

RAINGROWN COTTON VARIETIES

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Raingrown cotton is becoming a very important component of the Australian industry: the relative proportion of the crop grown with rain has been increasing over the past ten years. Given good prices and rainfall, the area of the crop grown with rain will exceed 50,000 ha. It is also important to note that during droughts, irrigators are forced to grow cotton semi-raingrown.

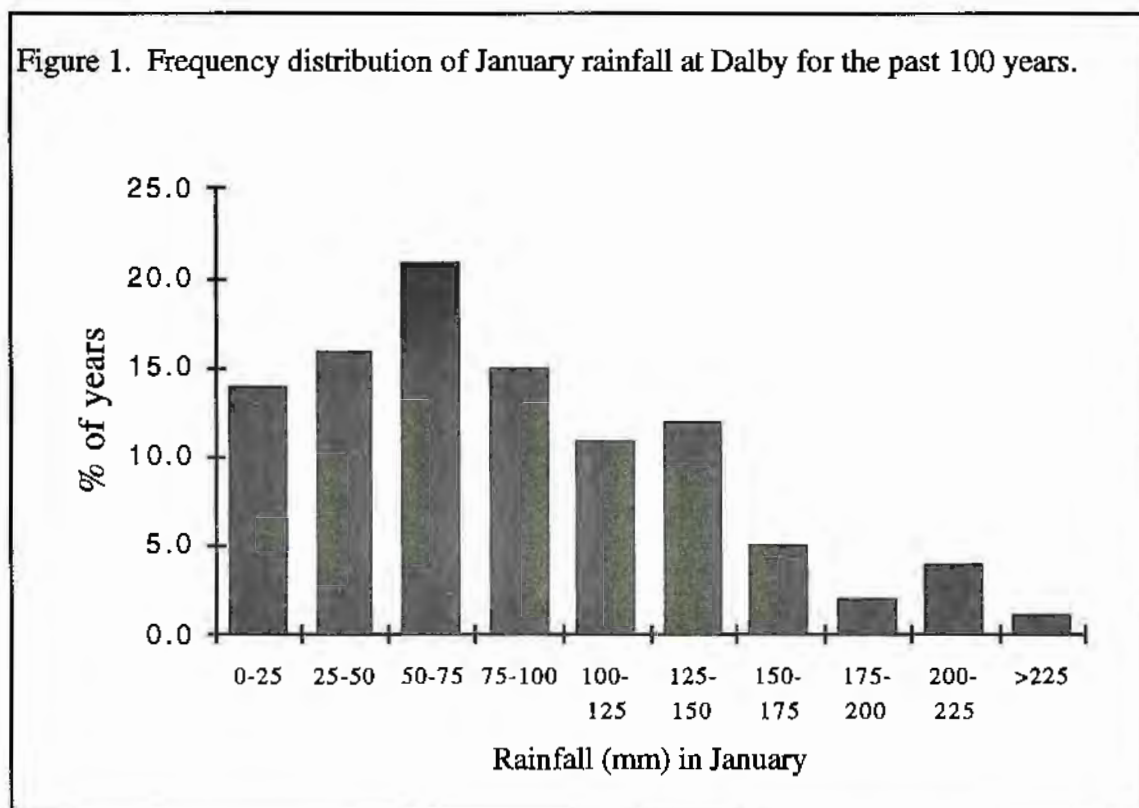
This article aims to point out principles and results which aid the decision as to which variety to grow under raingrown conditions. Data from raingrown experiments are presented. We also illustrate some primary points for crop water use/supply/response.

Our system

The most significant aspect of our raingrown cotton system is the variable rainfall. An example of that variability is shown in Figure 1, with January rainfall at Dalby. Other months and locations are also variable. Note how the rainfall data for January covers a wide range, with about 15% of years having a very low (less than 25 mm) or high (more than 150 mm) rainfall. Our irrigation studies have shown that the cotton crop is most sensitive to water stress during flowering. Given that January is such an important month for moisture supply to affect flowering and boll setting in cotton, this rainfall variability will be reflected in yield variability. In a paper at the 1990 ACGRA Conference, Brian Hearn presented data to illustrate that yield variability.

