EFFECT OF SALT STRESS ON SEED GERMINATION AND SEEDLINGS CHLOROPHYLL CONTENT OF SOME TOMATOES (*LYCOPERSICON ESCULENTUM* MILL.) LOCAL LANDRACES

EFECTUL STRESULUI SALIN ASUPRA GERMINAȚIEI SEMINȚELOR ȘI A CONȚINUTULUI DE CLOROFILĂ A PLANTULELOR LA UNELE POPULAȚII LOCALE DE TOMATE (*LYCOPERSICON ESCULENTUM* MILL.)

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Abstract. *Soil salinity is one of the most important abiotic stress factors affecting the global food security. The impact of salt-affected soils on plant productivity is sometimes disastrously. This requires the identifying and creating new plants genotypes tolerant to osmotic stress. These activities are difficult because the physiological, biochemical and molecular mechanisms responsible for the growth reduction of crops is not completely understood. In the effort to increase plant resistance to salinity, special attention should be given to local landraces as important genetic resources. The aims of the present study were to contribute to a better understanding of the physiological mechanisms involved in salt stress tolerance of Lycopersicon esculentum Mill. plants, especially during seed germination and seedlings growth and to identify the local landraces tolerant of salts excess. The results show that all from the tested cultivars represent a valuable germplasm source useful for improvement of the salinity resistance in the tomato plants.*
Key words*: salinity, tolerance, Lycopersicon esculentum Mill.*

Rezumat. *Salinitatea solurilor este unul dintre cei mai importanți factori de stres abiotic care afectează securitatea alimentară a omenirii. Impactul solurilor cu exces salin asupra productivității diferitelor culturi este uneori dezastruos, fapt care determină identificarea și crearea de noi genotipuri de plante tolerante la stresul osmotic. Aceste activități sunt dificile deoarece mecanismele fiziologice, biochimice şi moleculare răspunzătoare de reducerea creşterii nu sunt pe deplin elucidate. In efortul de a creşte rezistența plantelor la salinitate, o atenție deosebita ar trebui acordata populațiilor locale ca importante resurse genetice. Obiectivele cercetărilor au fost acelea de a contribui la o mai bună înțelegere a mecanismelor fiziologice implicate în toleranța la stres salin a speciei Lycopersicum esculentum Mill., în special în timpul proceselor de germinare şi creştere a plantulelor și de identificare a populațiilor locale tolerante la excesul de săruri. Rezultatele demonstrează că toate cultivarele testate reprezintă surse valoroase de germoplasmă pentru ameliorarea rezistenței tomatelor la stres salin.*
Cuvinte cheie: *salinitate, toleranță, Lycopersicon esculentum Mill.*

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INTRODUCTION

Plant response to salinity has been much studied, since a good knowledge of the effect it has on plants to NaCl, it is a critical factor of cultivation in saline areas. The salinity may inhibit plant growth by a low water absorption potential from the outside, by toxicity and by reducing the uptake of nutrient ions, in particular potassium.

During the development, the tomato seeds are the first to face with the stress conditions, particularly affect the salinity of the active growth of the embryo. Throughout the growing season, the salinity affects various physiological and biochemical processes, the main effect being in the hydric relations, but is also manifested by ion toxicity (Jităreanu *et al.,* 2014).

Following investigations, Dayme Camejo and W. Torres (2000) suggested that in this stage of development, the germination, is strongly influenced by the environment salinity. Thus the saline concentrations may change in time the moment of maximum speed of the germination process, due to a low power seed to absorb water and / or a toxic effect of the ions, that cause problems in some of the enzymes and the hormones of the seed, the consequences can be seen by delay or inhibit the germination process.

On the other hand, high concentrations of NaCl causes the physico-chemical changes in the seeds, with the effect of delay or reduction in germination capacity value. The effect of external environment salinity on seed germination may be partially osmotic or toxic ionic can affect physiological processes and enzymatic activities (Jogendra Singh *et al.,* 2012).

Chlorophyll, one of the main components of the chloroplast involved in photosynthesis and chlorophyll content is correlated positively with the degree of photosynthesis. Water deficit and water transport inability to the leaf, can decline the photosynthesis (Marta *et al.,* 2014).

