THE INFLUENCE OF SALT STRESS ON FOLIAR WATER CONTENT LEAVES OF SOME TOMATO CULTIVARS FROM N-E ROMANIA

INFLUENȚA STRESULUI SALIN ASUPRA CONȚINUTULUI DE APĂ LA NIVEL FOLIAR A UNOR GENOTIPURI DE TOMATE DIN NORD-ESTUL ROMÂNIEI

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Abstract: *Water is an important factor for the distribution of plant species on Earth, under stress leaves are the organs which are observed first symptoms. The research was conducted under greenhouse condition. The biological material was represented by ten local tomatoes populations collected from areas with saline soils from Moldavia region and compared with commercial type salt-tolerant tomato. Tomato genotypes in the study were subjected to salt stress for a period of 30 days is constantly wetted with saline solution to a concentration of 100 mM and 200 mM. There have been a number of quantitative investigations in the foliar ascertaining the fact that the genotypes subjected to salt stress is a reduction in the content of free water and to increase the amount of water bound thereby increasing the capacity of the biological tolerance of such local populations of tomatoes.*
Key words: free water, bound water, tomato cultivars, salinity, stress

Rezumat: *Apa este un factor important pentru repartiția speciilor vegetale pe glob, în condiții de stres frunzele sunt organele la nivelul cărora se observă primele simptome. Au fost luate în studiu 10 genotipuri de tomate colectate din solurile saline ale Moldovei şi un soi comercial rezistent la salinitate. Acestea au fost expuse stresului salin pe o perioadă de 30 de zile, fiind udate constant cu soluții saline de concentrație 100 mM şi 200 mM. S-au realizat o serie de investigații cantitative la nivelul aparatului foliar constatându-se, faptul că la genotipurile supuse stresului salin are loc o reducere a conținutului de apă liberă şi o creştere a cantității de apă legată mărindu-se capacitatea biologică de toleranță a acestor populații locale de tomate.*
Cuvinte cheie: apă liberă, apă legată, genotipuri de tomate, salinitate, stres

INTRODUCTION

High salinity is the most widespread abiotic stress and constitutes the most stringent factor in limiting plant distribution and productivity (Iqbal and Ashraf, 2005; Yildirim *et al.,* 2009; Qin, 2010). The main negative effects of high salinity that influence plant growth and development are photosynthesis inhibition water deficit, ion toxicity

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associated with excessive Cl^- and Na^+, interference with nutrition leading to nutrient imbalance (Qin, 2010). Water is the environment for conducting biochemical reactions, solutes participating in circulation, regulate temperature, maintaining and increasing plant turgidity (Ciobanu and Şumălan, 2009; Şerbănescu-Ionescu, 2012; Ivan, 2015). Given the vital functions that it performs water in living organisms, knowledge of plant water regime of economic interest has great practical significance.

The amount of water in the plant body in a state of active life ranging from 60-90 % depending on the internal factors (species, organ, tissue, developmental stage) and external factors (atmospheric humidity and soil, temperature, air movements), reducing generally the advance older plants (Trifu and Bărbat, 1997).

Water absorption is intense when the soil solution is hypotonic to the cell vacuole absorbent juice. The usual concentration of soil solution is 0.5-1.5 % the plants grow and develop normally. Soil solution becomes more concentrated in drought conditions, according to the excessive application of chemical fertilizers in arid and salty soils where (Heller *et al.*, 1989).

Free water and bound water is liquid water fractions of a particular biological importance, having functional role in different periods of life of the organism. In most cases predominate the free water. In dry conditions as in winter it decreases the amount of free water and the bound water increases, which results in a higher resistance of the plant. From the quantitative point of view, the ratio of the two kinds of water in all cases is in the favor of free water (Sand, 2001).

MATERIAL AND METHOD

The research was conducted under greenhouse condition from USAMV Iaşi during the years 2014-2015.

The biological material was represented by local tomatoes populations collected from areas with saline soils from Moldavia region and compared with commercial type salt-tolerant tomato (*Ursula* $_{F1}$) from Israel.

The bifactorial experience was conducted in a pots experiment in randomized blocks with four repetitions. Ten tomato genotypes (*Moşna* $_2$, *Şcheia* $_1$, *Dorohoi* $_6$, *Dorohoi* $_8$, *Copălău* $_2$, *Copalău* $_3$, *Copalău* $_4$, *Copălău* $_5$, *Dorohoi* $_4$, *Moşna* $_3$) studied were subjected to salt stress for a period of 30 days is constantly wetted with saline solution to a concentration of 100 mM and 200 mM.

Water lost after 24 hours, the relative percentage of the initial weight of the plant material is considered free water. The same plant material is then dried in an oven at a temperature of 105 °C, up to constant weight. The amount of water lost through the drying oven is regarded as bound water. The amount of free water and is linked to the total water.

