Canola Pre-breeding for Heat Tolerance in Australia

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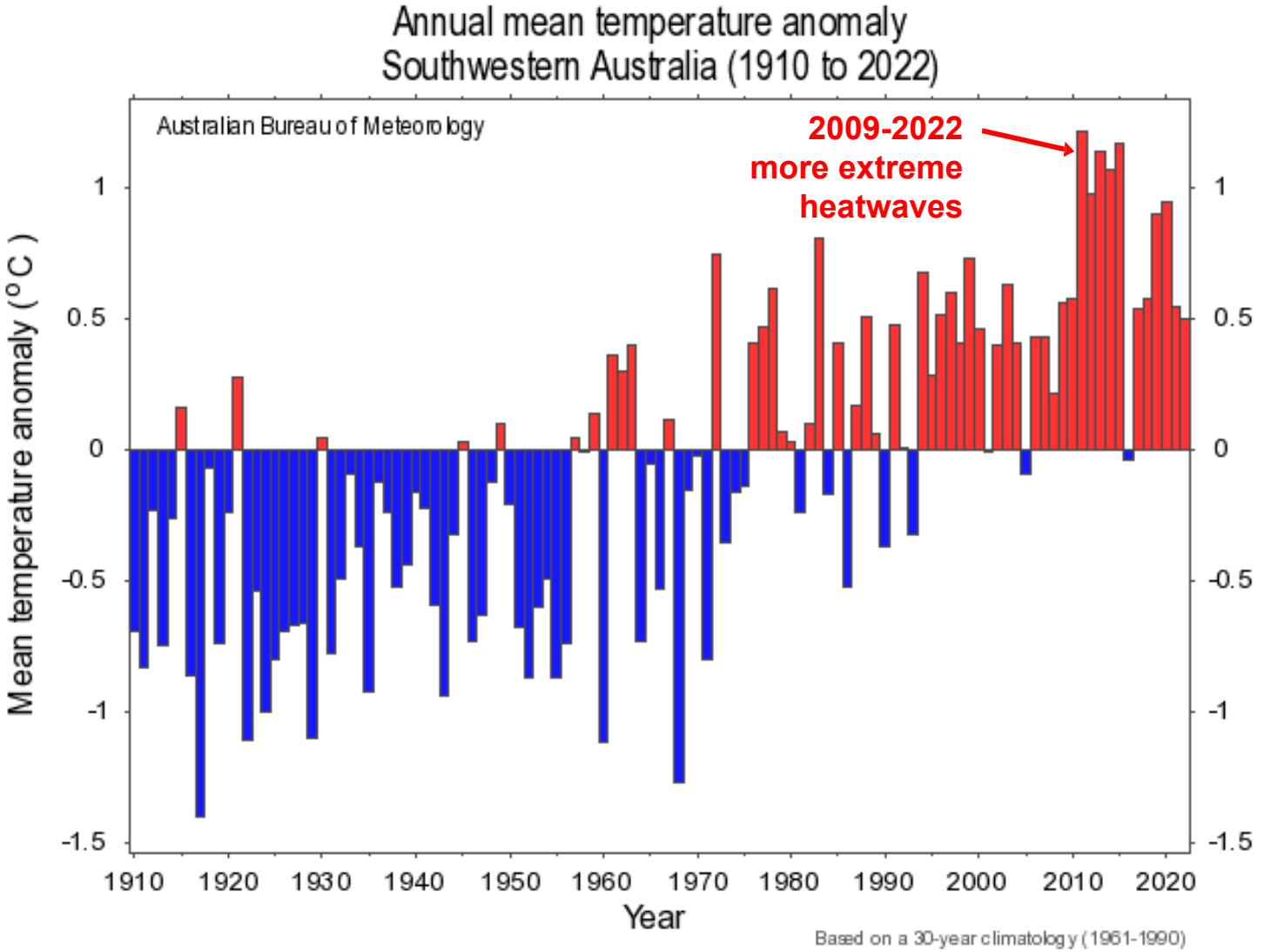
Heat waves are occurring more frequently in Australia

