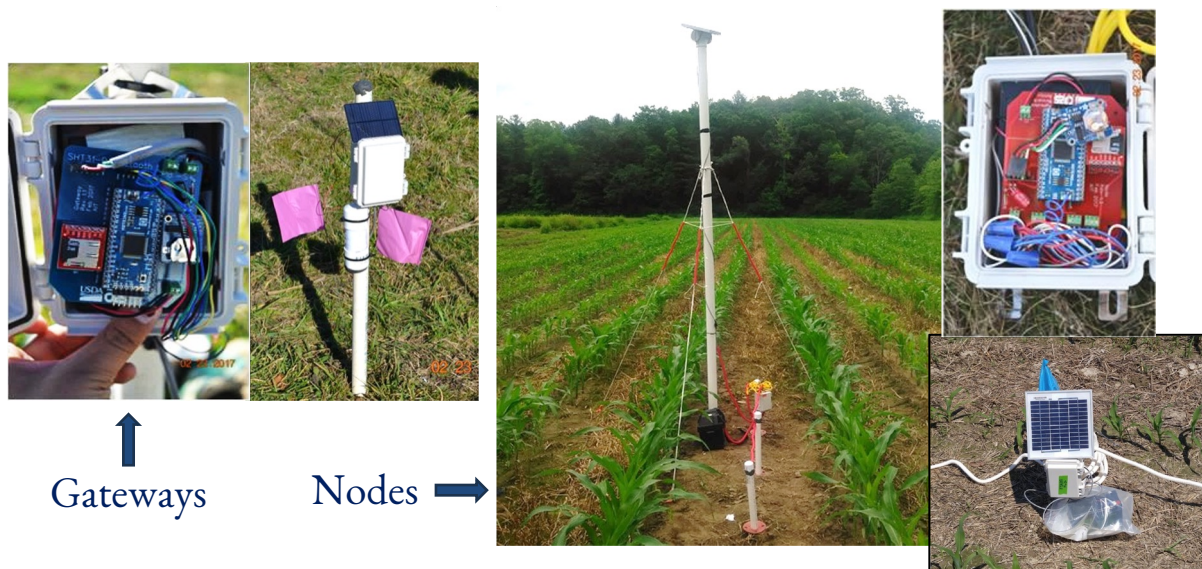
20

Soil Moisture and Temperature Sensors



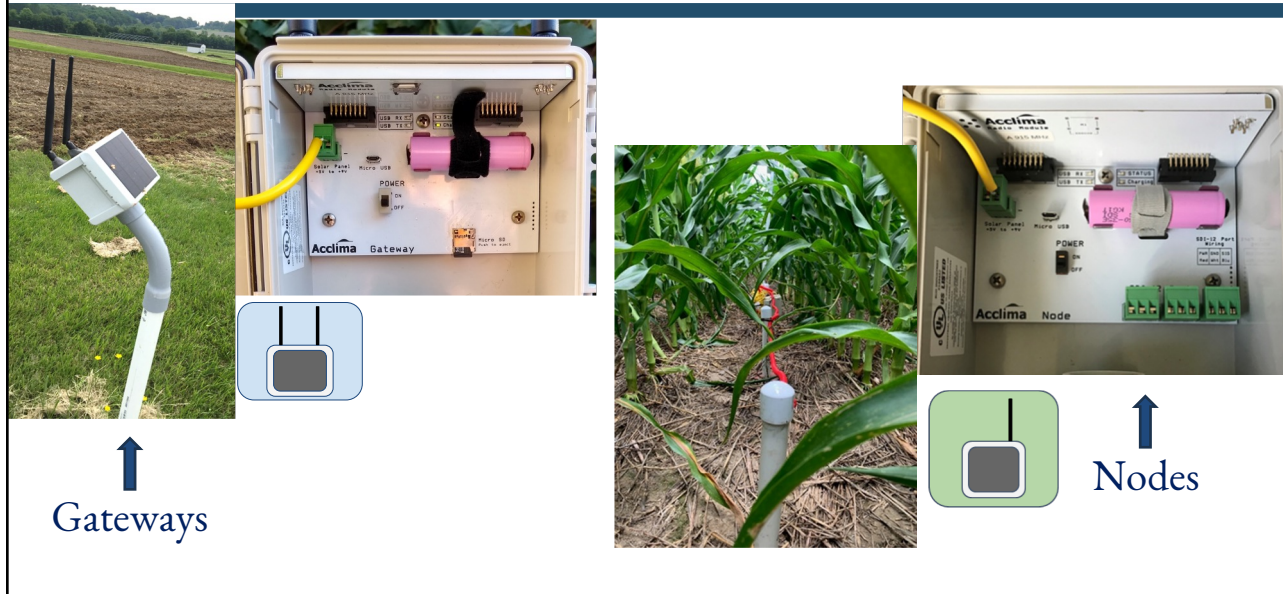
21

