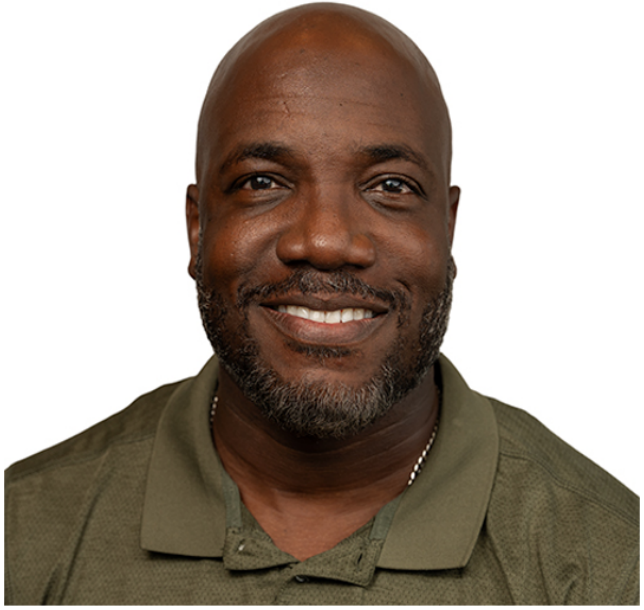
N.C. Plant Sciences Initiative

Garey Fox

Dean, College of Agriculture and Life Sciences

Adrian Percy

Executive Director, N.C. Plant Sciences Initiative



Cranos Williams

Goodnight Distinguished Professor of Agricultural Analytics

Platform Director of the Data-Driven Plant Sciences, N.C. PSI

Building BeanPACK

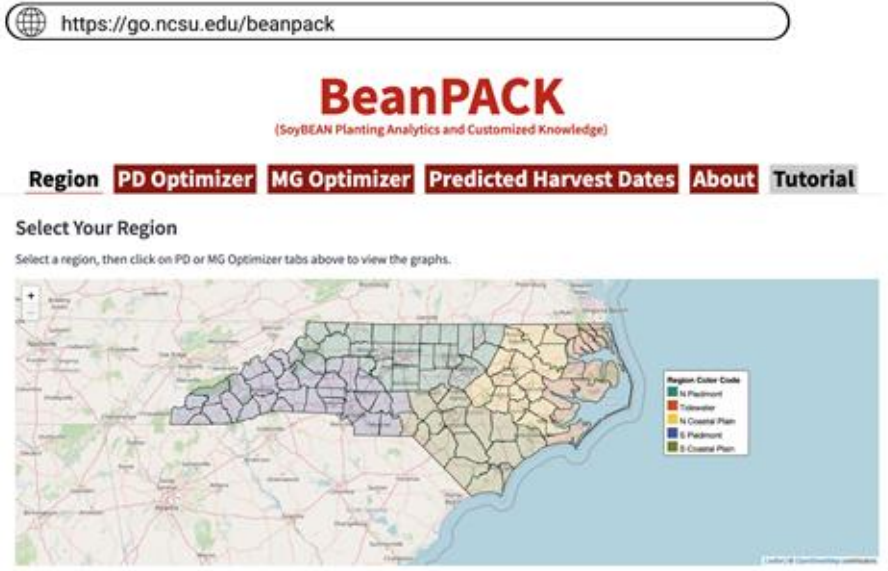
NC STATE

Leveraging interdisciplinary team science to build an AI-powered decision support tool for North Carolina's soybean growers.

BeanPACK

SoyBEAN Planting Analytics and Customized Knowledge

A web-based decision support tool for North Carolina's soybean farmers to prioritize their core agronomic production practices with data-driven recommendations.

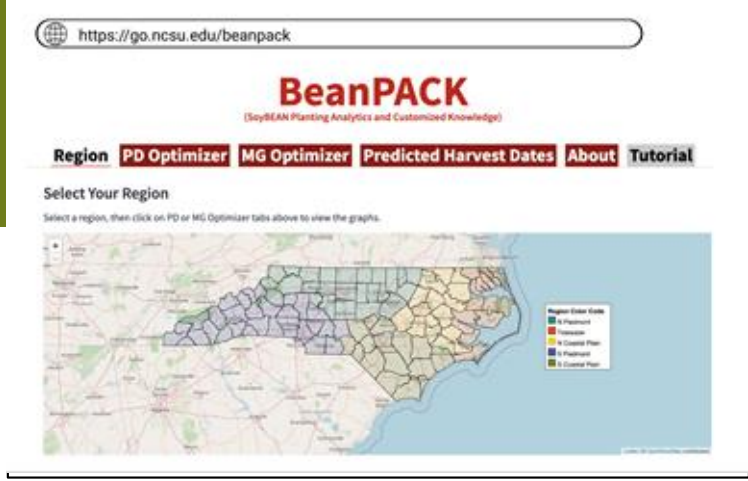


Rachel Vann
Soybean Extension Sp.

go.ncsu.edu/beanpack

Building BeanPACK

Leveraging interdisciplinary team science to build an AI-powered decision support tool for North Carolina's soybean growers.



BeanPACK (SoyBEAN Planting Analytics and Customized Knowledge) is a web-based decision support tool for North Carolina's soybean farmers to optimize their core agronomic production practices with data-driven recommendations.