Canola yield is reduced by heat waves during flowering

Heat tolerance: genetic crop insurance against global warming

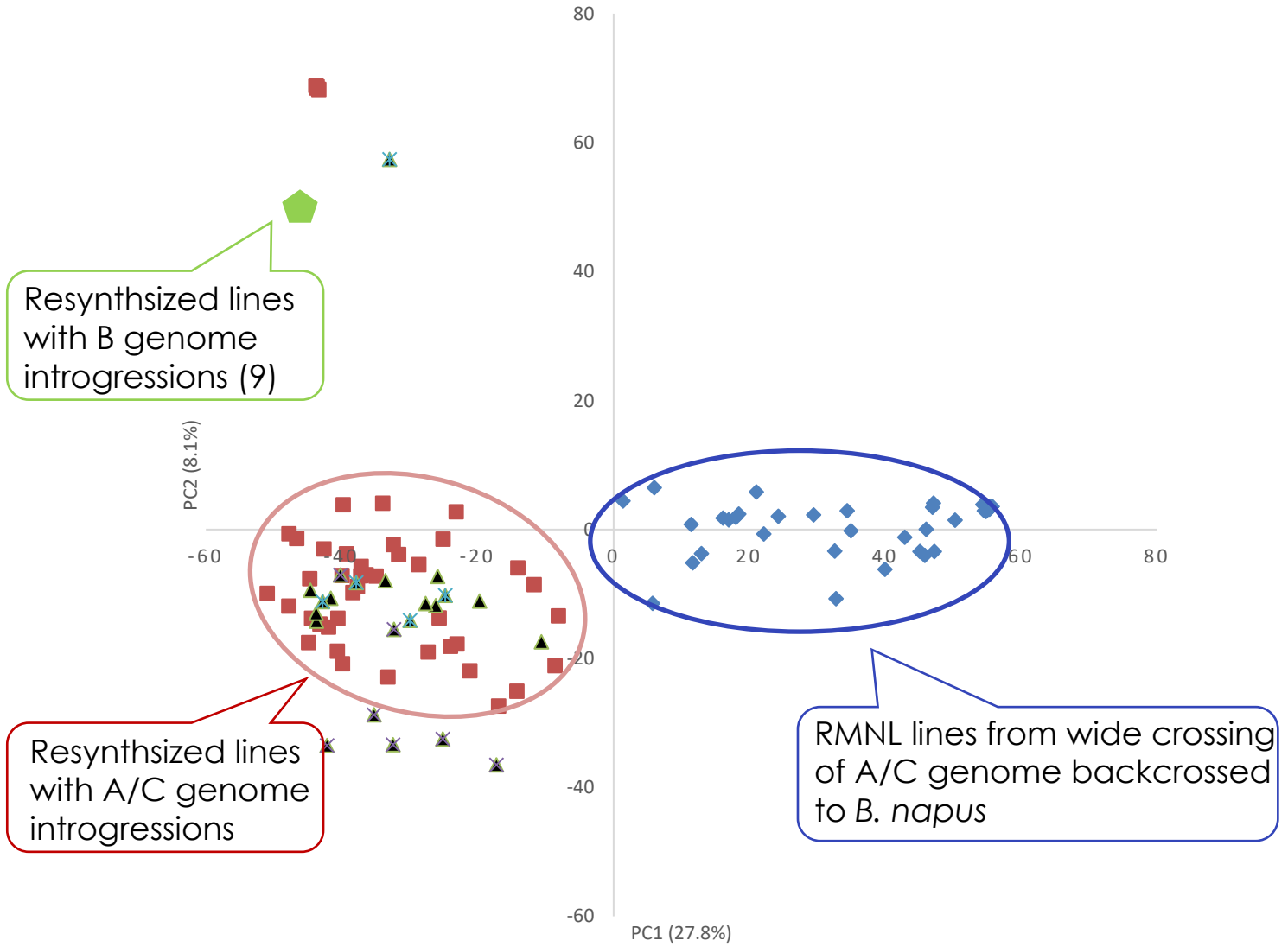


Source: Bureau of Meteorology
http://www.bom.gov.au/cgi-bin/climate/change/timeseries.cgi?graph=tmean&area=swaus&season=0112&ave_yr=0

Genomic analysis reveals large diversity in germplasm from India and China

ACIAR/GRDC Project CIM-1999/072 "Oilseed Brassica improvement in China, India and Australia" (2004-2009)

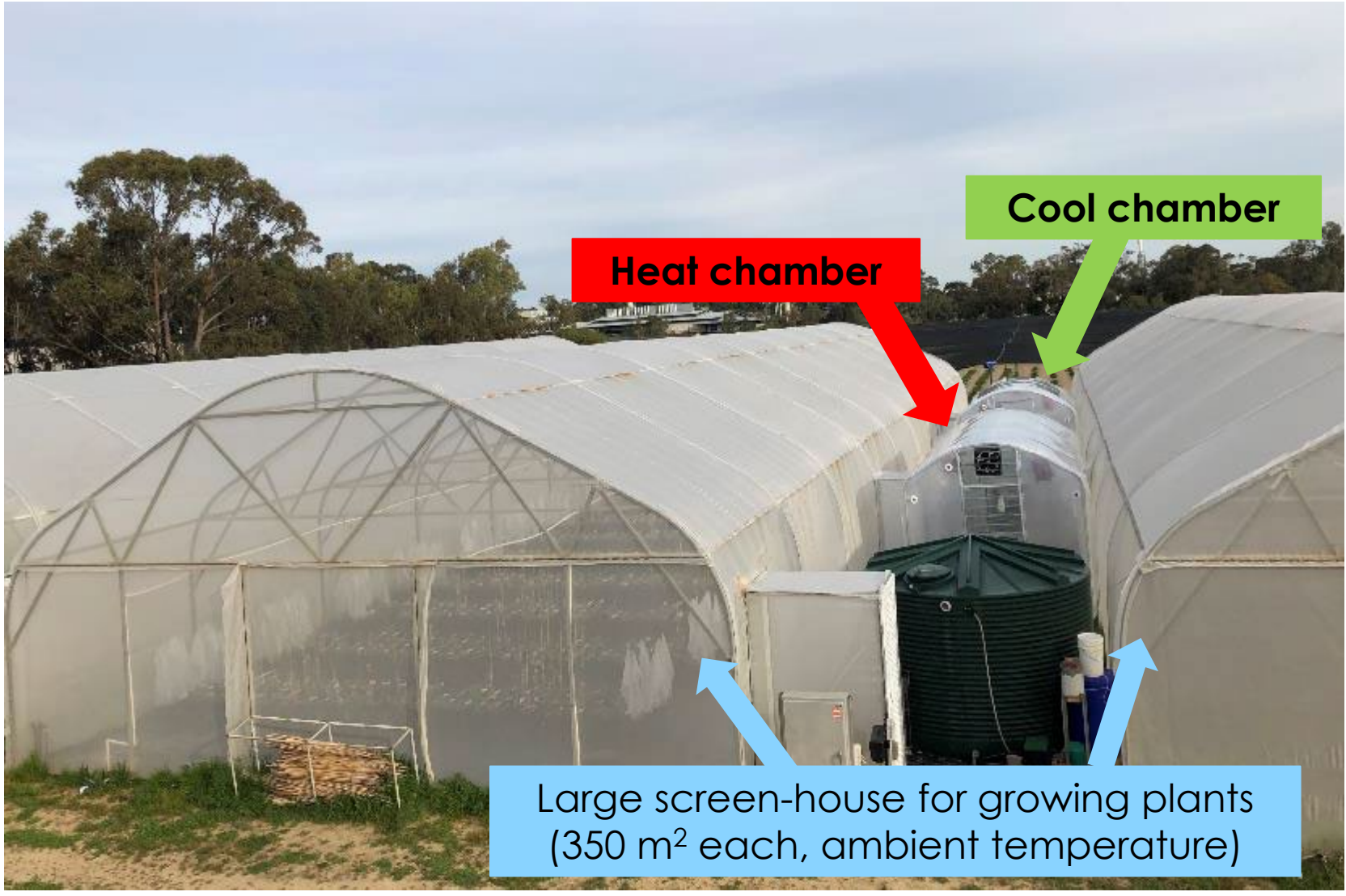
GRDC project UM0045 "Expanding Brassica germplasm base through collaboration with China and India" (2012-2017)



