



Department of
Agriculture and Food



GRDC Grains Research &
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Role of stubble management on the severity and duration of frost

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February 2014



Outline

- How stubble increases the severity and duration of frost
- The position in the landscape on frost severity
- Yield and quality impacts



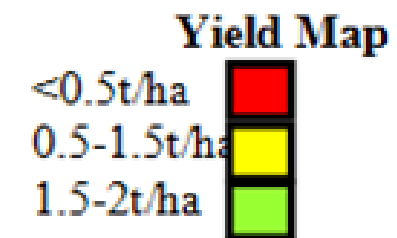
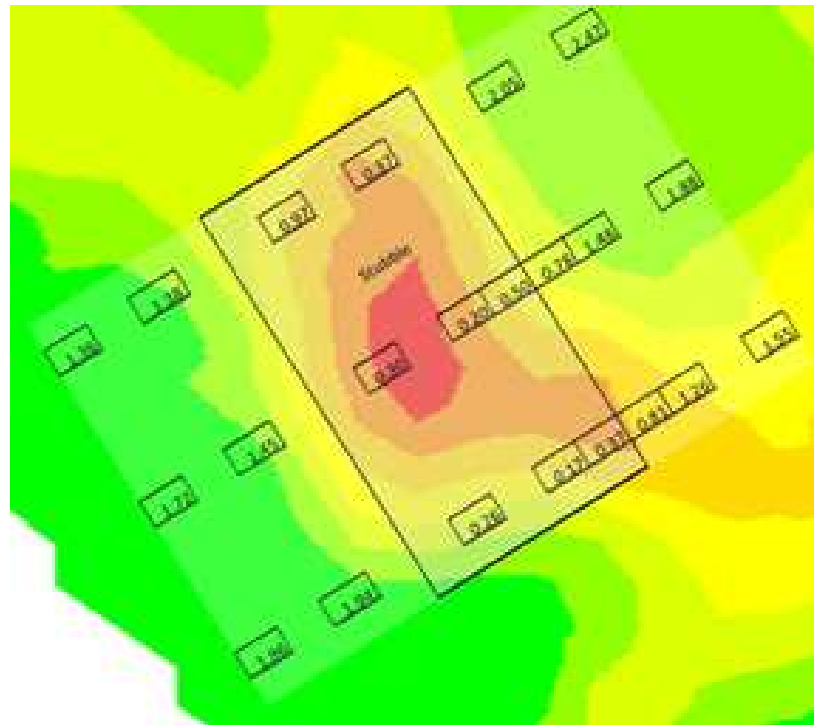
2012 Research

- Standing stubble:
- Treatments were 1°C colder
- Total time below 0 degrees is longer (9 hours vs 8 hours)
- Lower yield (0.39t/ha vs 1.71t/ha)



2012 Research

- PA trials in York



2013 Aims

To quantify the impact of stubble on the extent, severity and duration of frost and determine its effect on canopy temperature and grain yield.

- Retaining stubble increases frost severity = Decreased yield
- Retaining stubble increases duration of frost

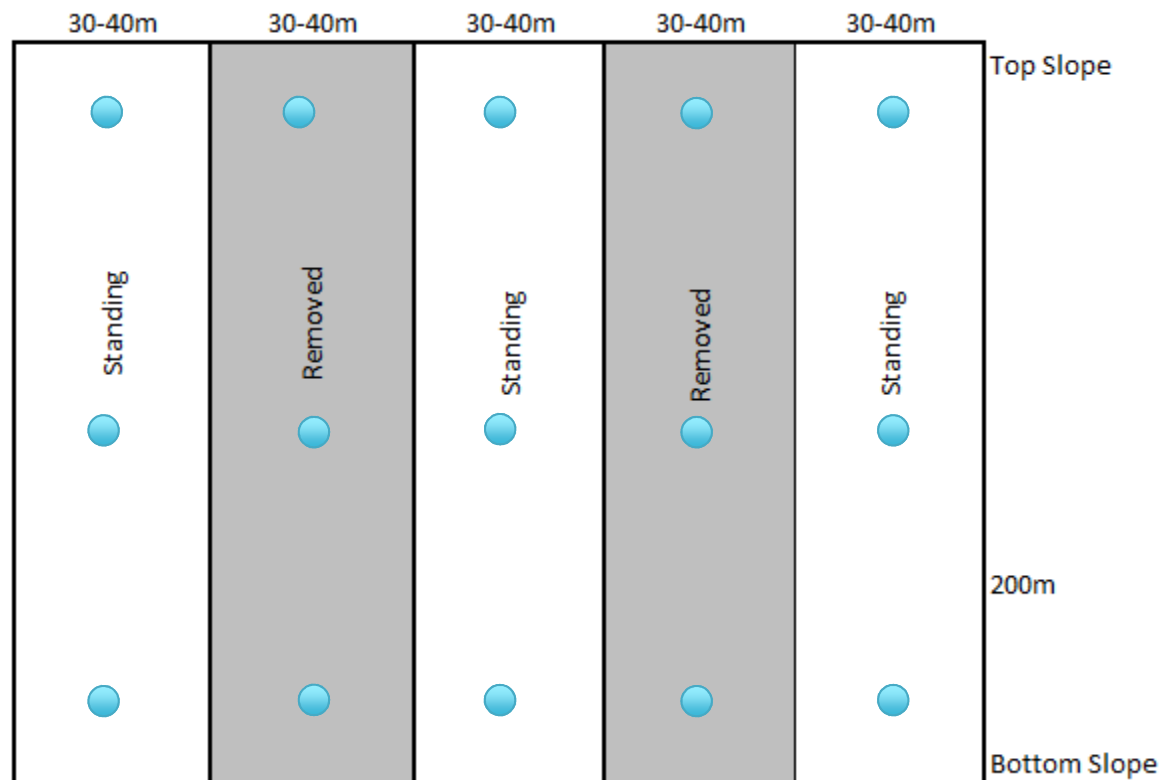


Method

- Large scale replicated trials
- Three locations: Nyabing, Wickepin & York
- Two main treatments
 - Standing and removed stubble
- Placement of tiny tags along the slope



