VARIABILITY OF COTTON LINT YIELD AS PREDICTED BY BOLL COUNTS

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Abstract

Boll counts are often utilized as yield prediction tools and have been proven accurate in estimating yield in small plot studies. However, there are often questions about the validity and accuracy of boll counts to predict yields in commercial settings, due to the amount of in-field variability and the fact that models rely on assumptions of individual boll weight and turnout percentage to estimate yield from boll counts performed around 60 days prior to harvest. To evaluate the accuracy of boll counts, three models were used in the current study, each with increasing number of required inputs. Although all models recommend that 10' of row are utilized for the counts, with two of the models converting that number into bolls per foot of row. The Texas A&M Model (TAMU) from Prostko et al., 1998 requires the least amount of inputs, which are boll number per foot of row and row spacing. This model assumes an average boll weight and doesn't incorporate options for turnout. The second model utilized was the Mississippi State Model (MSU) from McCarty, 1999, updated by Boman, 2012. It requires boll number per foot of row and row spacing, along with various options for individual boll weight and turnout. The third model evaluated was the Auburn Model (AU) from Goodman and Monks, 2003. Inputs for this model are bolls per 10 ft. of row, row spacing, and estimations of individual boll weight, turnout, and harvest efficiency (87% efficiency for picker harvest was stated in the model). This model also employs a constant factor for boll weight of 0.008685 when weighing in grams. It is important to note that all models state that 4 grams per boll is the average boll weight. However, it is obvious when making predictions based on boll counts taken weeks prior to harvest that both boll weight and turnout must be assumed or estimated.

To test the variability in lint yield as predicted by boll counts, and to compare the actual yield to the predicted yield, an on-farm variety trial in Oklahoma was utilized. Four varieties were evaluated from four separate seed companies to ensure variability in both boll size and turnout. The varieties included were Deltapine 2020 B3XF (DP 2020), NexGen 4098 B3XF (NG 4098), PhytoGen 400 W3FE (PHY 400), and Stoneville 5707 B2XF (ST 5707). These varieties were included among the 12 total variety entries in the on-farm variety trial, which included three replications, with each plot approximately 1 acre in size. Boll counts were conduced 56 days prior to harvest and 3 days prior to harvest to determine if accuracy could be increased by quantifying bolls closer to harvest. At both timings all harvestable size bolls (56 days prior to harvest) or open bolls (3 days prior to harvest) were quantified from 10' of row, with three total counts taken in each plot for a total of 9 counts for each variety. At the counts taken 3 days prior to harvest, five to six plants were completely removed from each 10' area to ensure that at least 50 boll were collected. The lint was hand removed from all open harvestable bolls and the number of bolls was recorded. The lint was then weighed to determine average boll mass in grams. The field was harvested with a CP 690 and each plot was wrapped in a round module. A seedcotton sample was taken from each module and ginned on a research gin to determine turnout and lint yield per acre. These values were then compared back to the yields as predicted by boll counts taken at 56 and 3 days prior to harvest.

Regardless of the model used yield predictions had an extremely low correlation with actual yields, with R^2 values ranging from 0.08 to 0.13. This appeared to be primarily due to two conditions. First, when actual yield was plotted against boll numbers per foot of row, a wide range of boll numbers resulted in a narrow range of lint yield per acre. For example, a <200 lb. ac^{-1} yield difference across a range of 20 – 35 bolls per foot. Secondly, the boll weights recorded from all varieties ranged from 4.8 – 5.6 grams, much higher than the 4 gram value traditionally utilized. In an attempt to determine if the models would predict yield if actual values instead of assumed values were used, the actual boll weights and turnout values were incorporated into the model instead of the standard assumptions. While there was great improvement in the correlations between predicted yield and actual yield when these actual boll weight and turnout values were used (R^2 values ranging from 0.50 – 0.76) it is important to note that these improvements were gained from values that wouldn't be known until the end of the year (boll weights) or after ginning (turnout). Even when utilizing this end of season or post-harvest data, depending on the variety a different

model proved to be the most effective predictor, with DP 2020 and ST 5707 yields best predicted utilizing boll counts taken 56 days prior to harvest with the MSU model, NG 4098 best predicted by boll counts taken 3 days prior to harvest with the MSU model, and PHY 400 best predicted by boll counts taken 3 days prior to harvest with the AU model.

The results of the first year of this study provide evidence of the variability of boll number to predict yield in a commercial setting, and specifically the large range of boll counts that may result in a narrow range of actual yield. It appears that the relationship between increasing boll number and increasing lint yield may not be as highly correlated as the models predict. There was also a very weak correlation between boll number and individual boll weight ($R^2 = 0.12$) across all four varieties. Additionally, evaluations of the boll number and mass across various production environments, and the stability in turnout values within each variety year-to-year, will be key to identify potential methods to improve yield predictions based on boll number.

References

Boman, R. Estimating Cotton Yield Using Boll Counting. 2012. Oklahoma State University Cooperative Extension. Available online at http://cotton.okstate.edu/yield-estimation/OK%20Yield%20Estimation%202012.pdf.

Goodman, B., and C.D. Monks. 2003. A Farm Demonstrations Method for Estimating Cotton Yield in the Fiedl for Use by Extension Agents and Specialists. 2003. Journal of Extension Volume 41, No. 6.

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