BOLL DIAMETER AND SEED NUMBER RELATION TO SEEDCOTTON WEIGHT PER BOLL

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Abstract

When estimating yield of cotton, the weight of seedcotton or lint per boll is variable and often unknown. A sampling study was conducted in the Rio Grande Valley of Texas to determine if sufficient correlation existed between seedcotton weight and either boll diameter, seed number, or number of locs such that these parameters could be helpful in predicting the average seedcotton weight per boll. Seedcotton weight per boll was significantly related to all three parameters although each parameter was able to account for only of the fraction of the variability in boll weights. The parameters measured were poor predictors of individual boll weight, but may be useful for making inferences as to average boll weight. Boll diameter was as good a predictor of seedcotton weight as any other parameter or combination of parameters. Seedcotton weight was related to boll diameter by the equation: weight(g) = -3.96 + 0.253diameter(mm) (r^2 = 0.169).

Introduction

It is often desirable to estimate the yield of cotton. Such estimates may be required for marketing plans, harvesting plans, crop insurance adjusting , or other reasons. Estimating the number of bolls per unit of land area is easy and is relatively accurate if multiple counts are made in each field, but the mass of either lint or seedcotton per boll is often variable as well as unknown. Under average conditions, cotton bolls and cottonseed reach their maximum size and volume at approximately three weeks post-anthesis, whereas the fiber and seed continue to accumulate weight until reaching a maximum at approximately 45 days post-anthesis (Oosterhuis et al., 1994). Any variation in environmental factors affecting plant growth and development during the boll growing and filling period would be expected to affect the relation between seedcotton weight and boll diameter.

The objective of this study was to determine if a reasonably good correlation existed between the mass of seedcotton per boll and either boll diameter, seedcount per boll, or number of locs, and whether any of these parameters could be used to help predict yield of cotton.

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Methods

Mature but unopened cotton bolls were sampled from five varieties at each of three sites in the Lower Rio Grande Valley of Texas in 1996. Site one was a dryland site located in northern Willacy County on a Lyford sandy clay loam soil. At this site, cotton experienced moderate heat and moisture stress during the early and mid bloom period, but received some rainfall near cut-out which helped to fill out bolls. Both site two and site three were irrigated and were in southeastern Hidalgo County on Raymondville clay loam soils. Samples were taken from variety test plots located at all sites. The five varieties sampled at each site were DP&L NU33, DP&L 51, DP&L 5409, SG 125, and SG 404. Cotton was approximately 20 to 40 percent open at the time of sampling. All bolls sampled were hard, mature bolls within four nodes of a cracked first position boll. Bolls which had soft areas due to boll weevil (*Anthonomis grandis*) damage were not sampled. No attempt was made to ensure that samples were representative of the entire population of bolls for a given variety or site, so no inferences can be made as to average boll diameter or weight for a given variety or site or for comparisons between varieties or sites. In contrast, an effort was made to sample as wide a range in boll sizes as possible. For each variety at each site, 40 to 60 bolls were sampled. Bolls were placed in plastic bags and were transported indoors within 30 minutes to begin measuring.

Thirty bolls from each variety at each site were measured for the average diameter at the widest cross-section perpendicular to the vertical axis of the boll. Bolls were measured to the nearest 0.5 mm. After measuring, the number of locs was counted and the seedcotton was excised from the bolls. Mature bolls had seedcotton that was damp but not wet. Any bolls which had wet seedcotton were replaced with a mature boll. After excising the seedcotton, the number of seed per boll was counted. Any aborted seed or any hollow seed which could be easily crushed were not included in the count. A wide range in seed size was observed. Seedcotton was placed into small paper bags and dried in a vacant greenhouse for one week prior to weighing.

After weighing, seedcotton was recombined for ginning into boll diameter classes for each variety. Boll diameter classes were based on values that would result in approximately one-third of the bolls in each class. Classes were defined as small (23.0 to 28.5 mm), medium (30.0 to 31.5 mm), and large (32.0 to 34.5 mm). The combined samples were ginned on a ten saw sample gin and percent turnout was determined for the various size classes.

Data, including diameter, number of locs, number of seeds, and seedcotton weight, was analyzed by single and multiple regression techniques using the SAS statistical analysis software. Percent lint turnout was analyzed using analysis of variance techniques with the same software.

Discussion

Sampled bolls ranged in diameter from 24.5 to 37.5 mm. Within site by variety combinations, however, most bolls were within a narrow range of diameters. For all sampled bolls, the diameter of the median 50% ranged from only 29.5 to 31.5 mm. Seedcount for all sampled bolls ranged from 12 to 43, whereas the seedcount of the median 50% ranged from only 27 to 32 seeds. Eighty-three percent of the sampled bolls had four locs, fourteen percent had five locs, and three percent had three locs.

Analysis of variance indicated that boll diameter, number of seeds, number of locs, and site were significantly related to seedcotton weight per boll (Table 1). Seedcotton weight per boll was not related to variety. Seedcotton weight was significantly related to boll diameter alone by the equation: weight (g) = - 3.96 + 0.253 diameter (mm). Although the p-value for the relation was highly significant ($p < 0.0001$ for H_0: slope = 0), only a small portion of variation in seedcotton weight was accounted for by variation in boll diameter, with an r-squared of only 0.169 (Fig. 1).

Seedcotton weight per boll was also significantly related to seedcount per boll ($p < 0.0001$ for H_0: slope = 0) by the equation: weight (g) = 1.64 + 0.073 seedcount, although only a small portion of variation in seedcotton weight was attributable to variation in seedcount, with an r-squared of only 0.100 (Fig. 2).

