

Sowing time, variety and temperature effects on crop growth and development in the Hillston region

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Choosing the best time of sowing in a particular region can often be difficult, as it is a decision that must strike a balance between sowing too early and enduring problems associated with cold weather or sowing too late and losing potential yield. This paper summarises a field experiment conducted at Hillston during the 2002/03 season that explored the impact of sowing time and temperature on growth and development of cotton of two varieties (Sicala 40i and Siokra V-16i) differing in their maturity and a Pima cotton variety (S-7). In this particular year the early and late sowing considerably reduced yield. Yield was reduced through a lower boll set and small boll size in the early sowing and poor ginout % in the late sowing. A sowing in late October maximised yield and allowed the crop to avoid the problems with cold temperatures, promote early vigour, and maximise season length thus allowing bolls and fibre to develop. The use of Sicala 40i an earlier maturing variety also improved yield by being able to set its bolls earlier and allow fibre to develop to more optimal conditions. Sicala 40i also offset the effects of the late sowing; highlighting the opportunity to use earlier varieties when sowing is delayed. Information collected from the study will contribute to an overall initiative in attempting to understand cotton's response to temperature to further improve recommendations for all cotton growing regions.

Introduction

One of the most important agronomic considerations for growers to optimise yield and quality is to select an appropriate sowing time for a crop of cotton. Choosing the best time of sowing in a particular region can often be difficult, as it is a decision that must strike a balance between sowing too early and enduring problems associated with cold weather or sowing too late and losing potential yield. Sowing too early when cold weather can be predominant slows crop growth often leading to poor establishment, poor early growth and exposes the crop to many seedling diseases. Sowing when conditions are warmer reduces the risk of poorer establishment because the crop grows more vigorously. Sowing too late however, will reduce season length and will reduce yield.

Temperature plays a critical and complicated role in the growth and development of cotton. Much of our current understanding of the impacts of cold temperature on cotton crop growth and development is based on experimental work undertaken in the early 70's with technology and cultivars quite different than those used commercially today. Current research is being conducted in different regions to collect data to explore the impact of sowing time (and temperature) on crop development and yield.

It is widely recognised that the optimum sowing time for regions will be different. While it is not possible to collect data and produce sowing time responses for all regions concurrently, we can use the data collected from most sowing time trials to help improve our understanding of the cotton crop's response to temperature. In gaining this understanding, we will then be able to extend our knowledge of cotton's growth response to sowing time in other regions. Importantly this information will be used to improve the crop simulation model OZCOT. Using OZCOT we can also explore the impact of sowing time on yield using historical climate records as well as utilising seasonal climate forecasts.

This paper summarises a field experiment conducted at Lachlan Farms in Hillston during the 2002/03 season that explored the impact of sowing time and temperature on growth and development of cotton of two varieties differing in their crop maturity and a Pima cotton variety.

Materials and Methods

The field experiment was located at Lachlan Farms near Hillston and grown with full irrigation and pest control on 1m row spacing. The treatments were three sowing times with three cotton cultivars that were replicated three times (3 sowings x 3 cultivars x 3 replications = 27 plots) laid out in a randomised complete block design. The sowing times were:

- Sowing 1 – 27th September 2002 (Early)
- Sowing 2 – 24th October 2002 (Normal)
- Sowing 3 – 27th November 2002 (Late)

The three cultivars used in the experiment were:

- Cultivar 1 – Sicala S40i (early to medium maturity)
- Cultivar 2 – Siokra V-16i (medium to late maturity)
- Cultivar 3 – Pima S-7

Timing of crop maturity (60% bolls open) was estimated by taking repeated weekly counts of the number of open bolls in 1m of row in each plot. The lint collected from these samples was kept to calculate final handpicked yield, yield components (final boll number, boll size and Ginout percentage), and fibre length (inches) and micronaire (a measure of fibre fineness and maturity, no units). Air temperature was collected using two TinyTalk data loggers suspended in a Stevenson's screen located nearby the trial. The results of this study were analysed using ANOVA.

Results

Day-degree accumulation

Figure 1 describes the temperature environment (using day-degree accumulation) experienced by the three sowings. A more rapid increase in day-degree highlights warmer temperatures experienced during a period. As expected the early sowing experienced cooler

temperatures as highlighted by the lower day-degree accumulation earlier in crop growth. The late sowing (Sowing 3) had the most rapid accumulation of day-degrees early in growth. Late in the crop growth sowing 2 experienced the highest temperatures while Sowing 3 experienced the lowest.

