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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

EFFECT OF HIGH SALT STRESS ON MORPHOPHYSIOLOGICAL AND BIOCHEMICAL CHARACTERISTICS OF THE SUGAR BEET PLANT

Speciality: 2411.02 - Plant Physiology

Field of Science: Biology

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GENERAL CHARACTERISTICS OF THE WORK

Relevance of the topic and degree of development. It is known that in recent years the rapid development of science and technology, as a result of climate changes occurring on a global scale, the ecological situation on Earth has worsened, biological diversity has been disturbed due to the gradual reduction of quality, arable and productive land areas. As a result, threats to the ecosystem have arisen, irreversible changes on our planet have led to global warming, salinization and desertification. This, in turn, is a serious obstacle for the development of cultivated plants. Therefore, the creation of productive and stress-resistant varieties using resistant plant genotypes as initial material is one of the most important problems facing modern biological science. Therefore, the study of the physiological-biochemical bases of metabolic processes has great scientific and practical importance .

It is known that biological processes are influenced by light, temperature, humidity, salinity, etc. is regulated within a certain limit by being affected by abiotic factors such [1]as According to the information of the International Food and Agriculture Organization (FAO), as a result of the salinization of 25% of the Earth's land areas, the annual loss of crops worldwide is estimated at $27.3 million. [FAO][2]

The study of the mechanisms of adaptation against the influence of external environmental factors in the evolution of plants remains relevant to this day. In the study of resistance mechanisms in plants, the study of amino acids and sugars is also important, in addition to member acids such as malate and oxaloacetate . Invertase, which is one of the osmotic-active components in spare tissues, regulates the density of sucrose and cell turgor by ensuring the

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[1]Nico, DS The impact of environmental stress on male reproductive development in plants: biological processes and molecular mechanisms / DS Nico, G. Danny // Plant, Cell and Environment -2014.v. 37. - p.1-18.

[2] FAO. Global symposium on salt-affected soils 20-21 October. 2021

breakdown of sugars into glucose and fructose [3].

The antioxidant defense system plays an important role in the detoxification of active forms of oxygen (ROS- O_2^- radical, H_2O_2, OH^- radical) in plant organisms. ROS is involved in many processes such as signal transduction, gene expression, protein synthesis and degradation, and regulation of metabolic processes related to oxidation-reduction processes. High generation of ROS in plants leads to disruption of many processes, including physiological-biochemical mechanisms. The analysis of the data published in the scientific literature in recent years shows that the interest in the study of ROS has increased and there is a need to conduct research in this field .

In the literature, there is very little information on the study of antioxidant enzymes in sugar beet under the influence of salt stress. Taking into account that these enzymes have an adaptive property, one of the objectives is to study them during the active development stages of sugar beet.

Taking these into account, the study of the biochemical, biometric and morphophysiological changes occurring during salt stress in the sugar beet plant, which is of exceptional importance in our country and does not lag behind cereal crops in terms of its possibilities of use and economic efficiency, and the determination of the practical application areas of the obtained results formed the main direction of the dissertation work. .

The object and subject of the research. Cooper, Tarifa and Taltos varieties of sugar beet imported from Denmark were used as the object of research. The varieties mentioned are NZ-sugar intended.

The purpose and tasks of the study. The main goal of the research work is the effect of NaCl and Na_2SO_4 salts on the biometric and morphophysiological indicators of the plant, the intensity of photosynthesis, the amount of protein, lipid and carbohydrates synthesized in the leaves of the plant, as well as the utilization of

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[3]Munns, R. Genes and salt tolerance: bringing them together /R. Munns. // New Phytologist, -2005. v. 167. № 3,- p. 645-663.

ROS, which is formed as an intermediate product of metabolism in plant organs, during the active development stages of sugar beet varieties. was to study the effect on antioxidant enzymes. For this purpose, the following tasks have been set:

- Studying the effect of salts on the germination percentage and germination intensity of sugar beet seeds, determining the cultivation conditions of plants in a phytotron;
- Investigation of water parameters in sugar beet leaves during initial stages of ontogenesis during salt stress;
- Studying the effect of salt stress on the amount of chlorophyll (*a* and *b)* and carotenoids in sugar beet leaves ;
- Study of the effect of salt stress on biometric and some morphophysiological indicators of sugar beet seedlings;
- Study of the dynamics of changes in the amount of fats, sugars and proteins in the leaves of sugar beet varieties under salt stress in the initial stages of ontogenesis;
- Study of the quantity and morphological structure of the mouth cells in sugar beet leaves under salt stress;
- Investigating the role of catalase and benzidine-dependent peroxidase enzymes in adaptive responses under salt stress in sugar beet leaves;
- Based on the obtained results, explanation of the physiological-biochemical adaptation mechanisms formed against salt stress in sugar beet varieties;

Materials and methods of research. As the research material, Taltos, Cooper and Tarifa seeds imported from Denmark were exposed to 0.2 and 0.5% NaCl and Na_2SO_4 salts from the initial stages of the vegetation period. 20 seeds were planted from each sample taking into account the soil mineral content, temperature and relative humidity.

The vegetation period of the plant was 60 days. The main purpose of choosing this vegetation period is that sugar beet is more sensitive to salt in the first periods of vegetation and the fruiting root is formed from the 60th day.

Climate indicators were measured with a TKA-PKM device (Model 43, St. Petersburg, Russia), determination of the amount and functional state of the gill cells in leaves with a LABOMED LX 400 (USA) microscope, and determination of leaf gas exchange parameters with the help of a LI-COR 6400 XT portable analyzer. has been fulfilled. Analysis of soil samples at the AR ETN Institute of Soil Science and Agrochemistry according to the method of Antipov and Karatayev [Антипов-Каратаев, 1953], separation of chloroplasts according to Shutilova [Шутилова и др., 1979], relative amount of water in the leaf and water scarcity according to Tambussi [Tambussi et al., 2005], soil moisture according to Aleksandrova and Naydenova [Александрова, Найденова, 1967], analysis of soil chemical composition was carried out according to Arinushkin [1970]. The amount of pigments was determined by the spectrophotometric method of Sims, Gamon [Sims, Gamon, 2002], the amount of fats was determined by Soxhlet [Эрмаков и др., 1972], the amount of sugars was determined by Bertrand [Эрмаков и др., 1972], and the amount of protein was determined by Lowry [Lowery, 1951] methods. has been appointed. CAT activity was determined by the method of Kumar and Knowles [1993], BPO activity by Nakano and Asada [1981]. During the analysis of the results of the research, the average mathematical errors and deviations (M±m) were taken into account, and the significance level of $P<0.05$ was accepted as a reliability coefficient.

