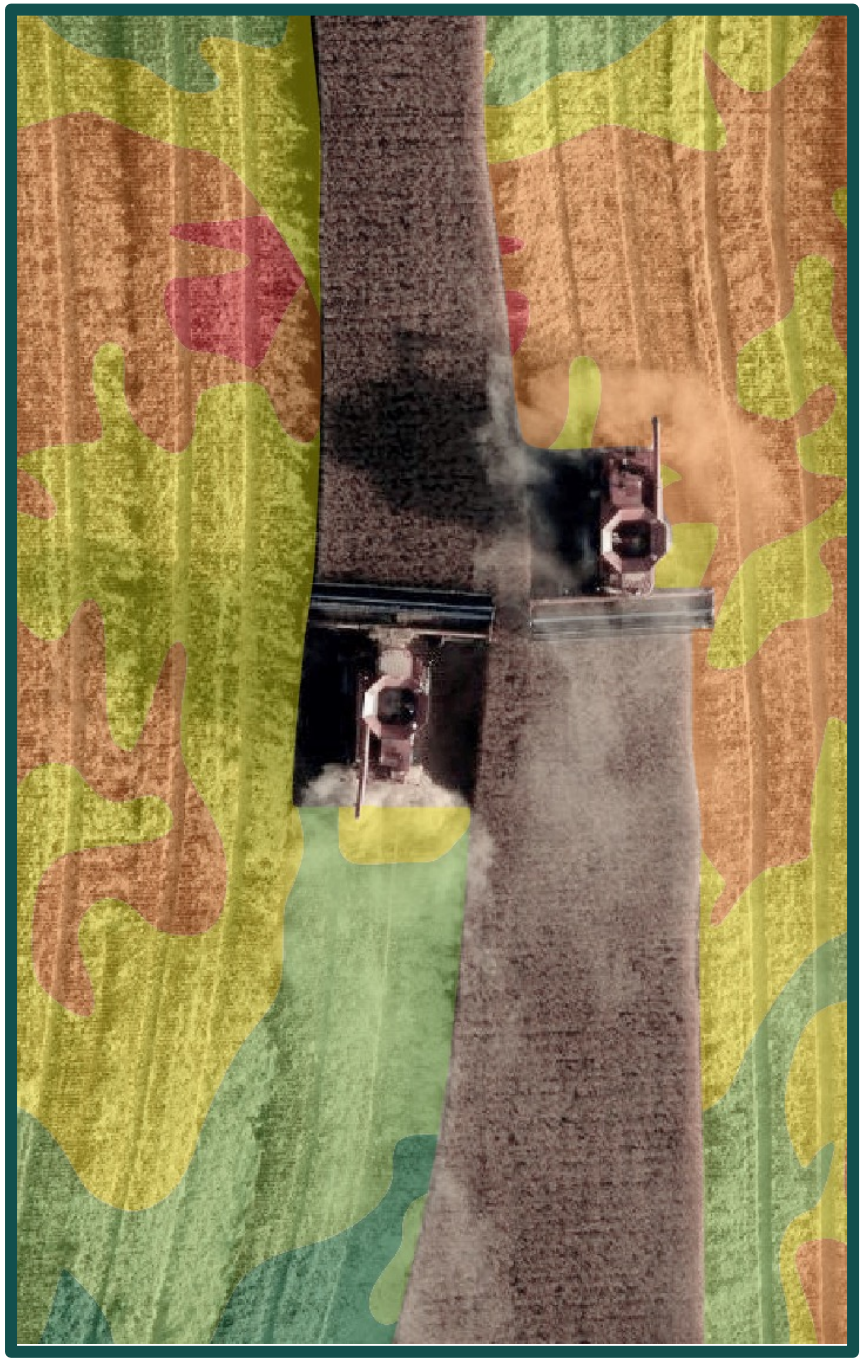

Mapping Soybean Protein and Oil Quality in Farmer Fields

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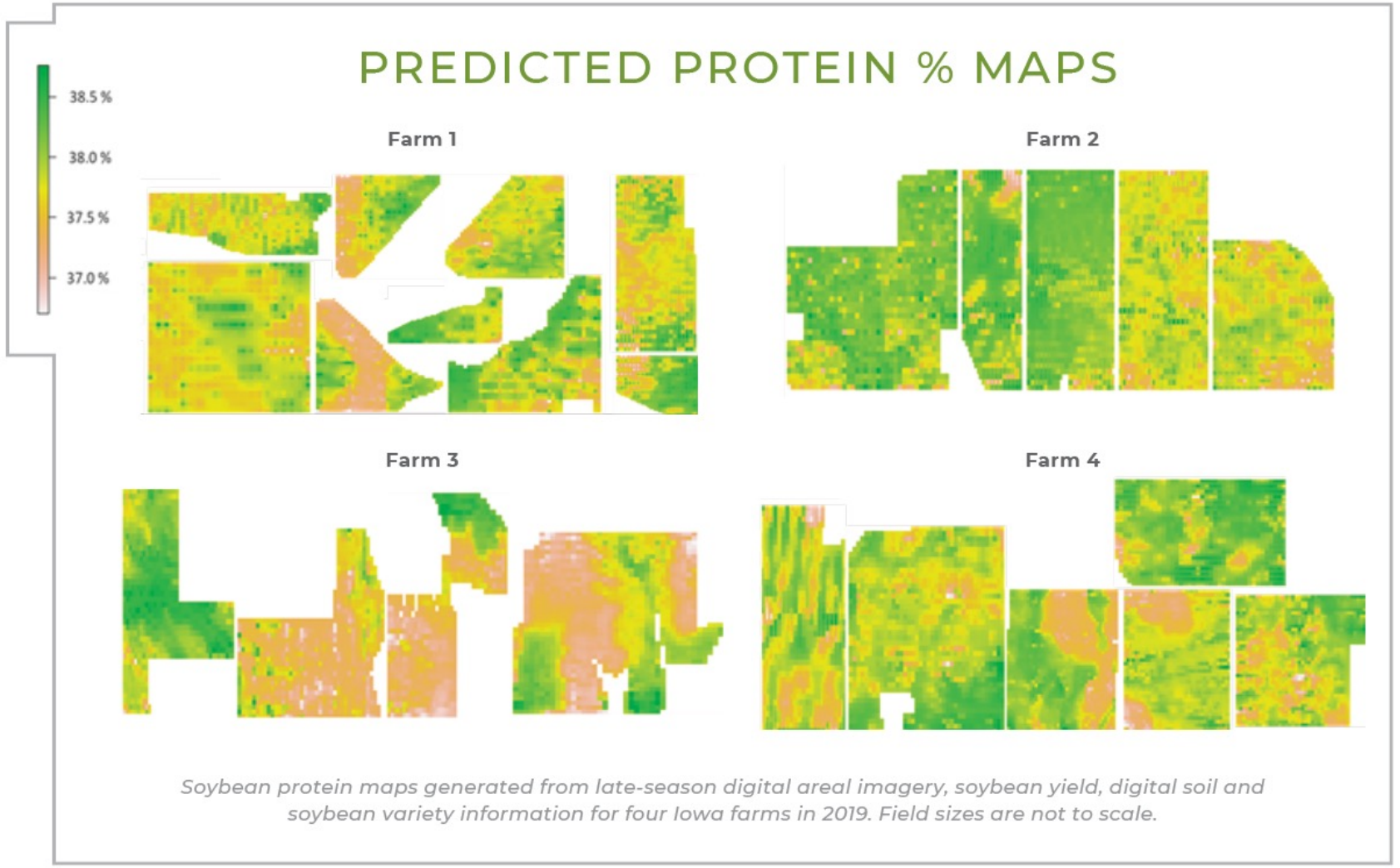
NCSRP NORTH CENTRAL SOYBEAN RESEARCH PROGRAM

OUR SOY CHECKOFF™

Opportunity for segregation of soybean seed quality within a field

Changes within-the field of protein in farmer fields at harvest time, using combine protein sensor.



