Response of pumpkin genotypes to drought stress at germination stage

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The PRIMA programme is supported and funded under Horizon 2020, the Framework European Union's Programme for Research and Innovation

Introduction

Drought is one of the most severe environmental stressors affecting a wide range of crops, thus placing adaptation to water deficit conditions in the core of breeding activities. Therefore, using the genotypes with a higher ability to adapt to arid conditions has been established as the main criterion in the breeding efforts for the development of novel drought-tolerant cultivars. Given that germination is the most critical phase in the plant growth cycle, this study aimed at evaluating the seed germination and seedling growth potential under drought conditions as a screening approach to identify tolerant pumpkin germplasm at early growth stages.

Materials and Methods

Drought stress experiments were carried out using both commercial genotypes (Fytro FS 243 and Big Max) and local landraces (1, 2, 3, 4, 5), which adaptation to adverse climatic conditions has not been elucidated. Drought stress was induced by adding D-mannitol at three concentrations (100, 200 and 300 mM), while non-stressed plants were used as controls. Drought tolerance was assessed on the basis of germination percentage, seed water absorbance, seedling water content, shoot and root length, seedling vigor index and number of seedlings with abnormal genotype.

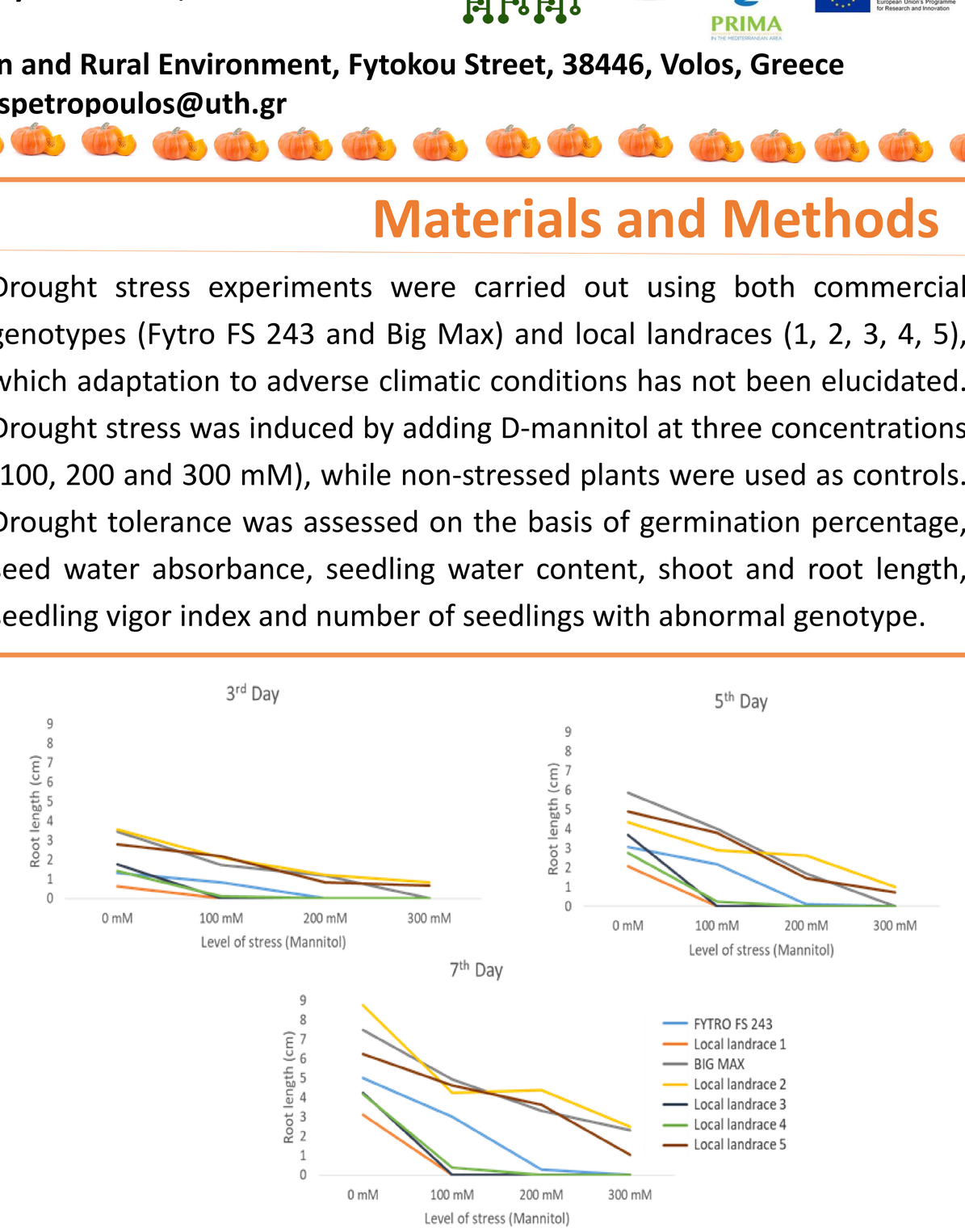
Germination percentage (GP %) of pumpkin genotypes (G) in relation to water stress (mM of Mannitol) throughout the germination test (7 days).

