

Yield Prophet® Periodical

Maximising Profit — Minimising Risk

October 2008

Introduction

Welcome to the second edition of the Yield Prophet Periodical. In this edition we will focus on the new climate change report, and provide some interpretation of an example from Birchip, in north western Victoria. We would also like to remind you that we are very happy to receive any questions or comments relating to this document and Yield Prophet. This will enable us to address any specific questions that you may have.

★ *New climate change report* ★

The end of the 2008 cropping season is rapidly approaching and once again the majority of cropping regions in Australia have received well below average spring rainfall. Another poor year raises questions about the future and the effect climate change may have on crop production in your region. As a result, the Yield Prophet team is pleased to advise that a climate change report is now available to Yield Prophet subscribers. This report allows you to see the effect of climate change on yields for current Yield Prophet paddocks.

With the exception of nitrogen inputs, the report uses the soil and crop information pertaining to the 2008 paddock selected e.g. the sowing date for the 2008 crop will be used as the basis for simulations in the climate change report.

Section 1 of the climate change report relates to the impacts of historic climate variability on potential grain yields. Figure 1

shows historic potential yield, given unlimited nitrogen and the phenology of modern crop varieties. The blue bars represent the potential yield of the crop in each year since 1889 based on the climate data from the BOM station selected. The black line denotes the 10-year rolling average yield of the crop.

Table 1: Yield Prophet climate change report details

Location	Birchip	Soil Type	Clay Loam (Culgoa)
Crop	Wheat	Weather Station	Birchip Post Office
Variety	Yitpi	Stubble Type	Wheat
Sowing Date	10 May	Stubble Quantity	1,000kg/ha
Plant Density	150plants/m ²		

It is evident from Figure 1 that there has been significant variation in the potential yields over the 119 year period with simulated yields ranging from 0 t/ha to 7 t/ha.

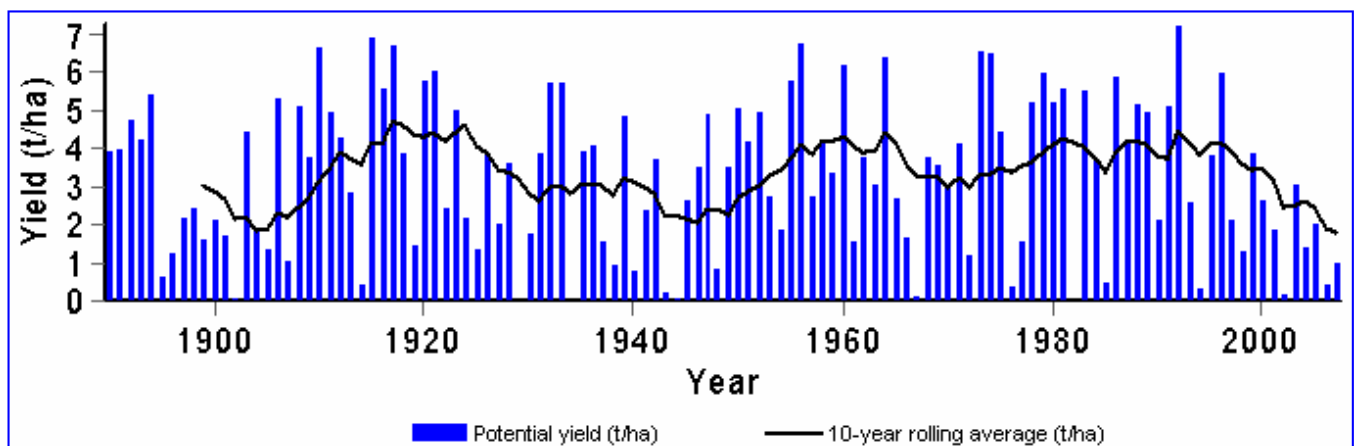


Figure 1: Historic potential yield (nitrogen unlimited) of the current crop

It is also apparent from the rolling average that there have been periods of consecutive years of both high and low yield potential. Interestingly, the current ten year period is not yet as bad as the 1895 to 1905 and 1936 to 1946 periods. However, when the 2008 yields are incorporated into the report this may not be the case.

