Physiological and Agronomic Benefits of Seed Priming in Durum Wheat Exposed to Tillering and Anthesis Drought

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INTRODUCTION

- Durum wheat is among the most essential field crops grown under rainfed conditions in Jordan for ensuring food security at the national level.
- Drought is a major environmental (abiotic) stress with adverse impacts on crop production
- Seed priming has been developed as a crucial method to produce drought-tolerant plants
- Information is lacking regarding the yield and physiological performance of primed seed of wheat varieties in Jordan that were exposed to drought at either tillering or anthesis stage. Therefore, this study was conducted to investigate if the response of primed wheat seeds is differs when imposed under different growth stages of drought

MATERIALS AND METHODS

- Four durum wheat (Triticum durum L.) varieties were used: Maru1, Hourani, Sham 1 and Umqais
- Seed priming treatments: hydropriming, PEG, $CaCl_2$ and control
- A pot experiment was conducted in a glasshouse
- One hundred and forty-four pots (27 cm diameter × 27 cm height) were used
- Drought was imposed by withholding watering for 7 days at either tillering (GS 22; D1) or anthesis (GS 65; D2) on separate sets of plants, and compared with well-watered (WW) plants
- Leaf relative water content (RWC) was determined, Transpiration rate (µg cm-2 s-1) was measured with a portable steady state porometer (LICOR model LI-1600), and total chlorophyll content was determined non-destructively using a portable chlorophyll meter; SPAD 502 Chlorophyll Meter
- At the full maturity stage, the number of tillers and heads per plant were counted and the plants were harvested when they had reached their final maturity to determine yield and yield components
- This experiment was performed in a factorial (4 x 4 x 3) completely randomized design

RESULTS

Table 1. Mean values of transpiration rate (T), total chlorophyll content by SPAD, and relative water content (RWC) for seed priming treatments and for the beginning of drought (Day 0) and end of drought (Day 7) at tillering and anthesis stages averaged across wheat varieties. PEG_Polyethylene glycol; CaCl2_Calcium chloride; DW_Distilled Water; HSD_honestly significant difference at p< 0.05 probability level using Tukey's test. Different letters within the same columns indicate significant differences.

		Tillering			Anthesis	
Priming treatments	T ($\mu g\ cm^{-2}\ s^{-1}$)	SPAD	RWC (%)	T ($\mu g\ cm^{-2}\ s^{-1}$)	SPAD	RWC (%)
PEG	5.7 a	57.5 a	84.7 a	17.8 a	54.4 a	79.9 a
$CaCl_2$	5.5 a	57.3 a	83.3 ab	16.9 a	52.8 a	77.7 ab
DW	5.7 a	57.5 a	82.4 b	13.2 b	52.3 a	76.2 b
Control	4.7 b	52.4 b	78.7 c	10.8 c	47.7 b	71.2 c
Standard error	0.25	1.37	0.86	0.73	1.1	1.23
HSD (0.05)	0.66	3.62	2.26	1.9	2.91	3.24
Drought						
Day 0	6.4 a	61.2 a	92.2 a	19.4 a	58.5 a	91.6 a
Day 7	4.4 b	51.2 b	72.4 b	9.9 b	45.1 b	60.9 b
Standard error	0.18	0.97	0.61	0.52	0.78	0.87
HSD (0.05)	0.35	1.94	1.21	1.04	1.56	1.73

Table 2. The main effects of seed priming treatments on tiller number/plant (TN), head number/plant (HN), grain number/plant (GN), 1000-grain weight/plant (TGW), grain weight/plant (GW), dry matter weight/plant (DMW), and harvest index (HI) averaged across drought conditions and wheat varieties.

