

Heat Stress and Frost Risk in Irrigated Wheat Crops

ICC GRDC Irrigated Update Moama

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Which is worse,
frost damage or heat damage?



N Gregory



Which is worse, frost damage or heat damage?



N Gregory

Missing heads

Missing grains

Shriveled grain

Up to 100% worst case loss

Often hard to tell when less than
15% loss

Complex with drought stress



Which is worse, frost damage or heat damage?



Head tipping

Cooked crop

stress

Loss of the 3rd, 4th or 5th grain in the floret

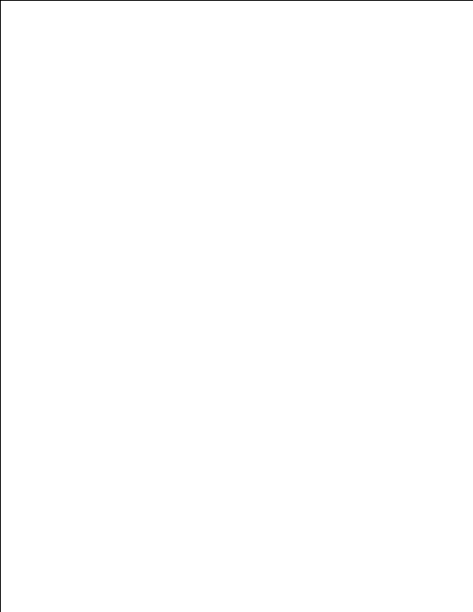
Complex with drought

Smaller or at worst shrivelled grain.

% loss? Rarely 100% but often hard to tell.

Why? Decreases the length of grain filling. Each 1°C over 30°C is 3 days less.

More importantly which is most likely,
frost damage or heat damage?



2.2°C in here



?°C up here



1.5m high

0°C down here

What We Did

We chose 5 sowing dates starting at ANZAC Day and roughly every 10 days after that, 25th April, 10th May, 25th May, 10th June, 25th June

We “sowed” Janz wheat on those dates in the Yield Prophet® program that uses the APSIM model. Prewatered and 2x spring
It then gave us the average flowering period for wheat over a 100 years.

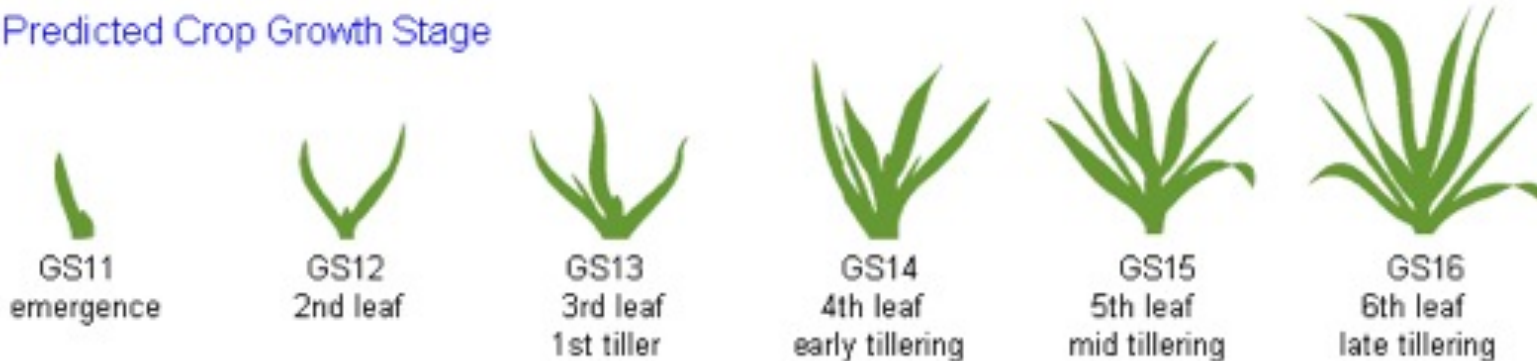
We decided to look at all frosts below +2°C
And at moderate to heavy frosts below 0°C
5 days before or 15 days after flowering

We decided to look at all heat stress above +30°C
And at moderate to harsh heat stress above +34°C
In the grain fill period 30 days after flowering.

We then counted the numbers of days historically where frost and heat at these temperatures and flowering dates could have affected the crop.

Death by Excel spreadsheet.

