Assessing genotypic variation in heat tolerance using portable heat chambers in canola

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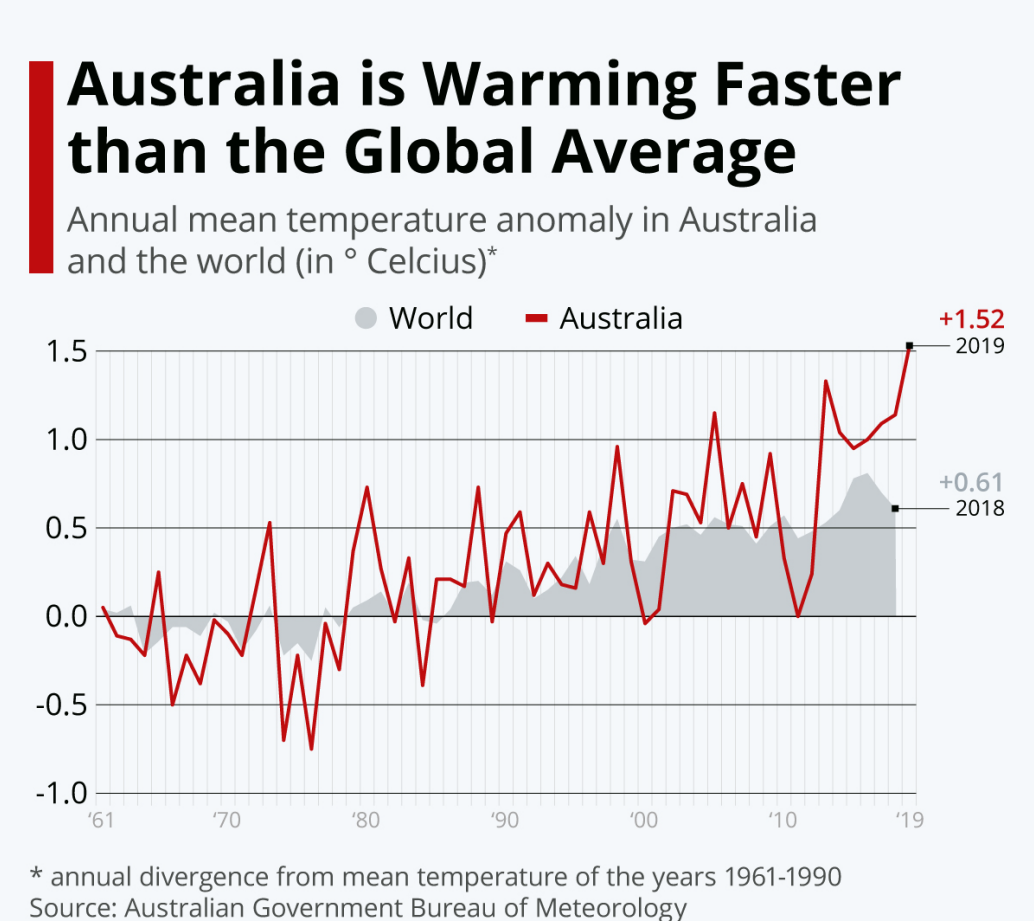
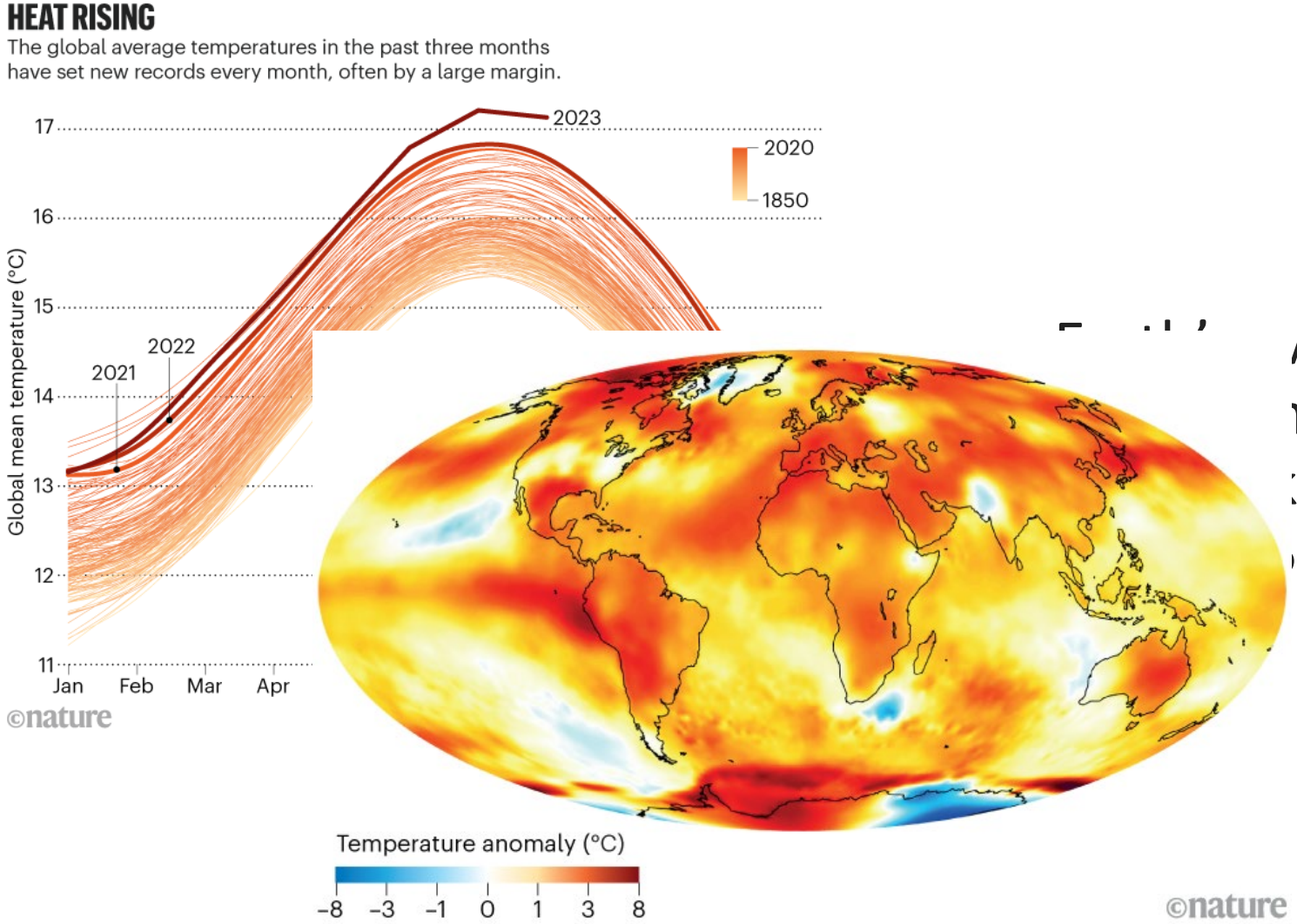