Priming treatments	TN	HN	GN	TGW (g)	GW (g)	DMW (g)	HI
PEG	11.4 a	10.8 a	449.1 a	40.3 a	18.6 a	19.9 a	0.47 a
$CaCl_2$	11.5 a	10.7 a	426.4 b	40.0 a	17.8 a	20.0 a	0.45 ab
DW	10.6 b	9.9 b	380.9 c	38.8 b	15.4 b	18.1 b	0.44 b
Control	9.7 c	9.0 c	322.1 d	35.7 c	12.3 c	16.3 c	0.40 c
Standard error	0.26	0.23	8.02	0.46	0.31	0.47	0.06
HSD (0.05)	0.67	0.61	20.97	1.21	0.82	1.24	0.018

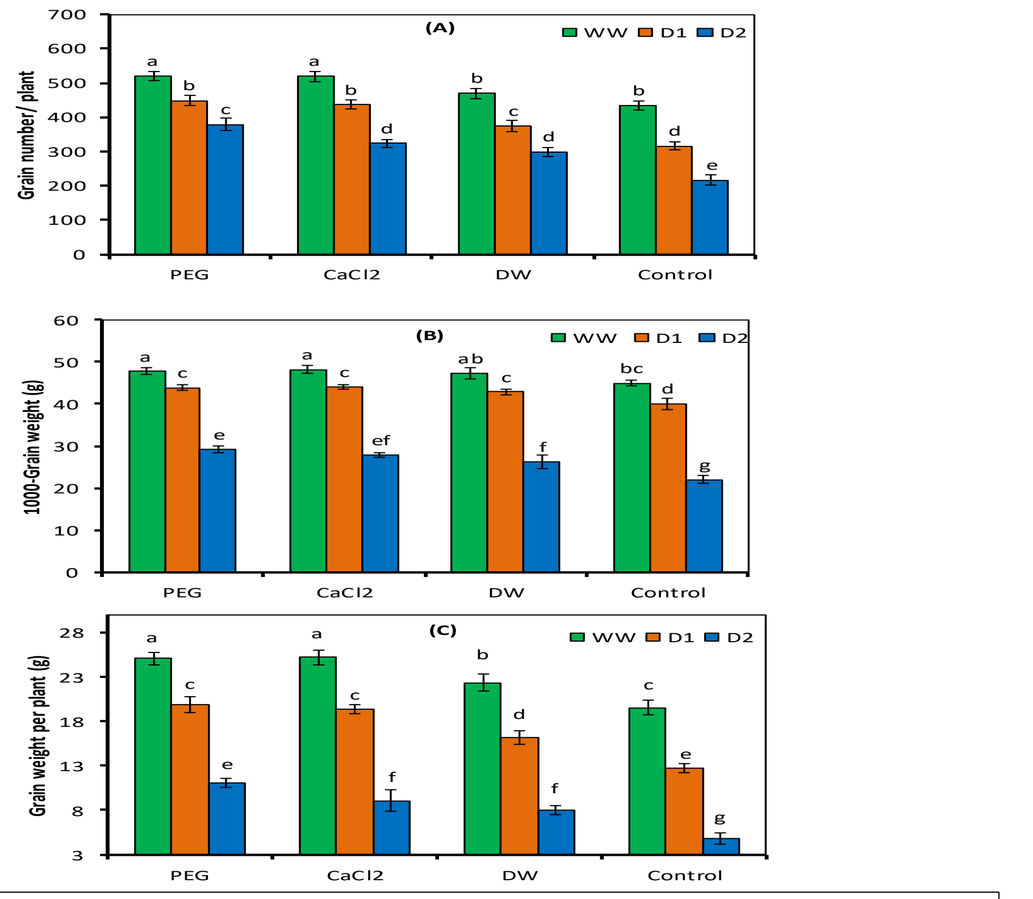

Fig 1. Interaction between seed priming and drought conditions for grain number per plant (A), 1000-grain weight per plant (B), and grain weight per plant (C). Lines with the same letter are not significantly different at p< 0.05 using Tukey's test. Error bars show standard errors, n = 3.

CONCLUSION

- The highest grain weight was attained in var. Sham 1 under PEG priming compared with unprimed conditions, whereas the lowest improvement was for var. Hourani when seeds were primed with DW
- Seed priming performed much better at anthesis drought in terms of grain yield, possibly through enhancement of RWC and photosynthetic physiology