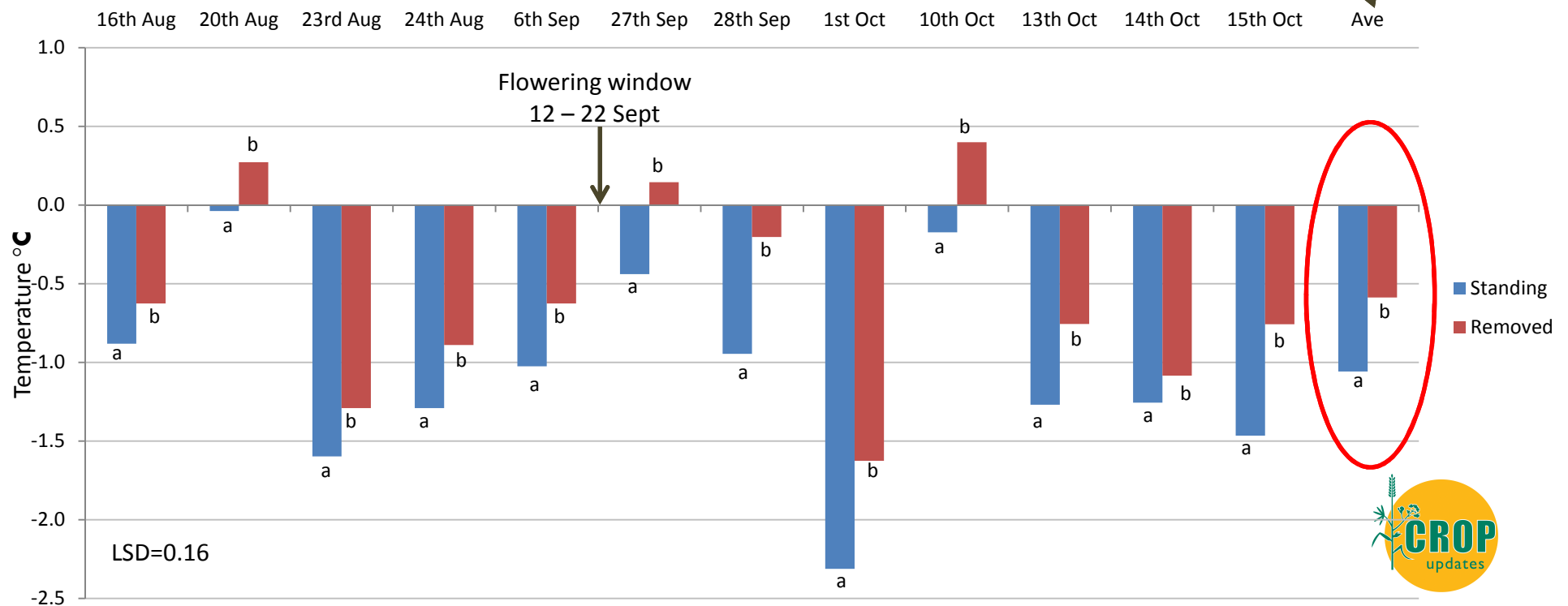
York & Wickepin



Results: York

Frost Severity

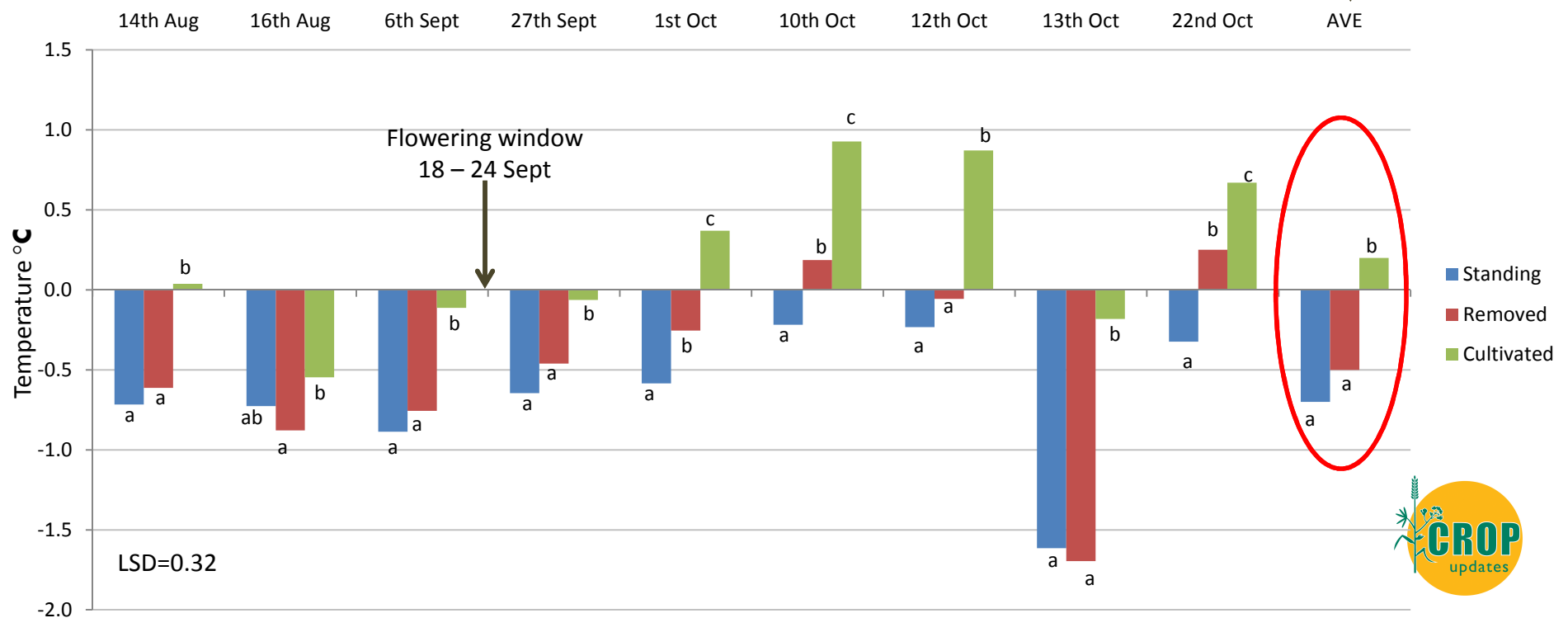
AVERAGE
Standing: -1.1°C
Removed: -0.6°C



