Warm and dry: A perfect recipe for high (irrigated) cotton yields

By Dirk Richards[1] and Michael Bange[2]

While the drought has continued over much of Australia, the long and warm season has provided irrigated cotton crops with an ideal growing season as evidenced by the many high yielding crops picked. Throughout the industry, warm conditions during September and October gave an excellent start to many crops, with cold conditions only in southern growing areas during November.

Accumulated day degrees for the remainder of the season were close to average, although many locations experienced weeks of above average maximum temperatures during January and February. The lack of significant rain in most areas since January may have challenged irrigation scheduling, but provided excellent growing conditions where water was available and has helped with picking.

In this article we compare the weather conditions of the 2004–05 cotton growing season at 12 locations across the industry, with the long-term averages from climate data recorded from 1957 to the present day. Official Bureau of Meteorology and SILO Patched Point Dataset climate records have been used to generate the results presented, and Hay has now been added to the analysis.

The 2004–05 season in review

Figure 1 presents an analysis of cumulative day degrees calculated at the end of each month over the cotton season. We have then graphed the deviation from the long-term average, to determine if conditions were cooler or hotter than the average.

September totals were close to the long term average, followed by a cooler October which was up to 60 day degrees below average in some locations, specifically Dalby and Emerald. November was close to average in all locations, followed by above average accumulation in December at Gunnedah, Narrabri, Moree, and Goondiwindi.

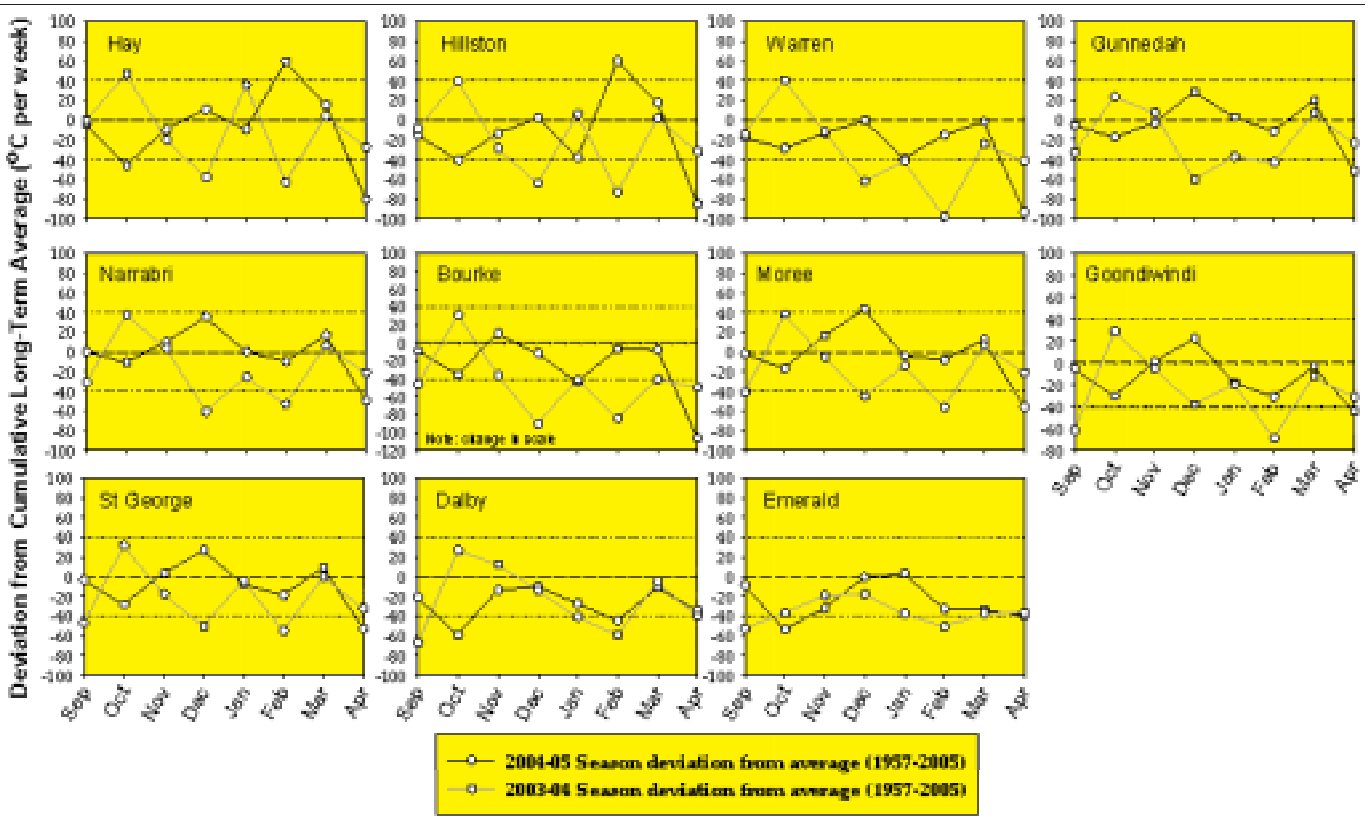
January and February were close to average at Gunnedah, Narrabri, Moree and St George, while other locations were below average with a similar pattern to the 2003–04 season. When cool mornings did occur during January, the day degrees were more than compensated by warmer days in the following weeks.