Simulated and Predicted Crop Growth Stage



Predicted

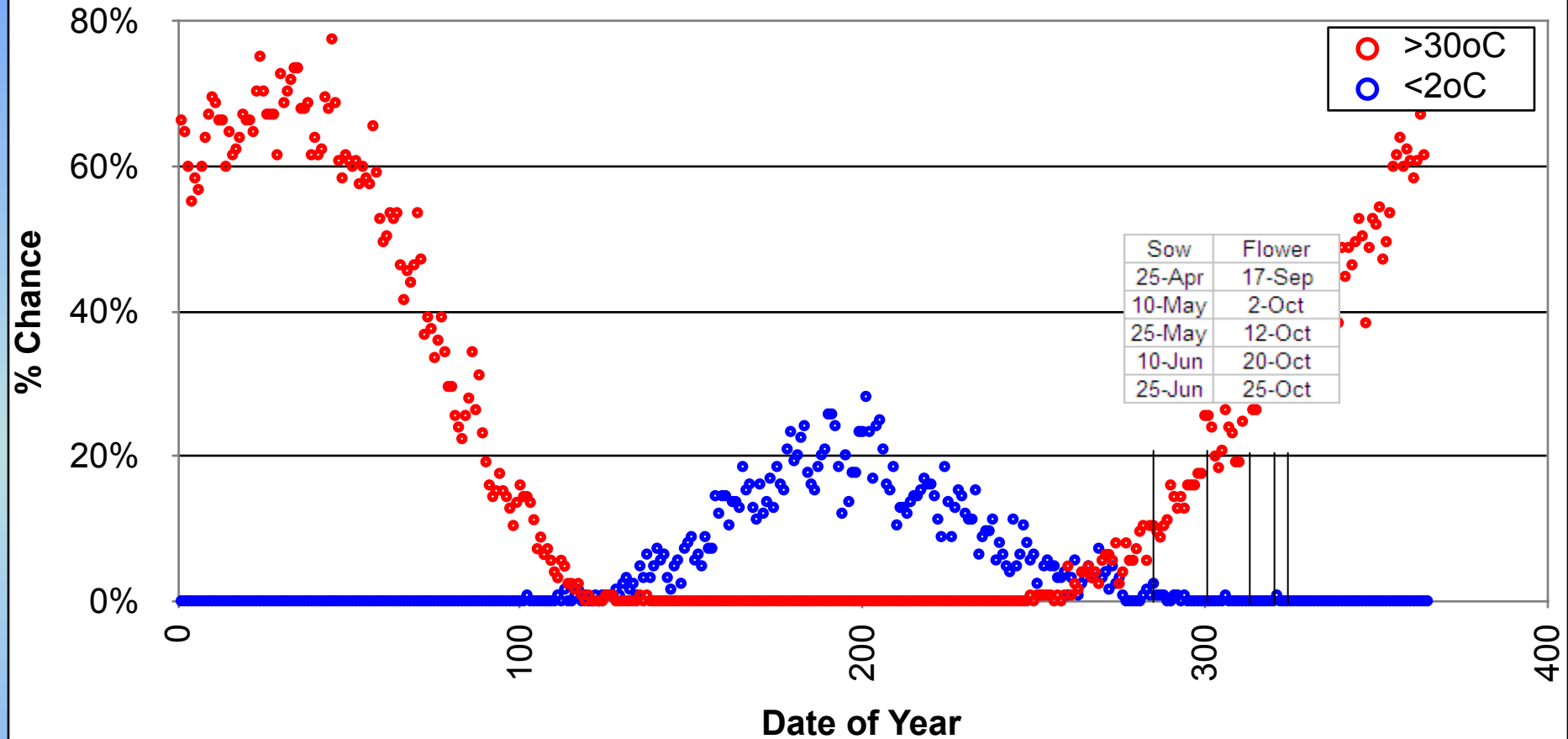
Earliest	18-May	30-May	9-Jun	19-Jun	30-Jun	8-Jul
Median	18-May	30-May	9-Jun	19-Jun	30-Jun	9-Jul
Latest	18-May	30-May	9-Jun	19-Jun	30-Jun	10-Jul



