



VI SPANISH SYMPOSIUM
ON PHYSIOLOGY AND
BREEDING OF CEREALS
16-17 OCTOBER · SALAMANCA 2024

Response of barley landraces and heritage varieties under heat stress conditions in the greenhouse

Rubén Sancho, Aziza Zerrouk, Ana Casas, Ernesto Igartua

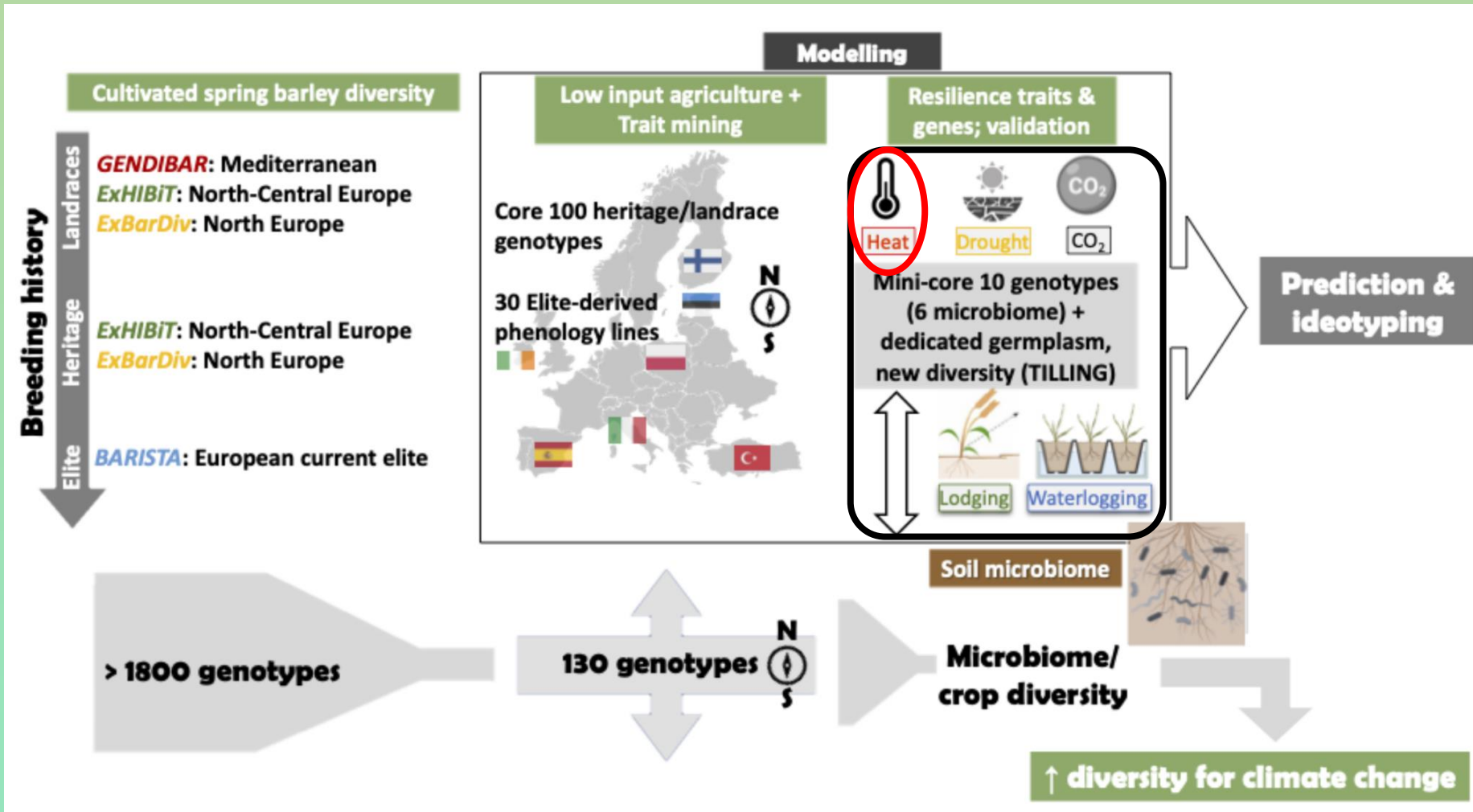
Estación Experimental de Aula Dei (EEAD, CSIC), Zaragoza, Spain





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An Roinn Talmhaíochta,
Bia agus Mara
Department of Agriculture,
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EXPERIMENTAL DESIGN

Genotypes & Design

12 barley genotypes

Including landraces, old and modern cultivars

2 treatments (control and heat)

4 pots/treatment

2 plants/pot

Conditions

Control greenhouse (C)

20 °C-day; 15 °C-night

Well watered (90% FC)

Heat greenhouse (H)

32 °C-day; 24 °C-night

Well watered (90% FC)

Z39 (Flag leaf ligule just visible)

7 days

Two data sets

1

All spikes of two plants
(experimental unit: pot)

2

Labelled tillers (5+5)
(experimental unit: (10) labelled spikes)

Parameters

- ✓ Total no. and weight* of spikes
- ✓ Total no. and weight* of seeds
- ✓ Rachis weight*