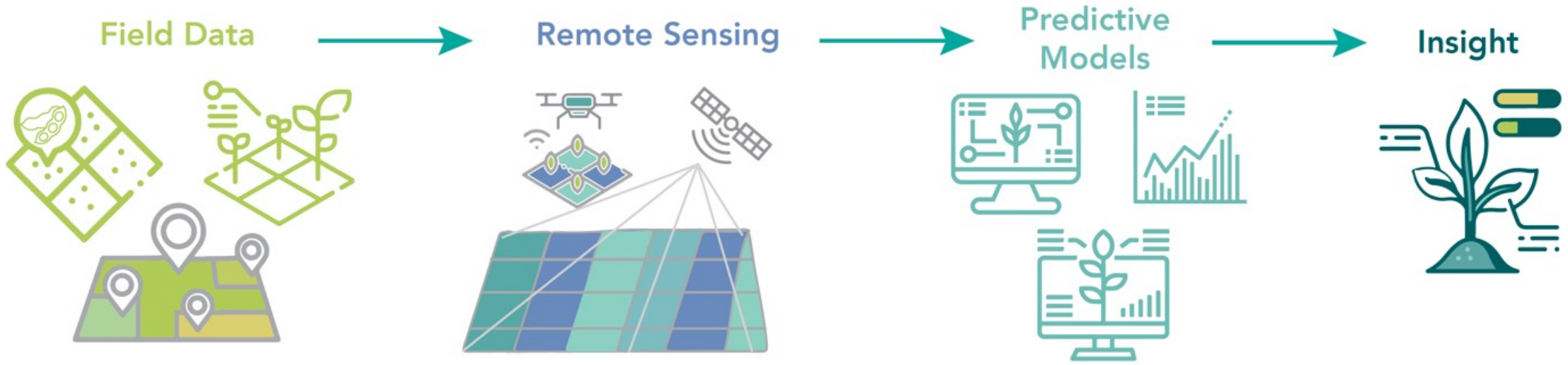
Soybean protein maps generated from late-season digital areal imagery, soybean yield, digital soil and soybean variety information for four Iowa farms in 2019. Field sizes are not to scale.

Iowa Soybeans, 2021

Outline

Description of Goals

Development of a multi-state database to allow upscaling of soybean quality predictions to regional levels and benchmark agronomic practices, soybean genetics, and environmental conditions that can lead to large-scale improvements in soybean quality.

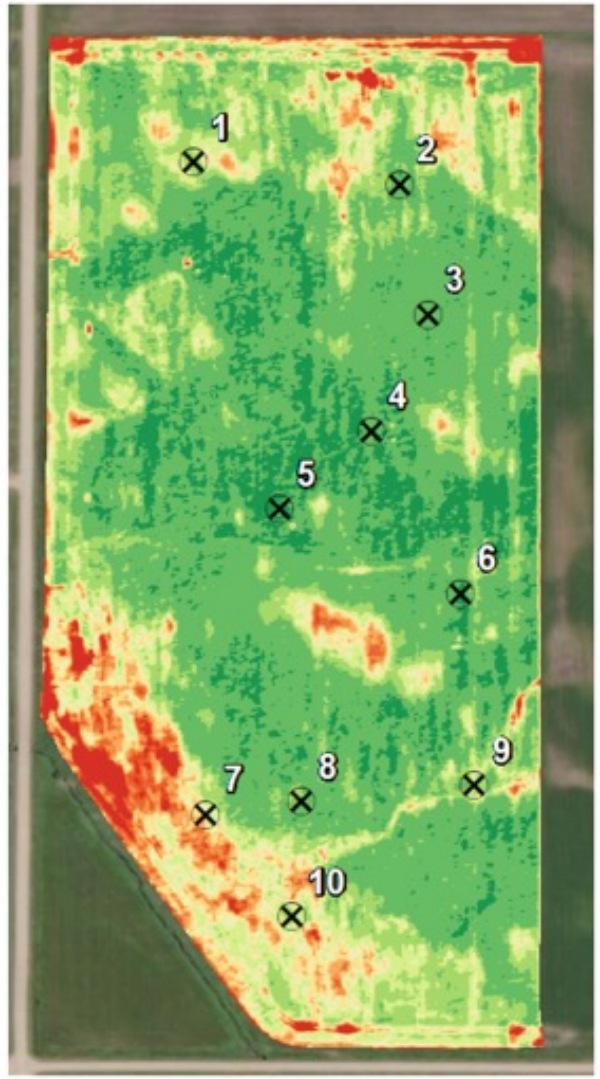


Framework of data processing and development of soybean mapping quality tool.

Development of a multi-state database

Development of a farmer field-scale protocol for sampling soybean seed quality.

A protocol was established using available satellite data from past years and for defining zones within a field with different productivity to “direct” the sampling for seed quality.



Field sampling protocol based on aerial imagery of soybean canopy and soil type.

Development of a multi-state database

Protocol for data collection and clustering

1) Select available images between "May" and "September" (growth time), from the last 3 years.
2) Build a database and apply Kmeans to find the best clustering.
3) Build a new database for each best cluster (e.g., 1, 2, 3).
4) Define the optimal number of samples based on geostatistical analysis through the parameters: "range" and "total area of the cluster". If the result is less than 2 samples per clustering, set 2 as the number of samples.