Looking closely at the average weekly maximum and minimum temperatures reveals some variation across the locations, when compared with long term averages. From the week beginning September 15 through to October 26, above average maximum temperatures were recorded at most locations, with above average maximum and minimum temperatures again during the week beginning November 24. A sharp dip in temperature was uniformly felt across all locations in the week beginning February 2, with the exception of Emerald.

Hot temperatures

Figure 2 shows the frequency of the

FIGURE 1: Deviation of monthly accumulation of day degrees from the long-term average (1957–2005)



number of days during each week of the season that equalled and exceeded a maximum temperature of 36°C. Research has shown that growth rates do not continue to increase above optimum temperatures, due to increased respiration and possibly the inability to maintain transpiration. This means the plant is producing less energy to fill bolls and grow new leaves and stems, which can slow crop development.

Most locations had a day or two of above 36°C temperatures in the week beginning October 13. The week beginning November 24 brought more unseasonally warm conditions, followed immediately by below average frequency of hot days. Notably Moree and Goondiwindi received four weeks of moderate temperatures from December 8 through to January 4.

During mid January, from the 12th to the 25th in particular, all locations except Hay experienced above average numbers of hot day events. Above average days were also recorded later in February (week beginning February 23) at most locations, followed by another warm week in March (week beginning March 9) in Hay, Hillston and Bourke. This was in contrast to most

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FIGURE 2: Frequency of high temperatures each week during the period September 2004 to April 2005 compared to the long-term average (1957–2005)