- ✓ Average weight spikes*
- ✓ Average no. and weight* of seeds
- ✓ Average rachis weight*
- ✓ Average no. of total and fertile spikelets
- ✓ Average (visual) seed set [fertile spikelets/total spikelets x 100]
- ✓ Average spike length (mm)
- ✓ Fruiting efficiency [Number seeds/rachis weight (g)]
- ✓ Thousand Grain Weight (g) (TGW)

*After drying for 3 days at 70°C

EXPERIMENTAL DESIGN

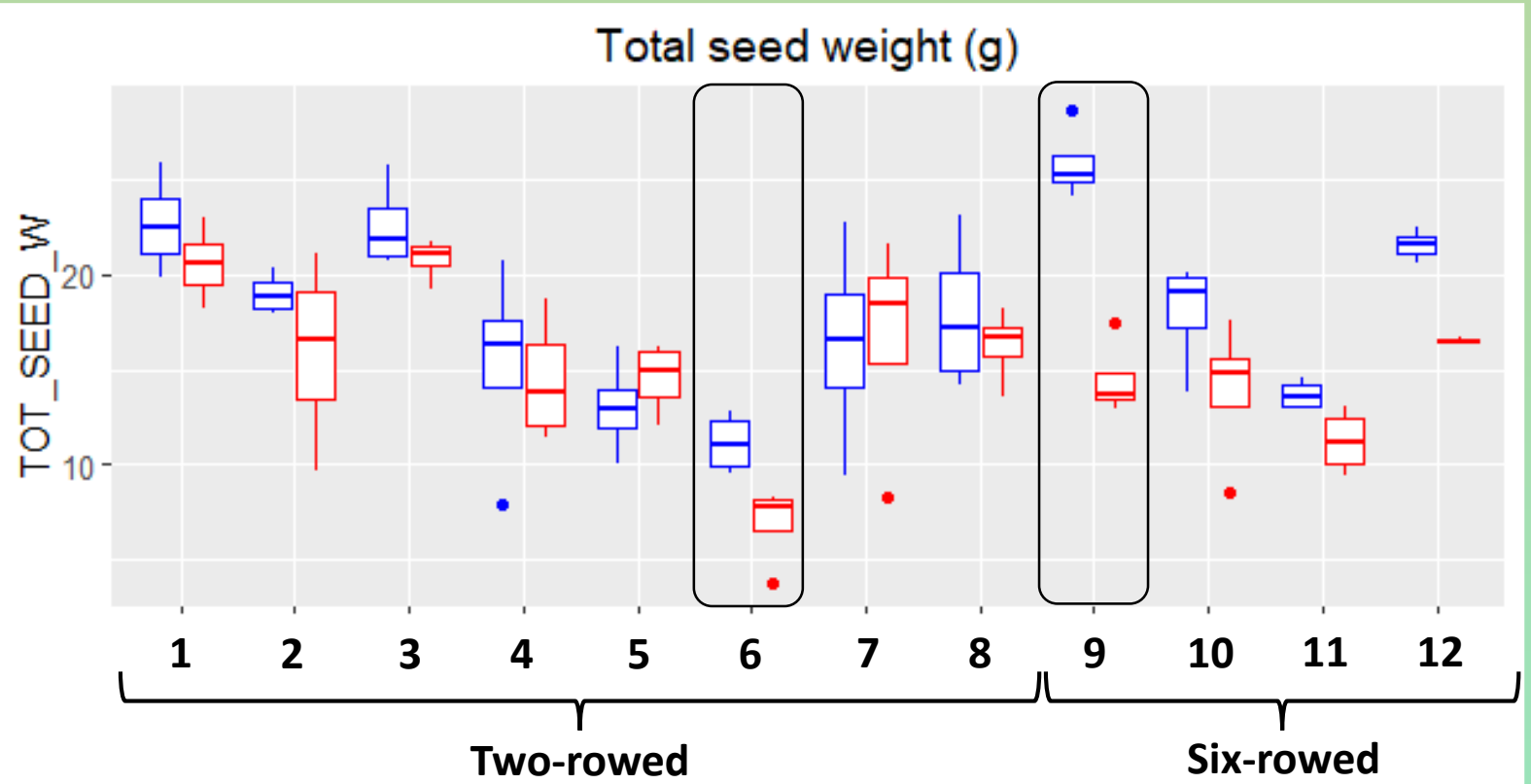
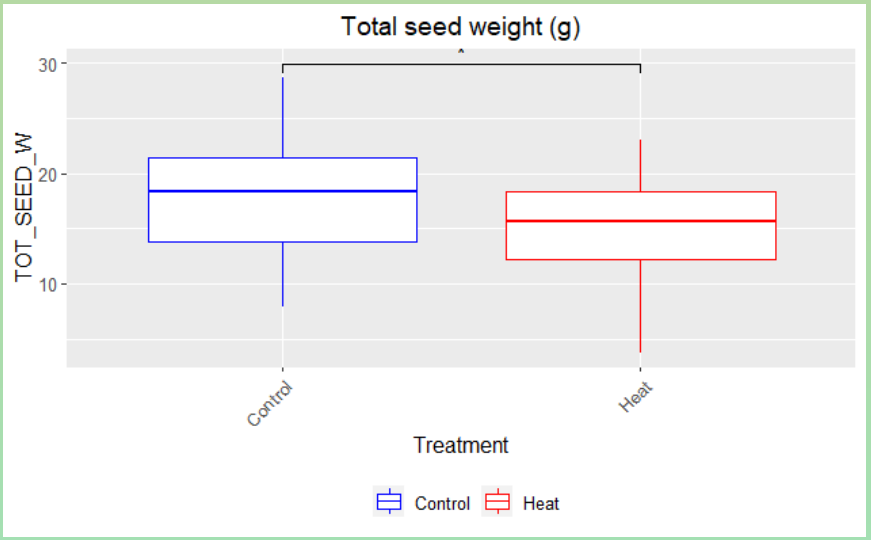