2017 – 2018: Prototyping Wireless Sensor Data Network



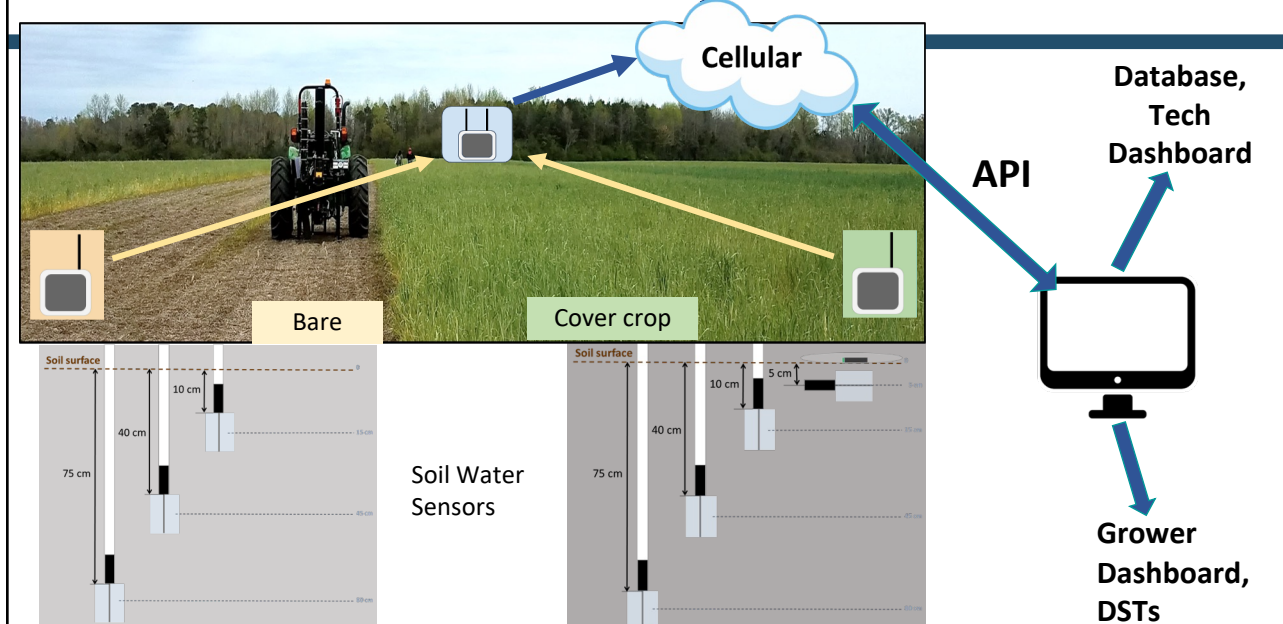
22

2019 – 2023: Scaling Partnership with Acclima, Inc.



