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SOIL SALINITY AND SOME PHYSIOLOGICAL CHARACTERISTICS OF SOYBEAN VARIETIES

***Abstract**: This article presents information on the effect of salinity on some physiological parameters of soybean varieties. Under the conditions of field experiments, the total, metabolic and bound water content in the leaves of soybean Slovia, Oyjamol, Vestochka, Viktoria, Nafis, water retention capacity of leaves, the density of cell sap, the viscosity of protoplasm of leaf cells, daytime and residual water deficit in leaves, the water potential of leaves and photosynthetic net the effect of medium-high salinity on productivity was studied. It was proved that the degree of salt tolerance of Slovia, Oyjamol and Nafis varieties is higher than other varieties.*

***Key words**: soil salinity, soybean varieties, water content, viscosity, water potential, net photosynthetic productivity.*

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Introduction

In recent years, the issue of food security has become one of the priority tasks in all countries of the world, and food shortages are observed on a global scale. The increase in natural disasters has a negative impact on the supply of food products for the population. The main goal of the work being carried out today is to provide the population with the necessary food products. Abiotic stressors have a strong negative effect on agricultural plants, reducing plant growth and productivity. Water scarcity, soil salinity, and high temperatures are among the main causes of declining crop yields and food supplies around the world. In order to obtain high, stable and high-quality grain yield from soybeans, it is necessary to create, and introduce into production new, fertile, fast-ripening, high-quality grain varieties that are suitable for each region, region, soil and climate conditions, resistant to adverse factors of the external environment, diseases and pests. selection and planting of varieties adapted to local conditions, the establishment of their seed production system, and the improvement of agrotechnologies for growing high yields are one of urgent tasks [1].

One of the important issues is the study and scientific justification of the technological properties of soybean cultivation and their use in the food and processing industry. The value of soybeans is the presence of all amino acids in their composition - lysine, arginine, leucine, methionine and other non-exchangeable amino acids. It is known that the growth and development and productivity of plants depend on their genotype and environmental factors. Varieties of soybean plants require the use of agrotechnical measures adapted to the soil-climatic conditions of each region. Timely and high-quality implementation of agrotechnical activities, taking into account the biological characteristics of soybean varieties, ensures a high and stable yield of soybeans [2].

The production and reproduction of plant protein are one of the most urgent problems of agriculture. One of the main solutions to solve this problem is to rapidly increase the cultivation of leguminous crops. Among these crops, the soybean plant stands out due to its good quality and quantity of protein. Due to its high-quality protein and oil in the grain, and its wide use in food, fodder, and technical and medical fields, soybean is of great importance in the national food programs of many countries. In the USA, Brazil, Argentina, China, India and Russia, soybean is given a lot of attention. In the following years, the production of soybean grains in the world is 60 mln. 130 million per ton. per ton, cultivated areas increased 1.6 times, and productivity increased 1.35 times [3].

Soybean is one of the most important sources in solving the main problem of today - protein deficiency. Due to the fact that soybean protein is similar to animal protein in terms of its chemical composition, great attention is paid to soybean cultivation in all developed countries. A lot of scientific research and practical work on soybean has been carried out in our republic. In order to obtain a high yield from soybeans, it is necessary to select varieties suitable for certain soil-climatic conditions and to use methods of their cultivation, taking into account their biological characteristics, in addition to creating a sufficient agro background [4].

Soybean is one of the most widespread crops in the world. According to scientists, the homeland of soybean is the southeastern region of Asia. Soybean has been cultivated as a food crop in Eastern countries since ancient times. Soya was planted in China 6 thousand years ago. India is the second most widespread homeland of soybean after China. Soybean has been planted in the lands around the Ganges since ancient times. Investigations show that in countries such as Japan, Korea, Vietnam, and Indonesia wild types of soybeans are not found, which means that cultivated soybeans have spread to these countries as a result of trade [3].

It has been 100-120 years since soybeans began to be planted in large areas in other countries of the globe. Over the next 30 years, soybean acreage will increase rapidly. In Japan, after rice and vegetable crops, the land occupied by soybean occupies the third place in terms of its size. Japan is also buying large amounts of soybeans from abroad. The grains are used for different purposes. Currently, soybean protein is used in keeping silkworms. The artificial food made by Japanese experts consists of 67% soybean protein, 2% soybean oil, citric acid, B group vitamins and various other additives. In Japan, silkworms are fed five times a year, and artificial feed made from soybeans plays a major role in this. High-quality food products are also made from soybeans. Soybean varieties created in Japan differ from soybean varieties grown in other countries due to their high protein content [5].

Studying the effect of soil salinity on the physiological and biochemical parameters of soybean varieties will help to reveal the ability of these soybean species to adapt to salt stress and create new varieties. At the same time, it is of great importance to reveal the specific characteristics of the salt stress effect on the physiological and biochemical processes of grain crops, including soybean.