RESULTS per POT (two plants, all spikes)



RESULTS per POT (two plants, all spikes)

Total Seed weight (g)



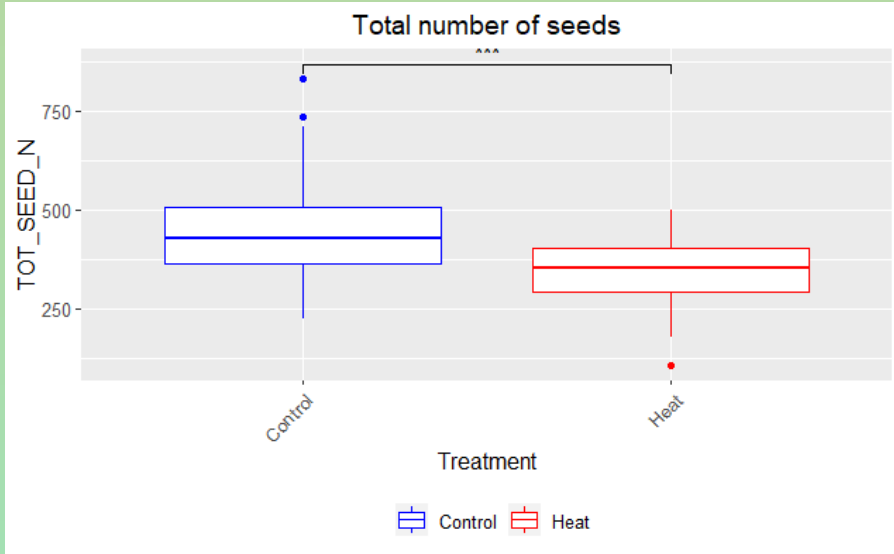
Within the black rectangle, genotypes with significant differences between treatments are indicated.

Genotype
▢ Control ▢ Heat

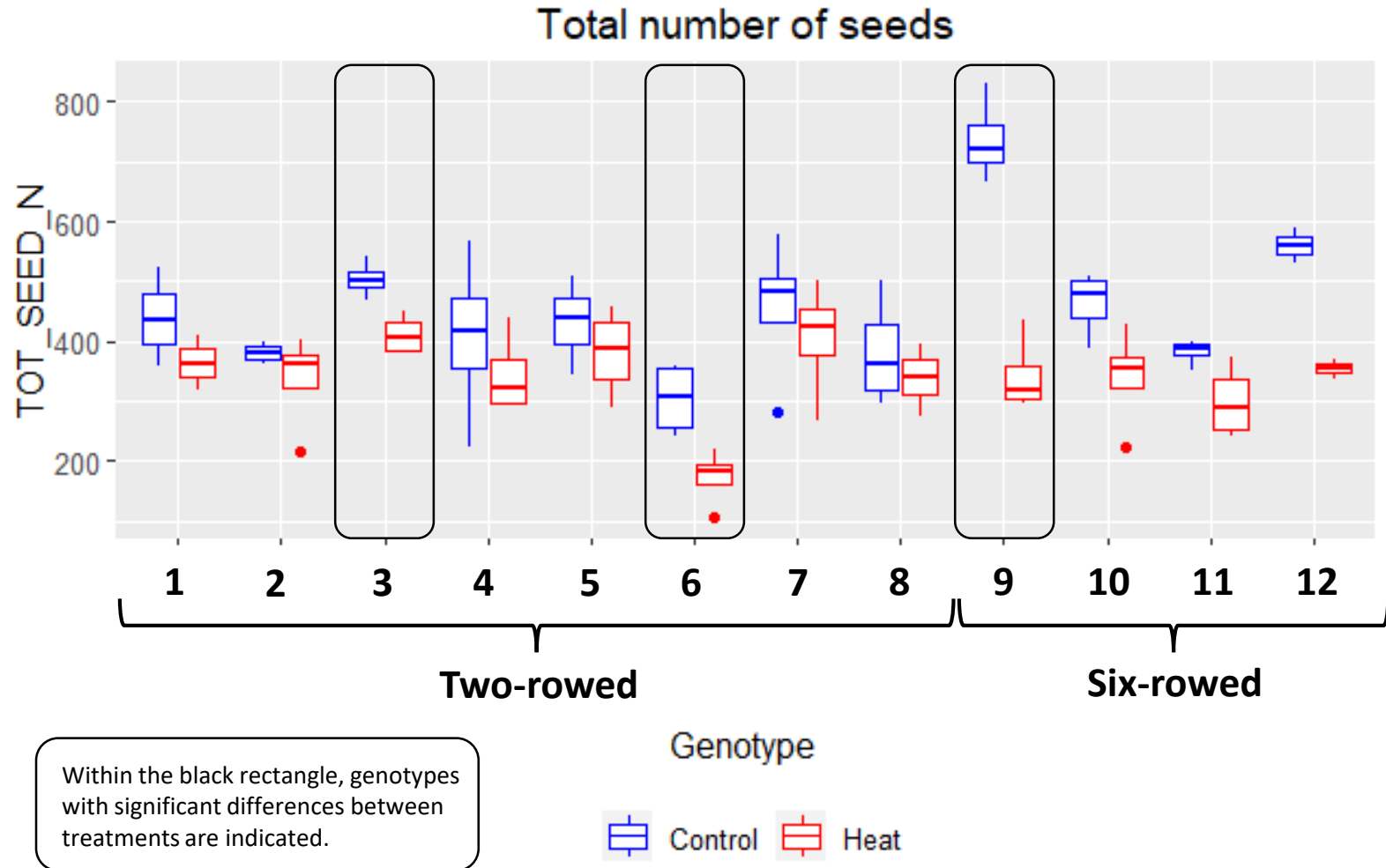
Genotype-6: (11.1 g (C) and 6.9 g (H); ≈-38%)
 Genotype-9: (25.9 g (C) and 14.5 g (H); ≈-44%)