- ❑Annual frequency of days above 35°C increase by 20-70% by 2030
- ❑Heat wave frequency during grain set and filling increase by 85%

IPCC Report on climate change 2022



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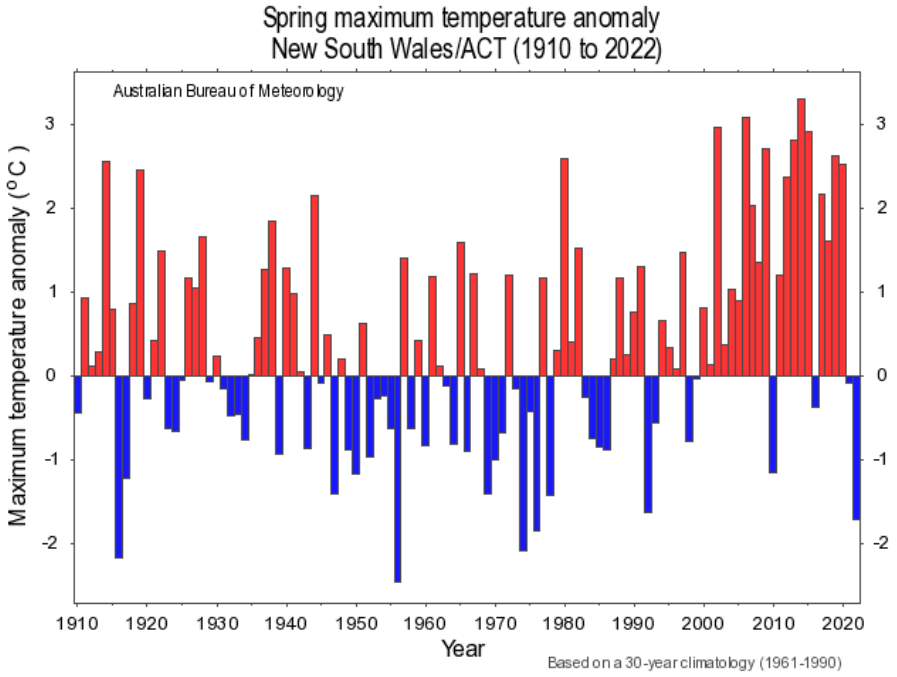
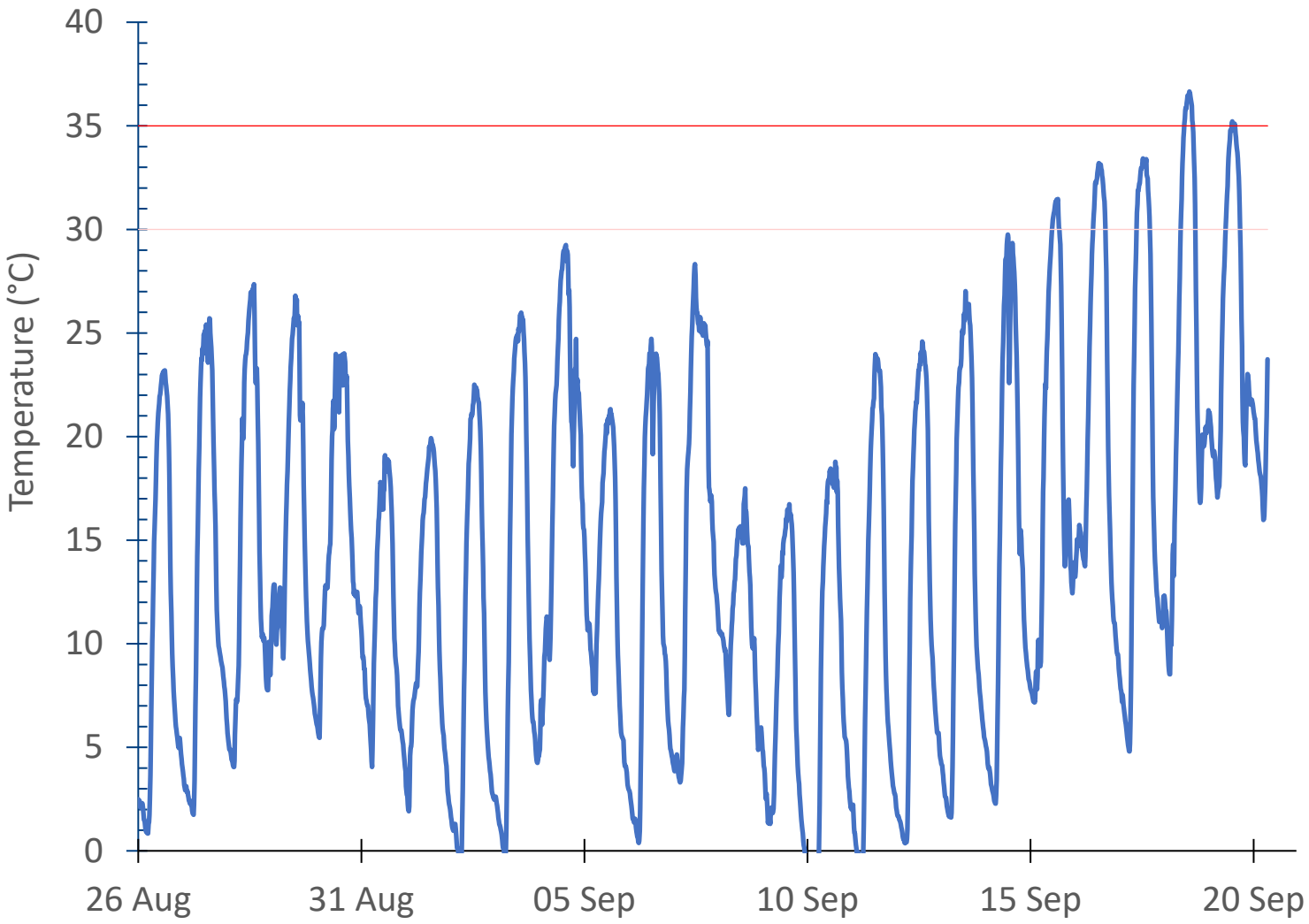
Nature, doi: https://doi.org/10.1038/d41586-023-02995-7