Days	Genotypes (G)	Mannitol (mM) (C)				
		0	100	200	300	
1st						Mean (G)
	FYTRO FS 243	82.50a	17.50ab	0.00b	0.00b	25.00a
	Local landrace 1	2.50c	0.00b	0.00b	0.00b	0.62b
	BIG MAX	62.50ab	27.50ab	20.00a	0.00b	27.50a
	Local landrace 2	50.00b	25.00ab	20.00a	10.00a	26.25a
	Local landrace 3	22.50c	0.00b	0.00b	0.00b	5.62b
	Local landrace 4	5.00c	0.00b	0.00b	0.00b	1.25b
	Local landrace 5	75.00ab	35.00a	10.00ab	0.00b	30.00a
	Mean (C)	42.85a	15.00b	7.14bc	1.43c	
3rd						Mean (G)
	FYTRO FS 243	92.50a	42.50a	0.00b	0.00b	33.75b
	Local landrace 1	27.50b	0.00b	0.00b	0.00b	6.88c
	BIG MAX	77.50a	45.00a	30.00a	0.00b	38.12ab
	Local landrace 2	50.00b	42.50a	35.00a	35.00a	40.00ab
	Local landrace 3	40.00b	0.00b	0.00b	0.00b	10.00c
	Local landrace 4	47.50b	2.50b	0.00b	0.00b	12.50c
	Local landrace 5	82.50a	67.50a	37.50a	35.00a	55.62a
	Mean (C)	59.64a	28.57b	14.28c	10.00c	
5th						Mean (G)
	FYTRO FS 243	95.00a	42.50b	5.00b	0.00b	35.62bc
	Local landrace 1	47.50d	0.00c	0.00b	0.00b	11.87d
	BIG MAX	80.00abc	45.00b	32.50a	2.50b	40.00b
	Local landrace 2	52.50cd	55.00ab	45.00a	32.50a	46.25ab
	Local landrace 3	52.50cd	0.00c	0.00b	0.00b	13.12d
	Local landrace 4	65.00bcd	2.50c	2.50b	0.00b	17.50cd
	Local landrace 5	87.50ab	85.00a	47.50a	42.50a	65.62a
	Mean (C)	68.57a	32.85b	18.92bc	11.07c	
7th						Mean (G)
	FYTRO FS 243	95.00a	47.50b	5.00c	0.00b	36.87bc
	Local landrace 1	50.00b	0.00c	0.00c	0.00b	12.50d
	BIG MAX	90.00a	47.50b	32.50b	2.50b	43.12b
	Local landrace 2	52.5b	55.00b	55.00a	32.50a	48.75ab
	Local landrace 3	57.50b	0.00c	0.00c	0.00b	14.37d
	Local landrace 4	72.50ab	2.50c	2.50c	0.00b	19.37cd
	Local landrace 5	90.00a	85.00a	47.50ab	45.00a	66.87a
	Mean (C)	72,50a	33,92b	20,35bc	11,42d	