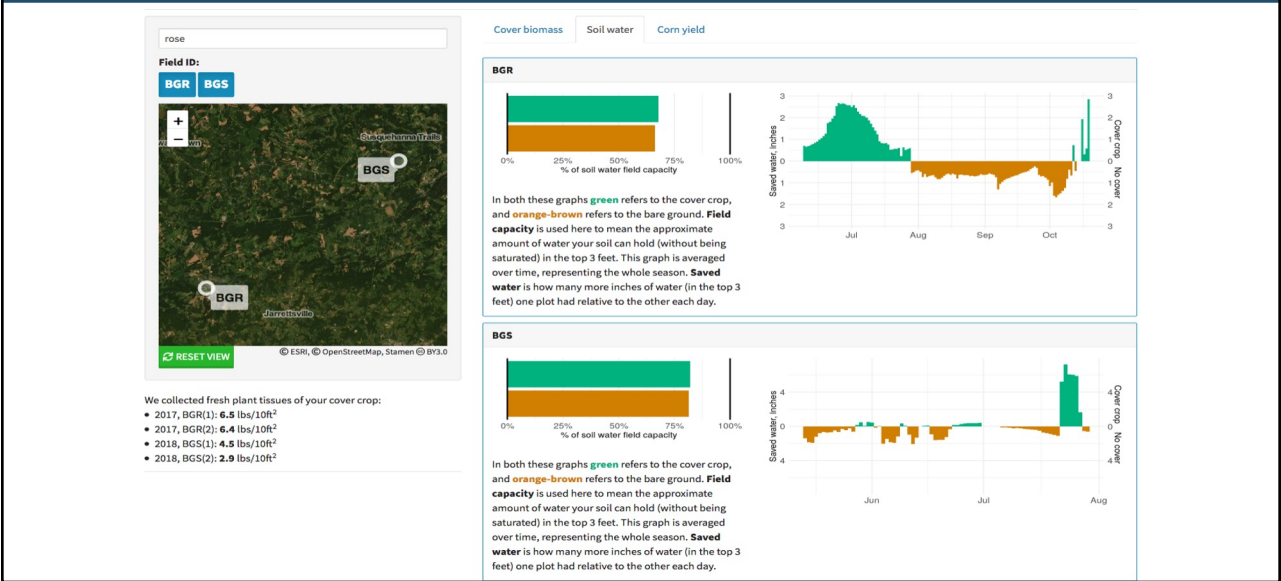
23

On-Farm Soil Water and Temperature Data Collection



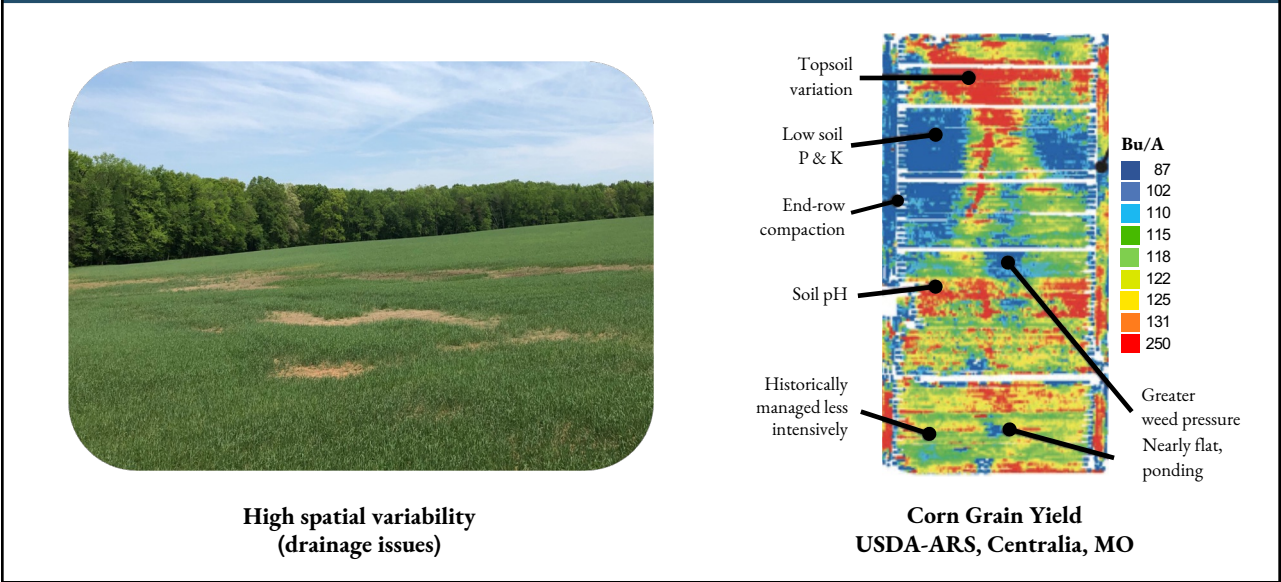
24

Grower Data Dashboard



25

Cover crop performance varies between and among fields



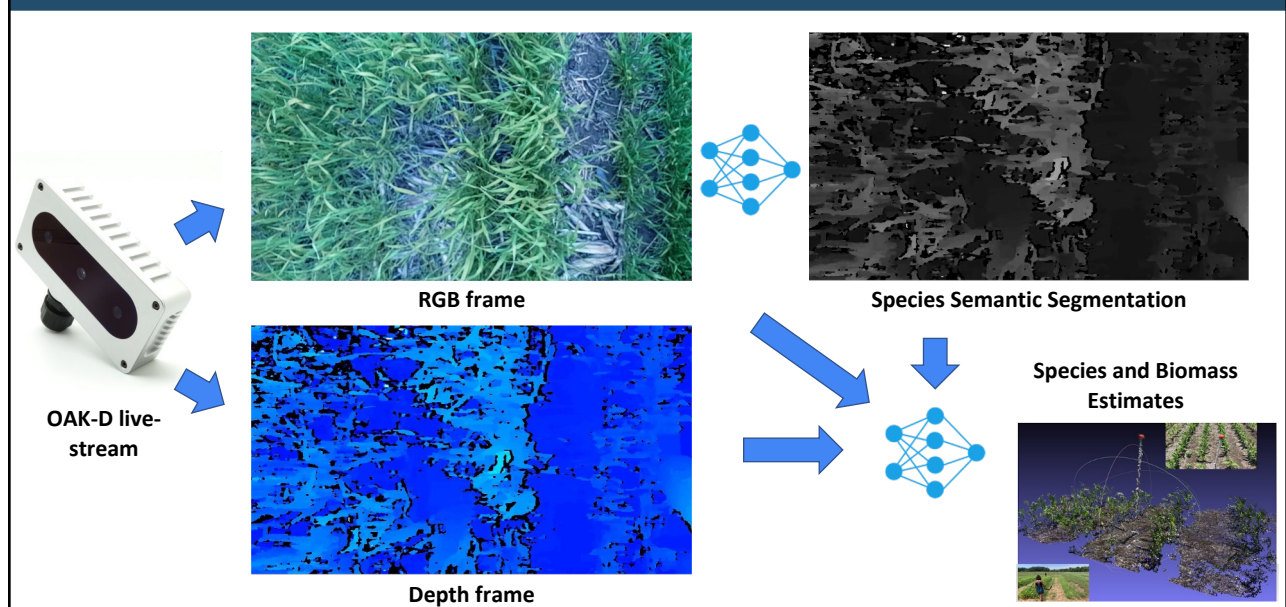
26

Crop, Weed, and Cover Crop Performance Mapping



27

Crop, Weed, and Cover Crop Performance Mapping



28

Crop, Weed, and Cover Crop Performance Mapping

Precision Sustainable Agriculture

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High Resolution, Open-access Image Repositories