Built in 3 Steps

1. **Small-plot Data Collection:** 5 years, 20 sites, 11,000+ small field-plots
2. **Advanced Tool & Technique Implementation:** High-speed computing, cloud infrastructure, AI/ML modeling, app development & deployment
1. **Grower & Extension Agent Beta-Testing**

Enabled by the N.C. Plant Sciences Initiative

N.C. PSI BUILDS
Interdisciplinary Teams

+

N.C. PSI ASSEMBLES
Technical Expertise

+

N.C. PSI HOUSES
State-of-the-art Infrastructure

= **BeanPACK**

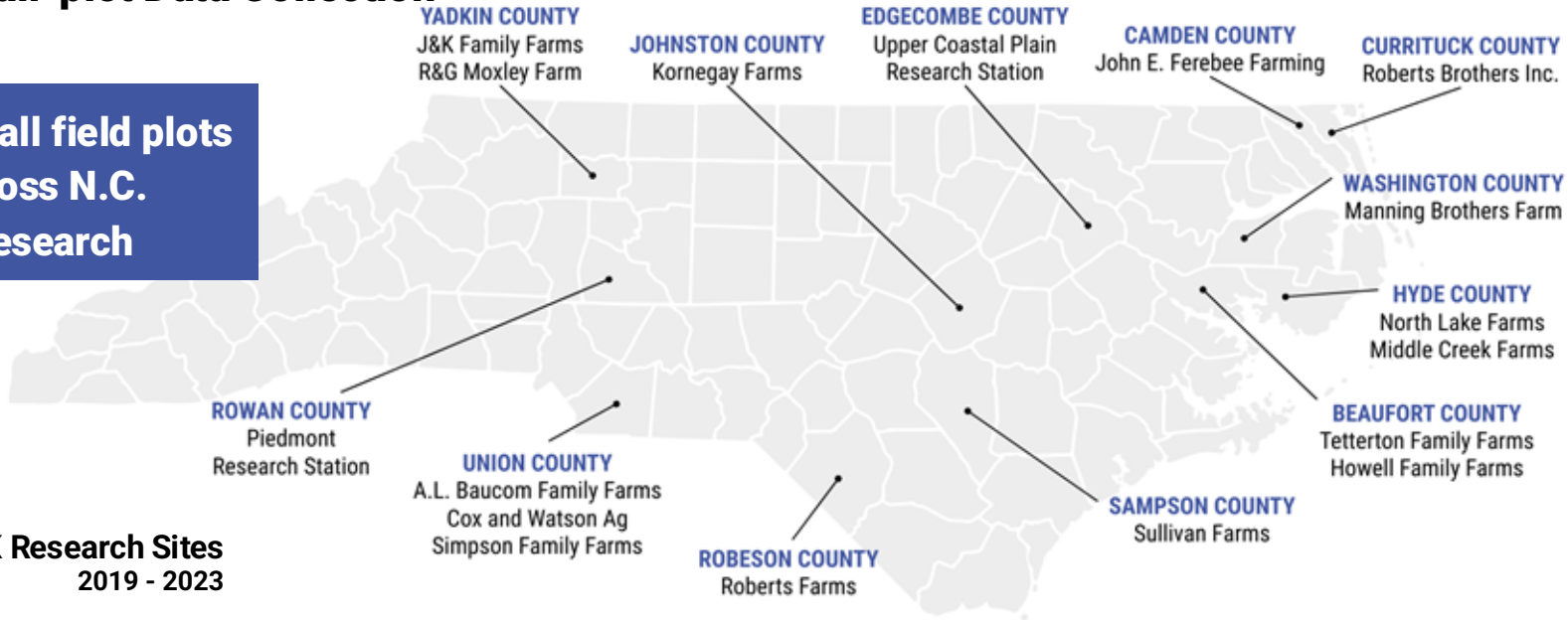
Building BeanPACK

Leveraging interdisciplinary team science to build an AI-powered decision support tool for North Carolina's soybean growers.

BeanPACK (SoyBEAN Planting Analytics and Customized Knowledge) is a web-based decision support tool for North Carolina's soybean farmers to optimize their core agronomic production practices with data-driven recommendations.

Step 1: Small-plot Data Collection

11,000+ small field plots
20 sites across N.C.
5 years of research



BeanPACK Research Sites
2019 - 2023

Building BeanPACK

AG ANALYTICS
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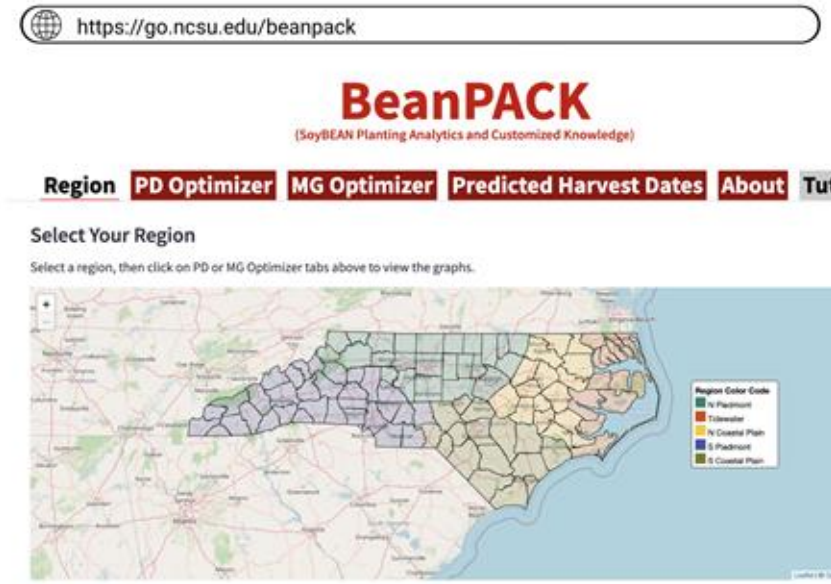
Step 2: Advanced Tool & Technique Implementation

