A season of two halves: 2001–02 weather in review

By Dirk Richards, Michael Bange, and Stephen Milroy

In early December last year, it again appeared that mother nature had dashed hopes for a warm season following a warmer than average September. Cumulative day degrees during October and November were well below the long-term average and the number of cold shocks was higher.

The only exception to this was Emerald, where day degrees were slightly above average and considerably less cold shocks recorded. Fortunately, the season warmed considerably to finish with higher than average cumulative day degrees recorded from the middle of January through to April in most regions.

In this article we compare the weather over the last season at 10 locations in the industry to the long-term averages from climate data recorded from 1957 to the present day.

The 2001–02 season in review

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

With the exception of Emerald and Hillston, most regions had a similar pattern of day degree accumulation of warm conditions in September, a cooler October and November with the rest of the season being warmer than the average. In Emerald the season was close to the average early but considerably higher from December onwards.

Hillston in contrast was colder than the average from November through to February. Both 2000–01 and 2001–02 seasons were similar in having very good (warm) conditions in the last half of the season when compared to long-term means.

In terms of crop growth and development, the cooler conditions early would have made

A great finish to the season more than compensated for the cold start in most areas.

FIGURE 1: Deviation of monthly accumulation of day degrees from the long-term average (1957-2002)

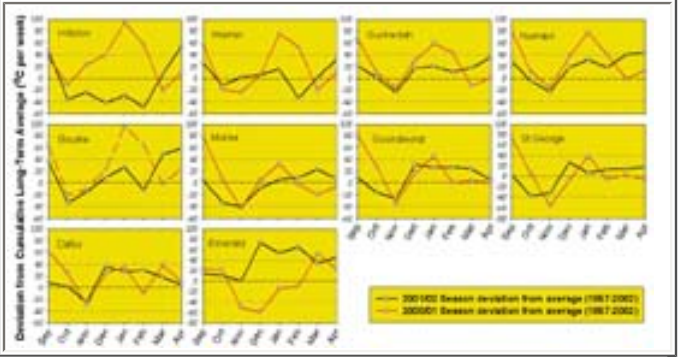


FIGURE 2: Frequency of cold shocks in each week in the period September 2001 to April 2002 compared to the long-term average (1957-2002)

seedling growth difficult. Later in the season the warmer conditions would have been ideal for the critical periods of flowering and boll filling, which reflects in the yields achieved in many valleys.

In some areas though, the extreme hot conditions may have impacted on growth.

Cold Shocks

When daily minimum temperatures fall below 11° C, crop growth and development the following day can be reduced regardless of the maximum temperature reached. The frequency of cold shocks throughout the season was generally commensurate with the day degree accumulation analysis presented previously. In most regions the number of cold shocks was higher during late September and October (Figure 2).

Emerald had less than their long-term average (1957–2002), while Hillston had more over the whole duration of the season. Several sites, including Gunnedah and Warren received an uncharacteristic cold shock mid-season during the week of February 5 to 11.

Hot Temperatures

While variation in the rate of crop development can be caused by a number of environmental influences (such as waterlogging, pest attack, disease and cold shock), there is evidence to suggest that the rate of crop development may be slowed by excessively high temperatures. We believe the day degree concept could be improved in this regard, as temperatures above 35°C may not be improving development as implied by calculated day degrees.

Figure 3 shows the frequency of the number of days during each week of the season that exceeded a maximum temperature of 35°C. This temperature was arbitrarily chosen as a high temperature likely to be approaching the limit beyond which the current day degree calculation may no longer be applicable. With the exception of Hillston, in most regions the frequency of days with maximum temperatures exceeding 35°C was higher than the average from late December through to February.

This contributed to the higher day degree accumulation through this period. Of all the regions, Emerald stands out as the region that had considerably more than the average extreme hot days.

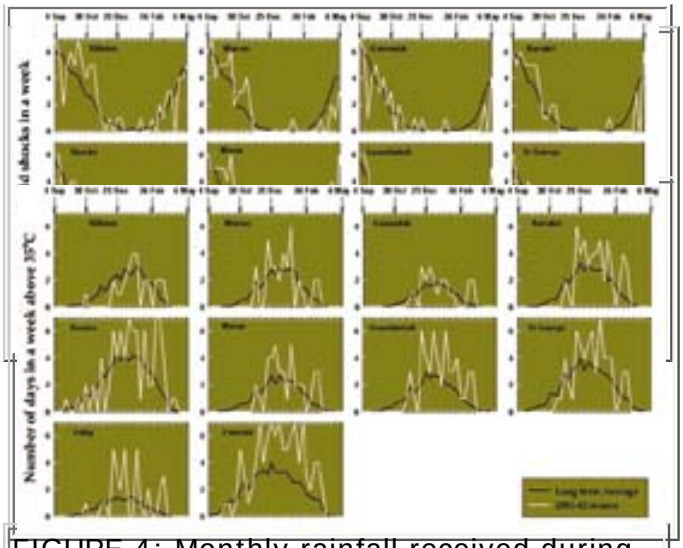


FIGURE 4: Monthly rainfall received during the September 2001 to April 2002 period compared with the long-term average (1957-2002)