A prototype heat screening facility (HSF) for canola breeders

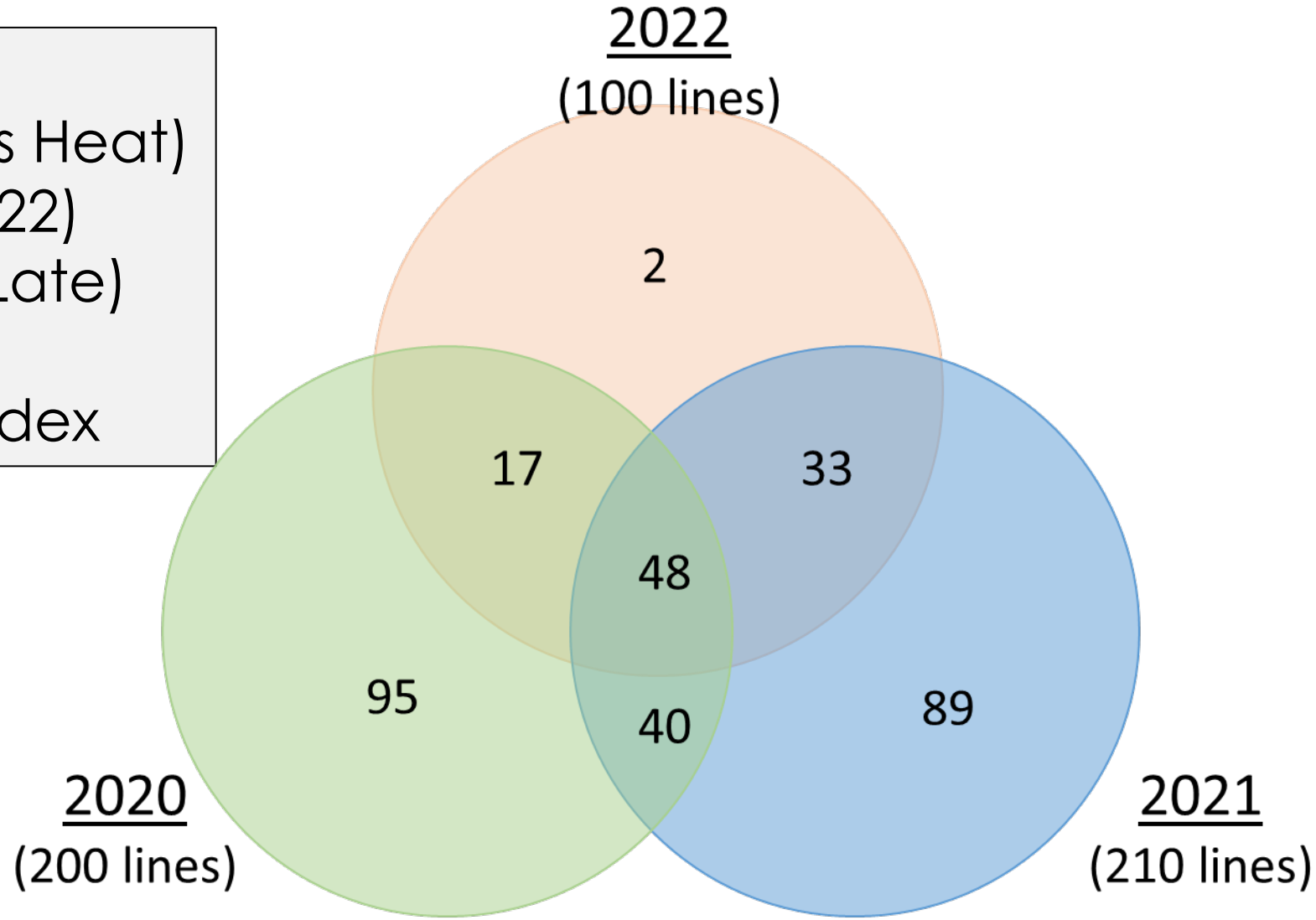
At UWA Field Station:

- Large screen-house for plant growth
- Move to chambers for **7 days at first flower**
- Cool chamber (25/15 °C)
- Heat chamber (32/22 °C)
- Temperature, ventilation, irrigation & fertilization are all centrally controlled

