MALLEE CATCHMENT
TECHNICAL BULLETIN

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How climate change may affect sowing times and variety selection at Werrimull

Above: Wheat crop trial site in the Mallee. Photo: Mallee CMA.

Time of sowing has a big impact on the yield potential achieved by wheat crops growing in the low rainfall Mallee. Maturity length is a key attribute of wheat and Mallee farmers commonly use varieties that have short to mid season maturities.

A previous project undertaken in 2010 by Mallee Sustainable Farming (MSF), with funding from the Mallee Catchment Management Authority (CMA), showed that mid maturity varieties tended to have greater yield potential when sown early (start of May); however, as seeding was delayed (early and late June), switching to shorter maturity varieties improved yield outcomes in most seasons[1].

The aim of this study was to see what impact climate change may have on wheat production in the Mallee and to assess if time of sowing and variety selection could provide adaptation options for farmers seeking to mitigate the impact of climate change on production.

Modelling climate change

Agricultural Productions Systems Simulator (APSIM) was used to model wheat crop yields under possible future climate scenarios for 2030. The climate parameters (Table 1) were adjusted each year from 1960 – 2011.

Table 1: Climate scenarios used in the modelling.

	Mild	Moderate	High	Extreme
Temp	+1°C	+ 1°C	+ 1°C	+ 1°C
Rainfall	- 5%	- 10%	- 20%	- 40%
CO_2 (ppm)	420	420	420	420

Under medium Carbon Dioxide (CO_2) emissions, the average annual projections for the Mallee in 2030 are 0.9°C temperature increase and 4% rainfall decline[2].

At a glance

- This project models the impact climate change could have on wheat production in the Victorian Mallee;
- A warmer drier climate is likely to reduce yields at Werrimull; however, extent will depend on the year to year variability.

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mallee catchment management authority

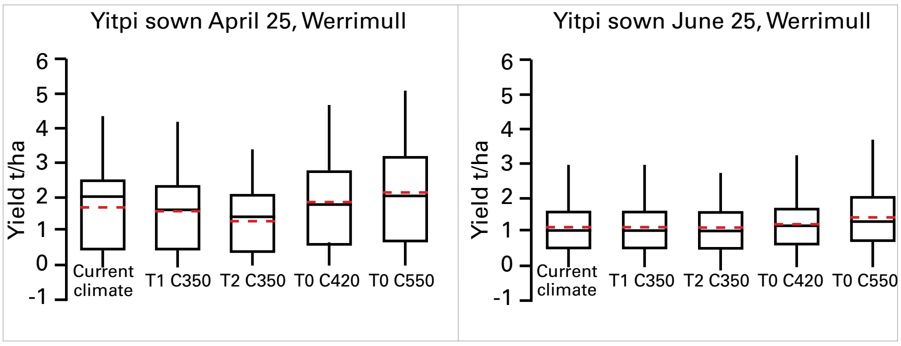

Figure 1: How climate variables of temperature (T1=1°C increase, T2=2°C increase and T0=no change) and CO_2 (C350=350 ppm CO_2 and C420=420 ppm CO_2 and C550=550 ppm CO_2) effect simulated wheat yields.

How sensitive is APSIM modelled yield to temperature and CO_2?

APSIM is very sensitive to a reduction in rainfall but when rainfall is not changed, temperature and CO_2 also have an impact. For Yitpi sown April 25 with CO_2 at 350ppm, an increase in temperature of 1-2°C will reduce yields. However this decrease was not evident with later sowing. In comparison to the current climate, an increase in CO_2 alone will only slightly increase production. Therefore CO_2 fertilisation is unlikely to significantly alter wheat yields in the Mallee in the short to medium term.

Will climate change impact yields by 2030?

A warmer and drier future under predicted climate change scenarios is expected to reduce crop yields at Werrimull (Figure 2). When simulated yields were averaged across all varieties (Axe, Mace and Yitpi) and sowing dates (25 of April, May and June), in comparison to the historic climate, yield reductions of 4% for the mild, 13% for the moderate, 32% for the high and 69% for the extreme climate change scenarios were estimated.