RESULTS per POT (two plants, all spikes)

Total Seed number



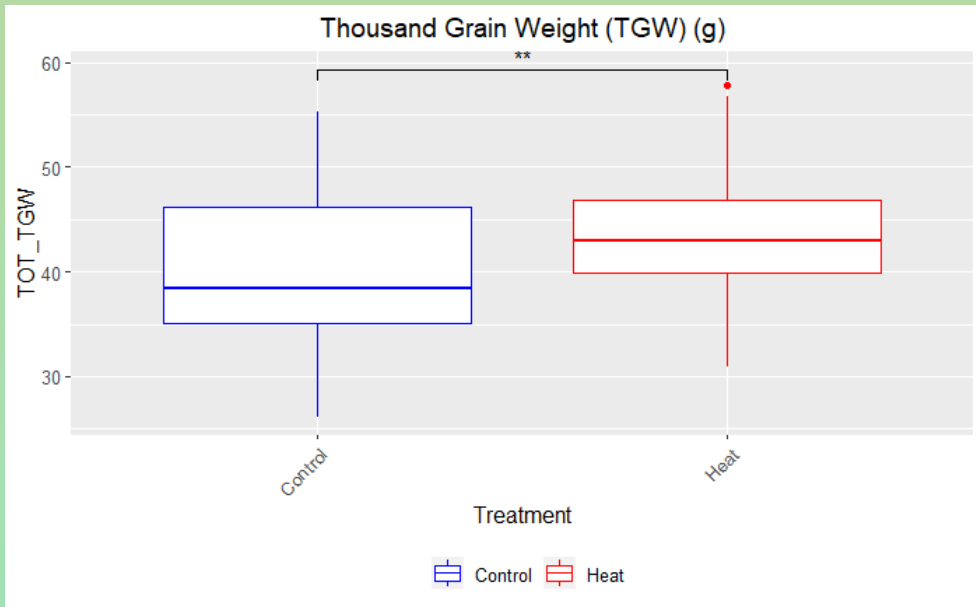
Genotype-3: (503.5 (C) and 411.5 (H); \approx -18%)
 Genotype-6: (304 (C) and 172.3 (H); \approx -43%)
 Genotype-9: (735.5 (C) and 342.8 (H); \approx -53%)



