COMPARISON OF ON-FARM COTTON VARIETY TRIAL RESULTS WHEN USING YIELD MONITORS VS. WEIGH WAGONS

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Abstract

On-farm cotton variety trials provide valuable information on the performance of cotton varieties; however, they present some logistical challenges. The need to conduct trials at multiple locations and the time constraints of cooperators can make moving weigh wagons with load cells to measure yield difficult. On-board cotton yield monitor equipped cotton pickers could help alleviate some of thee challenges. Cotton yield monitors have been demonstrated to be accurate for conducting on-farm research in fields planted to a single variety. However, when multiple varieties are planted, their accuracy has been questioned. The objective of this research was to determine the suitability of cotton yield monitors for conducting on-farm variety trails. Yield monitor and weigh wagon data from seven trials in Louisiana in 2007 were correlated using linear regression. Yield monitor-derived data generally correlated well with weigh wagon data, although individual varieties exhibit less correlation than others. The yield monitor tended to under-estimate yield and the degree of under-estimation varied substantially across varieties. Because of the lack of acceptable correlation for some varieties and a lack of consistency for the degree of under-estimation of yield with a yield monitor, it is recommended that weigh wagons be utilized for conducting on-farm variety trials at this time.

Introduction

On-farm variety trials provide valuable cotton variety information for producers, seed companies, and universities. On-farm cotton variety trials almost always have fewer entries and can be conducted at numerous locations compared with Official Variety Trials and cotton variety screening tests conducted on research stations. There are, however, numerous challenges to collecting reliable data from on-farm trials. These challenges include the logistical problems of having multiple locations, the time constraints of cooperators, and the need to transport equipment such as boll buggies to multiple locations in a timely and safe fashion. To overcome some of these logistical challenges, many have proposed or resorted to reliance on cotton yield monitors to collect yield data. Most aftermarket yield monitors estimate yield by utilizing optical sensing technology to monitor light interception in ducts and convert the flow of seedcotton into weight.

Although the accuracy of cotton yield monitors is well established when calibrated to a particular variety or field, their utility for on-farm variety trials that contain multiple varieties planted in strips within a field is questionable. Robertson et al. (2006) reported variation in yield monitor data across several varieties in Arkansas. Those researchers stated that yield monitors have great utility for on-farm trials in which a single variety is planted, but recommended that they not be used for tests involving multiple varieties. The objective of this research is to evaluate the correlation between yield monitor and weigh wagon data for trials in which multiple varieties were planted and determine the yield monitor's usefulness in conducting on-farm variety trials.

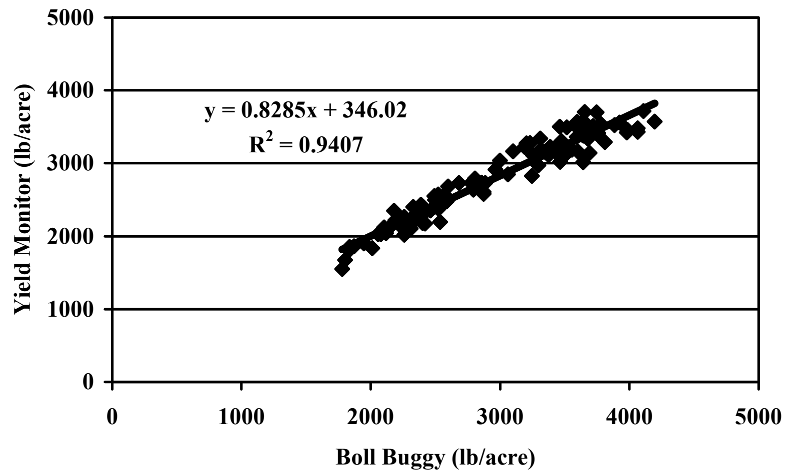
Methods

Yield monitor and weigh wagon, or boll buggy, data for yield were collected from 7 on-farm variety trials in Louisiana in 2007. These variety trials varied in the number of entries from 5 to 15, and the number of replications from 1 to 3. Plot sizes ranged from 8 to 16 rows and plot lengths varied from 0.15 to 0.25 miles. In each trial, an Ag-Leader yield monitor was used to record seedcotton weight in each plot. Seedcotton was dumped into boll buggies equipped with scales capable of being tared between each plot. An approximate 10 pound sub-sample of seedcotton was collected from the boll buggy after weighing for ginning to determine lint percent and calculate lint yields. Linear regression was utilized to characterize the relationship yield monitor and boll buggy obtained data for seedcotton yield. Although a total of 29 cotton varieties were included in the entire data set, 5 that were common to most locations are presented in detail. To determine if final results obtained with a yield monitor would have been similar to those obtained with the boll buggy, data for the 5 that were common to four locations were subjected to analysis variance using PROC GLM procedures.