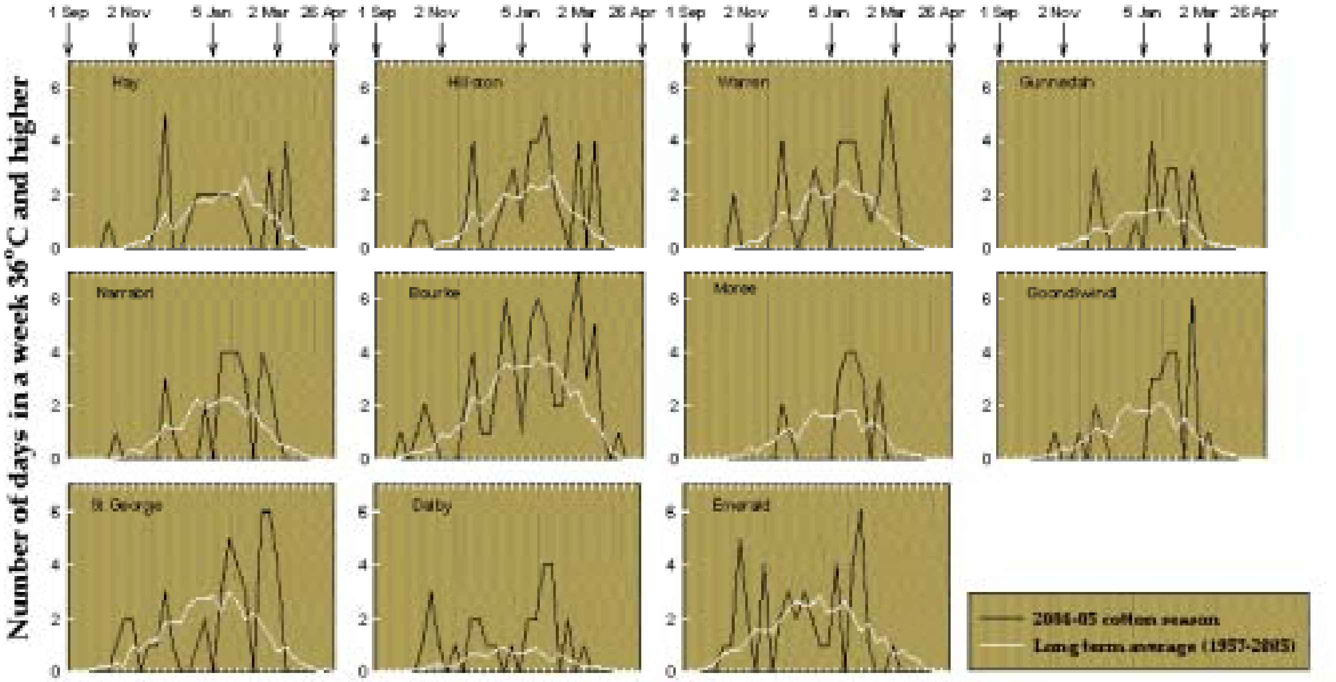
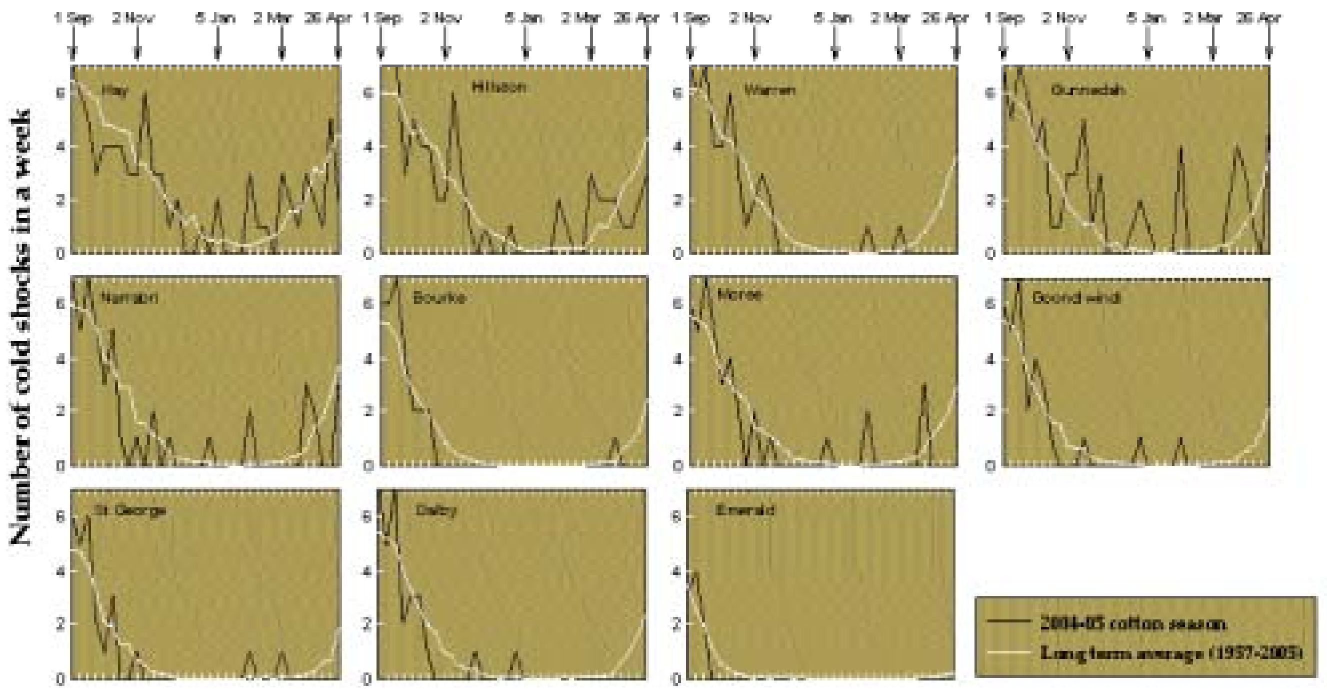


FIGURE 3: Fequency of cold shocks in each week during the period September 2004 to April 2005 compared to the long-term average (1957–2005)



other locations with below average numbers of hot days from March onwards.