Section 2 of the climate change report focuses on the impacts of recent climate change on grain yield. Most of Australia has recorded a warming trend (as well as rising CO₂ levels) over the last 50 years. By comparing the yield potential over the last 30 years with that of prior years, it is possible to get an impression of whether climate change has already had an impact on your yield potential.

As there is little difference between the potential yields from 1889 to 1976 and 1977 to 2007 (Figure 2), it is evident that climate change has to date had minimal effect on the potential yield of this crop. The slight discrepancies at the 60% (a) and 30% (b) probabilities could be due to the small sample size (30 years) of the recent probability distribution curve. The 'gateway' year of 1977 is used as there is a consensus in the scientific commu-

nity that some effect of climate change became apparent.

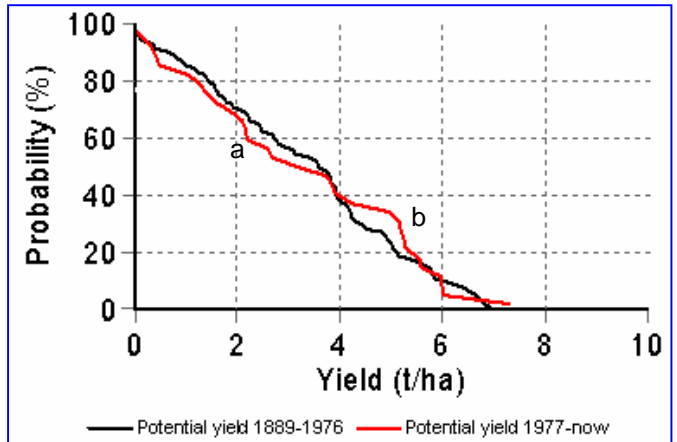


Figure 2: Comparison of the potential yield from 1889 to 1976 versus the potential yield from 1977 to 2007 of the current crop.

Section 3 of the climate change report shows the potential change in temperature and rainfall based on two climate change scenarios relative to the 1889 to 2007 period. The 'best case' scenario is based on low emissions and a climate model with low sensitivity to increases in CO₂. The 'worst case' scenario is based on high emissions and high climate sensitivity.

Climate Change Scenarios from CSIRO's OzClim website (www.cmar.csiro.au/ozclim)

CO2	Best case Based on low emissions and low climate sensitivity		Worst case Based on high emissions and high climate sensitivity	
	420 ppm	460 ppm	Temperature	Rainfall
Jan	0.8 °C	2.2 mm	1.2 °C	0.0 mm
Feb	0.7 °C	1.4 mm	1.0 °C	0.1 mm
Mar	0.6 °C	0.4 mm	1.2 °C	-1.9 mm
Apr	0.6 °C	-0.3 mm	1.0 °C	0.4 mm
May	0.5 °C	0.0 mm	0.9 °C	-1.7 mm
Jun	0.5 °C	0.3 mm	0.9 °C	0.4 mm
Jul	0.4 °C	-1.0 mm	0.9 °C	-5.0 mm
Aug	0.4 °C	-1.5 mm	1.0 °C	-9.1 mm
Sep	0.4 °C	-2.3 mm	1.3 °C	-15.9 mm
Oct	0.6 °C	-4.0 mm	1.4 °C	-8.1 mm
Nov	0.7 °C	0.6 mm	1.1 °C	0.2 mm
Dec	0.8 °C	1.7 mm	1.1 °C	0.5 mm

Figure 3: 2030 climate change scenario for the Birchip Post Office BOM station from the CSIRO's OZCLIM website (www.cmar.csiro.au/ozclim)

The CO₂ emissions under these scenarios were determined at the second International Governmental Panel on Climate Change (IPCC) assessment report in 1995. It should be noted that CO₂ emissions in 2008 are exceeding the 1995 'worst case' forecast, a consequence of the strong global economic growth over recent years and the lack of a co-ordinated mitigation response.

Under the 'worst case' scenario, if CO₂ emissions continue at the 1995 rate, by the year 2030 the estimated atmospheric CO₂ concentration will reach 460 parts per million (ppm). If CO₂ emissions are mitigated, the estimated 'best case' scenario for the atmospheric CO₂ concentration is forecast to be 420 ppm by 2030.

