Transgenic Wheat Plants under Heat Stress

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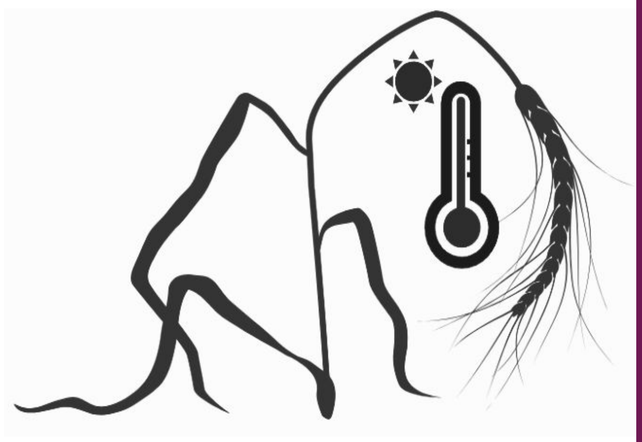
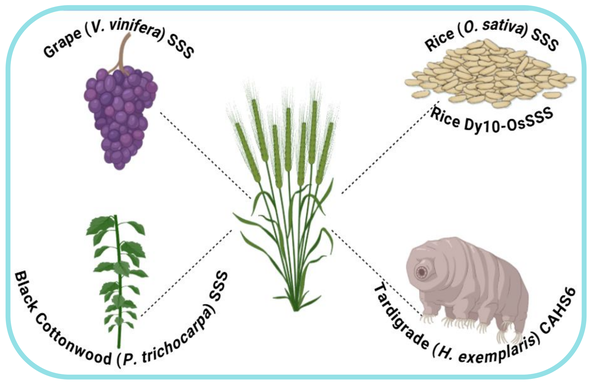


Background

- ∴ As one of the world's most consumed crops, wheat must remain versatile and accessible.
- ∴ Reproductive-stage wheat plants subjected to temperatures above 22°C begin to lose their ability to produce starch and viable pollen [1]. For example, Wardlaw (1989) found that each 1°C above optimal temperature can reduce wheat yield by 3 to 4%.
- ∴ Are transgenic wheat plants with genes from heat-tolerant plants and animals an effective and potentially long-term solution?



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Objective

Evaluate the pollen viability and seed quality of transgenic wheat plants containing heat-tolerant genes during heat-stress conditions.

Methods

Organism: *Triticum aestivum*, 'Bobwhite' wheat plants subjected to biolistic transformation with soluble starch synthase (SSS) and cytoplasmic abundant heat-soluble 6 (CAHS6) genes

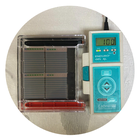
Feekes stage 10 plants from greenhouse and growth chambers were subjected to heat treatment. When the plants reached Feekes 10.0-10.5, pollen and leaf samples were collected. When the plants matured, seeds were collected.

Treatments: (each with 1 wild type and 6 transgenics)

Group 1- from growth chamber, 20/15°C
Group 2- from growth chamber, 35/32°C
Group 3- from greenhouse, 20/15°C
Group 4- from greenhouse, 35/32°C

Assess pollen viability by staining [2] and viewing under 10x and 40x objective
Viable Nonviable

Isolate leaf DNA and amplify using a 25 µL PCR with transgene-specific primers



Perform gel electrophoresis using PCR products and a 100 base-pair DNA ladder

Harvest seeds and record each plant's 1000 kernel weight (TKW)