High-speed Computing

Cloud Infrastructure

App Development & Deployment

AI/ML Modeling



Step 3: Grower & Extension Agent Beta-testing

1,000+
unique site visitors in 2025
(as of July 16)

Building BeanPACK

COLLABORATIVE PARTNERS

College of Engineering
Somshubhra Roy
Viraj Sanap
Cranos Williams

N.C. PSI
Brad Lewis
Lauren Maynard
Jevon Smith

College of Agriculture and Life Sciences
Extension Agents
Dwight Cauthen
Ryan Heiniger
Tristan Morris
DJ Stokes
Rachel Vann

United Soybean Board
Katherine Drake Stowe

"I'm thrilled about the tool's potential. It marks a milestone in helping us growers make informed decisions, ultimately improving our productivity."

Forrest Howell, soybean farmer, Beaufort County

IMPROVEMENTS TO BeanPACK

1. Integrated NC State Official Variety Testing Data to improve tool precision
2. Improve ability to work on handheld device
3. Track usage metrics and use to shape future improvements

"This tool is loaded with information and will help us growers reach the next level on soybean yields."

John Fleming, soybean farmer, Edgecombe County

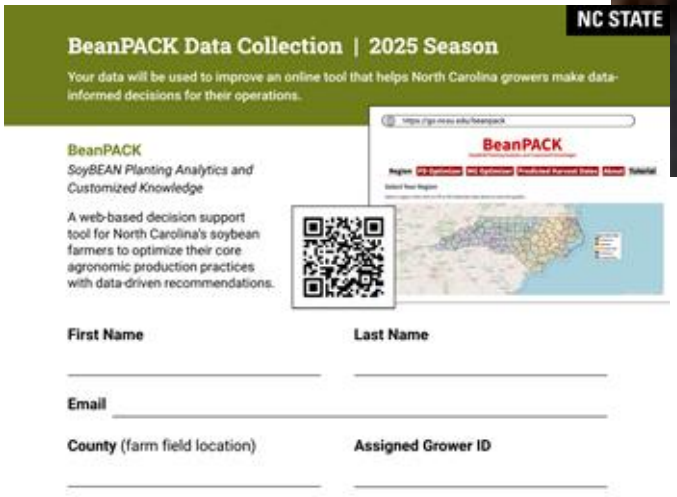
SPECIAL THANKS TO EXTENSION AGENTS & RESEARCH STATION STAFF

Andrew Baucom
MiKayla Berryhill
Mike Brake
Tim Britton
Austin Brown
Ryan Coe
Craig Deal
Adam Formella
Andrea Gibbs
Brad Graham
Rod Gurganus
Tim Hambrick
Della King
Mac Malloy
Morgan Menaker
Zach Parker
Jalynne Ward

Building BeanPACK

NEXT STEPS

1. Integration of farmer data
2. Continued integration of small-plot data and model improvement



Jenny Carleo
Ext Agent

go.ncsu.edu/beanpack

Andrea Gibbs

Extension Agent, Agriculture – Field Crops
Hyde County Center

NC COOPERATIVE EXTENSION

Connecting Research & Technology to Rural Communities

Impact of the N.C. PSI Extension Agent Network

Andrea Gibbs
Agriculture Extension Agent
Hyde County Center

N.C. A&T STATE UNIVERSITY

NC STATE UNIVERSITY

Hyde County, NC

- Located in the Blacklands
- Challenges:
  - Flooding & water management
  - Saltwater intrusion
  - Limited infrastructure and broadband

Extension connects farmers with researched based solutions

N.C. Plant Science Initiative Extension Agent Network

- Beta-test N.C. PSI-developed technologies in the field to accelerate seamless adoption on farm
- Leverage agent's strong relationships at the local level to drive future N.C. PSI projects
- Provide an opportunity for agents to interact with researchers in disciplines outside of agriculture

N.C. Plant Science Initiative Extension Agent Network

- Cover Crop Cohort – Dr. Chris Reberg-Horton (2023-2025)

N.C. PSI Extension Agent Network

- Attended AI 101 in 2025
- SAS Viya Cohort (2025-2026)

Building a Practical Sensor Network for Flooding & Saltwater Intrusion Management

NC COOPERATIVE EXTENSION

NC STATE UNIVERSITY

N.C. Plant Sciences Initiative

AG ANALYTICS
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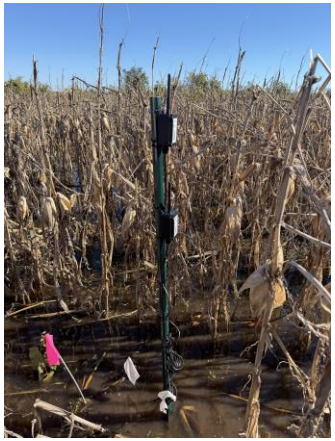
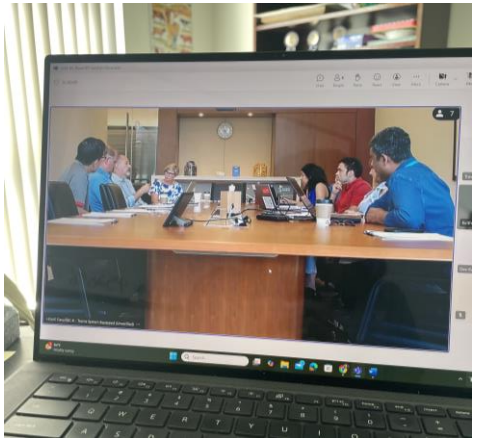
NC COOPERATIVE EXTENSION

sas

ECU
COLLEGE OF ENGINEERING AND TECHNOLOGY





Colby Sawyer & Dr. Chip Popoviciu (ECU)