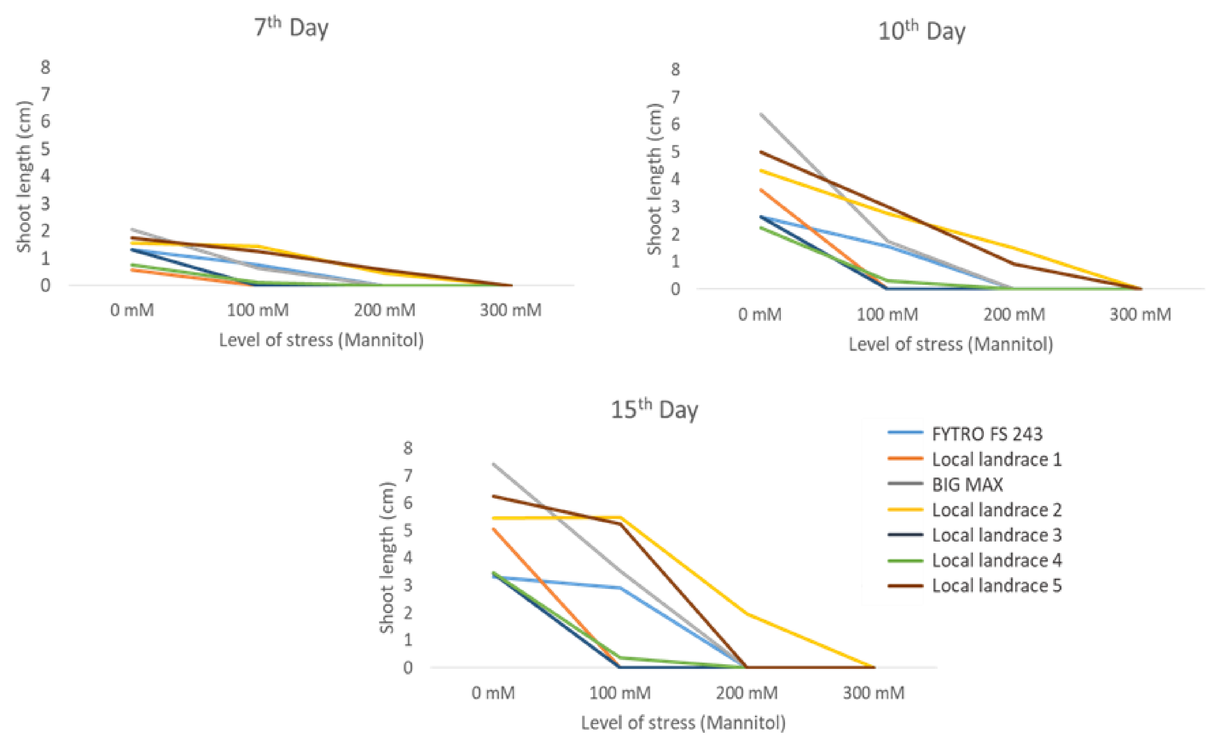
Seedling vigour index (SVI %) in relation to genotype (G) and water stress (mM of Mannitol) 7 days after stress initiation

Days	Genotypes (G)	Mannitol (mM) (C)				
		0	100	200	300	
7th						Mean (G)
	FYTRO FS 243	127.50abc	26.00b	0.00c	-	38.37abc
	Local landrace 1	27.00d	0.00b	0.00c	-	6.75c
	BIG MAX	184.00a	31.25b	0.00c	-	53.81ab
	Local landrace 2	82.00cd	35.50b	14.25b	-	32.93abc
	Local landrace 3	83.25bcd	0.00b	0.00c	-	20.81bc
	Local landrace 4	53.75cd	1.25b	0.00c	-	13.75c
	Local landrace 5	157.50ab	80.50a	27.25a	-	66.31a
	Mean (C)	102.14a	24.92b	5.92bc	-	

Values followed by the same letter, within each factor, are not significantly different according to LSD (P ≤ 0.05).



Root length at day 3, 5 and 7 in relation to genotype (G) and water stress level (mM of Mannitol, C).



Shoot length at day 7, 10 and 15 in relation to genotype (G) and water stress level (mM of Mannitol, C).

Results and Discussion

Overall findings pointed to the superiority of landraces 2 and 5, while landraces 1 and 4 proved the most sensitive genotypes. Further, this study highlights the possibility of using this methodology for revealing the existing genetic variation in pumpkin germplasm of unknown tolerance to drought stress, preferably employing seedling vigor index as the main screening criterion, at early growth stages, thus upgrading the efficiency of breeding activities targeted at achieving drought tolerance in pumpkin.

Funding: This work was funded by the General Secretariat for Research and Technology of Greece and PRIMA foundation under the project Pulping (Prima 2019-08).

Literature available upon request.