Spring are warming in Australia



- Coincident at later flowering or grain-filling
- Few hot days above 30°C
- Dry conditions and shorter season
- **Slash yield potential**
- @ 300kg/ha per degree rise in mean daily T during flowering

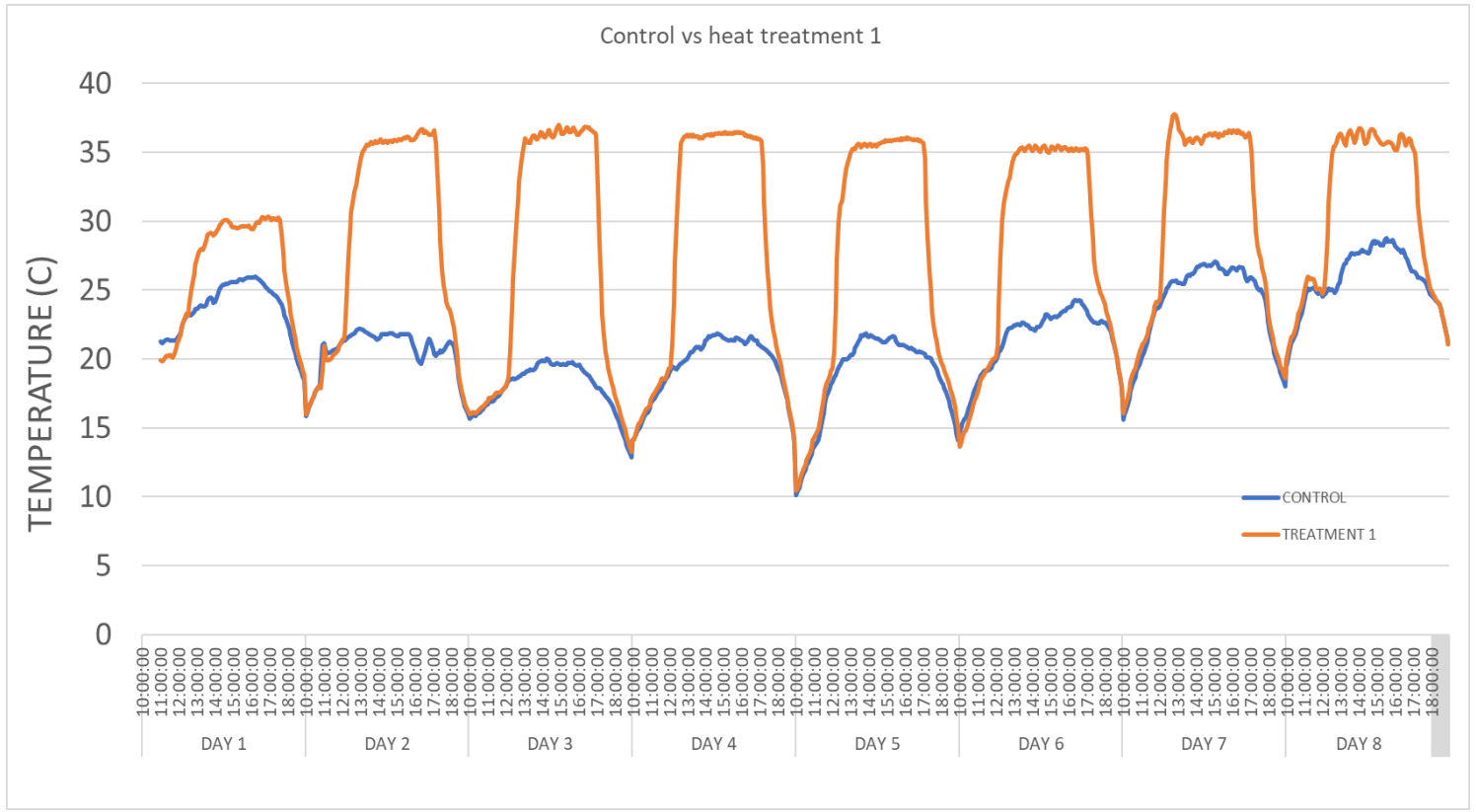

Temperature (°C)
40
35
30
25
20
15
10
5
0
26 Aug
31 Aug
05 Sep
10 Sep
15 Sep
20 Sep

Canola heat tolerance –a coordinated multidisciplinary approach

- Heat Screening facility at UWA
- Multilocation heat tolerance trials
- Portable heat chamber facility at WWAI

Portable heat chambers facility at WWAI

Successful for imposing heat wave for multiple days



Measurements

Plot level

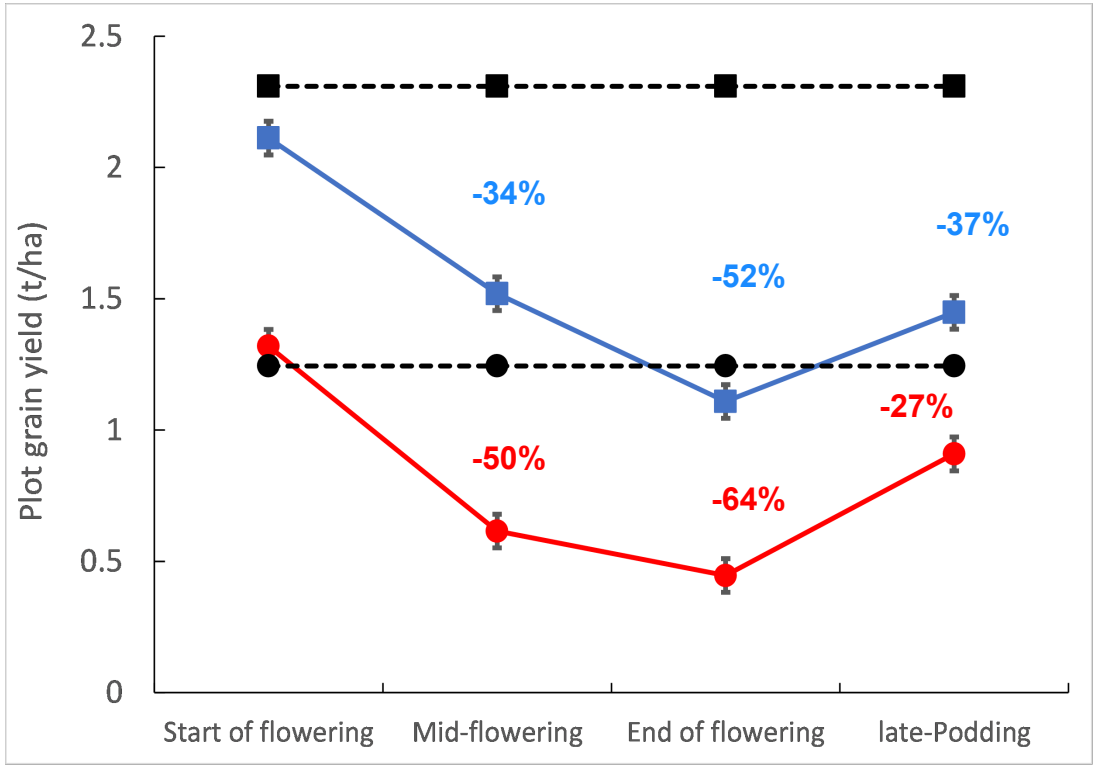
- Phenology
- Grain yield
- Aboveground biomass
- Harvest index
- Seed number
- Seed weight
- Pod number
- **Mean productivity**
- **Percentage change in Yield**

