Managing the Sicot 71 family

By Cotton Seed Distributors extension and development team

The Sicot 71 family has set new benchmarks for cotton yields in Australia. Experience via extensive trials and commercial data gathered during the 2004–05 season shows that with appropriate management and attention to detail, growers can enjoy the benefits of the yield potential this family offers, and also make base grade length, as demonstrated in the following two case studies.

Following its release in 2002, and subsequent incorporation of transgenic traits, the Sicot 71 family has captured a major share of the irrigated portion of the Australian cotton crop, showing consistent performance across all growing regions.

Yield performance

Its exceptional yield potential has driven the success, illustrated by its performance within the extensive CSD variety trial program. Both Sicot 71 and Sicot 71BR have ranked first in over two-thirds of these trials, averaging 9.0 and 10.3 bales per hectare respectively (Table 1).

The regional adaptability of this family has also been impressive, performing exceptionally in all growing regions. The consistency of Sicot 71 for instance is well illustrated in the long term performance of trial sites at Wathagar and St George (Table 2) where it has ranked 1st in every trial, and has never yielded below four and five bales per acre respectively.

In addition to this trial data, CSD conducted a survey of growers who received Sicot 71BR in the 2004 ballot. From the 68 growers who supplied yield information on their crops, 23 per cent averaged greater than five bales per acre (12.35 bales per hectare) and one greater than six bales per acre (14.8 bales per hectare). The average yield of all these crops was 11.1 bales per hectare (4.5 bales per acre).

Staple length

Recently, staple length has generated a lot of attention since the decision to increase Australian base grade from 35/32nds of an inch (1.08 inches) to 36/32nds (1.11 inches).

The Sicot 71 family generally has slightly shorter staple length than most other irrigated varieties (Figure 1). The comparative length figures provided in the CSD variety guide are generated by the extensive long-term regional evaluation of all varieties in the CSIRO advanced line trial program. All lint samples are picked with the same machine, ginned in the same 20 saw gin, and classed with the same HVI instrument, resulting is a totally valid comparison of all varieties.

Sicot 71BR for instance has a relative length of 1.15 inches, which is 0.02 inches shorter than Sicot 289BR (1.17 inches). This means that under any situation, when all other variables are the same, Sicot 289BR will have staple approximately 0.02 inches longer than Sicot 71BR.

Data from CSD's extensive variety trial program has indicated that under the previous length grading system (35), base grade for both Sicot 71 and Sicot 71BR was met on well over 90 per cent of occasions, which is similar to most commercial

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FIGURE 1: Relative staple length of major CSD irrigated varieties for the 2005 plant

Sicot 71 family indicated by arrows.
Data derived from CSIRO small plot data using the same picker, gin and HVI instrument.

TABLE 1: Yield from all CSD large-scale replicated CRDC approved trials including Sicot 71 and Sicot 71BR

	Sicot 71	Sicot 71BR
Total Trials	73 (2001–2005)	41 (2004–2005)
Ranked 1st	49 (67%)	32 (78%)
Ranked 2nd	15 (21%)	6 (15%)
Ranked 3rd	6 (8%)	1 (2%)
Average Yield	9.0 bales/ha (3.64 bales/acre)	10.3 bales/ha (4.2 bales/acre)

TABLE 2: Yield (bales per hectare) from long term CSD trial sites where Sicot 71 has been included for the past five years

	St George	Wathagar
2005	10.6	13.9
2004	10.5	trial lost
2003	9.9	13.3
2002	10.8	13.0
2001	9.7	Sicot 71 not included in trial
Average	10.3	13.4

TABLE 3: Staple length from all CSD large scale replicated CRDC approved trials where Sicot 71 and Sicot 71BR have been included — Sicot 73 and Sicala 60BR have been included as examples of varieties with longer staple length

	Sicot 71	Sicot 73	Sicot 71BR	Sicala 60BR
Total trials (years)	73 (2001–05)	17 (2004–05)	41 (2004–05)	44 (2003–05)
35 Staple or better	93%	100%	95%	98%
36 Staple or better	64%	100%	80%	95%
Average staple inches (32nds)	1.12 (36)	1.16 (37)	1.12 (36)	1.15 (37)

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varieties. As with all varieties, changing base grade to 36 sees an increase in incidence of both Sicot 71 and Sicot 71BR being below base grade for staple length (Table 3).