Results: Wickepin

Frost Severity

AVERAGE
Standing: -0.7°C
Removed: -0.5°C
Cultivated: 0.2°C



Nyabing

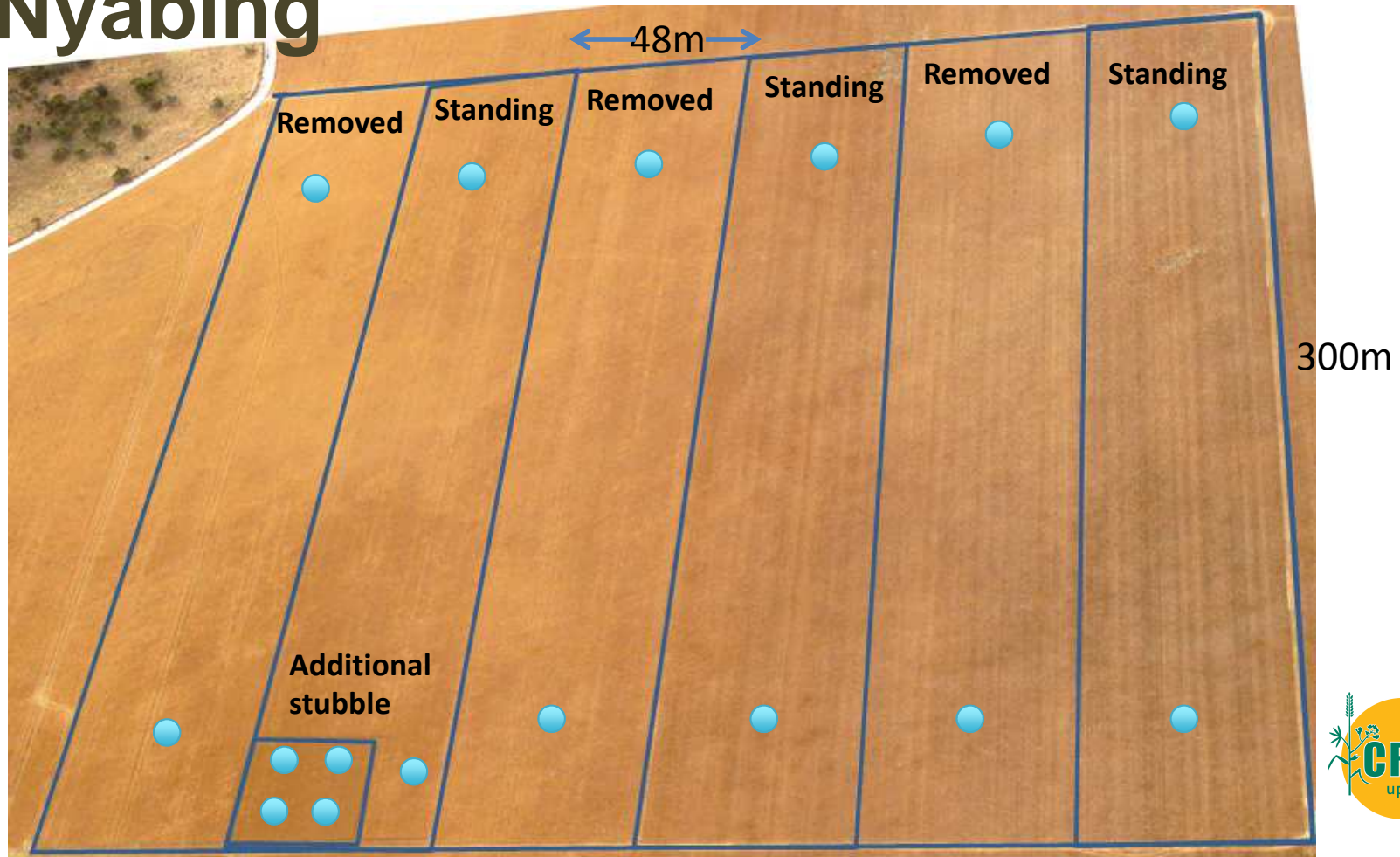


Photo: Steve Curtin



Nyabing



Raked Stubble Plot (0.5t/ha)



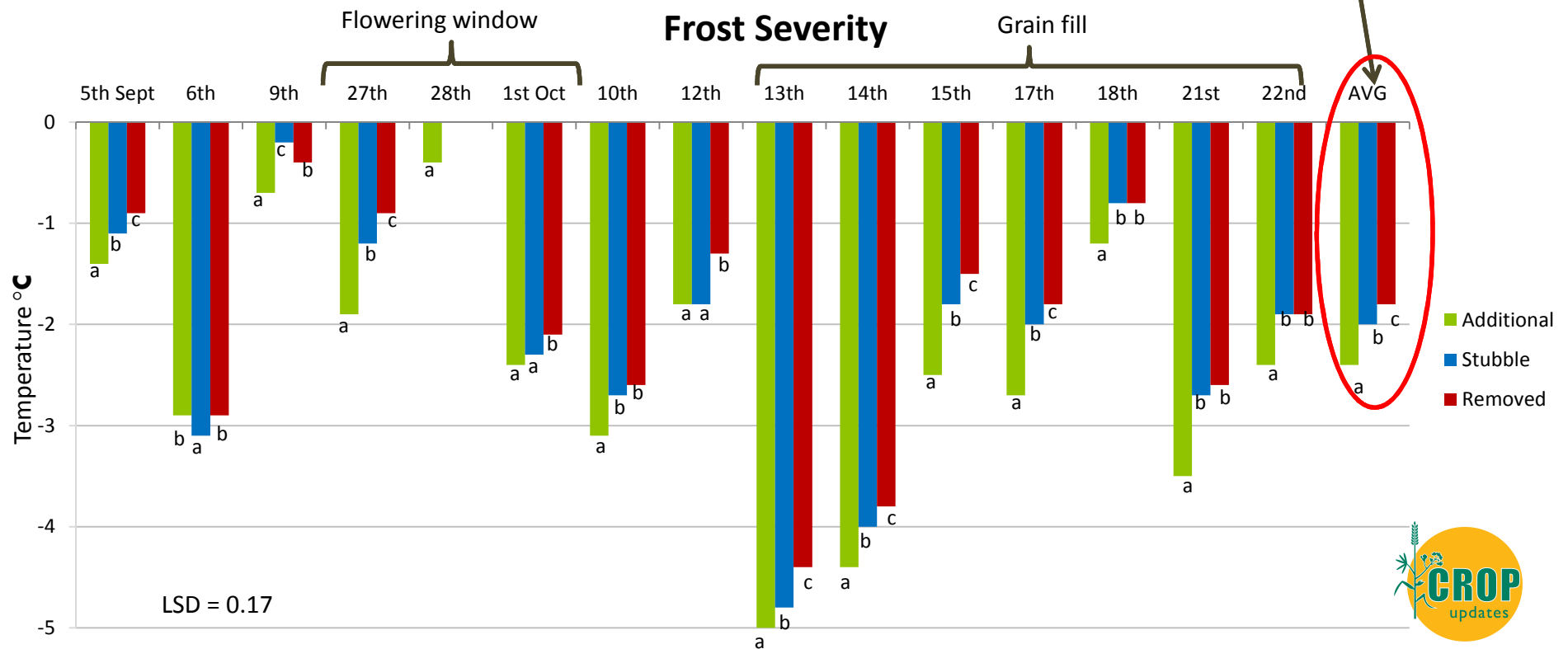
Additional Stubble Plot (3.5t/ha)