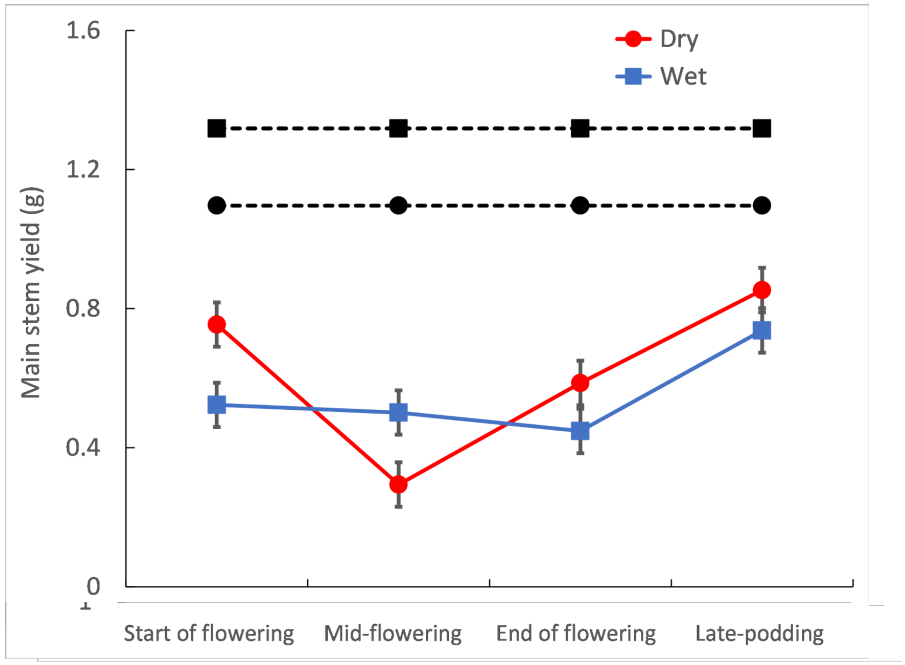
Plant level

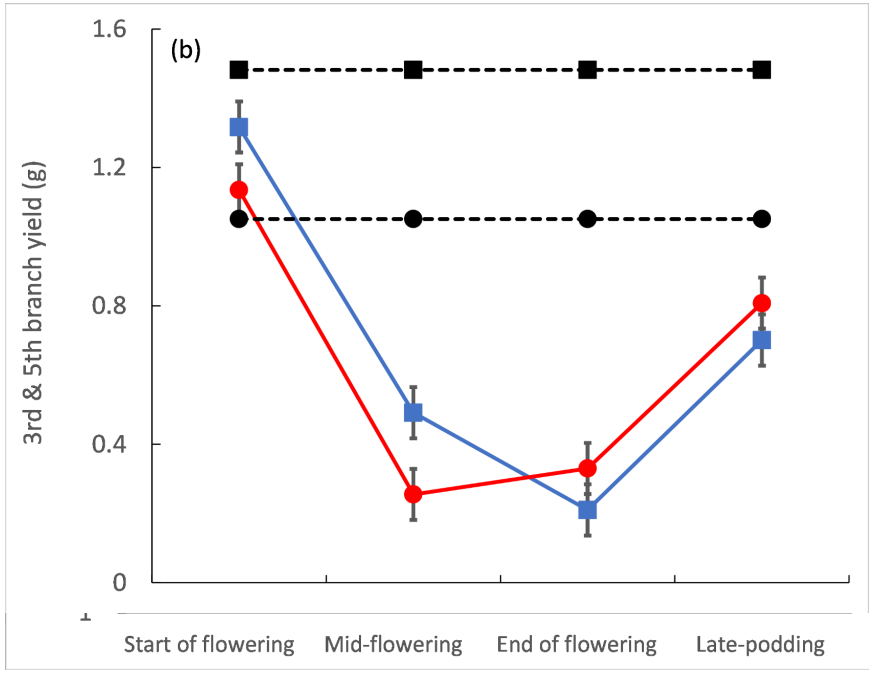
- Main and two lateral branches tagged (10 plants, 2880 branches)
- Total pods
- Fertile pods
- Seed yield
- Seed number

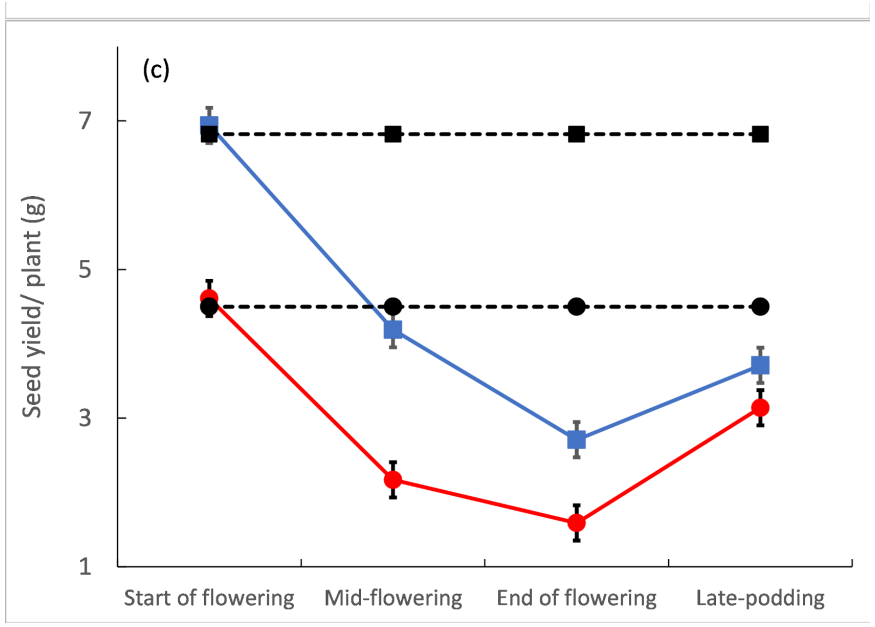
Heat stress at mid- to end of flowering result in maximum yield reduction

- 2018
- One variety (4 Reps)
- Two water regimes (250 and 425 mm)
- Control vs 35°C
- Heat stress timing (first flower, mid-flowering, end of flowering, late podding
- 35°C for 8 days excluding weekends for recovery (4h each day)