Data from CSD's survey of Sicot 71BR growers in the 2004–05 season mirrors the trial data for this variety. Of the 63 growers who provided staple length information, 100 per cent had staple length of 35 or better and 82 per cent had staple length of 36 or better (Table 4).

To put it simply, the shorter staple length of the Sicot 71 family means there is less margin for error in management decisions which impact on staple length when conditions are not conducive to fibre elongation.

TABLE 4: Staple length category percentages for Sicot 71BR crops across the industry in 2004–05 (63 respondents provided fibre length details)

Staple length range (32nds of an inch)	% of growers
34	0
35	18
36	52
37	29
38	1

Management

Basic management principles for this family are no different than those for any other variety, but there are periods in the season where timeliness can have a great impact on yield and quality. In the previous issue of *The Australian Cottongrower*, James Quinn discussed in detail the factors that contributed to very high yielding crops. The results of our data collection reveal that many of these same factors are conducive to good staple length.

The fibre lengthening or elongation period is during the first 15 to 23 days after flowering. Individual fibres may grow 0.05 to 0.08 inches per day until they reach their final length, when the plant's genetic code tells them to stop.

Once elongation has finished, fibre thickening begins, and at this point, nothing can make that fibre grow longer. The daily elongation of each fibre is influenced heavily by turgor, or water pressure within the plant.

FIGURE 2: Fibre elongation occurs during the time of highest crop water use

Adapted from Browne (1984)

TABLE 5: Sensitivity of various plant growth parameters to water stress

What goes first?	
Leaf growth	Most sensitive
Fibre length*	↓
Stem growth (height)	↓
Rate of squaring	↓
Node production	↓
Boll growth	↓
Root growth	Least sensitive

* Fibre length was not included in the original diagram.

Adapted from Hearn (1994).

Reductions in turgor can be caused by heat stress, moisture stress or by severe waterlogging. During a period of low turgor, the daily rate of fibre elongation is slowed, but can resume to normal once the stress has passed. Fibres elongating during that stress period may end up shorter because of those days of reduced elongation.

Fibre length is not the only part of crop growth to be impacted upon by conditions of low turgor. In reviewing an extensive amount of work on the subject, Brian Hearn (1994) suggests that under moisture stress, bolls are given priority over the growth of vegetative parts of the plant (leaves, stem), meaning that boll growth can continue after stem growth has ceased.

But in these situations, the rate of fibre elongation will slow first (Table 5). Under waterlogged conditions, the same priority is not given to bolls and their growth will be decreased at the same rate as vegetative growth.

From a management perspective, the crucial time for managing a crop for staple length is from first flower (777 day degrees) until 15–20 days after the last effective flower. For most regions, this is a two-month period from mid-December until mid-February (Figure 2), or by crop stage, it is from node 15 to 22 (Figure 3).

This is a period when daily crop water use increases to its greatest because of the rapidly growing crop, and it generally corresponds with the period with the highest

FIGURE 3: Minimising stress while the crop is between node 15 to 22 is important in achieving good staple length

Adapted from Oosterhuis (1990)

FIGURE 4: The impact of moisture stress on staple length

FB=Fruiting Branch on the main stem, Veg= Fruit on vegetative or lateral branches. Staple length measured from each plant segment of a dryland crop of V16B grown near Moree in 2004–05

FIGURE 5: Staple length measured at each plant segment of an irrigated crop of Sicot 71BR grown in CQ in 2004–05

Top graph indicates actual data, bottom graph indicates estimated staple length if stress had been avoided.

air temperature. This means irrigation intervals are short, but unfortunately it's when there is least margin for error in relation to staple length.

Detailed evaluation of a number of crops conducted by the CSD extension and development team in the 2004–05 season illustrates clearly the impact of moisture stress at various stages in crop growth. In these evaluations, parts of crops were hand harvested, dividing up sections of the plant so fibre analysis could be conducted for each stage of the crop separately.