Cold shocks

When minimum air temperatures fall below 11°C, crop growth and development the following day can be reduced regardless of the maximum temperature reached. This type of temperature extreme has been given the term 'cold shock'.

Following the trend of day degree accumulation, the frequency of cold shocks was different from the long term average (Figure 3). Average numbers of cold shocks occurred in September and October, with below average numbers recorded late in October at some locations. Cold shock events occurred in the weeks beginning December 29 and February 2 at most locations, with the exception of Bourke and Emerald. The notable absence of late season cool temperatures is apparent from Narrabri north, which will have contributed to even boll maturity and development of late bolls in these areas.

Rainfall

Rain during the season was generally below average, with the exception of large falls in November, December and January at some locations. Monthly rainfall totals for September to April compared with the long term average (1957–2005) are presented in Figure 4. The large storm events that occurred at Narrabri, Moree, and to a lesser extent at St George and Dalby, in November and December were a welcome addition to most crops.

At most locations, low rainfall totals have been recorded since January, with the exception of Emerald. In common with the previous 2003–04 season, low rainfall totals late in the season have assisted with picking operations at most locations.

Season summary

An overall analysis of the 2004–05 cotton season (Table 1: September 1 to April 30) shows that the seasonal day degree accumulation at all locations was above the long-term average. In the case of Warren, Bourke, Dalby and Emerald by over 200 day degrees, as a result of above average temperatures in February and March.

Most locations recorded below average rainfall for the season with the exceptions of Narrabri and Moree, although the higher totals in NSW fell prior to Christmas with little during January and February. Therefore these figures do not indicate the importance of timing of rain events and their benefit to crops. Incidence of hot days was generally above average, particularly in Warren, Bourke and Dalby whilst only Gunnedah received above average numbers of cold shocks.

ADDITIONAL INFORMATION SOURCES

The information in this article may help growers understand climate variability, and explain their cotton's growth and performance during the 2004–05 season. For further information about the impact of cold shocks, frost and hot temperatures, please see the March–April 2000 *Australian Cottongrower*, "Cool Starts: What is normal?" (Vol 21, No. 2).

Cotton growers seeking further information about weather, seasonal forecasts and potential impacts on crop growth may be interested in accessing:

The Australian Cotton CRC web site

- For further details regarding the SILO day degree calculator, early Season Diagnosis tool, NutriLOGIC and other tools visit the Cotton CRC web site at *www.cotton.crc.org.au*.

Other web sites

- *http://www.bom.gov.au/silo* (SILO)
- *http://www.bom.gov.au/* (Bureau of Meteorology)
- *http://www.dnr.qld.gov.au/longpdk/* (The Long Paddock)
- *http://www.cvap.gov.au/* (Climate Variability in Agriculture R&D Program)

Computer software

- HydroLOGIC — is an irrigation management system to assist in the effective

FIGURE 4: Monthly rainfall received during the September 2004 to April 2005 period compared with the long-term average (1957–2005)