Results

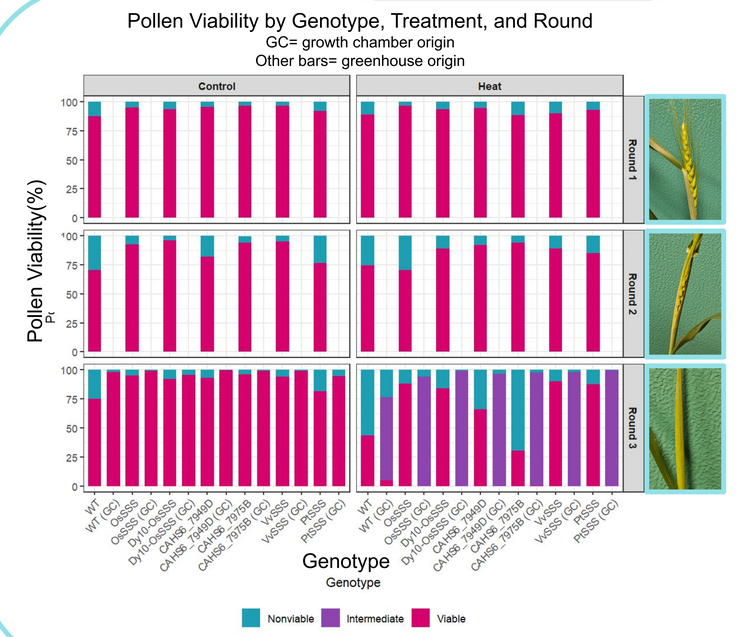


Fig. 1.
Round 1- placed in heat stress at Feekes 10.4-10.5
Round 2- placed in heat stress at Feekes 10.1
Round 3- placed in heat stress at Feekes 10.0

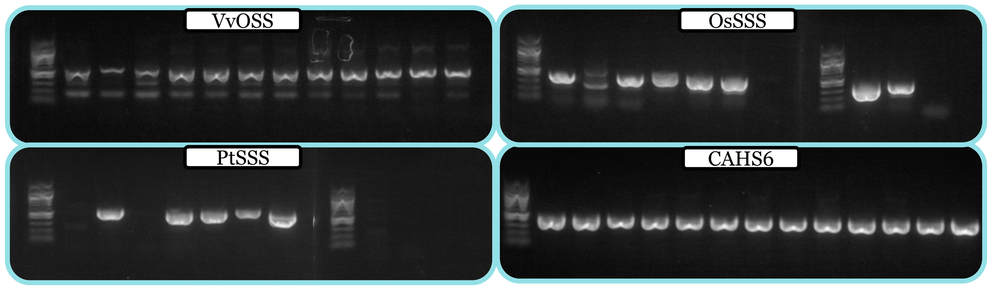


Fig. 2. Agarose gels of PCRs that identify whether each transgenic plant possesses its gene of interest (VvOSS, OsSSS, PtSSS & CAHS6).

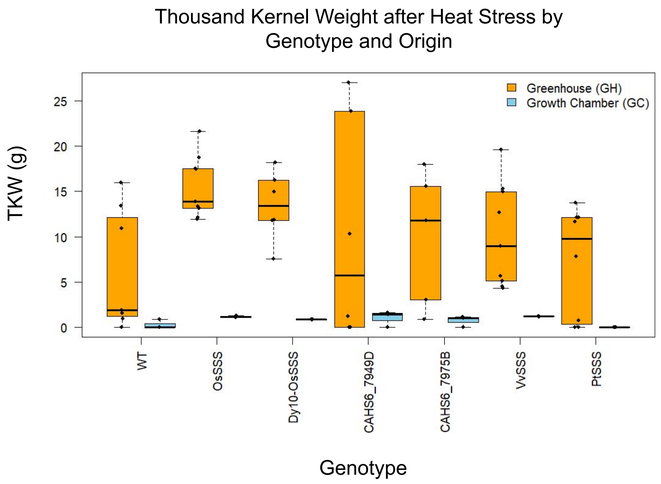


Fig. 3. Thousand kernel weight (TKW) is the median TKW for all 3 rounds of each genotype. Bars represent spread of TKW values, and dots represent individual TKWs.

Summary

- ∴ Heat stress decreases pollen viability, especially applied during the boot stage (Feekes 10), observed in round 3 plants.
- ∴ All plants possessed the gene of interest, except two of the PtSSS transgenes. This indicates that PtSSS plants were still segregating for the transgene.
- ∴ Despite heat stress, plants from the greenhouse produced larger seeds than plants from the growth chamber. A trend of increased pollen viability and TKW was observed from the OsSSS and VvSSS transgenes (from greenhouse). This observation may be the result of acclimation, as greenhouse temperatures fluctuated more than growth chamber temperatures.
- ∴ Further studies are needed to induce heat stress at Feekes 10 with additional replications.

Scan for more information

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Sources

1. H.S. Saini. (1982). *Annals of Botany*, 49.
2. Peterson, R. (2010). *International Journal of Plant Biology*, 1.
3. Wardlaw, I. (1989). *Crop and Pasture Science*, 40.

Acknowledgements

Kansas State University
Kansas Wheat
USDA National Institute of Food and Agriculture
U.S. Department of Agriculture

This work is supported by the NIFA Research and Extension Experiences for Undergraduates (REEU) Program grant no. 2024-68018-42431/project accession no. 1032359 from the U.S. Department of Agriculture, National Institute of Food and Agriculture.