Boots on the Ground 2: AI-Driven Tools for Maximizing Soybean Yield and Profitability

2025 Research Protocol

WI > Shawn Conley: spconley@wisc.edu, PA > Paul Esker: pde6@psu.edu OH > Laura Lindsey: lindsey.233@osu.edu, MI > Maninderpal Singh: msingh@msu.edu, IA > Joe McClure: joem@iasoybeans.com, NE > Nicolas La Menza: nicolas.cafaro@unl.edu, ND > Lindsay Malone: lindsay.malone@ndsu.edu, MO > Blake Barlow: bbarlow@mosoy.org, IN > Christian Krupke: ckrupke@purdue.edu, IL > Nicholas Seitler: nseiter@illinois.edu

PART 1 Agronomic Management Comparison

Project Summary

Participating farmers will be able to evaluate their present agronomic system (i.e. planting date, seeding rate, row spacing, use of foliar pesticides, and nitrogen rate) against Agroptimizer recommendations for their specific conditions such as soil type, tillage practices, seed, nitrogen, and pesticide costs and projected soybean selling price. Agroptimizer is open and free for any soybean grower in the North Central Region to use.

Agroptimizer on YouTube

Agroptimizer on the web

Participating grower and field identification

Complete by April 1, 2025

- Contact interested growers and schedule field visits to meet the grower and view candidate fields.
- Enroll a minimum of 5 fields per state
- Run Agroptimizer on several candidate fields to gauge interest and narrow treatment options.
- Consult with the grower to help identify the best treatments to try. Consider treatments that the grower is personally interested in trying and would have most value.

Candidate growers should have:

- An understanding and interest (enthusiasm!) in the project
- An understanding of our expectations of them and what we will do (Addendum 1)
- Equipment, technology, and expertise to plant and harvest the trial in a precise and timely fashion
- An understanding that data generated on their farm will be kept confidential and only released without any identifiers. Data and results may be used in UW Extension presentations and publication in scientific journals, with any identifiers redacted.

Criteria for selection of fields: (ranked in order of importance)

1. 5 acres or more (at least 500 ft length and 10 planter passes wide)
2. Mostly uniform soils with even drainage and slope
3. Crop, tillage and fertilizer application history available
4. Fields with previous yield history
5. No large historically wet areas, previous building sites, roads, internal fence lines

Additional criteria to consider with randomized block design and field layout:

Ability to harvest the entire width or a subsample of the width of one treatment combination. To assess this, please consider row spacing, planted width, and the harvester header width

Treatment comparison options

Final treatment selection is based on growers' normal practices and Agroptimizer recommendations for a particular field.

Planting date

Agroptimizer recommended vs earlier or later date, minimum separation is 10 days

Row spacing

Agroptimizer recommended vs your choice of wider or narrower spacing

Seeding rate

Agroptimizer recommended vs your choice of higher or lower rate

Foliar fungicide

Agroptimizer recommended vs your choice of application or not

Nitrogen rate

Agroptimizer recommended vs your choice of a higher or lower N rate, minimum N rate difference is 25 lbs N/a

Notes:

- Soybean variety will remain constant over all treatments
- There will only be two treatments. One is the standard practice and the other is the Agroptimizer recommended practices
- 1 to 5 treatment combinations can be picked for the Agroptimizer treatment. The strength of Agroptimizer is in optimizing cropping systems, try to avoid testing only one or two management practices if possible. Pick 3 at minimum if possible.
- Two treatments x 3 reps = 6 total plots. More reps can be used if space permits
- UW CoolBean team can assist in applying foliar fungicides and/or granular nitrogen with a drone if those are selected as the treatments
- If post planting nitrogen and/or foliar fungicides are chosen as the only treatments, the field can be bulk planted, and application(s) and plots boundaries can be imposed later.
- Experimental design will be optimized to capture environmental and field variables and replicated a minimum of three times in the field

Field experiment initiation and data collection

April to November 2025

Data collected before, during, and after the growing season will be performed by UW personnel using Open Crop Manager (OCM) (https://open-crop.vmhost.psu.edu/) as a record keeper.

After emergence, field scouting will commence, and in-field data will be collected using OCM in random patterns across each treatment plot. In addition to in-field scouting, information will be collected on field and input management, such as planting date, soybean variety, tillage method, and inputs (seed, fertilizer, foliar product + application cost, etc.) and yield for each treatment.

Finalize all data collection by Dec. 1, 2025.