Research objects and methods

Oyjamol, Slovia (Russia), Victoria (Serbia), Vestochka (Russia) and Nafis varieties were used as objects of research. Currently, these varieties are planted in several regions of our republic. The experiments were carried out in the conditions of meadow-alluvial soils common in the region. Such soils form the main areas of the Bukhara region. Experiments were carried out in non-saline and medium-strong saline soils. During the experiments, the effect of medium-high salinity on the total, the metabolic and bound water content of leaves, the water storage capacity of leaves, density of cell sap, the viscosity of leaf cell protoplasm, daytime and residual water deficit in leaves, the water potential of leaves and net photosynthetic productivity were studied.

Research results and their discussion

The soybean is an annual herbaceous plant belonging to the legume family. The stem is upright, strong and branched, the length of the stem is up to 80-150 cm, and that of “hashaki” varieties is up to 2 meters. The root belongs to the axial root system, is well developed, and penetrates the soil up to 1.5-2 meters, but the root base develops in the arable layer of the soil. Soybean plant in natural conditions often faces various stresses such as drought, extremely high temperature, and salinity. At the same time, salinity has the greatest harmful effect. Soybeans belong to the group of low-moderate salt-tolerance crops. It can withstand up to 0.2 and 0.4 per cent of salt in the dry mass of the soil. Salinity inhibits plant growth and development, alters water exchange and ion balance, photosynthesis processes, and respiration, and as a result, yields of agricultural crops decrease [6,7].

In the course of the conducted experiments, the negative effect of salinity on the physiological characteristics of all studied varieties was observed in conditions of medium-highly saline meadow-alluvial soils. It was proved based on experiments that such a negative influence is less evident in Oyjamol, Slovia, and Nafis than in other studied varieties. Significant differences were also observed between the studied varieties in terms of the above indicators. The highest daytime water deficit was found in the saline variants. In the control variants, a decrease in the value of this indicator was observed in all varieties. In recent years, the comparative study of the physiology of water exchange of zoned soybean varieties in certain soil and climatic conditions is one of the urgent problems. Especially during the next 5-10 years, global environmental changes, including soil salinization, and a sharp increase in air temperature, require studying the level of resistance of soybean varieties to such unfavourable factors. Transpiration is one of the important physiological processes and is important in the study of water exchange of plants growing in saline areas. Most of the water absorbed by plants evaporates due to transpiration. Slowing down the rate of transpiration in saline conditions causes a violation of the water balance in the plant body and an increase in water deficit. As a result, the physiological and biochemical processes in the body of plants slow down, and their overall productivity decreases. The activity of providing water to plants is closely related to the rate of transpiration. 1.5-2% of the water received by plants is absorbed by them and the rest is evaporated through the leaves during transpiration. The value of the rate of transpiration in plants is related to many external factors. These include air temperature, relative humidity, soil and climate conditions, wind, solar radiation, soil moisture, plant development stages and cultivar characteristics, etc. Transpiration is not only water evaporation through the leaf but also water adsorption and movement of water and dissolved substances throughout the plant. In the course of the research, the transpiration rate of regionalized Oyjamol, Slovia, Victoria Vestochka and Nafis soybean varieties was studied. It was noted that the transpiration rate of soybean varieties grown under medium-high soil salinity conditions was lower than the varieties grown under the control option. A decrease in the rate of transpiration in conditions of soil salinity may also be related to the condition of the stomata. According to the obtained data, it was noted that the transpiration was rapid in the soybean varieties Oyjamol, Slovia, and Nafis. It was determined that it is related to the activity of metabolism and characteristics of the soybean variety. An increase in the value of this indicator was observed in the salted variants from the budding to the ripening stage of all varieties.

According to the data, it was found that there is an organic relationship between transpiration and soil salinity. This connection, in turn, ensures the entry of water into the root system. An increase in salinity in the soil led to a decrease in the rate of transpiration. Also, the increase in air temperature accelerates this process. The transpiration rate of soybean varied across varieties during its ontogeny. Also, it was determined on the basis of experiments that the transpiration rate depends on the amount of metabolic and bound water in the plant, as well as on the colloidal properties of the cell protoplasm. Salt-resistant varieties store a large amount of water in leaf cells, and in the conditions of water shortage, it was expressed in all the experiments conducted. When plants are provided with enough water, the physiological and biochemical processes in their bodies are activated. The amount of water in the soil is higher or lower than the optimal level, which has a negative effect on the above processes. If there is also a water shortage in areas with saline soil, then the soybean plant will be severely damaged by the lack of water. By determining the amount of water in plants, it is possible to observe the changes that occur in the water balance of plants under the influence of favourable and unfavourable factors. The water contained in the plant is mainly divided into two groups. These are free and bound waters. The sum of the two makes up the total amount of water. Free water is often referred to as metabolic water. Because such waters are directly involved in the metabolic processes taking place in the plant body. Bound water does not take part in metabolic processes, it is mostly combined with high molecular substances. Therefore, depending on the amount of free water in the body of plants, it is possible to draw conclusions about metabolic processes. The amount of bound water often determines the resistance of plants to unfavourable factors. Studying the total water content of plants is of great importance in their water supply. If this indicator is studied in parallel with other processes that characterize water exchange, more extensive information can be obtained. The speed of physiological and biochemical processes in plants depends on the amount and state of water in cells and tissues. An increase in total water content was found in all varieties under the influence of soil salinity. The amount of bound water varies in plants grown in saline environments. In particular, it was noted that the amount of bound water is the highest in conditions of high soil salinity.

