# Burdekin research update

**By Paul Grundy, Steve Yeates and Jess Woods – Cotton Catchments Communities CRC**

"Is the Burdekin a goer?" or "What was the average yield?" have been the two most frequent questions asked of us over the past couple of months in the wind-up of the second season of attempting cotton production in the Burdekin.

After two seasons of R&D we can say that from an agronomic perspective that the answer to the first is probably 'yes' (with a regionally relevant agronomic package and skilled agronomic management). To the second, our answer of 'variable' is quickly responded to with "So you're saying not very good then?"

With a 2009 valley average (four growers and about 700 hectares) yielding 6.7 bales per hectare it is difficult to suggest otherwise, but the real story lies in the reasons for the wide variations of field averages (ranging from 3.0 to 9.5 bales per hectare) that contributed to 2009's unimpressive valley average.

While southern Australia continues to struggle against the grip of a prolonged drought, the opposite has been true of the Burdekin over the past three seasons with a run of wetter than average summers of which 2009 was amongst the wettest on record (registering just under 1800 mm of rain during the growing season) and epitomised the challenge for cotton production.

**Figure 1: All of the squares on this plant have begun to abort due to extended overcast wet conditions in January and February.**

## NATURAL BLESSINGS

The region is blessed with near limitless water, reasonable soils and optimal temperatures for cotton but these advantages are potentially offset by meteorological records that suggest 30 per cent of years will be wetter and cloudier than average, seasons for which cotton production is difficult unless a production package that abates these risks can be developed.

The yield average of 2009 is a forceful demonstration of the climatic risk for cotton production in the Burdekin, which was exacerbated this year by the lack of an appropriate agronomic package and growers/consultants inexperienced with wet season production. But the current run of wet years has ensured that the R&D program has been well positioned to develop detailed crop response data and test agronomic strategies for managing wet years that will be critical for the success of any future industry.

A key focus of the R&D program has been to examine and understand the plant response to tropical cloudy wet weather conditions which is critical to developing an informed agronomic package for cotton production in the Burdekin. An understanding of plant response to wet season climatic conditions is also needed to better calibrate the CSIRO OZcot model for Burdekin conditions.

The model can then be used to improve predictions of yield potential across the spectrum of seasons that a Burdekin grower is likely to encounter according to historical weather records, thus enabling them to derive forward-selling positions that balance wet season severity risks. Our R&D strategy has been to plant several varietal types over a range of dates in replicated experiments to obtain a cross-section of plant responses to cloudy wet weather at different growth stages.

Of the 30 per cent of years that historical records indicate are wetter than average, one third of these years (one in every 10 seasons) could be described as particularly challenging in that wet cloudy conditions persist well into autumn, well past first flower, severely diminishing crop yield potential – a problem avoided in most other years with the recommended planting window of December 20 to January 20. 2009 was one of these seasons, with over 1.8 metres of rain falling between January and April.

The results during 2009 confirmed many of the responses recorded during the previous year with plants exhibiting extensive shedding of fruiting sites from pin squares to young bolls during extended cloudy weather. Yield potential then becomes a function of the cotton plants' ability to set compensatory positions when good weather returns at the start of the dry. The shedding associated with overcast conditions takes two forms:

- The abortion of newly formed bolls, (observed on all varieties primarily during overcast wet weather) with shed fruit remaining attached to the branch by desiccated petiole tissue.
- The 'en masse' shedding of squares regardless of size, position on the plants, or the physiological growth stage of the crop (see Figure 1).

Trial data suggest that this shedding can be a beneficial response to cloudy

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**Figure 2: This shedding resulted in very low retention on the lower fruiting branches with potential yield dependent on growing a top crop on the upper branches and outer positions during March and April.**

**Figure 3: If the crop is managed to encourage compensatory top bolls, yield recovery is possible. Despite having no bolls after a month of flowering, the cotton pictured here (Siokra 24) achieved nine bales per hectare after enduring two months of overcast wet conditions.**

**Figure 7: 'Slashing' cotton with a cutter bar achieved a 350–400DD delay in flowering, which for the Burdekin could be useful to ensure successful planting in late December with a delay of flowering until March when favourable growing conditions are more likely.**