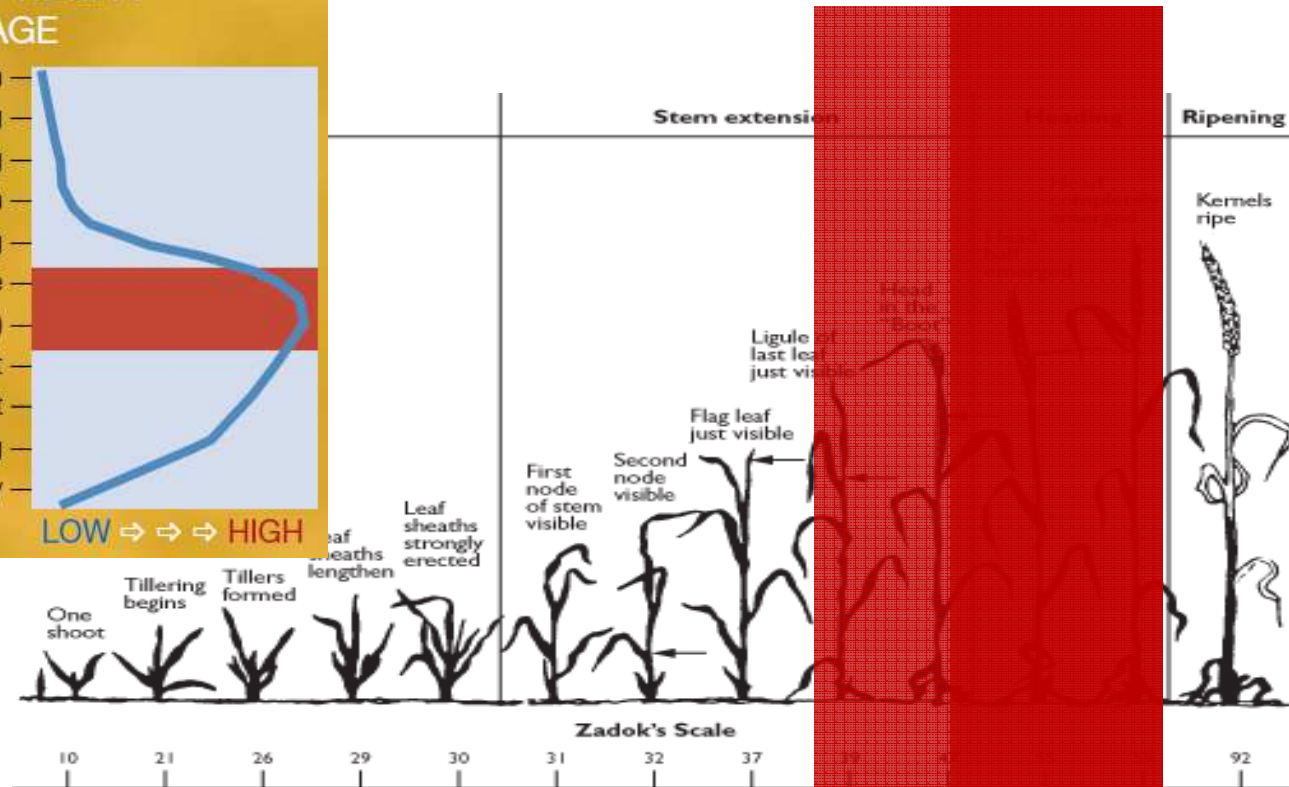
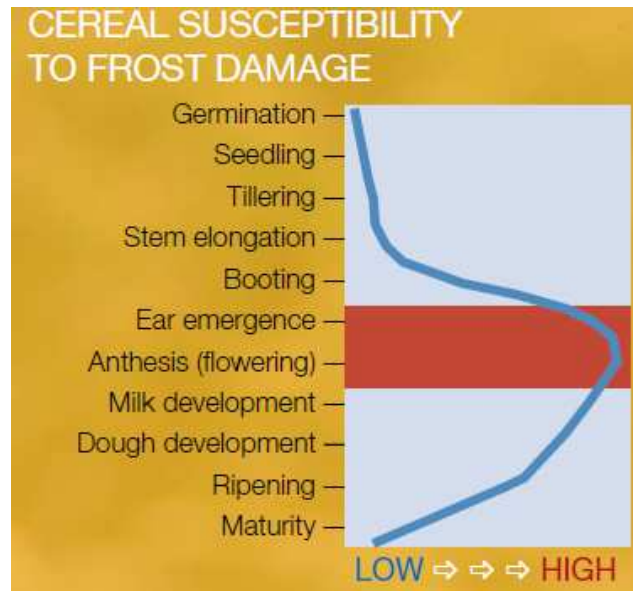
Photos: Fiona Martin

