EVALUATION OF SPRING BARLEY VARIETIES FOR POST-ANTHESIS DROUGHT TOLERANCE

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INTRODUCTION

Heat stress is one of the most severe abiotic factors limiting cereal productivity and requires intensified breeding efforts. Although high temperatures may occur during different stages, their incidence in the post-anthesis period causes significant yield losses by disrupting grain formation and filling processes. Even though the experiment was conducted in a favorable barley-growing area, local meteorological data indicate a consistent increase in post-anthesis temperatures over the past three decades. Consequently, barley is increasingly affected by the negative effects of this stress factor.

In this context, assessing heat tolerance and cultivar performance in relation to current climatic trends becomes essential.

MATERIAL AND METHOD

In the present study, chemical desiccation was employed to simulate the effects of heat stress and inhibit photosynthesis, aiming to evaluate the capacity of spring barley varieties to remobilize assimilates from vegetative organs to the grain as a compensatory mechanism.

The research was conducted over three years at the Agricultural Research and Development Station (ARDS) Turda and included ten spring barley varieties: Romanița, Daciana, Jubileu, Adina, Xanadu, Marthe, Vienna, Victoriana, Chronicle, Armada.

The response of each genotype was evaluated under both simulated stress and natural field conditions. The analyzed traits focused on the main yield components: number of grains per spike, grain weight per spike, and thousand-kernel weight (TKW). Experimental data was processed using Descriptive Statistics and Box Plot was used for graphical representation. Statistical analysis was performed with Microsoft Excel and Past4.

Genotype under chemical stress

Control (without desiccation)

RESULTS AND DISCUSSION

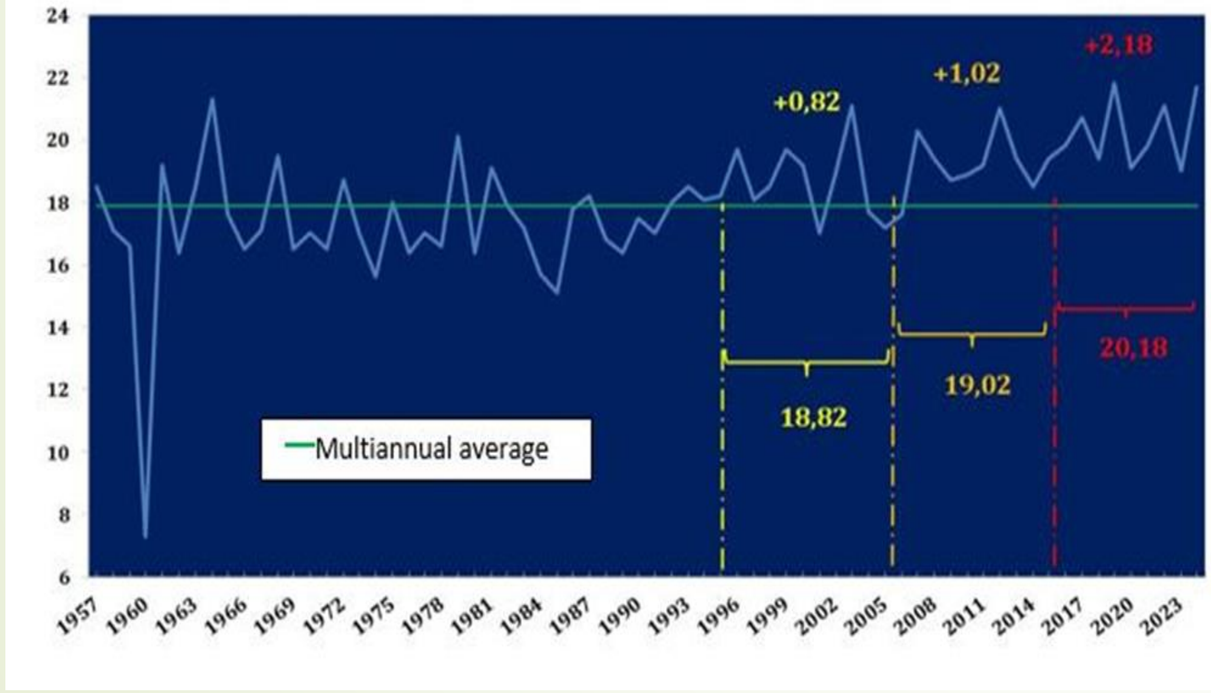
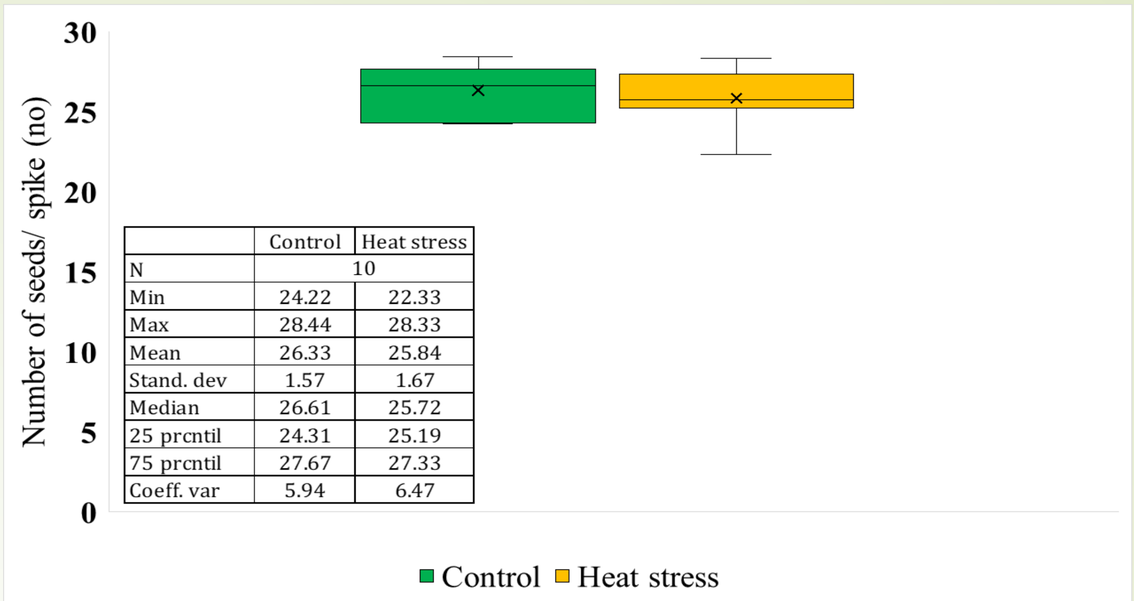