Predicted

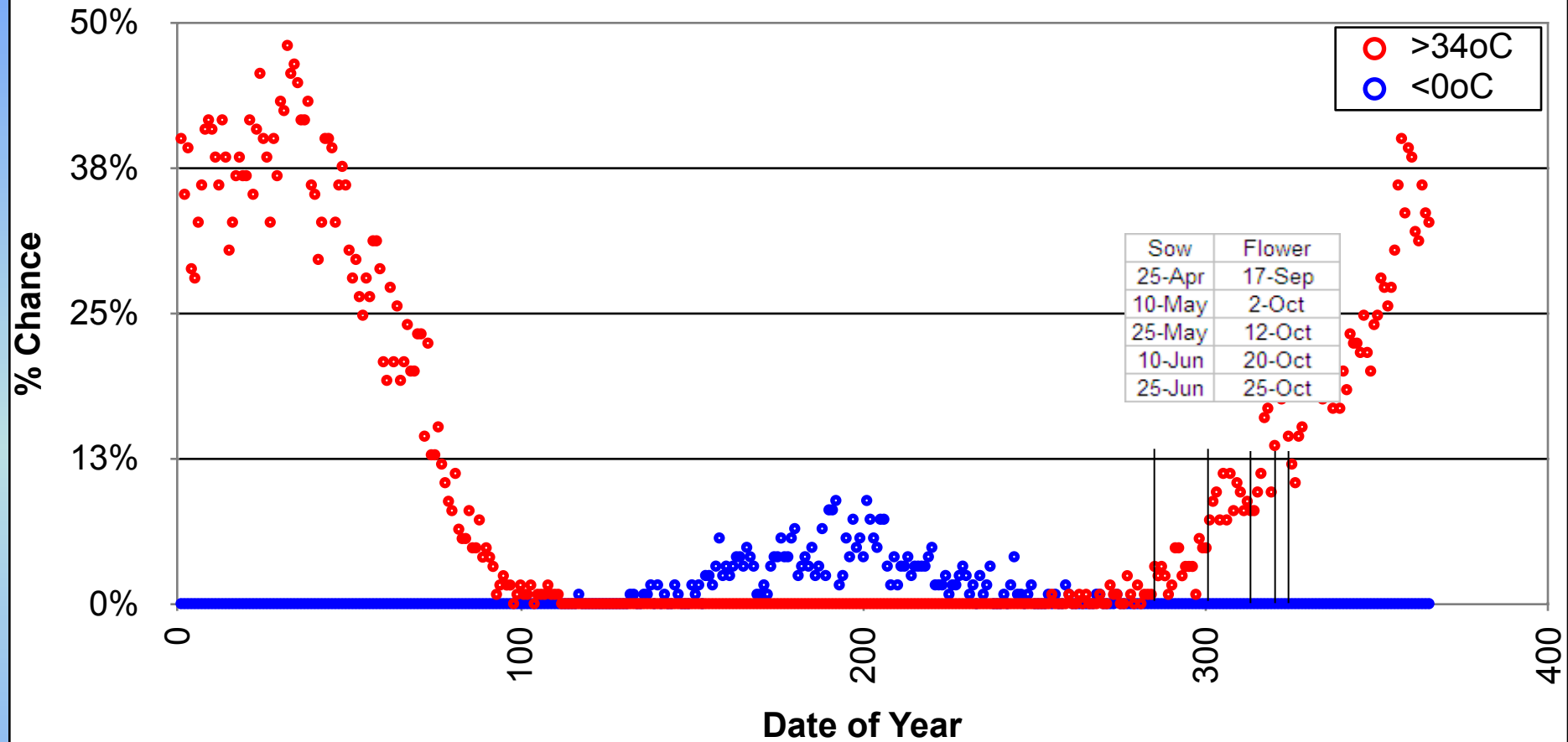
Earliest	3-Aug	8-Aug	12-Aug	25-Aug	30-Aug	6-Sep	13-Sep	22-Sep	10-Oct
Median	9-Aug	14-Aug	18-Aug	30-Aug	4-Sep	12-Sep	22-Sep	2-Oct	19-Oct
Latest	15-Aug	18-Aug	23-Aug	6-Sep	10-Sep	20-Sep	2-Oct	12-Oct	30-Oct