Results: Nyabing

AVERAGE
Additional: -2.4°C
Standing: -2°C
Removed: -1.8°C

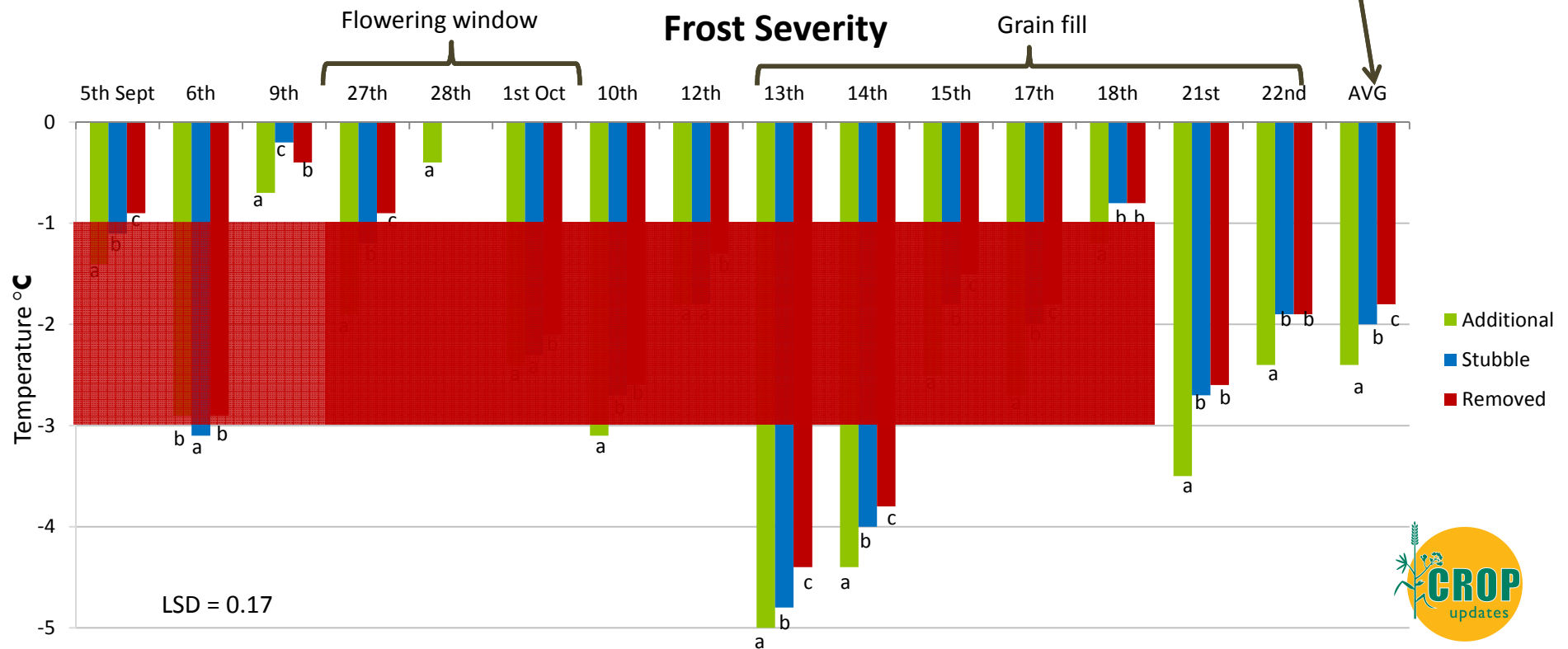


Frost and cold susceptible stages

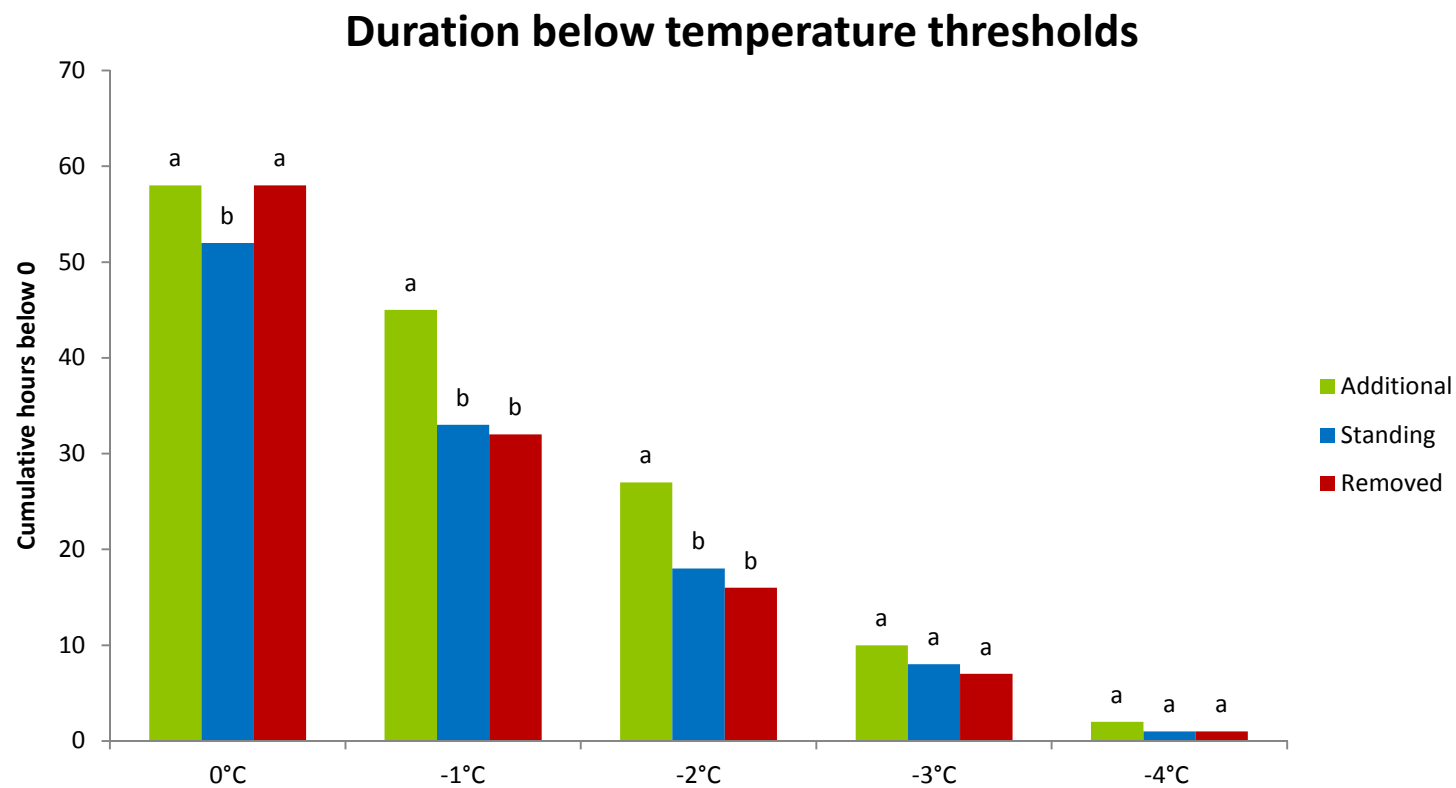