The total chlorophyll concentration is significantly reduced in tomato leaves under salt stress. This is a common phenomenon reported in many researches, due to its adverse effects on membrane stability, and a low concentrations of photosynthetic pigments can cause a direct reduction in production (Marta *et al.,* 2014).

MATERIAL AND METHOD

For testing we used local tomato populations collected in households of Iasi and Botosani. The populations analyzed were: Moşna 2, Moşna 3, Şcheia 3, Copalau, 3, 4 and 5, Ursula F1 and Jebel.

Seed germination under stress was tested to saline 75 mM NaCl concentrations, having a control salinity resistant population Jebel and Ursula F1, a resistant hybrid, created in Israel. The testing was made in growth chamber at 22^0C and 80% humidity. The comments were recorded for 7 days from the establishment of experiences.

After the completion of germination and growth of plants from the cotyledon leaves were extracted and studied the chlorophyll pigments by the spectrophotometric method.

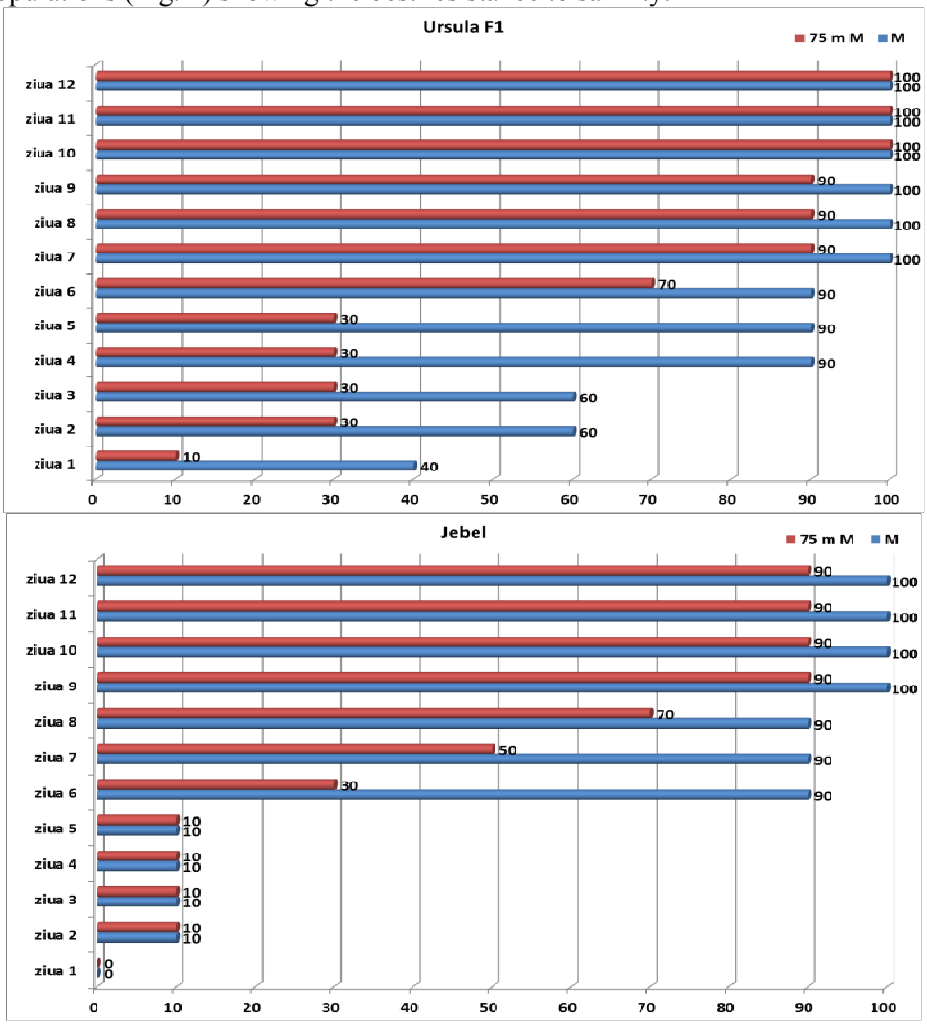
RESULTS AND DISCUSSION

Analysis of tomato seed germination capacity in saline

Among the physiological traits, state standards require only suitable for germination, showing the number as a percentage of seeds capable of producing germs during normal laboratory conditions of temperature and humidity and light set as optimal for each species.

