Development of best practices for collection and post-processing of yield monitor data, 48-2023

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Background and Objectives

Maps of site-specific crop yield variation are the foundation for making precision management decisions. Variation within the field can be used to define management zones and prescribe variable rates of inputs such as seed, fertilizer or pesticide as opposed to the traditional practice of uniform rates across a field. Yield monitors, which collect data on crop flow as a function of field position, are now standard on most combines making data collection more accessible. However, errors inherent in the data collection process must be removed or corrected to improve the accuracy. The current process is time intensive and the quality of the final data is assessed subjectively. Therefore; there is a *critical need* to develop of robust data sets for precision management decisions. Poor yield data quality limits producer's ability to conduct on-farm research and implement variable rate technologies which could lead to more economically and environmentally favorable production practices.

The *long-term goal* is to increase the sustainability of soybean production by adopting precision technology to lower inputs, increase yields, reduce off-target application, reduce operator fatigue, etc. The *overall objective* of this project is to support producers in improving the quality of their yield monitor data though the development of best practices. Some data suggests that unprocessed and processed data differ in average yield; however, data is needed about the within field variation using different post-processing techniques. Providing agricultural consultants and producers with best practices in generating high quality data to aid in decision making.

The following *specific aims* will guide the development of these practices to achieve the overall objective of the project:

- Assess the accuracy of yield monitor data collected across the state
- Compare currently available yield data post-processing techniques

Report of Progress/Activity

Objective 1: Assess the accuracy of yield monitor data collected across the state

Under objective 1, we surveyed the accuracy of 10 combine yield monitors across the state. We selected five machines in the Delta and North-Central regions of the state. Combine-estimated weights were compared with weigh wagon measurements and a full calibration of each machine was done according to manufacturer specifications. *We found that uncalibrated yield monitors overestimated harvested weight by an average of 31%.* Accurate estimation of crop yield is an important step in adopting precision technologies and should be done regularly during harvest. More data is need to draw conclusions about accuracy over time and between crops.

Table 1. Results of a survey of yield monitor accuracy in Mississippi.

Weigh Wagon Weight (lb)	Combine (lb)	Percent Error (%)	Moisture Content (%)	Crop
7260	3043	58.1		soybean
6811	3161	53.6	12.4	soybean
2814	1626	42.2	11.8	soybean
5150	3135	39.1	10.9	soybean
5694	3521	38.2	15.4	corn
5734	4116	28.2	11.6	soybean
3936	3150	20.0	14.1	corn
2740	3230	-17.9	11.6	soybean
6792	6122	9.9	12.8	soybean
3324	3125	6.0	15.6	corn

Objective 2: Compare currently available yield data post-processing techniques.
Under objective 2, historical yield data was gathered from 1,395 fields, primarily in the Delta region. Data for 342 of the fields in which soybeans were harvested, were post-processed with Yield Editor, a USDA product, and cleanRfield, an open-source product, to compare the results (Figure 1). For the Yield Editor method, automated following by manual cleaning was employed. For the cleanRfield method, the standard deviation approach was used with values developed from a random sample of 10 fields. Values of 2.6 and 3.0 were used for the standard deviation cutoff for yield and speed.