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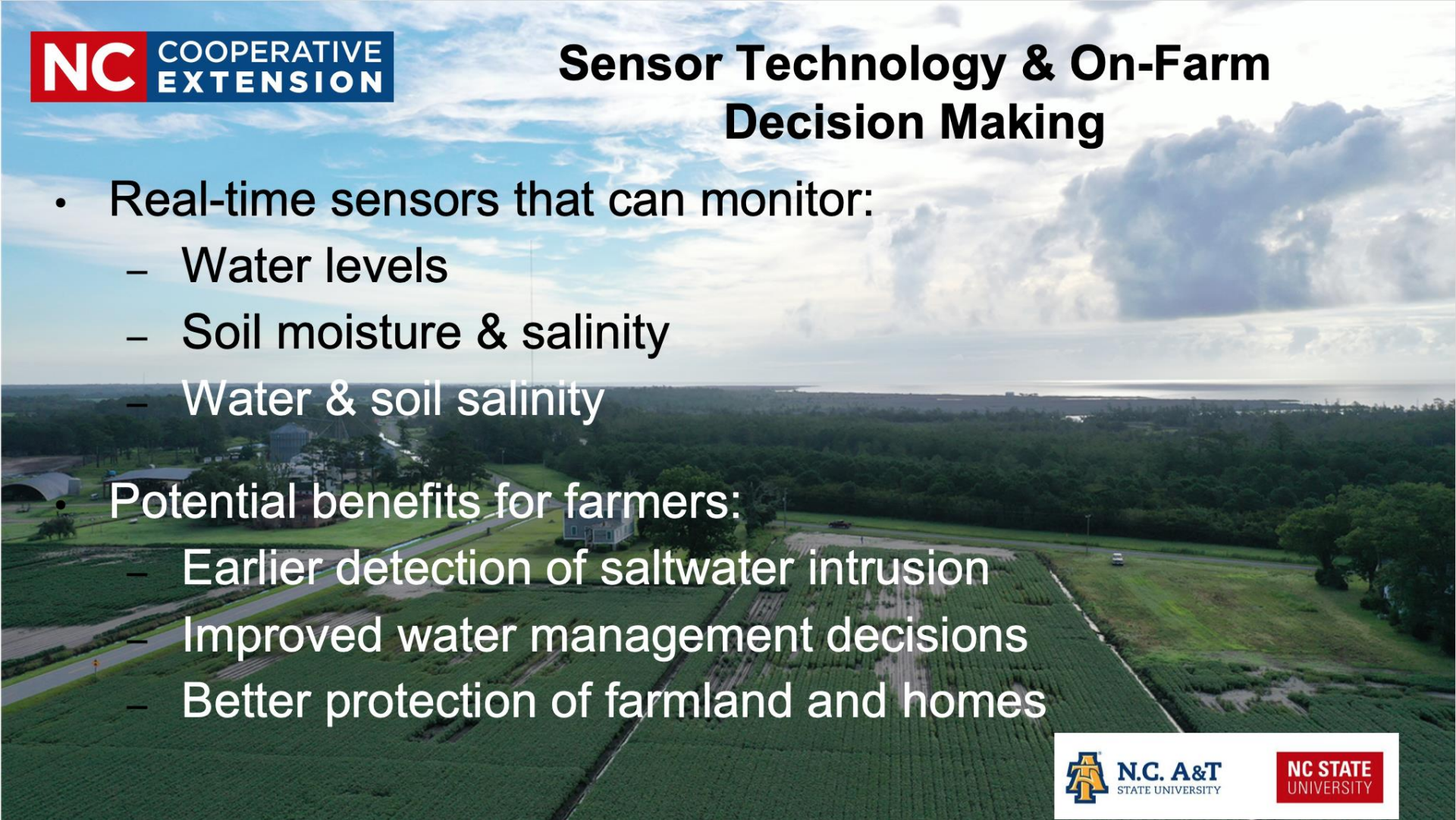
Sensor Technology & On-Farm Decision Making

- Real-time sensors that can monitor:
  - Water levels
  - Soil moisture & salinity
  - Water & soil salinity
- Potential benefits for farmers:
  - Earlier detection of saltwater intrusion
  - Improved water management decisions
  - Better protection of farmland and homes



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NC COOPERATIVE EXTENSION

Programs like the N.C. PSI Extension Agent Network help ensure:

- Rural communities are included in research and innovation
- Farmers help shape research priorities
- New technologies are beta tested in real-world ag systems to ensure that they are practical & useful.

This helps bridge the gap between research & implementation.