Results: Nyabing

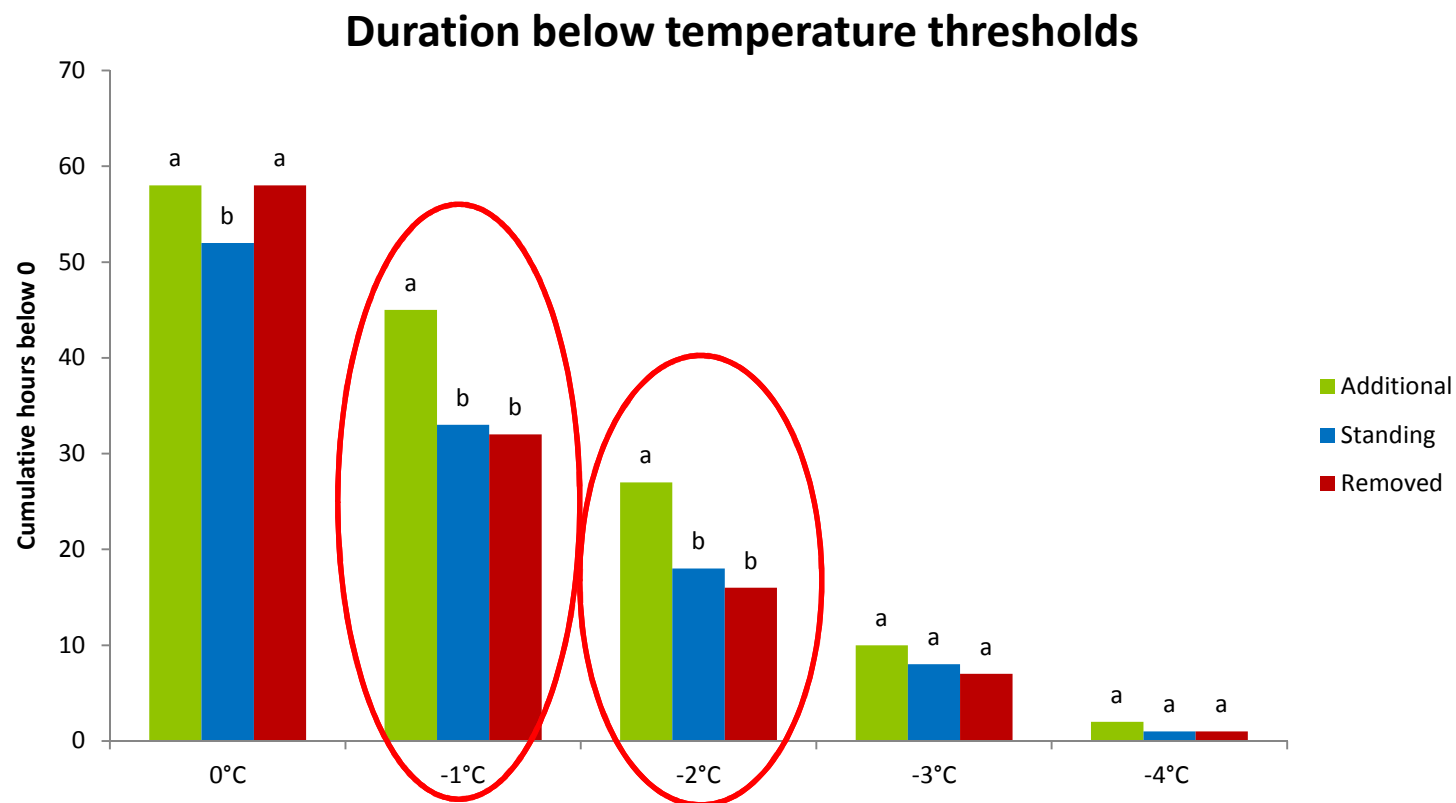
AVERAGE
Additional: -2.4°C
Standing: -2°C
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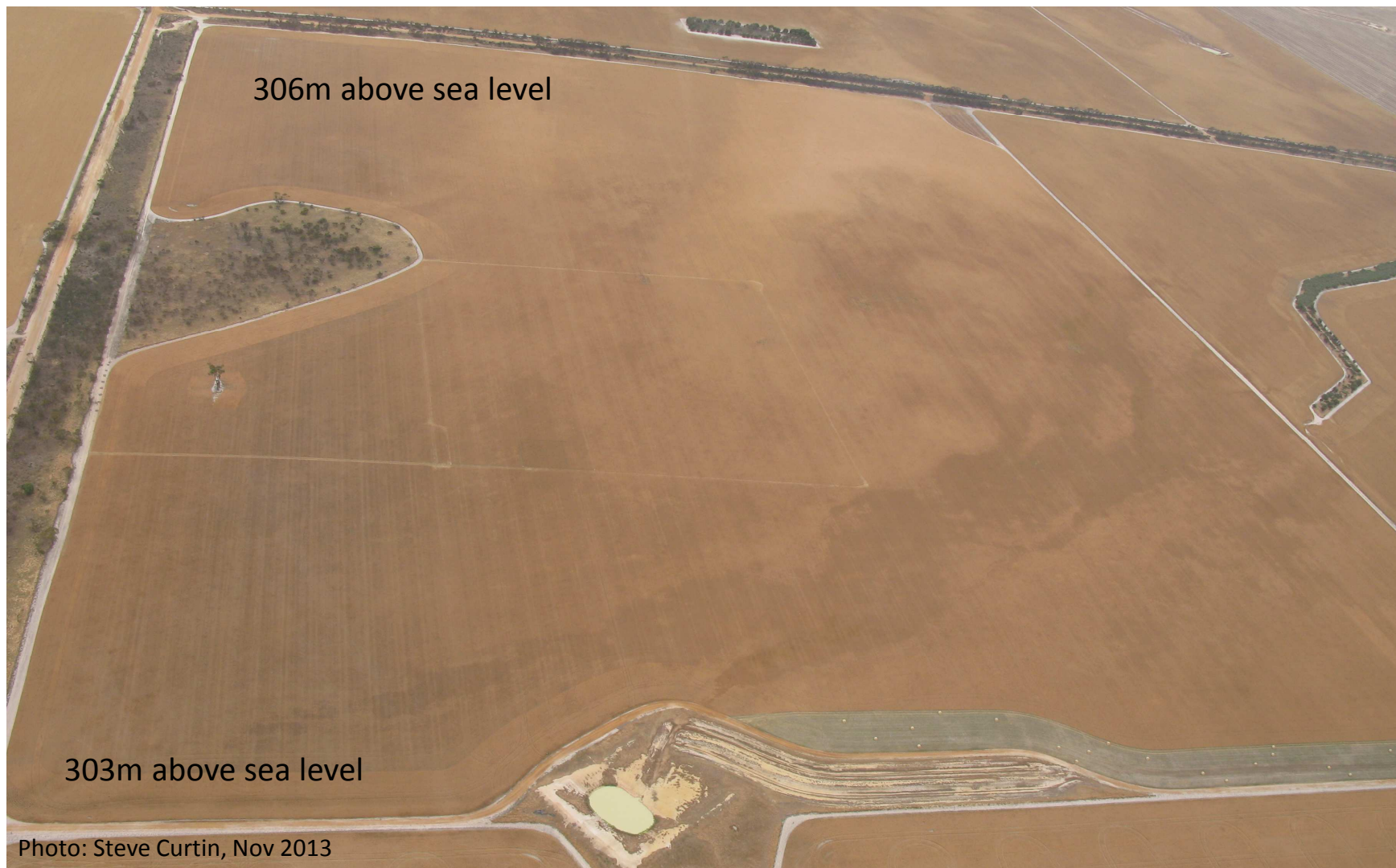