RESULTS AND DISCUSSIONS

Analysis of total water and forms was determined after 30 days to the salt stress. After 30 days there is observed an increase in the total water content for all genotypes at the three variants, it oscillating between 76.2 % and 91.2 %. We highlight that after this time the saline treatment application, the total water content is maintained close to that of control version, which indicates that these genotypes have adapted to osmotic stress. Also percentage values of total water content of local cultivars are quite close to those of cultivar and salinity resistant *Ursula* $_{F1}$ (fig.1.)

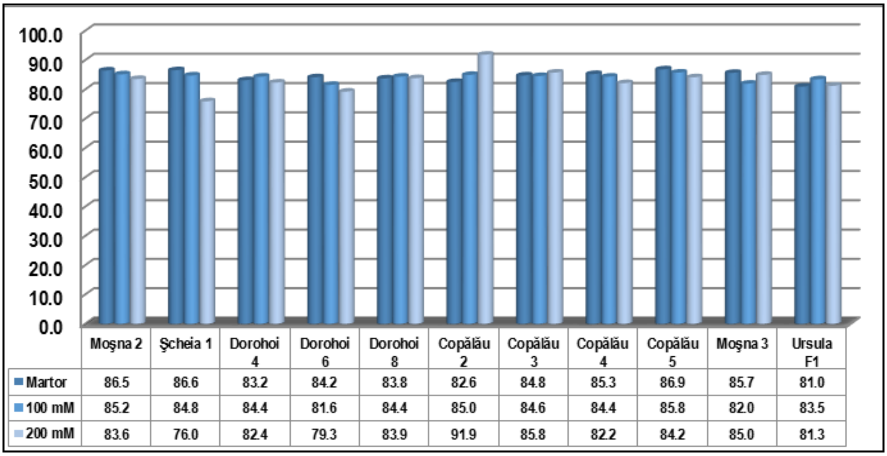


Fig. 1 Effect of salt stress on the total water content % after 30 days

Statistical analysis showed that after 30 days of treatment application saline genotype and saline concentrations differ statistically insignificant, this can be explained by the fact that the percentage values of variants 100 mM and 200 mM are very close to those of version control. Genotypes were adapted well from this point of view salt stress conditions (tab. 1)

Table 1.

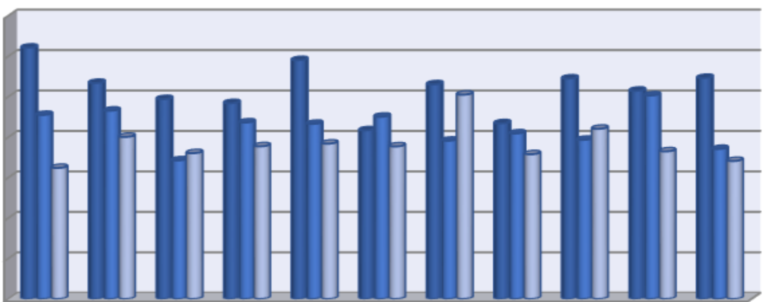
The variance analysis of the tomato genotypes under stress with NaCl for a period of 30 days on the total wather content

Variance source	***SP***	***GL***	***MS***	***F***	***P-value***	***F crit***	***Influence***
Genotype	71.03	10	7.10363	1.01584	0.46427	2.3478	NS
Concentration	10.63	2	5.31848	0.76056	0.48045	3.4928	NS
Error	139.8	20	6.99281				
Total	221.5	32					

Anova Two- Factor: ^{NS} insignificant statistical differences (p≥0,05); * significant statistical differences (p ≤ 0.05); ** distinctly significant statistical differences (p≤0,01); *** highly significant statistical differences (p≤0.001), F> F crit null hypothesis rejected

Analysis of water content free after 30 days of treatment application saline shown in figure 2, highlights a lower free water compared to the control for all genotypes variant 100 mM and variant 200 mM water free, which shows, according to data presented in the literature (Jensen et Collins, 1985; Şumălan, 2009) that reduce free water content increases the capacity of biological tolerance of plants to abiotic stress conditions. Of the all genotypes on the 100 mM solution cultivar *Moşna* are registered a 1.1% difference compared to the control and genotypes on the 200 mM variant cultivar *Copălău* $_4$ showed a difference of 2.6%. This shows a good ability for this genotypes to adapt on the salt stress.

Under stress, the plant vital activity is reduced, there is an increase in the amount of bound water, thereby ensuring the survival in such conditions. This was seen with cultivars studied in this experiment.