N.C. A&T STATE UNIVERSITY

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Thank you for supporting N.C. PSI initiatives like the Extension Agent Network

Andrea Gibbs

NC Cooperative Extension

Hyde County

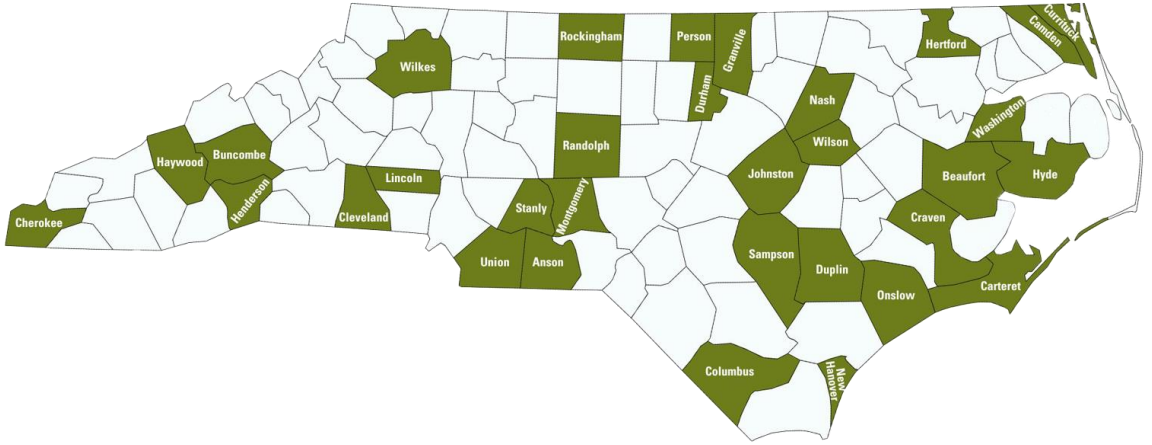
Karen Blaedow

Extension Agent, Agriculture - Vegetable and Small Fruit
Henderson County Center

Collaboration

- Access to Emerging Research & Technology
- Relationships with Specialists
- Breakdown of Work Silos
- Camaraderie Amongst Fellow Agents

The N.C. Extension Agent Network represents 32 different counties from across North Carolina.



Partnerships Beyond the Network

- Microneedle Patch Project Example
- Plant Disease and Insect Clinic
- NC State Micropropagation and Repository Unit
- NC State Strawberry Breeding Program

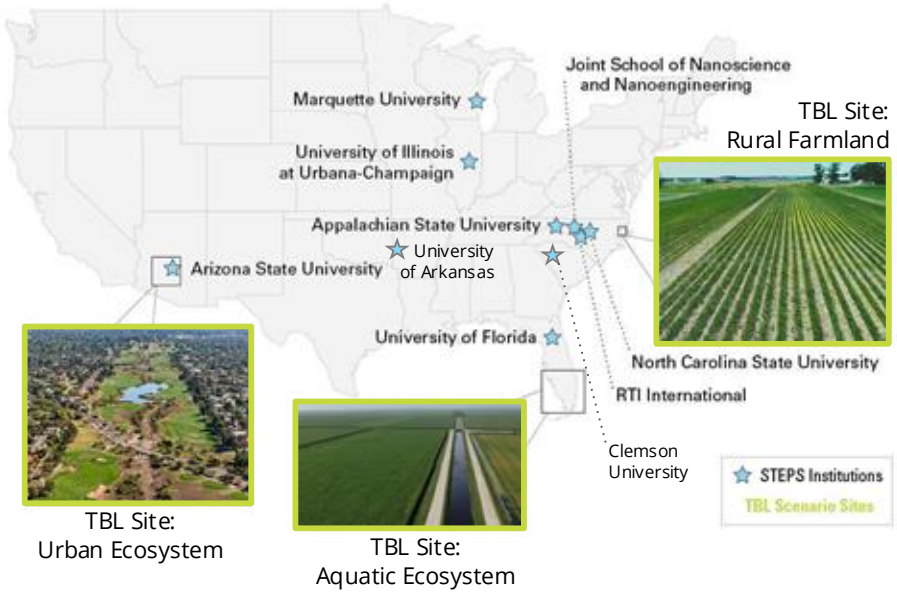
Collective insights for solving current and relevant issues

STEPS Cohort Team

Science and Technologies for Phosphorus Sustainability

Maude Cuchiara
STEPS Managing Director

Jehangir H. Bhadha
University of Florida



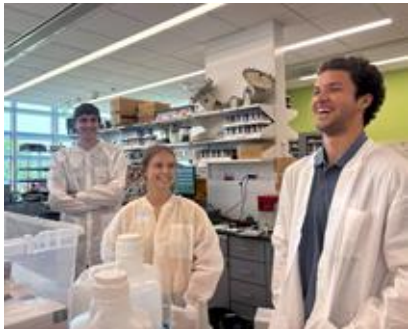
Meghan Baker
Extension Agent, Buncombe County, Agriculture - Small Farms

Karen Blaedow
Extension Agent, Henderson County, Agriculture - Vegetables & Small Fruits

Doug Clement
Extension Director, Cherokee County, Agriculture & Community Development

Sam Marshall
Area Specialized Agent, Ornamental Nursery & Greenhouse, Western Region