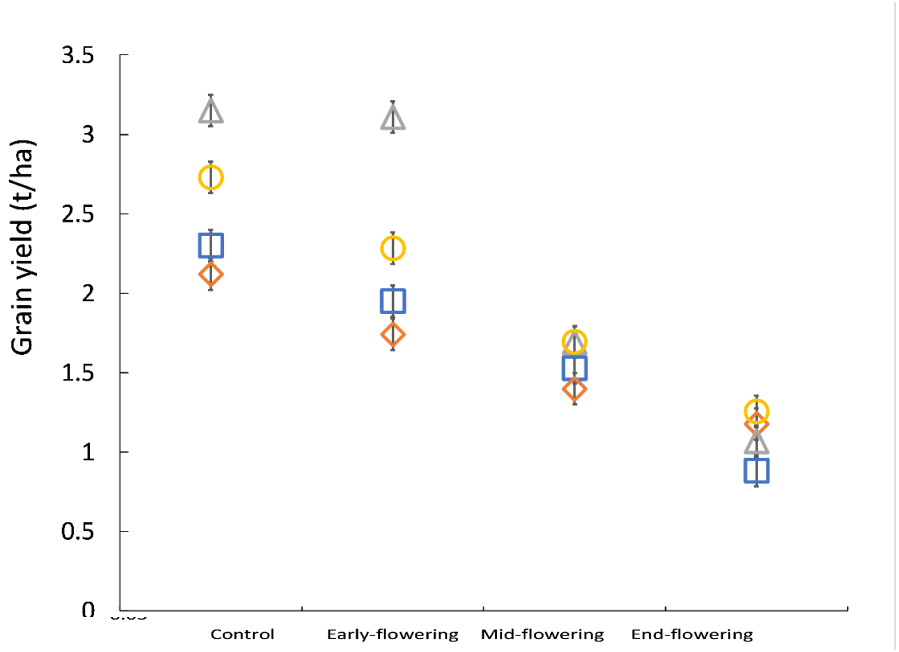



Dry
Wet
Main stem yield (g)
1.6
1.2
0.8
0.4
0
Start of flowering
Mid-flowering
End of flowering
Late-podding

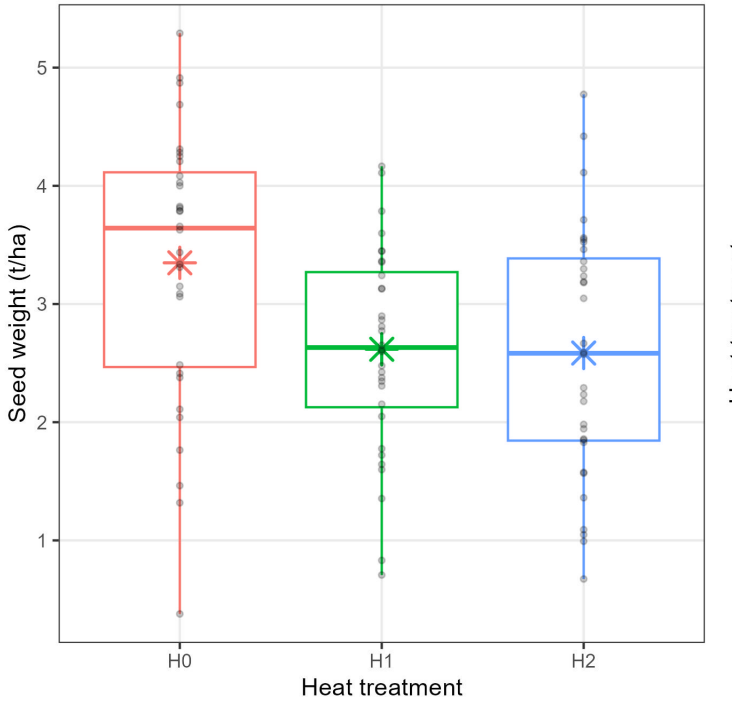

(b)
3rd & 5th branch yield (g)
1.6
1.2
0.8
0.4
0
Start of flowering
Mid-flowering
End of flowering
Late-podding


(c)
Seed yield/ plant (g)
7
5
3
1
Start of flowering
Mid-flowering
End of flowering
Late-podding