The best raingrown cotton variety for Australian conditions will be able to tolerate dry times, then utilise rainfall when it occurs.

Figure 1. Frequency distribution of January rainfall at Dalby for the past 100 years.



In general dryland agriculture worldwide, different crop species have a number of possible strategies to survive under water stress conditions. Two contrasting strategies are stress tolerance and stress avoidance. Knowledge of these strategies are of relevance to understanding the requirements for raingrown cotton in Australia.

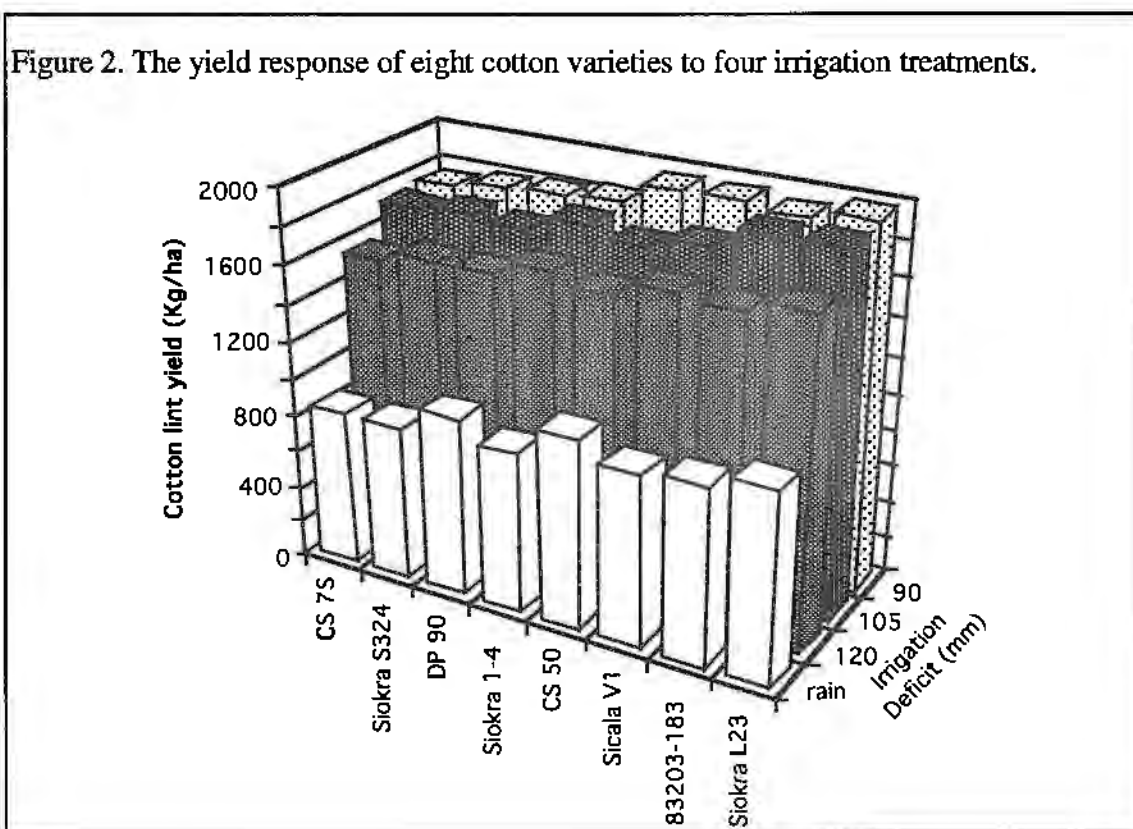
It is common for raingrown cotton in areas overseas such as Texas to use early maturing varieties to avoid stress. The intention for that climate is to utilise seedbed moisture and early season rainfall in a situation of 'terminal drought'. That is the best system for their environment. That strategy has not worked in Australia since we do not normally have terminal drought: a successful raingrown crop usually has significant mid summer rain. Evidence for that point is shown in Table 1 where the best yields over a range of sites and seasons were obtained from full season irrigation varieties; the yield ranking is similar to maturity ranking. A Texas line (Casco) had half the yield of Siokra L23.