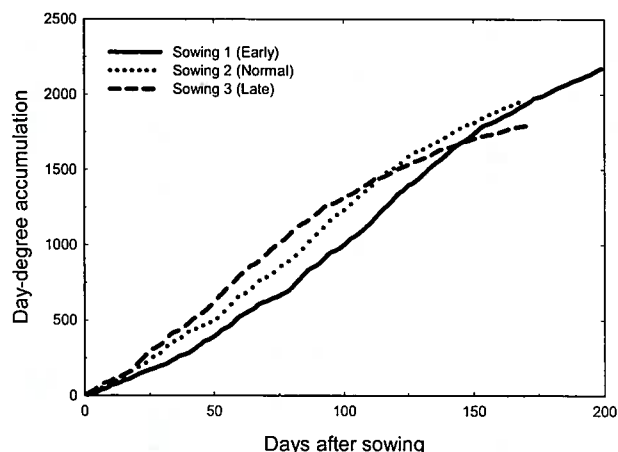


Figure 1: Day-degree accumulation during the average period of growth for each of the sowing treatments.

Yield, Quality and Maturity

The results collected for Pima cotton are presented separately as this is a different cotton species.

Sicala S40i and Siokra V-16i

The early sowing significantly reduced yield while the middle and late sowing had similar yields. When comparing the varieties, Sicala 40i had the highest average yield across all sowings when compared with V-16i. With the exception of the early sowing Sicala 40i significantly outperformed the V-16i (Figure 2).

Across the sowings the days after sowing to 60% maturity was significantly greater for the early sowing (approximately 26 d more). Across all sowings Sicala 40i was earlier than V-16i (an average of 7 d earlier) (Figure 2). In fact the later sown Sicala 40i was earlier than the sowing of V-16i. When average lint yields from all cultivars and sowings for Sicala 40i and V-16i were plotted against days to 60% maturity it showed that there was a significant negative response. That is that the longer the period from sowing to maturity in the season less yield was attained (Figure 3).

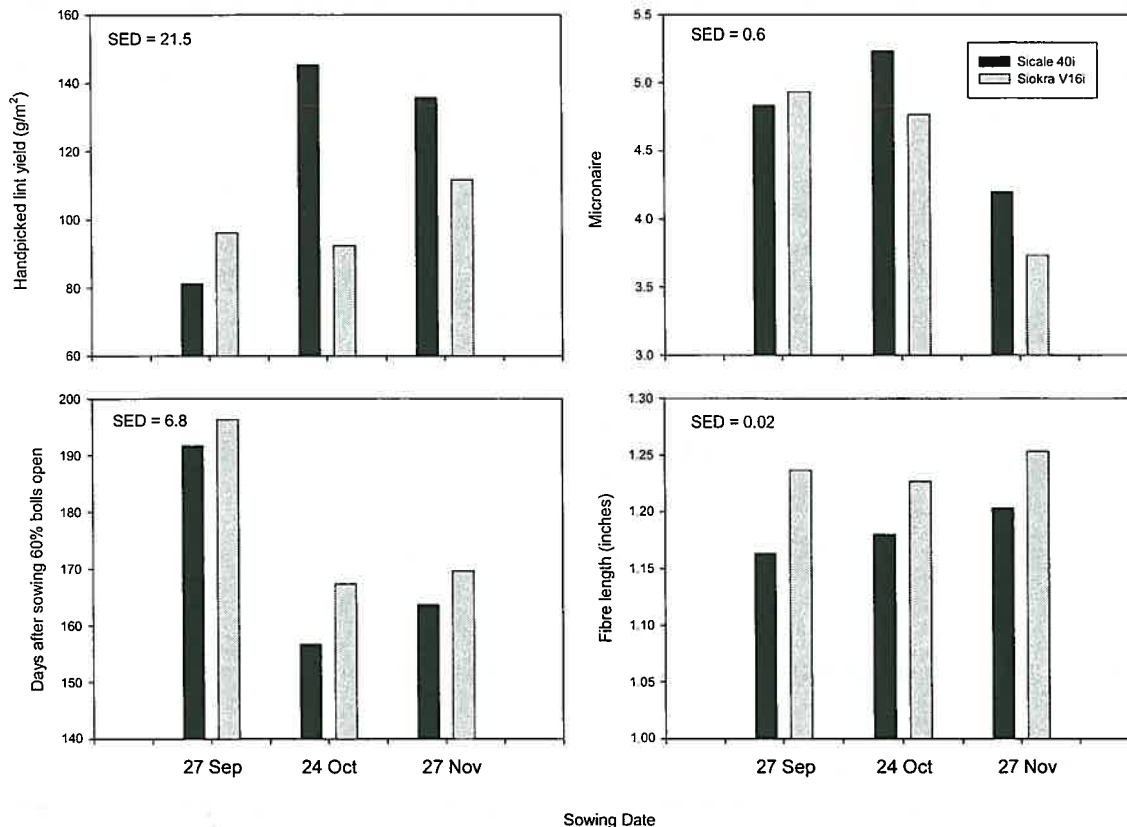


Figure 2: Average yield, 60% maturity, fibre length and micronaire for Sicala 40i and Siokra V-16i for each of the sowing treatments. SED is the standard error of the difference of means for the comparison between sowing and cultivar combined.