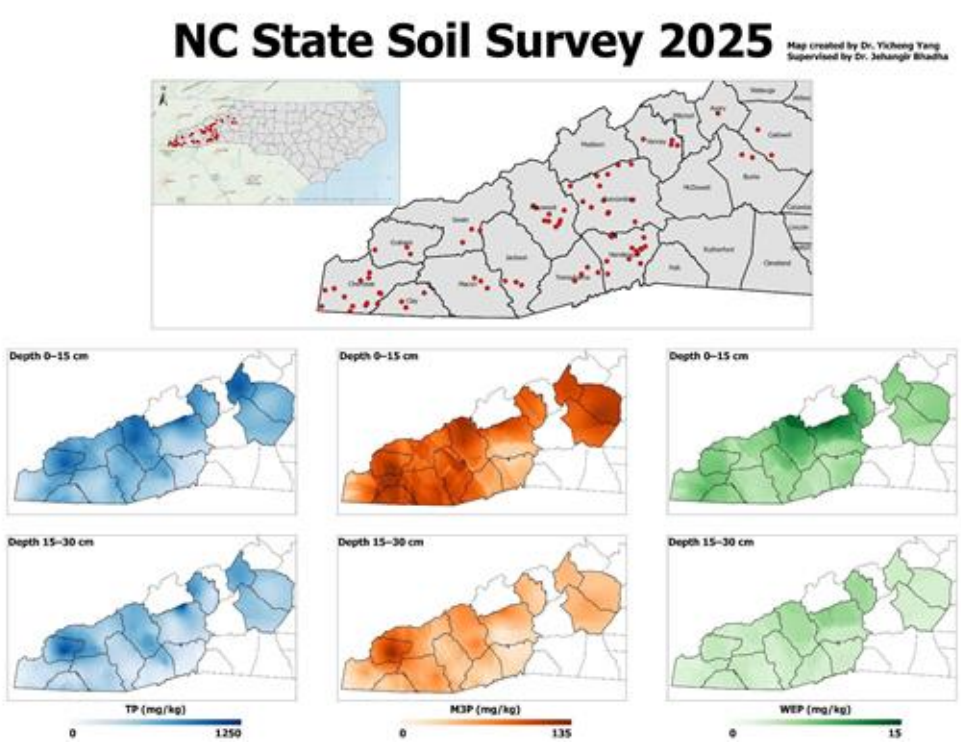
STEPS
Science and Technologies for Phosphorus Sustainability



NCSU Undergraduate Interns:

Anna Garner, Biological Sciences
Elliott Kohn, Biological Engineering
Nathaniel Rhein, Agroecology & Sustainable Ag.

Training The Next Generation



Yicheng Yang
Postdoc, University of Florida

STEPS

STEPS
Science and Technologies for Phosphorus Sustainability

NCSU PhD student Praneswar Ghosh's (PG) research in the Debjani Sihi Biogeochemistry Lab:

- Developed Nix Color Sensor to detect levels of phosphorus in soil
- Interns assisted with sensor calibration and testing
- Sensor is one of the first of its kind as an affordable and accessible field tool for growers
- 2026 STEPS Cohort - Expanded across NC

Timothy Kelleher

Roberts and Mikhail Distinguished Chair in Plant Genome Editing and Professor, Departments of Entomology and Plant Pathology and Horticultural Science


Tim Kelliher, Roberts & Mikhail Distinguished Professor
Department of Entomology and Plant Pathology,
Department of Horticultural Science
Genome Editing Center for Sustainable Agriculture
External Advisors
Eno River Farm
NORTH CAROLINA SWEETPOTATOES
NATURALLY HEALTHY
North Carolina Biotechnology Center
syngenta

My background

- Syngenta Seeds (2013-2025)
  - Head, Crop Traits and Technology Discovery
  - Key focus: Speed to market
- Stanford University Ph.D. in Biology (2007-2013)
  - Corn genetics and reproduction
- 2002 gap year spent working on farms in PA, NY
  - Inspired my passion for agriculture

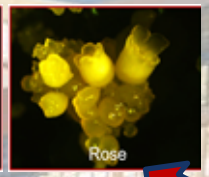
Genome Editing Center (GEC) for Sustainable Agriculture

GEC Mission:

- Shorten timeline to put genetic innovations in growers' hands
- Build a commercial research pipeline for crops critical to NC, and worldwide
- Foster innovation by collaborations with academics, public breeders, and industry
- Develop new plant gene editing tools

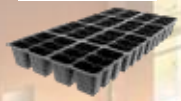
Plant Transformation Lab



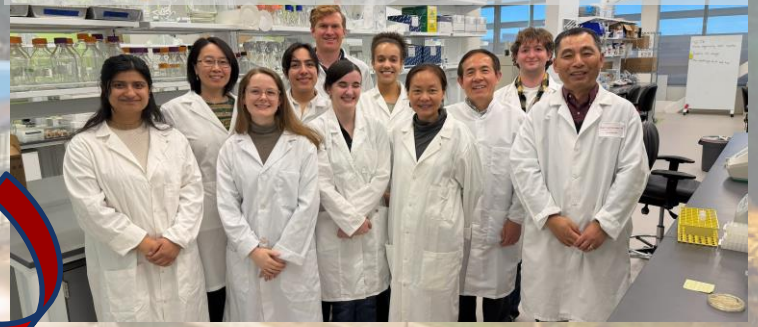



ARGUS CONTROL PERCIVAL

NC STATE PHYTOTRON

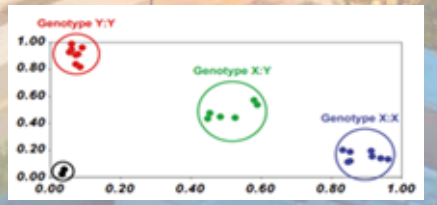



Timothy Kelliher, GEC Director
Roberts & Mikhail Distinguished Chair



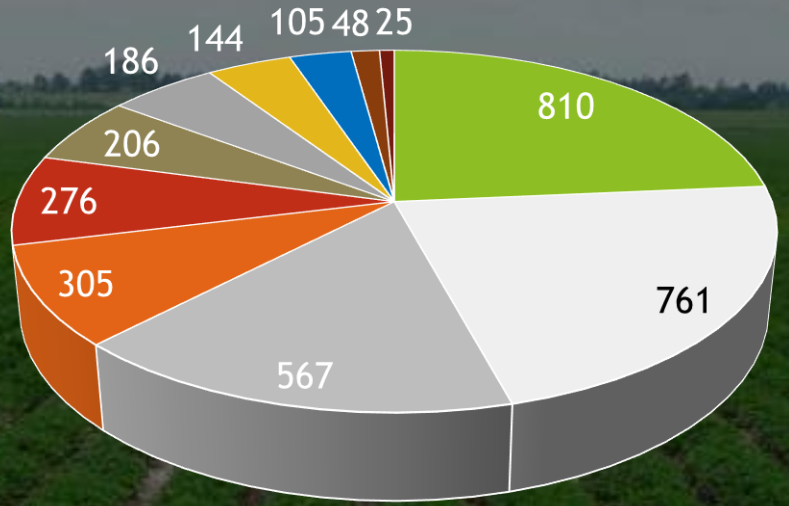
Ideas from labs working on 50 crops across the college of Ag and Life Sciences

