MinnesotaCorn RESEARCH & PROMOTION COUNCIL

PROGRESS REPORT

PROJECT TITLE: Phenomics tools for corn breeding and management decisions
PROJECT NUMBER: 4154-1SPX
REPORTING PERIOD: 10/01/21-12/31/21
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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD.

During this reporting period we harvested all trials and processed samples from each plot for test weight. We also processed all drone flights from Summer 2021 and started the aggregated analysis across the three growing seasons we have for these experiments. As we began to aggregate the data we identified an issue with the initial resolution of the stitched images that was preventing accurate height estimates of our GCPs and precluding us from using them to normalize heights across the flights and years. We are reprocessing all flights from the three growing seasons using an updated protocol that will allow better comparisons of growth curves across the growing seasons. There is a great deal of computational time that goes into this processing and we hope to have this done within the first few weeks of the next reporting period and be back on track for the aggregate data analysis early in the quarter.

During this reporting period we also prepared and submitted a review article summarizing the current literature and our findings on the opportunities and challenges in phenotyping row crops using RGB drone imagery. This review covers current platforms (i.e. ground sensing vehicles, fixed sensing platforms, aerial sensing vehicles) and sensors (i.e. RGB spectral sensors, non-RGB spectral sensors, non-spectral sensors) for collecting field phenotypic data, morphological trait extraction from UAV RGB images (i.e. plant height, canopy cover, leaf area index, biomass), biochemical parameter extraction from UAV images, biotic and abiotic stress detection, advantages of high temporal resolution, and major challenges still to be addressed in UAV phenotyping. Below are the figures from the review and the full text is provided as an attachment.

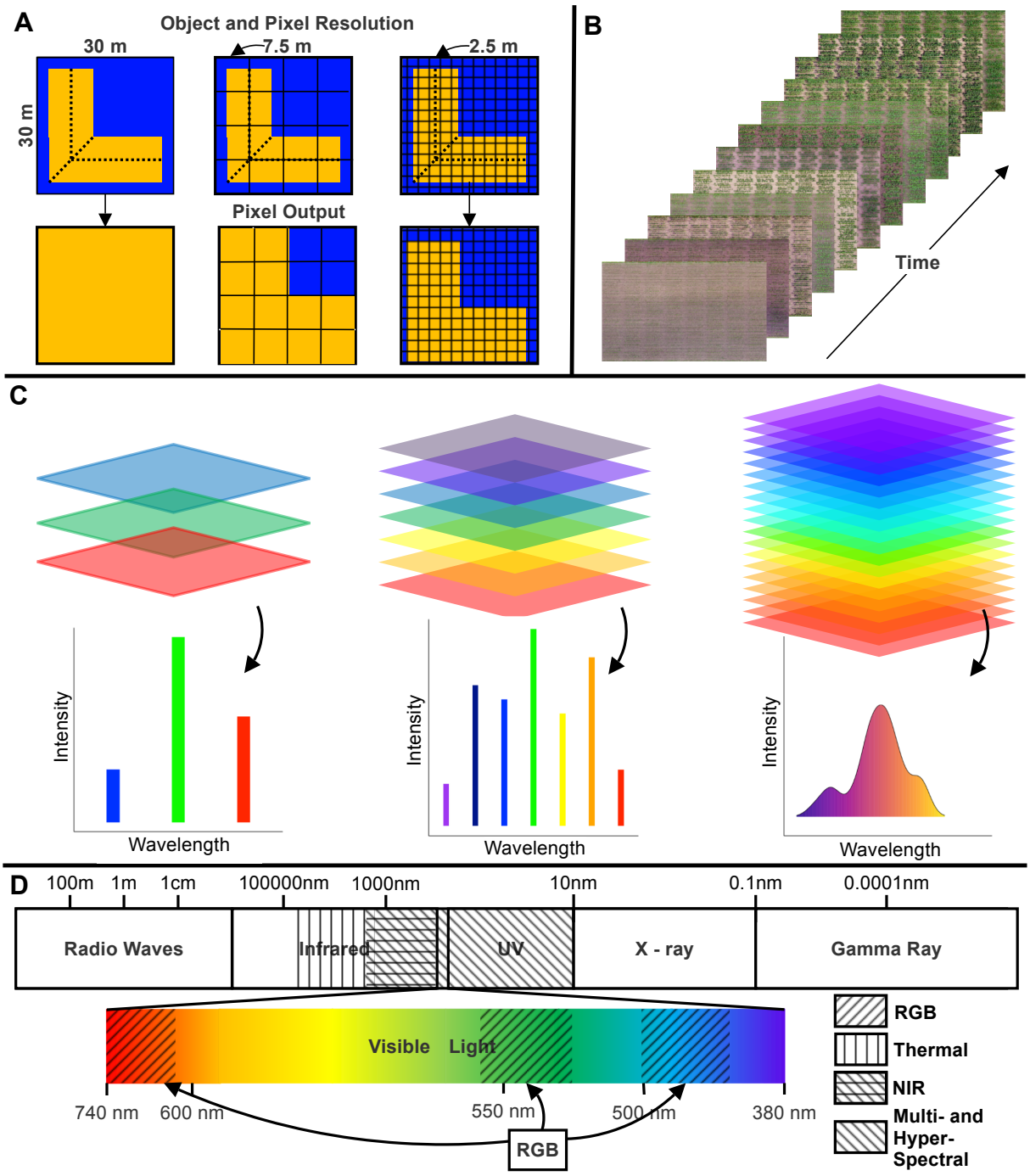

Figure 1. Levels of resolutions that are relevant to consider when collecting data. (A) Spatial resolution, (B) Temporal resolution, (C) Spectral resolution, (D) Locations of spectral wavelengths.