The impact of moisture stress was never more apparent than in dryland crops in 2004–05 which had ideal rainfall for the early part of the season and a very dry finish (Figure 4). The result of this was a clear definition between the early bolls that completed their elongation with adequate moisture, and hence had very long staple, and those that were under moisture stress when this occurred and produced short staple lint.

In irrigated situations, evidence was also found of particular events during the season impacting on the staple length of sections of the crop that ultimately impacted on the whole grade. One crop in Central Queensland had a delayed first irrigation at the time of first flower which was followed by a rainfall event on top of the irrigation (Figure 5).

The staple length of the earliest maturing bolls was obviously affected, and ultimately contributed to that crop achieving a staple length of 1.10 (35), which would be below base grade under the new classing system. If this stress had been avoided and this part of the crop achieved a similar staple length to other parts around it, it has been estimated that the crop's staple length would have been 1.12 inches, or base grade.

While considering the flowering period as being important for staple length, exactly the same can be said for yield. This is a period when a lot of fruit are filling and a lot of fruit are very susceptible to shedding.

Any factor that limits the availability of plant resources during this time may also decrease boll weight and decrease boll number as a result of fruit shedding. In general terms, a high yielding crop will have better fibre quality, which means conditions which result in high yields also produce good fibre properties.

This is clearly demonstrated when comparing yield and staple length in the 114 large scale replicated variety trials in which Sicot 71 and Sicot 71BR have been included (Figure 6). In the instance of both varieties, crops that produced a staple length of less than 36 were proportionally much less represented amongst crops that yielded greater than four bales per acre (9.88 bales per hectare).

Reviewing the grower comments on most of the trials where

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base grade has not been realised indicates that there were instances of stresses such as irrigation deficits being stretched in limited water situations, periods of excessive night temperatures and significant waterlogging events during the flowering period.

What is also evident from this data, is that given the right conditions, both Sicot 71 and Sicot 71BR can produce exceptional staple lengths — up to 38/32nds. While this has generally been associated with high yielding crops, in most situations staple lengths are well within base grade parameters, even at lower yield levels.

This further illustrates the point that if the objective it to meet base grade for length, then the Sicot 71 family may not be as forgiving as some other varieties should the crop experience conditions that impact negatively on staple length. The family is intended more for fully irrigated situations.

Processing

It is important to remember that while varietal selection, agronomic management and climate are the key factors in determining staple length in the field, the ginning process can have as much or more influence. There are numerous recent reports to indicate ginning can have impact on fibre length, length uniformity/short fibre and neps. Under some circumstances, cotton from fields suspected of having conditions or stress to affect quality could be ginned in such a way as to minimise the likelihood of those negative aspects and avoid price discounts. Research is continuing on this.

MANAGEMENT PRINCIPLES

The principles involved in achieving high yields and good staple length in the Sicot 71 family are no different to any other variety.

Watch the flowering period

Timeliness of irrigation during the flowering period is critical. There are many moisture scheduling tools available which provide excellent data. This can be complemented by intensive crop growth monitoring.

Field selection

Some fields may always produce slightly shorter staple — because of variable soil types or poor drainage for instance. Review the varieties grown in those fields in the past, the staple length achieved and compare this using the relative staple lengths provided in the CSD variety guide. If the Sicot 71 family appears it might be shorter than you are comfortable with, then select a longer stapled variety (see Figure 1).

Crops grown in fallow fields generally have better staple length than those in back-to-back fields. Information from the Sicot 71BR grower survey in the 2004–05 season suggested staple length in all varieties was up to one 32nd of an inch better in crops grown in fallow fields compared to back-to-back.

Monitoring and learning

Many growers will admit to improving how they irrigate through the adoption of soil moisture meters and furrow irrigation optimisation and monitoring. Both of these tools can lead to reduced water losses, reduced crop stress, better yields and quality — hence better returns per megalitre.

