Seasonal forecasts add value to DAFWA's rainfall to date and soil water tools

Fiona Evans, Department of Agriculture and Food, WA

Key messages

DAFWA has produced new tools to provide up to date, local seasonal climate information for growers.

When integrated into rainfall to date graphs, DAFWA's seasonal rainfall forecasts provide better information than climatological projections.

Combining rainfall forecasts with soil water models provides the most information about soil water available for crop use during the growing season.

Aims

This paper shows the advantages and disadvantages of DAFWA's rainfall to date and soil water tools for evaluating seasonal climate, and investigates whether DAFWA's seasonal rainfall forecasts can be used to add value to the rainfall to date and soil water tools.

Method

DAFWA seasonal climate tools

The Department of Agriculture and Food WA produces and publishes seasonal climate information to help growers manage seasonal climate variability. Monthly updates to statistical seasonal forecasts of rainfall, modelled plant available soil water and information about frost risk are published on the DAFWA Gateway: https://www.agric.wa.gov.au/agseasons/seasonal-climate-information.

A new tool on the DAFWA web site allows users to select any of 440 Patched Point or DAFWA automated weather stations and immediately plots the season rainfall to date graph for that station: https://www.agric.wa.gov.au/climate-weather/rainfall-date.

Rainfall to date graphs show the amount of rainfall accumulated from the start of the grain growing season (April) and can be used as a tool in the seasonal decision-making process. They have been routinely produced by DAFWA's AgTactics teams for selected weather stations, but are now available for more locations with automated updates using the most recently available rainfall records. Graphs can be downloaded and saved as images for insertion into documents and presentations.

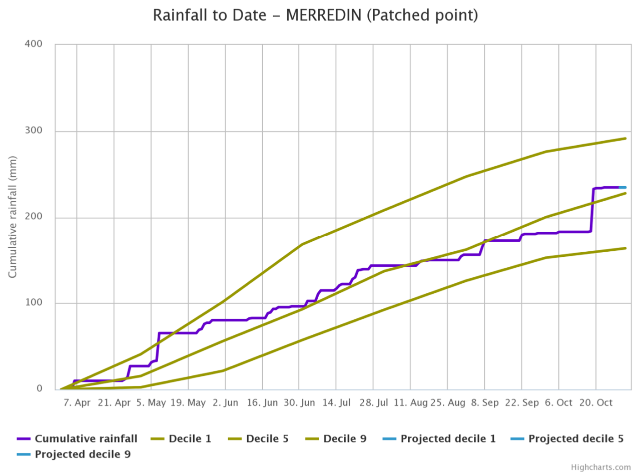

Figure 1: Rainfall to date graph showing cumulative rainfall from the start of the 2014 grain growing season recorded at the Merredin Patched Point weather station.

Commented [jwl1]: Would be better to include a mid season one to illustrate decile projections. Oh - I now see you are putting soil water alongside this actual rainfall. What do the soil waters look like mid season?

Another tool in development will provide a better indication of the amount of water available for crop use. Soil water models estimate the accumulated amount of water stored by the soil from rainfall, allowing for water movement within the soil, evaporation and crop water use. DAFWA's soil water tool uses a two-layer bucket model (Ritchie, 1972) with ten choices of soil type defined for WA soils (Oliver and Robertson, 2008). It implements two models: a fallow model and one where a wheat crop has emerged at the break of season, assumed to occur when there is 25mm of rainfall over three days after 25 April, or when there is 5mm over three days after 5 June.

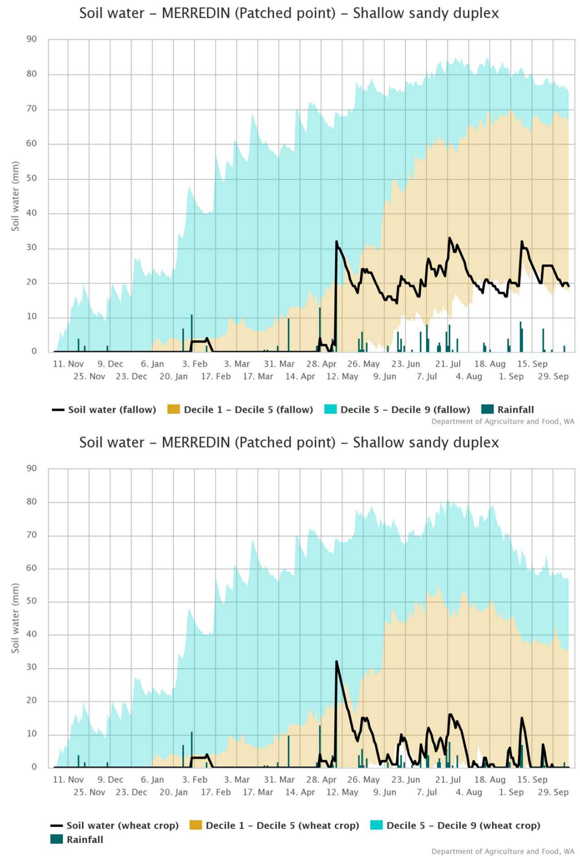

Figure 2: Soil water graphs for Merredin showing the difference between a fallow model (top) and crop model (bottom).