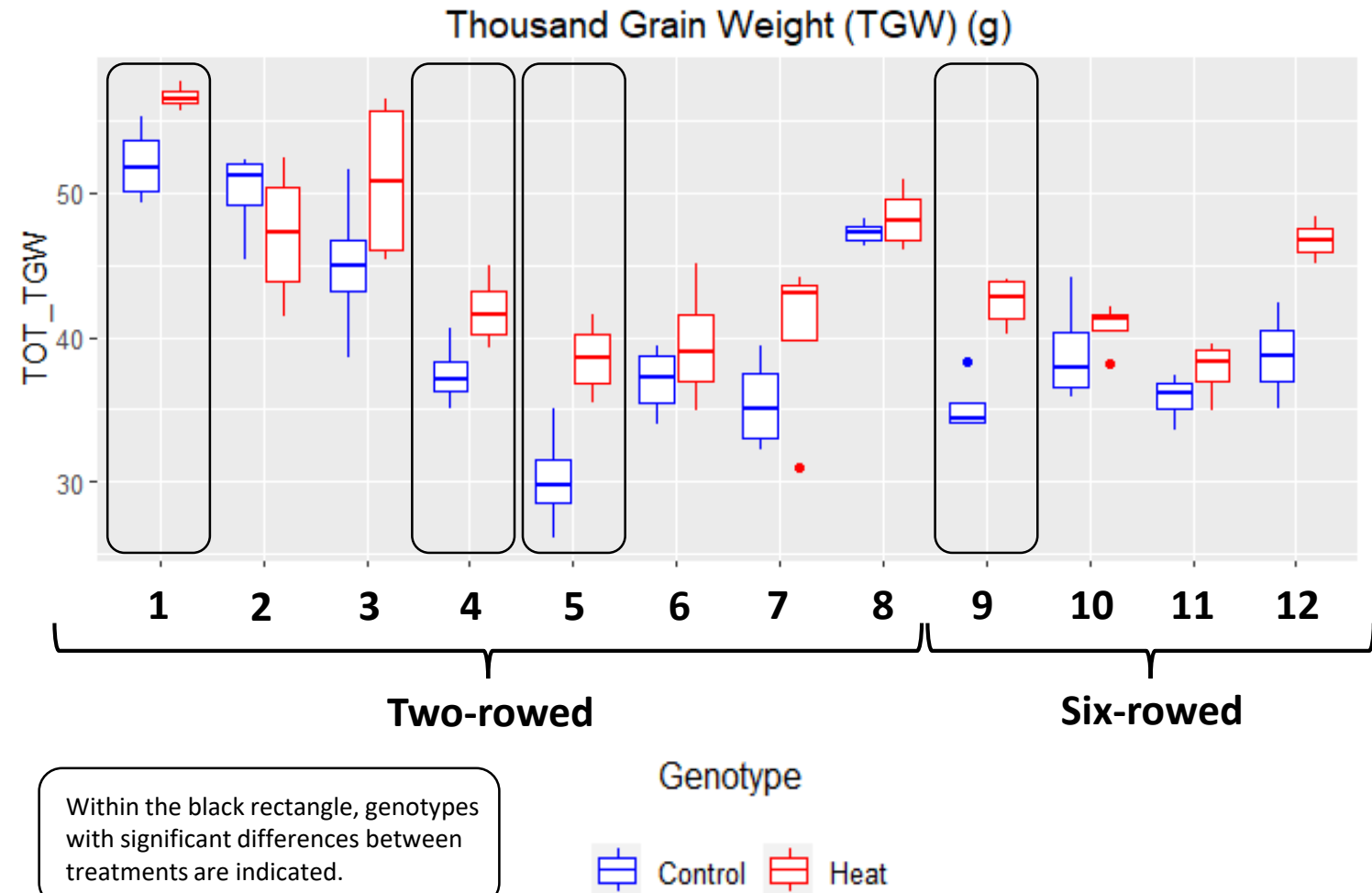
Within the black rectangle, genotypes with significant differences between treatments are indicated.

RESULTS per POT (two plants, all spikes)

Thousand Grain Weight (g) (TGW) (seed weight (g) x 1000/number of seeds)



Genotype-1: (52 (C) and 56.7 (H); ≈+8%)
 Genotype-4: (37.5 (C) and 41.8 (H); ≈+10%)
 Genotype-9: (35.3 (C) and 42.4 (H); ≈+17%)
 Genotype-5: (30.2 (C) and 38.5 (H); ≈+22%)

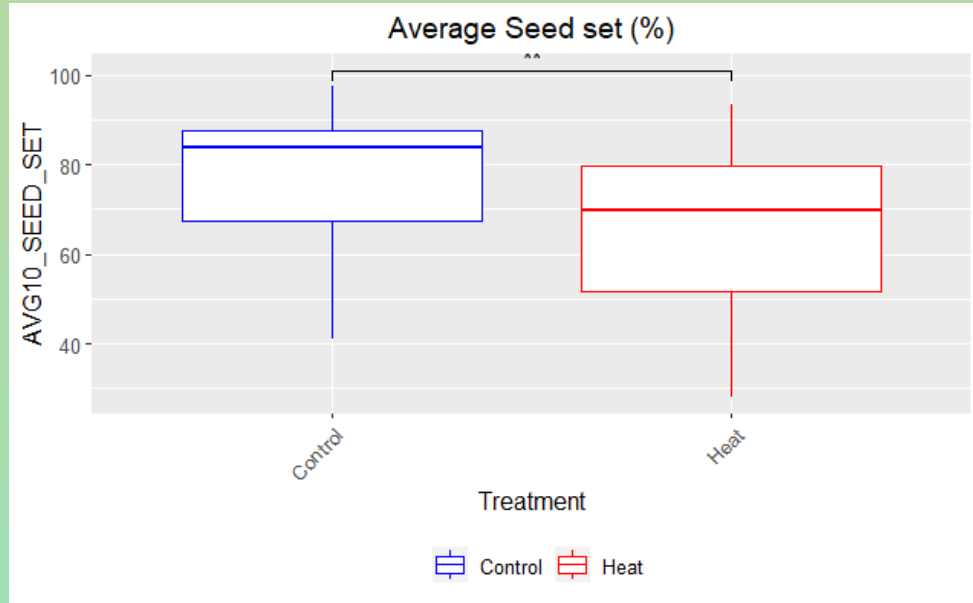


RESULTS per 10 labelled tillers (5+5 spikes for each plant)

