USING YIELD MONITORS TO EVALUATE COTTON VARIETY TESTS

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Abstract

Grain yield monitors have successfully been used to harvest variety and hybrid trials when certain guidelines were followed. However, there has been concern regarding cotton yield monitors and the way that they measure flow rate. A Beltwide effort was initiated to assess yield monitor performance in replicated variety trials with the objective of determining the source of yield monitor errors and developing protocols for using yield monitors to accurately

harvest cotton variety trials. Data were collected from at least seven trials across six states. The trials were conducted with field scale plots containing at least six varieties. Yield was measured with the yield monitor and a reference scale. The reference scale varied among locations, but was an accepted device to measure variety yield. Correlation between yield monitor and reference yields for cotton variety tests were generally high for four of six site years. However, the high correlation did not allow yield monitors to effectively group varieties the same as the reference scale. Errors were significant by variety for five of six site-years. No clear methods to adjust for error have been discovered.

Introduction

Robertson et al. (2006) evaluated the potential to use cotton yield monitors for on-farm testing. They considered the correlation between yield monitor and weigh wagon measured yields to determine if varieties were suitable to use in on-farm research plots. A high correlation indicated that the yield monitor reliably measured yield for that variety. They deemed that some varieties were more suited for on-farm research trials than others when a yield monitor would be used to measure yield. Rains et al. (2002) ranked cotton varieties using weigh wagon and yield monitor yields. The mean absolute difference between the two rankings was about 3 with the maximum/minimum difference was +/-9. While they recognized some challenges with the weigh wagons that they used, they believed that variety changes influenced yield monitor accuracy. They speculated that different seed mass among varieties could affect yield monitor weights. Stewart et al. (2008) harvested cotton variety trials to determine the suitability of yield monitors for harvesting on-farm variety trials. They concluded that although yield monitor and weigh wagon data were correlated, the correlation was variety dependent. Thus, yield monitors were not recommended for harvesting on-farm variety trials. The objectives of this research were to determine errors associated with using yield monitors to evaluate cotton variety tests and evaluate pertinent information regarding varieties and harvest conditions that could cause the errors.

Methods

Cotton variety trials were harvested over a two year period (2012 and 2013) in six states. Each trial contained at least six varieties which were replicated three times. The yield monitor manufacturer, mean plot length and mean plot mass as measured by the reference scale are shown in table 1. Yield monitor mass was recorded from the yield monitor display in the cab. It was also checked against the data from the yield monitor file, but the value from the display was used as the yield monitor's measured mass. After the plot was harvested and the value recorded, the seed cotton was unloaded into a boll buggy to measure the actual mass. This is the reference mass that was used to determine error. While the reference scale was different at each location, it was something that would typically be used to measure mass for on-farm research trials. The length and width of all plots were measured. Plots at some locations were uniform in length, however some varied. A sample from each plot was ginned to determine lint turnout. Again, while the ginning procedures, sample size and gin may have varied across locations, the individual procedures were typical for the researchers at each location.

Table 1. Summary data for each site year.

Year	Site	Number of Varieties	Mean Plot length, ft	Mean Mass, lbs	Yield Monitor
2012	Georgia	11	712	570	AgLeader
2012	South Carolina	6	500	1188	AgLeader
2012	Texas	8	536	321	John Deere
2013	Georgia	12	1442	986	AgLeader
2013	Oklahoma	10	590	2069	Trimble
2013	Texas	8	1427	1598	John Deere

Error was calculated for each plot on a mass basis. However, all variety comparisons were made based on seed cotton yield. Comparing varieties based on yield accounts for the non-uniform plot length at some locations.

Results

Mean seed cotton yield as determined by the reference scale and yield monitor are shown in table 2 by site-year. Mean yields ranged from 1977 to over 6000 lbs/ac. It should be noted that the 2013 Oklahoma site was stripper harvested, thus it had a greater seed cotton yield (in a very good crop year) and lower lint turnout. Correlation between yield measure by the two methods (reference and yield monitor) exceeded 0.90 for four of the six site-years. There was no correlation for the Oklahoma site in 2013 and a negative correlation for Texas in 2013 (figure 1). The high correlations were in line with those reported by Robertson et al (2006) and Stewart et al. (2008).

Analysis of variance was used to determine varietal yield differences at each site. This was done with yield calculated from both the reference scale and yield monitor. Significant yield differences among varieties were detected for all site-years. Yield monitors tended to group the varieties similar to the reference scale for the site years with the highest correlation coefficients. However there were differences that could potentially affect variety decisions. In general, the highest and lowest yielding varieties were placed in the same statistical groups by the yield monitor and reference scale. Varieties that yielded near the mean for a location were typically not grouped similarly by the two means for measuring yield. As expected the statistical groupings of varieties for the two site-years with low correlation coefficients were not similar using the two methods to determine yield.

Errors were significantly different by variety for five of the six site-years. This demonstrates that certain varieties are responding similarly when measured by the yield monitor. However, no clear methods to adjust for error have been discovered at this time. Yield monitor error for some site-years was related to lint turnout data, but this relationship was inconsistent across site-years (figure 2). While other data (boll mass, seed mass, etc.) were collected as part of this research, that data has not been fully analyzed.

Table 2. Mean yields, errors and correlation between reference and yield monitor yields.