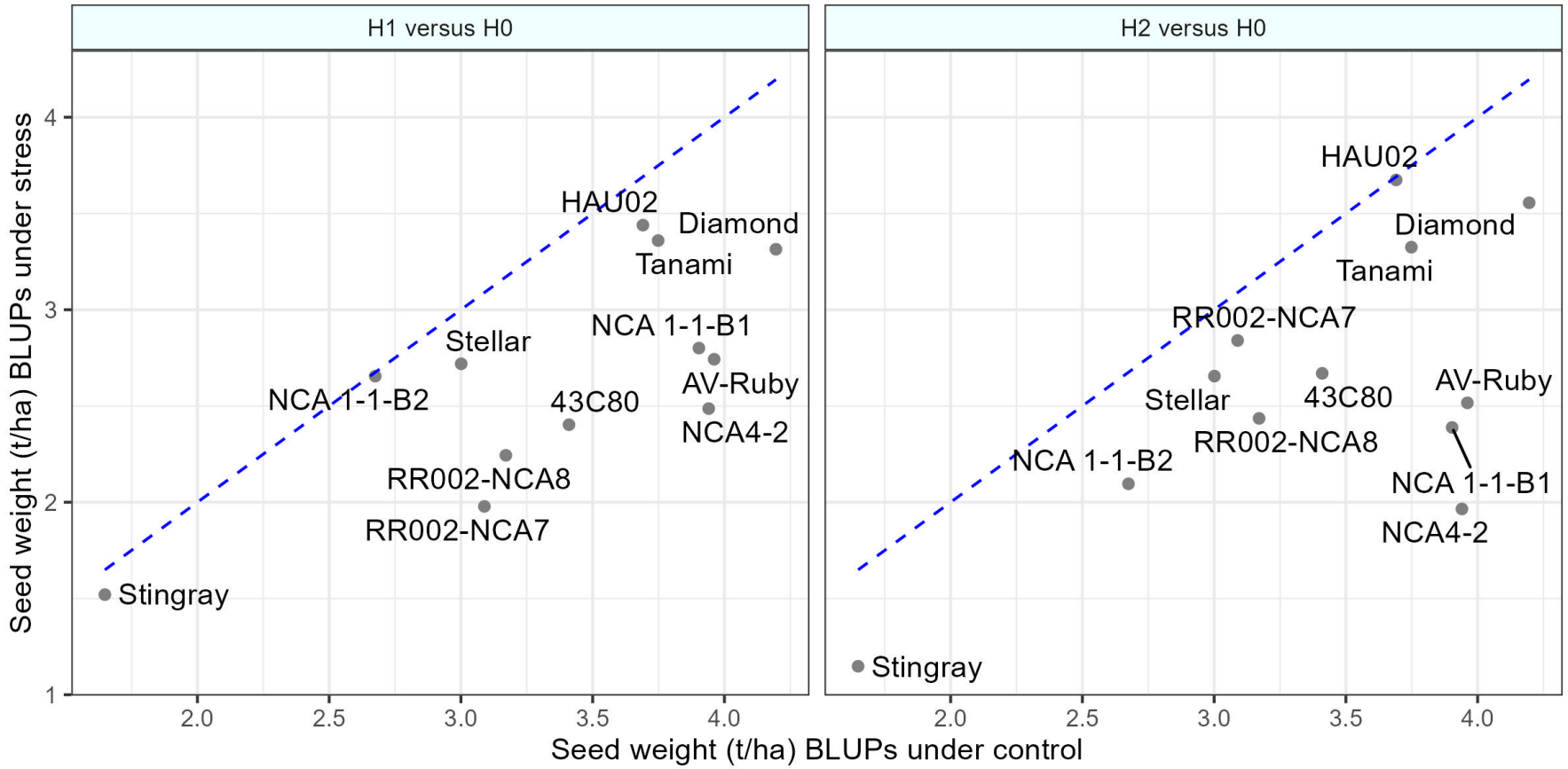
- 2019
- Four varieties (4 reps)
- Control vs 35°C
- Heat stress timing (first flower, mid-flowering, end of flowering)
- 35°C for 8 days excluding weekends for recovery (4h each day)