Frost and Heat Risk Distribution



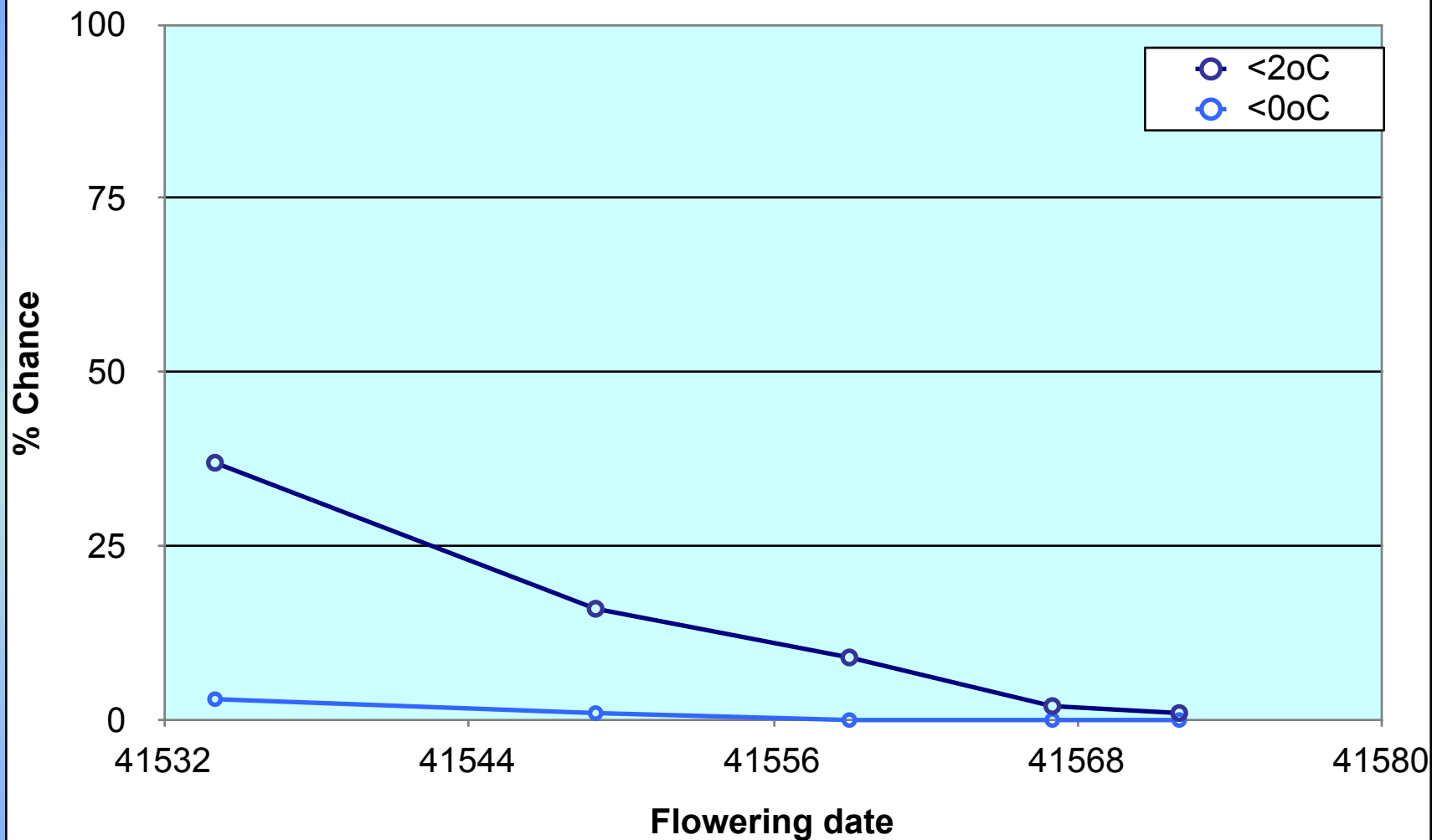
2 week period where the daily risk of either is less than 5%
Between 10-25 September

