Characterising the Fruiting Dynamics of Commercial Cotton Varieties

Bange, M.P. and Milroy, S.P.
CSIRO Cotton Research Unit, Narrabri.

Summary: This paper reports the results of an experiment to quantify the fruiting characteristics of eight cotton varieties to enable crop simulation models to more accurately reflect yield and maturity of current varieties. Characteristics measured were time to first square, square period, and boll period, and their subsequent effects on crop maturity. Thermal time to first square and boll period were correlated to the maturity ranking of the varieties. However, differences in the length of these periods compared with other reports indicates the need to pursue better methods to quantify these characteristics.

Introduction

Crop simulation models can be used to evaluate risks of management decisions before substantial investment has occurred. Variety selection for yield and its maturity (earliness) is an important decision, particularly in marginal areas or under conditions of late planting. In order to simulate the maturity of a particular variety, the processes that change between varieties must be identified and then related to an environmental factor such as temperature, so that they can be reliably predicted. This paper presents the results of continuing studies to update models to ensure that they reflect the fruiting patterns of current varieties.

Experimental Design and Management

A field trial was conducted at the Australian Cotton Research Unit in the 1995/96 growing season. Eight varieties were sown twice in a split-plot experimental design with three replications using conventional techniques. The two sowing times were 11th October and 29th November. The eight varieties are presented in Table 1 along with their maturity ranking. These varieties include six current commercial varieties and two which have just been released for the coming season.

The node of the first fruiting branch, the time of 1st square and 1st flower open were recorded on each plot. To determine boll period, in each plot, fifty new flowers were tagged on a single day in the middle of the flowering period, and were monitored daily when bolls began to open. The date on which bolls were open and suitable for picking was recorded. In addition when bolls began to open, a maturity pick was conducted on 1 m of row twice weekly to determine date of crop maturity. Just prior to a machine picked harvest, cotton was hand picked and bolls counted from 1 m of row in each plot to determine seed cotton mass per boll.

Table 1: Varieties used in field experiment and there respective ranking of maturity, where 1 is the earliest and 8 is the latest (Constable pers. comm).

Variety	Maturity ranking
CS 8S	1
Siokra S-101 (replaces S324)	2
CS 50	3
Siokra 1-4	4
Siokra V-15	5
Siokra V-2	6
Siokra L-23	7
Sicot 189 (replaces CS189+)	8

Boll period was only derived for the crop sown on the 11th October. Boll opening in the second sowing was accelerated by the effects of low minimum temperatures, and therefore, boll periods were excluded from the analyses.

Results

Yield: Machine picked yield in the first sowing was not significantly different among varieties (mean = 6.3 bales/ha). There was also no difference in number of bolls per m (mean 77 bolls), however, significant differences in seed cotton per boll (boll weight) were found (LSD 0.67).

Table 2: Yield parameters for varieties grown in 1995/96 season. Values followed by the same letter are not significantly different ($P < 0.05$) for seed cotton per boll.

Variety	Yield bales/ha	Open Bolls per m^2	Seed Cotton (g) per Boll
CS 8S	6.1	86	4.07 ac
Siokra S-101	6.5	85	3.93 ab
CS 50	5.9	85	3.75 a
Siokra 1-4	7.5	79	4.63 c
Siokra V-15	6.4	69	4.84 de
Sicala V-2	5.6	74	5.09 e
Siokra L-23	6.6	70	4.53 bc
Sicot 189	5.8	71	4.38 acd

Nodes to First Fruiting Branch: Nodes to first fruiting branch varied from 8 to 11 nodes and differed significantly ($P < 0.05$) between sowings (sowing 1 mean 9.85, sowing 2 mean 8.98, LSD 0.7) and among varieties (LSD 0.8). The differences among varieties was not consistent between the two times of sowing (significant interaction, $P < 0.05$, LSD 1.2) (Table 3).

Table 3: Nodes to first fruiting branch for varieties sown in field experiment in the 1995/96 season

Variety	Sowing 11th Oct	Sowing 29th Nov
CS 8S	8.2	9.0
Siokra S-101	10.3	8.7
CS 50	9.1	8.5
Siokra 1-4	10.7	9.4
Siokra V-15	10.7	9.1
Sicala V-2	9.8	9.4
Siokra L-23	10.8	9.1
Sicot 189	9.0	8.7

Time to First Square: Thermal time to first square was longest in Sicala V-2 and Siokra V-15, while CS 50 and CS 8S were shortest (Figure 1) and there were no significant differences ($P < 0.05$) between sowings . The correlation coefficient was 0.66 between the thermal time to first square and the maturity ranking of the variety.