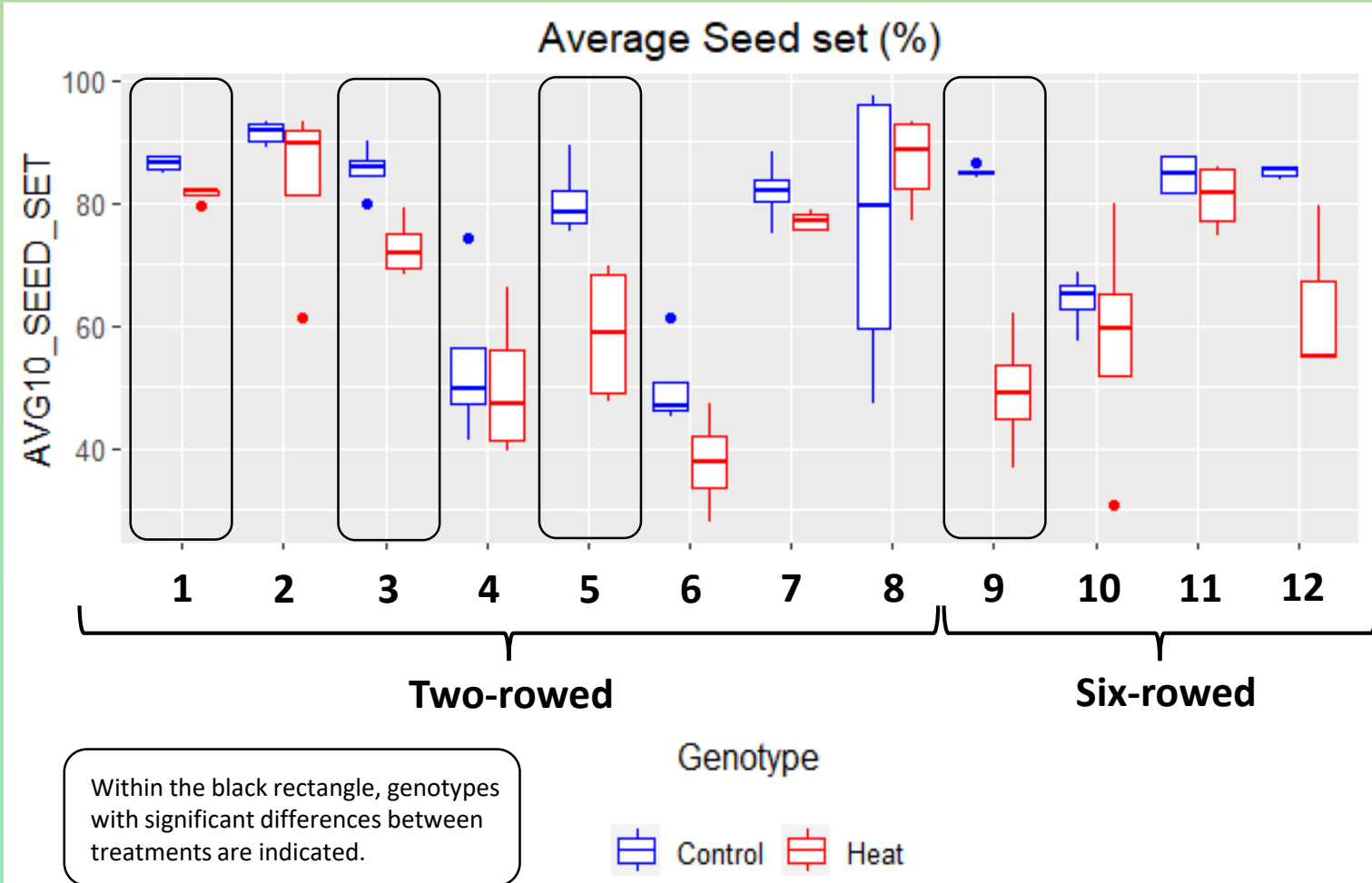


RESULTS per 10 labelled tillers (5+5 spikes)

(Visual) seed set
(fertile spikelets/total spikelets * 100)