The main provisions defended:

- Sugar beet varieties resistant to salt stress when carotenoid content is high.
- Sugar beet cultivars adapt to salinity by regulating the activity of antioxidant enzymes.
- The amount of a number of metabolites in sugar beet varieties depends on the type and concentration of salt and participates in the formation of resistance to stress.

Scientific innovations of research.

1. For the first time, in the early stages of sugar beet plant ontogenesis, at high concentrations of different salts (NaCl, Na_2SO_4), adaptation mechanisms are explained based on changes in plant biometric indicators, water status of leaves, photosynthetic pigments and high-energy organic nutrients in leaves, as well as the activity of

antioxidant enzymes. complex research works have been carried out.

2. Optimum conditions for planting and cultivation of sugar beet seeds in artificial climatic environment with high salt concentration have been determined.

3. It has been determined that species-specific changes in the activity of antioxidant enzymes occur due to salt stress. At this time, the decrease in the activity of one of the enzymes is compensated by the increase in the activity of the other enzyme.

Theoretical and practical significance of the study:

The results of the dissertation expand our knowledge about the modern mechanisms underlying the sustainability of plants, explain the principles of the antioxidant system in salt stress and their importance in the vital processes of plants.

Investigating adaptive mechanisms against the effects of abiotic stress factors in plant metabolism allows selection of varieties resistant to more complex stress conditions.

The results of the research can be used as a marker in understanding the physiological-biochemical and molecular mechanisms of plants' adaptation to stress, in the sustainability of photosynthesis, and in determining the limiting limits of drought and salt stress of ecological problems of plants.

The materials of the dissertation are used in the teaching of a number of specialized courses such as "Ecology and soil science", "Biology", "Adaptation", "Photosynthesis" and "Respiration", "Physiology and biochemistry of plants" in higher schools, in scientific research institutes of the Ministry of Science and Education of the Republic of Azerbaijan, can be used as auxiliary means in the fields of agrarian science, farms, as well as in the operation of large economic facilities engaged in the cultivation of ecologically clean and high-quality food products.

Approbation and application: The results of the research were discussed at local and international conferences and symposia. At the II International Scientific-Practical Conference on Current Problems of Modern Science and Education (Russian Federation, Petrozavodsk 2019), at the IV Republican Scientific-Practical Conference of Young Scientists (Azerbaijan, Ganja 2019), Scientific-Practical Development of Ecological Agriculture in Azerbaijan conference (Ganja 2019) was discussed at the Karabakh Applied Sciences II International Conference (Baku 2021).

Publications. 12 scientific works, including 8 articles and 4 theses, were published on the results of the research work.

Structure and scope of the dissertation. 308 sources were used with reference to 10 Azerbaijani and 298 foreign literature sources. The number of marks in the dissertation is 188667. The structure of the thesis includes the introduction, literature review, 5 pictures, 23 tables and 3 diagrams. Total number 188 667-, Introduction 10568, Chapter I 89921, Chapter II 61720, Chapter III 61720, Discussion of the result 4739, Conclusion 1998, Recommendation 242 signs.

I CONTENTS OF THE WORK

The main points of the dissertation **in the introduction** reflected: the topic is substantiated, its relevance, the main propositions defended are explained, the purpose and tasks of the research, the scientific innovation and practical significance of the obtained results are noted.

In the literature summary, the literature data available until the last period were analyzed to determine the modern level of the dissertation topic. Literature data on the study of the dynamics of changes in the activity of antioxidant defense system enzymes, biometric indicators, the amount of high-energy organic compounds, some physiological-biochemical processes, the change in the amount of photosynthesis pigments, the effect of the morphophysiological state of the mouthparts on the emergence of adaptation mechanisms against salt stress in higher plants were collected and discussed, and the thesis was discussed. the topic and the main directions of the research have been determined.

RESULTS OBTAINED AND THEIR DISCUSSION

1. Study of seed germination percentage and germination intensity. During the observation of the obtained sprouts, it was determined that the Tarifa variety is the first, the Cooper is the second, and the Taltos variety is the last in terms of the germination percentage of the seeds in different concentrations of both salts (Tab. 1) Regardless of the variety, the percentage of germination in both concentrations of Na_2SO_4 was higher compared to NaCl. The highest germination percentage was observed in the Tarifa variety under the influence of 0.2% Na_2SO_4 salt. Zhang [4]found that high concentrations of NaCl inhibited the germination of cucumber seeds.

Table 1

Germination percentage and germination intensity of sugar beet seeds

Kind	Variety	Number of seeds	Germ. energy	Germination %
Cooper	Control	20.0	20±2.38	90.0
	0.2% NaCl	20.0	25±3.67	60.0
	0.5% NaCl	20.0	12±1.48	50.0
	0.2% Na_2SO_4	20.0	18±1.76	70.0
	0.5% Na_2SO_4	20.0	16±1.42	55.0
Tariff	Control	20.0	19±1.82	95.0
	0.2% NaCl	20.0	12±1.45	75.0
	0.5% NaCl	20.0	10±0.96	60.0
	0.2% Na_2SO_4	20.0	14±1.42	90.0
	0.5% Na_2SO_4	20.0	11±1.0	80.0
Taltos	Control	20.0	15±1.39	75.0
	0.2% NaCl	20.0	13±1.52	65.0
	0.05% NaCl	20.0	10±0.89	50.0
	0.2% Na_2SO_4	20.0	15±1.43	75.0
	0.5% Na_2SO_4	20.0	12±1.41	60.0

[4]Wang G., Zhang B., Zhao Y., Zhang J., Shen J. Influenza NaCl stress germination of cucumber seeds // Agr . Univ., 2004, v. 26, No. 6, p. 624-627.

with a temperature of 23-25ºC, a photoperiod of 14 hours, a relative humidity of 60-70% and a light intensity of 10-15 klx was created in the phytotron for planting and cultivation of plants. A decrease in the relative amount of water in the leaves to ~70-75% causes water scarcityin plants. When relative amount of water drops below 30% in plants resistant to drought and salinity, regeneration of damaged organs and tissues does not occur .

