THE INFLUENCE OF SALIN STRESS ON THE DESHIRE RITM AND OF WATER CONTENT AT FOLIAR LEVEL, TO SOME LOCAL POPULATIONS OF BEANS, FROM NORTH-EAST OF ROMANIA SUBMITTED

Beatrice Alexandra MODIGA, Carmenica Doina JITĂREANU

University of Agricultural Sciences and Veterinary Medicine of Iasi
Faculty of Agricultural, Department of Biological Sciences, Mihail Sadoveanu Alley, no. 3, 700490 Iași, România;
modigabeatricealexandra@yahoo.com

Abstract: *Phaseolus vulgaris L. is a species sensitive to salts. For this reason the purpose of the work was determining the effect of excess NaCl on the rate of dehydration and bound water content, to 7 bean genotypes, collected from saline soils, from north-east of Romania. Overall objective of the study it is to contribute to a better understanding of the physiological mechanisms involved in tolerance to saline stress of species Phaseolus vulgaris L. and identify local bean populations tolerant to salinity. These forms can be used for improvement morphological traits involved in achieving production capacity. The results showed that after 15 days of treatment, saline concentration did not influence significant the tracking parameters. Instead, after 30 days of treatment, the influence of salinity is very significant, which it demonstrates the adaptability present by these local genotypes, over a long period of time.*

Key words: *dehydration rate, bound water, Phaseolus vulgaris L.*

INTRODUCTION

Studying the water regime can be done, from several points of view. In eco physiology research is recurring, to a series of physiological indices, what they are considering aspects of the hydric regime correlated with water balance satisfaction, with the hydrophilic properties and water retention of protoplasm (STRATU, 2002).

Dehydration of the leaf is influenced by anatomical and physiological morphological features of the foliage and may be an indication of the intensity of perspiration (JITĂREANU, 2007; BURZO ET AL., 2004).

In the plant body water is generally found in two states, liquid and gaseous. During winter, at very low temperatures it can also exist in the form of ice (COVAȘĂ, 2016).

The rate of water loss and the percentage of watere lost in the first hour, are indicators of the persistence of the sweating process. Linked water is retained in plants with large forces. It is composede of immobile molecules, unable to broadcast. Adsorption and absorption forces which retain it from the hydrophilic colloids of the cytoplasm, manifests the hydration property.

The bound water freezes at temperatures below -10°C. She not circulating in the cell or plant, do not take part to biochemical processes nor to the dissolution of organic or inorganic substances. Because of solvent properties, bound water does not take part in the transformation and circulation of substances in the plant body (ȘUMĂLAN, 2009). Linked water reflects the hydration status of plasma colloids; is water which increases the plant's ability to resist stress factors, such as salinity.

In the present case, we consider that the phenomenon was achieved by penetrating into the leaves the different microelements administered. This is the water the plant has at its disposal for the development of photosynthesis, growth and other physiological processes (TEȘU ET AL., 1980).

In unfavorable environmental conditions, when vital plant activity is considerably reduced, the amount of free water decreases, and that of related water increases, which results in higher plant resistance (SAND, 2001).

Following research, it has been shown that plants that have a better salinity resistance is characterized by a cuticular sweat and a dehydration speed of the leaves (PETCU ET AL., 2007).

MATERIAL AND METHOD

The experience was done in greenhouse, and the research took place in the Plant Physiology Laboratory, USAMV Iaşi. The biological material was represented by seven local bean populations (Blăgești 1, Blăgești 2, Blăgești 3, Blăgești 4, Moșna, Săveni, Trușești 2) collected from saline soils from the North-East region of Romania.

The bifactorial experience was set up in vegetation pots with a capacity of 12 l. This is it exposed to saline stress over a 30-day period, being constantly wetted with concentrations of 100 mM NaCl and 200 mM NaCl.

In the experiment, the foliar dehydration rate was performed at 1, 2, 3, 4, and 24 hour intervals, and bound water was calculated, referring to the percentage of water lost in the first hour and in 24 hours, but also according to free water the of the samples.

RESULTS AND DISCUSSIONS

Effect of saline stress on the rate of dehydration

The rate of water loss, respectively the rate of dehydration, but especially the amount of water lost in the first hour, are specific indicators of the intensity of the sweating process (COVAȘĂ, 2016).