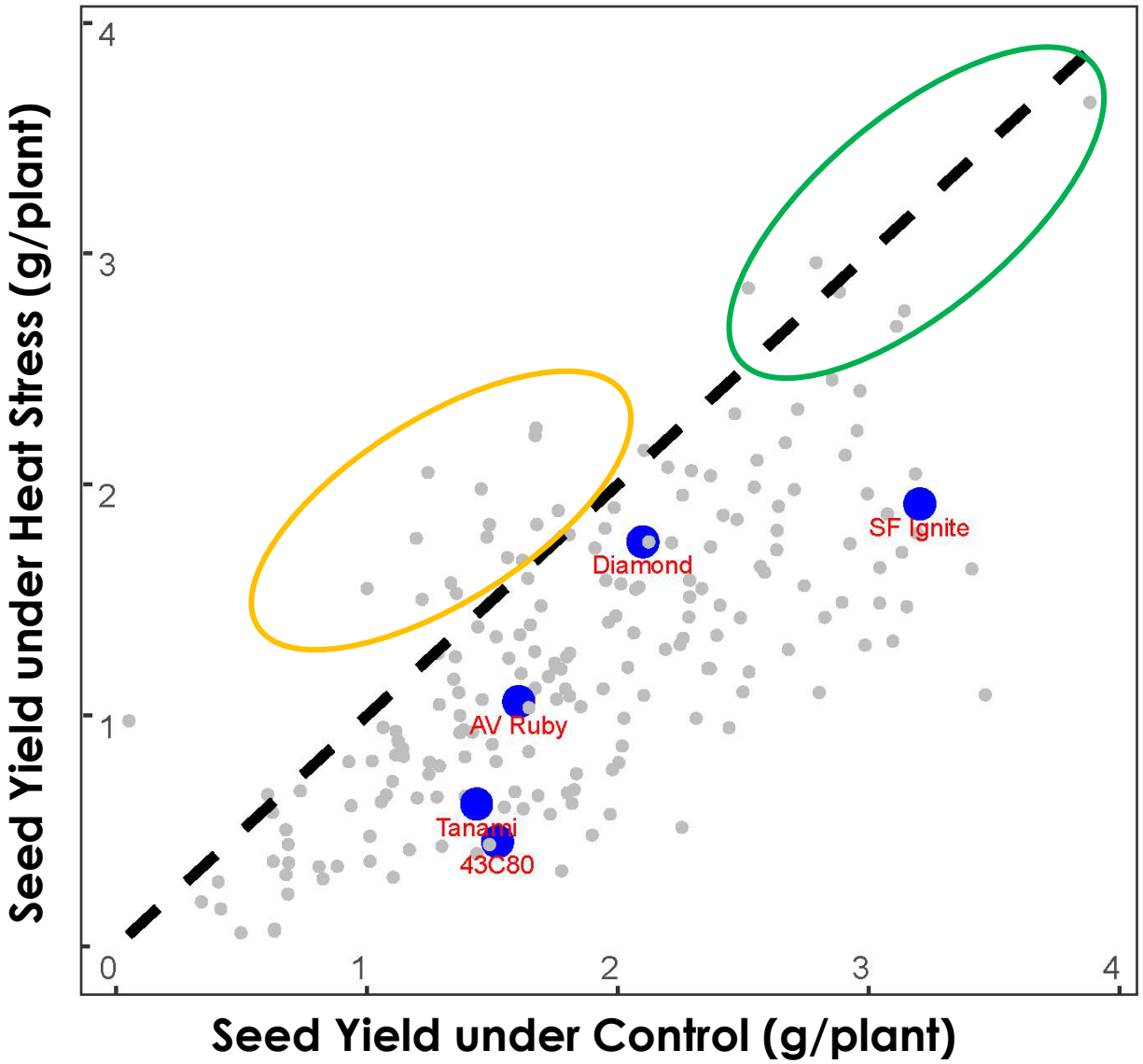


Phenotyping for heat tolerance using HSF

- 324 genotypes
  - x 2 treatments (Ctrl vs Heat)
  - x 3 years (2020, 21 & 22)
  - x 2 seasons (Early vs Late)
- 8 yield-related traits
  - x 2 heat tolerance index



Ranking genotypes for heat tolerance



Seed yield on main stem

High seed yield under control & heat stress (6)

Moderate seed yield under control & heat stress (20)

Portable heat chambers at NSW DPI

Trials 2020 & 2021:

12 lines x 3 treatments x

2-3 reps = 96 plots

Trials 2022 & 2023:

16 lines x 2 treatments x

3 reps = 96 plots

Treatments:

H0: No heat stress (Control)