Addendum.7

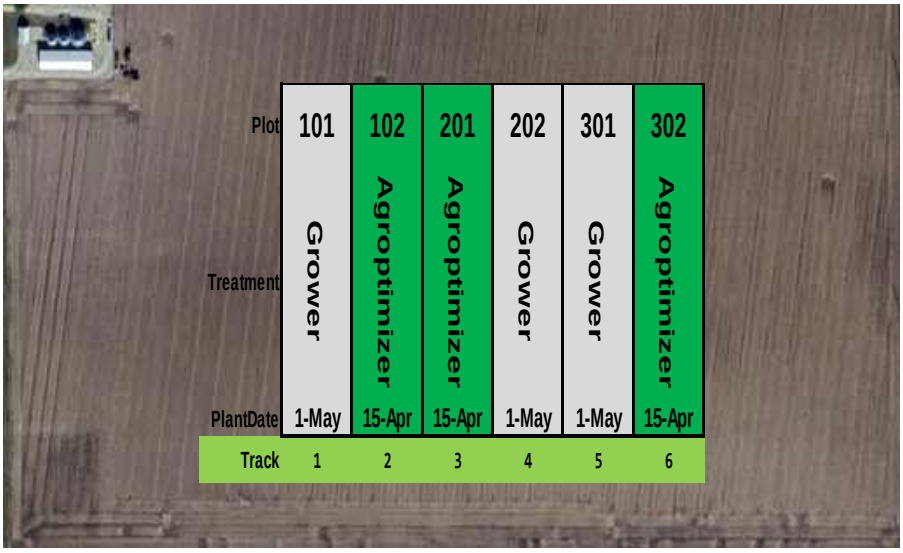
Research agreement between growers and project coordinators

Growers' responsibilities or What we expect from you:
Agree to be part of this field research project
Sharing of your knowledge of the field
Tillage prior to planting in either spring or fall using specified tillage treatments
Plant soybean crop using specified row spacings
Manage the crop for high yields
Apply herbicides for weed control
Restrict unnecessary wheel traffic in field
Keep field records on major input and management factors such as varieties and pest control
Properly calibrated yield monitors (weight and time delays) on combine
Harvest the research study so that data integrity is maintained
Transfer as-planted and harvest yield data to UW Bean Team
Contact us if you see anything that needs attention or have questions

UW Bean Team responsibilities or What you can expect from us:
Pre-season visit to discuss the project
Pre-season site visit to identify area(s) to be used and discuss tillage methods
Pre-plant visit to discuss final planting plans and details
Assistance in setting up field randomization
Scouting visits to the field throughout the season
Communication about status of project, crop condition, and answers to questions
Assistance in downloading yield data from combine monitor or desktop application
Share the conclusions of our research with you

Addendum.8

Example field layout for a planting date treatment. All other management practices are kept the same for both treatments in this example.



PART 2 Field Scouting Alert System

Project Summary

The proposed project aims to test and validate Open Crop Manager (OCM), a cloud-based management decision support tool along with satellite-assisted field scouting alerts in farmer fields across the NC-US region. We developed a new tool that uses Sentinel-2 satellite images and automatically extracts the Normalized Vegetation Difference Index (NDVI) for every 60 x 60 ft section in a field. We hypothesize that these can be used to guide precision scouting efforts throughout the growing season.

Participating grower and field identification

Complete by May 1, 2025

- Contact interested growers and schedule field visits to meet the grower and view candidate fields
- Enroll a minimum of 5 fields per state
- Fields should be in soybean in 2025, larger than 10 acres, planted and maintained uniformly, with easy field access
- Growers should be able to provide yield data from a yield monitor at the end of the season
- Enter field boundaries in OCM

Scouting procedure

Commence after emergence and complete by growth stage R6

- Visit the field and scout every 2-3 weeks throughout the season

Normal scouting

- Start with an overview of the field looking for any unusual patterns or odd areas that may require a closer investigation
- When walking through the field, have a general scouting plan and walk through the field in a pattern such as a “Z” or “W” pattern, or a diamond pattern to make sure you get a good observation of what’s happening across the field. Change up the route you take through the field each time
- As you traverse through the field, stop at several different points along your route and take a closer look at the plant level
- Use OCM to capture scouting data taking pictures along the way

Targeted scouting

- Using downloaded latest satellite imagery for the field visit areas with low NDVI and try to diagnose the cause of the poor plant health
    - Using the maps below as an example, begin in the red areas in the 5% quantile and move out from the center of the red area and document any plant health stressors
- Targeted assessment will be for biotic (insects, weeds, diseases), growth stages, and abiotic (drought, flood, nutrient deficiency, etc.) stressors
- Continue through each field and document your observation points in OCM