The atmospheric CO₂ concentrations from each scenario are then provided as inputs to different general circulation models (GCMs) to determine the change in temperature and rainfall at the location of the given weather station location, in this case the Birchip Post Office. GCMs are computer models used for weather forecasting, understanding climate and projecting climate change.

Figure 3 shows that the Birchip Post Office weather station, under the 'best case' scenario, will experience a slight (< 1°C) increase in temperature across each month relative to the 1889 to 2007 period. The concurrent change in rainfall has small but noteworthy deviations in both directions, with increases in

rainfall over the summer months and decreases over winter and spring. The net change in annual rainfall is estimated to be a decrease of 2.5 mm.

Given the worst case scenario, estimated increases in temperature in each month will be slightly larger than those in the 'best case' scenario (Figure 3). The largest increase in temperature is estimated to occur in October with a 1.4°C change. Of greater note is the predicted effect on rainfall the 'worst case' scenario is forecasting

The net change in annual rainfall is estimated to be a decrease of 41.1 mm, with the majority of this change expected to occur in late winter and spring. However, it is important to note that higher atmospheric CO₂ may partially compensate for warmer temperatures and lower rainfall provided adequate nitrogen is available.

The output shown in Figure 4 uses the temperature and rainfall results in Figure 3 to generate three probability of exceedence curves for comparison. As the historic and 'best case' scenario probability of exceedence curves are relatively similar, it can be assumed that yields comparable with the past would be realised under this scenario.

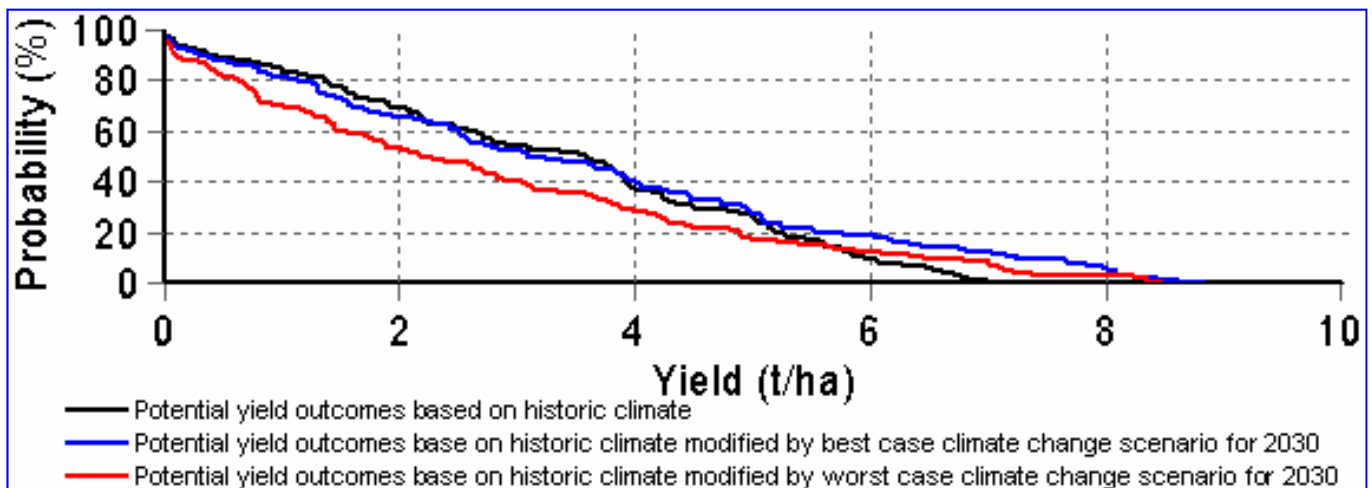


Figure 4: Impact of climate change scenarios at the Birchip Post Office weather station on the potential yield (nitrogen unlimited) of the current crop

<i>Percentage of years in which frost occurs</i>	Climate Scenarios		
	Historic	Best case	Worst case
Mild Minimum temperature between 2 and 0°C during flowering (Z60-69)	25%	32%	21%
Moderate Minimum temperature between 0 and -2°C during flowering and early grain fill (Z60-75)	4%	8%	4%
Severe Minimum temperature less than -2°C during flowering and grain fill (Z60-79)	0%	0%	0%
<i>Percentage of years in which heat shock occurs during grain fill (Z70-79)</i>			
	Historic	Best case	Worst case
Mild Maximum temperature between 32 and 34°C	31%	26%	25%
Moderate Maximum temperature between 34 and 36°C	13%	8%	12%
Severe Maximum temperature above 36°	9%	9%	6%