Figure 1. Variation of average monthly temperature during post-anthesis (stage) in the last 67 years

Our study investigated the effect of heat stress on the number of grains in ten spring barley varieties. On average, the number of grains decreased slightly, from 26.33 under control conditions to 25.84 under heat stress, indicating a moderate impact of high temperatures on yield. However, responses varied among varieties: Jubileu, Xanadu and Marthe showed significant reductions, indicating sensitivity to heat, while Adina, Victoriana and Chronicle remained stable or showed slight increases, demonstrating tolerance. These results suggest that selecting the appropriate varieties can help reduce losses and enhance crop resilience under heat stress conditions.

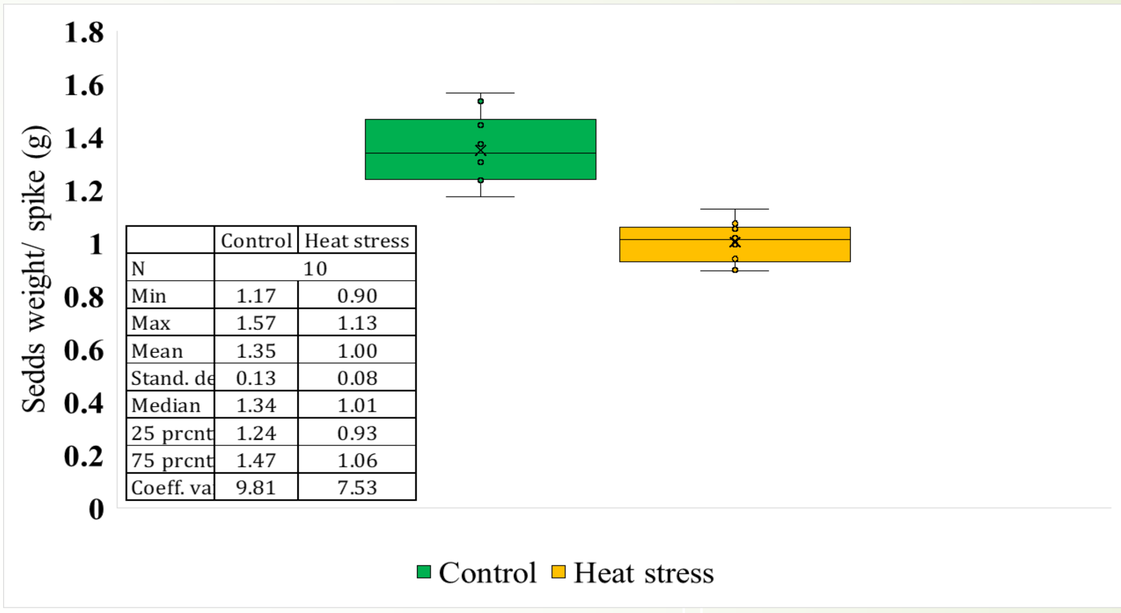
On average, grain weight decreased significantly from 1.35 g under control variant to 1.00 g under heat stress, indicating a substantial impact of high temperatures on individual grain mass. All varieties were affected, though the reduction was slightly more uniform than for grain number, with a decrease observed across both low and high-performing varieties. These results highlight that heat stress strongly reduces grain weight and varieties that maintain higher grain mass under stress could be considered more heat-tolerant, offering potential for improving crop resilience.