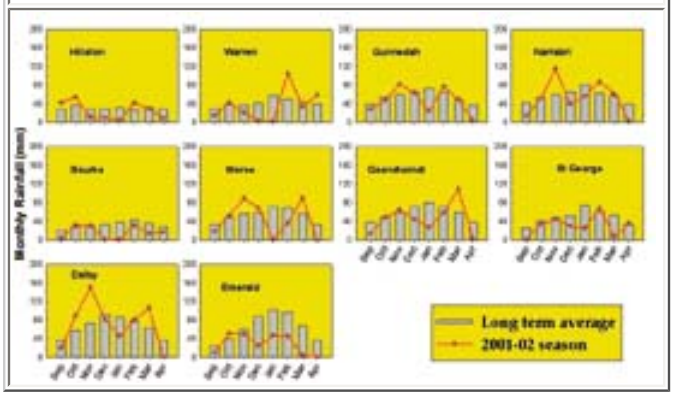
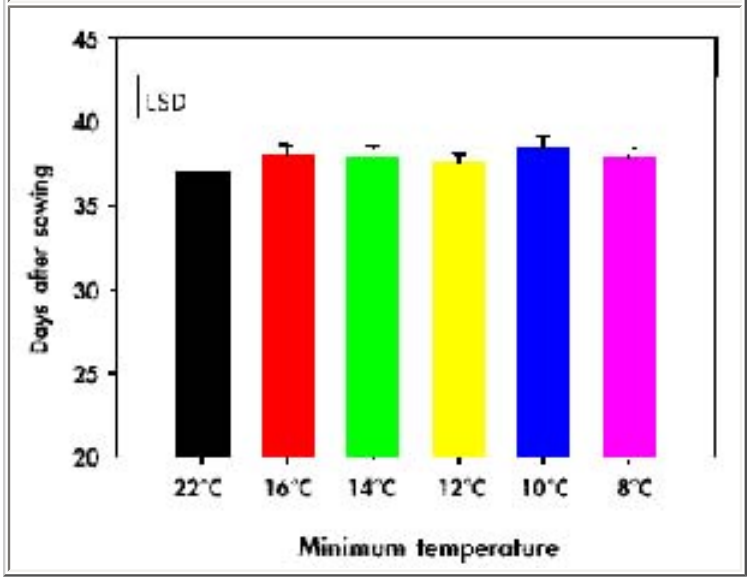


FIGURE 5: Response in the appearance of first square following four nights of cold temperature with minimums of 22°C, 16°C, 14°C, 12°C, 10°C and 8°C



The final piece in the puzzle for the season is monthly rainfall (Figure 4). December and January were very dry months across most of eastern Australia. Dry conditions have generally persisted to date which has helped with picking but may result in a drier than usual soil moisture profile next season.

An overall assessment of the season (Table 1: October 2 to April 29) shows that the seasonal day degree accumulation at most locations was close to or just above the long-term average, except Hillston and Moree which were slightly below average.

These results are expected given that day degree accumulation was less early in the season, but higher later. Similar to last year several locations had above average seasonal day degree accumulation and higher frequency of days above 35°C from December through to February — factors which could be associated with respectable yields but potentially higher micronaire.

TABLE 1: Average and 2001–02 season weather-related statistics

	Day degrees		Days above 35		Cold shocks		Rainfall	
Location	Average	01–02	Average	01–02	Average	01–02	Average	01–01
Hillston	2186	2062	37	28	50	62	226	158
Warren	2300	2305	37	36	36	35	320	268
Gunnedah	2209	2282	21	23	30	25	446	350
Narrabri	2433	2552	42	53	32	28	452	415
Bourke	2700	2774	64	81	18	17	240	127
Moree	2470	2431	34	41	26	32	418	338
Goondiwindi	2555	2624	35	54	15	13	436	357
St George	2761	2767	54	64	12	16	377	245
Dalby	2338	2433	20	31	19	17	506	554
Emerald	2986	3268	61	104	2	1	478	225

Future research

The information presented in this article emphasises the need for understanding the impacts of climate on crop growth and development, given the variation from season to season and in particular variation in the number of extreme events. Research is presently underway through a project supported by the CRDC, to gain a better understanding of the effects of extremes of temperature (both hot and cold) on cotton crop growth and use this information to develop better decision support tools. Some examples of the research being undertaken are:

• Developing a more robust day degree function over a considerable range of average temperatures.

• Quantifying more clearly the impact of cold shock at all stages of crop growth. Results of a controlled environment experiment are shown in Figure 5, where maximum temperature during the day was 30°C and minimum temperature at night was varied from 22°C to 8°C.

• Four nights of cold temperature with minimums of 22°C, 16°C, 14°C, 12°C, 10°C and 8°C did not delay the appearance of the first square. Subsequent experiments have explored larger numbers of cold shocks and variation in the

timing of cold shock.

• Exploring the impacts of higher night temperatures on growth through the use of insulated tents over cotton plants.

• Quantifying more clearly the impacts of frost on seedling survival and maturation.

Information Sources

The information in this article may help growers explain their cotton's performance during the 2001–02 season, and assist with future decisions on their farm. 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).

Growers can obtain up to date day degree calculations and historical climatic information by accessing the Australian Cotton CRC web site (http://www.cotton.crc.org.au/Tools/Weather/) and using the SILO day degree calculator. This tool uses Bureau of Meteorology weather data to calculate accumulated day degrees between specified dates for any official recording station in eastern Australia. The website also provide historical analysis of day degrees, cold shock and temperatures above 35°C.

Further information about weather and seasonal forecasts can also be accessed from the following sources:

Fax services

"Cottonfields" Bureau of Meteorology Farmweather service giving detailed forecasts for four days and beyond for key locations in NSW cotton growing regions
(Poll fax 1902 935 375).

Web sites

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)
http://www.bom.gov.au/silo (SILO)

Australian Cotton Cooperative Research Centre, CSIRO Plant Industry, Narrabri, NSW.