MAPPING IN-FIELD COTTON FIBER QUALITY UTILIZING JOHN DEERE HARVEST IDENTIFICATION SYSTEM

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Abstract

The option of having John Deere's Harvest Identification (HID), installed on roller pickers and strippers such as the CP/CS 7760 or CP/CS 690 has provided the cotton industry with the beginning to access of even more integration of technology. With this system, four Radio Frequency Identification (RFID) tags with predesignated serial numbers are incorporated into the module wrap. Each of these tags are imbedded with 18 different data points about that specific module. The integration of RFID technology utilization could add several benefits including the decrease of required in field labor, a more efficient tracking system of modules, and better on-farm decisions through more in-depth knowledge of the grower's fields. With the HID system, there is a decrease in labor cost and mitigation of error from using the traditional methods of spray-painted numbers or wire tags on each module. Each module is assigned a unique serial number and could allow for a seamless flow of data to and from the gin if this serial number is referenced for data transfer. Growers could take advantage of better tracking of their modules from initial wrapping until the module is ginned. This is initiated by using the onboard GPS from the machine and continued if strategically located RFID scanners are in place at the ginning location. Lastly, this project will provide growers with more knowledge of their fields. The in-depth tracking of each module provides growers with the ability to link bale AMS classification data back to a specific module and then link this module back to the location it was created from the field. Fiber quality maps were then generated linking average bale classifications back to their respective modules, and farther to their area of harvest in the field. This is a manually intensive project so for future work it is planned to find ways of decreasing the need the time for manual data entering. It is also planned to refine the methodology as there were challenges faced during the performance of the current steps. The main goal of this project is to develop fiber quality maps and educate producers on their importance.

Introduction

Cotton fiber quality is a parameter that normally goes untracked by producers until they receive the data back from the gin. Producers typically will receive quality data back from the gin and do not utilize it to make production changes. Producers are losing a large quantity of data through not monitoring these data. Utilizing John Deere's HID system producers gain the ability to track modules and link bale classification back to the modules and then back to the field. J. R. Williford (1992) stated that cotton yield and quality are dependent upon environmental stresses occurring during production and upon management decisions made during the production and harvest of the crop. Cotton fiber quality can be impacted by the environment, but if proper field decisions are made it can allow the crop to be more resilient. With better fiber quality or more uniform quality there are greater opportunities for efficiency increases in the textile industry. The less the cotton varies or the higher quality fiber can also result in high quality products produced from the fibers. The variability in physical attributes among cotton fibers within a bale has been shown to affect textile manufacturing efficiency and the quality of the finished textile products (Smith and Cothren, 1999). Utilizing the HID system, and incorporating RFID technology at strategic locations at the gin of choice would allow for producers to log when modules are created, picked up, at the yard, and then being ginned. This will allow farmers to track their products and know their status in the ginning process. Sabbaghi (2008) looked into the effects of integrating a system with RFID tracking and found that RFID technology enables an organization to significantly change its business processes, not only to increase its efficiency which results in lower costs, but also increase its effectiveness, i.e. improving mission performance and makes the implementing organization more resilient and better able to assign accountability, as well as responding to customer requirements to use RFID technology to support supply chains and other applications.

Objectives

The main objective of this study was to utilize the John Deere Harvest Identification System for tracking cotton module fiber quality. The sub-objectives of this study were to track round module creation in the field, follow the modules into and through the ginning process, then utilize the USDA-AMS Fiber Classification System to create cotton fiber quality maps for each field tested at the module level.

Materials and Methods

Three producers, in Southwest Georgia, were selected based on the availability of the HID system on their pickers. Due to the newness and lack of knowledge on full benefits of the HID system it has been slow in its adoption. After meeting with the producers they each selected a field or fields that would produce over 10 modules. On the day of harvest, a module scale was brought down to the field to calibrate the yield monitor. This is done to insure accurate yield data is captured. The type of module scale is indifferent, as long as it is able to accurately weight round cotton modules, which is typically between the ranges of 4,000-5,500 pounds. This calibration was done following the recommended calibration procedure outlined in John Deere Cotton Picker Operators manual and done with three modules to allow for correction of the calibration factor. Once the yield monitor is calibrated the field can be harvested. Post-harvest a labeling system for the modules needs to be developed. This will then be used in labeling modules as they are scanned using both the RFID reader and the module scan application. To label modules it was chosen to use approved module paint to ensure no impacts on fiber quality. A Trimble Nomad handheld computer with the Trimble RIFD reader attachment were used for collecting RFID tag information and position. Other readers can be used, depending on availability. Using an android tablet, the RFID module scan application was used in scanning and secondary tracking of modules. This application uses the 2-D barcode on the module tag to collect imbedded data. The scanning application is a cheaper alternative to the RFID reader, but does pose challenges if barcode is not visible or easily within reach. Once all modules are transported to the gin, a record of the gin's labeling system needs to be recorded. This involved a travel to the gin to manually record the gin's label and the corresponding label developed.

