GENETIC AND ENVIRONMENTAL FACTORS AFFECTING PRODUCTION AND RETENTION OF FRUITING SITES

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Abstract

Yield potential is intuitively used by producers to adjust production level inputs. A method to accurately determine that potential has been the focal point of many research projects. Since the number of bolls meter^{-2} is the major yield component of cotton, it is reasonable that the number of sites meter^{-2} would reflect yield potential. Studies that have recorded these parameters were used to correlate site production to boll production. Several variables of a production system were evaluated. It was found that the number of fruiting sites produced is not related to the final number of bolls harvested (r^2=0.08). Retention of fruit was found to be better related to the final number of fruit(r^2=0.44).

Introduction

Producers seek to select inputs where benefits are greater than costs, but to do so, they need to know what inputs the crop needs and what is a reasonable yield expectation. The many alternatives to increasing yield becomes a producer's dilemma when the technique of yield forecasting has not been perfected. A short growing season and the lack of adequate water throughout the season makes early fruit production and retention extremely important to cotton production on the Southern High Plains of Texas.

The primary limitation to yield on the Southern High Plains of Texas is water. Understanding effects of various management decisions to increase efficient water use would provide producers with options toward optimum growth and maximum production. If stress occurs during the period when fruiting sites are being established, then potential fruit numbers are reduced. If stress occurs during early fruit development, then the supply of reduced C and N to young fruit (<14 days old) is disrupted, fruit abortion occurs. Boll number per unit ground area is the major yield component and consists of plant population and bolls per plant.

The goal of this study was to correlate the production of fruiting sites and their retention with final boll number, the major yield component of cotton.

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Materials and Methods

Several years of field trials conducted by our lab have produced plant maps that describe various growth parameters of the cotton plant. The number of initiated sites and harvested bolls were evaluated under comparable production systems. These systems vary in genetic selections, water supplies, irrigation and fertility techniques, plant densities, and row spacing. The sampling intensity was a minimum of twenty plants per variable, five from each of four reps. Five consecutive plants were selected in a row that reflected the dominant growth in that rep. Plants with damaged terminals, adjacent to skips or late emerging plants were rejected. Each production system was evaluated on initiated sites, percent retention and final bolls per plant. All observations were combined and final bolls meter^{-2} was regressed against sites initiated and percent retention.

Results and Discussion

Individual varieties were classified into two categories of growth habit, determinant and indeterminant. The indeterminant varieties produced higher number of fruit due to its more perennial growth habit. (Fig. 1) They retained slightly more fruit per plant but expressed as percent of initiated sites; they retained only 54% compared to 58% by the determinant varieties.

The number of fruiting sites produced increased as the water supply increased as a percent of actual evapotranspiration (ETa) replacement.(Fig. 2) The number of fruit retained also increased until replacement nears 100% ET. The fruit retention in the 100% ET was less because late set fruit did not have enough time to mature. The percent retention in this case did not significantly differ across water supplies.

Not only water volume, but also irrigation type had an effect on fruit numbers.(Fig. 3) Row watering consisted of 75-100 mm applications at 10-12 day intervals throughout the season. It established high fruit numbers in the early season, but stress occurred between subsequent applications resulting in fruit abortion. Broadcast (BC) and Low Energy Precision Application (LEPA) were much more efficient at providing water at 5-6 day intervals to the crop. BC was less efficient though, because of the surface evaporation. LEPA concentrated the water in a specific area and reduced the amount of water lost to surface evaporation. LEPA essentially provided more water to the plant in a timely manner. This was shown by the sufficient fruit initiated and the most fruit retained. Percent retention of row, BC and LEPA were 25%, 56% and 53% respectively.

Under dryland production conditions the 1995 and 1996 crops differed significantly in their response to water supply. (Fig. 4) The 1996 dryland crop established a high yield potential by initiating many fruit but was not able to capitalize on this potential and produced relatively few bolls

(28%). The 1995 dryland crop initiated few fruiting sites causing a higher percent retention (58%). Although percent retention was less in 1996, more fruit per plant were harvest because of early growing season conditions. The 1995 season started with more rainfall events but volume per event was small and quickly evaporated. There were very few rainfall events throughout the season that established adequate soil moisture. The September rain (>200mm) in 1995 provided substantial subsoil water for the 1996 crop. Additionally, timely June rains promoted plant growth and fruit initiation. However, the late season did not provide adequate moisture to retain the potential fruit load.

Fertility application can also influence production and retention of fruit. (Fig. 5) Applying the total nutrient supply before planting resulted in initiation of more sites per plant but retention was reduced. The multiple application of nutrients through the season provided nutrients in a timely manner that is critical to plant growth. Multiple applications resulted in retaining more bolls per initiated site. Percent retention for preplant and multiple application of fertilizer were 25% and 43% respectively.

Conclusions

The results of this study indicated that the number of fruit produced was not linearly related to the final number harvested (r^2=0.08, fig. 6). Retention of fruit was found to be related to the final number of fruit(r^2=0.44, fig. 7). It was also found that various production strategies affected both fruit production and retention. High water amounts in the early season followed by stress produced high fruit numbers but low retention. Increasing water volumes resulted in increasing fruit numbers while retention was not significantly different. Frequent applications of fertilizer increased the organic N supply to fruit. This increased fruit retention. New production technologies have advantages that have not been fully exploited in today's cotton production systems. Combining technologies that enhance early fruit development and retention is a goal for the future producers but a technique to forecast a reasonable yield remains to be investigated.

Acknowledgments

We are grateful for the financial support provided by Cotton Inc. and the USDA/ARS for this research.

