

Development of a Yield Projection Technique for Arizona Cotton

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Abstract

A series of boll measurements were taken at numerous locations in cotton producing areas across Arizona in 1998 in an attempt to continue to develop a yield prediction model with a project that began in 1993. Results from 1995 showed the strongest relationship between final open boll counts and yield compared to a number of other measurements. Based on these results, data collection on boll counts began in 1996 and has continued in 1997 and 1998. Boll counts were taken as the number of harvestable bolls meter⁻¹. All boll count measurements were made within one week of harvest. Number of bolls per unit area were then correlated to lint yield and an estimate for the number of bolls per area needed to produce a bale of lint was calculated. Estimates using all three years data combined indicate that approximately 38 bolls meter⁻¹ are needed to produce one bale of lint per acre.

Introduction

Cotton grown in the desert Southwest has the advantage of a longer growing season allowing producers at lower elevations the option of carrying the crop through a second fruiting cycle, and attempting to produce a "top-crop" to increase yield. Additional inputs are required to support a second fruiting cycle. If a producer were able to obtain a reasonable estimate of crop yield potential at the time when the decision for crop termination is to be made, it could help in deciding whether to terminate the crop or carry it through a second fruiting cycle. A reliable yield estimation technique could serve a number of useful purposes in managing cotton fields for optimum yields, efficiencies, and profits. The objective of this study was to develop a model for predicting yield by use of easily measured plant parameters.

Materials and Methods

In an effort to continue to build upon previous yield prediction and boll sampling work, boll counts were taken from several experiments conducted in cotton producing areas of Arizona in 1998. Data was collected either on the date of harvest or as close to that date as was reasonably possible (all within 4-5 days). Data collected included; number of open bolls per meter and number of green bolls per meter. Yield estimates were made by mechanically picking the plots from which the boll counts were taken. Percent turnout for each plot was obtained from small sub-samples that were individually ginned. Data from 1996, 1997, and 1998 was analyzed by year and all data were combined for an overall analysis. Linear regression analysis was performed according to procedures outlined by the SAS institute (1994), on the data to evaluate the relationship between open bolls per meter and final lint yield. A mean and standard deviation was calculated for the number of open bolls per meter needed to produce one bale of lint per acre.

Results and Discussion

The original project was oriented towards the development of a model that would assist in predicting final lint yield based upon easily obtained boll measurements such as boll weight, boll diameter, and bolls/meter (Norton et al., 1995 and 1996). These results revealed a high degree of variability among these parameters that reduced the predictive capacity of the model. However, results did show some promise with respect to a correlation between final open boll counts (within one week of harvest) and final lint yield (Norton and Silvertooth, 1996 Norton and Silvertooth, 1997, and Norton and Silvertooth, 1998). Data collected in 1996 resulted in estimates of the number of bolls needed to produce a bale of lint yield as being 13 bolls per foot and 43 bolls per meter (Table 1). However, relatively large standard deviations were associated with these estimates. Data collected in 1997 (Table 2) served to further improve that estimate by lowering the coefficient of variation (CV) of the model from 22% to 17%, which is related to a much lower standard deviation associated with the mean. Data collected in 1998 (Table 3) also produced a low standard deviation associated with the mean estimate of bolls meter/acre needed to produce a bale of lint/acre. The overall estimate from the combined 3 years of data is shown in Table 3.

Results of the data analyses in Table 3 show that a count of approximately 12 harvestable (open) bolls/foot or 38 harvestable (open) bolls/meter will result in approximately one bale of lint yield/acre. A high degree of variability exists among varieties, plants, and within individual plants with respect to parameters such as boll size, number of locks/boll, and percent turnout. For this reason, the mean has a relatively large standard deviation associated with it. In practice, the estimate of the number of bolls needed to produce one bale of lint/acre may need to be adjusted for a given field, particularly in the case of varieties that tend to have small bolls.

Regression analysis performed revealed a significant linear relationship between lint yield and open boll count on a meter basis (Figure 1). It is important to understand that using the regression equation to estimate lint yield production based on boll counts can result in a different estimate than if the mean from Table 4 is used. The regression equation estimates the lint yield based upon a least squares difference of all the data points for that value of x (boll count). The value in Table 4 is an overall mean of the ratio of bolls/meter to lint yield. The more accurate of the two would be the overall mean (Table 4). The regression analysis was shown to illustrate the strong linear relationship between the two parameters.