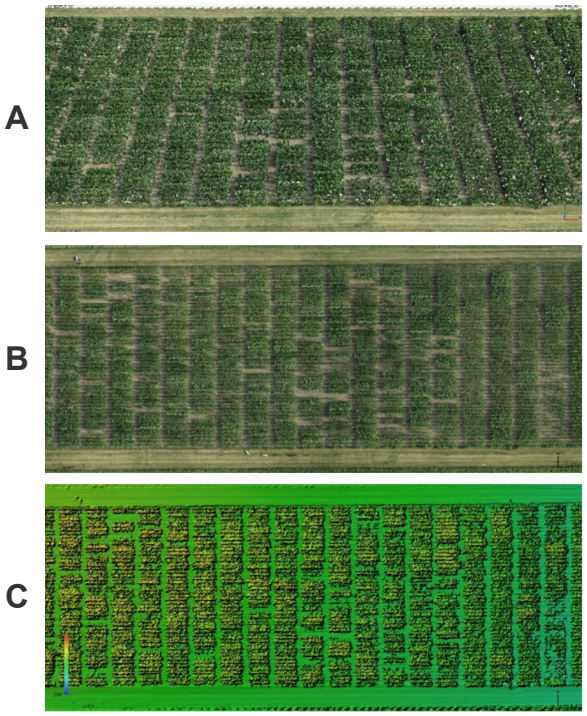

Figure 2. Outputs from structure from motion analysis. (A) 3-D dense point cloud, (B) Distortion corrected orthomosaic, (C) Digital surface model (DSM).

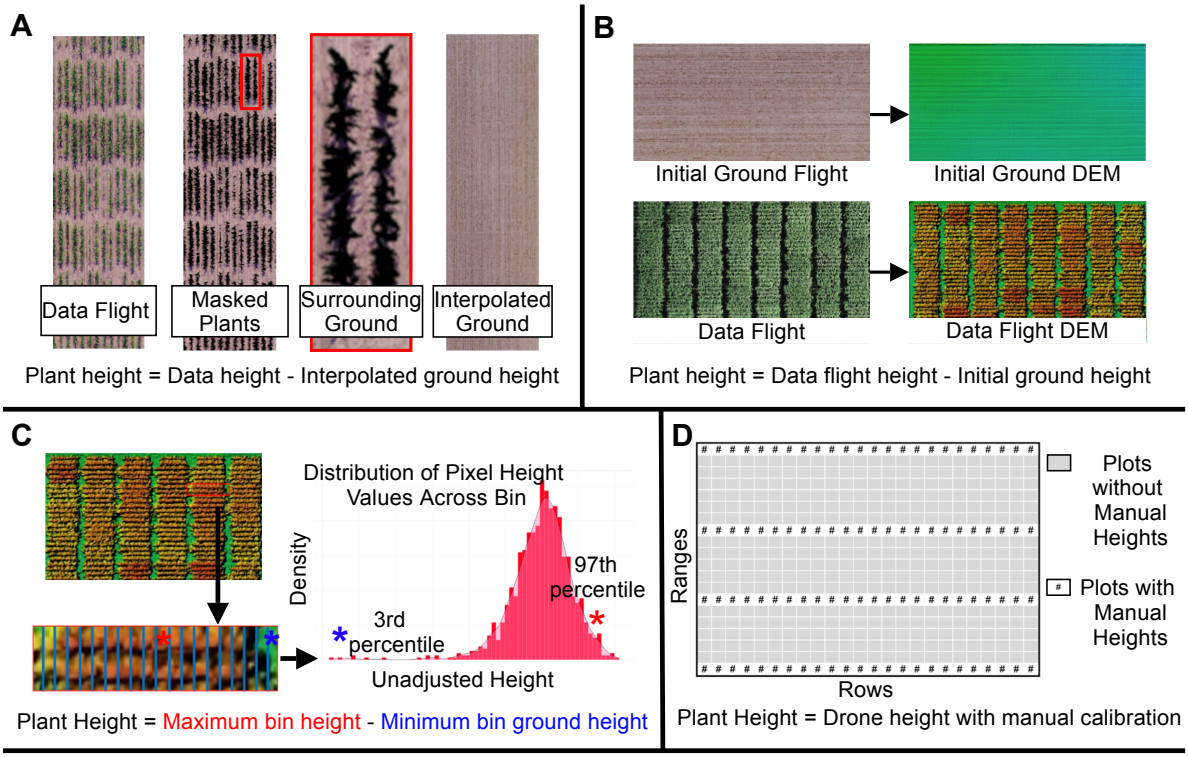

Figure 3. Methods in determining ground altitude. (A) Digital terrain model (DTM) interpolation method, (B) Difference based method (DBM), (C) Exposed alley subtraction method, (D) Manual measurement self-calibration method.

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT TO DATE.

Please see above for results in the previous quarter.

3.) CHALLENGES ENCOUNTERED.

No new challenges have been encountered during this quarterly reporting period.

4.) FINANCIAL INFORMATION

No budgetary challenges were encountered and there were no significant deviations from the projected project spending.

5.) EDUCATION AND OUTREACH ACTIVITES.

We submitted a review article for publication in an open access journal on opportunities and challenges in phenotyping row crops using RGB drone imagery to disseminate our more general findings from this project to the community. This manuscript is currently under review at The Plant Phenome Journal and is attached for your reference.