Results: Nyabing



Results: Nyabing



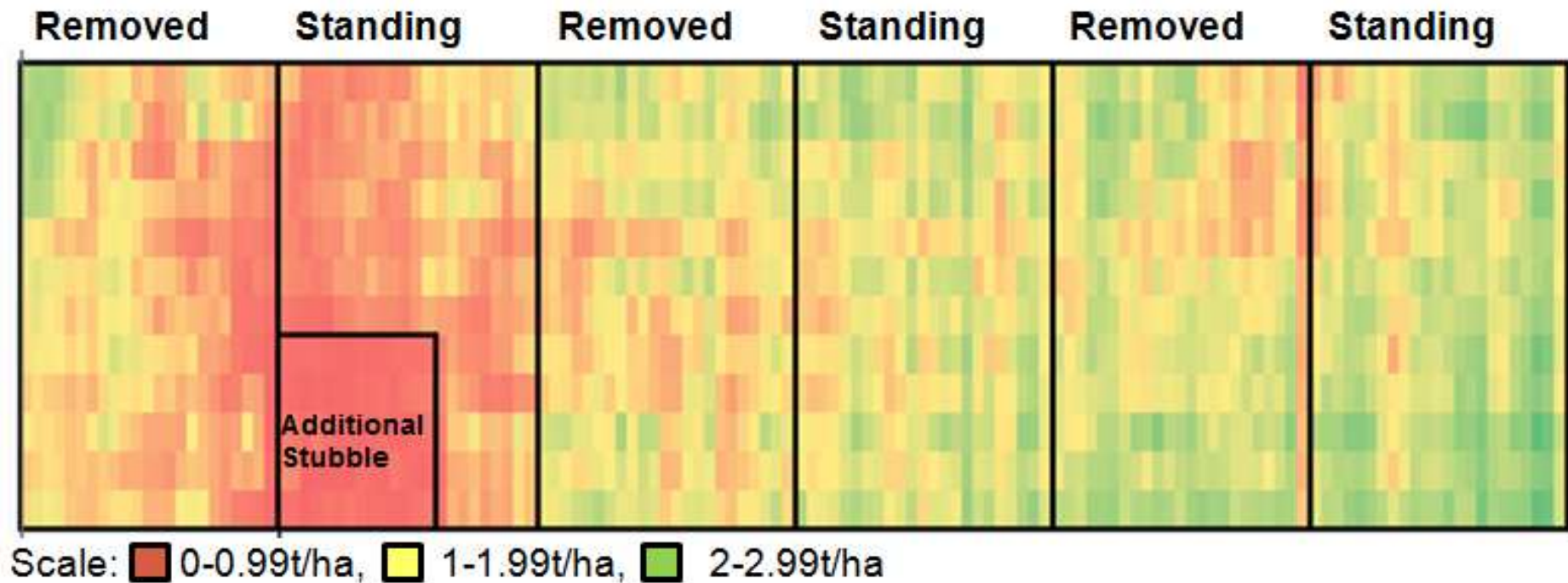


306m above sea level

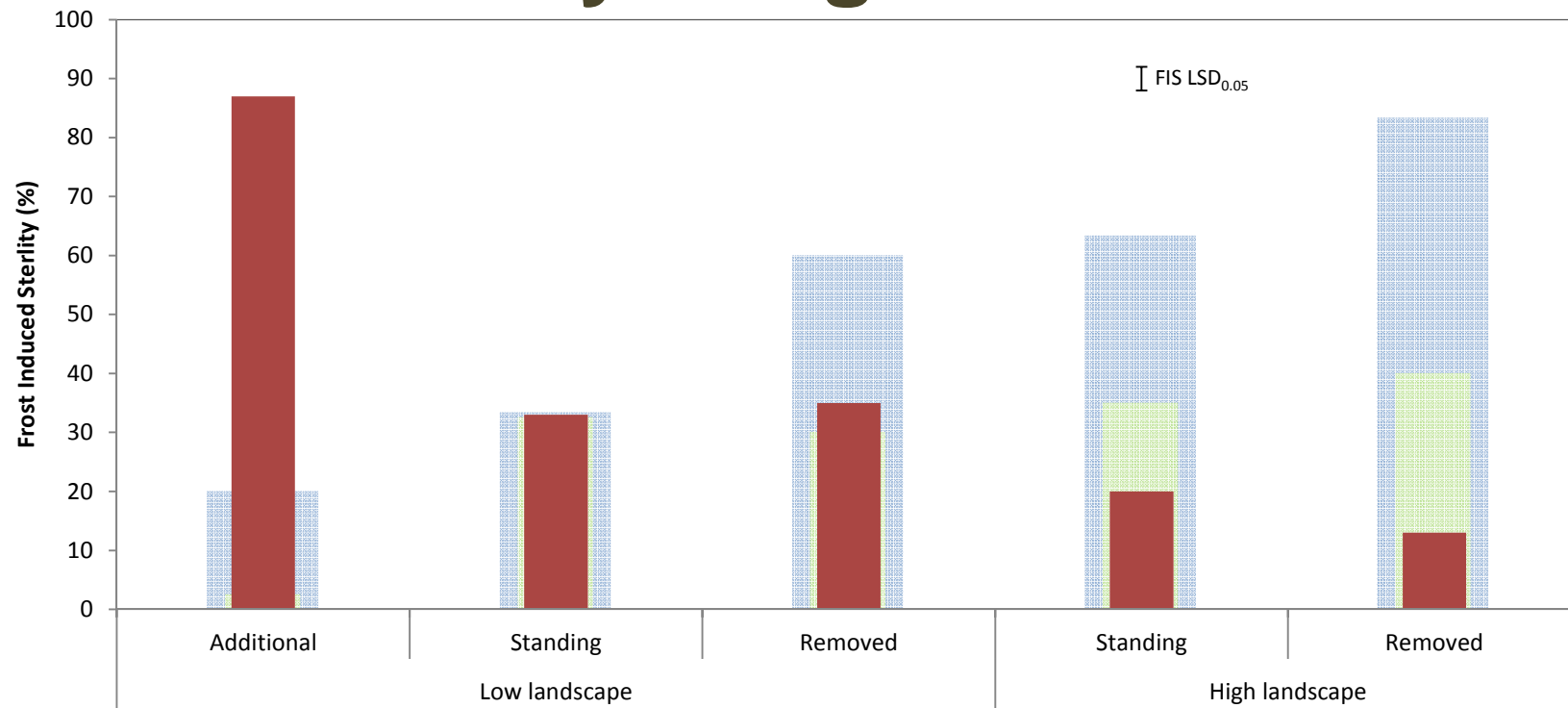
303m above sea level

Photo: Steve Curtin, Nov 2013

Results: Nyabing Yield



Results: Nyabing Yield



Results: Nyabing

Additional Stubble



Screenings: 56%
Frosted grain: 34%

Standing



Screenings: 9%
Frosted grain: 14%

Removed



Screenings: 9%
Frosted grain: 16%

Screenings LSD = 5.5
Frosted Grain LSD = 17.7



Summary of 2013 Project

- 3 sites; Nyabing, Wickepin and York
- Standing and removed stubble treatments
- Canopy temperature & yield components
- Assessing the severity and duration of frost



Key messages

- Stubble increased severity and duration of frost
- Removing stubble reduced frost damage
- Reducing stubble in high frost prone environments = higher yield
 - 0.6t/ha vs 1.8t/ha





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Questions?

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NSW Research

	2013 wheat yield (t/ha)		2013 canola yield (t/ha)		2012 wheat yield (t/ha)	
Treatment	Burn (30% frost damage)	Retain (59% frost damage)	Burn (43% frost damage)	Retain (59% frost damage)	Burn (10% frost damage)	Retain (10% frost damage)
Nil graze	3.3	2.2	1.0	0.7	5.0	4.4
Stubble graze	3.6	3.0	1.1	0.9	4.8	4.8
P value	<0.001		0.014		0.003	
LSD (P<0.05)	0.2		0.1		0.3	

Information courtesy James Hunt CSIRO & Farmlink



Results: Nyabing

Position	Low landscape			High landscape		