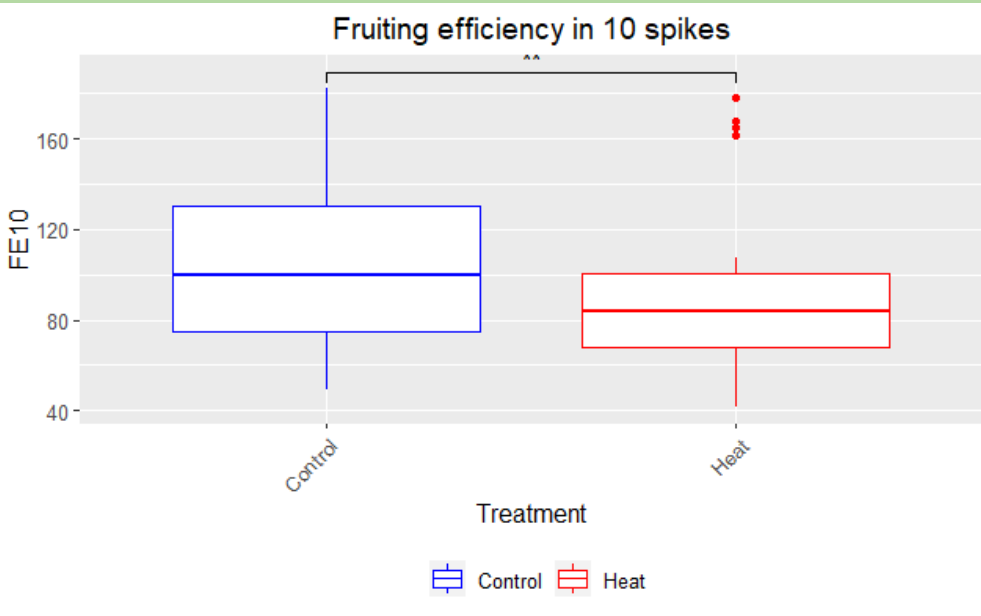


Genotype-1: (86.5% (C) and 81.5% (H); ≈-5%)
 Genotype-3: (85.6% (C) and 72.8% (H); ≈-13%)
 Genotype-5: (80.5% (C) and 58.7% (H); ≈-22%)
 Genotype-9: (85.2% (C) and 49.2% (H); ≈-36%)

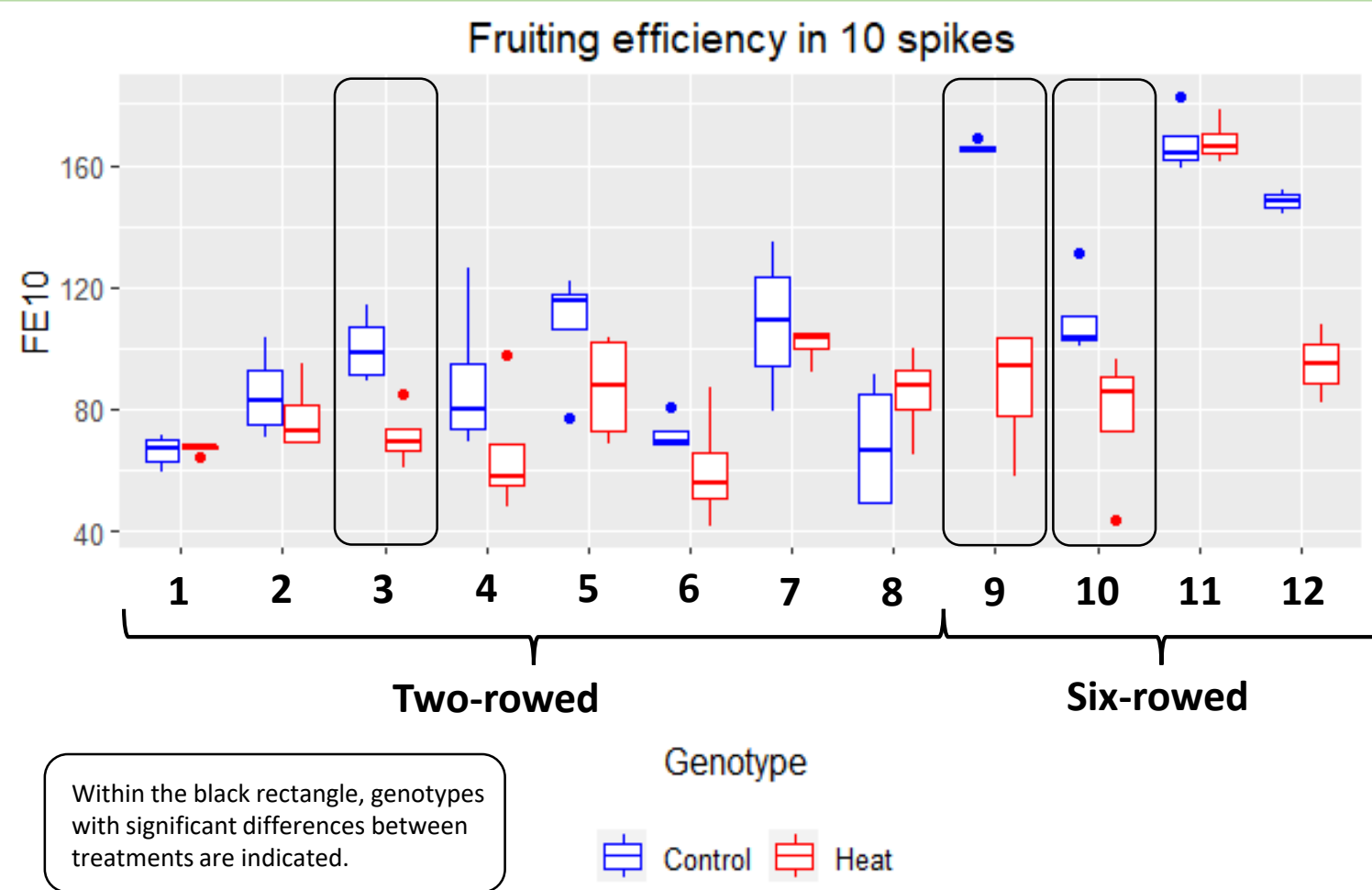


RESULTS per 10 labelled tillers (5+5 spikes)