Following the determinations made, it was found that after 15 days of applying saline treatments to the local population Blăgeşti 2, the most intense rhythm of dehydration was revealed, in all three variants taken in the study (tabel 1.a.b.c). If in the first hour of dehydration this genotype contained percentages of total water content between 90.37% (control), 90.49% (100 mM NaCl) and 88.03% (200 mM NaCl), in 24 hours has reached values between 21.85% (control), 25.79% (100 mM NaCl) and 17.70% (200 mM NaCl), which indicates a dehydration speed of the leaves is lower under conditions of high saline stress.

After 15 days of saline stress, the lowest dehydration rate was recorded to the genotype Blăgeşti 3. In the first hour of dehydration, the values oscillated between 94.44% (control), 89.25% (100 mM NaCl), 89.25% (200 mM NaCl), and after 24 hours the rate of dehydration recorded values between 41.35% (control), 41.79% (100 mM NaCl) and 40.07% (200 mM NaCl). After a low foliar dehydration rate, we can conclude that this genotype has a good ability to adapt to a high salt concentration.

According to the results obtained (tabel 1.a.b.c), the genotypesof Trușești 2 and Moșna are which has a lower dehydration rate, of the three variants studied, which shows a good adaptation of these genotypes to saline stress.

Table 1.a.

Effect of saline stress on the rate of dehydration
at the control variant after 15 days

Genotype	Gi	1h	2h	3h	4h	24h
Blăgești 1	*100%*	*88.14*	*80.74*	*73.70*	*66.29*	*25.16*
Blăgești 2	*100%*	*90.37*	*81.41*	*74.66*	*67.22*	*21.85*
Blăgești 3	*100%*	*94.44*	*90.58*	*87.65*	*82.87*	*41.35*
Blăgești 4	*100%*	*94.02*	*85.84*	*77.87*	*68.58*	*22.78*
Moșna	*100%*	*96.12*	*95.90*	*93.90*	*90.08*	*35.56*
Săveni	*100%*	*93.09*	*85.44*	*79.47*	*72.01*	*25.18*
Trușești 2	*100%*	*94.98*	*85.64*	*79.95*	*72.66*	*28.92*

Table 1.b.

Effect of saline stress on the rate of dehydration
at 100 mM after 15 days

Genotype	Gi	1h	2h	3h	4h	24h
Blăgești 1	*100%*	*89.29*	*84.87*	*80.44*	*74.90*	*29.15*
Blăgești 2	*100%*	*90.49*	*83.71*	*78.05*	*71.26*	*25.79*
Blăgești 3	*100%*	*89.25*	*84.96*	*82.03*	*78.51*	*41.79*
Blăgești 4	*100%*	*95.25*	*88.60*	*81.96*	*74.36*	*27.84*
Moșna	*100%*	*92.35*	*85.22*	*80.81*	*74.70*	*29.54*
Săveni	*100%*	*92.90*	*85.81*	*80.54*	*73.45*	*27.23*
Trușești 2	*100%*	*94.73*	*87.89*	*82.36*	*75.52*	*28.94*

Table 1.c.

Effect of saline stress on the rate of dehydration
at 200 mM after 15 days

Genotype	Gi	1h	2h	3h	4h	24h
Blăgești 1	*100%*	*93.41*	*87.65*	*81.48*	*74.07*	*21.81*
Blăgești 2	*100%*	*88.03*	*76.31*	*66.98*	*56.45*	*17.70*
Blăgești 3	*100%*	*90.37*	*86.24*	*82.90*	*78.38*	*40.07*
Blăgești 4	*100%*	*91.15*	*67.25*	*60.53*	*52.92*	*21.06*
Moșna	*100%*	*90.44*	*83.21*	*77.38*	*70.16*	*23.54*
Săveni	*100%*	*89.52*	*82.22*	*76.50*	*68.88*	*23.80*
Trușești 2	*100%*	*94.85*	*86.37*	*79.69*	*70.95*	*22.10*

After a period of 30 days of saline stress, the lowest rate of dehydration was also recorded at genotype Blăgeşti 3, which in the first hour of dehydration the total water content was approximately equale in all three variants analyzed: 93.32% (control), 93.09% (100 mM NaCl) and 93.38% (200 mM NaCl). After 24 hours, the dehydration rate the following values were recorded: 50.9% (control), 52.61% (100 mM NaCl), 60.00% (200 mM NaCl), which leads us to conclude that this genotype is resistant to high salt concentrations.