To access the yield data for each field, a John Deere farm data management software (My JD) account was linked with the producer's accounts. This required requesting access to their account and was easily accepted from the producer's account. The HID file and yield file were then downloaded from the My JD account and converted into a useable form, a csv file. This is done in order to add the data to the GIS software. It was found to be necessary to create an excel file logging all of the labels and module qualities pulled from the HID file. 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. Once the bales were averaged, the module's quality average were added to the master excel file. The yield shape file generated from the machine served as the travel path of the machine when added to a GIS program. It was then important to manually find the points from the yield file correspond to the appropriate module. This was done using the time stamp the machine outputted upon module creation. An example of find the corresponding points are, identifying points zero through the corresponding point with the correct time stamp relate back to module one. This will effectively give the area harvested by the machine by which the module came from. This area corresponded to the travel path for this module. The points from the yield shape file were exported into an excel file to be able to add the fiber quality. This excel file was simplified with columns for the point and the different grading parameters to remove excess data load. It was then necessary to copy the fiber quality data from each module to its respective range of points, and was continued for all the modules and points. It was then joined back into the GIS program, by sharing the point number as the common factor. Various maps were then generated by changing the displayed parameter.

Results and Discussion

Results

The John Deere HID system was utilized to collect data from 90 modules from three fields and three producers. For this paper due to the high level of data collected and the time the data were received only one field were utilized to create fiber quality maps. The resulting maps from this study are presented in the results here forward: Figure 1 represents the yield map from the field. This map is in bales per acre and was downloaded from the producer's My JD account. This map was used as the travel path of the machine and the basis of the fiber quality maps. The yield map was used to determine what passes each module came from.

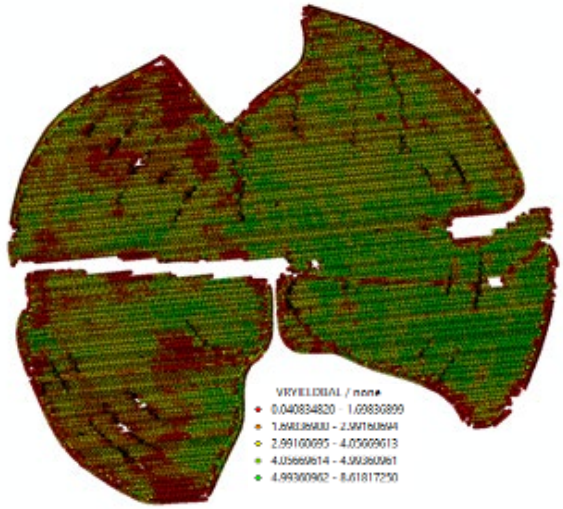

Figure 1. Cotton yield (bales/ac) from the field being used for the study.

Figure 2 below represents the micronaire across the field. Cotton Incorporated defines micronaire as “a measure of fiber fineness and maturity”. Cotton fibers are compressed and air permeability is measured through the sample. Fineness and maturity of cotton fiber can effect products strength and dye absorption.

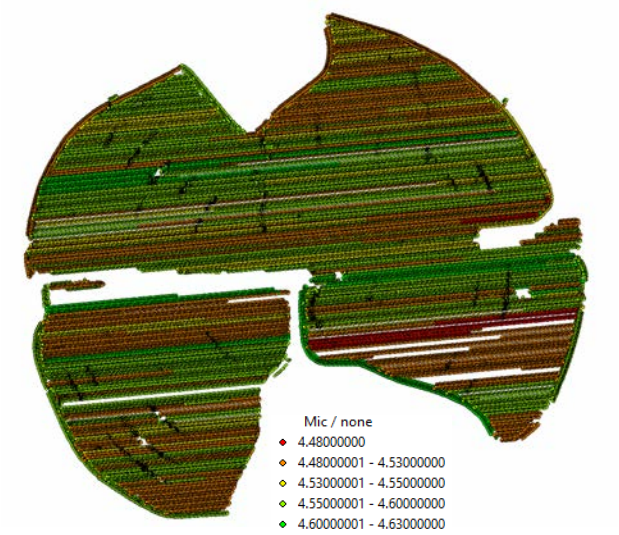

Figure 2. Micronaire (Mic) from the field being studied.