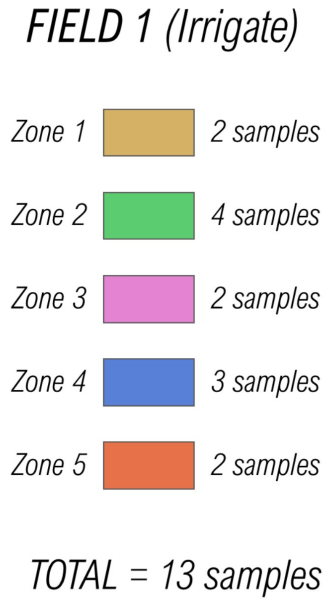
==========

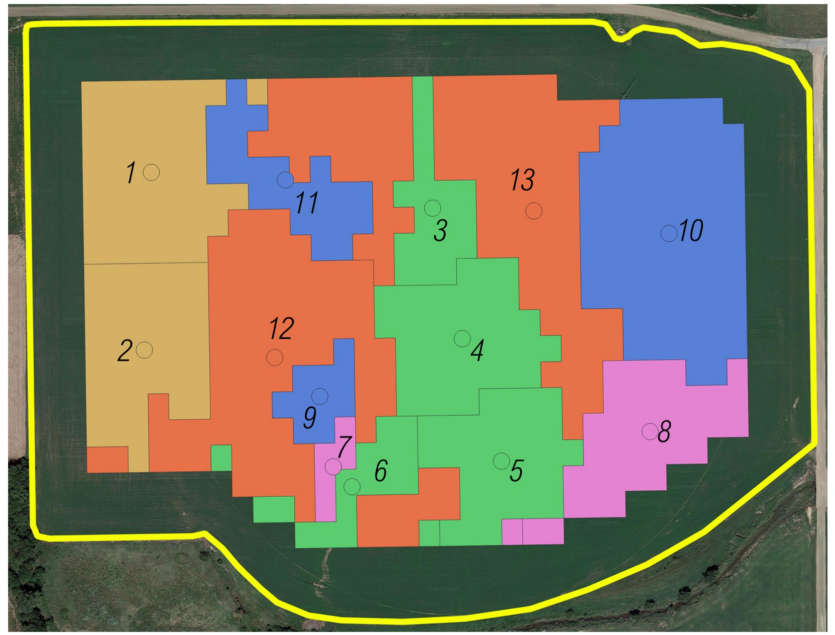
Field sampling protocol for mapping soybean seed quality

•Field selection and data collection (satellite imagery from 3 years)

•Clustering process, number and optimal management zones

•Optimal number of soybean quality seed samples based on clusters





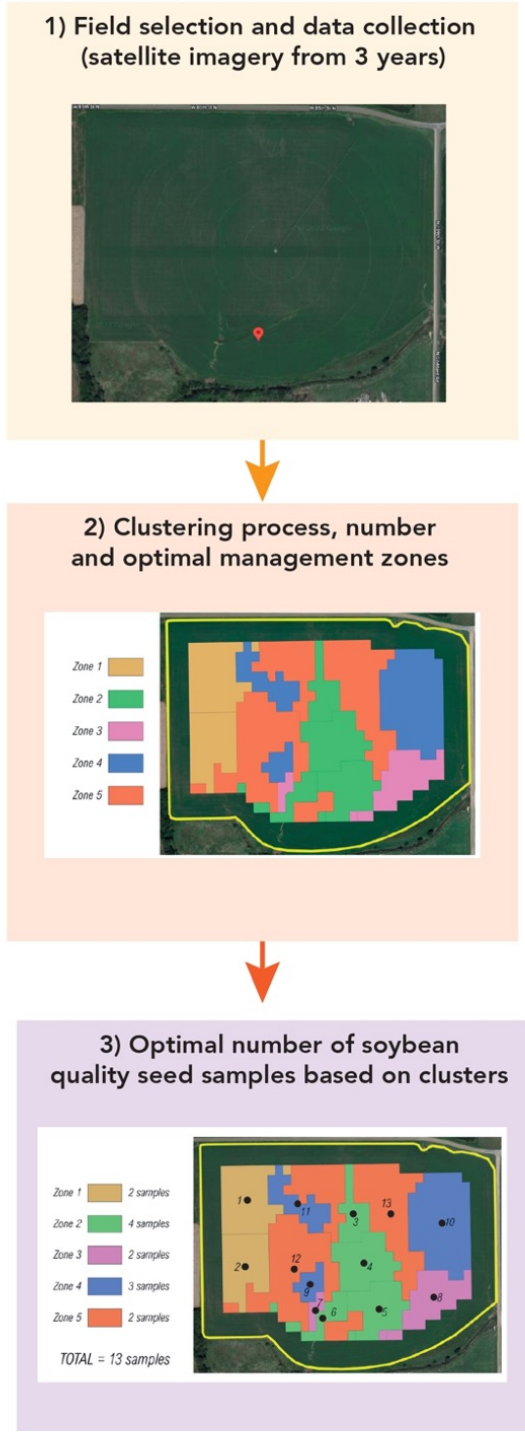
Development of a multi-state database

All field locations are received by early-to mid- summertime.

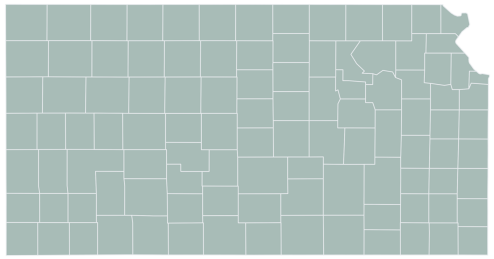
The data is processed (integrating past yield, soil, satellite data)

A clustering of field variation developed

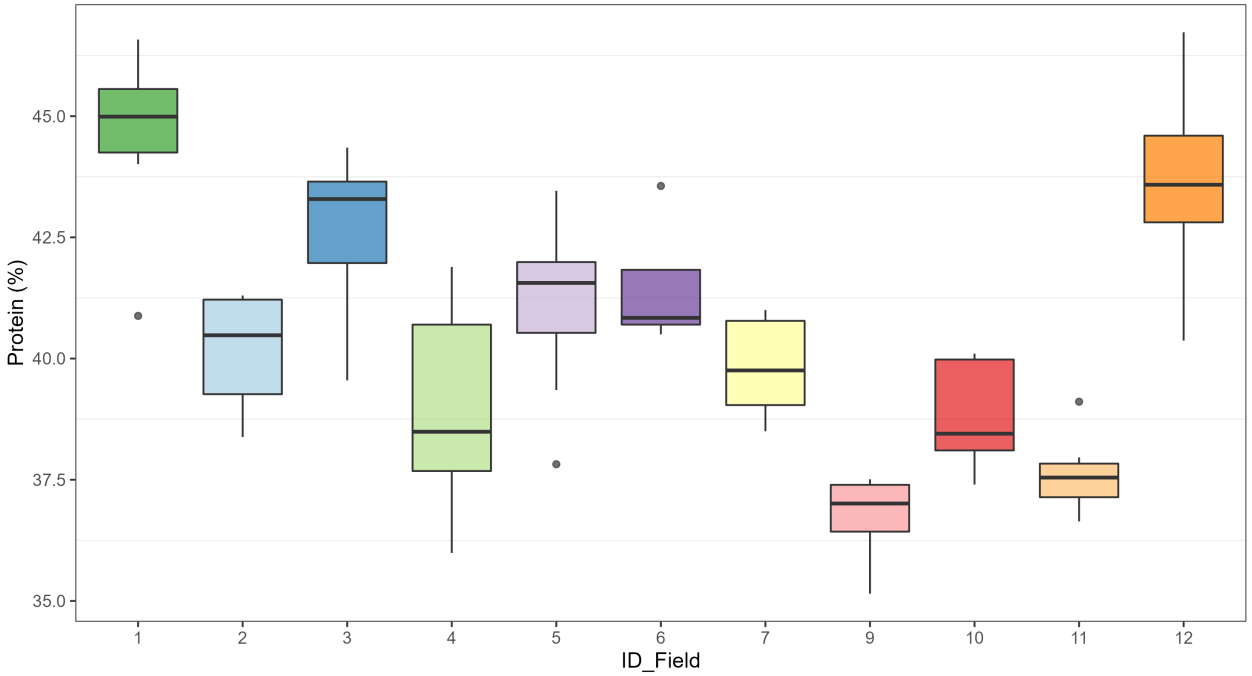
Field sampling guided to collected variability of soybean seed quality