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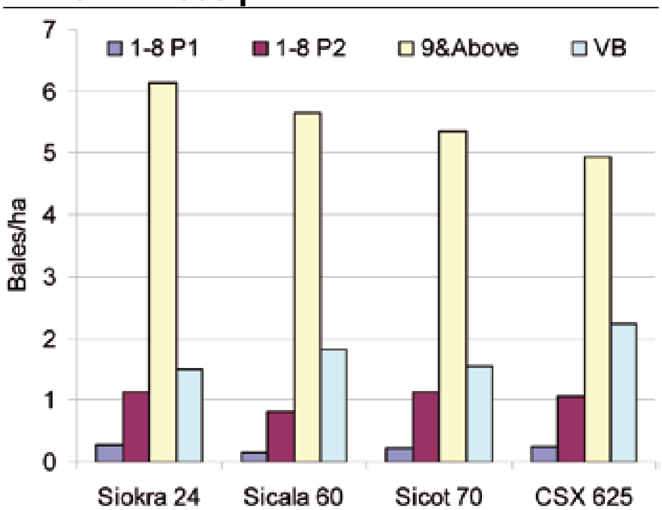
weather, allowing plants to effectively minimise carbohydrate losses, thus freeing resources for the development of later squares and bolls when sunny conditions return. Bolls retained on lower branches during extended periods of cloudy weather contain less seed cotton and reduce later compensatory fruit set resulting in lower final yields.

For the weather conditions experienced during 2009, the three planted crops simulated the following types of season:

- ***December 1, 2008*** – an initial dry start during vegetative and early flowering stages with wet overcast conditions occurring through the first six weeks of flowering and boll-filling. For the advocated Burdekin planting dates of December 20 to January 20 this would be the equivalent of a worse case scenario of a wet March–early April, which historically occurs in 10 per cent of years and (excluding a cyclone) is a worst case scenario for Burdekin cotton production.
- ***December 20, 2008*** – a much wetter than average wet season that finishes well into March with the crop exposed to wet weather from soon after emergence till the first 20–30 days of flowering followed sunnier conditions thereafter. Because the wet season of 2009 continued through until March this treatment ended up being very similar to the December 1 sowing with cloudy wet weather affecting the first four weeks of flowering.
- ***January 8, 2008*** – wet conditions during establishment through until the first fortnight of flowering with the majority of flowering and fruit set taking place in sunny conditions. This treatment largely escaped the late wet season scenario, but this planting date could not have been implemented commercially in the Burdekin during 2009 due to wet weather and severely reduced field traffic ability during January.

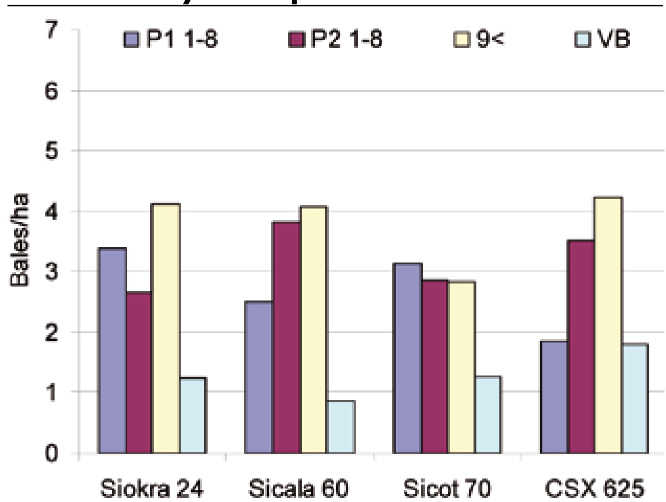
The December 1 and 20 plantings endured significant shedding from the lower fruiting branches that bore flowers during wet conditions in January and February. These losses were extensive with plants reaching 18 nodes by mid-February with minimal retention of all sites (Figure 2). When better weather began to return in March, these plants had a limited ability to compensate due to the extensive losses of six weeks of poor fruiting.

**FIGURE 4: Boll partitioning within the canopy for 20 Dec 2008 planted cotton varieties**



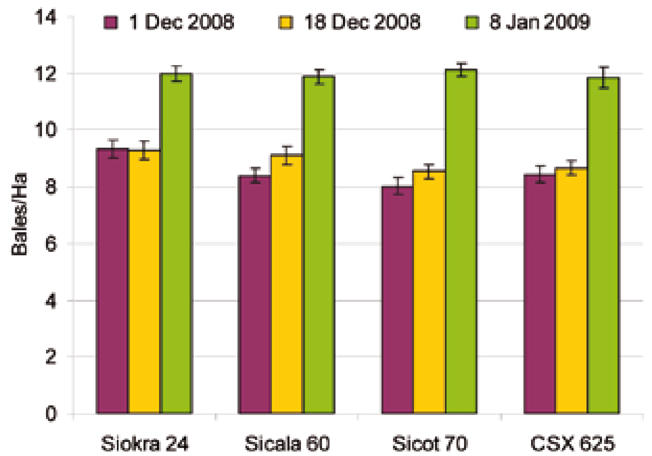

Note that shedding and cloudy weather during the first month of flowering dramatically reduces the contribution of the bottom 8 fruiting branches to overall crop yield. Without the compensatory bolls at nine branches and above the yield would have been very poor. P1 = first position fruit, P2 = second position or greater fruit and VB = vegetative branch fruit.