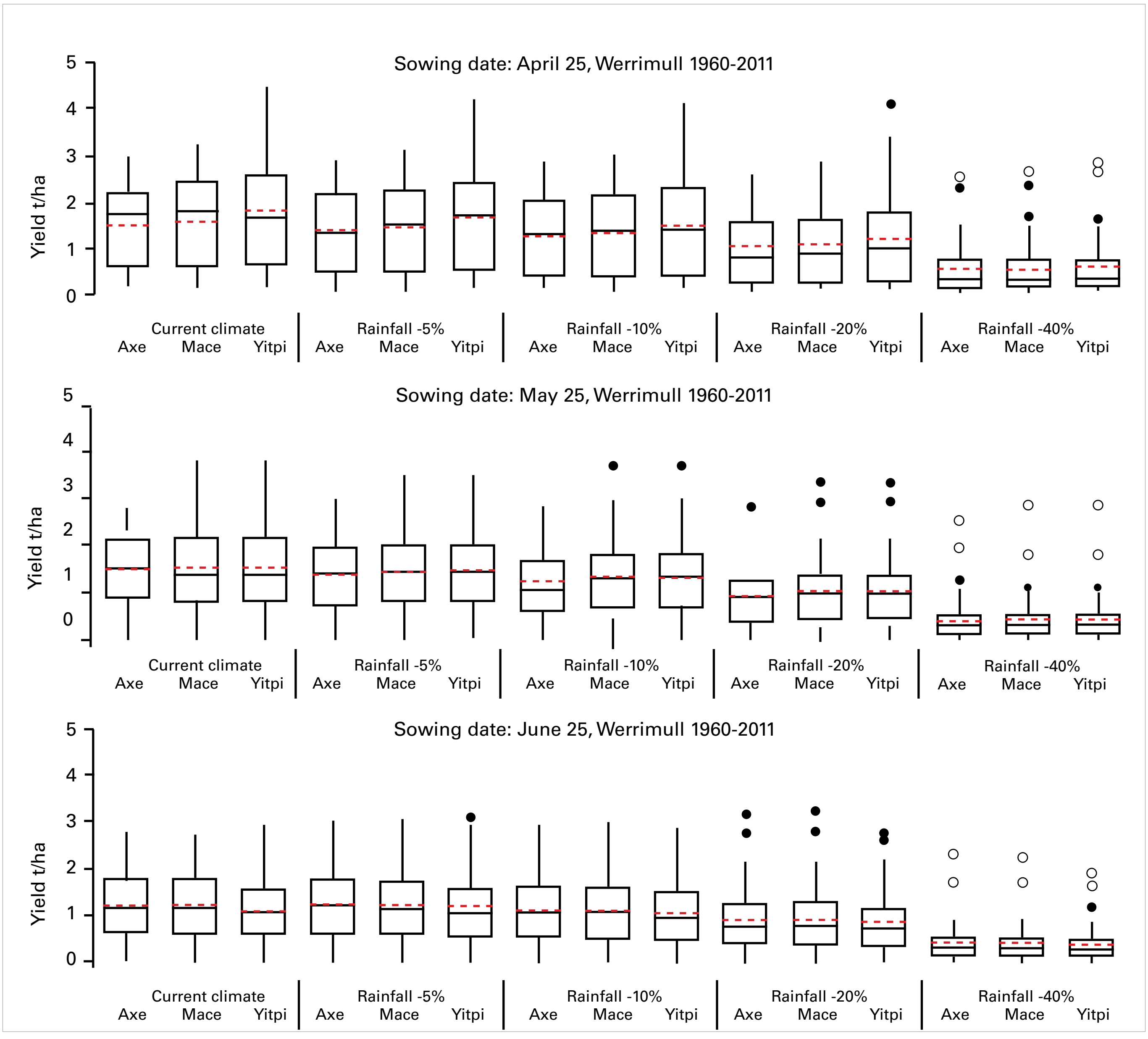

Figure 2: How possible future climate scenarios with a temperature increase of 1°C and a CO_2 concentration of 420 ppm coupled with a 5, 10, 20 or 40% decline in rainfall may affect the yield of Axe, Mace and Yitpi sown on the 25th of April, June or July at Werrimull.

A warmer drier future is likely to reduce crop yields, but the extent of reduction will depend on the year to year variability. For example in Figure 2, for Mace wheat sown on April 25th:

- The wettest year in four years (top 25%) has an estimated yield of 2.3t/ha in the current climate, however, under moderate climate change (10% rainfall decline) this yield is estimated to reduce to 2.1t/ha (11% less yield);
- The worst year in four (bottom 25%) corresponds to current yields of 0.5t/ha and is expected to drop to 0.3t/ha under moderate climate change (43% less yield).

Therefore the drier seasons under climate change are expected to show more reductions in yield compared to the wetter seasons at Werrimull.

Figure 3 shows climate change with a 20% decline in rainfall will result in a much greater chance of achieving yields of less than 1 t/ha than what is currently expected. Under the current climate at Werrimull, selecting a variety based on maturity length for different sowing times may result in increased yield potential. For example, sowing the longer season Yitpi variety will lead to an 18% yield increase over sowing Axe early (Figure 2). However, if sowing was delayed to the 25th of June, there would be an 8% yield advantage in using the shorter season varieties Axe in place of Yitpi.

Under all climate change scenarios, similar results were found for varieties with different maturity characteristics based on sowing date. Under the high climate change scenario with 20% less rainfall, Axe would again be expected to on average yield 15% less than Yitpi sown on the 25th of April. However when sown on the 25th of June, Axe would out yield Yitpi by 5% under a high climate change scenario.

Limitations

APSIM modelling captures the impact of temperature on crop development and moisture stress on yield for different sowing times. However, the interaction of sowing time with the risk of frost and heat shock is not well simulated. How the impact of extreme events will change in a changing climate is still very uncertain. Similarly there is low confidence in the prediction of rainfall seasonality. Climate models tend to predict a greater rainfall decline in spring rather than autumn, therefore different seasonal rainfall patterns may also affect APSIM predictions.