The ability of various single and multiple regression models to predict seedcotton weight per boll is given in Table 2. A model with boll diameter as the only independent variable resulted in an r-squared of 0.169. A multiple regression model with both boll diameter and seedcount as independent variables resulted in only a slight improvement in the r-squared and a slight reduction in the mean squared error.

The relation between seedcotton weight and boll diameter was nearly identical between sites one and three (Fig. 3). At site two, however, seedcotton weights were significantly lower at similar boll diameters. This deviation could be due to variation in growing conditions during the interim between maximum boll size and maximum boll weight. Such variation between sites or between years will likely complicate the use of boll diameter for making inferences as to seedcotton weight.

Analysis of variance indicated no significant differences in percent lint turnout among the three pooled classes of boll diameter.

Conclusion

Boll diameter, seedcount, and loc number were found to be significantly related to seedcotton weight per boll, but were poor predictors of individual boll weight. The objective in estimating yields, however, is usually to estimate the average yield or boll weight. A 95 percent confidence interval indicated that for large sample sizes, boll diameter may be useful for making approximate inferences as to average seedcotton weight per boll (Fig. 1). The relation between boll diameter and weight was not consistent across locations (Fig. 3) and would also be expected to vary across years. Such variation will complicate the use of and diminish the usefulness of the relation for purposes of estimating seedcotton yield.

Acknowledgments

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Reference

Oosterhuis, D., M. Stewart, and D. Guthrie. 1994. Cotton fruit development: the boll. Cotton Physiology Today. Vol. 5. No. 7. August. National Cotton Council. Memphis TN.

Table 1. Analysis of variance for effects on seedcotton weight per boll.

Source	d.f.	P > F
Diameter	1	***
# Seeds	1	***
# Locs	1	**
Site	2	*** †
Variety	4	NS †
Site x Variety	8	***
Sampling Error	432	

*, **, *** Significant at the 0.05, 0.01, and 0.001 probabilitiy levels, respectively.
† The error term for testing effect of Site and Variety was Site x Variety.

Table 2. Ability of various regression models to predict seedcotton weight per boll.

Model Parameters †	r-squared	MSE
D***	0.169	0.865
S***	0.100	0.937
L***	0.049	0.990
D*** S***	0.198	0.837
D*** L*	0.178	0.858
S*** L*	0.113	0.926
D*** S*** L^{NS}	0.200	0.837

† D = Diameter, S = Seedcount, L = Loc number.
*, **, *** Significant at the 0.05, 0.01, and 0.001 probability levels, respectively for H_0: parameter estimate equals zero.

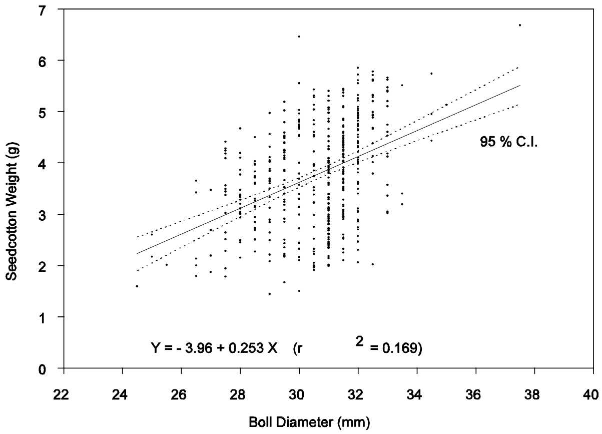

Figure 1. Seedcotton weight as related to boll diameter.

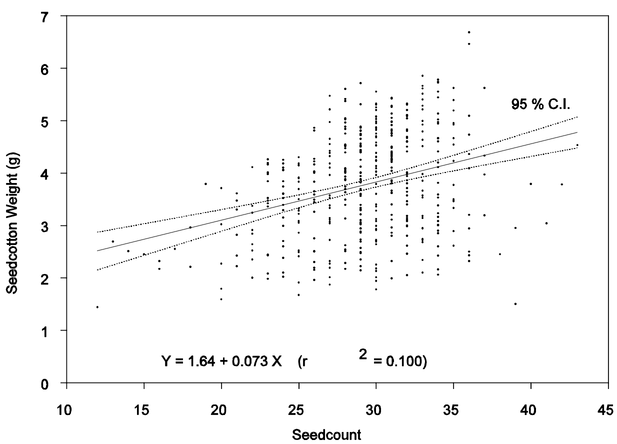

Figure 2. Seed cotton weight as related to seedcount.

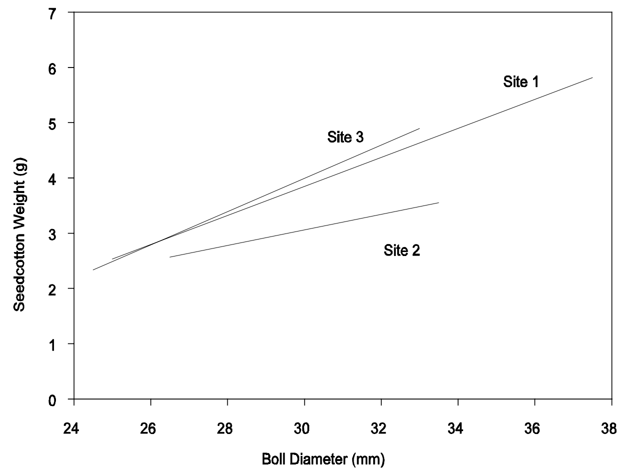

Figure 3. Seedcottonweight vs. Boll diameter for three sites (averaged across vartieties)