H1: 8d heat stress from the date of first flower

H2: 8d heat stress from the date of 50% flowering

Funded by GRDC: UWA1905 project

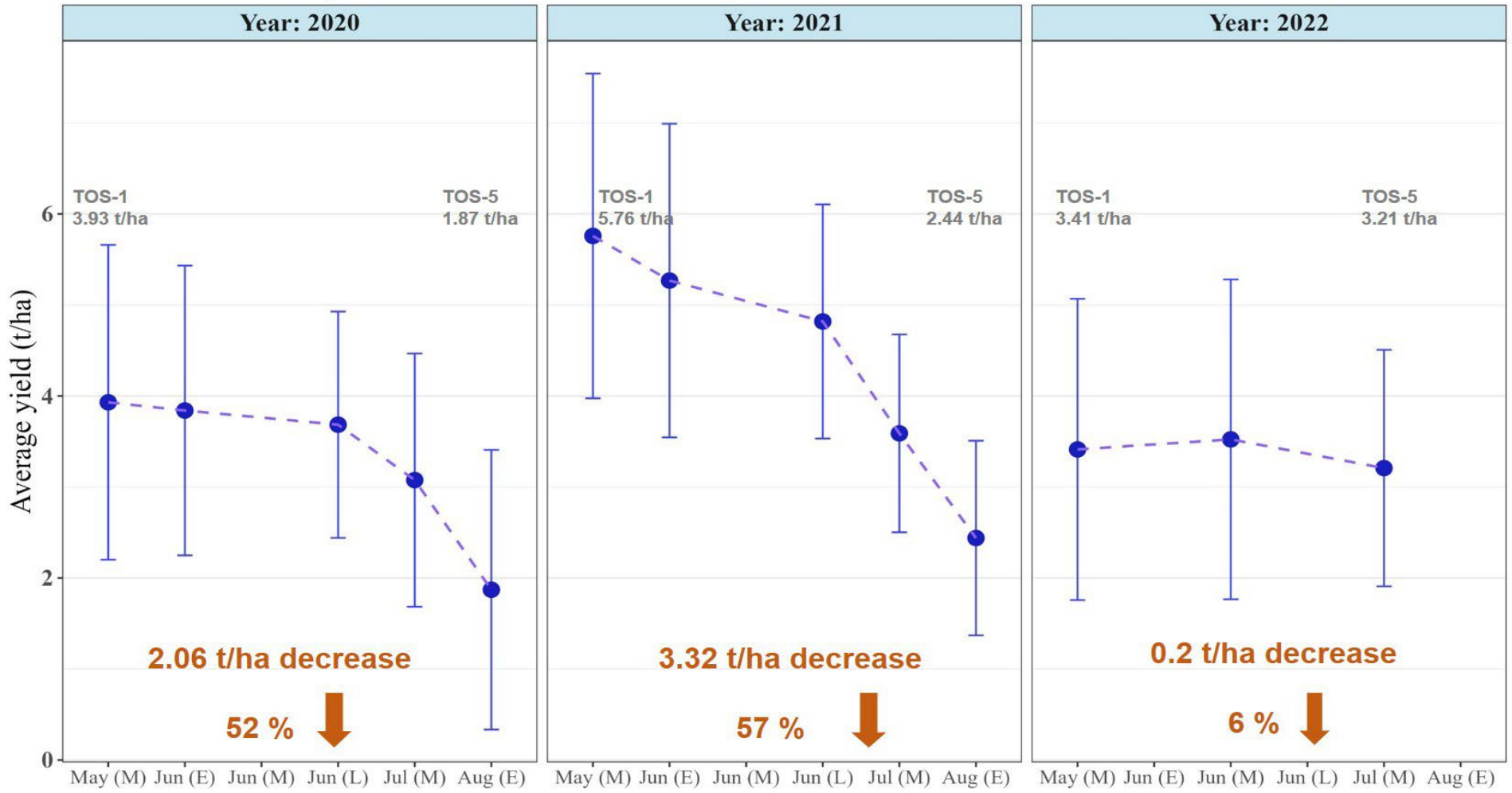
Validation of heat-tolerant germplasm in national field trials

2020 & 2021: 30 lines x 5 TOSs x 2 reps = 300 sample plots at 3-4 sites
2022 & 2023: 48 lines x 3 TOSs x 2 reps = 288 sample plots at 4-5 sites

