Germination and early seedling growth of local forms *Vicia ervilia L.* and *Vigna unguiculata* L. Walp. as affected by osmotic and salt stress

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Introduction

Crop landraces, well adapted to local edapho-climatic conditions, are an important genetic resource. The earliest phases of plant development are particularly sensitive to abiotic stresses, which affect uniform stand establishment and the final crop yield. A correlation exists between stress tolerance at germination and at later developmental stages. Estimation of stress sensitivity at germination could be a useful criterion for selecting perspective genotypes in breeding for sustainable agriculture**.**

The aim of this study was to compare the relative tolerance of selected local bitter vetch and cowpea accessions to moderate osmotic (10 or 15% PEG 6000) and salt stress (100 or 150 mM NaCl) at the germination stage.

Methods: Seeds were surface sterilized with sodium hypochlorite and germinated in Petri dishes (9 cm diameter) on filter paper (20 seeds per dish for bitter vetch, 10 for cowpea), in three independent replicas for each accession and condition.
Conditions were: 12 ml of distilled water (controls) or the same quantity of osmotically active solution (10% w/v PEG 6000 or 150 mM NaCl for bitter vetch, 15% w/v PEG 6000 or 100 mM NaCl for cowpea).
Germination at constant temperature (25 ^{o}C) in dark was followed daily. Seedling fresh weight (without cotyledons), root and shoot length (for bitter vetch) were registered after 120 h of germination.

The following **germination parameters** were calculated:
G% - percentage of germinated seeds from the total seed number**,**
RST-G% – relative stress tolerance - the ratio GS/GC where GS is G% under stress, GC is the G% of control seeds**;**
VI – seedling vigor index expressed as G% x FW (mean fresh weight of the seedlings for each condition, without cotyledon)
RST-VI - relative stress tolerance expressed as vigor index ratio stress/control conditions.

Results

Passport information of the tested accessions

Accessions of bitter vetch (*Vicia ervilia* L.)

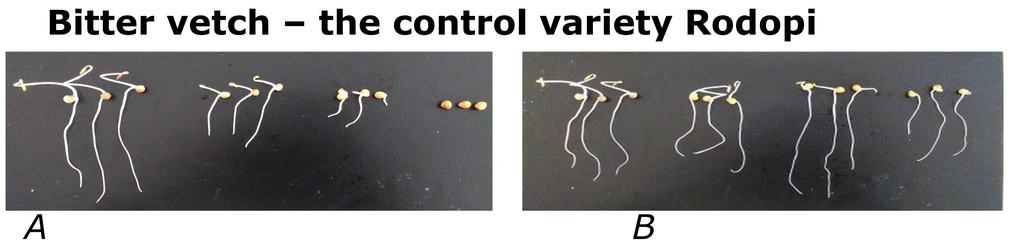
Accession	Name	Biological status	Origin	Source
A3BM0178	Rodopi	Variety	Bulgarian	IPGR genebank
BGR3051	-	Local population	Bulgarian	IPGR genebank
BGR3052	-	Local population	Bulgarian	IPGR genebank
BGR 6207	-	Local population	Bulgarian	IPGR genebank
BGR13526	Krasnodarskaia	Variety	Russian	IPGR genebank
C3000001	CPI 10385	Breeding line	Bulgarian	USDA, USA genebank
C3000002	SH B7-3-3-1	Breeding line	Bulgarian	USDA, USA genebank
C3000003	Borina	Variety	Bulgarian	USDA, USA genebank
C3000006	B92-198	Breeding line	Bulgarian	USDA, USA genebank
C3000007	B92-200	Breeding line	Bulgarian	USDA, USA genebank
C3E0118	-	Local population	Bulgarian	Ustrem, Topolovgrad
B9E0168	-	Local population	Bulgarian	IPK Gatersleben genebank

Accessions of cowpea (*Vigna unguiculata* L. Walp)

Accession	Biological status	Origin	Source
BOE0010	Local population	Bulgarian	Pazardghik
A4E0007	Local population	Bulgarian	Svilengrad
B1E0103	Local population	Bulgarian	Pazardghik
Hrisi	Variety	Bulgarian	IPGR selection
BOE0034	Local population	Bulgarian	Haskovo
A9E1230	Local population	Bulgarian	Smolyan
B1E0102	Local population	Bulgarian	Petrich
A7E0735	Local population	Bulgarian	Kavarna
A9E1105	Local population	Bulgarian	Kap. Andreevo
A8E0542	Local population	Bulgarian	Kap. Andreevo