Figure 5: Impact of climate change scenarios on frost and heat shock for the current crop

However, if the 'worst case' scenario eventuates it is apparent that crop yield would be reduced. It is important to remember that these outputs relate to current farming practices and varieties. With slight adjustments to these, the reduction in potential yield under the 'worst case' scenario may be compensated for.

Using the 'historic' 'best case' and 'worst case' simulations from Figure 4, Yield Prophet evaluates the likelihood of frost and heat shock on the crop (Figure 5). When analysing these results it is interesting to note that despite the average increase in temperature under the 'best case' and 'worst case' scenarios, the number of frost events increases and the number of heat shock events decreases compared to the 'historic'.

This seems to be a counterintuitive result, but is explained by the increase in winter temperatures causing the crop to mature faster. This results in the crop flowering at an earlier time of the year, which exposes the crop to a greater chance of a frost event. Similarly, the fast growth causes the crop to reach grain filling earlier in the year reducing its exposure to heat shock.

Another interesting observation is that as the crop matures faster, it reduces the growing season of the crop which limits exposure to the forecast reduction in spring rainfall under the 'worst case' scenario. However, under this scenario the reliance on winter rainfall becomes more pronounced. These changes will force growers to make adjustments to their agronomic decisions and explore different techniques to compensate.

An obvious response to the forecast changes in the climate change report is to adapt our agronomic practices e.g. sowing date. Under climate change it may be beneficial to sow crops earlier than we do now. Even though this may increase exposure to frost, it may become a viable management option if frost resistant crops are available.

Yield Prophet® Insight

Climate adaptation report

Currently, the Yield Prophet team is working on a climate adaptation report. This report is an extension of the current climate change report. In this report, you will be able to compare current practices with adapted practices under three different climate change scenarios, 'best case', 'moderate' and 'worst case'.

This report will allow you to adjust your crop, variety, sowing date, sowing density, starting nitrogen, starting moisture, and nitrogen, irrigation, stubble management and tillage applications. We hope that this report will be available early in the new year.

Soil Characterisations

The accuracy of Yield Prophet is largely dependent on having correct soil characterisations for your paddocks. If you are interested in measuring the crop lower limit (CLL) of your soils, now is a good time to be undertaking these measurements. The measurement of the CLL usually requires the construction of a rainout shelter. However, as rainfall has been limited in some areas, this may not be required.

If your crops have not received a significant rainfall event (>10 mm) since they matured, all that may be required is for a soil core to be taken down to 1 meter and broken up into four parts (e.g. 0-10cm, 10-30cm, 30-60cm, 60-90cm and 90-120cm) and soil moisture measured for each section. If you are unsure of methodology, please contact us and we will provide you with details.

Simulation validation

The end of the season is rapidly approaching and harvest is not very far away in some locations. This becomes a very important time of the year for Yield Prophet. It is the time when we compare Yield Prophet simulations with the actual yields achieved in the paddock.

When your harvest results are known please enter this information to the 'Results' page in the 'My Paddocks' section of the website. Please ensure that you note any external factors (eg, frost, disease, insects, water logging, weeds ...) that may have affected your crop's yield in the 'Additional Factors' window. This will help us with the final validation of results for 2008.

If your simulated yields do not match up with your actual yields and you cannot account for the discrepancy, we would encourage you to contact us so that we can work together to identify the problem. This process is very important as it enables us to identify problem areas and improve your simulations in future years.

Fallow monitoring and stubble management reports

We also remind you of the availability of the fallow and stubble management reports. The fallow report allows you to track paddock soil water and nitrogen following harvest up until sowing next year. The stubble management report enables you to compare and monitor soil moisture and nitrogen levels under different management scenarios.

Instruction Manual

There have been a number of requests for an instruction manual. We will endeavour to have this available as soon as possible. In the meantime we would like to remind you that as part of your subscription you are entitled to call the help line (0400 090 659) if you have any issues.

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