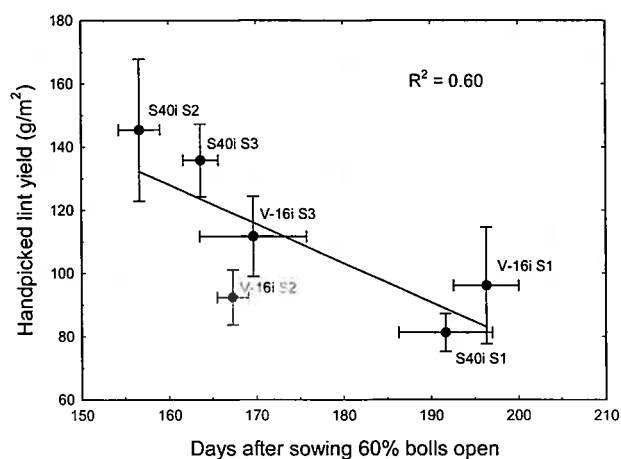


Figure 3: The relationship between handpicked yield and 60% maturity for Sicala 40i and Siokra V-16i. Error bars are the standard error of the means.

Tables 1 and 2 present the yield components and fibre quality for each sowing and each cultivar respectively. Sowing 1 had the lowest number of final bolls/m and the smallest boll size which would have contributed to its lower yields. In the late sowing (sowing 3) despite

the larger number of final bolls the lower ginout % would have reduced its yield. Fibre length was similar across all sowings but micronaire was significantly lower in the late sowing. The major reason for differences in yield between Sicala 40i and V-16i was the difference in Ginout%. Fibre length was slightly higher in V-16i but its micronaire was lower.

Table 1: Comparison of means of yield components and fibre quality traits across sowing times. SED is the standard error of difference of means (it is a measure of the variability and is used to compare differences between means)

Variable	Sowing 1 (Early)	Sowing 2 (Normal)	Sowing 3 (Late)	SED
Final Boll No. /m	51.7	54.7	61.1	7.0
Boll size (g/boll) [†]	3.9	4.9	5.0	1.2
Ginout %	37.0	40.4	37.0	2.8
Fibre Length (inches)	1.27	1.27	1.29	0.01
Micronaire	4.67	4.78	3.86	0.16

[†] Seed Cotton/boll

Table 2: Comparison of means of yield components and fibre quality traits across cultivars. SED is the standard error of difference of means (it is a measure of the variability and is used to compare differences between means)

Variable	Sicala 40i	Siokra V-16i	Pima S-7	SED
Final Boll No. /m	51.2	52.7	63.3	7.0
Boll size (g/boll) [†]	5.9	5.9	1.9	1.2
Ginout %	42.4	36.6	35.3	2.8
Fibre Length (inches)	1.18	1.24	1.40	0.01
Micronaire	4.76	4.48	4.07	0.16

[†] Seed Cotton/boll

Pima S-7

Similar to the response of the Sicala 40i and V-16i the second sowing was the best sowing for lint yield, had the shortest time to maturity and best fibre quality traits (Figure 4). Comparing the traits of Pima with the other varieties Pima had the lowest yield (more bolls but significantly smaller and low ginout %), similar micronaire, but had the highest fibre length (Table 2).