Data collection will continue for the 1999 growing season to further expand the database in an effort to improve the accuracy and precision of lint yield estimations.

References

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Table 1. Boll count estimates and associated standard deviations resulting in one bale of lint/acre, Arizona, 1996.

| | Mean | Standard Deviation |
|----------------------------|------|--------------------|
| 1996 n=64 | | |
| Bolls/foot (40 inch rows) | 13.3 | 10.4 |
| Bolls/meter (40 inch rows) | 43.7 | 34.1 |

Table 2. Boll count estimates and associated standard deviations resulting in one bale of lint/acre, Arizona, 1997.

| | Mean | Standard Deviation |
|----------------------------|------|--------------------|
| 1997 n=101 | | |
| Bolls/foot (40 inch rows) | 10.9 | 2.2 |
| Bolls/meter (40 inch rows) | 35.8 | 7.1 |

Table 3. Boll count estimates and associated standard deviations resulting in one bale of lint/acre, Arizona, 1998.

| | Mean | Standard Deviation |
|----------------------------|------|--------------------|
| 1998 n=229 | | |
| Bolls/foot (40 inch rows) | 11.3 | 2.9 |
| Bolls/meter (40 inch rows) | 37.1 | 9.5 |

Table 4. Boll count estimates and associated standard deviations resulting in one bale of lint/acre, Arizona, 1996, 1997, and 1998.

| | Mean | Standard Deviation |
|----------------------------|------|--------------------|
| 1996-1998 n=394 | | |
| Bolls/foot (40 inch rows) | 11.5 | 4.9 |
| Bolls/meter (40 inch rows) | 37.9 | 16.1 |

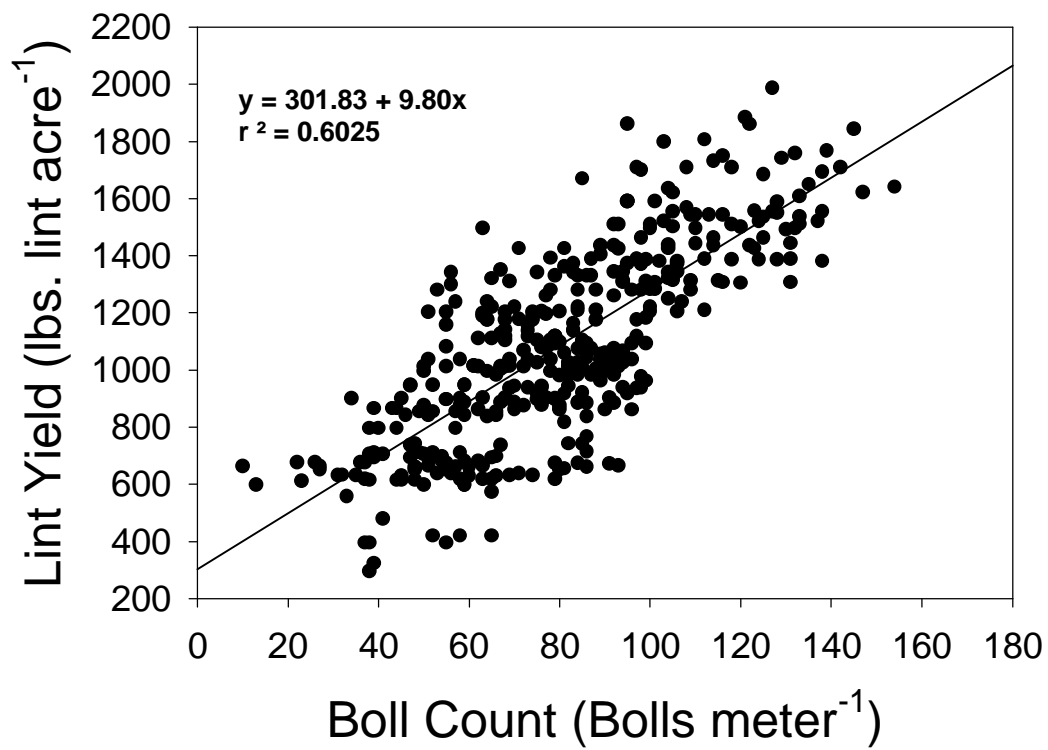


Figure 1. Regression results of lint yield data as a function of one meter open boll counts, Arizona, 1996, 1997, and 1998.