USING INFORMATION FROM THE JOHN DEERE COTTON HID SYSTEM TO AID IN MAKING PRODUCTION DECISIONS

Luke Fuhrer
W. M. Porter
G. Rains
J. L. Snider
S. Virk
A. R. Smith
Y. Liu
University of Georgia
Tifton, Georgia
E. Barnes
Cotton Incorporated
Cary, North Carolina
C. Holt
Quail Forever
St. Paul, Minnesota

Abstract

The advent of John Deere's Harvest Identification System (HID) provides producers with an additional layer of data which can aid them in making production decisions. With a procedure for the handling of HID data and creation of module level fiber quality field maps being completed the potential for this data can now be expanded upon. The main goal of this project is to determine how the HID data and associated maps can be used to aid in making future field and farm decisions. The data collected from both the machine as well as the module averaged quality parameters can be used in several ways. These fiber quality maps can be used by themselves or can be compared to other field data layers such as elevation, soil type, or yield. The generated maps can also be compared with information such as seeding rate, fertility, weather data, or other available production data. Profitability has become even more important to growers in recent years as prices for cotton are still low compared to the past. Utilizing the enterprise budgets, generated by UGA Extension, net-profit maps can further be created to show growers where in a field they are seeing real returns. These budgets show the cost of production per acre and can be created for each field. The ability to show net profit can be used in making decisions for the future on marginal areas in the fields. This project resulted in a better understanding of the uses of these data and allows for greater understanding of the true performance of a field from both a fiber quality perspective as well as financial perspective. This could let growers be more confident in their decisions and aid in the production and quality of a crop that is not only sustainable, but profitable.

Introduction

With the ever-growing amount of technology and machinery aids, growers are given a large selection of avenues to better their production practices, better conserve the land they work, and increase revenue from crops. John Deere created their Harvest Identification, HID, for the purpose of aiding growers. This system uses an onboard RFID reader, the GPS system, moisture sensor, and telehandler weighing system. The HID system uses the serial number, from the imbedded RFID tag in the module wrap, to attach information about each module to a file for later export. This system is able to time stamp and geo-reference specific moments for each module. These moments can include module creation location and time as well as module drop location and time. The idea of module tracking can then be taken further, if combined with gin fiber quality data, by creating module level resolution fiber quality maps. These maps can then be used for several applications. These maps of course serve their purpose of visualizing the distribution of the fiber quality across the field. It also can be used in analyzing the fiber data such as net profit maps using the Extension Enterprise Budget. Improvements were made to the methodology that impact both the efficiency of the study as well as the clarity of the developed maps through the cleaning of the HID data.

Objectives

The main objective of this study is to utilize the John Deere Harvest Identification system for creation of module level fiber quality mapping. The sub-objective of this study is to use the developed maps alongside production enterprise budgets to show profitability in fields, and aid in the education of growers to be the most profitable while sustainable.

Materials and Methods

The overall materials and methods of this study were unchanged as compared with last harvest season. In addition to the methods followed in Fuhrer et al 2019 a few improvements were developed to aid in several areas of the study. A single grower, with multiple fields, was selected this season as to eliminate a complicated harvest schedule and to focus on data collection. As a benefit to both the study and the grower, the grower actually implemented their own on farm trial for one of the selected fields. This trial included four planned seeding rates and three different varieties. The experimental treatments and configuration of the trial is shown in Figures 1 and 2. The four seeding rates were 20,800, 24,000, 27,200, and 32,000 seeds/acre. The varieties used were DG3615, DG3799, and DP 1646. This trial allowed the study to be able to focus on varying profitability scenarios South Georgia growers can find themselves in, such as selecting the appropriate variety or seeding rate. Between the two tested variables a bale value map was made (Figure 4) to show the varying levels of profit across the different varieties and populations. Maps such as this will give growers more insight into variety and population effects on both their fiber quality and their profitability.

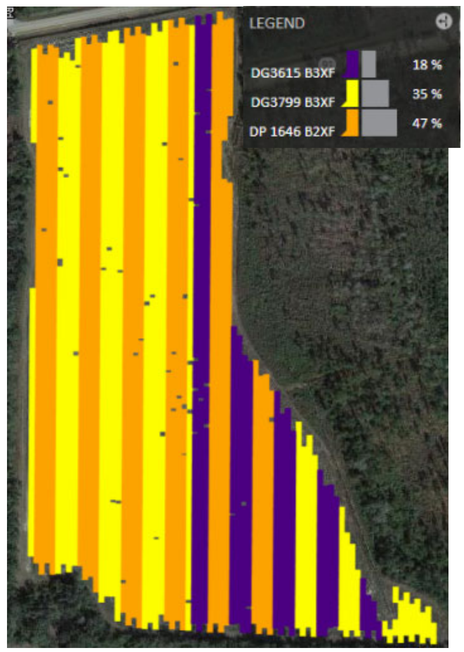

Figure 1. The experimental design of the three different cotton varieties.