**FIGURE 5: Boll partitioning within the canopy for 8 January 2009 planted cotton varieties**




The contribution of lower fruiting branches to overall yield is much higher because these positions flowered during sunnier conditions in Autumn.
But for a wetter than average season a high yield is still dependent on setting P2 fruit on the lower branches as well as a top crop on fruiting branches nine and above.

**FIGURE 6: Yields from the 2008–09 climate experiment**




Wet conditions that extended well past first flower for the 1 and 20 December sowings resulted in lost yield due to the reduced size of lower bolls and extensive shedding. The January 8 planting did not commence flowering until early March by which time sunnier conditions were increasing resulting in more positions set and bigger boll size.

Despite this, both planting dates went on to set acceptable yields of eight to nine bales per hectare with the majority of bolls set on upper and outer positions (Figures 4 and 6).

These yields represent a 25 per cent improvement compared to the similar climate treatment scenarios from 2008, largely the result of having a better understanding of shedding and taking a management approach encouraging later compensatory boll growth. This was achieved by avoiding excessive pix usage and ensuring adequate nutrition and 'optimal' soil moisture conditions to ensure rapid compensation during the first weeks of sunnier weather.

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**Figure 8: Despite the delay in flowering, tipped out plants matured at the same time or earlier than un-cut controls. This is because shedding and poor boll set as seen in the above control (left) resulted in a maturity delay and the need to grow a compensatory top crop, something that requires high level management and has not been easy to achieve under commercial conditions. Premature cut-out has been a problem on many commercial crops during extended wet weather. Slashing might alleviate this problem as it removes the early boll loads and resets flowering to a later period when better weather is more likely. Trials are ongoing.**

Despite initial shedding from the lower branches, the third planting went on to set a more typical boll load compared to a southern crop, which resulted in high yields of 12 bales per hectare (Figures 5 and 6). This was primarily due to the crop's ability to set and fill lower positions during better weather in April and May.

The results from the past two wetter than average seasons highlight a climate conundrum facing industry development in the Burdekin. Planting in early January is largely sufficient to 'avoid' the worst of the wet season effects during flowering and boll set and ensure a high yield potential in wetter than average years, but it is these same wetter than average years (when a January sowing date would provide the most benefit) that planting beyond December becomes most risky due to rainfall.

Planting around December 20 in these years minimises crop establishment risks but necessitates a management style that is flexible depending on conditions so that compensatory fruit set is achieved when the dry season resumes. How this objective is achieved is the focus of current and future experiments with data collected so far suggesting that sowing density within rows, pix application, irrigation management at the onset of the dry, and crop nutrition all play an important part.

One of the more unusual experiments conducted during 2009 was a controlled tipping-out study where slashing with a cutter bar was tested at various growth stages and degrees of cutting severity to see how long flowering could be delayed. Such a strategy could be useful in the Burdekin to ensure crop establishment by planting during dry conditions in December but then preventing the possibility of setting small low quality bolls by removing early fruiting sites. The resultant delay could also shift flowering into better conditions similar to a January planting.

For this experiment, the cotton was planted on December 4 and cutting treatments (removal of the terminal, upper three–four and six–seven nodes) were enacted at seven nodes, 12 nodes and first flower (16 nodes) growth stages to build a profile of responses in terms of delay in flowering, fruit set, yield and maturity compared to an uncut control.

Most treatments gave a very similar flowering delay of 300–400 DD which in January corresponds to about 17–23 days. This would be enough to defer the flowering of a December 20 sown crop to the equivalent of a January 10 sown crop and might provide the boll setting benefits as seen between these sowing dates for the past two wetter than average seasons.

In this particular experiment, the earlier sowing date resulted in an equivalent of a December 20 sown crop and not surprisingly there was no yield response between treatments just as there were no differences between the December 1 and December 20 plantings in the climate experiment. But this experiment did demonstrate that despite the delay in flowering, crop maturity was not delayed and crop height was significantly lower, reducing the need for pix applications (a continual challenge during wet weather conditions).

Conceptually, slashing is an attractive management option for mitigating wetter than average seasons in the Burdekin as it enables early crop establishment but prevents flowering and boll set in February. The delay of flowering until early March would also enable better targeted and efficient side-dressing of nitrogen, something that has been nearly impossible for crops that would otherwise flower by mid February in wet fields.

With an understanding of when to cut and what to expect, this experiment will be repeated at several sites in the coming season as a wet season risk mitigation strategy for the Burdekin (Figures 7 and 8).