Table 1. Lint yields from small scale raingrown experiments. Data are expressed as a percentage of the site mean yield. Note that the varieties are ranked for maturity.

	Narrabri	Moura	Narrabri	mean
	90/91	90/91	91/92	
Siokra L23	125	124	124	124.3
Siokra L22	114	115	115	114.7
CS 189+	113	118	99	110.0
CS 189	110	108	106	108.0
DP 90	109	104	110	107.7
Sicala V-1	109	93	89	97.0
Siokra 1-4	96	107	91	98.0
CS 50	108	96	86	96.7
Sicala 34	96	115	84	98.3
CS 7S	89	97	98	94.7
Siokra S324	84	107	86	92.3
Cascot	64	65	72	67.0
Site lint yield (kg/ha)	576	387	567	510

Brian Hearn set up a number of experiments in the mid 1980's to examine the relative performance of different varieties to water stress. That research was in response to water supply problems at the time; one particular question was whether early season varieties were best for raingrown or limited water situations. The results gave a clear rejection of that theory. In full season areas, early season varieties were more sensitive to stress possibly due to shallower roots and also had a lower yield potential; full season varieties performed best under raingrown and limited water situations. Tony Wells reported similar results at the ACGRA Conference in 1992. That experiment in a full season area showed the same result (data reproduced in Figure 2). Note that the early maturing

varieties in that experiment (Siokra S324 and CS 7S) had the lowest yields in all irrigation treatments.



Water use efficiency

Water has a crucial and fundamental role in plant growth: water is required in the process of photosynthesis and to maintain turgor. The water use efficiency of cotton as measured at a number of levels is shown in Table 2. Cotton compares well with other species: it has desert origins, so it can survive very dry conditions.

Table 2. Measures of water use efficiency of cotton at the leaf, plant and crop level.

Level	Value	Units	Time scale
Leaf (plant physiology)	1.0×10^{-2}	g CO ₂ /g water	seconds
Plant (crop physiology)	0.2×10^{-2}	g DM/g water	days
Crop (agronomic)	1.3	bales lint/Ml water	season

With an agronomic WUE of 1.3 bales/Ml, a moisture supply of about 3 Ml is required to produce a yield of 3 bales/ha (1.2 bales/ac). The 3 Ml might be provided by 1.5 Ml of soil storage and 1.5 Ml rain (150 mm or 6"). Note that these values are what is potentially obtained. At the crop level, many factors such as pest damage and unfavourable temperatures will reduce water use efficiency.

Fibre quality

The main fibre quality issues for raingrown cotton are grade, fibre length and micronaire. Fibre length can be reduced under moisture stress, and high micronaire can also be a problem with raingrown cotton in hotter areas. In both cases Siokra L22 can confer some advantage: the longer finer fibre of Siokra L22 can be important in reducing penalties for length and micronaire.