With respect of the weight of 1,000 grains, on average, it decreased from 50.93 g without desiccation to 38.41 g under heat stress, indicating a substantial reduction due to high temperatures. The minimum and maximum values also declined, from 45.92–54.99 g in control to 34.69–41.13 g under stress, showing that all varieties were affected, though to varying degrees. The standard deviation decreased slightly under stress (3.37 → 2.39 g) and the coefficient of variation remained relatively stable, suggesting a fairly uniform impact of heat across varieties. These results highlight that heat stress strongly reduces the total grain mass, and varieties maintaining higher 1,000- grain weight under stress can be considered more tolerant and suitable for breeding programs aimed at improving crop resilience.



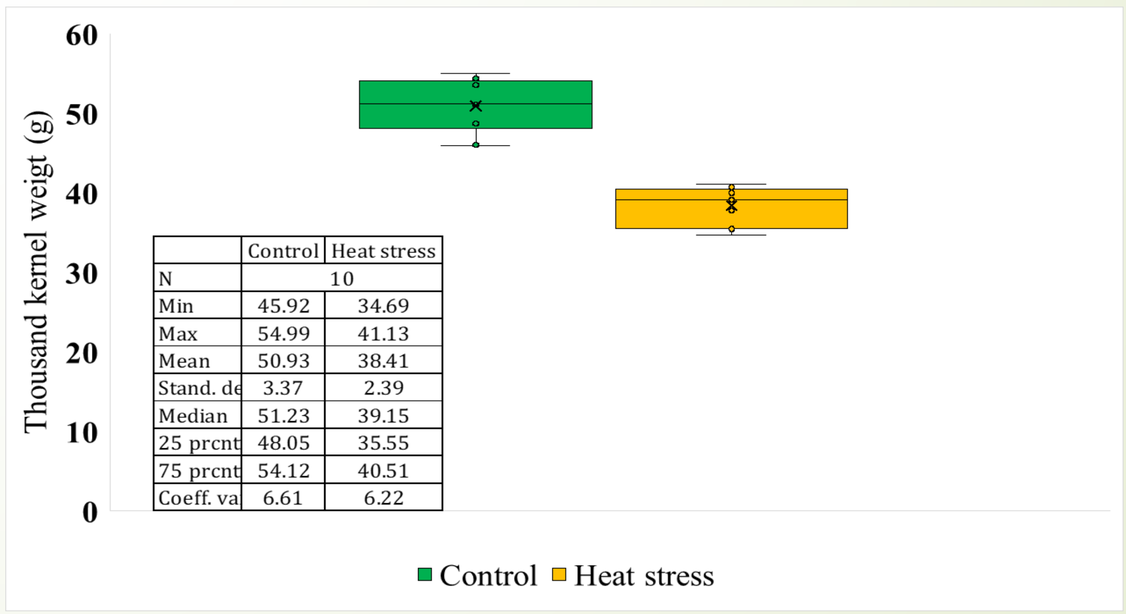
	Control	Heat stress
N	10	
Min	24.22	22.33
Max	28.44	28.33
Mean	26.33	25.84
Stand. dev	1.57	1.67
Median	26.61	25.72
25 prcntil	24.31	25.19
75 prcntil	27.67	27.33
Coeff. var	5.94	6.47

Figure 2. Variation in grain number per spike in 10 spring barley varieties under normal conditions versus stress conditions



	Control	Heat stress
N	10	
Min	1.17	0.90
Max	1.57	1.13
Mean	1.35	1.00
Stand. de	0.13	0.08
Median	1.34	1.01
25 prcnt	1.24	0.93
75 prcnt	1.47	1.06
Coeff. va	9.81	7.53

Figure 3. Variation in grain weight per spike in 10 spring barley varieties under normal conditions versus stress conditions



	Control	Heat stress
N	10	
Min	45.92	34.69
Max	54.99	41.13
Mean	50.93	38.41
Stand. de	3.37	2.39
Median	51.23	39.15
25 prcnt	48.05	35.55
75 prcnt	54.12	40.51
Coeff. va	6.61	6.22

Figure 4. Variation in TKW in 10 spring barley varieties under normal conditions versus stress conditions

CONCLUSIONS

Application of chemical desiccation proved effective in differentiating genotypes based on their adaptive responses, facilitating the identification of cultivars with enhanced heat tolerance. The selection of high-performing parents can guide breeding programs toward more targeted improvement strategies and accelerate the release of barley varieties with increased tolerance to heat stress.

- ✓ **Heat stress reduces yield components in spring barley:** both the number of grains per spike and grain weight decrease under high temperatures.
- ✓ **Genetic differences are evident:** Some varieties, such as Adina, Victoriana and Chronicle, showed relative tolerance, maintaining grain number and weight, while others like Jubileu, Xanadu, Marthe, Romanița, and Daciana were more sensitive.
- ✓ **Uniform effect on total grain weight:** The weight of 1,000 grains decreased significantly across all varieties, indicating that high temperatures impact overall productivity.
- ✓ **Breeding implications:** Varieties that maintain higher grain number and mass under heat stress are promising candidates for developing heat-tolerant barley cultivars.
- ✓ **Practical recommendation:** Selecting tolerant varieties can help stabilize yield under increasing temperatures and contribute to sustainable barley production in regions prone to heat stress.