Precision Sustainable Agriculture

Contributing sites

30

Enterprising BenchBot V2 with Farm-ng



31

Image Repositories that are Portable to All Camera Sensors

Degrading resolution

Color matching



reduction in image quality to match deployment system

32

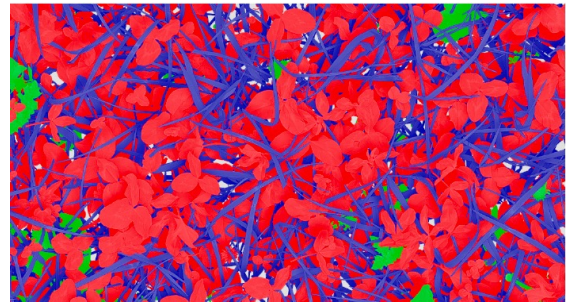
Semantic Segmentation of Species

Pixel-based Classification

Image



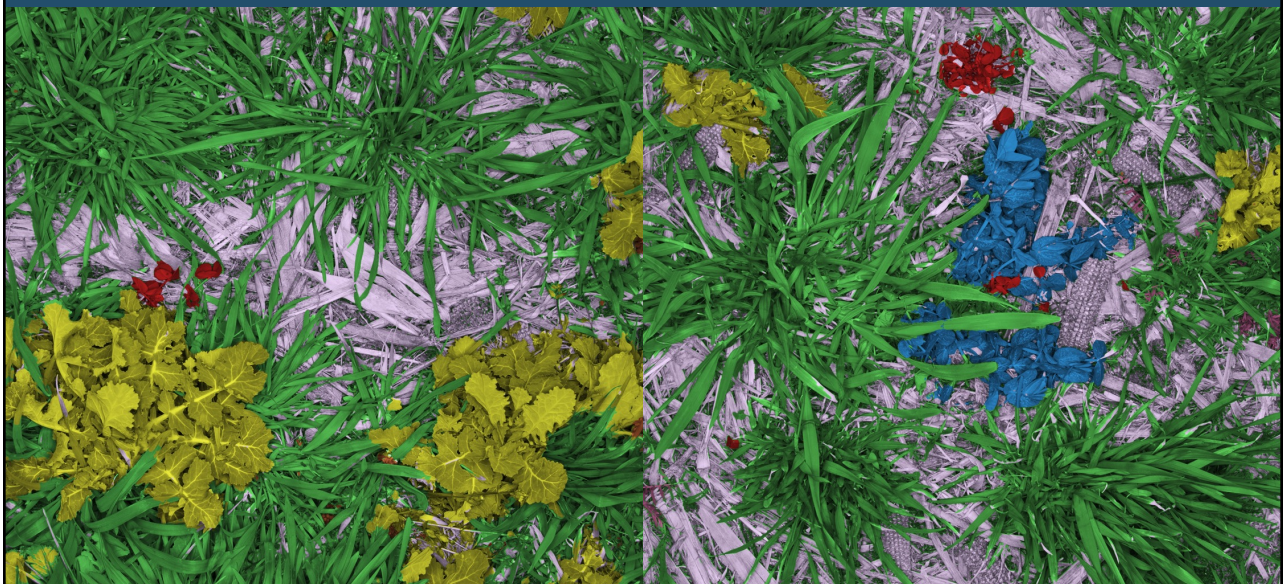
Label