Figure 3 represents the observed average reflectance across the field. Reflectance is a sub category in fiber quality measurements. This is measuring the level of brightness in a sample. This is typically measured by a percentage. Below the class standard is used for the map legend. Reflectance along with +B, or yellowness, are used together to assign color grade to a sample. The brightness of cotton fiber can affect its absorbance if the color deteriorates.

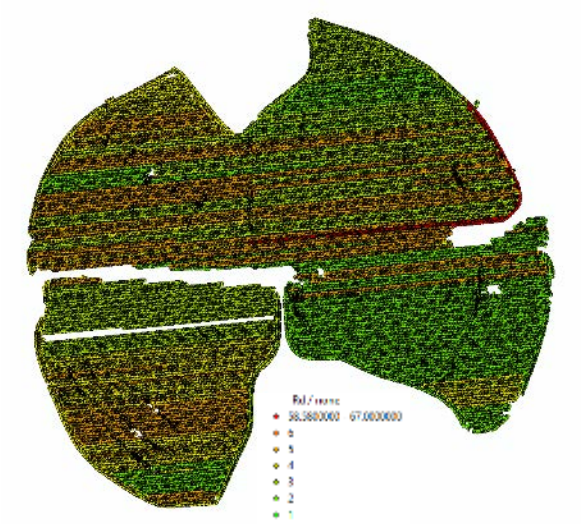

Figure 3. Reflectance (standard classification) from the field being studied.

Figure 4 below is the map generated from the module average bale loan value. The bale loan value is the actual dollar amount each bale is bringing to the producer. "The 2019-crop differential schedules are applied to 2019-crop loan rates of 52.00 cents per pound for the base grade of upland cotton and 95.00 cents per pound for extra-long staple cotton." (USDA, 2019) After weight and grade for each bale is recorded quality premiums are then applied to achieve the loan value.

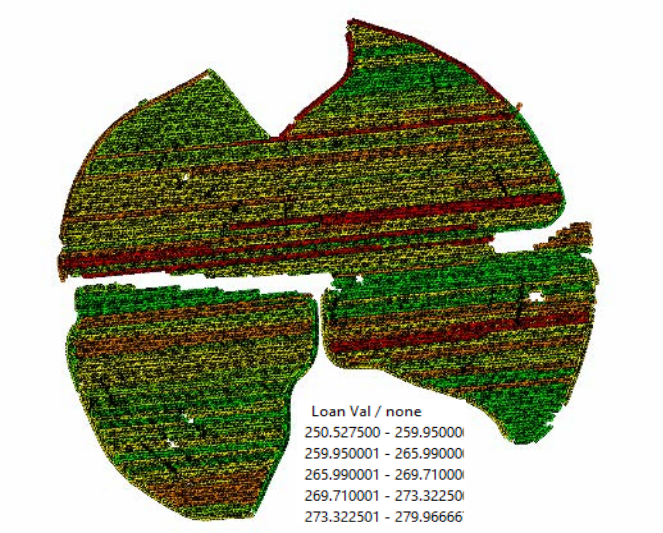

Figure 4. Bale loan value ($) from the field of study.

Discussion

The development of module level fiber quality maps will provide growers with another layer of data to make production decisions. A combination of the yield and fiber quality maps will provide the grower with a more in-depth relationship between yield and fiber quality. These data will show variations and relationships to those variations within a field. It is then important to use the industry standard ranges as this will allow producers to see if the variations in fiber quality are of significant impact on bale value. This project had some specific challenges associated with the methodology that could be improved to ensure smoother and adequate data collection. One of the procedures which is critical to successful data collection and that needs to be addressed for next harvest season is to check the machine's RFID and identification systems. Data were lost during the 2019 production season due to the machine's RFID system failing. Currently the process of data collection and map creation is a very manual process that involves large quantities of data. Both of these are large challenges that will allow for future innovation.

Summary

Since fiber quality maps were successfully created using the John Deere HID system has shown that it can be a valuable tool which producers can use in understanding their crop, and the impact of their field decisions. Further work will be continued on this project to increase its practicality and education of the producers on the use of these maps. In order to accomplish these goals, the current methods will need to be adapted to make the process of data collection, map creation, and analysis more automated and user friendly. Further replications of this process will allow for a better understanding of the data which is being collected to develop more focused and informed educational programs. As this project progresses, there will be greater knowledge of its impact and use for growers. Through this project it is shown that round cotton modules can be tracked through the ginning process. It also shows that fiber quality data can be linked back to the module, and then back to the area of harvest in the field for that specific module.

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