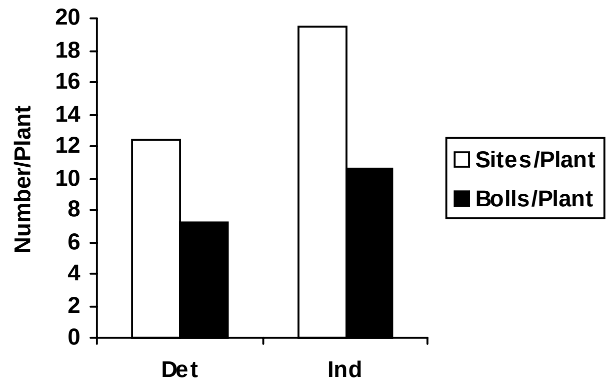

Figure 1. Comparison of indeterminant (Ind) and determinant (Det) varieties on fruiting site production and boll retention.

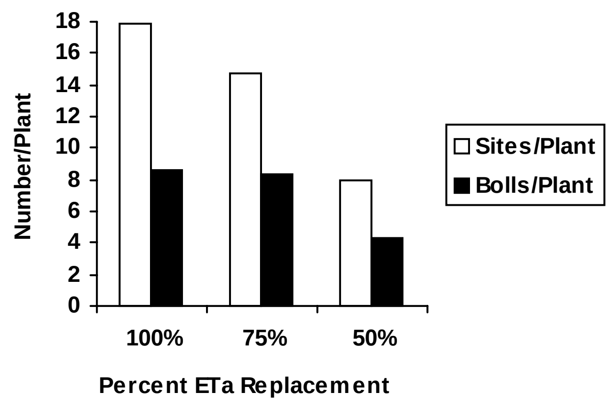

Figure 2. The effects of water supply on fruiting site production and boll retention.

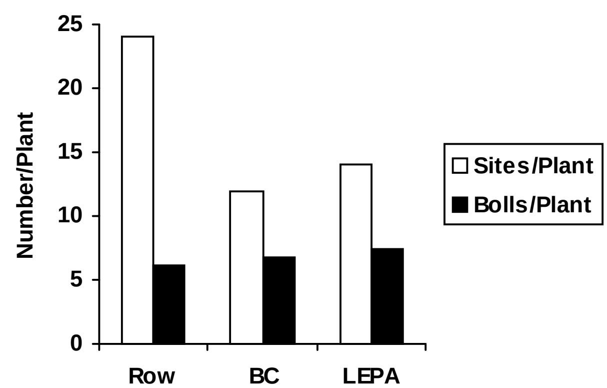

Figure 3. Irrigation type effects on fruiting site production and boll retention.

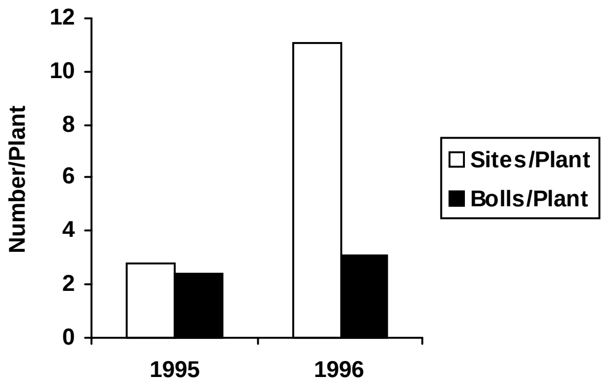

Figure 4. The effect of early water supply in dryland production on fruiting site production and boll retention.

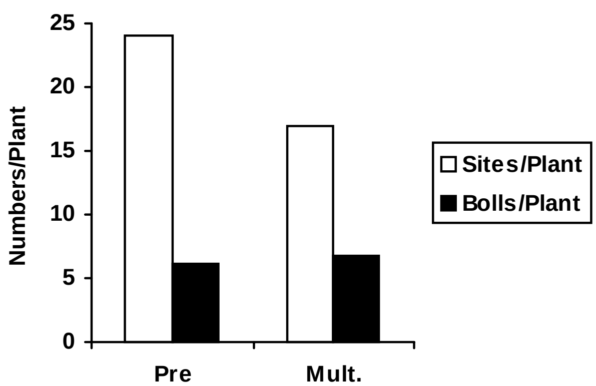

Figure 5. The effects of preplant (Pre) and multiple (Mult.) fertilizer applications on fruiting site production and boll retention.

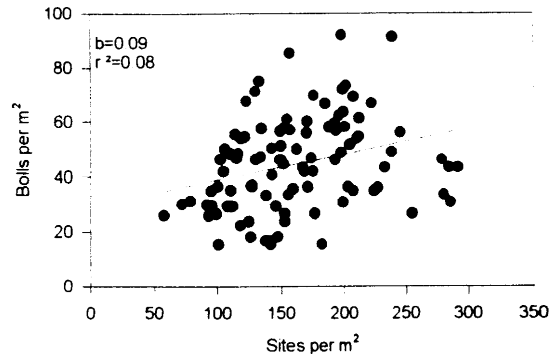

Figure 6. The relationship between fruiting site production and boll production.

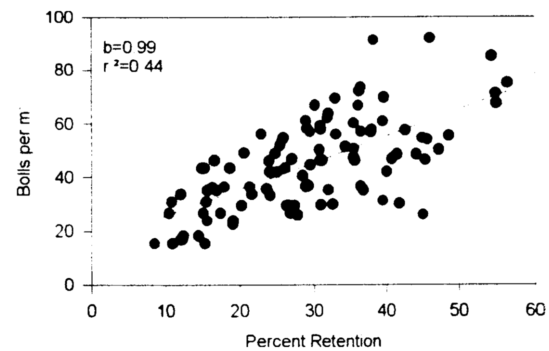

Figure 7. The relationship between percent fruit retention and boll production.