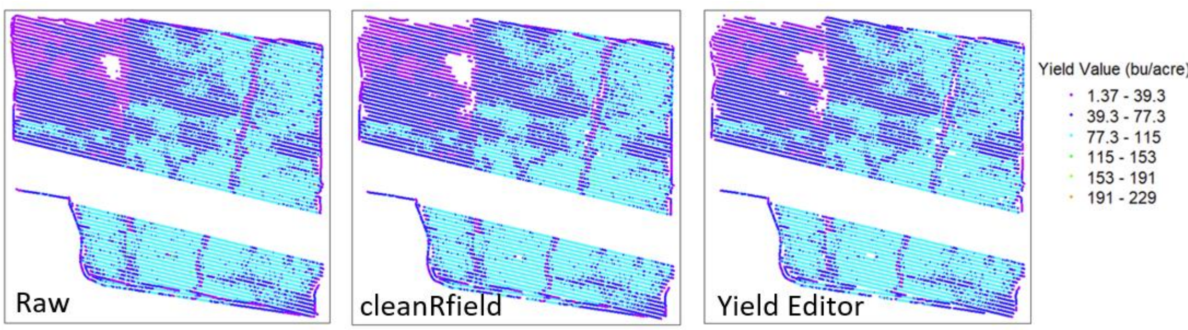

Figure 1. Example yield maps of raw and post-processed data

The results for the 342 fields are summarized in Table 2. The average yield increased and the standard deviation decreased with post-processing of the data. Yield Editor removed more points on average, likely due to additional filtering options as compared with cleanRfield. While both methods performed similarly for the data set, there were some issues of overlap and erroneous data points that were not filtered well by cleanRfield. Ensuring settings such as header width are set and adjusted, if needed, during harvest are also critical in collecting quality data. *Based on these results for soybean, we would recommend the use of Yield Editor, but caution that automated cleaning will not catch all data issues and results should be monitored, especially when a large change in yield between raw and post-processed data is seen.* More data on corn and soybean from producers within a wider region allow us to draw stronger conclusions.

Table 2. Summary of raw and post-processed yield data for 342 soybean fields.

Average parameters per field	Raw data	CleanRfield	Yield Editor
Yield (bu/acre)	68.8	70.3	71.9
Standard deviation (bu/acre)	18.6	15.6	15.0
Removed points (%)	0	5.7	11.1

Experimental data was also collected at the Delta Research and Extension Center (DREC) and Black Belt Experiment Station (BBES) to compare the results of yield monitors and plot combines. Plots were planted with gaps in planting (Figure 1) to induce yield variation within the field. The center two rows of each plot were harvested with a plot combine in 50 ft increments while the remaining rows were harvested with a yield monitor equipped combine at either 2 or 3 mph. Plot combine data was post-processed using Yield Editor software.

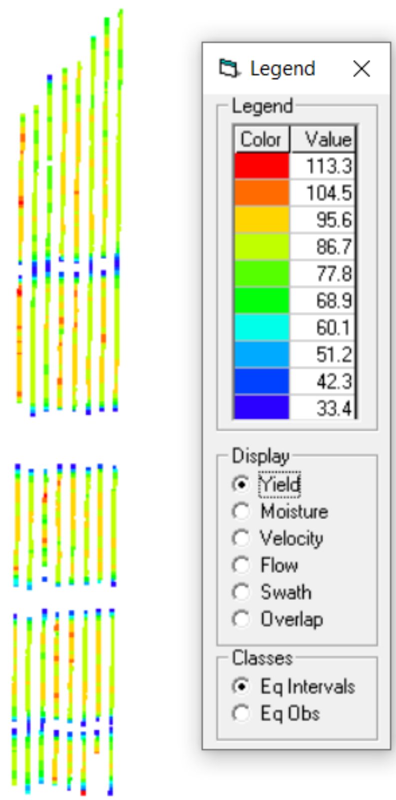

Figure 2. Yield map of the experimental plots at the Delta Research and Extension Center in bu/acre. Yield was varied by harvesting crosswise passes of different widths, seen as gaps in the yield data.

Data from each site was analyzed by pass. At DREC, estimated yields were significantly higher for the lower (2 mph) harvesting speed and after post-processing (Figure 3). At BBES, a similar trend was seen, but the results were not statistically significant (Figure 4). At DREC, the yield monitor consistently underestimated yield by an average of 10% across the eight passes. At the BBES, over- and underestimates were seen with an average error of 1%; however, the maximum error seen was 30%. The different models of yield monitors at each location varied in their ability to detect missing crop, especially for shorter gaps. *While more data is needed to draw a definitive conclusion, we identified a trend of post-processed yield decreasing as harvest speed.* This data will lead toward a better understand of yield monitor accuracy and the development of best practices to collect high quality yield data.