2. Effect of salt stress on biometric parameters of sugar beet.

The effect of stress on the organs of plants, on the development of leaves and architecture, depends on the type of stressor, the duration of stress and the mineral content of the soil. Table 2 shows the results regarding the dynamics of leaf area (S_w), leaf mass (M_l), leaf length (L_l), plant mass (M_p) and root length (L_r) in sugar beet vegetative organs. As can be seen from the table, NaCl and Na_2SO_4 salts have different effects on the sugar beet plant, depending on their concentration. So, although all the parameters in the control options of all three varieties received high values compared to the experimental options, there were certain differences: 1) Biometric indicators gradually increase during the 60 days of active plant development in all three varieties; 2) Tarifa ranks first, Cooper second, and Taltos variety third in terms of salt resistance; 3) Na_2SO_4 salt at concentrations of 0.2% and 0.5% had a more effective effect compared to those concentrations of NaCl. In addition, in the first 45 days of plant development, 0.2% concentrations of both salts (NaCl and Na_2SO_4) stimulated the development of the studied parameters, and in the later stages, such growth was accelerated by the effect of 0.5% Na_2SO_4 salt. was carried out. The analysis of the L_l /L_r ratio shows that this ratio is close to each other in all options, except for the control option, and ranges from 1.2 to 1.6. The obtained results show that the stress has a similar effect on the root and leaf of the plant. As can be seen from the table, S_y and M_b increase similarly in both options. It can be said that the obtained results are related to the energetic exchange going on in the cell. From this point of view, Bybordi [5][2010] found in *Canola rape* plant that as a result of increasing salinity, seed germination, germination energy, root length and the number of young shoots decrease. Accumulation of mineral nutrients and proline increases height, leaf area, and dry biomass in *rape seed* . It is known that changes in the development and architecture of roots in halophytic plants depend on the salinity level, type and mineral content of the soil. Testernik [6]study the growth and development the roots of *Arabidopsis* seedlings under salt stress in the agar-agar solution, they concluded that the elongation of the main root due to the effect of stress slows down more than that of the lateral root, and the amount of the lateral root increases.

Table 2.

Change dynamics of some biometric indicators during the active development phases of sugar beet under salt stress

kind	Variety	Length leafe, mm	L_l, Mm	L_l/L_r	S_r, (cm^2)	M_{plant},(q)
30 days						
Cooper	Control	60.0 3.43	40.0±2.46	1.5	10.3±0.99	28.9±2.14
	0.2%NaCl	45.0±3.14	35.0±2.12	1.3	8.0±0.86	28.8±2.06
	0.5% NaCl	35.0±2.11	30.0±2.06	1,2	4.0±0.26	28.6±2.01
	0.2%Na_2SO_4	57.0±3.93	40.0±2.44	1.4	10.1±0.78	28.9±2.05
	0.5%Na_2SO_4	40.0±2.57	33.0±2.11	1,2	7.4±0.69	27.8±2.0
Taltos	Control	68.0±4.01	42.0±3.0	1.6	14.6±1.35	21.1±1.94
	0.2% NaCl	52.0±3.66	44.0±3.98	1,2	9.0±0.99	28.8±2.02
	0.5%NaCl	45.0±3.03	35.0±2.14	1.3	6.2±0.57	28.7±2.03
	0.2%Na_2SO_4	49.0±3.13	41.0±2.51	1,2	7.3±0.59	29.5±2.12
	0.5%Na_2SO_4	44.0±2.95	36.0±2.14	1,2	6.1±0.49	29.0±2.15
Ta rif	Control	70.0±4.51	40.0±2.43	1.8	16.1±1.79	32.3±2.18
	0.2% NaCl	64.0±4.28	41.0±2.49	1.6	11.8±0.97	31.9±2.19

[5] Bybordi, A. The influence of salt stress on seed germination, growth and yield of canola cultivars / A. Bybordi // Not. Bot. Horti. Agrobot, Cluj-Napoca, -2010.v. 38, No. 1, - p. 128-133.

[6]Pasternak, T. Morphogenic effects of abiotic stress: reorientation of growth in Arabidopsis thaliana seedlings / T. Pasternak, V. Rudas, G. Potters, MAK Jansen // Environ. Exp. Bot.- 2005. v. 53.- p . 299-314.

						Table 2 follows
	0.5% NaCl	48.0±3.21	36.0±2.13	1,2	6.8±0.49	30.6±2.49
	0.2%Na_2SO_4	60.0±3.48	45.0±3.16	1.3	11.8±0.97	33.2±2.58
	0.5%Na_2SO_4	58.0±3.22	40.0±2.41	1.5	10.1 ±0.86	29.9 ±2.13
45 days						
Cooper	Control	85.0±6.78	60.0±5.87	**1.4**	21.0±2.67	81.0±7.34
	0.2% NaCl	80.0±6.54	50.0±4.33	1.6	11.8±0.98	79.1±6.87
	0.5% NaCl	51.0±3.03	43.0±3.11	1,2	7.7±0.56	79.0±6.88
	0.2% Na_2SO_4	72.0±5.93	57.0±4.63	1.3	15.0±1.21	79.4±8.65
	0.5% Na_2SO_4	55.0±4.32	42.0±3.03	1.3	9.5±0.82	78.9±6.56
Taltos	Control	81.0±7.13	57.0±4.88	1.4	19.2±1.45	70.9±6.46
	0.2% NaCl	69.0±5.14	56.0±4.47	1,2	13.7±1.03	78.4±6.73
	0.5% NaCl	60.0±5.14	55.0±4.44	1.1	9.6±0.86	78.1±6.73
	0.2% Na_2SO_4	62.0±5.15	54.0±4.90	1,2	11.3±1.0	71.4±6.44
	0.5% Na_2SO_4	56.0±4.62	49.0±4.87	1.1	8.5±0.67	79.0±7.0
Tarifa	Control	91.0±7.76	60.0±5.0	1.5	27.0±2.48	84.8±7.47
	0.2% NaCl	70.0±6.58	55.0±4.42	1.3	15.1±1.26	82.7±7.22
	0.5% NaCl	60.0±4.66	51.0±4.01	1,2	10.5±0.96	80.5±7.12
	0.2% Na_2SO_4	75.0±6.73	62.0±4.99	1,2	17.0±1.43	82.0±7.13
	0.5% Na_2SO_4	79.0±6.86	52.0±4.02	1.5	21.2±2.01	83.5±7.16
60 days						
Cooper	Control	99.0±8.36	80.0±7.23	1.3	27.4±2.34	113.9±10.1
	0.2% NaCl	75.0±6.67	64.0±5.67	1,2	13.8±1.22	111.6±10.0
	0.5% NaCl	63.0±5.45	59.0±4.88	1.1	9.3±0.87	109.7±10.0
	0.2% Na_2SO_4	88.0±7.02	72.0±6.84	1,2	18.9±1.67	110.5±9.99
	0.5% Na_2SO_4	69.0±5.21	57.0±4.68	1,2	11.1±1.00	109.9±9.82
Taltos	Control	101.0±9.28	72.0±6.66	1.5	30.8±2.89	115.1±10.21
	0.2% NaCl	96.0±8.01	68.0±5.86	1.4	21.9±2.11	112.9±10.13
	0.5% NaCl	93.0±7.99	70.0±6.22	1.4	18.5±1.54	112.0±10.1
	0.2%Na_2SO_4	98.0±8.25	65.0±5.03	1.5	19.7±1.67	113.7±10.11
	0.5%Na_2SO_4	94.0±7.67	60.0±4.99	1.6	13.6±1.12	113.0±9.86
Tariff	Control	95.0±7.87	71.0±6.74	1.4	24.7±2.23	112.8±9.98
	0.2% NaCl	94.0±7.91	71.0±6.83	1.3	18.0±1.67	111.1±9.94
	0.5% NaCl	72.0±6.73	63.0±5.42	1,2	11.1±1.01	110.0±9.78
	0.2% Na_2SO_4	91.0±8.44	83.0±7.64	1.1	19.0±1.89	112.5±9.85
	0.5%Na_2SO_4	92.0±8.56	67.0±5.81	1.3	20.0±2.0	111.9±9.79