Kansas

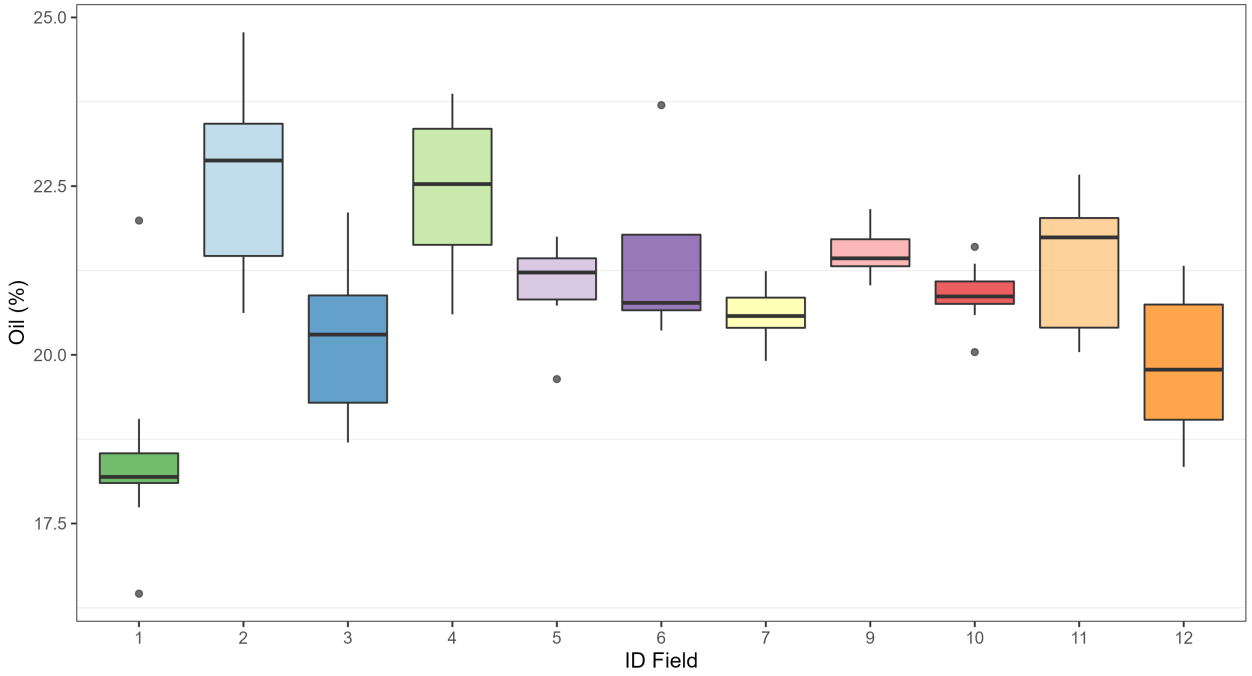


Soybean **protein concentration (%)** in each Kansas field



NIR Analysis

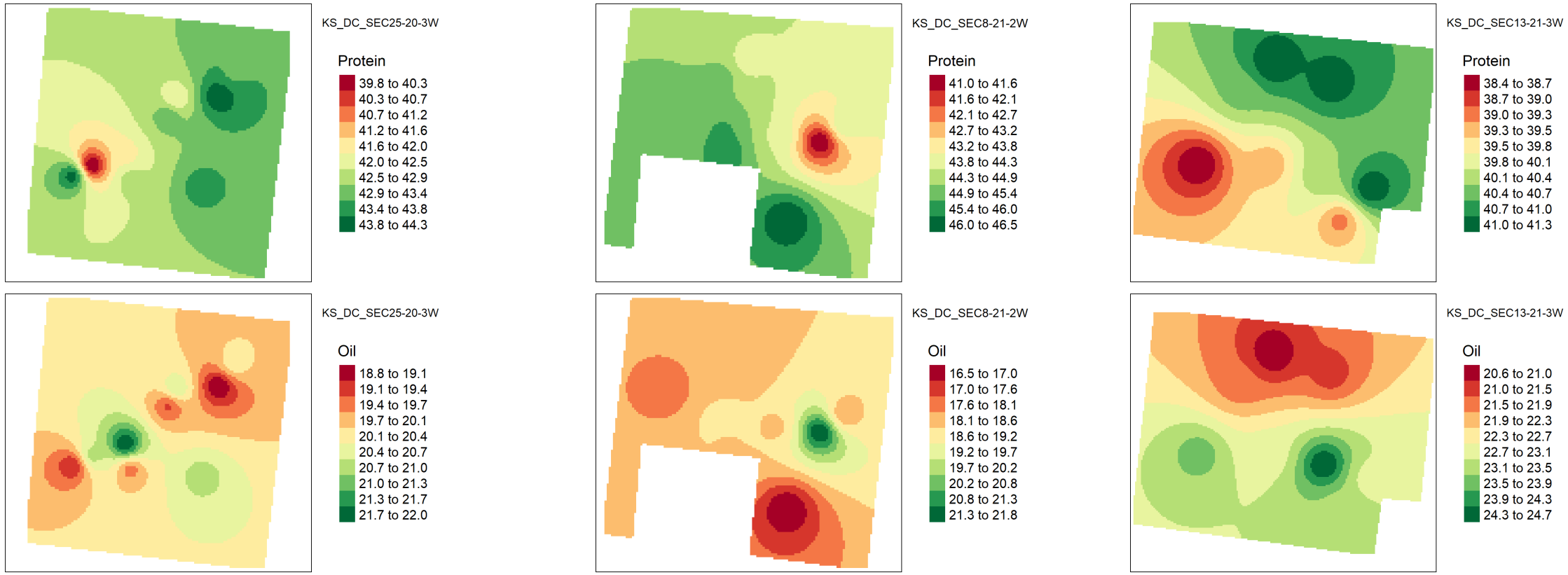
Soybean **oil concentration (%)** in each Kansas field