## OTHER ASPECTS OF 2009 – CULTURAL DIVIDE

One of the most under-estimated challenges encountered since commercial scale trials began in 2008 is the difficulty some local growers have had adjusting to row crops like cotton, which have very little in common with the well established practices of cane production. Basic cotton operations such as planting, fertilising and spraying have proven on occasion to be a challenge for first time growers, exacerbated this season by having to conduct operations at short notice due to wet season conditions (Figure 9).

Small mistakes on planter setup or failure to properly decontaminate booms have resulted in a reduction in yield potential over large areas. Of the 1800 hectares of cotton sown during the past two years, 400 hectares has suffered from a poor plant stand due to inappropriate planter setup and a further 300 hectares has been affected by phenoxy herbicide damage due to boom contamination.

These aspects along with poor drainage and ineffective irrigation infrastructure on some fields have contributed considerably to the low yields recorded across the region in these first years (Figure 10). But none of these problems is insurmountable, and many can be easily remedied with more experienced management.

Insect management was more of a challenge in 2009 compared to the 2008 season. Extreme levels of Helicoverpa (over 200 eggs per metre) during late March necessitated the application of Steward for larvae control on nearly all crops in the valley. Mealy bugs (*Phenacoccus angophorae*) were an unexpected pest in some fields and proved difficult to control (Figure 11).

Low numbers that were present during the wet season (particularly in fields that were untidy at sowing with cotton volunteers from 2008) increased rapidly during March and April with the only product providing relief being Clothiodan (Shield) applied twice with a 10–14 day interval. While it is unclear as to why mealy bug populations exploded, Pakistan reported a similar problem several years ago, where mealy bug appeared out of the blue and

**Figure 9: Wetter than average years have been un-forgiving to first time growers. Pictured is a field where fertiliser application was "patchy" at planting. The following two months of wet weather prevented remedial action by which time it was too late to salvage the crop.**

**Figure 10: Constrained drainage capacity of many cane fields has been a problem for cotton during 2008 and 2009. Many cane farmers do not see this water logging as adversely affecting their cane.**

caused widespread crop devastation only to later subside.

One hypothesis for the Pakistan outbreak was that it coincided with a run of wetter than average seasons and that natural enemy complexes within the broader environment brought the problem back under control when drier conditions prevailed. Likewise the Burdekin has had its third wetter than average season in a row and mealy bug have been abundant not only on cotton but a range of other crops, weeds and ornamentals.

Time will tell if the pest outbreak in some fields was a function of a broader shift in mealy bug populations within the external environment, but in the interim growers will be paying much better attention to on-farm hygiene in the coming season with the removal of volunteers as well as weedy hosts on field boundaries as this was clearly a contributing factor in the worst affected fields.

With a better understanding of how cotton responds to local conditions and potential management strategies, our R&D focus over the coming three years will be expanded towards issues of wet season nutrition, soil management and cropping systems agronomy.

One of the biggest challenges highlighted by commercial crops during the past two years is the difficulty in knowing how much, when and where to apply nitrogen early during the life of a crop, particularly when heavy rainfall can cause leaching or de-nitrification losses.

Experiments are planned for the coming seasons to examine these issues as nitrogen management is one of the most critical issues for the development of a sustainable industry given the potential for yield loss, cost overruns and environmental contamination.

Cropping systems development will be part of this research with an examination of different approaches to integrating cotton with cane and grains in the region with emphasis on nutrient recycling and stubble management. This expansion will be part of a second CRDC and CRC project aiming to fast track farming systems issues facing cotton production in the Burdekin.

Whilst 2009 has been a season that could be easily used to justify abandoning efforts to develop a cotton industry in the Burdekin, most growers are looking at the bigger picture in that 2009 was one of the wettest years on record and that cotton production is still very much in a developmental phase. The current R&D program is suggesting that even in the most difficult of seasons that one could expect to encounter in the Burdekin, reasonable yields are still attainable with tailored agronomic management. Importantly the past two seasons have provided a lot of data needed to develop these agronomic strategies which will go a long way to managing the impact of wet years.

For 2010 the area of cotton is likely to remain around 700 hectares with a small core of pioneering growers remaining committed to the Burdekin. Recent Bureau of Meteorology predictions based on current SOI values are beginning to point towards the start of a drier cycle for north Queensland which would be a welcome change compared to the previous three seasons and would allow growers to recoup some of the losses of the previous two seasons and examine the potential of cotton in a more typical season.

**Figure 11: Mealy bug were an unexpected problem in some Burdekin fields, primarily where cultural control of weeds and cotton volunteers had been lacking. Infestations cause severe stunting and loss of vigour as well as honeydew.**