Frost and Heat Risk Distribution

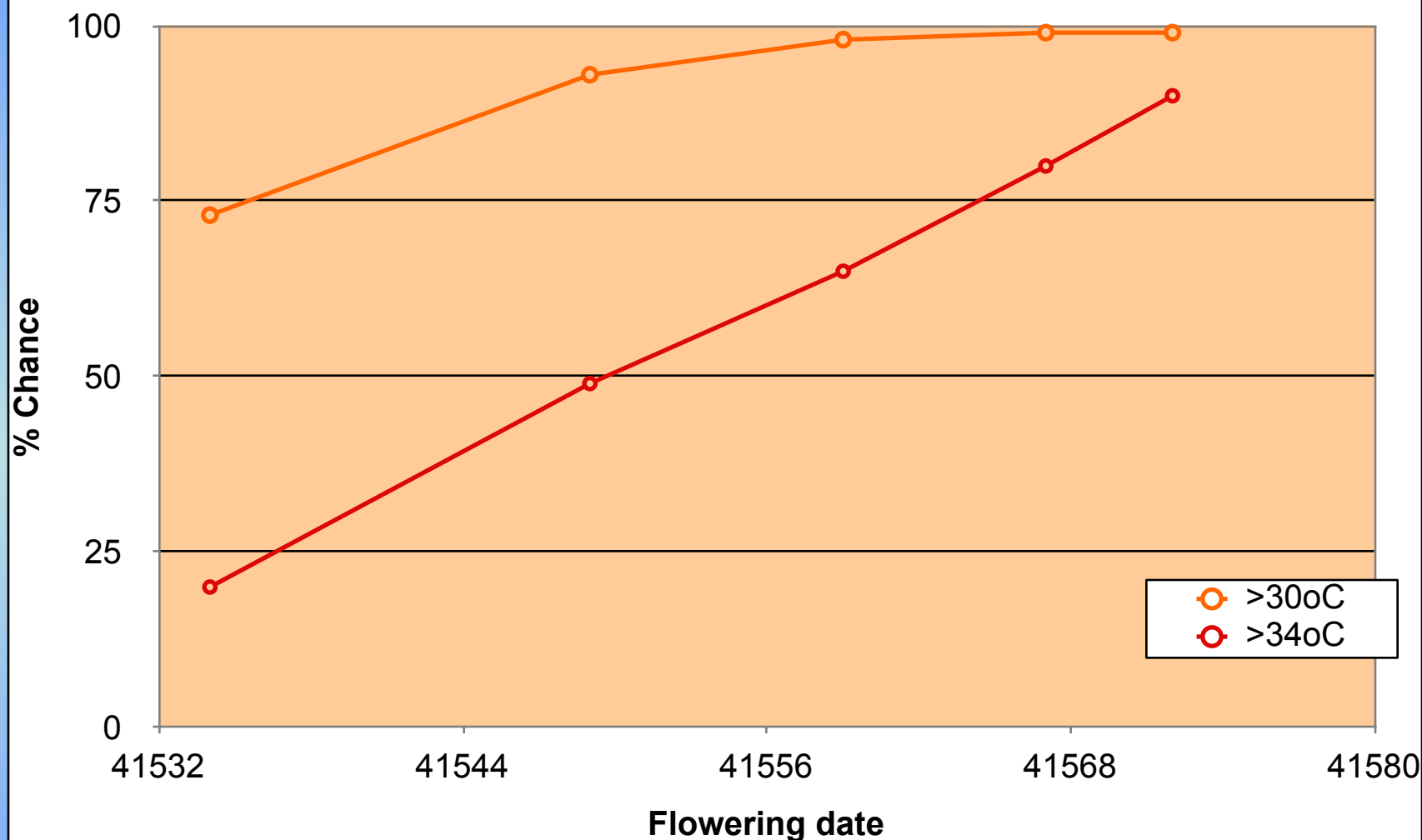


Negligible frost risk at normal sowing times.

% Chance of frost happening near flowering



% Chance of heat shock during grain fill



In a nut shell



At Deniliquin

The chance of minor frost at the earliest sowing date was significant.
The chance of moderate to major frosting is negligible at all times

Choosing sowing dates based on frost risk alone would seem to be unnecessary.

The chance of minor or worse heat shock is a very common even at the earliest sowing date. Becoming almost certain at later sowing dates
The chance of moderate to major heat shock is minor at the early sowing date but rises dramatically to almost certain at the later dates.

More attention to matching flowering windows to avoid heat is needed.

THANKYOU



Deniliquin	Flowering date	% Chance of a frost near flowering	Median No. days in years with frost	Range in No. of days	% Chance of heat at grain fill	Median No. days in years with heat	Range in No. of days
Sown 25 April							
0°C, 34°C	17 Sept	3	1	1-3	20	1	1-3
2°C, 30°C	17 Sept	37	1	1-6	73	2	1-9
Sown 10 May							
0°C, 34°C	2 Oct	1	1	1	49	2	1-6
2°C, 30°C	2 Oct	16	1	1-3	93	4	1-15
Sown 25 May							
0°C, 34°C	12 Oct	0	0	0	65	2	1-9
2°C, 30°C	12 Oct	9	1	1-3	98	6	1-17
Sown 10 June							
0°C, 34°C	20 Oct	0	0	0	80	3	1-15
2°C, 30°C	20 Oct	2	1	1-2	99	8	1-23
Sown 25 June							
0°C, 34°C	25 Oct	0	0	0	90	3	1-16
2°C, 30°C	25 Oct	1	1	1	99	8	1-22