Institute of Agricultural Sciences in the Tropics (Hans- Ruthenberg-Institute) Water stress Management (490g)

Assessing physiological responses in different leaf positions of wheat genotypes under water deficit

Prem Sagar Mathangi[1], Geckem Dambo[1], Alejandro Pieters[1], Matthew Reynolds[2], Folkard Asch[1]

[1]University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Germany
[2]CIMMYT, Physiology and Remote Sensing, Mexico

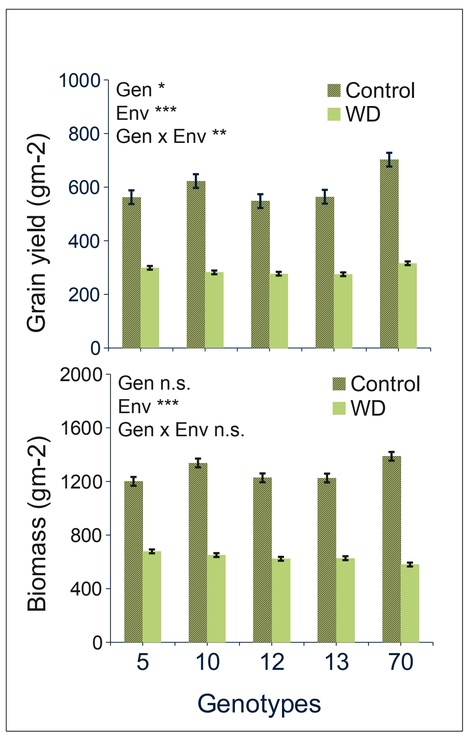
Introduction

- Heading and grain-filling stages are highly susceptible to water deficit. Flag leaf is the most metabolically active in providing carbohydrates for grain filling.
- Lower leaves also contribute to yield, but their response to water deficit is not well studied.
- This study examines physiological changes in flag and third leaves of five genotypes from CIMMYT's Best Physiological Traits (PT) panel grown in the field under well-watered and water deficit conditions.

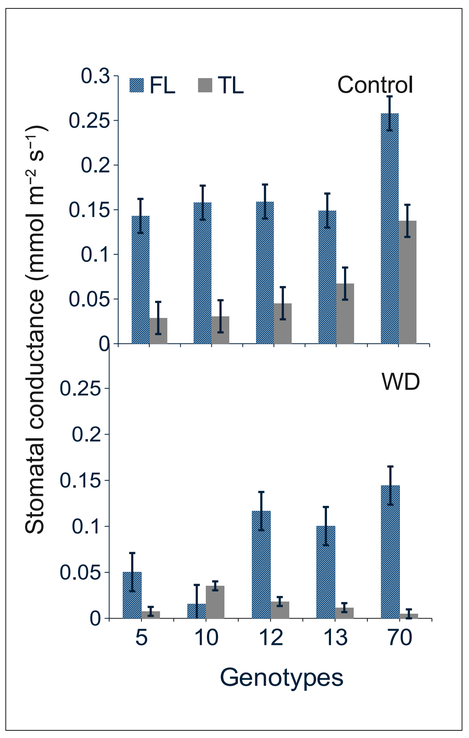
Conclusions

- Results show that SPAD values, transpiration rate, and stomatal conductance decreased under the water deficit.
- Flag leaves consistently showed higher stomatal conductance and SPAD values compared to third leaves. However, under water deficit, PSII efficiency declined, particularly in the third leaf, while flag leaves were less affected.
- Genetic differences were observed in terms of yield and physiological responses, but no significant differences were found in PSII efficiency across genotypes.

