

# Expanded row configuration options for Australian rain-fed cotton

Michael Bange<sup>1</sup>, Jane Caton<sup>1</sup>, Darin Hodgson<sup>1</sup>, Rose Brodrick<sup>1</sup>, David Kelly<sup>2</sup>, Robert Eveleigh<sup>3</sup>, John Marshall<sup>3</sup> and James Quinn<sup>3</sup>

<sup>1</sup>[CSIRO](#), Plant Industry, Cotton Community Catchments CRC, Locked Bag 59, Narrabri, NSW 2390. [Michael.Bange@csiro.au](mailto:Michael.Bange@csiro.au)

<sup>2</sup>Macpherson Agricultural Consultants, PO Box 276, Goondiwindi, Qld 4390.

<sup>3</sup>Cotton Seed Distributors, PO Box 117, Wee Waa, NSW 2388.

## Abstract

Rain-fed cotton is often grown using skipped rows because of variable summer rainfall. Skip configurations are used to: (a) increase the amount of soil-water available for the crop especially during flowering, which can influence the potential lint yield and quality; (b) reduce the level of variability or risk associated with production; and (c) reduce input costs. Expansion of production into new areas and the need for flexibility in farm equipment setup has meant super single (1 present, 2 skipped) may be suitable where rainfall is considered too low for profitable double skip production, while alternate row (1 present, 1 skipped) configurations are being considered instead of double skip to take advantage of equidistant spacing to improve yield and quality. Super single and alternate row were compared to double skip over several seasons to (i) establish when super single should be considered as an option instead of double skip, and (ii) assess improvement in yield of alternate row compared to double skip. Results showed that super single should be considered when yield potential is less than 525 kg/ha for double skip while alternate row may improve yield especially at higher double skip yield potential. Higher water use earlier in the season in alternate row did not lead to lower yield as equidistant row spacing may have led to improved water use later. More comparisons of alternate row configuration are needed at lower yield potentials and when early stress is encountered to establish its performance to other configurations.

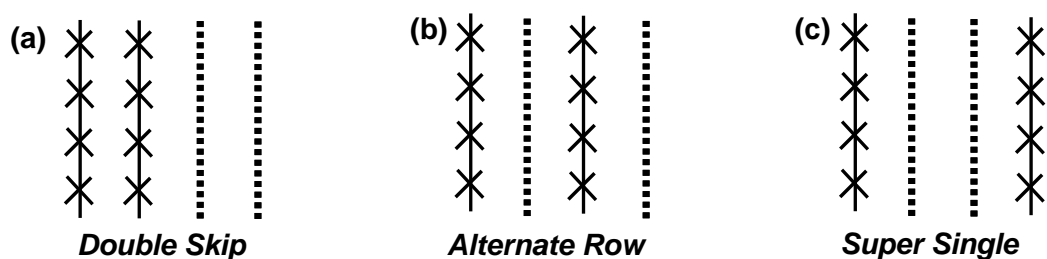
## Key Words

Cotton, rain-fed, dryland, skip row

## Introduction

One of the management techniques that rain-fed (dryland) cotton growers have at their disposal to improve crop moisture status is being able to modify row configuration. Growers can choose to sow their crops using conventional solid row configurations similar to those used in Australian irrigated production, or use configurations that considerably increase row spacing or remove entire rows. The intention behind skip row configurations is to provide slowly available soil water to the planted rows to allow continued growth during dry periods between rainfall events. In practice, however, the benefits lie primarily in: (a) a reduced risk of negative effects of water stress on fibre quality, (b) reduced yield variability, and (c) better economic returns due to production costs being reduced more than the yield loss relative to solid planted cotton (Bange et al. 2005). Skip row cotton provides an option for increasing the area of cotton which can be grown, allowing some upside in production if conditions are favourable and far less downside in potential yield losses and fibre quality discounts if the seasons are un-favourable.