The level of water exchange and water supply is of great importance in increasing the productivity of plants in saline soils. Total water content decreased from the budding to ripening stage of the vegetation in the studied control variants of soybean cultivars and plant leaves grown under salinity conditions. Depending on the level of soil salinity, it was found that in all options, the amount of metabolic water decreases, while the amount of bound water increases. Even under salinity conditions, it was observed that the amount of bound water in leaves increased from the budding to the ripening stage.

Therefore, a moderate amount of total water in plants, especially metabolic water, activates all physiological and biochemical processes in the plant body. An increase in the amount of bound water is of great importance in increasing the tolerance of soybean varieties to salinity. During the experiments, the amount of water in the leaves of the studied cultivars varied depending on the salinity. High values of total and bound water content were found in

Oyjamol, Slovia, and Nafis varieties. Based on the obtained data, it was observed that the water retention properties of soybean leaves vary depending on the salinity of the soil. In all cultivars and variants, leaf water loss decreased from the budding to ripening stage, while water retention properties increased. An increase in the level of water retention of leaves of all soybean cultivars was noted in the environment with saline soil. However, the degree of such reduction was different depending on the biological and individual characteristics of the varieties.

In conditions of soil salinity, water loss of leaves of all cultivars decreased, while their water retention properties increased. Based on the obtained data, it was noted that the water retention properties of the leaves increased with the adaptation of plants to salt. In such plants, the amount of bound water increased, and the amount of slightly soluble salts decreased. It was also found during the experiments that the water retention property of soybean leaves is directly proportional to the salinity of the soil. The data obtained on the water retention properties of the leaves indicate the diversity of the adaptation of the studied cultivars to salinity. Oyjamol, Slovia, and Nafis varieties were distinguished by high water retention properties compared to other varieties in moderately saline conditions at all stages of development.

Victoria and Vestochka varieties took the next place according to this indicator. In the experimental variants, Oyjamol, Slovia, and Nafis cultivars showed high levels of cell sap density and the amount of bound water in the leaves compared to other cultivars, and low values for daytime water deficit. Variations of the above indicators were noted in different degrees according to the studied other Victoria, and Vestochka varieties.

In general, soil salinity had a strong negative effect on the water retention properties of the leaves of all studied cultivars. Especially, as a result of the effect of salinity, drastic changes occurred in the process of water exchange in soybean varieties. In Oyjamol, Slovia, and Nafis varieties, which have a strong mechanism of adaptation to such adverse factors (high water retention properties), metabolic processes are activated and they have the property of quickly changing their homeostasis. Such characteristics observed in plants were noted based on the experiments, in which the changes depend on the influence of stress factors and the biological and individual properties of the varieties. During the experiments, the coefficient of stability of the level of turgor of soybean leaves was also studied along with several indicators that determine the adaptation characteristics of soybeans to salinity.

The stability coefficient is one of the main criteria in determining the degree of adaptation of cotton to salinity. The coefficient of stability of soybean leaf turgor was determined at the budding, flowering and ripening stages of varieties. According to the data obtained during the experiments, it was found that the coefficient of stability of the level of turgor of soybean leaves is different depending on the growth and development stages of the varieties and their biological and individual characteristics. Soybean varieties with a high level of adaptation to salt have a higher value of this indicator.

Conclusion

In the course of the conducted experiments, the negative effect of salinity on the physiology of water exchange of all studied varieties was observed in the conditions of saline meadow-alluvial soils. It was proved based on experiments that this negative influence is less evident in Oyjamol, Slovia, and Nafis than in the other studied Victoria and Vestochka varieties. Significant differences were also observed between the studied varieties in terms of the above indicators.

In the course of the research, some physiological parameters related to salt tolerance of soybean varieties were determined - transpiration rate, total, the metabolic and bound water content in leaves, water storage capacity of leaves, density of cell sap, the viscosity of protoplasm of leaf cells, daytime and residual water deficit in leaves, the water potential of leaves and it was found that the state of the net productivity of photosynthesis changes to different degrees in the section of the studied varieties depending on the soil salinity and the characteristics of the variety.

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