Stubble	Additional	Standing	Removed	Standing	Removed	LSD _{0.05}
Yield (t/ha)				1.9	2.5	0.40
Yield (t/ha) –map	0.6	1.0	1.8			0.30
FIS (%)	87	33	35	20	13	4.0
HI	0.02	0.26	0.24	0.28	0.32	0.10
100GW (mg)	16	46	45	43	44	3.0
Screenings (%) <2mm	56	9	9	13	13	5.5
Frosted grain (%)	34	14	16			17.7



Results: Wickepin

Position	Low landscape			Mid landscape			High landscape			
Stubble	Standing	Removed	Cultivated	Standing	Removed	Cultivated	Standing	Removed	Cultivated	LSD _{0.05}
Yield (t/ha)	4.4	4.4	4.61	5.0	3.9	5.09	3.0	3.6	4.51	0.941
FIS (%)	11	10	10	9	9	10	12	8	6	1.9
HI	0.38	0.36	0.39	0.36	0.33	0.36	0.30	0.29	0.38	0.043
100GW (mg)	39	38	37	39	41	41	38	41	44	NS
Screenings (%) <2mm	15	19	21	14	11	15	23	11	6	NS
Frosted grain (%)	0.5	0.2	0.3	0.3	0.3	0.6	0.5	0.5	0.3	NS

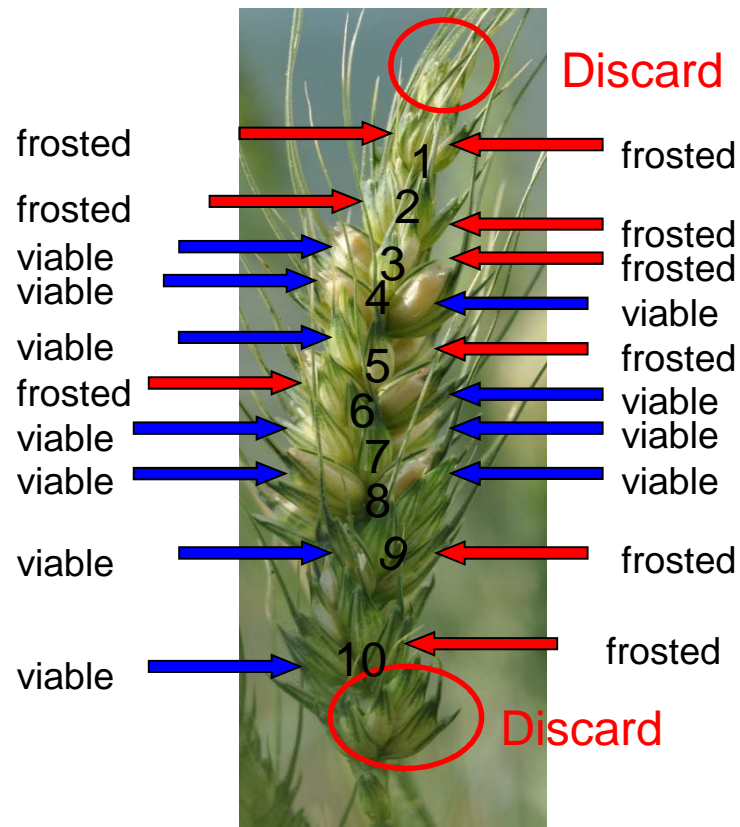


Results: York

Position	Low landscape		Mid landscape		High landscape		
Stubble	Standing	Removed	Standing	Removed	Standing	Removed	LSD _{0.05}
Yield (t/ha)	4.5	3.4	4.8	5.1	5.0	4.8	0.75
FIS (%)	4	3	5	4	4	4	1.0
HI	0.36	0.35	0.37	0.39	0.38	0.38	0.015
100GW (mg)	33	32	35	35	35	34	2.4
Screenings (%) <2mm	50	50	36	35	35	40	10.3
Frosted grain (%)	1.0	0.6	0.3	0.2	0.2	0.3	0.46



Frost Induced Sterility (FIS) estimation



On this side of the head

- 10 pairs of spikelets, = 20 florets in total,
- 9 florets frosted
- 11 florets viable
- Count the other side of the head as well

If we assume it's the same ratio then calculate damage as;

$$\text{FIS} = \frac{18}{40} \times 100 = 45\%$$