UPDATE ON THE COTTON GINNING DATA STANDARD

Edward M. Barnes
Cotton Incorporated
Cary, NC
David Blakemore
Blakemore Cotton & Grain
Campbell, MO
Mathew G. Pelletier
John D Wanjura
Greg A. Holt
USDA-ARS Cotton Production and Processing Research Unit
Lubbock, TX
Harrison Ashley
National Cotton Council
Cordova, TN
Robert G. Hardin
Texas A&M University
College Station, TX
Jason K Ward
North Carolina State University, Raleigh, NC
Christopher D. Delhom
USDA-ARS Cotton Structure and Quality Research Unit
New Orleans, LA
Paul A. Funk
USDA-ARS Southwestern Cotton Ginning Research Laboratory
Mesilla Park, NM

Abstract

Large amounts of data are now automatically collected by agricultural and ginning machinery. Additionally, the ability to add automated data collection on parameters such as processing rate and energy use is possible with minimal costs and modification to the gin. There are also emerging needs to share data to support sustainability, traceability, and other certification programs. Therefore, to help ginners capture the maximum value from these data and allow for efficient data sharing, a possible voluntary data standard(s) for gin data is under consideration. This paper provides an update on efforts to develop a data standard and plans for a related pilot study to demonstrate the potential value to the ginning industry of having an aggregated database of ginning performance data. Currently consensus has been developed on the project's objectives and highest priority measurements.

Introduction

Both agricultural and gin machinery are now capable of capturing data during operation as evidenced by the fact the latest cotton harvester from John Deere can provide data such as module weight, moisture, and coordinates where that module was both wrapped and dropped (Wanjura et al., 2020). The U.S. cotton industry has a long history of benefiting from the fiber quality data provided on every bale of cotton produced. The U.S. ginning industry also has a history of surveying its membership to track the costs of ginning that has found its use in not only assessing gin charges, but also contributed to life cycle assessment of cotton products (Cotton Incorporated, 2017). With the growing sources of data, the Technology Committee of the National Cotton Ginners Association (NCGA) launched an effort to evaluate opportunities for ginners and producers to gain more value from these data.

Methods

A starting set of objectives and possible measurements associated with the standard follow based on preliminary discussion with USDA gin lab, university, NCGA and Cotton Incorporated representatives. These objectives were then reviewed and refined by representatives from nine gin companies across the U.S. The current set of objectives are listed in Table 1.

Table 1. Project objectives ranked by priority.

Rank	Project Objectives
1	Automate data collection for much of the NCGA cost of ginning survey
2	Define key performance indicators (KPIs) to monitor a gin's efficiency (i.e., optimize dollars per bale)
3	Provide a means to justify variable ginning charges (e.g., show a grower their wet cotton slowed down the gin and increased dryer fuel use by 400%)
4	More efficiently and automatically monitoring data to have real-time alerts of problems
5	Determine optimum machine settings for different varieties to preserve fiber quality
6	Have a meaningful comparison of a gin's performance to regional and national averages of participating gins
7	Collect data that can be securely shared with downstream customers for sustainability efforts
8	Contribute to a larger database of production practices, variety information, weather and soil data, etc. that will facilitate the use of advanced analytics to optimize the entire cotton production system
9	Develop a database that will allow predictive maintenance of equipment
10	Implement an electronic data system that could be integrated with blockchain or other traceability systems. Create the ability to integrate grower data and pass with gin data downstream

Table 2. Measurements of greatest interest ranked in order of priority.

Rank	Measurement
1	Seed cotton moisture content at module feeder
2	Classing data
3	Bales produced per hour
4	Fiber moisture content at bale press
5	Total electricity use per bale
6	Seed moisture content at module feeder (if possible)
7	Cotton variety being ginned
8	Fuel (gas) use for drying
9	Seed cotton moisture content after dryer
10	Seed moisture content after gin stand
11	Online quality data that may be available (e.g., Intelligin)
12	Motor data for predictive maintenance (temperature, noise, vibration, amp load, etc.)
13	Process parameters: air temperature, velocity, static pressure (gin can control)
14	Fuel (gas) use for humid air
15	Anonymous farmer ID (so we can look at trends in data by farm)
16	Model of harvester used (basket, round modules, stripper, picker…)

Figure 1 represents preliminary data we hope to collect from a selected group of gins from their 2020 season to explore what data proves most valuable in meeting the multiple objectives of the project. In Figure 1, the column "Required", "Y" indicates part of the minimal data set, "P" = preferred, "N" = no, but would be helpful to have. The data are listed according to the source during the processing sequence, realizing that sometimes the data may originate from more than one source. In the data from the grower, variety will be the most critical to the objective of variety specific settings. Figure 1 also allows for the possibility the grower and gin are using the radio frequency identifiers (RFID) and specifies what data available from the harvester is of interest. "Gin Extra" is to accommodate data that some, but not all gins may be collecting, such as seed moisture content, seed weights, gas usage, and motor loads. Date and time data for both harvest and ginning allow the possibility to add weather records (temperature, rainfall) from NOAA weather databases. The figure also reflects all the data available for every U.S. bale from the USDA-AMS classing reports.