The comments were recorded for 7 days from the establishment of experiences and germination was analyzed for 12 days.

Analyzing all the tomato populations, a behavior close to control Ursula F1 and Jebel observed the local population Copalau 3, the germination at the variant treated with saline began in the 2nd day of observations compared to other local populations (Fig. 1) showing the best resistance to salinity.



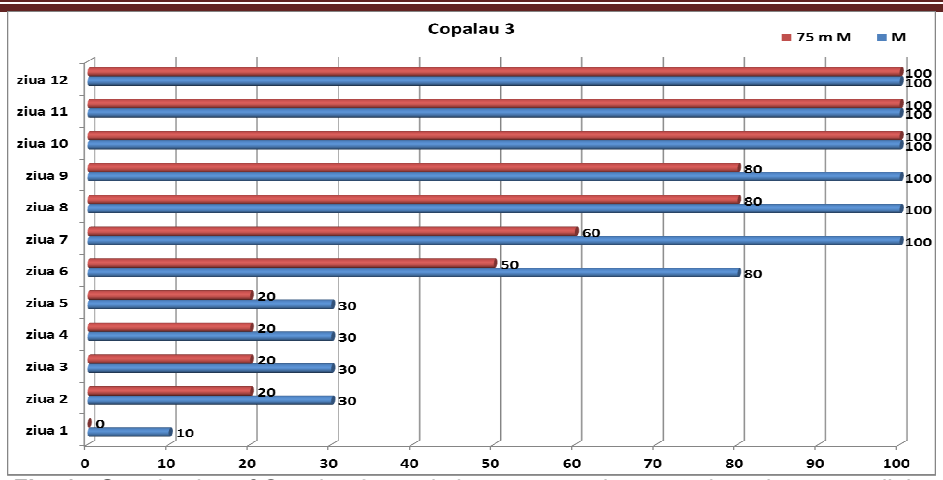
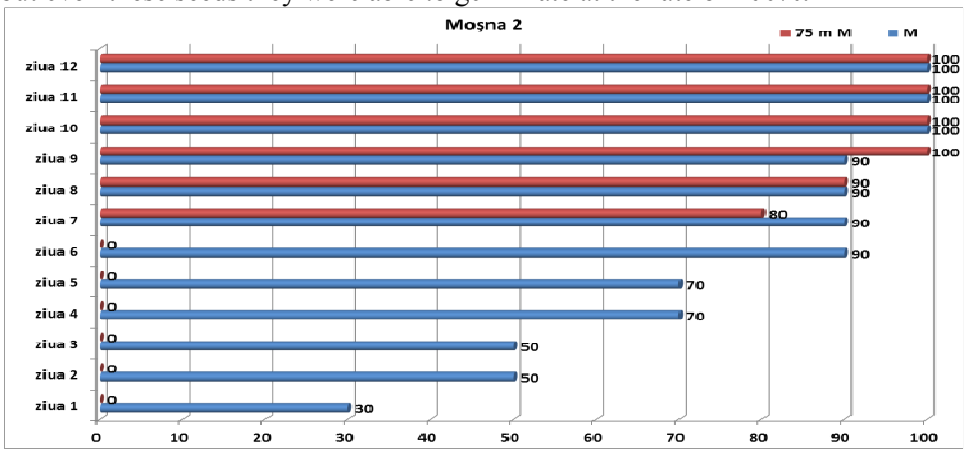