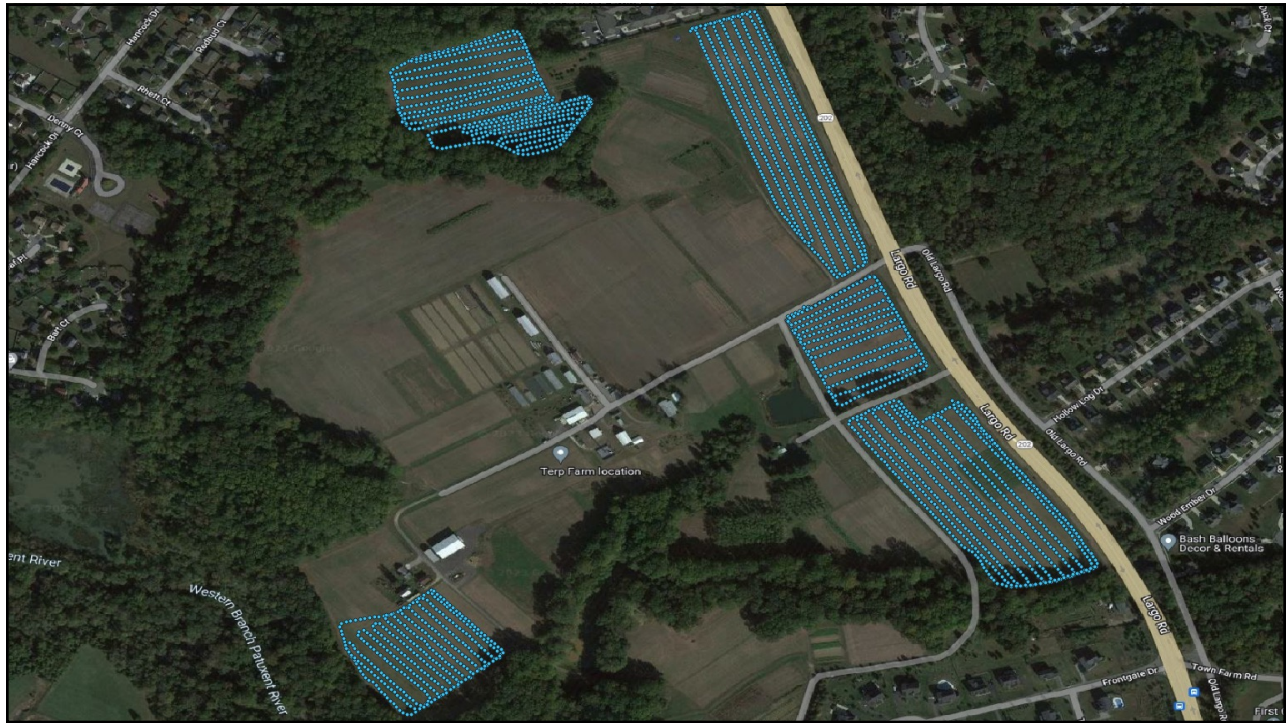
33

Mapping Cover Crop Biomass – Mixed Species

Pixel-based Classification



34



35



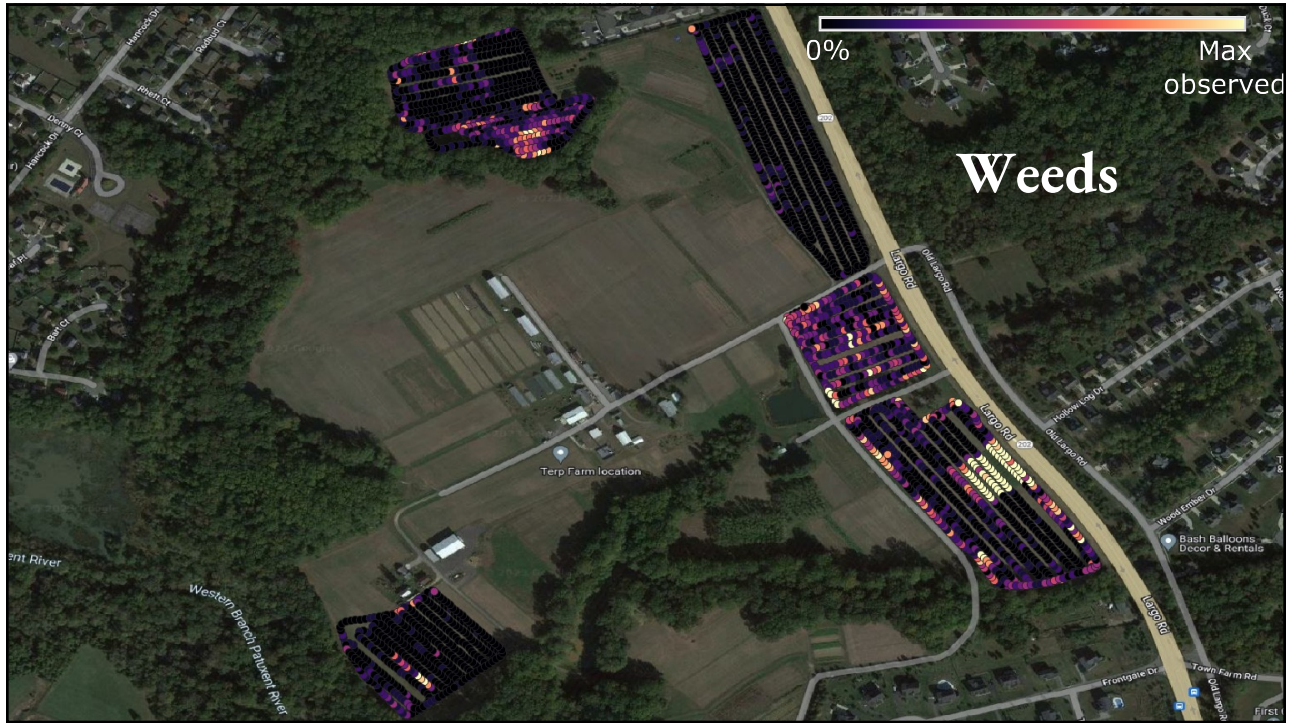
36



37

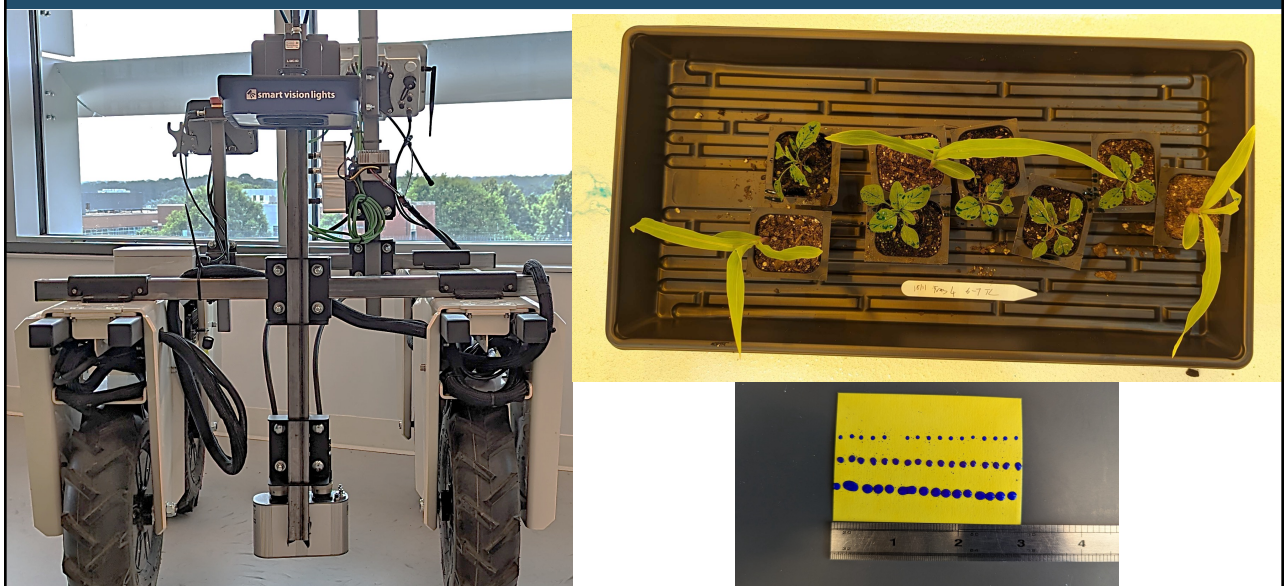


38



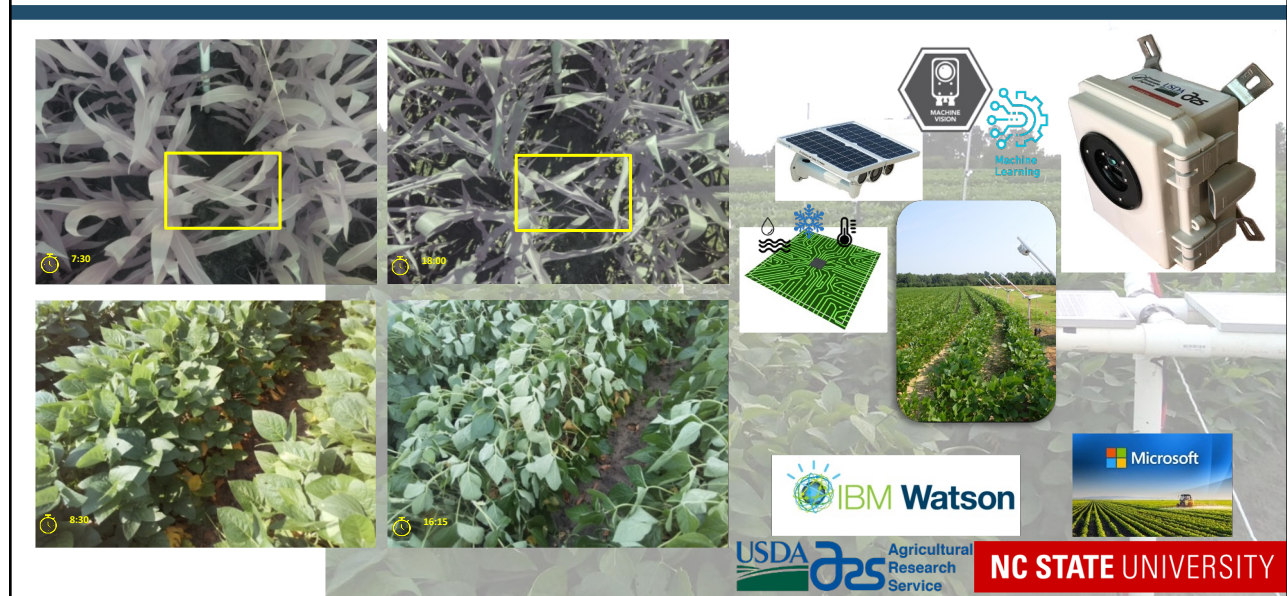
39

Autonomous Precision Sprayers



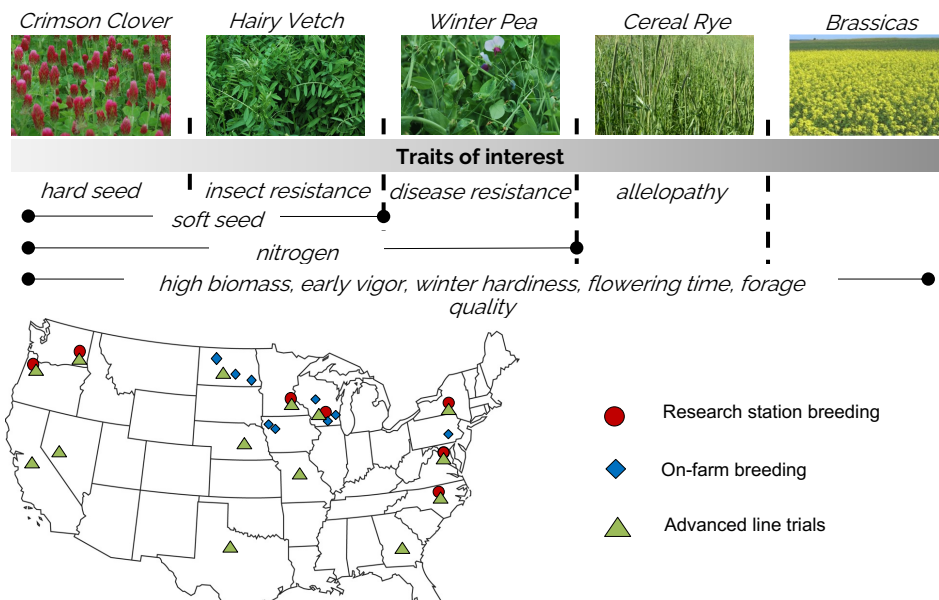
40

StressCam: Real-Time Water Stress Monitoring



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Cover Crop Breeding Network



42

Breeding Cereal Rye for Allelopathy



43

National Outreach Team

GROW Website

www.growiwm.org

About **475 subscribers**:

- Farmers
- Crop Advisors
- Media Outlets
- Ag Scientists
- Government organizations
- ✓ Weed Management Toolbox
- ✓ Weed Identification Pages
- ✓ IWM Definitions, Resources & Tools
- ✓ News Page updated weekly with IWM research & news
- ✓ Newsletter: The Weekly Update from GROW

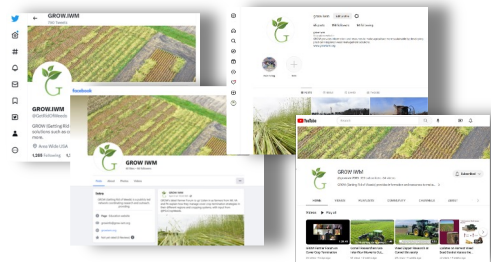
**60,000+
users
(2023)**

**74,000+
visits (2023)**



Social Media

- Twitter: @GetRidOfWeeds
- YouTube: GROW IWM
 - 45 videos posted in 2023
- Facebook: GROW IWM
- Instagram: @grow.iwm



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Questions?



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www.precisionsustainableag.org

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