NIR Analysis

Development of a multi-state database

Oil-Protein (%) by different zones of the field

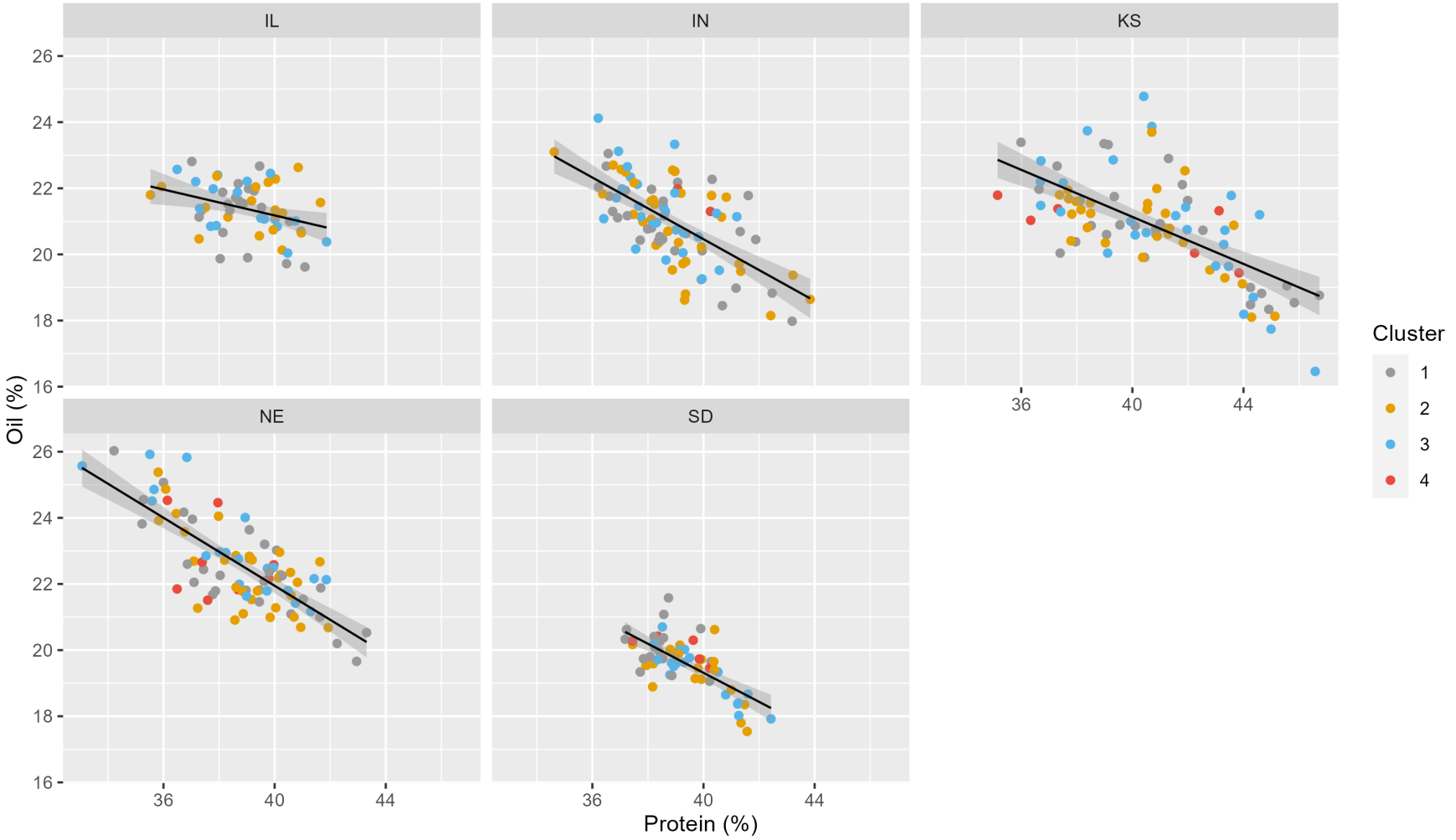


Protein levels can broadly range in different areas of the field (from 38 to 44%) with similar changes for oil concentration (16 to 24%) – with large spatial variations within a field!

Development of a multi-state database

Oil-Protein (%) relationship by cluster (different zones of the field) and by state

The reported ‘trade-off’ between oil and protein is stronger in many fields (states), but there is variation with potential for better protein and oil levels.



NIR Analysis

Development of a multi-state database

This project will retrieve relevant management data from farmers to guide future research investigations focused on improving soybean quality for farmers across the country.

Relevant management data for +90 fields in year #1 is currently collected to connect with soybean seed quality, soil and climate variation.

Mapping Soybean Protein and Oil Quality in Farmer Fields

ignacio.a.ciampitti@gmail.com (not shared) Switch account

* Required

Email

Your answer

Indicate your State *

Your answer

Planting Date in this field *

MM DD YYYY

/ /

How do you want to describe this field location? *

- Specify by Section: Township: Range
- Specify by GPS coordinates of field centroid