Expansion of production into new areas and the need for flexibility in farm equipment setup has meant that a greater range of skip row configurations are being considered. Predominately single (67% planted area) or double skip (50% planted area) have been utilised. However 'super single' (33% planted area) is being used where rainfall is considered unreliable, while alternate row (50% planted area) configurations are being considered instead of double skip to potentially take advantage of equidistant spacing to improve yield and quality. To allow growers to choose the appropriate configurations, information on differences in relative yield and quality potential, and costs between is needed. This paper presents data collated from both on-farm and specific field experiments that compare the differences in yield between double skip, alternate row and super skip row configurations.



**Figure 1. Diagrammatic representation of row configurations used in this study. Solid lines represent rows with plants present, while dotted lines represent skipped rows**

## Methods

Field comparisons of row configurations, shown in Figure 1, were conducted at various sites in NSW and Queensland from 2005 to 2011 (Table 1). Comparisons in Narrabri were conducted at the Australian Cotton Research Institute using plots 10m by 10m using a randomised block design with four replications. All other comparisons were made in commercial fields. These comparisons all had large scale plots with at least three replications of row configuration treatments. Due to logistical constraints of handling large amounts of seed cotton, all replications were combined into a single cotton module for each row configuration treatment, and the module weighed at the cotton gin. This prevented individual statistical analyses to be conducted on all comparisons. Individual plot data was however available, for the Rowena and Spring Ridge comparisons. All sites were machine harvested and samples collected for fibre quality analysis. ANOVA was used to compare row configurations in the Narrabri, Rowena, and Spring Ridge comparisons. Additionally, in order to compare the performance of row configurations across all sites, the yields of super single and alternate row configurations were plotted against the comparable yields of double skip configurations for the same experiment; a methodology employed in both cotton (Bange et al. 2005) and sorghum (Butler et al. 2001, Routley et al. 2003).

In the Narrabri comparison sown in 2010, two neutron probes access tubes per plot were located in the vacant area between rows of cotton in the alternate row and double skip configurations. The tubes were 0.5 m and 1.0 m from the cotton row, and soil moisture to a depth of 1.2 m was monitored approximately every 10 days until crop maturity.

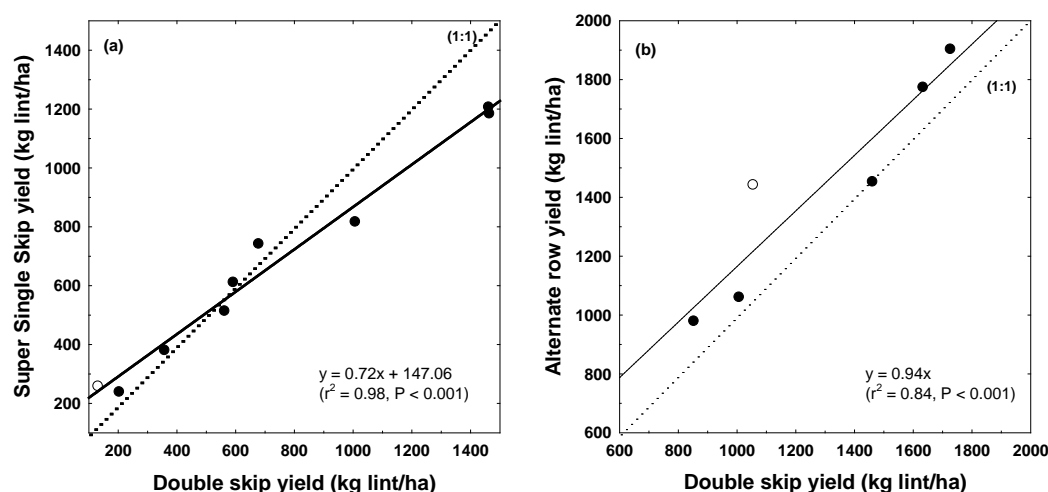
## Results

Yields across sites ranged from 130 to 1725 kg/ha for the double skip configuration, reflecting differences in seasonal conditions including rainfall (Table 1). Where statistical analyses were undertaken significant differences in row configurations were measured except for the comparison sown in Narrabri in 2009. When comparing super single to double skip there were instances when the super single row configuration significantly outperformed double skip and vice versa. This was also the case when comparing means generated at other sites. In alternate row configurations there were no significant differences for the Narrabri comparisons however, the alternate row outperformed double skip at Spring Ridge. At the three other sites (Moree 2009, Toobeah 2010, and Macalister 2010) the means for alternate row configuration were numerically greater. When all data was combined across all comparisons, there was a significant association between yield of super single versus double skip yield (Figure 2a), with the slope significantly different from unity and the intercept different from 0. While there was a significant association between alternate row with double skip, the slope was not significantly different from unity, or the intercept significantly different from 0 (Figure 2b).