The obtained results show that the change of biometric parameters of the plant also depends on the nature of the stressor. So, our results and literature data show that NaCl salt has a higher toxic effect than Na_2SO_4 . That is why the biometric indicators of the plant are not seriously damaged by the effect of Na_2SO_4 salt .

3. Effect of salt on the amount of pigments in sugar beet leaves.

One of the diagnostic methods of studying salt resistance of B losses is the determination of changes in the amount of photosynthetic pigments in the leaves. Showed in Table3, the amount of chl *a* pigment in the leaves of all 3 cultivars in the control variants gradually decreased as the age of the plant increased. The amount of xl *a* in the 30-day-old Cooper cultivar was higher than that of other cultivars. In the Tarifa variety, this indicator had the lowest value. These obtained results can be explained by the durability properties of the varieties. Thus, the high amount of chlorophyll in the Cooper variety suggests that it is non-sustainable, and the low amount of chlorophyll in the Tarifa variety is related to its persistence property. It is known that along with the chl *a/b* ratio in the leaves, the car/chl(a+b) ratio also provides information about the stress resistance of the plant during the analysis of the obtained results. The ratio of chl *a/b* in 60-day-old leaves of Tarifa cultivar decreased with time in control samples of Na_2SO_4 It increased in concentrations of 0.2% and 0.5%, as well as in concentrations of 0.2% and 0.5% of NaCl. This trend was also observed during the analysis of carotenoid content, except for minor outliers. Only in 30-day-old plants, the amount of carotenoids increased by 0.5% Na_2SO_4 in the Tarifa cultivar compared to the control variant. This can be considered as the sugar beet plant's response to salt stress (Tab. 3). As can be seen from the table, the amount of chl *a* decreased synchronously with the increase in the concentration of salts. It can be concluded from this that the increase in the amount of salt in the soil creates a drought effect by slowing down the diffusion of water in the process of mineral nutrition through ion exchange in root systems. Chlorophyll pigment is dispersed in the leaves, and as a result, the rate of photosynthesis (P_n) weakens, plant height, mass, biometric measurements of leaves and other indicators are reduced. During the study, the car/chl *(a+b*) ratio was determined. Carotenoids are mainly involved in the durability of plants , and chlorophylls are involved in photosynthesis [7]. The increase in the ratio of these two quantities occurs due to the increase in the amount of carotenoids during stress, which in turn leads to an increase in the plant's resistance to the effect of the stressor. It can be seen from Table 3 that this ratio has increased in both concentrations of Na_2SO_4 in the 60-day-old Tarifa variety. In Tarifa variety, under the influence of 0.2% NaCl salt, the car/chl (*a*+*b*) ratio increased ~2 times compared to Cooper variety, and ~3 times compared to Taltos.

Chla/b ratio decreased in 0.5% Na_2SO_4 and NaCl concentrations, while in the Tarifa variety, this ratio increased, which was due to the decrease in the amount of chl *b* . These results suggest that Taltos and Cooper cultivars are less salt resistant than Tarifa cultivar. Liu A [8]shows that under salt stress, the synthesis of photosynthetic pigments increases in plants in the early stages of vegetation, and in the later stages, as plant growth is weakened, the relative amount of pigments in leaves decreases, and in stronger stress, plastids disintegrate, resulting in a decrease in the total amount of chlorophylls. Appropriate processes occur under both drought and salt stress conditions. In the experiments conducted with salt-tolerant and non-salt-tolerant plants, it was determined that at the beginning of stress, the amount of chl *a* and *b, the chl a/b* ratio first increases and then decreases, and this process is more intense in non-tolerant varieties.

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[7]Smolikova, G.N., Daman, N.A., Boriskevich, O.V. The role of chlorophylls and carotenoids in the resistance of seeds to abiotic stress // Physiologiya rastenii, - 2011, t. 58, No. 6, - 817-825 c.

[8]Liu A, Hu Z, Bi A, Fan J, Gitau MM, Amombo E, Chen L, Fu J) Photosynthesis, antioxidant system and gene expression of bermudagrass in response to low temperature and salt stress. Ecotoxicology 2016.25:1445–1457. doi:10.1007/s10646-016-1696-9

Table 3

Changes in the amount of pigments in sugar beet leaves under the influence of salt (μmol/ml)