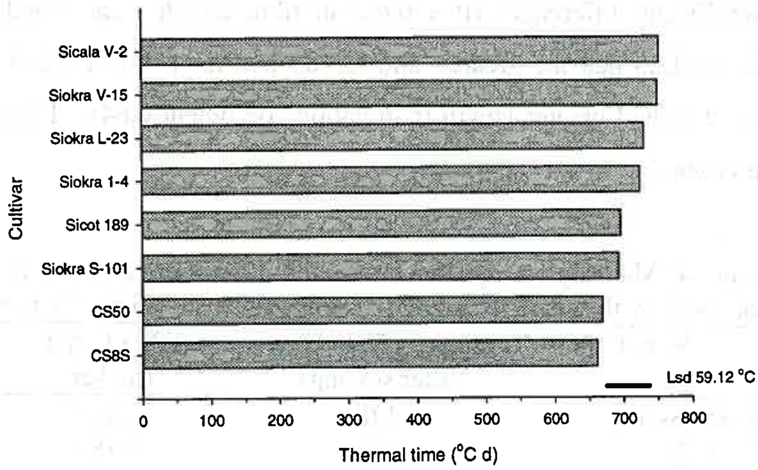

Figure 1: Thermal time to first square for varieties during 1995/96 season.

Square and Boll Period: Square period differed significantly ($P < 0.05$) among varieties (Figure 2) but not between sowings. CS 8S had the longest square period while Line 114 had the shortest. There were no significant differences between sowings, and no correlation was found between maturity ranking and square period.

While Figure 2 shows that there were no significant differences ($P < 0.05$) in boll period found among varieties in the first sowing, there was however, a correlation coefficient of 0.65 when compared to the recommended maturity ranking.

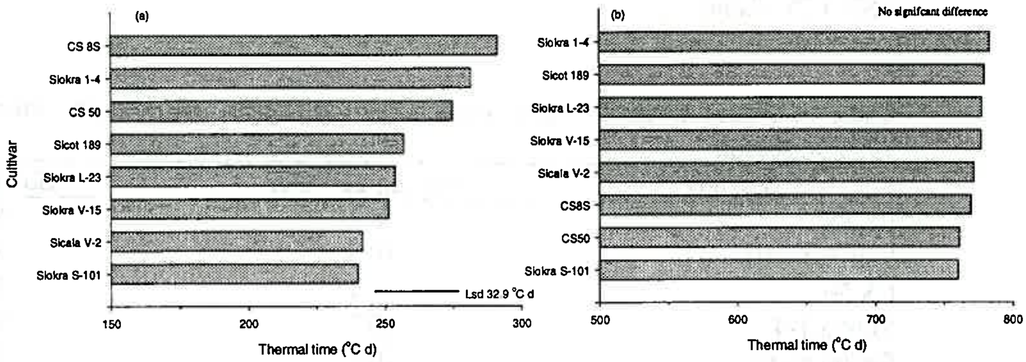

Figure 2: (a) Square period for both sowings and (b) boll period for the first sowing in 1995/96 season.

Crop Maturity: Days from sowing to 60% of bolls open was not significantly different among varieties in the first sowing. Maturity dates varied from 177 to 186 days after sowing and had a correlation coefficient of 0.55 when compared with the maturity ranking (Table 4).

Significant differences ($P < 0.05$) in fibre length were found among varieties where Siokra L23 had the greatest and CS 8S had the shortest (LSD 0.035). Later maturing varieties had greater length (correlation coefficient 0.64). There were no differences in micronaire.

Table 4: Maturity and quality parameters for varieties grown in 1995/96 season. Values followed by the same letter are not significantly different ($P < 0.05$) for fibre length.

Variety	Maturity Date (Days after sowing)	Fibre Length (inches)	Micronaire
Siokra S-101	178	1.18 c	3.67
Sicot 189	186	1.18 c	3.00
CS 8S	177	1.12 a	3.67
CS 50	184	1.14 ab	3.67
Siokra V-15	183	1.16 bc	3.67
Siokra 1-4	179	1.19 c	3.33
Siokra L-23	182	1.20 c	3.00
Sicala V-2	177	1.17 c	3.33

Discussion

Crop yields were variable and generally depressed, probably due to cool temperatures and waterlogging problems experienced during this season. Greatest yields were measured in Siokra 1-4 which generally had a longer thermal time to first square and boll period. Fibre length was greatest for Siokra L-23 and 1-4, and was also related to maturity.

Measured crop maturity found in this experiment was not correlated with time to first square, square period, and boll period, as maturity in this experiment was probably effected by cool temperatures effecting boll development. Time to first square and boll period were however, related to the recognised maturity ranking of the varieties. These two periods have an effect on maturity via their effects on carbon supply. A shorter time to first square places a demand on carbon supply earlier, whereas a shorter boll period places a greater demand on resources because each boll is trying to grow faster. Square period is not so important because the demand for carbon of developing squares is small in comparison.

The duration of all the periods were different to those found by Wells (1994). He also found that the thermal time for these periods differed across times of sowing and between years. The results in this experiment in conjunction with his data indicate that the methods for measuring fruit development traits requires further exploration. Further studies are investigating in more detail the quantification of fruit development traits and the interaction of these traits and carbon supply on crop maturity.

References

Wells, A.T. (1994). Estimating parameters for the OZCOT cotton crop model for a range of cotton cultivars by field measurement. Master of Engineering Thesis, University of Southern Queensland, Toowoomba.

Acknowledgments

This research is funded by the Cotton Research and Development Corporation.
Deeanne Johnson and Nigel Smith for assistance in the field.