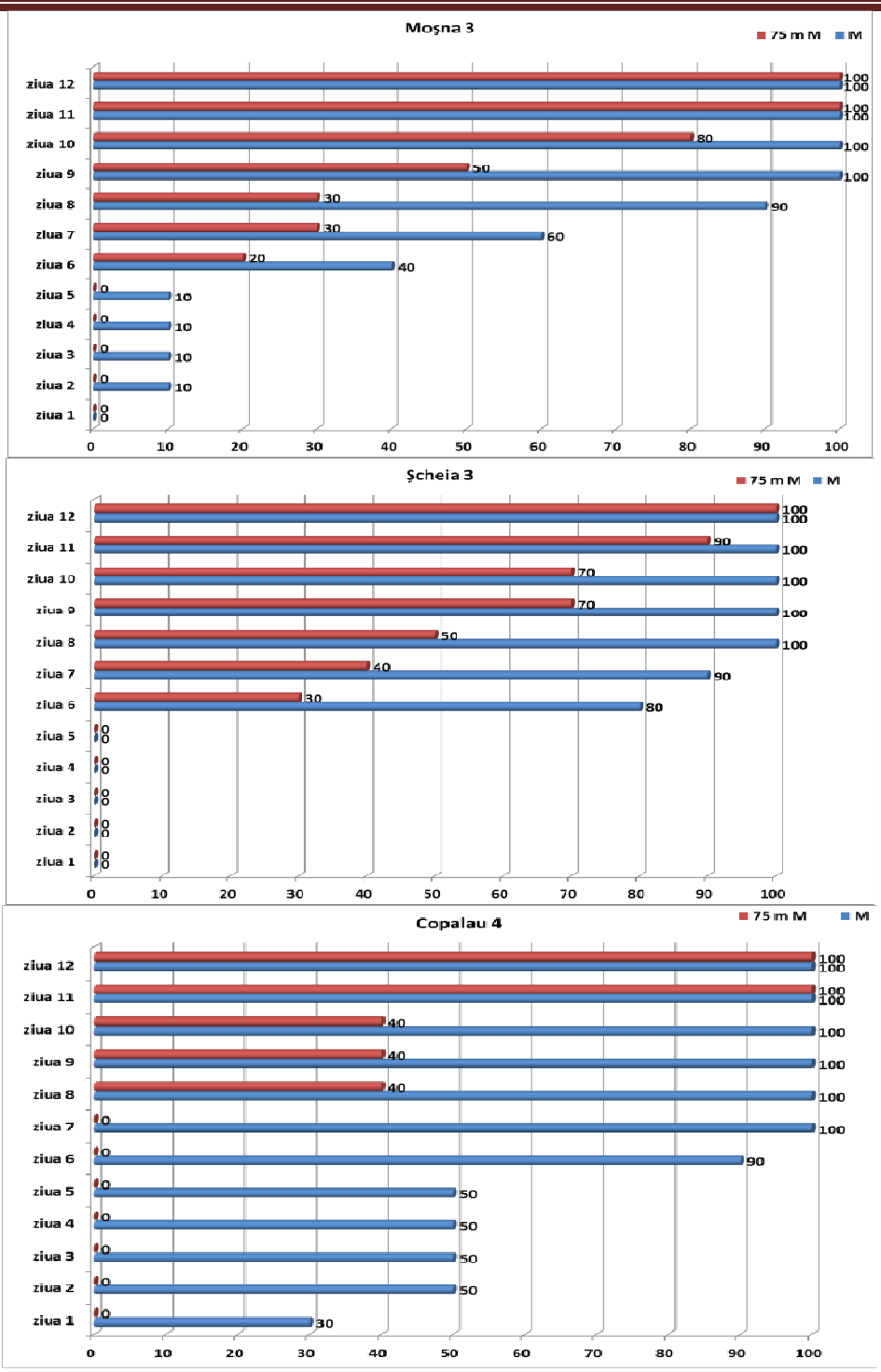
Fig. 1 - Germination of Copalau 3 population, compared to controls resistant to salinity

In most tomato populations concentration 75 mM NaCl had resulted a delay of 5-6 days in the germination capacity, however, finally reaching a maximum of 100% germinabilitate (Fig. 1 and 2).

At populations Moşna 2 and 3 and Copal 4 the treatments with saline solutions have resulted a delay germination, while at Şcheia 3 was a slight inhibition, and at Copălău 5 the germination was affected by saline treatments, resulting in the end only 70% germinated seeds (Fig. 2).

We recommend the tests carried out Copălău 3 population as the most resilient, followed by Moşna 2 and 3 and Copalau 4 that could be kept and used as tomato germplasm to improve resistance to salt stress. In the case of plants, the salt stress adaptation strategies are undergo biochemical, physiological and molecular processes. Even if were observed negative effects of salinity on seed germination, most obvious differences were observed in populations Copălău Moşna 2 and 4 with a delay of 7-8 days compared to other populations analyzed, but even these seeds they were able to germinate at the rate of 100%.