Kind	Variety	chl a 10^{-2}	chl (a+b)·10^{-2}	chl(a/b)	car·10^{-2}	car/chl (a+b)
30 day						
Cooper	Control	1.59±0.341	0.55±0.045	4.6	0.46±0.032	84.5
	0.2% NaCl	0.28±0.022	0.45±0.032	1.6	0.34±0.024	75.2
	0.5% NaCl	0.11±0.008	0.44±0.035	0.3	0.25±0.015	58.0
	0.2%Na_2SO_4	0.4±0.034	0.57±0.048	2.5	0.34±0.021	60.3
	0.5%Na_2SO_4	0.24±0.016	1.45±0.93	0.2	0.17±0.013	11.3
Taltos	Control	0.26±0.015	0.47±0.036	1,2	0.24±0.015	51.7
	0.2% NaCl	0.32±0.027	0.59±0.054	1,2	0.32±0.027	54.4
	0.5% NaCl	0.19±0.014	0.30±0.019	1.7	0.14±0.007	69.1
	0.2%Na_2SO_4	0.22±0.016	2.90±1.020	2.9	0.20±0.014	67.1
	0.5%Na_2SO_4	0.29±0.022	1.17±0.086	0.3	0.37±0.030	31.3
Tarifa	Control	0.18±0.011	0.23±0.013	3,4	0.23±0.014	97.3
	0.2% NaCl	0.01±0.001	0.17±0.014	0.4	0.1±0.007	57.7
	0.5% NaCl	0.23±0.014	0.31±0.026	2.5	0.13±0.009	40.8
	0.2%Na_2SO_4	0.20±0.013	0.27±0.019	2.8	0.2±0.013	74.5
	0.5%Na_2SO_4	1.10±0.092	1.19±0.087	5.8	0.49±0.035	41.3
45 day						
Cooper	Control	0.18±0.011	0.36±0.029	1.0	0.24±0.015	65.0
	0.2% NaCl	0.29±0.022	0.40±0.030	0.3	0.2±0.015	60.2
	0.5% NaCl	0.20±0.014	2.1±0.998	4.0	0.1±0.007	46.6
	0.2%Na_2SO_4	0.85±0.072	1.12±0.084	3.2	0.43±0.034	38.3
	0.5%Na_2SO_4	0.68±0.051	0.91±0.068	3.1	0.40±0.031	43.0
Taltos	Control	0.87±0.064	0.97±0.070	1,2	0.23±0.014	23.9
	0.2% NaCl	0.18±0.011	0.14±0.007	2.7	0.1±0.007	63.4
	0.5% NaCl	0.29±0.022	0.58±0.044	1.1	0.34±0.022	58.2
	0.2%Na_2SO_4	0.82±0.068	1.53±0.089	1,2	0.96±0.069	62.6
	0.5%Na_2SO_4	0.33±0.028	0.48±0.034	2.1	0.08±0.003	16.2
Tarifa	Control	0.55±0.042	0.75±0.065	2.8	0.44±0.036	59.3
	0.2% NaCl	0.93±0.078	1.63±0.593	1.3	1.99±0.099	30.4
	0.5% NaCl	0.16±0.011	0.61±0.050	0.4	0.54±0.040	88.7
	0.2%Na_2SO_4	0.60±0.046	0.79±0.061	3.1	0.48±0.033	66.7
	0.5%Na_2SO_4	0.29±0.022	0.47±0.035	1.5	0.21±0.015	45.7
60 day						
Coo	Control	0.19±0.014	0.34±0.021	1.3	0.24±0.016	71.4

	Table 3 follows					
	0.2% NaCl	1.91±0.980	2.03±1.01	6.2	0.77±0.067	38.0
	0.5% NaCl	0.96±0.075	1.66±0.89	1.4	0.65±0.049	39.4
	0.2%Na_2SO_4	0.72±0.063	1.13±0.85	1.8	0.56±0.044	49.2
	0.5%Na_2SO_4	0.13±0.009	0.23±0.014	1,2	0.09±0.004	37.2
Taltos	Control	0.87±0.064	1.97±0.99	2.9	0.63±0.047	32.1
	0.2% NaCl	0.11±0.008	0.38±0.026	0.4	0.09±0.004	24.5
	0.5% NaCl	0.21±0.013	0.35±0.024	1.3	0.07±0.003	19.0
	0.2%Na_2SO_4	0.33±0.026	0.53±0.039	1.7	0.10±0.007	17.9
	0.5%Na_2SO_4	0.33±0.028	0.92±0.081	0.6	0.10±0.007	10.9
Tarifa	Control	0.55±0.041	0.73±0.064	2.8	0.54±0.042	71.9
	0.2% NaCl	0.52±0.039	0.77±0.067	2.9	0.58±0.049	75.9
	0.5% NaCl	0.39±0.029	0.53±0.040	3.0	0.09±0.004	27.9
	0.2%Na_2SO_4	0.86±0.063	1.14±0.86	3.0	0.91±0.77	79.2
	0.5%Na_2SO_4	0.54±0.041	0.85±0.059	1.8	0.59±0.049	70.1

The higher ratio of Car/chl(*a+b)* in the experimental variants compared to the control variants occurred due to the increase in the amount of carotenoids in salinity and the decrease in the total amount of chlorophylls. During the vegetation period of the plant, there is no significant difference in the change of this ratio in the leaves of the control samples (Tab. 3). The analysis of the obtained results shows that the plant's physiological state, productivity and adaptability depend on the level of biological processes formed under the influence of environmental stress factors.

As showed on Table 3, salt had a different effect on the amount of pigments in all three sugar beet varieties. Thus, the amount of pigments increased at low concentration of salt, and decreased at high concentration. Thus, the amount of pigment indicators was the highest in the 60-day-old Tarifa variety under the influence of 0.2% Na_2SO_4 salt, relatively less in the Cooper variety, and less in the Taltos variety.

Hui[9]et al. They showed a decrease in fluorescence of chlorophylls due to the effect of NaCl salt in *Lycium barbarum* plant.

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[9]Hui HX, Xu X., Li QR Effect of NaCl stress on chlorophyll betaine fluorescence and chloroplast pigments with Lycium barbarum leaf // Rss . Arid. Areas., 2004, v. 22, No. 3, c. 1457-14929.

During long-term stress, the increase of car/chl ratio in leaves as salt concentration increases are shown as one of the reasons for salt resistance of *L. barbarum* plant.

4. Effect of salt stress on the activity of stem cells in leaves.

The condition of the stomata in the leaves under the current conditions is one of the important biometric parameters during stress and affects the assimilation of T_r and CO_2 in the leaves. During the experiments, the stomata were examined microscopically. Due to the large number of samples, a fixative (3:1, acetic acid-ethanol) solution was first used to keep the morphology of the stomata stable. Then, the plates with the samples were quickly transferred to the refrigerator, and the number of open and closed stomata was determined under a microscope with 400 times magnification. If the dimensions of the stomata are less than 0.004 mm, it is considered closed. As a result of the effect of salt stress, the complete or partial closing of the stomata in the leaves of plants leads to a decrease in the amount of CO_2, even completely not entering the cell, as a result, the rate of photosynthesis (P_n) decreases. Under these conditions, the high-energy compounds synthesized during photosynthetic assimilation cannot replace the energy spent in catabolism, so the plant looks for alternative ways of living. The resistance of plants to the influence of any external environmental factor is based primarily on energetic factors, so resistance is closely related to the exchange of CO_2.

It was determined that under salt stress, Pn in sugar beet varieties first increases and then gradually decreases. On the 45th-60 th days of the development of the investigated cultivars, Pn in the control variants was 19.7, 17.5, and 14.8 µmol $CO_2 \cdot m^{-2} \cdot s^{-1}$, respectively, during the exposure to NaCl salt, 14.5, 12, and 9.9 µmol $CO_2 \cdot m^{-2} \cdot s^{-1}$, and under the influence of Na_2SO_4 salt, respectively, 17.1, 16.7 and 16.0 µmol $CO_2 \cdot m^{-2} \cdot s$ was equal to $^{-1}$. At this time, the amount of carbon dioxide (Ci) collected in the intercellular spaces increases as the stress dose and exposure duration continue, while the permeability of the stomata (g_s) and the intensity of transpiration (T_r)

decrease sharply. NaCl salt caused a greater decrease in gas permeability (g_s) and transpiration (T_r) of stomata than Na_2SO_4.