Specify by Section: Township: Range

Your answer

Specify by GPS coordinates of field centroid

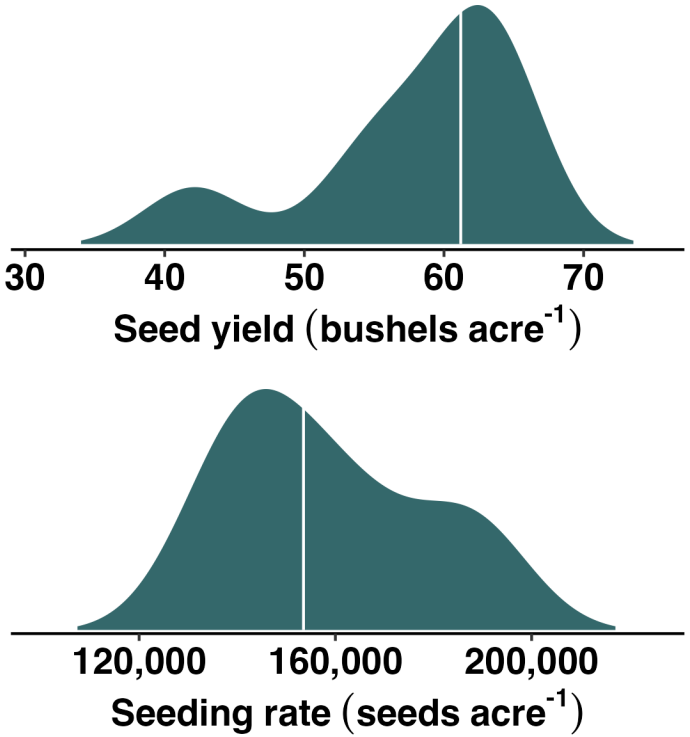
Your answer

Development of a multi-state database

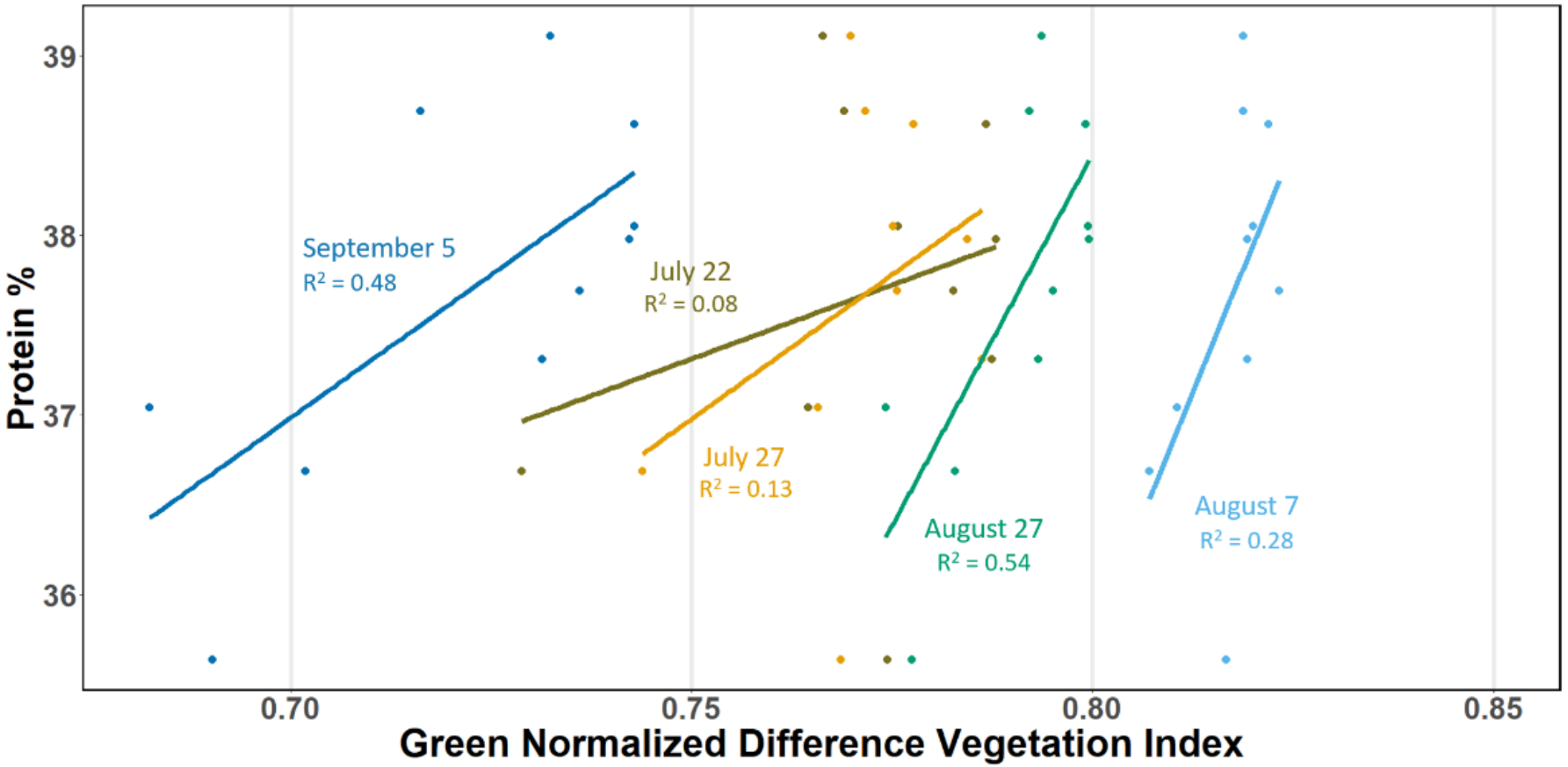
8 out of 91 answered: Michigan (6), Ohio (2)

- Planting date — Early may (50%), Late may – early June (25%), Late June (25%)
- Drainage — Tile (63%), surface (13%), none (25%)
- Row spacing (in) — 15 in (75%), 7.5 in (25%)
- Previous crop — 100 % corn
- Tillage — Till (88%) – No till (12%)

- All dryland



Technologies for assessing yield-quality and other traits



Iowa Soybeans, 2021

Relationship between Green Normalized Difference Vegetation Index (GNDVI) and soybean protein with temporal calibrated aerial imagery taken on July 22, July 27, August 7, August 27 and September 5 in 2019 in Iowa. Late August and early September imagery can be used to predict protein (Iowa Soybean Association).

Is this research and information relevant for farm
Survey 2020-2021

Do you know the current oil and protein levels in your harvested soybear

***R:* The 84% of farmers are not aware of the oil or protein concentratio**

Would you like to know more about how you could manage your soybear concentration?

***R:* The majority of farmers (71%) are opened to learn how to improve whereas 22% have no interest. Only 13% have no opinion or did not a**

Would protein levels be important to you if you could receive a price diffe increase profit?

***R:* The great majority would consider to manage for quality, if a premiu of farmers think $0.50 per bushel is a reasonable deal.**

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Agronomy Journal

FORUM

Soybean management for seed composition: The perspective of U.S. farmers

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Abstract
The soybean [*Glycine max* (L.) Merr.] compositional quality is mainly provided by the seed concentration of protein and oil. These traits are critical for sustaining global use, and although there is demand for high protein soybean, no mechanism to differentiate production is in place. At the opposite end of the supply chain, farmers are remunerated on a mass basis without having any incentive regarding seed composition. This study evaluated farmers' perspectives and knowledge on soybean quality and their propensity to adopt quality improvement technologies. Farmers from the main U.S. producing regions ($n = 271$) were investigated with a self-administrated survey containing 21 questions during 2020 and 2021. Our results show that 84% are unaware of the current protein and oil levels from their own production. A small portion (1.4%) make management decisions (e.g., choice of genotypes or monitor quality) based on the implications on seed quality. However, practices already in place are likely to enhance the quality of seed, namely N nutrition (via rhizobia [12.9%] or fertilizer [5.9%]) and late-season crop protection (17.1%). If farmers are financially rewarded by US$0.50 per bushel, a mindset change may occur. Based on these results, we concluded that shifts in the U.S. production system targeting protein or