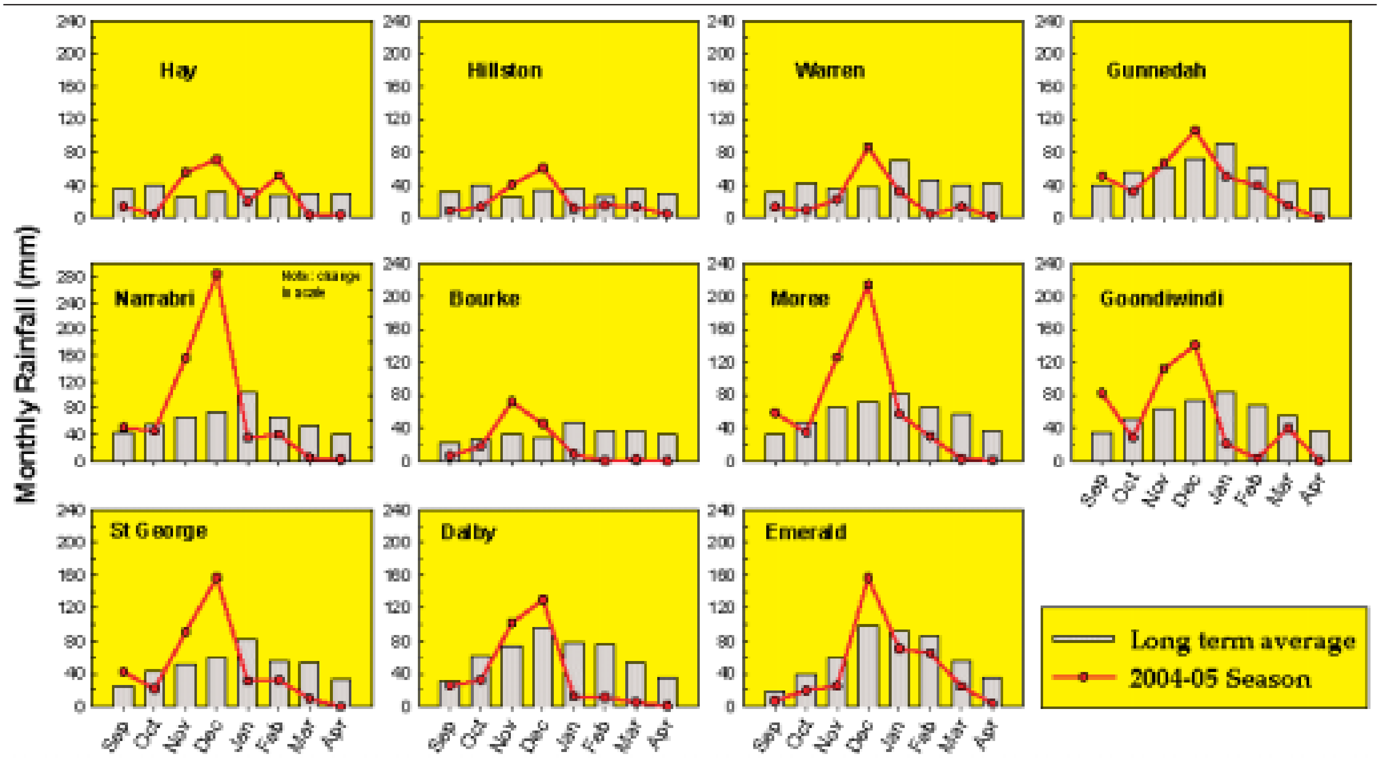


TABLE 1: The 2004–05 cotton season (September 1 to April 30)

	Day degrees			Rainfall			Days >36°C			Cold shocks		
Location	2004–05	Av*	Diff**	2004–05	Av*	Diff**	2004–05	Av*	Diff**	2004–05	Av*	Diff**
Hay	2287	2219	69	222	251	–29	28	27	1	83	89	–6
Hillston	2452	2335	117	166	254	–88	38	29	9	74	75	–1
Warren	2681	2466	215	181	341	–160	40	28	12	47	61	–14
Gunnedah	2444	2400	44	358	458	–100	20	17	3	76	57	19
Narrabri	2636	2624	12	617	498	119	30	28	2	49	56	–7
Bourke	3152	2938	214	149	257	–108	69	53	16	30	36	–6
Moree	2674	2654	20	522	451	71	20	22	–2	41	48	–7
Goondiwindi	2852	2738	114	425	459	–34	26	25	1	31	36	–5
Dalby	2760	2533	227	320	504	–185	28	12	16	31	40	–9
St George	3073	2994	78	384	400	–16	45	40	5	26	30	–4
Emerald	3476	3270	206	373	481	–108	43	41	2	9	11	–2

* Average
** Difference

and timely application of irrigations for furrow irrigated cotton crops. The software has the ability to evaluate the consequences of different irrigation strategies on daily crop growth, yield and water use, using a range of simple plant and soil moisture measurements. For further information visit: *www.cotton.crc.org.au/CottonLOGIC/* or contact the Australian Cotton Technology Resource Centre on 02 6799 1500.

- Rainman Streamflow V4.3 — the aim of the Rainman StreamFlow software, developed by the Queensland Department of Primary Industries, is to provide rainfall and stream flow information for better management of climatic risks and opportunities throughout Australia. For further information visit: *www.dpi.qld.gov.au/rainman/*
- Whopper Cropper — is an easy-to-use computer program designed to provide crop management advisers with the latest technology in rain-fed cropping systems modelling and seasonal climate forecasting. For further information visit: *www.apsru.gov.au/apsru/Products/Whopper/*

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