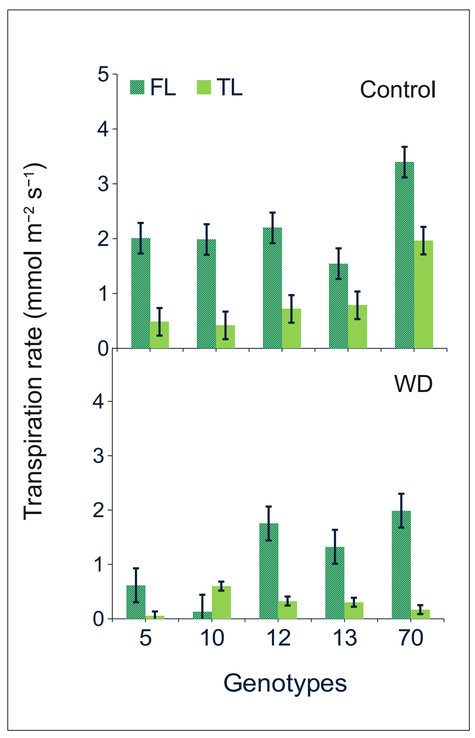
Results and Discussion



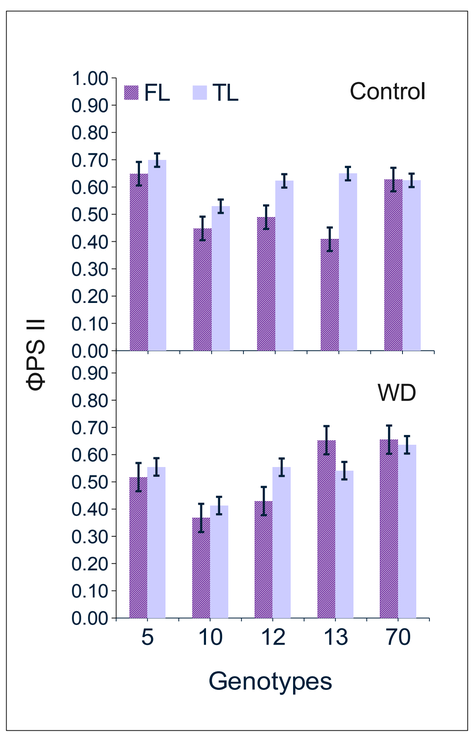
- Water deficit decreased grain yield and biomass.
- Genetic differences and significant GxE interactions were observed in grain yield but not in biomass.



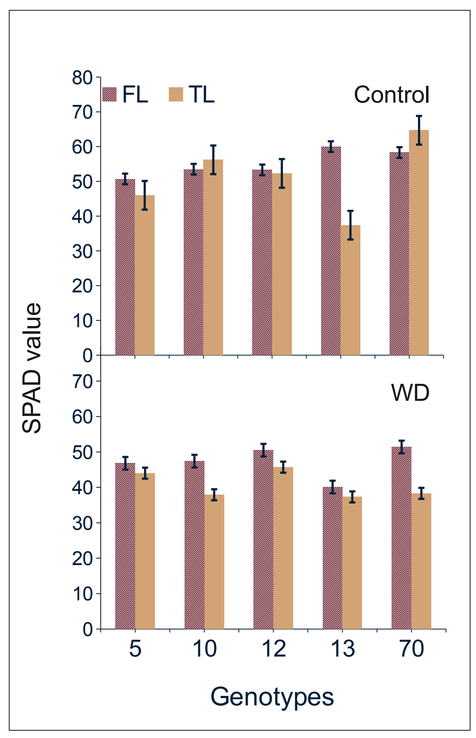
- As expected, stomatal conductance decreased under water deficit in both leaf positions.
- Flag leaves showed a higher stomatal conductance compared to the third leaves in both, control and water deficit.



- Transpiration rate followed the same response to water deficit as stomatal conductance.
- As in stomatal conductance, transpiration was lower in the third leaf compared to the flag leaf, except for genotype 10.



- Drought did not affect significantly the efficiency of PSII in the flag leaf.
- However, water deficit decreased the efficiency of PSII in the third leaf.
- No genotypic differences could be detected.



- Chlorophyll concentration as estimated by SPAD measurements decreased with water deficit.
- On average, flag leaves showed higher chlorophyll concentrations than third leaves.