The advantage of using soil water models is clearly shown by comparing Figure 1 and Figure 2. The rainfall to date graph (Figure 1) shows cumulative growing season rainfall tracking close to the median for 1975 – 2013 until late September. However, the soil water graphs (Figure 2) show that a crop emerging after the large rainfall event in early May will be at risk of running out of soil water well before that time.

The soil water graph allowing for crop water estimated the break of season occurred on 8 May 2014. While there was sufficient rainfall in that one event to allow germination, the lack of rain for the rest of May meant that soil water dropped rapidly. Rainfall in June was below average, but with average rainfall in July there was sufficient soil water to maintain a crop. However, poor August rainfall would have meant potentially drying crops.

Integrating tools with seasonal rainfall forecasts

Seasonal rainfall forecasts are integrated with DAFWA's seasonal climate tools by taking the most likely amount of rainfall forecast for each month and dividing it equally into four rainfall events on the 4th, 11th, 18th and 25th day of the month. This is not necessarily the most realistic method for converting monthly rainfall amounts to daily forecasts, because it does not allow for large rainfall events and extended dry periods, but it is sufficient to indicate the value of the forecasts. Forecast daily rainfall is then used to produce cumulative rainfall to date plots and soil water plots.

This paper presents only the results for the Merredin Patched point weather station.

Results

Figure 3 shows forecast rainfall to date from four different times within the 2014 grain growing season. It can be compared with the actual cumulative rainfall to date, shown in Figure 1.

Forecasts made earlier in the growing season suggest that growing season rainfall at the end of October will be close to the median growing season rainfall calculated for 1975 – 2013 (shown as khaki lines). At the earliest forecast date, 1 May 2015, the forecast is similar to the climatological projection at that time (shown in blue lines). After that date, the climatological projections are all for higher amounts than those forecast. Actual growing season rainfall was strongly influenced by a large rainfall event in October that fell on crops already near maturity and they could not make use of it. Forecasts of growing season rainfall made as early as 1 July were close to the actual growing season rainfall (excluding rain that fell after crop maturity), and gave a much better indication of growing season rainfall than climatological projections made at the same time.