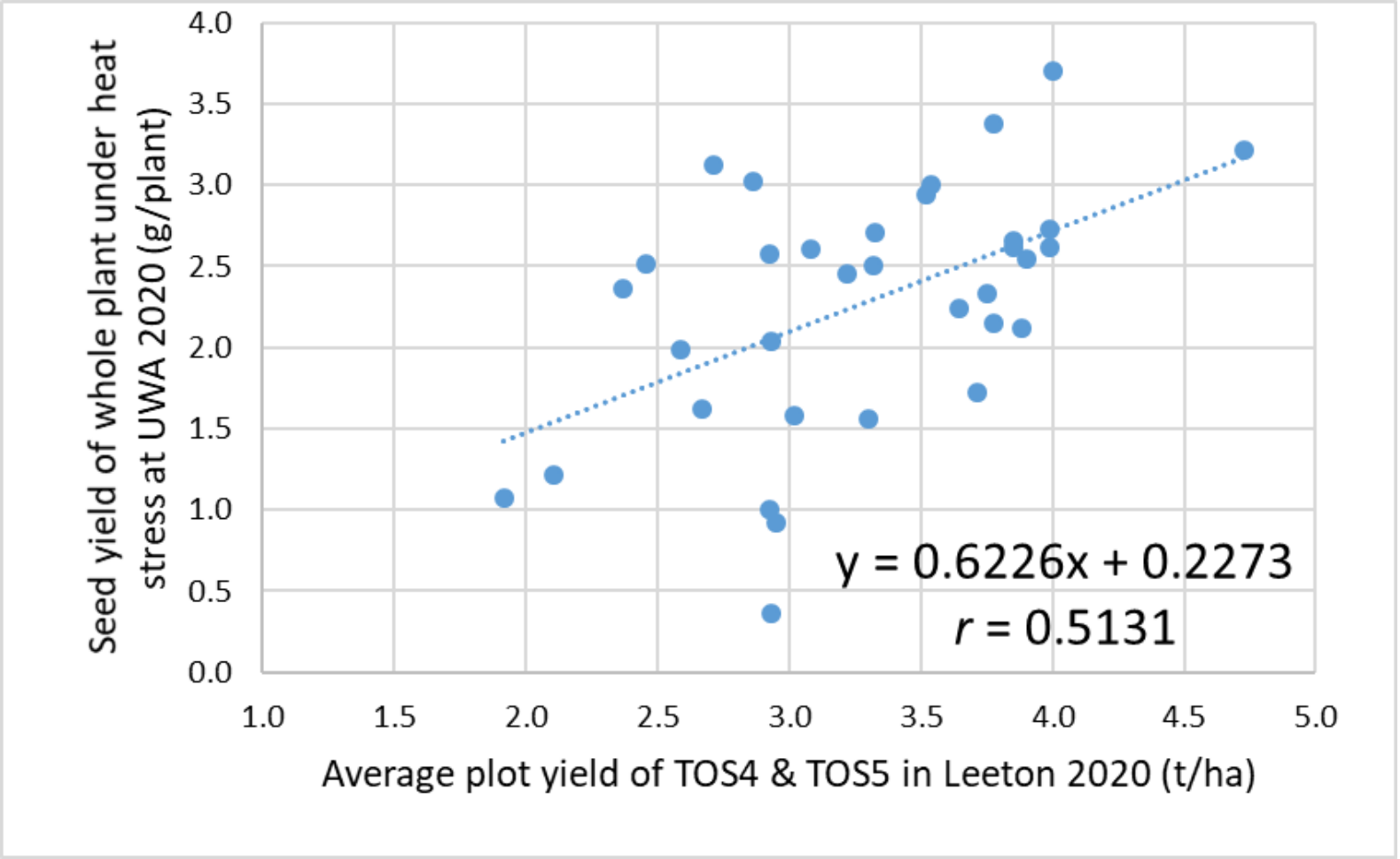
Narrabri NSW, May 2020

Yield performances over three years in Leeton, NSW

Leeton, NSW: mean yield with 95% CI across three years.

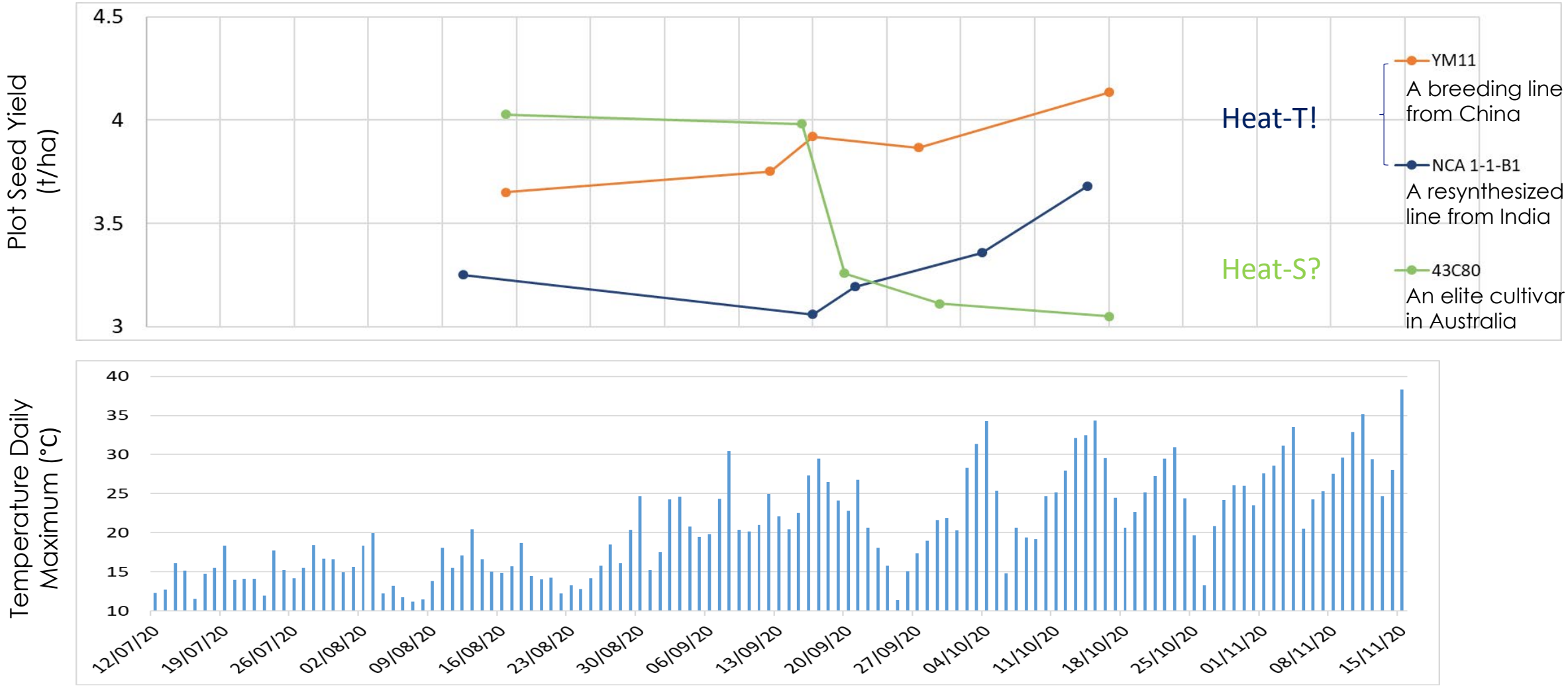


Seed yield under heat stress Controlled env. *vs* Field env.