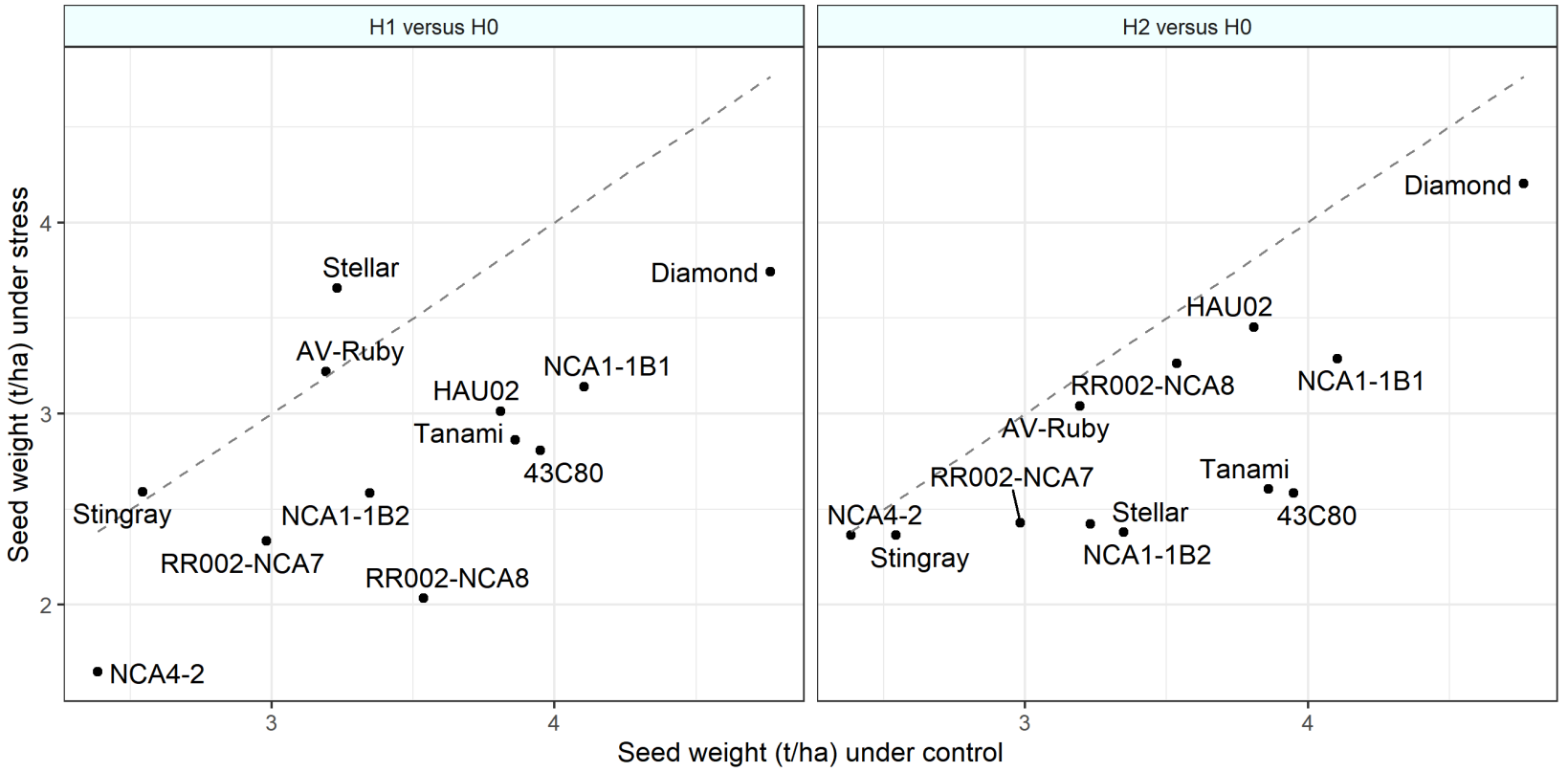
- 2020 and 2021
- 12 varieties (3 reps)
- Control vs 35°C
- Heat stress timing (early and late flowering)
- 35°C for 8 days excluding weekends for recovery (4h each day)