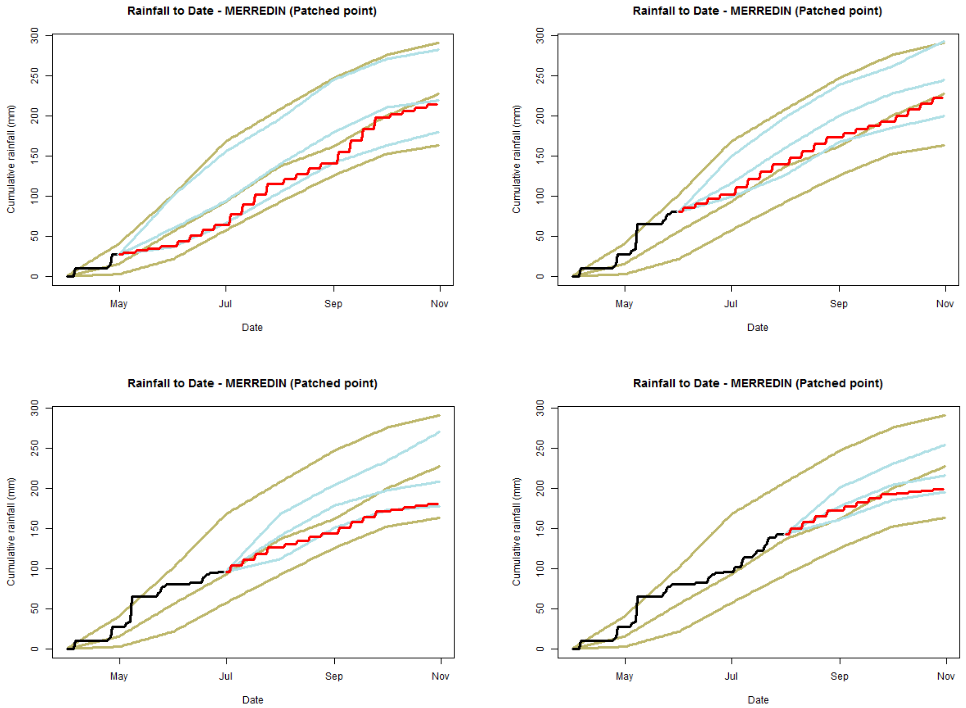

Figure 3: Rainfall to date with cumulative rainfall forecasts from 1 May 2014 (top left), 1 June 2014 (top right), 1 July 2014 (bottom left) and 1 August 2014 (bottom right). Cumulative rainfall is shown in black, climatological deciles in khaki, projected climatological deciles in blue and forecasts in red.

Figure 4 shows the results of using forecast rainfall in the soil water, allowing for crop water use after the break of season on 8 May 2014. The forecasts consistently show that crops will be at risk of running out of water, as shown in

the soil water modelled using actual rainfall (Figure 2). However, the simple methods used to divide monthly rainfall forecasts into four weekly rainfall events has prevented forecast simulations of larger rainfall events that have a higher proportion of the rain event going deeper into the profile for crop use and less lost to evaporation. More work is required to develop a realistic method for downscaling monthly to daily rainfall forecasts.

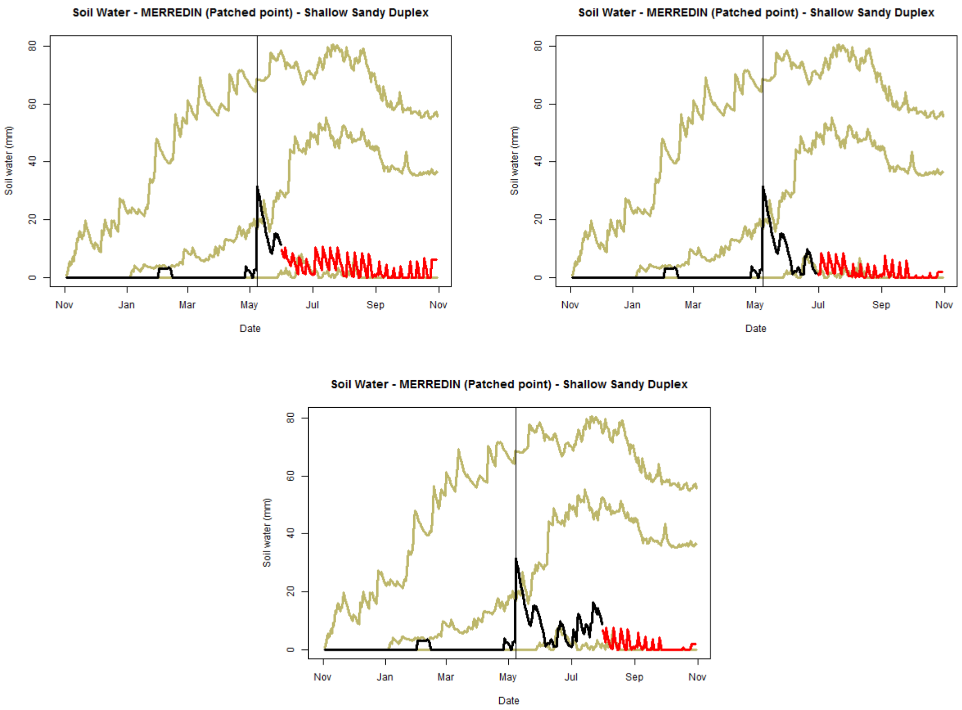

Figure 4: Plant available soil water with soil water forecasts from 1 June 2014 (top left), 1 July 2014 (top right) and 1 August 2014 (bottom). Soil water is shown in black, climatological soil water deciles in khaki and forecasts in red.

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Conclusion

Since growing season rainfall is often the limiting factor on crop growth and yield, understanding how rainfall forecasts can be used with seasonal decision tools can help growers make better decisions about crop management. This work has shown that combining rainfall forecasts with seasonal climate tools can provide insight into the amount of water available for crop use during the season.

References

Oliver, Y.M. and Robertson, M.J. (2008), Quantifying the benefits of accounting for yield potential in spatially and seasonally responsive nutrient management in a Mediterranean Climate.

Ritchie, J.T. (1972), Model for predicting evaporation from a row crop with incomplete cover.

Key words

Decision tools, forecasts, rainfall to date, soil water

Paper reviewed by: Jeremy Lemon