Table 4

Determing amount stomata cells of varieties of sugar beet

Kind	Variety	common number stomata	closed stomata number	open stomata number
30 days				
Cooper	Control	50	11	39
	0.2% NaCl	44	27	17
	0.5% NaCl	45	30	15
	0.2% Na_2SO_4	49	20	29
	0.5% Na_2SO_4	46	24	22
Taltos	Control	44	16	28
	0.2% NaCl	37	22	15
	0.5% NaCl	32	18	14
	0.2% Na_2SO_4	40	21	19
	0.5% Na_2SO_4	38	25	13
Tarifa	Control	55	36	19
	0.2% NaCl	40	21	19
	0.5% NaCl	38	29	9
	0.2% Na_2SO_4	42	22	19
	0.5% Na_2SO_4	40	24	16
45 days				
Cooper	Control	72	27	45
	0.2% NaCl	67	43	24
	0.5% NaCl	65	33	32
	0.2% Na_2SO_4	70	41	29
	0.5% Na_2SO_4	68	45	23
Taltos	Control	58	15	43
	0.2% NaCl	40	22	18
	0.5% NaCl	35	21	14
	0.2% Na_2SO_4	33	17	16
	0.5% Na_2SO_4	43	24	19
Tarifa	Control	75	52	11

	Continuation of Table 4			
	0.2% NaCl	42	27	15
	0.5% NaCl	40	24	16
	0.2% Na_2SO_4	44	27	17
	0.5% Na_2SO_4	47	29	18
Cooper	Control	89	63	26
	0.2% NaCl	70	37	33
	0.5% NaCl	67	39	28
	0.2% Na_2SO_4	71	39	32
	0.5% Na_2SO_4	70	42	28
Taltos	Control	60	45	15
	0.2% NaCl	42	24	18
	0.5% NaCl	37	24	13
	0.2% Na_2SO_4	35	21	15
	0.5% Na_2SO_4	46	32	14
Tarifa	Control	47	38	9
	0.2% NaCl	42	24	18
	0.5% NaCl	45	27	18
	0.2% Na_2SO_4	49	32	17
	0.5% Na_2SO_4	50	27	23

It can be seen from Table 4 that the number of stomata cells is more in the leaves of the control samples of all three cultivars. It was determined that in the leaves of Cooper, Taltos and Tarifa cultivars, the number of closed stomata is greater than the number of open stomata in all stages of plant development. In such conditions, since closed stomata reduce water loss in the plant by reducing T_r and using water sparingly, there is no serious change in osmotic processes and excess amount of salt is prevented from entering the cell.

5. Effect of salt stress on the total content of sugars, lipids and proteins in sugar beet leaves.

The results obtained from the determination of the amount of sugars in the leaves of the sugar beet plant are given in table 5. As can be seen from Table 5, Na_2SO_4 salt with concentration of 0.2% and 0.5% stimulates more the amount of sugars synthesized in control and experimental plants. In all variants, the amount of sugars in the studied leaves first increases over time, and then gradually decreases . This similarity was always expected, but different results were obtained under the condition of maintaining the general trend in the stress variants. So, as can be seen from result the amount of sugars in the Tarifa variety is higher. Based on the comparison of the results, it was determined that the amount of sugars in the Tarifa variety is ~ 1.14 times higher than the Cooper variety, and ~ 1.29 times higher than the Taltos variety. If we show these results in units of density, then the amount of sugar under the influence of 0.5% Na_2SO_4 salt in the Cooper variety is on average 16.2 mg/ml, in the Taltos variety it is 14.3 mg/ml, and in the Tarifa variety it is was equal to. 18.4 mg/ml. As can be seen from the table, the amount of sugars due to the effects of 0.2% and 0.5% NaCl and 0.2% Na_2SO_4 salts was higher compared to the control options, but under the influence of 0.5% Na_2SO_4 salt, was low (Tab 4). The analysis of the obtained results shows that the change of the amount of sugars in the leaves of all three studied varieties of sugar beet due to the effect of salts of different composition and concentration depends on the systematic affiliation of the plant, the type of salt, the age characteristic of individuals and is regulate by genetic laws.

The several times increase in the amount of sugars in the leaves of the investigated cultivars and the differences between the cultivars due to this growth level are related to the alternative defense mechanisms that appear in the plant metabolism during stress, indicating that there is a specific reaction environment for each species.

Table 5

Effect of salt stress on the content of sugars in leaves of sugar beet cultivars

Kind	Option Soluble sugars mg/ml			
		30 days	45 days	60 days
Cooper	Control	5.3±0.40	6.2±0.43	3.5±0.18
	0.2% NaCl	4.5±0.39	5.7±0.44	3.9±0.19
	0.5% NaCl	8.3±0.68	9.4±0.79	6.6±0.33
	0.2% Na_2SO_4	7.5±0.52	8.5±0.67	6.1±0.31
	0.5% Na_2SO_4	14.7±1.21	16.2±11.8	10.3±0.51
Taltos	Control	7.2±0.57	8.5±0.79	5.2±0.26

	Continuation of Table 5			
	0.2% NaCl	5.5±0.41	6.3±0.55	3.2±0.16
	0.5% NaCl	8.2±0.63	6.7±0.57	7.3±0.37
	0.2% Na_2SO_4	14.5±1.51	15.7±1.34	12.1±0.81
	0.5% Na_2SO_4	13.7±1.05	14.3±1.04	11.6±0.68
Tarifa	Control	8.7±0.71	10.3±0.99	7.9±0.49
	0.2% NaCl	11.8±0.99	14.1±1.12	10.4±0.52
	0.5% NaCl	14.7±1.33	17.3±1.41	13.9±1.11
	0.2% Na_2SO_4	14.4±1.32	16.1±1.33	13.5±1.01
	0.5% Na_2SO_4	17.5±1.53	18.4±1.58	16.4±1.37

During the analysis of the dynamics of changes in the amount of lipids in the leaves of sugar beet varieties under similar conditions, it was determined (Tab 6), except for the Tarifa variety, the amount of lipids in the leaves of Cooper and Taltos varieties in the control samples shows a different growth dynamics compared to the amount of sugars. In experimental variants, on the contrary, the amount of lipids gradually increased during 45 days, ensuring adaptation to stress, and then gradually decreased.

As can be seen from Table 5, the Tarifa variety was exposed to more biological oxidation under the influence of 0.5% NaCl salt. Based on the obtained results, we can say that plants satisfy their energy needs under stress conditions by accelerating the catabolism of non-photosynthetic and highly energetic products. It is worth noting that the Tarifa variety is more active in this regard.