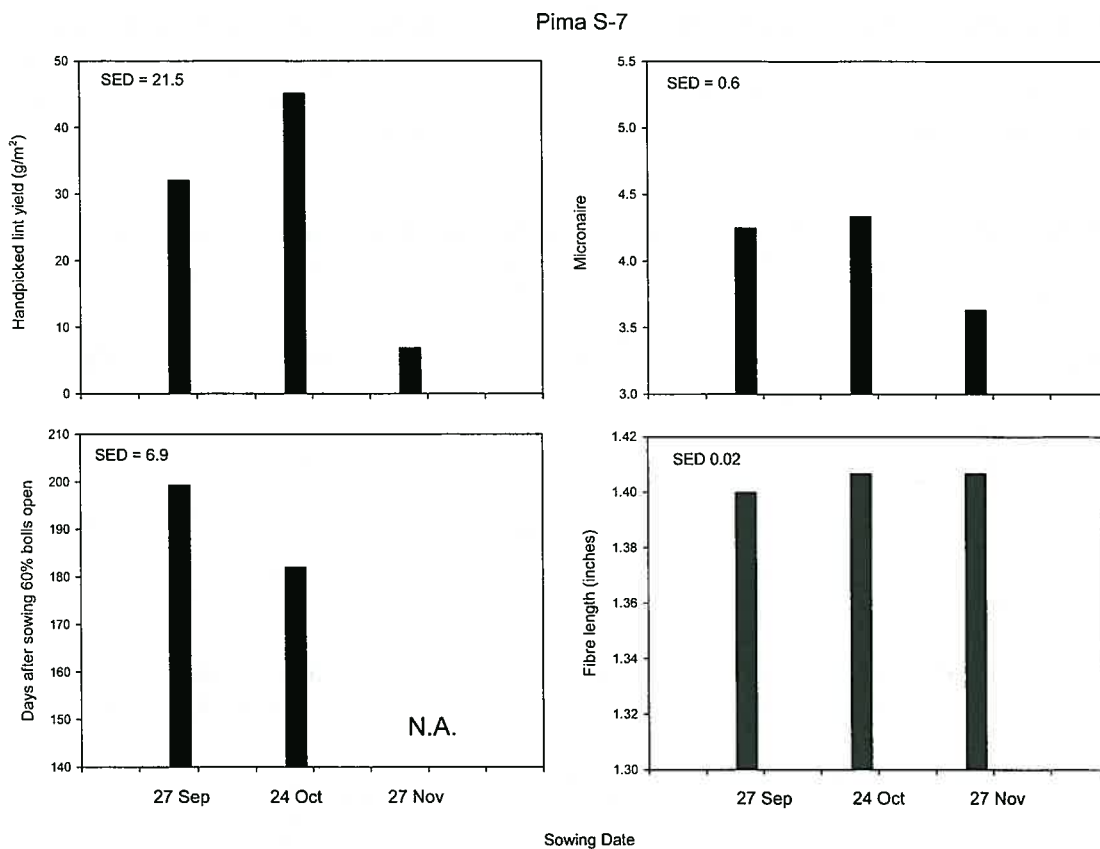


Figure 4: Average yield, 60% maturity, fibre length and micronaire for Pima S-7 for each of the sowing treatments. SED is the standard error of the difference of means for the comparison between sowing and cultivar combined. (N.A.- samples not collected).

Discussion

The results of this experiment showed that in this particular year the early and late sowing considerably reduced yield. Yield was reduced through a lower boll set and smaller boll size in the early sowing and a poorer Ginout % in the late sowing. In addition the use of earlier maturing cultivar was able to offset the effects of a later sowing.

The early sowing was exposed to cool conditions early probably causing the crop to have poorer establishment, higher potential incidence of seedling diseases, and promoting less crop vigour. Despite the longer period for growth yields were less. This is in contrast with regions in the north where yields can be greater when season length is longer (Bange and Milroy, 2004). The later sown crop (sowing 3) also yielded less and this was primarily due to lack of season to allow crop growth to occur. Much of the fibre growth was occurring when conditions were cooling. This is reflected in poorer Ginout % and lower micronaire. The second sowing in late October allowed the crop to avoid the problems with cold temperatures, promote early vigour, and maximise season length thus allowing bolls and fibre to develop.

The use of Sicala 40i with its earlier maturity maximised yield compared with Siokra V-16i and was also able to compensate for the effects of the late sowing. This is because an earlier

maturing variety is able to set its bolls earlier and allow fibre to develop to more optimal conditions (reflected in the higher micronaire for this variety). Clearly the use of earlier maturing varieties is an option to avoid yield loss when sowing is delayed.

The sowing time response of Pima was no different from the other varieties. The poorer yield of Pima is because of its longer season requirement and its lack of tolerance to bacterial blight, which would limit boll and fibre growth (reflected in the smaller boll size). Cotton breeding is seeking to improve disease tolerance and adaptation.

This work also highlights the narrow sowing window for this region. It appears that sowing towards the end of October with an earlier maturing variety is possible. Information collected from the study will contribute to an overall initiative in attempting to understand cotton's response to temperature to further improve recommendations for all cotton growing regions.

Reference

Bange, M.P. and Milroy, S.P. 2004. Growth and dry matter partitioning of diverse cotton genotypes. *Field Crops Research* 87(1): 73-87.

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