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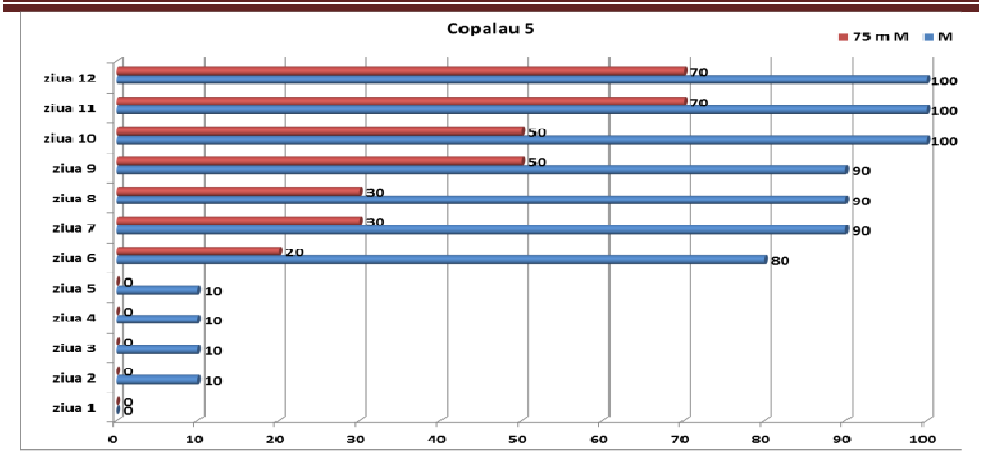

Fig. 2- Inhibition of germination capacity by treatment with saline in the first 5-7 days of starting observations

Analysis of chlorophyll pigments in cotyledon leaves of tomato in spectrophotometer

By analyzing in spectrometer it was determined the chlorophyll pigments in cotyledon leaf from seedlings grown from seed germination testing in saline.

Of the types of chlorophyll pigments analyzed, the highest values were recorded by **431-432 nm** chlorophyll, the main component of the absorption center in photosynthetic systems. This type of chlorophyll was determined to 6 local populations of tomato and two controls, a population (Jebel) and a hybrid (F1 Ursula) both resistant to salinity variations with 75 m M NaCl treated and controls with distilled water.

From figure 3 it notes three types of behavior: at control Jebel nearly equal values.882 absorbent). At Ursula F1, Moşna 2 Moşna 3; scaffolding three values are observed maximum absorbance at variants control (1113 to Moşna 3, 1082 at Moşna 2, 1051 at Şcheia 3 and 0.808 Ursula F1) and lower in those treated with saline (are observed both in control and treated with 75 mM solution in saline (0.881 resp. Moşna 0.943 to 3, 0.810 to Moşna 2, 3 and 0.778 to 0.681 Ursula Şcheia F1), saline treatment with inhibiting effect on the photosynthetic capacity of these populations.

At variants of Copalau (Copălău 3 Copălău 4 Copălău 5) there is a completely different reaction: maximum values in those treated with saline (1,529 to Copal 4, 1041 at Copal 5 and 0.918 at Copal 3) and lower in controls (1.011 at copal 5; 0.953 to 0.686 in copal copal 4 and 3), being stimulated photosynthetic capacity of these populations as a response to salt stress.

The high values obtained in Copalau recommends variants to be the most resistant to saline (Fig. 3).