Fruiting efficiency (Number seeds/rachis weight (g))



Genotype-3: (99.9 (C) and 70.8 (H); $\approx -29\%$)
 Genotype-10: (109.7 (C) and 77.8 (H); $\approx -29\%$)
 Genotype-9: (166 (C) and 87.3 (H); $\approx -47\%$)



SUMMARY

The analysis of all the spikes from each pot shows that heat:

- ✓ **Had a negative effect** on both **total weight** and **total number of seeds**, but it was **more** significant on **number of seeds**
- ✓ **Reduced the total number of seeds** in Genotype-3 and **both** the **total number** and **total weight of seeds** in Genotype-6 and Genotype-9
- ✓ As a consequence of the **reduction in the number of seeds** under heat conditions in some genotypes, and that **grain filling takes place under control (optimal) conditions**, some varieties **increased the thousand-grain weight**

The analysis of the ten labelled tillers shows that heat:

- ✓ **Reduced the seed set** in Genotype-3, Genotype-5, Genotype-9 and, to a lesser extent, in Genotype-1
- ✓ **Reduced the fruiting efficiency** in Genotype-3, Genotype-9 and Genotype-10

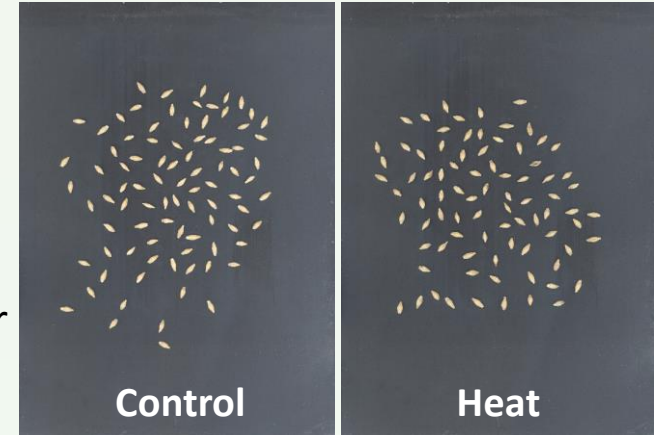
- Genotype-9 was the most **heat-sensitive** 6-row variety and, to a lesser extent Genotype-10
- Genotype-3, Genotype-5 and Genotype-6 **were more sensitive to heat** stress than Genotype-1. The varieties Genotype-2, and especially Genotype-7 and Genotype-8 **showed tolerance to heat**

NEXT STEPS...

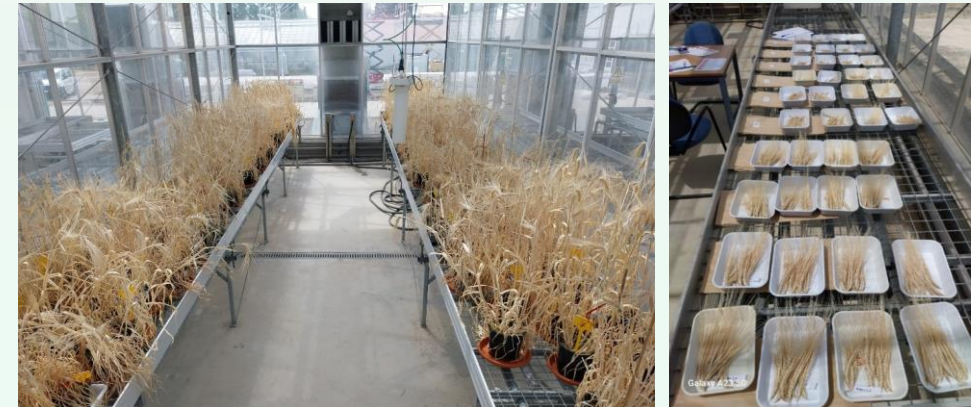
Analyze the photographs of the spikes (control and heat) to see which part of the spike (top, middle, bottom) is most affected by heat



Analyze seed scans to determine morphological differences of genotypes under control versus heat conditions



Repeat the greenhouse experiment with the same varieties to increase statistical power since some samples had to be discarded



Test the same genotypes in field using tunnels/cabins to apply heat stress



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Genetics and Plant Breeding Lab

Research Leader: Ernesto Igartua

Researchers: Ana María Casas, Dolors Villegas

Post-Doctorals: Rubén Sancho

Post-Graduates: Aziza Zerrouk, Francesc Montardit

Technicians: Alejandra Cabeza, María Asunción Costar, Patricia Fustero, Francisco Javier Gozalo, Vanesa Martínez, Antonio Pérez

External Personnel: Achraf Elamrani, David Gómez Candón



Thank you for your attention