Year	Site	Mean Reference Seed Cotton Yield, lbs/ac	Mean YM Seed Cotton Yield, lbs/ac	Mean Error, %	Mean Lint Turnout, %	Correlation Coefficient
2012	Georgia	2909	2741	-5.5	41.8	0.91
2012	South Carolina	4085	3967	-2.6	42.2	0.92
2012	Texas	1977	1208	-40.8	36.7	0.91
2013	Georgia	2637	2725	3.4	39.4	0.90
2013	Oklahoma	6364	6583	4.7	26.8	0.04
2013	Texas	3668	2758	-24.5	37.5	-0.20

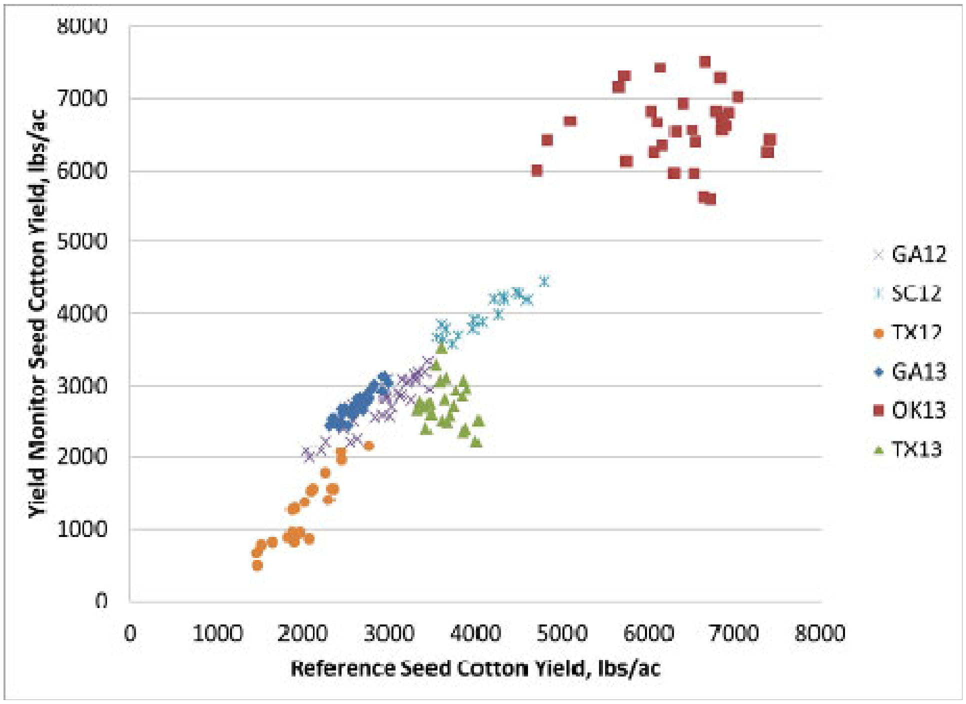

Figure 1. Relationship of seed cotton yield using two measurement methods for six site-years.

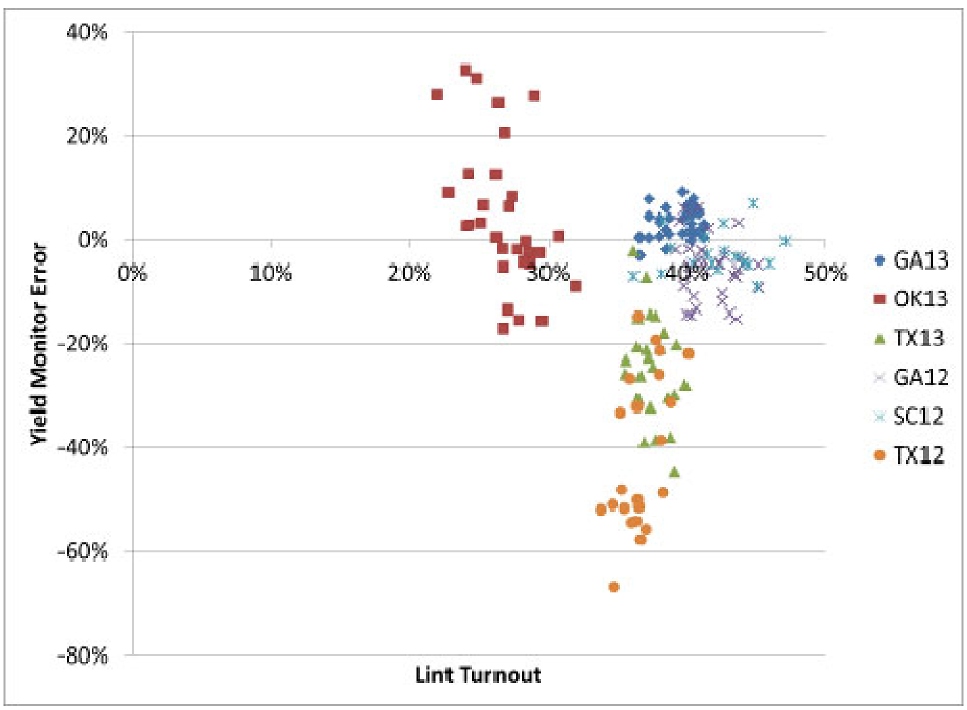

Figure 2. Relationship of yield monitor error to lint turnout.

Summary

Correlation between yield monitor and reference yields for cotton variety tests were generally high for four of six site years. However, the high correlation did not allow yield monitors to effectively group varieties the same as the reference scale. Errors were significant by variety for five of six site-years. No clear methods to adjust for error have been discovered.

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