The Sicot 71 family has been bred and promoted as high yielding, disease tolerant varieties suited to full irrigation. They were never intended for raingrown and reduced irrigation systems, because of their shorter staple length, and their growth habit. These varieties should be considered as the selection that will achieve the best return with full irrigation, and there are better options within CSD's suite of 32 varieties in limited water situations.

Mike Stone (ICMS Moree) and Doug Marshall "Oaklands", Mallawa, in a crop that yielded 14.3 bales per hectare.

CASE STUDY 1

Sicot 71BR, 14.3 bales per hectare

Most of Doug Marshall's 2004–05 crop on "Oaklands" west of Moree was Sicot 71BR. He averaged 14.3 bales per hectare, achieving a staple length of 37 and micronaire in the 3.8–4.5 range.

Doug's principles of crop nutrition are fairly straight forward: "Give the crop what it needs when it needs it," he says. "We put on about 190 kg of nitrogen per hectare pre-plant, along with a blend of 40 kg per hectare of phosphorous as MAP, and five kg per hectare of Zinc as zinc sulfate monohydrate. During the season we water run urea with the first seven irrigations, and just prior to the third irrigation, during early flowering, we flew on 50 kg per hectare of potassium as potash.

"There was also one foliar application of potassium during peak flower. At the end of each season we do a fertiliser audit on each field using soil tests. We calculate how much the previous crop has used, how much is remaining in the soil, and adjust our nutritional requirements for the following crop based on that."

Equal attention has been dedicated to irrigation. This season there were nine in-crop irrigations.

"We have 600 mere runs and pretty good field slope and work off a 55–60 mm deficit during the season," says Doug. "By using double siphons we can have the water on and off the field in four hours. It's a very efficient way of watering. Since we've been doing this we've been able to grow 15–20 per cent more cotton per megalitre."

The crop was planted into rain moisture, achieving an even stand of eight to nine plants per metre. It was quite slow in development due to mild conditions in October and November. There were four insecticides applied, mainly targeting sucking insects, but one was timed with a period of intense heliothis pressure during peak flower.

Two applications of Pix (250 ml per hectare) were made at 18 and 24 nodes respectively to aid in finishing the crop. All season the crop maintained high fruit retention of 75–80 per cent and at the end of the season had a harvestable boll count of between 170–180 bolls per metre.

When asked what were the most important factors in achieving these big yields, Doug and his crop management consultant Mike Stone both agreed: "Attention to detail. There's no room for error, whether that be nutrition or water management."

CASE STUDY 2

Sicot 71, 15.6 bales per hectare

A 31 hectare cotton field on Henry Moses' property "Bronte" west of Moree, has produced the highest commercial cotton yield in the world.

The crop of Sicot 71 delivered 6.31 bales to the acre. Fibre quality was also excellent with staple length of 36 and micronaire of 3.9.

The crop was deliberately managed for maximum yield by Larry Johnson, manager of "Bronte" Moree, guided by local ICMS consultant, Mike Stone. It was ginned by North West Ginning at Moree.

Larry Johnson said the vital ingredients of the recipe for producing the successful crop included 200 units of N pre-plant, 100 units of N water run post-plant, and replacement levels of K, P and Zinc.

In-crop activity included 12 insecticide sprays, nine irrigations, two cultivations, and one shielded spray.

"We did not stress this crop," said Larry. "We watered on time, and if the weather looked like getting hot we brought the crop in one day early. It did not have any stress, not for one day — it held its colour throughout the season.

"We tried to get the water through this field as quickly as possible, changing siphons every eight hours. In some cases we were able to get four changes through in about 24 hours," Larry said.

Consultant Mike Stone acknowledged that the crop was consciously pushed for yield, but had to combat early damage from flights of puntigera, which were managed to normal insect thresholds.

"But with the good season we were able to finish the crop off. Watering intervals were tightened to ensure the plant was not stressed — we watered on a 55 ml deficit.

"Timing of operations was a key to this crop. I would recommend an operation, and Larry would have it done almost before I finished talking to him," Mike said.

FIGURE 6: Staple length vs yield from all CSD large scale replicated CRDC approved variety trials

Percentage indicate proportion of the crop that was above or below 36 staple and 4 bales per acre (9.88 bales per hectare).