https://doi.org/10.1002/agj2.21082

Current results

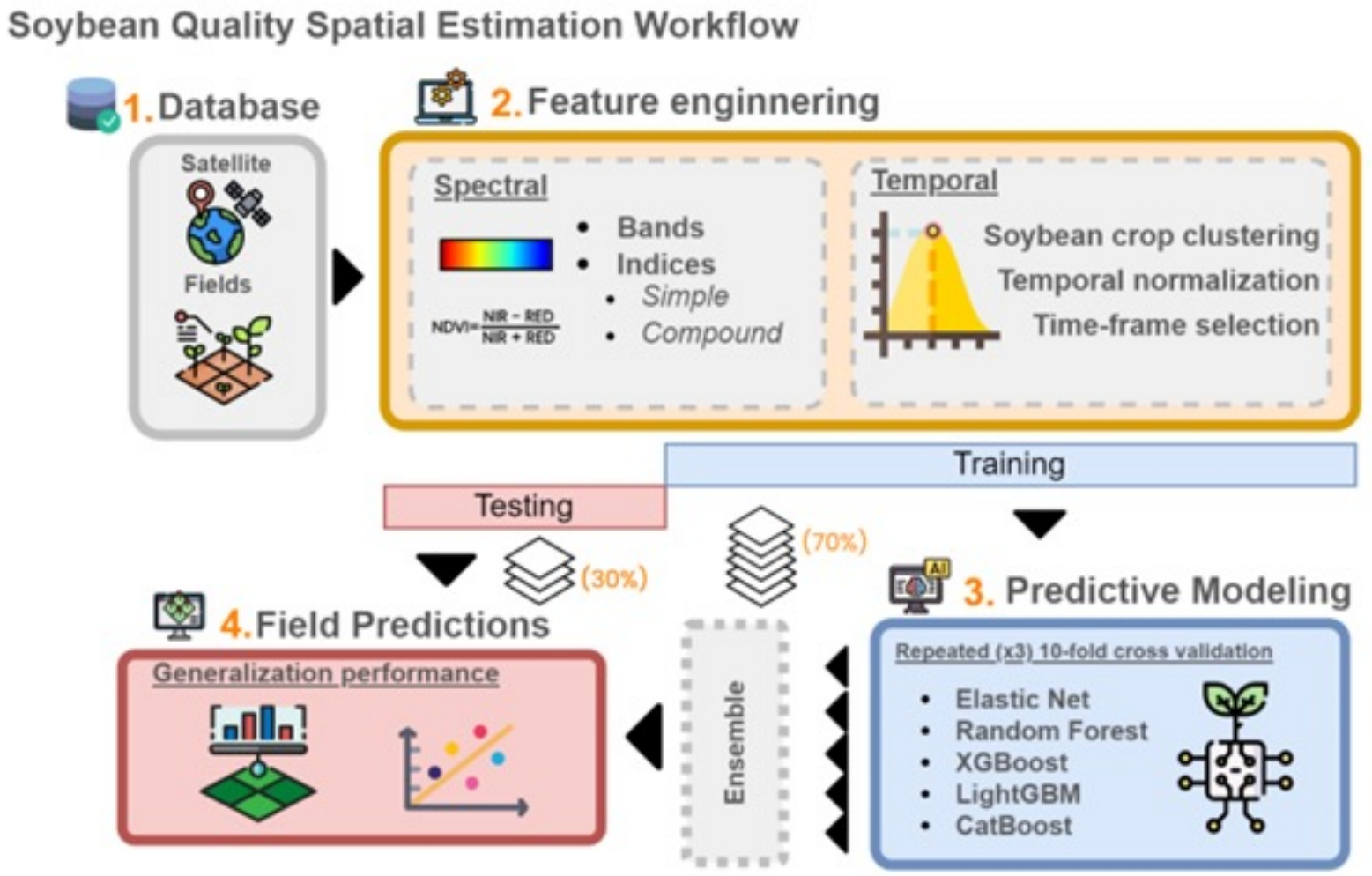
Field predictions before harvest time

1) On-farm data collection

2) Satellite imagery

3) Algorithm development

4) Predictive Models

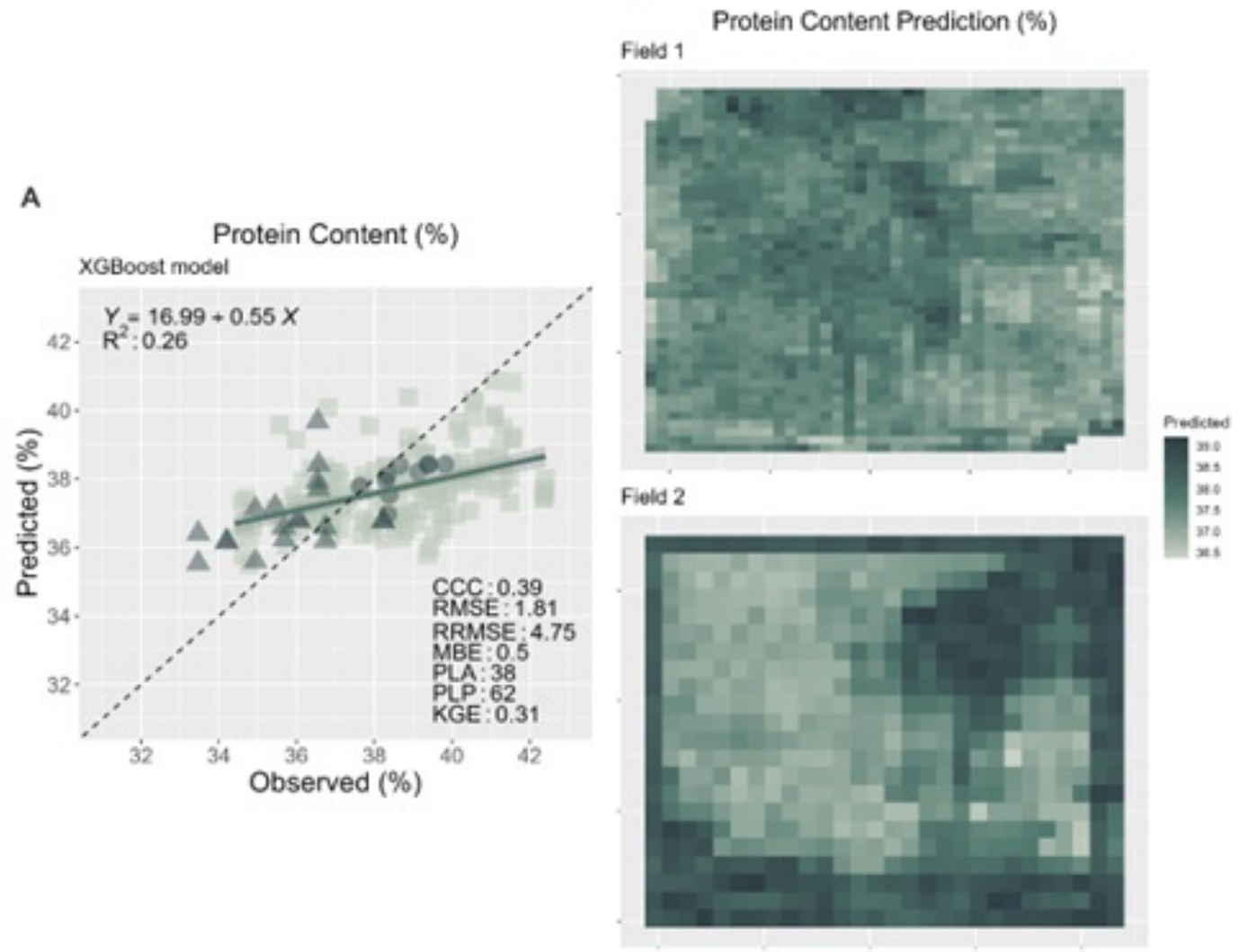


Hernandez, et al., Ciampitti, 2023

Current results: Protein Prediction

Field predictions for Protein concentration

In overall, the protein prediction was achieved several weeks before harvest with an error of close to 1.8% for protein concentration.