Table 2.a.

Effect of saline stress on the rate of dehydration at the control variant after 30 days

Genotype	*Gi*	*1h*	*2h*	*3h*	*4h*	*24h*
Blăgești 1	*100%*	*91.14*	*87.45*	*83.02*	*78.96*	*36.53*
Blăgești 2	*100%*	*81.78*	*78.21*	*72.85*	*68.92*	*31.78*
Blăgești 3	*100%*	*93.32*	*90.07*	*86.82*	*84.47*	*50.90*
Blăgești 4	*100%*	*91.60*	*85.40*	*78.83*	*73.35*	*25.18*
Moșna	*100%*	*81.53*	*77.79*	*73.67*	*69.94*	*32.61*
Săveni	*100%*	*84.24*	*78.99*	*73.03*	*69.45*	*32.93*
Trușești 2	*100%*	*96.46*	*90.33*	*84.19*	*80.18*	*37.73*

Table 2.b.

Effect of saline stress on the rate of dehydration at the 100 mM variant after 30 days

Genotype	*Gi*	*1h*	*2h*	*3h*	*4h*	*24h*
Blăgești 1	*100%*	*87.87*	*85.08*	*81.35*	*77.85*	*37.76*
Blăgești 2	*100%*	*90.65*	*86.11*	*80.16*	*75.07*	*33.99*
Blăgești 3	*100%*	*93.09*	*90.11*	*87.12*	*84.51*	*52.61*
Blăgești 4	*100%*	*92.70*	*85.41*	*76.89*	*69.60*	*22.18*
Moșna	*100%*	*88.51*	*83.61*	*80.03*	*77.02*	*41.43*
Săveni	*100%*	*92.14*	*88.61*	*83.19*	*79.40*	*36.58*
Trușești 2	*100%*	*97.44*	*93.92*	*88.17*	*84.02*	*41.85*

Table 2.c.

Effect of saline stress on the rate of dehydration at the 200 mM variant after 30 days

Genotype	*Gi*	*1h*	*2h*	*3h*	*4h*	*24h*
Blăgești 1	*100%*	*85.58*	*81.28*	*76.38*	*72.08*	*33.43*
Blăgești 2	*100%*	*91.37*	*84.05*	*75.00*	*67.67*	*20.25*
Blăgești 3	*100%*	*93.38*	*90.98*	*88.59*	*86.61*	*60.00*
Blăgești 4	*100%*	*94.75*	*92.26*	*89.50*	*82.87*	*35.08*

Moșna	*100%*	*89.50*	*84.50*	*77.75*	*73.00*	*30.75*
Săveni	*100%*	*91.18*	*87.05*	*80.71*	*76.58*	*31.95*
Trușești 2	*100%*	*95.26*	*88.01*	*78.23*	*71.92*	*24.60*

Effect of saline stress on bound water content (%)

Free water and bound water are fractions of liquid water of particular biological importance, having a functional role in different life stages of the body. In the vast majority of cases free water predominates to the bound one. Under unfavorable conditions (drought, salinity) the amount of free water decreases, and that of connected water increases, which results in higher plant resistance (SAND, 2001).

After 15 days under the influence of NaCl, higher values are observed compared to the control variant, to all genotypes studied (Blăgești 2 (64.6%), Blăgești 3 (19.86%), Blăgești 4 (57.88%), Moșna (55.18%), Săveni (56.38%) when a concentration of 200 mM NaCl was administered; in the variant treated with 100 mM NaCl, the highest free water content is noted for the Moșna population (40.92%) (table 3).

Table 3.

Effect of saline stress on bound water content (%) after 15 days

Genotype	***Control %***	***100 mM NaCl%***	***200 mM NaCl%***
Blăgești 1	*56.30*	*41.70*	*56.38*
Blăgești 2	*49.68*	*48.42*	*64.60*
Blăgești 3	*17.30*	*16.42*	*19.86*
Blăgești 4	*54.44*	*44.32*	*57.88*
Moșna	*28.88*	*40.92*	*55.18*
Săveni	*49.64*	*45.54*	*52.40*
Trușești 2	*42.16*	*42.12*	*55.80*

In contrast, after 30 days of exposure to stress conditions, the values of the 200 Mm NaCl variant increase significantly compared to the control variant (tabel 4), which demonstrates the salinity resistance of the studied genotypes.