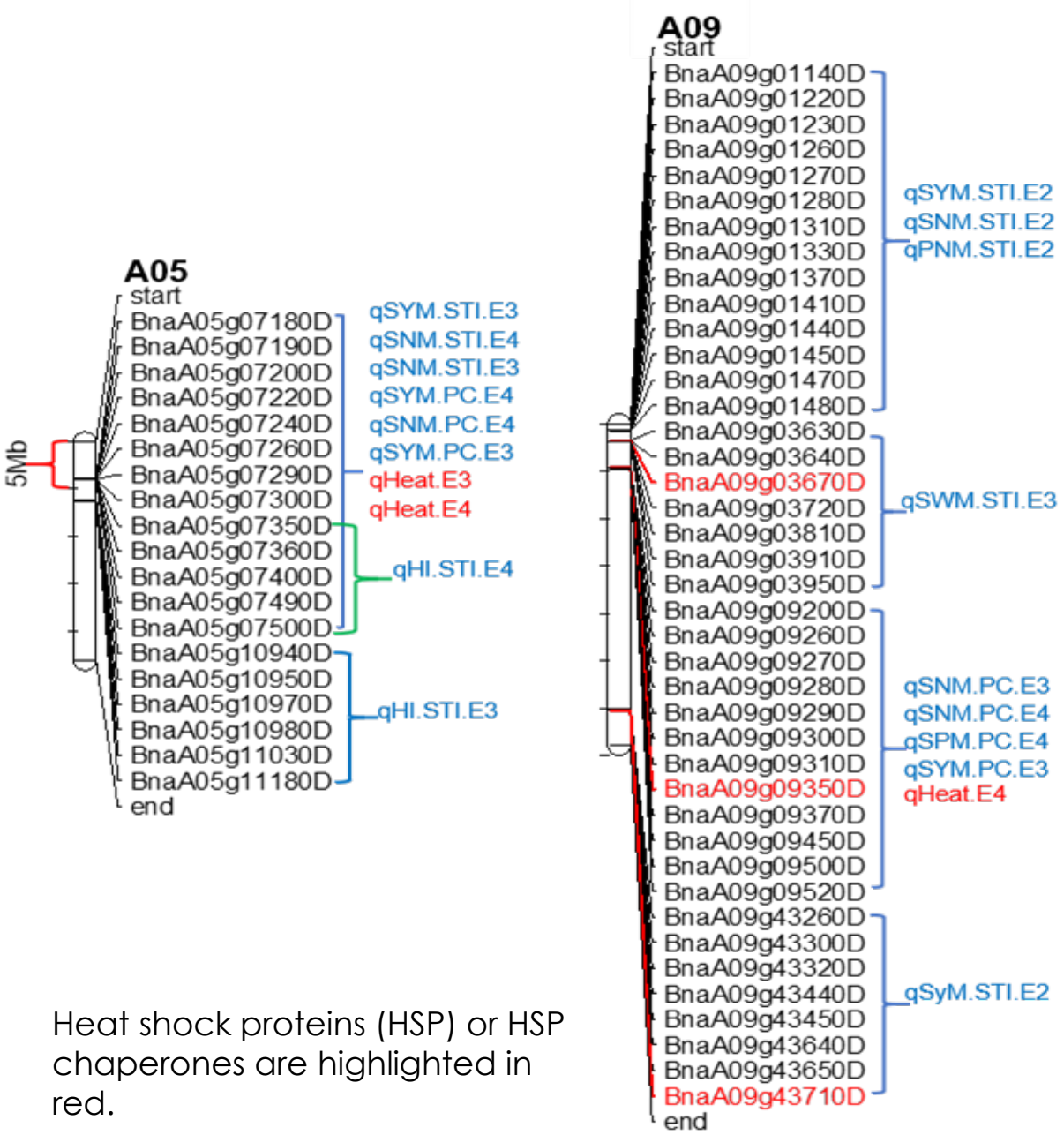
Funded by GRDC: UWA1905 project

Validation of heat-tolerant lines in field trials (Leeton 2020)



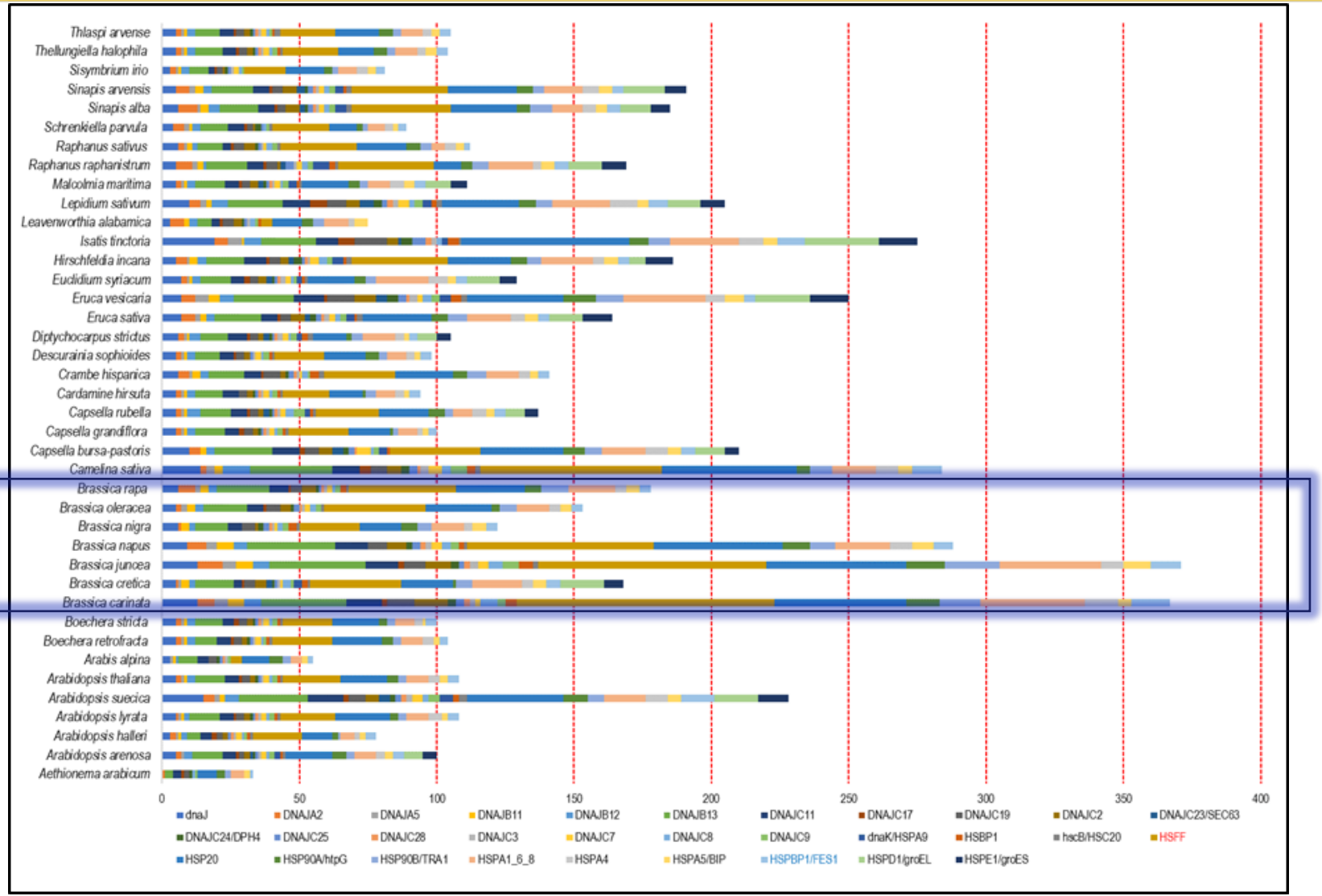
GWAS analysis of heat tolerance traits & Candidate genes in the regions