Response to gradual osmotic stress at germination stage

Bitter vetch – the control variety Rodopi



A *B*

A- salt stress 0; -0,3MPa; -0,6MPa; -0,9MPa (0 to 150 mM NaCl)
B- osmotic stress 0; -0,3; -0,6; -0,9MPa (0 to 15 % PEG 6000 w/v)

Cowpea – the control variety Hrisi

A *B*

Germination parameters and relative stress tolerance of the compared accessions

Bitter vetch

Accession	Germination %			Seedling VI			RST- G %		RST- VI %	
	H2Od	PEG	NaCl	H2Od	PEG	NaCl	PEG	NaCl	PEG	NaCl
A3BM0178	83.2	86.9	55.8	6.8	6.2	0.9	1.045	0.671	0.903	0.139
BGR3051	42.2	29.6	30.5	2.9	1.7	1.2	0.701	0.721	0.576	0.417
BGR3052	93.9	91.2	82.6	6.9	4.5	1.8	0.970	0.879	0.661	0.267
BGR 6207	71.9	67.6	44.4	5.3	3.6	1.4	0.941	0.617	0.689	0.258
BGR13526	70.9	72.4	32.0	5.2	6.2	2.3	1.021	0.452	1.184	0.437
C3000001	79.9	61.4	15.0	5.4	4.0	0.1	0.768	0.188	0.737	0.020
C3000002	95.0	98.0	63.5	8.3	5.5	1.5	1.032	0.668	0.662	0.186
C3000003	95.9	73.4	69.3	7.5	4.3	2.2	0.765	0.723	0.572	0.297
C3000006	56.2	66.6	5.8	3.1	3.5	nd	1.186	0.104	1.131	nd
C3000007	80.6	53.7	0	7.5	3.1	nd	0.666	0.000	0.411	nd
C3E0118	93.7	80.3	52.4	7.3	4.8	1.6	0.857	0.559	0.743	0.222
B9E0168	88.5	79.3	50.8	6.0	4.5	1.2	0.897	0.575	0.744	0.194
average	79.3	71.7	41.9	6.0	4.3	1.2	0.904	0.513	0.751	0.203
CV%	15.9	18.5	43.7	22.8	21.9	62.1	14.22	42.75	22.04	55.66

Cowpea

Accession	Germination %			VI (G% x g FW)			RST- G %		RST –VI	
	H2Od	PEG	NaCl	H2Od	PEG	NaCl	PEG	NaCl	PEG	NaCl
BOE0010	94.7	92.1	89.3	22.7	6.6	8.1	0.973	0.944	0.293	0.358
A4E0007	81.5	62.7	47.3	7.8	1.1	2.8	0.770	0.580	0.145	0.353
B1E0103	77.5	78.1	81.1	8.7	3.1	6.8	0.963	1.047	0.354	0.782
Hrisi	79.2	56.3	65.4	10.7	2.1	3.9	0.711	0.826	0.191	0.363
BOE0034	73.7	38.6	59.1	10.1	1.4	2.7	0.524	0.801	0.142	0.267
A9E1230	91.4	84.9	82.8	9.1	2.2	4.7	1.024	0.906	0.241	0.513
B1E0102	67.9	47.2	62.1	6.2	1.5	2.8	0.695	0.914	0.245	0.446
A7E0735	91.2	55.1	78.8	8.2	0.8	2.4	0.604	0.864	0.093	0.286
A9E1105	85.2	60.9	60.5	21.0	3.6	6.2	0.715	0.709	0.171	0.295
A8E0542	93.9	64.9	90.9	20.1	1.7	6.7	0.691	0.968	0.086	0.331
average	83.6	64.1	71.7	12.5	2.4	4.7	0.767	0.856	0.196	0.399
CV%	9.2	19.8	17.9	42.4	50	38.3	17.2	11.8	35.2	27,1

Stress sensitive accessions are shaded in blue, the tolerant ones in red

Conclusions Among the studied local forms of both species, accessions have been found which were tolerant to both stresses, sensitive to both stresses, tolerant to osmotic but sensitive to salt stress, and tolerant to salt but sensitive to osmotic stress. The mechanisms underlying differential stress tolerance are a subject of further studies. Revealing accessions with differential stress tolerance could be useful as selection criterion for breeding purposes**.**

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