Results

When considering all available data, linear regression indicated a strong relationship between yield monitor and boll buggy data (R^2=0.9407). Slope of the line, however, was 0.8285. When regressing yield monitor data on boll buggy data, a slope of 1.0 would indicate the same estimation of yield; greater than 1.0 indicates an over-estimation, and less than 1.0 indicates an under-estimation of yield by the yield monitor. Our data indicate the yield monitor system under-estimated yield, although the relationship was strong when considering the entire data set.

Figure 1. Correlation of all observations of yield monitor and boll buggy data (n=114).



Utilizing the entire data set for correlation can mask differences in correlation for individual varieties which is of the most interest. Therefore, data for five varieties for which at least 9 observations existed are summarized in Table 1. Data indicate a good correlation (R^2>0.90) for four of the five varieties. However, data for Stoneville ST 4554B2RF showed a much weaker correlation (R^2=0.7991) between yield monitor and boll buggy results than others. The slope of the linear relationship was less than 1.0 for all five varieties. However, the slopes varied from a low of 0.7242 for Deltapine DP 117 B2RF to a high of 0.8577 for PhytoGen PHY 485 WRF. These data indicate that the yield monitor under-estimated the yield of all varieties, but the magnitude of under-estimation varied and was not consistent among the five varieties.

Table 1. Summary of linear regression of yield monitor and boll buggy yield data for five cotton varieties

Variety	R^2	Slope
DP 117 B2RF	0.9022	0.7242
DP 143 B2RF	0.9535	0.7951
DP 164 B2RF	0.9620	0.8425
PHY 485 WRF	0.9453	0.8577
ST 4554B2RF	0.7991	0.8303

Some variance in the data are expected due to experimental error. Therefore a mock scenario was used to determine of the variance was small enough so as not to affect the overall results if a yield monitor had been utilized. When data were pooled together for the five varieties across the four locations at which they were common entries, the rank, or order, of the varieties for lint yield did not change (Table 2). The coefficient of variation (CV) remained relatively unchanged. However, the calculated LSD was different enough to change the LSD groupings, indicating that if the yield monitor had been used, some varieties that were statistically similar in the boll buggy data set would not have been so, and vice versa. The changes in the data using the mock scenario could have been considered minor, but they were changes nonetheless. When the individual locations were analyzed, it was found the rank of the five varieties changed in one of the four locations (data not shown).

Table 2. Variety trials results for lint yield using boll buggy and yield monitor derived data. Data pooled across 4 locations in Louisiana in 2007.

	Boll Buggy		**Yield Monitor**	
Variety	**Lint yield**	**(rank)**	**Lint yield**	**(rank)**
	lb $acre^{-1}$		lb $acre^{-1}$	
Deltapine DP 117 B2RF	1222 a*	(1)	1169 a	(1)
Stoneville ST 4554B2RF	1162 b	(2)	1079 b	(2)
PhytoGen PHY 485 WRF	1084 c	(3)	1072 b	(3)
Deltapine DP 164 B2RF	1014 d	(4)	988 c	(4)
Deltapine DP 143 B2RF	995 d	(5)	938 d	(5)
Mean	1095		1050	
$LSD_{0.05}$	44		38	
CV(%)	3.6		3.3	

* Means followed by the same letter do not differ significantly at the 0.05 level of probability.

Summary

The correlation of the yield monitor data with boll buggy data was strong for some varieties and weaker for others. Determining how much variation is acceptable is an arbitrary decision; however, at least an R^2=0.90 should be considered a minimum as this would roughly correspond to a 90% confidence level. For one variety, the R^2 was much less than 0.90. Just as importantly is the slope of the regression lines. If the yield monitor consistently under-estimates yield, then this would be acceptable so long as the magnitude of under-estimation were consistent across varieties. Our data indicate this is not so as the slopes of the lines differed by as much as 18% varieties for the varieties analyzed.

Our results are in general agreement with Robertson et al. (2006) that the use of yield monitors is not recommended for collecting yield data from on-farm trials that contain multiple varieties. Our results show that although a strong correlation can exist for some varieties, the degree to which the yield monitor under-estimates or over-estimates yield can vary significantly. If a correction factor for individual varieties could be determined, it would be beneficial. Unfortunately, at this time no such correction factor exists. Therefore boll buggies equipped with scales should be considered the only reliable method of collecting yield data from on-farm cotton variety trials at this time.

Robertson et al. (2006) pointed out that yield monitors can be of great value for trials that contain a single variety and evaluate a cultural practice. This should be largely true, although as those researchers stated, some varieties may always have a weak correlation with the yield monitor, so the choice of variety for such a purpose is important and should be verified through calibration procedures.

References

Robertson, B., M. Cordell, S. Matthews, and F. Groves. 2006. Utility of Yield Monitors for On-farm Research. Proceedings Beltwide Cotton Conferences, pp. 1756-1758.