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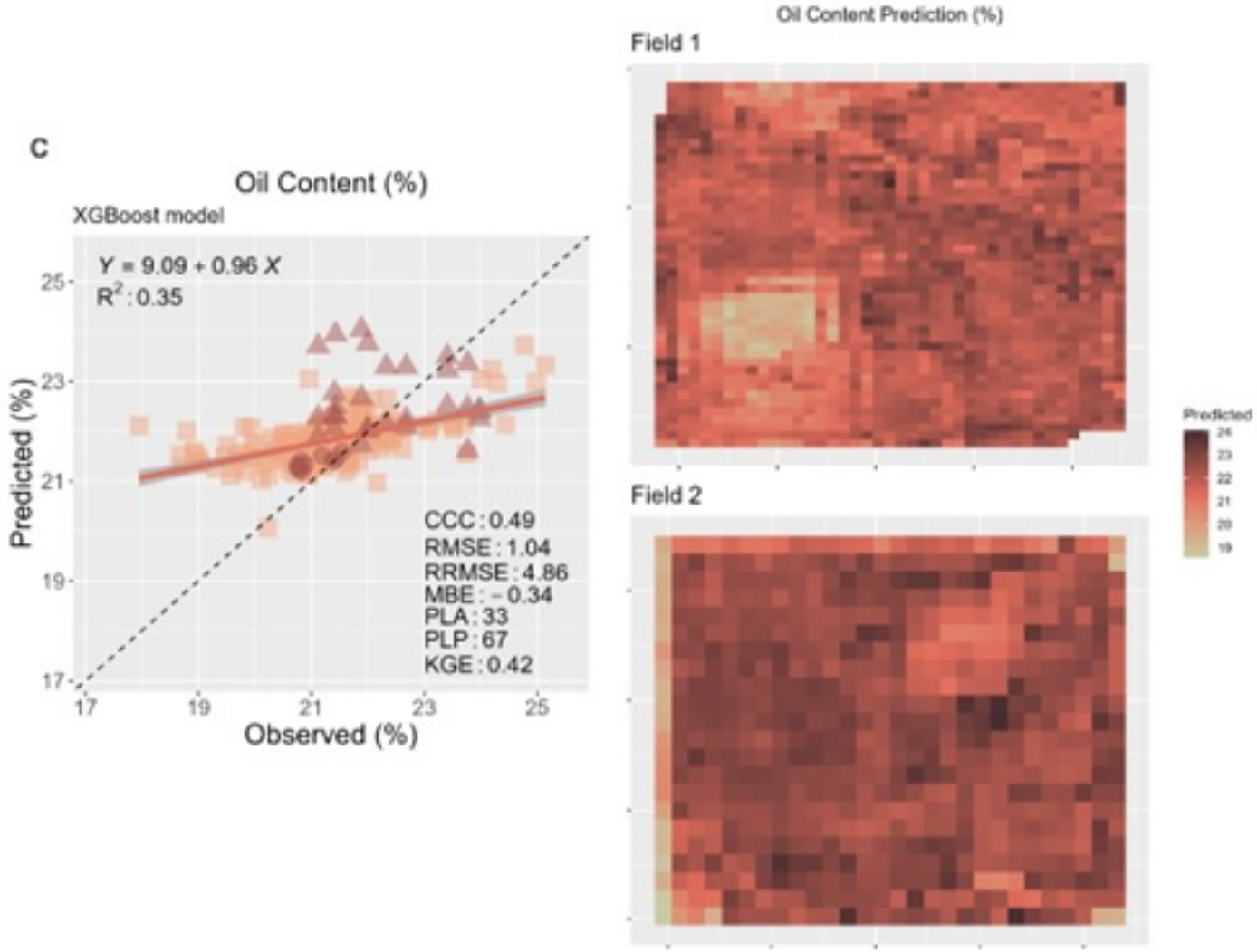
Current results: Protein Prediction

Field predictions for Oil concentration

In overall, the oil prediction was achieved several weeks before harvest with an error of close to 1.0% for oil concentration.



Hernandez, et al., Ciampitti, 2023

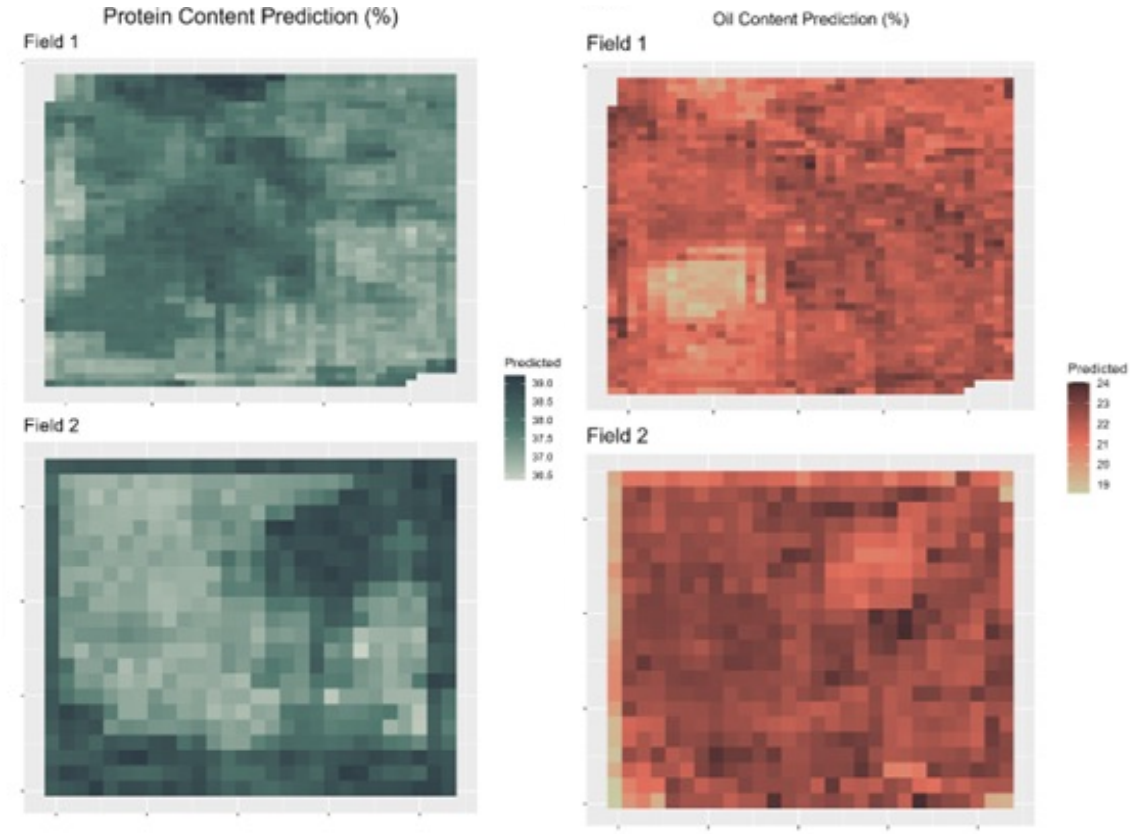
Next Steps Soybean Quality Field Mapping Project

- Processing all seed quality, soil samples, and management data from all (2022) +90 fields

- Connect the field database with satellite data and weather information to develop predictions

Future management use of this data/project:

- Timely characterization of seed quality at harvest will guide protein segregation at the farm-scale,
- Improve the estimation of nutrient budgets, minimizing environmental impacts, and
- Provide a foundation for improving fertilization plans for the following crop in the rotation.



Hernandez, et al., Ciampitti, 2023

Thanks for your time!

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