Performance

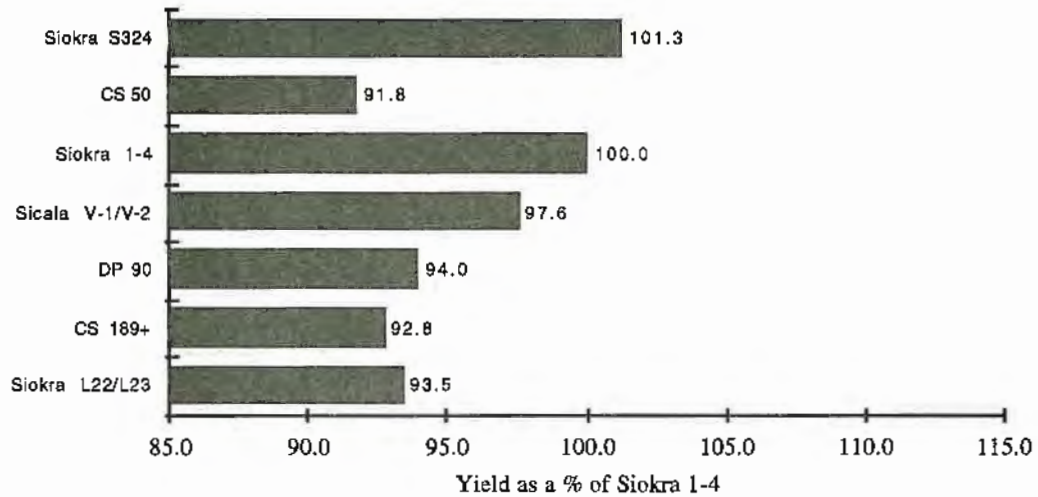
Figure 3 shows a summary of large scale trials in the past five seasons. It is clear from that data that okra leafed varieties have been very consistent. The pest tolerance advantage of okra leaf has certainly played a part in those results.

The data shows that for shorter season areas (eg eastern Downs and eastern Namoi), the best two varieties are Siokra 1-4 and Siokra S324. Although only limited data is available, the new early maturing variety CS 8S also shows some promise in those districts.

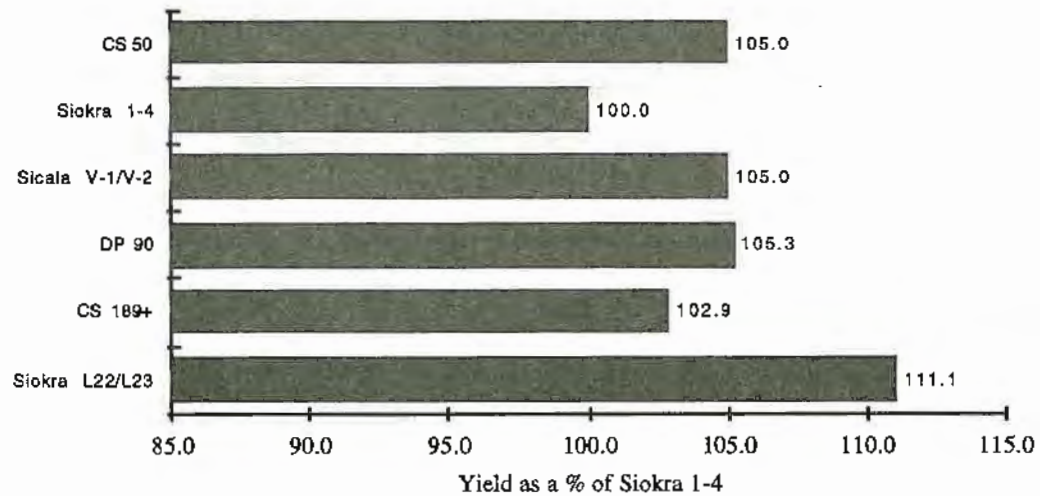
For full season areas at normal sowing dates, the best varieties have been Siokra L22 and L23. Note how the best yields have been from full season varieties. The new okra leaf variety V-15 shows promise.

Figure 3. Relative yields of cotton varieties in CSD large scale experiments. Data only included where at least two seasons results are available and for at least six sites.

(a) Cool areas (Eastern Namoi, Eastern Darling Downs).



(b) Full season areas.



Summary

The best raingrown cotton variety for Australian conditions will be able to tolerate dry times, then utilise rainfall when it occurs.

Data is presented from a range of experiments to show that for raingrown production in full season areas, the best yield is obtained from full season varieties. Early maturity does not necessarily impart stress tolerance.

Agronomic water use efficiency is up to 1.3 bales/Ml; so for a raingrown crop to yield 3 bales/ha, it will require a total water supply (soil storage plus rain) of nearly 300 mm.

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