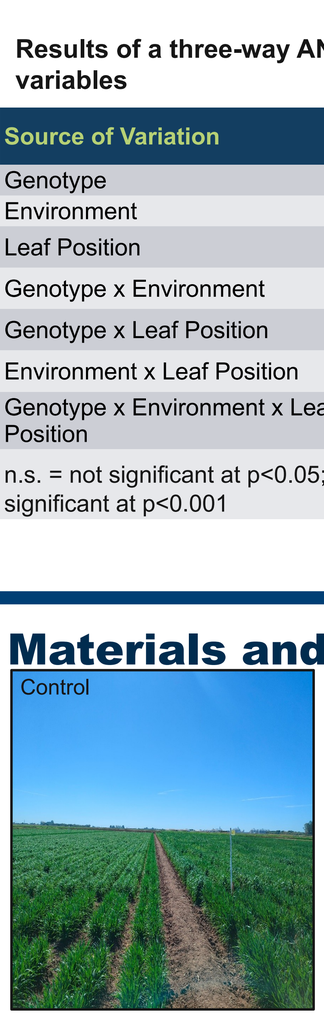
Results of a three-way ANOVA showing level of significance for physiological variables

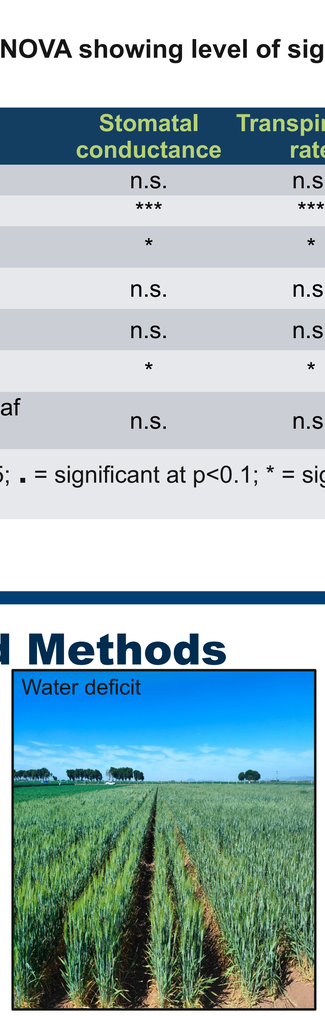
Source of Variation	Stomatal conductance	Transpiration rate	Φ PSII	SPAD value
Genotype	n.s.	n.s.	n.s.	n.s.
Environment	***	***	.	***
Leaf Position	*	*	n.s.	***
Genotype x Environment	n.s.	n.s.	n.s.	n.s.
Genotype x Leaf Position	n.s.	n.s.	n.s.	n.s.
Environment x Leaf Position	*	*	n.s.	*
Genotype x Environment x Leaf Position	n.s.	n.s.	n.s.	n.s.

n.s. = not significant at p<0.05; . = significant at p<0.1; * = significant at p< 0.05; *** = significant at p<0.001

- The heat map of correlations among physiological traits and yield showed that in the control PSII efficiency showed a moderate positive correlation with yield and biomass.
- Correlation between PSII efficiency and biomass and yield was stronger at the third than at the flag leaf
- Under WD, correlation patterns changed, showing weak relationships and positive or negative correlations between yield and crop performance traits, particularly affecting PSII efficiency, Gs, and transpiration.

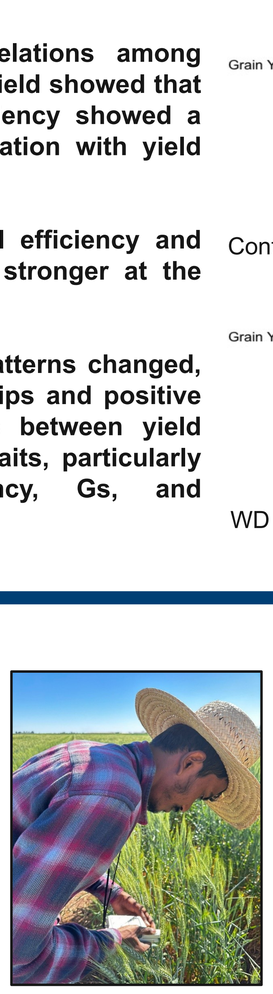
Materials and Methods





A field experiment was conducted on Nov 2023 at CIMMYT CENEB, Ciudad Obregon, Mexico. Seventy two genotypes of the Best PT panel were planted and 5 genotypes were selected for physiological characterization.

The water deficit treatment was irrigated at sowing, and the well-watered environment was irrigated at the sowing stage and every 15 days and later adjusted to every 10 days during late grain filling.



Physiological parameters were measured using the LICOR LI-600 porometer and SPAD 502 Plus during grain filling stage on the flag and the third leaves counted from the top.

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