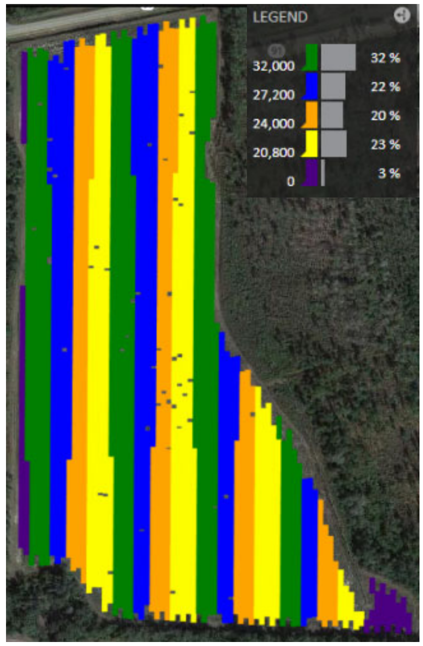

Figure 2. The experimental design of the seeding rate configuration.

Another large improvement that was made to the methodology was the cleaning of data prior to import into ArcGIS. Each operation a machine or implement preforms generates points as it travels across a field that are associated with various parameters such as yield, seeding rates or application rates. As the swath of each of these varies in lengths, sections are created across them to show effective tracking of the field operation. An example of this is the three sections created across the head of a six-row cotton picker. The three sections across the head log points at the same time and are assigned the same values for the data being collected for that harvest. This begins to generate a large quantity of data that becomes very repetitive rapidly. It was found to be necessary to remove these duplicates data points. In the case of the cotton picker example above it was decided to keep only the middle section of data. This reduced the data load by two-thirds. The reduced amount of redundant data allowed for a much cleaner map. The original maps created during the 2019 harvest season were messy and hard to read clearly. With the data reduced it allows for a clean picture and a clear travel path to be followed. The next benefit was the decreased load on the computer. When working with a large number of spatial points like these, it can greatly impact the time needed to render the georeferenced maps in ArcGIS. This cleaning decreased the render time significantly and mitigated stalling of the computer. This process of data cleaning can be performed on other operations as well. As stated above the grower did their own trial this season. The planting file generated was exported and it was also necessary to clean this file and only keep representative sections for the same reasons above.

Lastly another methodology improvement was made through the development of a python program. This program was developed to aid in the averaging of module fiber quality data. Originally individual cotton bale fiber quality data was averaged into a single module by using an Excel calculator and a paper copy of the bale fiber quality report. "Once the study's modules are ginned it was asked of them to send a copy of the quality data for each of the bales. Quality data for the bales produced from each module were then averaged and recorded. This was accomplished by using a simple excel calculator to allow for quicker computations."(Fuhrer,2020) The program takes the gin bale report, as an Excel file, and then averages the module by a load number or module identifier designated by the gin. In the case of this study the gin gives each module a load number so this allows for the averaging of each module. In the code the fiber quality parameters that are of interest are selected and specified to be averaged. At the end of the code it is instructed to create an Excel file for the module averaged fiber quality for further use. The python program improved this process in several ways. The program took a process that normally took hours to complete and reduced the time to a matter of seconds. It also helps to mitigate the human error introduced from hand entering data for an extended period of time. It is currently planned to publish the code for this program on GitHub or similar open source server so others may benefit from the code. Also, the code is potentially going to be added to the UGA precision agriculture website as a free service to others. This will allow for growers or researchers alike to see the benefits this study has as well as further the education and understanding of cotton fiber quality.

Results

The HID system was utilized to collect data on 98 modules from three fields in the Colquitt, GA area. The one field shown above, with the grower's on farm trial was selected as the field of interest for data collection and evaluation. In addition to the fiber quality maps generated a travel path map for each of the modules was developed. This allows for the visualization of from which part of the field each module was created. The module creation map aided in determining where each module was created so that each one can be associated with which seeding rate and variety it represents.