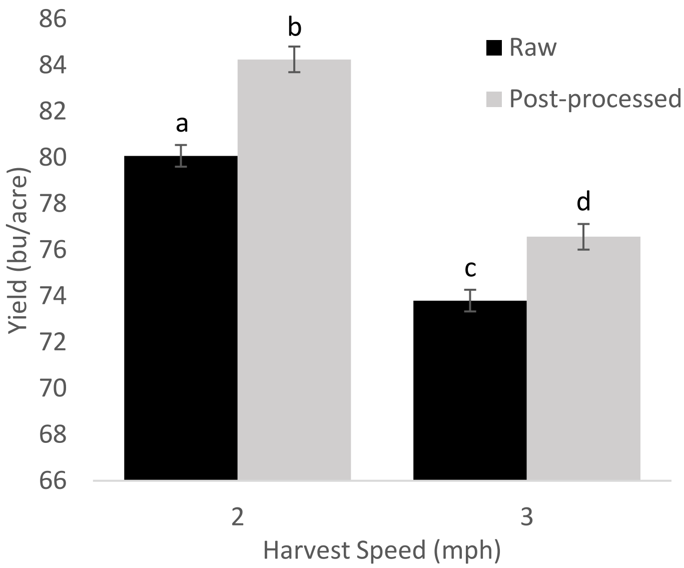

Figure 3. Yield for raw and post-processed data at harvest speeds of 2 and 3 mph at the Delta Research and Extension Center.

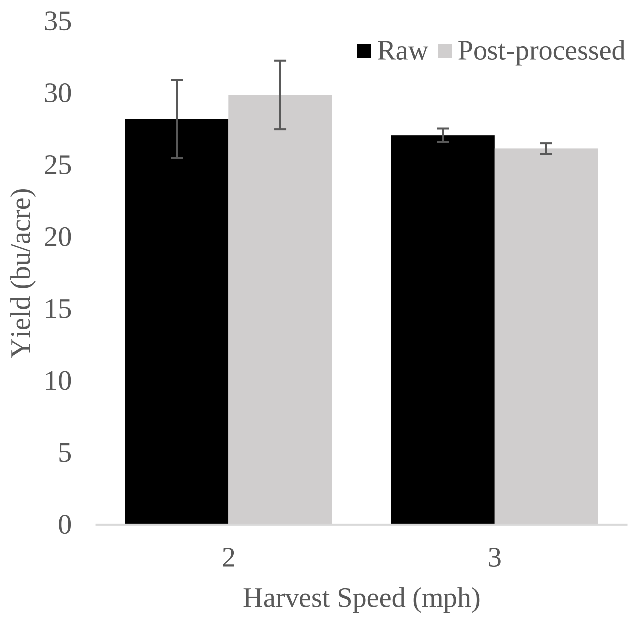

Figure 4. Yield for raw and post-processed data at harvest speeds of 2 and 3 mph at the Black Belt Experiment Station.

Impacts and Benefits to Mississippi Soybean Producers

Data collected in this project will lead to best practices for colleting and post-processing yield data. This will allow producers to make more informed decisions about the quality of their data which can impact management decisions.

End Products-Completed or Forthcoming

- Dr. Drewry presented preliminary results at the SMART Ag Lunch and Learn which will be turned into an online course in 2024
- Minhaj Uddin, graduate student on the project, presented a poster on his results at Producer Advisor Council in Verona, MS
- Minhaj Uddin presented a poster at the MSU Extension booth at the Mid-South Farm and Gin Show

Once data from the 2024 field season is collected, we plan to develop and extension publication of best management practices for the collection and post processing of yield data. Additionally, the data will be presented in Mr. Uddin's thesis and developed into a peer-reviewed journal article. He will also present his findings at the ASABE Annual International Meeting in July 2024.