Table 6.

Effects of salt stress on lipid content in leaves of sugar beet cultivars

Kind	Fat %			
		30 days	45 days	60 days
	Control	5.85± 0.49	8.32±0.79	9.40±0.83
	0.2% NaCl	8.36±0.72	8.27±0.78	4.90±0.41
Cooper	0.5% NaCl	9.96±0.88	8.26±0.75	6.38±0.53
	0.2% Na_2SO_4	4.31±0.35	5.00±0.45	4.25±0.37
	0.5% Na_2SO_4	3.11±0.29	4.39±0.31	2.27±0.15
	Control	2.39±0.18	5.29±0.39	8.49±0.75

				Continuation of Table 6
Taltos	0.2% NaCl	5.57±0.43	6.86±0.52	4.31±0.40
	0.5% NaCl	3.84±0.24	5.41±0.44	4.23±0.41
	0.2% Na_2SO_4	5.34±0.42	7.03±0.66	2.40±0.19
	0.5% Na_2SO_4	3.72±2.39	4.39±0.34	0.63±0.05
Tarifa	Control	4.14±0.35	7.85±0.71	5.26±0.42
	0.2% NaCl	3.41±0.28	7.61±0.69	2.37±0.18
	0.5% NaCl	4.04±0.36	3.33±0.2	0.62±0.05
	0.2% Na_2SO_4	7.13±0.69	10.8±0.99	4.90±0.39
	0.5% Na_2SO_4	3.41±0.26	5.6±0.48	6.92±0.57

Rusult can be seen from table 7 that during salt stress, the total amount of proteins in plants changes proportionally with the degree of salinity of the environment. It was determined that as salinity increased, the amount of protein in Cooper and Taltos varieties increased in 45-day-old samples, but decreased in 60-day-old plants . Similar results were obtained in the Tarifa cultivar, except for some minor differences.

The obtained results show that as salinity increases, the amount of soluble proteins in sprouts increases . As from the resut, the greatest reduction of proteins was recorded in the Tarifa variety under the influence of 0.5% NaCl salt . It can be assumed that the increase in the total amount of proteins in salt-resistant varieties compared to resistant varieties In comparison, low molecular stress is related to the synthesis of proteins at a higher rate .

Table 7

Effects of salt stress on total protein content in sugar beet leaves

Kinds	Variety	Amount of proteins, mg/ml		
		30 days	45 days	60 days
Cooper	Control	11.9±1.01	19.2±1.17	12.7±1.06
	0.2% NaCl	6.8±1.12	14.4±1.24	7.8±1.22
	0.5% NaCl	7.0±1.10	15.4±1.18	8.1±1.17
	0.2% Na_2SO_4	7.8±0.81	12.5±0.99	9.6±0.97
	0.5% Na_2SO_4	12.0±1.01	12.9±1.25	6.5±1.24
Taltos	Control	16.7±1.13	15.8±1.08	13.3±1.06

	Continuation of Table 7			
	0.2% NaCl	14.2±1.08	13.3±1.12	10.9±1.0
	0.5% NaCl	4.2±1.01	13.8±1.05	8.1±1.02
	0.2% Na_2SO_4	8.6±0.90	12.5±0.97	8.4±0.94
	0.5% Na_2SO_4	3.4±1.03	13.8±1.04	5.4±1.02
Tarifa	Control	6.28±0.81	14.7±0.86	10.6±0.84
	0.2% NaCl	10.3±0.83	9.2±1.70	8.1±0.66
	0.5% NaCl	6.2±0.58	16.4±1.31	5.2±0.63
	0.2% Na_2SO_4	6.9±0.56	13.9±0.98	9.6±0.79
	0.5% Na_2SO_4	3.7±0.29	14.4±1.10	8.4±0.89

6. Study of the dynamics of catalase activity change in sugar beet leaves.

Catalase (CAT), benzidine peroxidase (BPO), superoxide dismutase (SOD), etc. are involved in the disposal of active forms of oxygen (ROS), which have a destructive effect on organisms. enzymes play an important role.

As result shown Table 7, the activity of the enzyme in the control variants in the leaves of all three cultivars gradually increases with time. Different results were obtained in the experimental options. Thus, the activity of CAT enzyme was higher in 45 and 60-day-old Tarifa varieties under the influence of 0.2% NaCl salt than in other varieties. The highest activity of CAT enzyme was observed in the 45-day-old Tarifa variety under the influence of 0.2% NaCl salt. However, in the same period of ontogenesis, enzyme activity was 2.1 times lower under the influence of Na_2SO_4 salt with a concentration of 0.2% compared to the influence of NaCl salt . In other cultivars, the effect of 0.2% Na_2SO_4 salt on enzyme activity was 1.2 times lower than that of NaCl salt at the same stage of ontogenesis.

Table 8

Effect of different concentrations of salt on catalase enzyme activity in sugar beet leaves

Kinds	Variety	Catalase activity, μmol H_2O_2 /mg protein min		
		30 days	45 days	60 days
Cooper	Control	18.21±1.01	21.23±1.17	23.21±1.16
	0.2 % NaCl	20.73±1.12	27.37±1.24	25.48±1.22
	0.5 % NaCl	21.51±1.10	25.32±1.18	23.35±1.17
	0.2%Na_2SO_4	16.58±0.81	20.56±0.99	19.40±0.97
	0.5%Na_2SO_4	21.78±1.20	26.80±1.25	24.83±1.24
Taltos	Control	15.35±1.03	18.25±1.08	21.23±1.06
	0.2% NaCl	20.01±1.08	27.04±1.12	24.09±1.10
	0.5% NaCl	19.25±1.01	23.31±1.05	20.35±1.02
	0.2%Na_2SO_4	17.53±0.90	20.83±0.97	18.73±0.94
	0.5%Na_2SO_4	19.21±1.03	22.40±1.04	20.44±1.02
Tarifa	Control	18.73±0.81	22.73±0.86	24.74±0.84
	0.2% NaCl	31.70±0.68	36.21±1.70	33.25±1.66
	0.5% NaCl	11.30±0.70	14.31±0.71	12.51±0.63
	0.2%Na_2SO_4	14.01±0.78	16.90±0.81	15.80±0.79
	0.5%Na_2SO_4	16.79±0.88	20.99±0.90	18.99±0.89

The activity of CAT enzyme increased with a similar tendency due to the effect of 0.5% NaCl and 0.5% Na_2SO_4 salts, as in Tarifa variety. The activity of CAT enzyme in 45-day-old samples of the mentioned varieties was higher than the effect of 0.2% and 0.5% NaCl salt, and in 60-day samples, it was higher than the effect of 0.5% Na_2SO_4 salt. The analysis of the results obtained in the experimental variants showed that the high activity of the CAT enzyme in Taltos and Cooper varieties is related to the fact that both of these varieties are sensitive to the effects of stress. The fact that 0.2% and 0.5% Na_2SO_4 salt in the Tarifa variety does not significantly affect the activity of the enzyme even at the end of vegetation, and the increase in the activity of the CAT enzyme at a high concentration of NaCl allows us to say that this variety is more salt-tolerant. On the other hand, the variable behavior of the enzyme under the influence of stress can be evaluated as a resistance response of the plant to the effect of abiotic stress factors.