Physical map of Chr A05 & A09



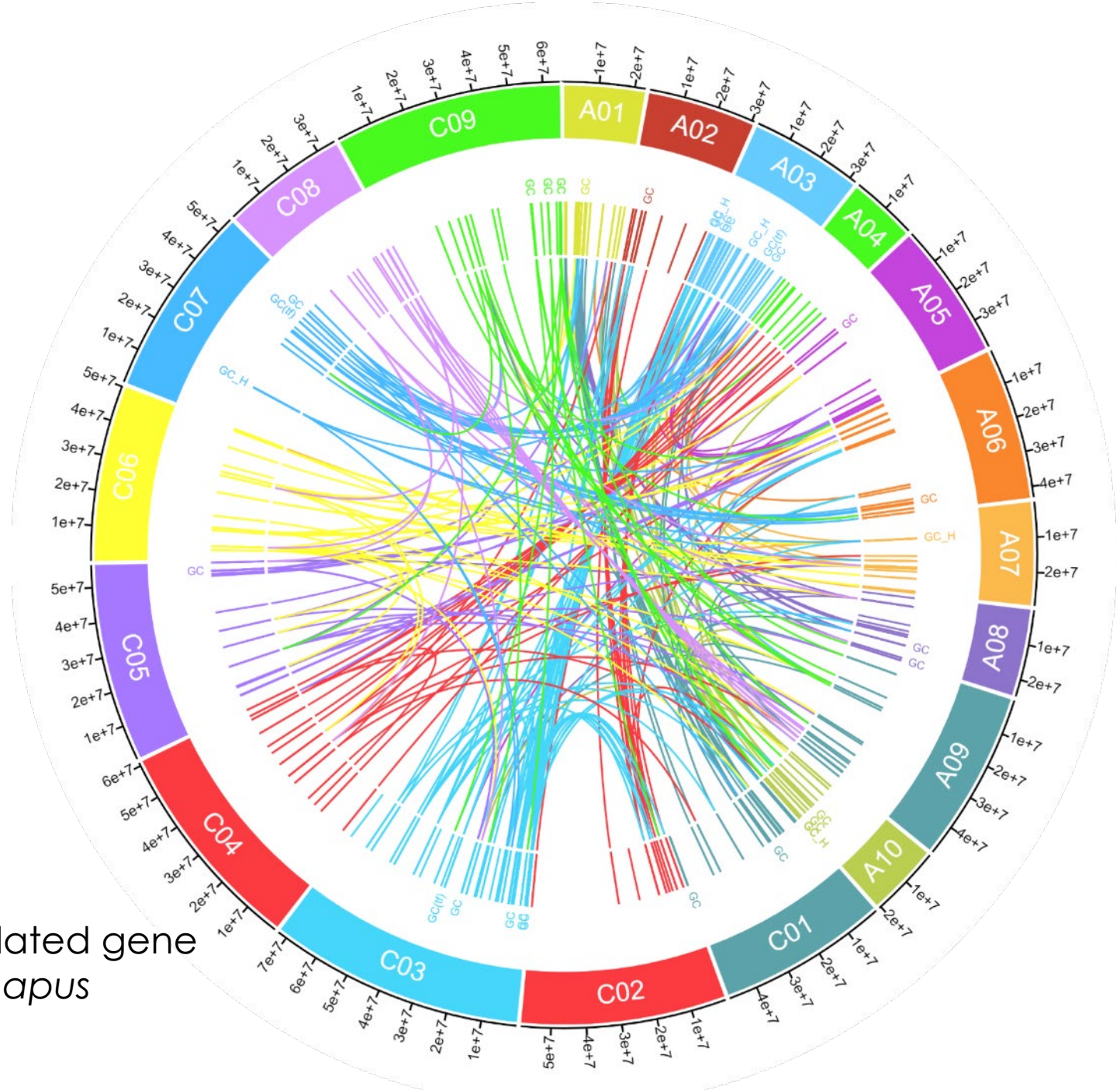
Heat shock proteins (HSP) or HSP chaperones are highlighted in red.

Heat-related gene domains across 40 Brassicaceae species



The number and distribution of DNAJ and HSP-related gene domains across 40 Brassicaceae species

High frequency of gene duplication in *B. napus*



DNAJ & HSP-related gene domains in *B. napus*