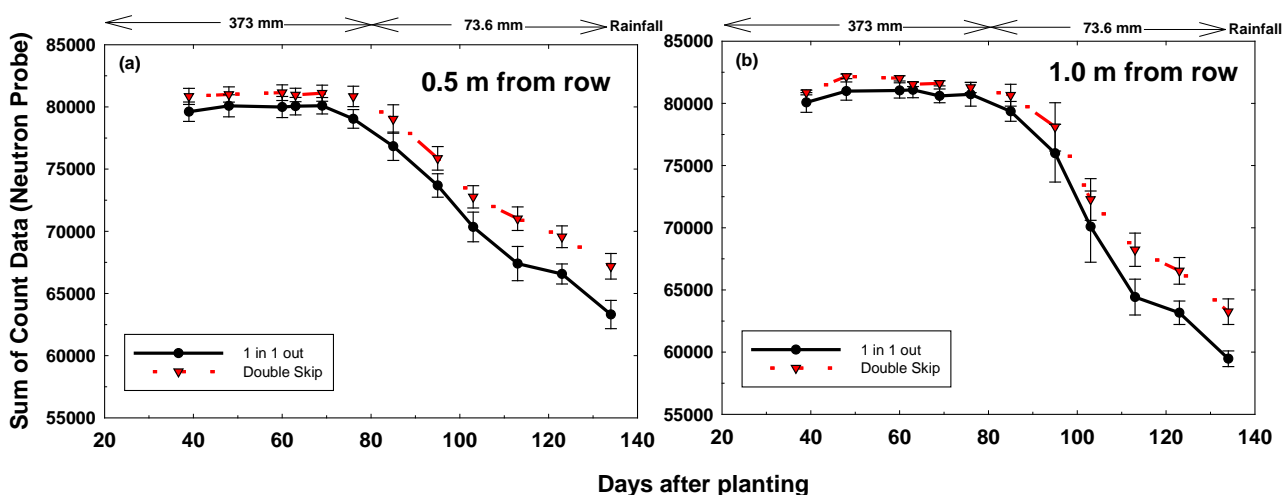
In the Narrabri comparison sown in 2010 soil water extraction in both the 0.5 m and 1.0 m locations in the vacant skip row areas of both alternate row and double skip configurations was similar until approximately 70 to 80 days after sowing where soil water extraction was greater in both locations in the alternate row configuration through to harvest (Figure 3), although yields were the same.

**Table 1. The effect of row configuration on lint yield. (n.a. – not applicable as there was no statistical analysis conducted). Yields followed by the same letter for each row configuration treatment for individual comparisons are not different at 0.05 level according to LSD. Rainfall is the total from sowing to harvest.**

Location/Year	Cultivar	Rainfall (mm)	Double	Super	Alternate	LSD (0.05)
			Lint yield (kg/ha)			
Rowena NSW 2005_06	Sicot 289BR	106	130a	260b	-	41
Narrabri NSW 2006_07	Sicot 80BRF	199	202a	241b	-	37
Tulloona NSW 2006_07	Sicot 80BRF	66	357	381	-	n.a.
Bongeen Qld 2006_07	Sicot 289BR	88	561	515	-	n.a.
Narrabri NSW 2007_08	Sicot 80BRF	358	1463b	1186a	-	60
Narrabri NSW 2008_09	Sicot 80BRF	413	677a	743b	-	89
Narrabri NSW 2009_10	Sicot 80BRF	515	1459a	1208a	1455a	254
Spring Ridge NSW 2009_10	Sicala 60BRF	451	1053a	-	1443b	158
Moree NSW 2009_10	Sicot 74BRF	Partially Irrigated	1632	-	1775	n.a.
Narrabri NSW 2010_11	Sicot 80BRF	493	1005b	817a	1062b	165
Moree NSW 2010_11	Sicala 340BRF	356	590	612	-	n.a.
Macalister Qld 2010_11	Sicot 71BRF	545	851	-	980	n.a.
Toobeah Qld 2010_11	Sicot 80BRF	Partially Irrigated	1725	-	1904	n.a.



