Decision-Support Tool Development at the Nexus of Statistics and Programming for Better Integration of Research with Extension

Wesley France[1,2], Aurelie Poncet[1,2], Larry Purcell[1,2], Trent Roberts[1,2], Jason Kelley[3]

[1]Department of Crop, Soil, and Environmental Sciences, University of Arkansas, Fayetteville

[2]Arkansas Agricultural Experiment Station, University of Arkansas System Division of Agriculture, Fayetteville

[3]Cooperative Extension Service, University of Arkansas System Division of Agriculture, Little Rock, AR

Project Timeline

Small-Plot Research
- ❑ Proof-of-concept
- ❑ Focus on stress identification
- ❑ Calibration equations

2020

Web-Tool Prototype Development
- ❑ Automate image processing
- ❑ User interface development
- ❑ Validation

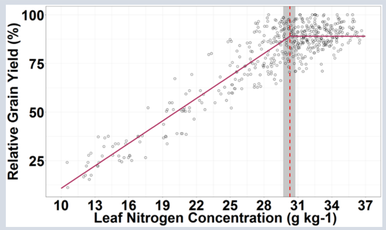
Research into New Functionalities
- ❑ Mid-season N rate recommendation
- ❑ Satellite as an alternative to sUAS?

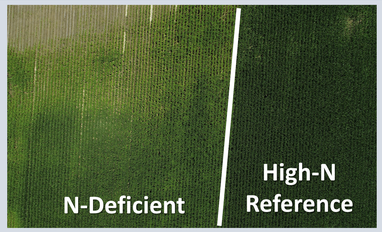
2024

Web-tool deployment
Tool Improvement
- ❑ Addition of new functionalities
- ❑ Validation of version 2.0.

Research into New Functionalities
- ❑ Economic analysis
- ❑ Resilience to climate variability

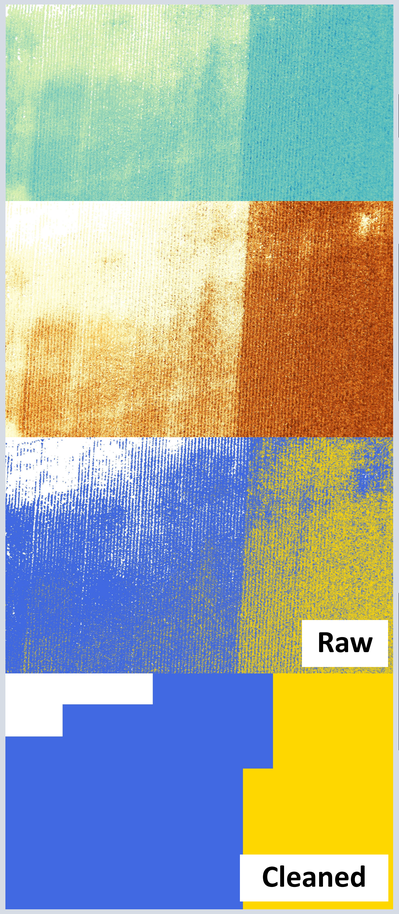
Small-Plot Research





- ❑ Yield-limiting nitrogen (N) deficiency occurs when mid-season leaf N concentration is < 3% (Espinoza and Ross, 2008)
- ❑ Pre-tassel N fertilizer application can help minimize yield loss from mid-season N deficiency (Slaton et al., 2013)
- ❑ Mid-season leaf N concentration strongly correlates to canopy greenness measured using RGB cameras mounted on sUAS and the Dark Green Color Index (DGCI) (Dos Santos et al., 2020)
- ❑ Calibration equations were created to predict yield loss from N deficiency by comparing DGCI values between normal field conditions and a high-N reference (Dos Santos et al., 2020)