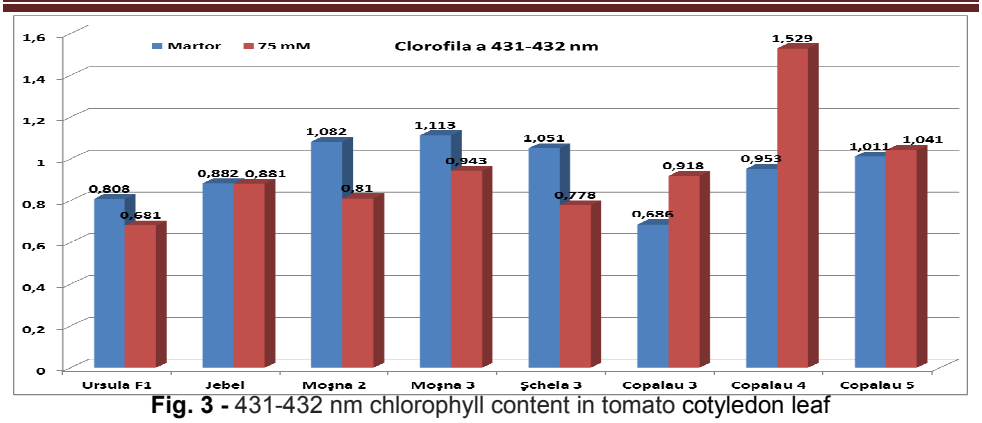

Fig. 3 - 431-432 nm chlorophyll content in tomato cotyledon leaf

Chlorophyll content of 662-663 nm, the main component of the photosynthetic reaction center systems showed two different behaviors: Ursula F1, Moşna 2, 3 and Şcheia3 notes higher values in controls (0.593 to Moşna 2; 0.568 Şcheia3 to Moşna 3 and 3; 0,400 to Ursula F1), the chlorophyll content of cotyledonar leaves being subjected to salt stress inhibited variants (fig. 4).

Another type of behavior is observed in populations from Copalau, with maximum in variants treated with saline (0.831 at Copalau 4, 0.578 at Copalau 5 and 0.496 at Copalau 3) and much lower in controls (0.497 at Copalau 4, 0.530 to Copalau 5 and 0.353 in Copalau 3), the photosynthetic activity of variants subject to salt stress was highest in this case being registered a stimulating effect on the chlorophyll content of 662-663 (Fig. 4).

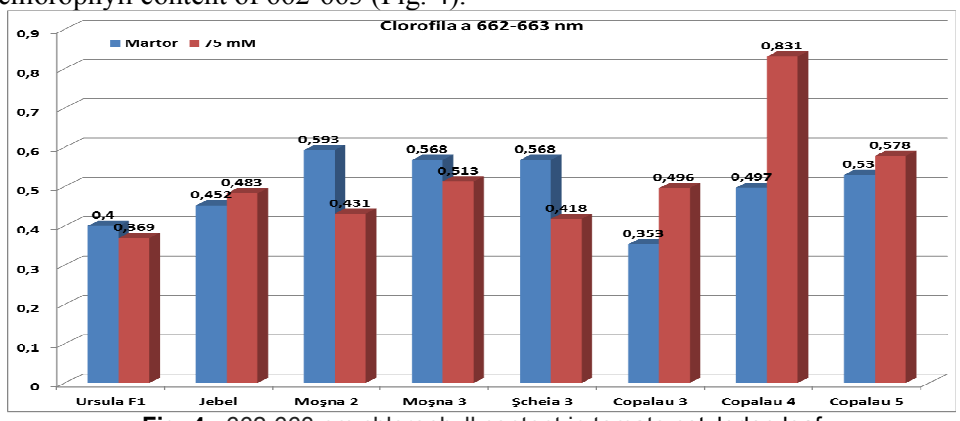

Fig. 4 - 662-663 nm chlorophyll content in tomato cotyledon leaf

CONCLUSIONS

1. In terms of germination capacity the most resistant local population can be considered Copălău 3 while populations Moşna 2, 3 and 4 Copălău saline treatments have resulted in a delay of 5, 6 days of germination.

2. The tomato plants were reacted to salt stress according to the biphasic model proposed by Mann, with the first phase, osmotic, characterized by reducing the growth and chlorophyll content of leaf and the manifestation of a phase of toxicity caused by excess sodium ions, and chlorine, characterized by the appearance of foliar chlorosis and necrosis.

3. Of the types of chlorophyll pigments analyzed in cotyledon leaves, the highest values were recorded by 431-432 nm chlorophyll, the main component of the absorption center of photosynthetic systems, and chlorophyll 662-663 nm. At variants of Copalau (Copălău 3, 4 copal, copal 5) it was observing a particular behavior: maximum values at variants treated with saline and lower in control, plantlets in salt stress response is increased photosynthetic activity.

RECOMMENDATIONS

► The analyzes and observations show that some populations of tomato analyzed react to salt stress after biphasic pattern proposed by Manns, so we recommend Copălău 3 as the most resilient, followed by Moşna 2 and 3 and Copălău 4 could be kept and used as germplasm.

►The high values of germination capacity and chlorophyll pigments content obtained in variants from Copalau, recommends as the most resistant to saline solutions, given that in this area there are about 100 ha of soils strongly and moderately saline

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