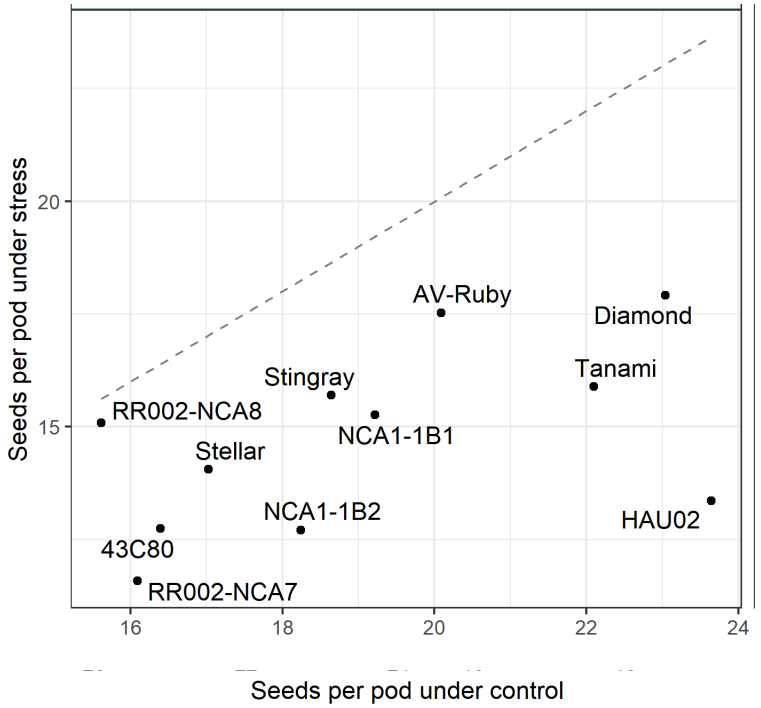


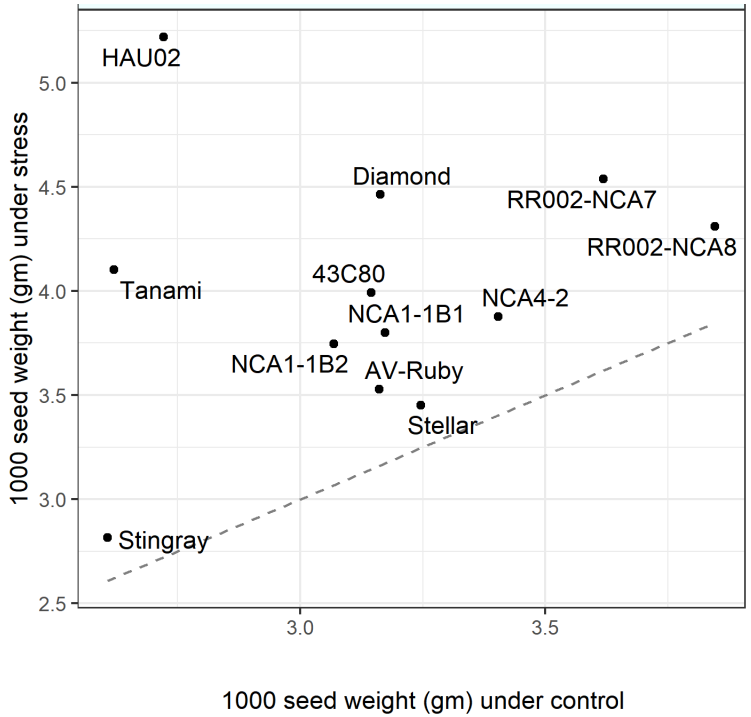
Percentage change in yield under heat stress (2020)



Percentage change in yield under heat stress (2021)




Seeds per pod under stress
20
15
AV-Ruby
Diamond
Tanami
Stingray
RR002-NCA8
NCA1-1B1
Stellar
NCA1-1B2
HAU02
43C80
RR002-NCA7
16
18
20
22
24
Seeds per pod under control


1000 seed weight (gm) under stress
5.0
4.5
4.0
3.5
3.0
2.5
HAU02
Diamond
RR002-NCA7
RR002-NCA8
Tanami
43C80
NCA4-2
NCA1-1B1
NCA1-1B2
AV-Ruby
Stellar
Stingray
3.0
3.5
1000 seed weight (gm) under control

Summary

- Genotypic variation in heat tolerance exist
- Heat impacts on quality important

Acknowledgments

- John Bromfield
- Warren Bartlett
- Matt Dunn
- Danielle Malcolm
- Casual staff