The increase in the activity of CAT enzyme depends on the duration of stress and salt concentration. Some authors show that CAT is the most important among the enzymes that detoxify H_2O_2 in plant leaves. Thus, it was determined that CAT enzyme plays an important role in the formation of salt resistance in plants. The authors show that CAT is a key participant in the detoxification of ROS formed during salt stress.

7. Study of the dynamics of changes in benzidine peroxidase activity in sugar beet leaves.

It was determined that Cooper, Taltos and Tarifa cultivars differ from each other in terms of BPO enzyme activity in control and experimental variants (Table. 9). In all three cultivars, BPO enzyme activity increased during the first 45 days, and then gradually decreased. The comparison of cultivars according to the age of the plants showed that enzyme activity in 60-day-old plants was higher than in 30-day-old plants, and less than in 45-day-old plants. As it can be seen, the activity of BPO enzyme was lower in Tarifa variety compared to other varieties.

The obtained result allows us to assume that normal metabolic processes occur in the Tarifa variety and that the variety is sustainable. It can be noted that the activity of some enzymes increases due to stress. The low activity of the BPO enzyme due to the effect of stress may be related to the formation of a small amount of ROS, which is one of the resistance indicators of the plant. The obtained results show that the activity of BPO enzyme in Cooper and Taltos varieties is affected by 0.5% NaCl and 0.2% Na_2SO_4 salts, while in the Tarifa variety, 0.2% NaCl and 0.2% Na_2SO_4 was higher under the influence of salt. Enzyme activity recorded in this cultivar is 60-80% lower than other cultivars due to both salt effects.

Table 9

Effect of different concentrations of salt on benzidine peroxidase enzyme activity in sugar beet leaves

Kind	Variety	Benzidine-peroxidase activity µmol benzidine/mg protein min		
		30 days	45 days	60 days
Cooper	Control	0.23±0.01	0.32±0.01	0.28±0.01
	0.2% NaCl	0.17±0.01	0.21±0.01	0.19±0.01
	0.5% NaCl	0.20±0.01	0.26±0.01	0.23±0.01
	0.2% Na_2SO_4	0.30±0.02	0.42±0.02	0.34±0.02
	0.5% Na_2SO_4	0.18±0.01	0.23±0.01	0.20±0.01
Taltos	Control	0.20±0.01	0.24±0.01	0.22±0.01
	0.2% NaCl	0.19±0.01	0.23±0.01	0.21±0.01
	0.5% NaCl	0.31±0.02	0.39±0.02	0.35±0.02
	0.2% Na_2SO_4	0.23±0.01	0.27±0.01	0.25±0.01
	0.5% Na_2SO_4	0.17±0.01	0.20±0.01	0.19±0.01
Tarifa	Control	0.16±0.01	0.19±0.01	0.17±0.01
	0.2% NaCl	0.29±0.01	0.31±0.01	0.14±0.01
	0.5% NaCl	0.15±0.01	0.17±0.01	0.29±0.01
	0.2% Na_2SO_4	0.18±0.01	0.22±0.01	0.19±0.01
	0.5% Na_2SO_4	0.16±0.01	0.18±0.01	0.16±0.01

8 . Economic efficiency of the sugar beet plant.

It is known that the results of every conducted scientific research work should have access to practice. That is why the economic assessment of practical, applicable works is of great importance. Table 10 shows the productivity indicators of the studied sugar beet in saline soils. Based on this, the economic efficiency of beet varieties can be estimated. So, as a result of the research, the fruiting roots, leaf area and sugar content of Tarifa, which is a salt-resistant variety, are more than other varieties, which is an indication of its productivity.

Table 10

Yield of sugar beet varieties (t/ha)

Kind	Carrot	Leaf	Sugar content , %
Cooper	30-25	2.5	12.0
Taltos	35-43	3.2	13.0
Tariff	35-45	3.5	13.5

RESULTS

1. Na_2SO_4 salt had a higher germination percentage than Cooper and Taltos varieties, and the biometric indicators of vegetative organs increased more.

2. *(a+b) ratio* in sugar beet cultivar Tarifa at 0.2% NaCl salt concentration compared to Cooper and Taltos cultivars shows that it is more resistant to the effect of salt.

3. For the first time, it was found that there is a positive relationship between the number of stomata, transpiration and diffusion of CO_2 in sugar beet leaves. It was determined that the number of closed stomata in the Tarifa cultivar under salt stress conditions is greater than that of the Cooper and Taltos cultivars, and due to the economical use of water, the regulation of osmotic processes in plant tissues prevents excess accumulation of salt in the cells.

4. It was determined that 0.2% NaCl has a more activating effect on catalase enzyme in Tarifa variety than Cooper and Taltos varieties. Compared to the effect of 0.2% Na_2SO_4 salt in the Tarifa variety, the activity of catalase enzyme was approximately 2.1 times lower under the influence of 0.2% NaCl salt. This result is due to the fact that NaCl salt has more toxicity than Na_2SO_4 .

5. The fact that the benzidine peroxidase activity was lower in the Tarifa cultivar compared to the Cooper and Taltos cultivars in the control samples indicates that it is resistant to stress. When the variety is salt-tolerant, ROS is produced in small amounts and the activity of the enzyme is low. When analyzing the activity of the enzyme between varieties under stress conditions, it was

determined that the activity of benzidine peroxidase enzyme increased in Tarifa variety due to the effect of 0.2% NaCl salt, and in Cooper and Taltos varieties due to the effect of 0.5% NaCl salt. The activity indicator of the Tarifa variety was lower than other varieties.

6. In the 45-day-old samples of the studied varieties of sugar beet, due to the effect of high-concentration salts, the increase in the amount of sugars and proteins in the leaves, and the gradual decrease in the amount of lipids, is an indication of the existence of a species-specific reaction environment under stress conditions.

List of scientific works published on the dissertation

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3. Hajiyeva, I.N. The effect of high concentration of salts on the amount of proteins in the leaves of sugar beet varieties // Proceedings of the Agricultural Scientific Research Institute of the Ministry of Agriculture of Azerbaijan, 2018, XXIX c, p. 308-311.
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