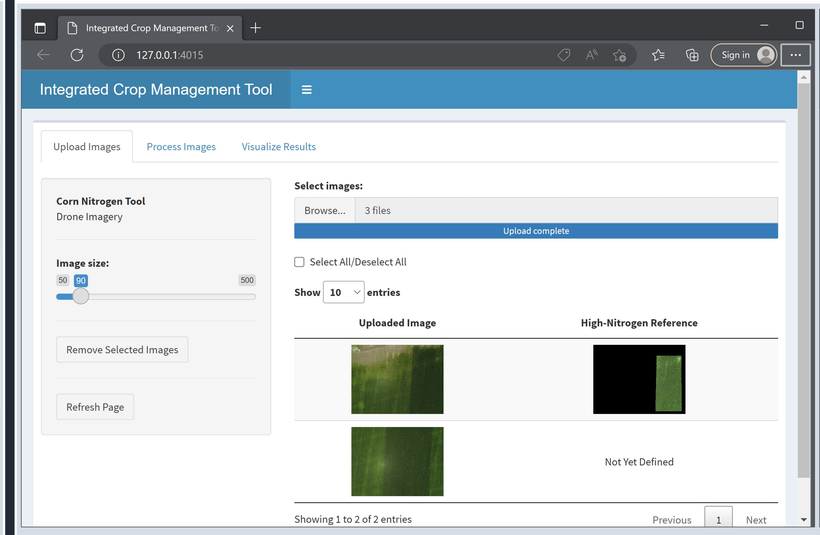
Image Processing



DGCI → Relative Grain Yield (RGY) → Mid-Season Corn N Status

Figure 1. Automation stages of image processing. A drone equipped with an RGB camera is flown over a field with a high N reference strip before corn tasseling (located on the right side of each image). Soil was filtered out (white pixels). The RGB image was converted into DGCI, RGY, and N status maps.

Prototype User Interface



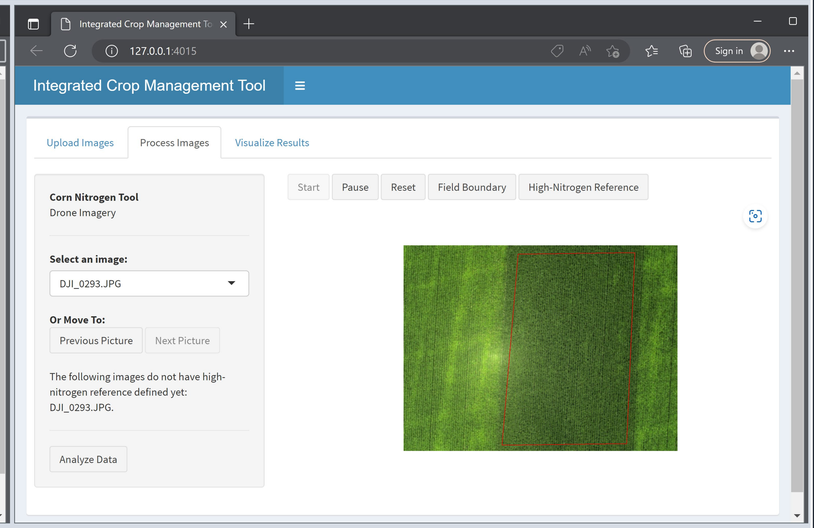


Figure 2. User interface of the corn nitrogen tool prototype. The users upload images and delineate the high-N reference. Images are processed automatically, and results are displayed in tab.

Practical Considerations

- ❑ Web tool can be used with affordable drones and without stitching
- ❑ No need to fly whole field
- ❑ Tool development is dynamic and cyclic process that occurs with research
- ❑ *Limitations*: no predictive capabilities because of DGCI saturation and assumes other stressors are controlled

Next Steps

- ❑ Addition of new functionalities
- ❑ Deployment/commercialization
- ❑ On-farm validation
- ❑ Development of sUAS IoT system with real-time image processing capabilities

Acknowledgements

- ❑ Arkansas Corn and Grain Sorghum Board
- ❑ University of Arkansas/University of Arkansas System Division of Agriculture
- ❑ USDA-NIFA, Hatch Project ARK 2734

Arkansas Corn & Grain Sorghum Board

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System