**Figure 2. The relationship of lint yield of (a) super single skip row configuration and (b) alternate row configuration versus lint yield of double skip row configuration. Also shown is the 1:1 line (dotted).**



**Figure 3. Changes in soil water measured by a neutron probe moisture meter to a depth of 1.2 m at positions (a) 0.5 m and (b) 1.0 m from the plant line in both alternate row and double skip row configurations (Narrabri 2010\_11). Count measurements are the sum of measurements taken through the profile. Error bars are two standard errors of the mean.**

## Discussion

Similar to other responses comparing yields of skip row configurations (e.g. double skip versus single skip (2 rows present, 1 row skipped) (Bange et al. 2005)), super single performed better when yield potential for double skip was low, and this was generally associated with low seasonal rainfall. Using the regression in Figure 2a super single performed better when the yield potential of double skip was less than 525 kg/ha lint.

Although there were no significant differences in comparisons conducted in Narrabri investigating alternate row configurations, four of the commercial sites had improved yield when compared to double skip. This suggests that in certain circumstances (especially at higher yield potential for double skip) this configuration may offer opportunities to improve yield. The lowest yield attained by the double skip in these comparisons was 851 kg/ha lint and all sites had considerable seasonal rainfall (most of which occurred early in the season). While the regression in Figure 2b could not be used to compare configurations, it again highlighted that yields for alternate row were higher or similar to double skip.

In this study fibre quality was improved or unaffected in the super single configuration reflecting greater access to soil water during flowering and boll filling (data not shown). The alternate row configuration had fibre quality similar to the double skip configuration.

Despite increased water use in the alternate row configuration once substantial rainfall had ceased, there was no suggestion that the crop became more stressed later as yield was unaffected. Final water extraction at harvest was greater in both the 0.5 m and 1 m locations compared to double skip which may have assisted growth. The equidistant row spacing in the alternate row configuration may have contributed to better access to soil moisture.

## Conclusion

Skip row configurations have been successfully used to reduce the risk and improve the productivity in terms of yield and quality of rain-fed cotton production particularly in low rainfall seasons and sites. Both super single and alternate row configuration expand the options available to cotton growers in various regions. Research is ongoing developing the necessary information to enable growers to choose the appropriate configuration for their own situation. More comparisons of alternate row configuration are needed at lower double skip yield potential as well as comparing to single skip. Further research is needed to establish the performance of this configuration where significant early stress is encountered.

## References

- Bange MP, Carberry PS, Marshall J and Milroy SP (2005). Row configuration as a tool for managing rain-fed cotton systems: Review and simulation analysis. *Australian Journal of Experimental Agriculture* 45, 65-77.
- Butler G, Cawthray S, Castor M, Yeates S. and Christian T. 2001. Improving the reliability of sorghum production in the farming system: Proceedings of the 10<sup>th</sup> Australian Agronomy Conference, 29 January – 1 February, The Australian Society of Agronomy, Hobart.  
<http://www.regional.org.au/au/asa/2001/3/a/butler.htm>
- Routley R, Broad I, McLean G, Whish J, Hammer G. 2003. The effect of row configuration on the yield reliability in grain sorghum: I. Yield, water use efficiency and soil water extraction: Proceedings of the 11<sup>th</sup> Australian Agronomy Conference, 2-6 February, The Australian Society of Agronomy, Geelong, Australia. <http://www.regional.org.au/au/asa/2003/c/9/routley.htm>.