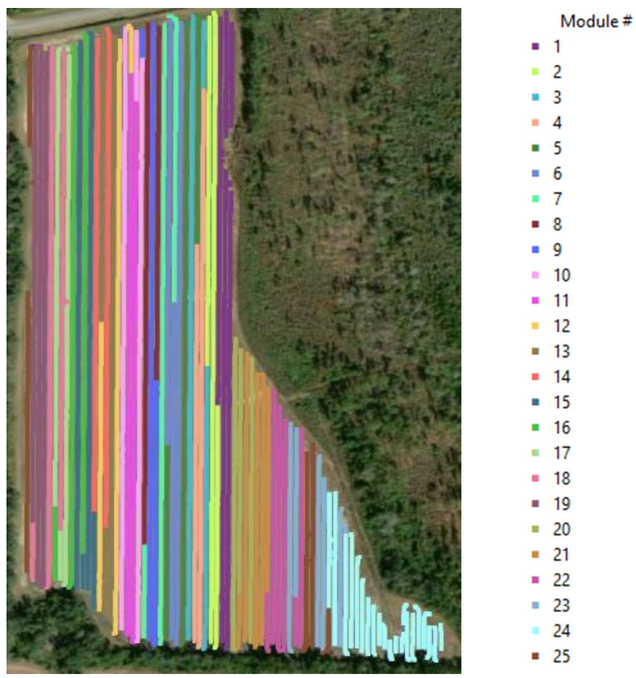

Figure 3. A depiction of the module travel paths.

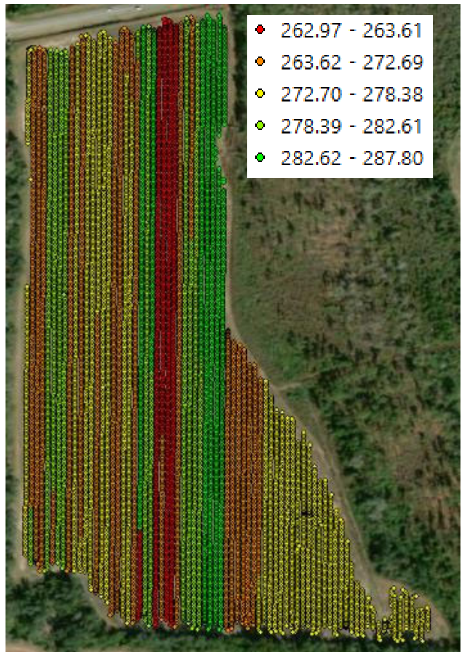

Figure 4. A depiction of the loan value ($/bale) distribution across the field of interest, as well as a map with cleaned section data.

Module fiber quality are still being analyzed to make assessments of field variation effects on fiber quality. Though early observations of the loan value do show visual correlations with the different varieties of cotton seed used a more in-depth analysis is required to determine statistical correlations. A profit map will be created and compared to the loan value map using the UGA Extension Enterprise Budget. The enterprise budget provides an average baseline production cost for crops produced in the state. A grower can input their personal cost to adapt it to their unique operation. To better show the profit variations, for the field of interest this season, the seed cost will be changed to reflect each plot's variables. This will then be mapped as to show a net profit map for the field. This analysis will also be done to the other two fields, but these will mostly be affected by field characteristics, as seed variety and populations were held constant in these two fields. As Dr. Barnes states "Seed coat fragments (SCFs) have been a long-term issue for cotton and outbreaks of SCFs occur sporadically every 3 to 5 years in a region of the U.S. This year the region includes Alabama, Georgia and Florida with the biggest outbreak of SCFs calls in the last 20 years."(Barnes, 2020) Seed coat fragments problems have resurfaced in southeastern cotton this season. Another analysis that will be done is looking at the spatial distribution of modules noted to have seed coat fragments as extraneous matter. Dr. Barnes goes deeper in the article on what typically causes these problems

Summary

With two harvests seasons completed, this study is beginning to show how HID data can be utilized in various ways. It has gone from simply developing a procedure of how to generate fiber quality maps from the data. We are now able to use cleaner maps and data to create useful tools for growers to see how their yield and fiber quality are correlated to their profitability. With the improvements of the methodology and the further analysis planned, the studies usability has increased. Through these strides the understanding of the HID has grown, though there is still more to be done to create a useful tool that growers can easily navigate and benefit from.

Acknowledgements

The author of this paper would like to acknowledge Cotton Inc. for their funding of this project. The author would also like to thank Russ Worsley for all his help with coordination of harvest and allowing the UGA precision ag team to collect another season of data with him.

References

Barnes, E. (2020) SEED COAT FRAGMENTS – ANOTHER REASON TO HATE 2020.

L. Fuhrer, W. M. P., G. Rains, J. L. Snider, E. Barnes (2020). MAPPING IN-FIELD COTTON FIBER QUALITY UTILIZING JOHN DEERE HARVEST IDENTIFICATION SYSTEM. Beltwide Cotton Conference, Austin, Tx.