RELATIONSHIP BETWEEN BOLL COUNTS AND LINT YIELD

Seth Byrd
Oklahoma State University
Stillwater, OK
Bradley R. Wilson
University of Missouri
Portageville, MO
Cayden B. Catlin
Andrea J. Althoff
Wyatt Medina
Trace Holsted
Oklahoma State University
Stillwater, OK

Abstract

Boll counts are commonly utilized by consultants and producers to predict lint yields once the flowering period has ended. There are three models developed by various extension programs that are commonly used to predict yield based on bolls counts. While there is a plethora of evidence that lint yield is strongly related to boll number, particularly in small plot settings, questions surrounding the reliability of yields as predicted by boll counts in commercial production settings is common. To enable boll counts to be utilized with confidence and examination of the ability of these boll count models to accurately predict yield is required. The objectives of this study were to evaluate the relationship between lint yield as predicted by multiple boll count models and actual lint yield. An additional objective was to evaluate the individual components of boll count models to determine the source of error when the predicted and actual yield differ.

Materials and Methods

An on-farm large plot variety trial in Jackson County, Oklahoma was the location of boll count evaluations in 2020. These trials consist of multiple commercial varieties planted in a minimum of three replications with varieties randomized withing each replication. At this location, plots consisted of six rows spaced 38 in apart approximately 2,200 ft in length. Boll counts were conducted in four varieties in 2020, including Deltapine 2020 B3XF (DP 2020), NexGen 4098 B3XF (NG 4098), PhytoGen 400 W3FE (PHY 400), and Stoneville 5707 B2XF (ST 5707). Three counts were conducted in each replication of each variety, the counts within in plot or replication conducted approximately 400 ft apart at two timings, 59 days prior to harvest and 3 days prior to harvest. At 59 days prior to harvest, all harvestable sized bolls (minimum diameter of approximately 1 in) in 10 linear ft of one row were quantified. The first and last plants at each count location were flagged so that these exact same areas could be used for the second count. At 3 days prior to harvest all open, harvestable bolls were quantified with hard-locked bolls omitted. After counts were recorded at 3 days prior to harvest five or six plants were removed from each sample area (enough to ensure a minimum of 50 bolls were collected), bolls were counted, and the lint from all harvestable bolls was removed and then weighed to determine average lint weight per boll. The plots were harvested with a John Deere CP690 (John Deere, Moline, IL), and round modules were weighted on a portable platform scale (Western Forage Systems, Marsing, ID).

Three different models or methods of using boll counts to predict yield were utilized, each with varying degrees of required inputs. Texas A&M Model (TAMU) from Prostko et al., 1998. Inputs: boll number per foot of row and row spacing. Assumptions: uses average boll weight and doesn't incorporate turnout. Mississippi State Model (MSU) from McCarty, 1999, updated by Boman, 2012. Inputs: boll number per foot of row, row spacing, individual boll weight, and turnout. Auburn Model (AU) from Goodman and Monks, 2003. Inputs: bolls per 10 ft. of row, row spacing, individual boll weight, turnout, and harvest efficiency. This model also employs a constant factor for boll weight of 0.008685.

Results

A wide range of bolls per foot numbers within plot, and because there were three counts per plot but ultimately only one yield number, counts from each plot were averaged. There was a moderate linear trend with higher yield values resulted from higher boll counts. Surprisingly, the boll counts conducted 59 days prior to harvest had a stronger correlation to lint yield than counts taken 3 days prior to harvest (R^2 values of 0.624 and 0.502, respectively). Utilizing the models resulted in a very weak relationship with actual lint yield. To determine if this relationship could be improved, information that wouldn't be available at the time predictions were made was fed back into the models. This included factors such as actual turnout and boll mass that would only be available after harvest. When this was done, the TAMU model consistently underestimated yield, although magnitude of the difference between predicted and actual yield values lessened as bolls per foot of row increased, regardless of sample date. The MSU model was closely related to yield at counts between 25 and 30 bolls per foot, while the AU model was most predictive between 30 and 35 bolls per foot at both sample dates.

Besides likely the biggest factor, the variability of bolls per plant across large plots, much less a whole field, two observations were made that may explain at least some of the lack of relationship between the yield predicted by models and actual yield. Models tended to underestimate average bolls weight, with the AU model stating 4 grams per boll was a likely average weight across an entire plant, while the MSU model topped out at 5 g boll^{-1}. In this study average weights ranged from 4.8 – 5.6 g boll^{-1}, with three of the four varieties having average bolls weights greater than 5 g. Another factor that needs to be carefully considered is turnout. This was variable by variety, with turnout values ranging from 36.4 – 41.3 in this study. In summary, boll count models were not strongly correlated with actual lint yield. Only when information that would not be available at the time boll counts are conducted was used in the model was the correlation improved. This is due to variability of boll numbers in the field and differences across varieties in the factors the models use to predict yield, namely turnout and individual boll mass. It is likely that additional work is needed to determine ways to strengthen the predictability of boll count models and lint yields, although it is more likely that in the near future a more high tech innovation will become available.

References

Goodman, W. R., and C. D. Monks. 2003. A Farm Demonstrations Method for Estimating Cotton Yield in the Field for Use by Extension Agents and Specialists. Journal of Extension (41)6.

McCarty, W. 1999. Cotton Yield Estimation. Mississippi State University Cooperative Extension Service. Available online at https://extension.msstate.edu/sites/default/files/topic-files/cotton/estimating_yield.pdf.

Prostko, E., R. Lemon, and J.T. Cothren. 1998. Field Estimation of Cotton Yields. Texas Agricultural Extension Service SCS-1998-20.