Genome Sciences Lab





$M annual production value to NC

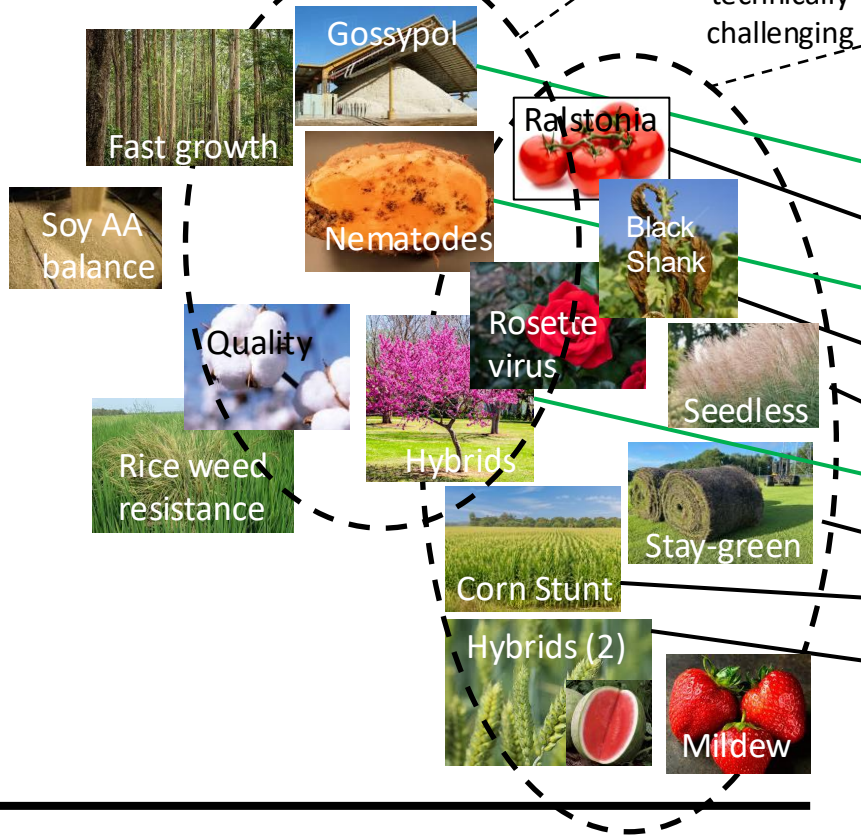


- We can edit the crops important to NC
  - Soybean, corn, tobacco, sweet potato, cotton, wheat, peanuts, blueberries, cucumbers/melons, tomatoes

Trait Matrix

Medium to long term
Higher value but more technically challenging

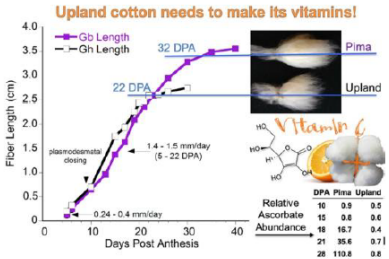
Quick wins – using startup funds, or applying for small grant support



Societal/reputational value	Economic value
Sustainability of US industry	Low
#1 gardener frustration	High – IP capture
Eliminating invasiveness	Low
Reduce water use on turfgrass	High – IP capture
Major disease coming to US	High – IP capture
20%+ yield improvement	Medium

Cotton: Improved Fiber Length and Quality

U.S. cotton is being outcompeted by Australia and Brazil: improved quality is a strategic opportunity.



Project overview – with Prof. Candace Haigler

Compelling preliminary data implicate Vitamin C synthesis as a major key to improving fiber length in cotton. Upland cotton composes 97% of the US crop despite its lower fiber quality compared to Pima, but Pima is more than twice as expensive to grow due to lower yield and high water demands. Our goal is to cause high-yielding Upland to produce high quality fibers like Pima. This is especially needed as water limitations restrict US Pima production in western states.

Why it matters

Farm gate value, ancillary services, products, and employment from cotton result in ~$120 billion value to the US economy, including in rural areas of the 17 states in the Cotton Belt. Recent prices for Upland have been <65 cents/lb while Pima fetches 170 cents/lb. Higher quality would allow U.S. growers to earn higher prices / bale, keep cotton fiber competitive with synthetic fiber, and make economical, durable clothing more available to consumers.

Resources to 1st milestone: $800k over 3 years (edited plants, greenhouse and field trials).

Sweetpotato Guava Root-Knot Nematode Resistance

Guava root-knot nematode (GRKN) is driving increasing crop losses and threatening profitability in the southeastern US.

Project overview – with Prof. Craig Yencho

GRKN is the most aggressive nematode pest, overcoming resistance effective against other species, leaving growers reliant on labor-intensive sterilization and chemical control. Durable host resistance represents a scalable, long-term solution. This project builds on the recent identification of a strong, naturally occurring resistance gene, delivering that resistance into highly susceptible cultivars like Covington, while preserving yield, quality, and storage traits.