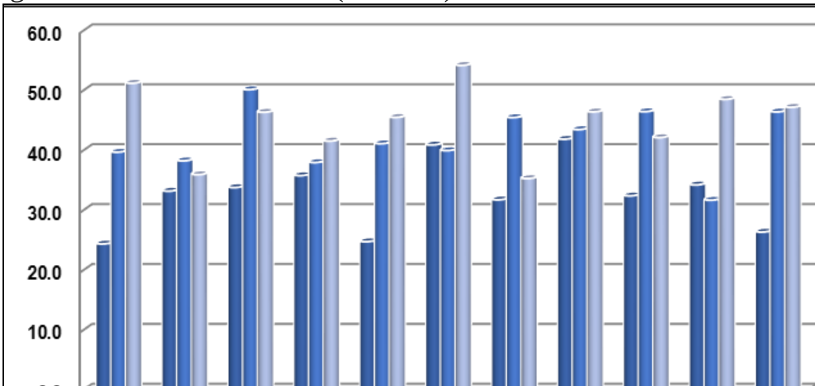


	Moşna 2	Şcheia 1	Dorohoi 4	Dorohoi 6	Dorohoi 8	Copălău 2	Copălău 3	Copălău 4	Copălău 5	Moşna 3	Ursula F1
Martor	62.1	53.4	49.4	48.4	59.1	41.7	53.1	43.5	54.5	51.5	54.7
100 mM	45.5	46.6	34.3	43.6	43.3	45.1	39.1	40.9	39.4	50.3	37.1
200 mM	32.4	40.1	36.0	37.8	38.4	37.7	50.5	35.8	42.1	36.5	34.1

Fig. 2 Effect of salt stress on the free water content % after 30 days

After 30 days of exposure to stressful conditions values within 100 mM and 200 mM variants increase significantly compared to the control (fig. 3), which shows resistance to salinity genotypes studied.

The cultivars *Moşna* $_3$, *Copălău* $_2$ *and Moşna* $_2$ shows a higher degree of adjustment due to the large amount of bound water, treated under the conditions of a high concentration salt stress (200 mM).



	Moşna 2	Şcheia 1	Dorohoi 4	Dorohoi 6	Dorohoi 8	Copălău 2	Copălău 3	Copălău 4	Copălău 5	Moşna 3	Ursula F1
Martor	24.4	33.2	33.8	35.8	24.7	40.9	31.7	41.8	32.4	34.2	26.3
100 mM	39.7	38.2	50.1	38.0	41.1	39.9	45.5	43.5	46.4	31.7	46.4
200 mM	51.2	35.9	46.4	41.5	45.5	54.2	35.3	46.4	42.1	48.5	47.2

Fig. 3 Effect of salt stress on the bound water content % after 30 days

Statistical analysis shows that after 30 days concentration of salt has a lot of influence significantly the content of bound water to local populations tomato studied, which highlights the adaptive high that presents these genotypes in conditions of prolonged stress saline (table 2).

Table 2

The variance analysis of the tomato genotypes under stress with NaCl on the bound wather content

Source of variance	SP	GL	MS	F	P-value	F crit	Influence
Genotype	277.999	10	27.7999	0.83256	0.60404	2.3478	NS
Concentration	897.133	2	448.566	13.4337	0.0002	3.4928	***
Error	667.818	20	33.3909				
Total	1842.95	32					

Anova Two- Factor: NS insignificant statistical differences (p≥0,05); * significant statistical differences (p ≤ 0.05); ** distinctly significant statistical differences (p≤0,01); *** highly significant statistical differences (p≤0.001), F> F crit null hypothesis rejected

The ratio of free and bound water plant ensures survival in stressful conditions such as frost, drought, salinity. In this context, the free water content decreases, and the content of bound water increases the biological resistance to dehydration (fig. 4).

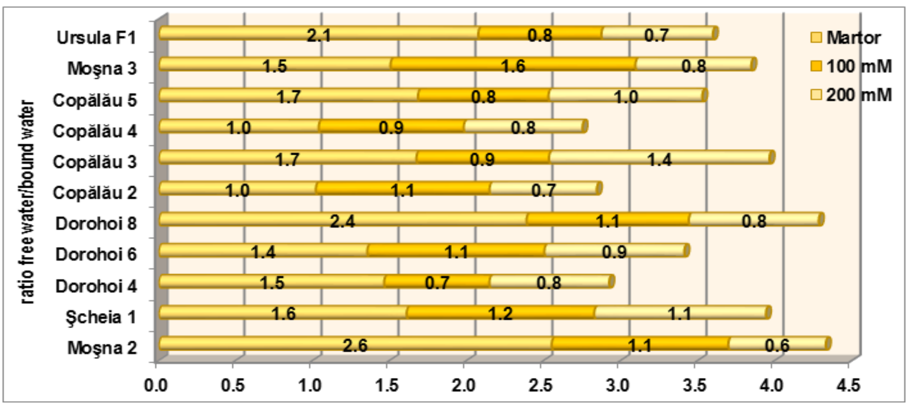


Fig. 4 Effect of salt stress on the report free water/bound water after 30 days

CONCLUSIONS

1. On the genotypes of variant 100 mM and 200 mM it reduces of the content of free water, increasing the ability of biological tolerance.

2. The genotypes *Moşna* $_3$, *Copălău* $_4$ and *Moşna* $_2$ it has a higher degree of adjustment because of the large bound water, treated under the conditions of a high concentration salt stress (200 mM).

3. The ratio of free and bound water plant ensures survival in stressful conditions as salinity.

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