Future Plans

Once data is provided by collaborating gins, the data will be used with advanced statistical models to evaluate what inputs provide the most predictive information regarding fiber quality parameters and gin performance (e.g., bales per hour and energy use per bale). It is anticipated that this process will help further identify key measures for future study. It is also anticipated that some of these measurements will require standardization across gins as is currently done with seed-cotton drying system temperature control sensors in cotton gins (ASABE, 2017). Another example of a measurement standard is an engineering practice established for agricultural weather stations (ASABE, 2015). That standard defines things like the name of the measurement, measurement units, where the sensor is deployed and how frequent the sensor is read and data stored. Such standards are voluntary, and the likely goal of any from this project will be to standardize the measurements so that data from multiple gins can be anonymously aggregated to allow more meaningful comparisons between a gins and a national or region average, and better allow models to be developed to correlated attributes such as variety types to leaf grades.

References

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Cotton Incorporated. 2017. LCA Update of cotton fiber and fabric life cycle inventory. Retrieved from https://cottontoday.cottoninc.com/wp-content/uploads/2019/11/2016-LCA-Full-Report-Update.pdf

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ID	Data Source	Column Heading	Required	Sample Data	Description / Comment
1	Grower	Grower ID	P	1	Anonomous grower ID
2		Date Harvested	N	10/25/2019	Ideally have the date the module was harvested - optional
3		Time Harvested	N	10:15	Unlikely to get the time but would be nice
4		Variety	Y	DP555	Variety - will need to have standard set of variety names
5		Harvester Model	N	JD 7760	In addition to telling if picked or stripped, could help settle the debate if round modules systems increase trash.
6		Yield (lb/acre)	P	985	Pounds of fiber per acre
7	John Deere Harvest ID (HID)	Serial number	N	18403132917	Serial number from RFID tag
8		GMT Date	P	9/26/2014	GMT Date (from GPS?)
9		GMT Time	P	21:28:47	GMT Time (from GPS - I have seen files where the "local" time was wrong. I think this is less impacted by user errors)
10		Lat**	N	35.82833	Decimal latitude where the wrap was applied to the module during the harvest process. Positive values Northern hemisphere; negative values southern. 5 decimal places = ~1 m. ** Will keep this confidential and use only to extract soil and weather data for site.
11		Long**	N	-78.78722	Decimal longitude where the wrap was applied to the module during the harvest process. Postive values east; negatvie values west
12		Moisture (%)	P	10.5	Moisture content estimated by Cx690, wet basis
13		Diameter (cm)	N	236	Diameter of round module in cm
14		Weight (kg)	P	2363	Weight of module in kg from harvester
15		Incremental Area (Sq m)	P	8428	Area that was harvested to create round module, square meters
16	Gin	Module / Load ID	Y	527	This will be the primary identifier to link all the data along with Gin ID
17		Date Ginned	P	20151101	Date module processed
18		Time Ginned	P	10:00	Time module enterred feeder
19		MC Mod Feed (%wb)	P	10	Moisture content (wet basis) of module at module feeder
20		Seed Cotton Wt (lb)	P	18000	Pounds of seed cotton in load
21		Fiber weight (lb)	P	7200	Mass of fiber in load of seed cotton
22		Bales per hour	P	45	Production rate of gin while module / load processed
***	Gin Extra	Misc monitored data	N	TBD	May not be uniform across gins. Will depend on what gin has access to and willing to share
23	USDA-AMS Callssing Office [Their data headings and format - data conversions not applied]	Gin Code*	Y	1	* Change to anonomous gin identifier
24		Bale #	P	60596	Bale number without gin code
25		Date Classed	N	20151104	Provided by classing office
26		Mod/Trail	P	1	0 = single bale; 1 = module average; 2 = trailer avg
27		Mod #	P	527	Not always recorded - only required for module averaging
28		Bales/Mod	P	17	Only available if module averaged
29		Color Grade	Y	51	
30		Length (32)	Y	36	
31		Micronaire	Y	42	Raw value in example here - not divided by 10
32		Stength	Y	293	Raw value in example here - not divided by 10
33		Leaf Grade	Y	3	
34		Ext Matter	Y	0	
35		Remarks	N	0	Mainly applies to Pima
36		Inst Color Gr	Y	51	
37		Color Quad	Y	1	
38		Rd	Y	678	Raw value in example here - not divided by 10
39		+b	Y	75	Raw value in example here - not divided by 10
40		Trash	Y	4	
41		Length - in	Y	111	Raw value in example here - not divided by 100
42		LUI	Y	806	Raw value in example here - not divided by 10
43		Up/Pima	Y	1	1 = upland; 2 = pima
44		Type	N	0	Record type - (orginal, review or reworked)
45		Status	N	0	0 = no correction; 1 = corrected record
46		CCC loan	Y	-120	Raw value in example here - not divided by 1000
***	The data that varies by gin will be at end of combine data set.				

Figure 1. Working version of desired data for pilot study.