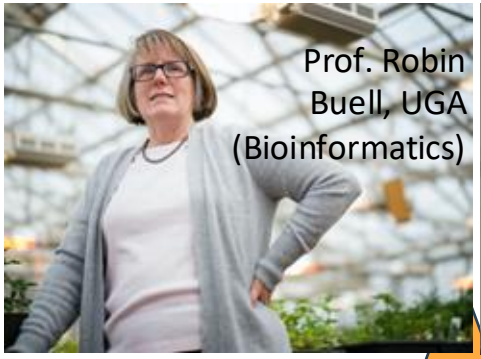
Top: GRKN infection
Bottom: Covington

Why it matters

Without resistance deployed by the clean seed program, nematode pressure will continue to increase production costs and reduce yields in a crop underpinning **>$5 billion** in farm-gate revenue. Covington is the most important US variety, as it is grown on 60% of US acres.

Resources to 1st milestone: ~$450k (gene synthesis, reagents, post-doc, field trials, IP)


Prof. Craig Yencho, Co-PI
(Sweetpotato Breeding)

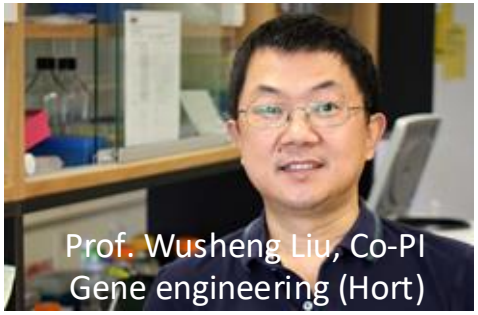

Prof. Robin Buell, UGA
(Bioinformatics)


Prof. Tim Kelliher
(Biotech industry)


Dr. Kedong Da, Co-PI
Biotech (Hort)


Dr. Nicole Juba
BCA


Bindu Upadhyay, PM


Prof. Wusheng Liu, Co-PI
Gene engineering (Hort)

A world-class team

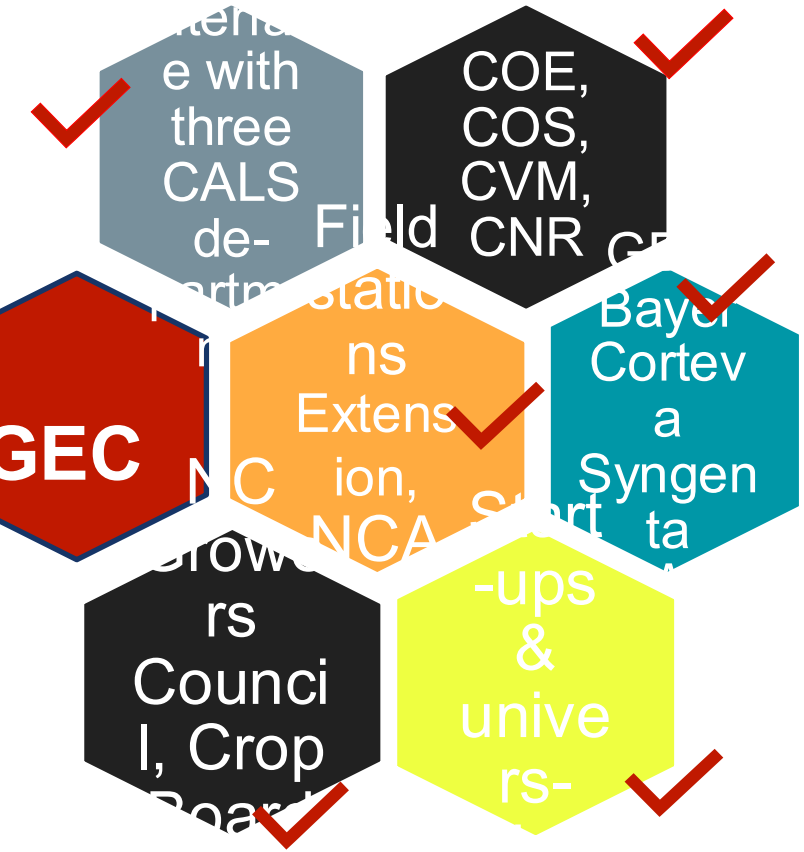

Dr. Simon Fraher, Co-PI
(Breeding / Genetics)


Prof. Adrienne Gorny
CoPI, Eextension


Ms. Michelle Grainger
NC SwP Commission
End User


Devesh Srivastava
PhD, JD
Tech Transfer Officer, ORI

Collaboration strategy – industry and academia



Who	Topic	Stage
Embrapa	Corn disease	NDA in review
Syngenta	(Best) Cas12a toolbox	Signed Res. Agreement
		Commercial pre-discuss.
Pairwise	Fulcrum toolbox	NDA signed, commercial license terms shared
Ginkgo	Mantis toolbox	
Corteva	Cas9	Haven't started
Profluent	OpenCRISPR	Sourcing sequence
Seed Partner	Wheat Hyb: 2 enabling technology aspects	Agreed to terms
CIMMYT/Gates		Pre-proposal
Instadeep	AI GE target discovery	
BASF, Bayer	AA balance in soybean	Ideas shared via NDA
Clemson (Saski)	Dicot elite editing	Proposal to USDA-NIFA
CRISPR startup	Elite line editing	NDA signed
Food Res (NZ)	Blueberry editing	Pre-discussion
Corteva	Editing in veg, wheat	Pre-discussion
CSIRO	Cisgenic tech	NDA shared (long delay)

N.C. Plant Sciences Initiative