Table 4.

Effect of saline stress on bound water content (%) after 30 days

Genotype	***Control %***	***100 Mm NaCl%***	***200 mM NaCl***
Blăgești 1	*26.94*	*24.48*	*33.43*
Blăgești 2	*36.44*	*32.02*	*59.50*
Blăgești 3	*34.30*	*31.36*	*50.60*
Blăgești 4	*25.18*	*24.20*	*29.84*
Moșna	*34.78*	*17.14*	*38.50*

Săveni	*34.14*	*26.84*	*37.30*
Trușești 2	*24.54*	*16.30*	*50.80*

In the case of the blank, the minimum value (24.54%) belongs to the Trușești 2 genotype, and the maximum value (36.44%) for the Blăgeşti 2 genotype.

Variant of 100 mM NaCl presents a minimum (17.14%) for cultivar Moşna and a maximum (32.04%) for cultivar Blăgești 2.

With the application of saline solutions of 200 mM NaCl, there was a significant increase in both the water treated and the 100 mm NaCl variant, the minimum value of 29.84% belonging Blăgeşti 4 genotype, and the maximum value of 59.5 % of the Blăgeşti 2 genotype.

These results demonstrate that all studied genotypes have a high degree of adaptation due to the large amount of bound water, assimilated under conditions of a saline concentration of 200 mM NaCl.

CONCLUSIONS

Knowing that, plants with better salinity resistance are characterized by a cuticle sweating and lower leaf dehydration speed, the present study revealed the Blăgeşti 3 genotype, which showed a good ability to adapt to saline stress conditions over a long period of time, because it recorded a lower dehydration speed compared to the control variant, with the application of 200 mM NaCl solution.

Analyzes of the percentage of water bound, which increases the resistance of plants to unfavorable factors (salinity), reveals that, the Blăgeşti 2, Trușești 2 and Blăgeşti 3 cultivars have a higher degree of adaptation due to the large quantity of bound water, assimilated under conditions of a high concentration of saline stress (200 mM NaCl) at the end of treatment.

Dehydration and related water analysis, after 30 days, highlights that the values shown are normal given that the plants are at the end of the growing season, and the results show that all 7 studied, has a good ability to adapt to saline stress for an indefinite period of time.

BIBLIOGRAPHY

BURZO I., DELIAN E., DOBRESCU A., VOICAN VIORICA, BĂDULESCU L., 2004- Physiology cultivation plants I. Ed. Ceres, Bucharest.

COVAȘĂ MIHAELA, 2016- Research on the physiological reaction of some tomato genotypes to saline stressors. PhD thesis, Iaşi.

DE COSTA W., ZORB C., HARTUNG W., SCHUBERT S., 2007 - Salt resistance is determined by osmotic adjustment and abscisic acid in newly developed maize hybrids in the first phase of salt stress. Physiologia Plantarum, 131: 311-321.

JITĂREANU CARMEN DOINA, 2007 - Plant Physiology. Ed. Ionescu from Brad, Iasi.

PETCU ELENA, ȚERBEA MARIA, LAZĂR C., 2007 - Researches in field field physiology at Fundulea. Vol. LXXXV, AN.I.N.C.D.A. Fundulea.

SAND CAMELIA, 2001- Plant physiology. Ed. Mira Design, Sibiu.

STRATU ANIȘOARA, 2002- Physiological and biochemical research on the species of the Umbeliferae family. Doctoral thesis, UAIC Iaşi.

ŞUMĂLAN R., 2009 - Plant physiology. Elements of plant physiology applied in horticulture. Ed. Eurobit, Timisoara.

TEȘU VIORICA, TOMA LIANA-DOINA, CIREȘĂ ELENA, 1980 - Influence of macro and microelements applied externally on the absorption capacity of light energy, respiration and water regime in Aligote vine. Scientific Works, Horticulture Series, Vol. 24, ISSN 0379-8372.