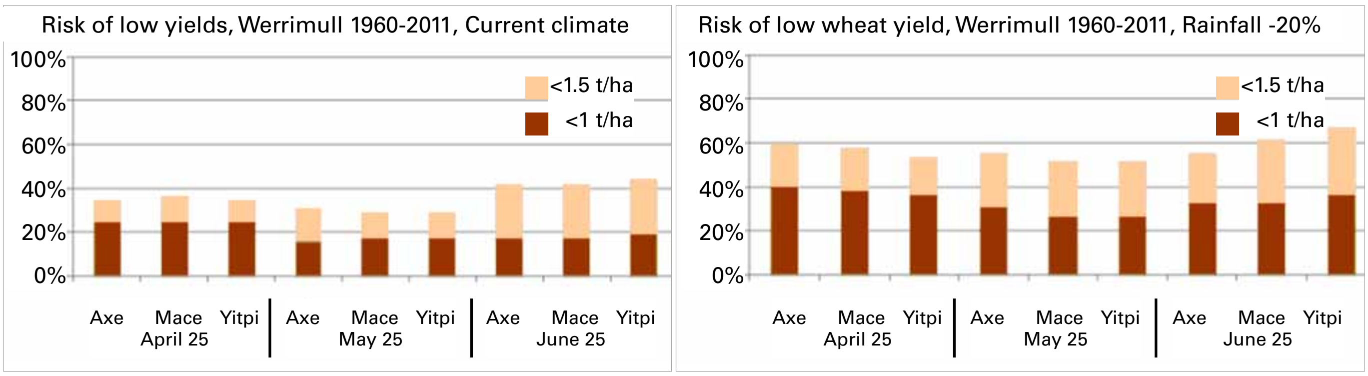

Figure 3. The probability of yields of less than 0.5 or 1 t/ha under the current climate (left) and a high climate change scenario with a temperature increase of 1°C, a CO_2 concentration of 420ppm and a 20% decline in rainfall (right).

Above: Mallee trial site. Photo: Mallee CMA.

Summary

- Wheat yield reductions of 13% or less are expected under mild and moderate climate change scenarios (rainfall decline of 5-10%) at Werrimull while high and extreme climate change scenarios (rainfall decline 20-40%) could reduce yield by approximately 25-70%;
- Yield reductions under predicted climate change will be most severe in the drier growing seasons resulting in a greater proportion of seasons where yields are less than 1 t/ha;
- Utilising varieties with different maturity lengths based on sowing date is important under the current climate, and will continue to be important under expected climate change conditions.

Further information

Further information, including a copy of the original project report is available from the Mallee CMA website at:

www.malleecma.vic.gov.au

Acknowledgements

Mallee Sustainable Farming was engaged by the Mallee CMA to undertake this project, with funding provided by the Victorian Government.

Peter Hayman and Bronya Alexander of South Australian Research and Development Institute (SADRI) Climate Adaptations Unit contributed to the modelling of this project.

[1] *MSF (2011) Impereal variety options for increased groundcover, Unpublished report for the Mallee CMA, (Mildura: Victoria)*

[2] *www.climatechange.vic.gov.au*

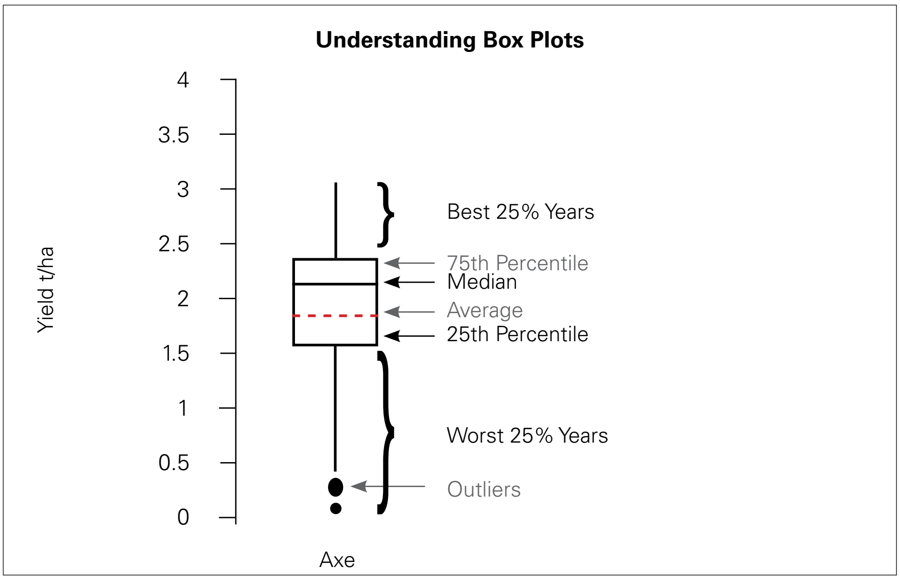

Figure 4: Understanding box plots.

Above: Mallee Sustainable Farming Field Day - trial site. Photo: Mallee CMA.

Project Partners

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