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Adaptation Characteristics of Autumn Wheat Varieties to Salinity Stresses

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ANNOTATION

The article deals with the data on the effects of different levels of salinity stress on winter wheat varieties Starshina, Pervitsa, Grom, Asr, Alekseevich, Krasnodarskaya-99, Vassa and Antonina. In areas where soil salinity is low and moderately-strong saline meadow-alluvial soil type, some physiological indicators characterizing the water exchange and salinity adaptation of winter wheat varieties have been identified. According to the results it was obtained the degree of adaptation of wheat to saline stress relative to the control in Starshina, Krasnodarskaya-99, Grom and Antonina varieties is higher than in other studied varieties.

KEYWORDS: wheat varieties, abiotic factors, soil salinity, water deficiency, adaptation.

INTRODUCTION

In recent years, it has become important the changings of global climate, high yields of agricultural crops, including grain, the creation and improvement of high-quality varieties of cereals resistant to diseases, salinity, drought and heat, adapted to different soil and climatic conditions on the basis of innovative agro-technologies.

In order to obtain high, stable and high-quality grain from wheat, it is necessary to create new varieties, high-yielding, fast-ripening, resistant to adverse environmental conditions, diseases and pests, high-quality varieties suitable for each region, soil and climatic conditions. One of the urgent task is the selection, planting of varieties adapted to local conditions, the establishment of their seed system and the improvement of high-yield agro-technologies.

Each region of the republic has its own soil and climatic conditions according to its territorial location and regions. For this reason, local and imported varieties of autumn cereals, which are planned to be planted in the grain sector, should be tested in scientific and practical experiments on the ground. At the same time, a new set of agro-technological measures for new promising varieties should be developed based on the natural conditions of the area and recommended to farms.

Soil salinity are common in many countries around the world. They occupy a quarter of the land surface, including half of the irrigated land, and the saline areas are gradually expanding. In arid climates, almost all irrigation water evaporates and soil salinity gradually increases.

Currently, more than 50-60 percent of irrigated land is saline to varying degrees and is prone to salinization. The saline soils of Uzbekistan are very diverse in terms of the quality of salts. Types of chloride, sulfate-chloride, chloride-sulfate, sulfate, carbonate salinity are found here. Among them, chloride salinity is the most toxic.

The salinity of irrigated lands drastically reduces their productivity, which leads to a decrease in the gross yield of agricultural crops and primarily wheat, which is very important for food security. Under such conditions, it is necessary to study and identify valuable genotypes of wheat adapted to climate change conditions. In this regard, the study of the mechanisms of resistance and adaptation of wheat to salt stress is relevant and of great theoretical and practical interest.

In addition, the study of the effect of soil salinity on the physiological and biochemical parameters of winter wheat varieties allows to determine the ability of this type of wheat to adapt to salt stress and helps to create new varieties resistant to soil salinity conditions.

However, the physiological and biochemical aspects of the resistance of crops to different types of salinity and the characteristics of the impact of salt stress on the physiological and biochemical processes of wheat need to be reconsidered. In this regard, this work is of great importance for the theoretical study of the effect of soil salinity on the physiological and biochemical properties of salt resistance of winter wheat in different soil and climatic conditions.

The territory of Bukhara region is located entirely in the desert zone, there are no local irrigation water sources, and salt and chemicals dissolved in the sewage and collector-drainage waters flowing through the Zarafshan River flow into the region and most of them accumulate in this land.

Natural humidity is not enough in the region. Annual precipitation is 90-150 mm. forms. Evaporation from the surface reaches up to 2000 mm. In this regard, Bukhara region belongs to the arid zone. Evaporation from the surface of the ground and from the leaf surface of plants several times faster than precipitation causes groundwater to rise to the soil surface. As a result, soil salinity becomes more active.

The agro-ameliorative method is a key factor in the prevention of soil salinity. However, even with this method, soil salinity cannot be completely eliminated. In particular, the heavy labor, cost and, most importantly, the consumption of large volumes of fresh water (10-15 thousand m^3/ha) in the process of saline washing indicate the seriousness of the problem. In addition to harmful salts with high concentrations in the soil, macro and microelements, which are essential for plants, are filtered and added to groundwater and sewage during saline washing. It also causes great damage to the complex of soil microflora, which works to increase soil fertility.

The study of the impact of salinity on the growth and development of wheat varieties in the saline soil conditions of Bukhara region and the scientific substantiation of specific adaptive responses of varieties are of great theoretical and practical importance.

Climate change will inevitably lead to a deterioration of the ecological situation, which will lead to drought and salinization of fertile soils, resulting in a sharp decline in crop yields. Saline soils are common in many countries around the world. They cover about a quarter of the earth's surface, including half of all irrigated land, and saline areas are expanding. In arid climates, almost all irrigation water evaporates and soil salinity gradually increases.

The salinity of irrigated lands drastically reduces their productivity, which leads to a decrease in the gross yield of crops and, above all, wheat, which are very important for food security. Under such conditions, it is necessary to study and identify valuable genotypes of wheat suitable for climate change conditions. In this regard, the study of the adaptive potentials and mechanisms of wheat stress resistance to salt is relevant.

Salt tolerance varies according to the developmental stages of the wheat. Young plants are resistant to salt, especially during the flowering stage, when the plants are adversely affected by salt. They grow poorly due to their sensitivity to salt, and as the plant grows, its resistance to salt increases. Excessive accumulation of salts in the soil is harmful to most cultivated plants. In saline soils, salt-tolerant plants called halophytes grow. They differ from other plants by their many anatomical and physiological features. Excessive salinity of the soil is harmful to plants on both sides. On the one hand, the accumulation of salts increases the osmotic pressure of the soil solution. This pressure prevents the swollen movement of the roots, making it difficult for the plants to get water. However, the excessive accumulation of soluble salts in the soil, in addition to the osmotic effect, also has a toxic effect on plants. Even salts that are neutral at weak concentrations are toxic at dark concentrations.

The adaptation of plants to extreme environmental factors depends on the genotype that determines the morphological, biochemical, and physiological mechanisms that ensure the growth and development of plants under adverse conditions. Thus, high concentrations of salts lead to a violation of the ionic, osmotic and oxidative state of the organism. Maintaining homeostasis under these conditions is accomplished through the accumulation and division of ions, the synthesis of corresponding osmolites, the accumulation of free polyamines, and changes in activity.

Under natural conditions, wheat is often subjected to various stresses such as drought, extreme temperatures, salinity. In this case, salinity has the greatest detrimental effect. According to the level of salt tolerance, wheat belongs to the average tolerant crops. Withstands salt content between 0.4 and 0.6% of dry soil mass [1].

Under saline conditions, plant growth and development slows down, water exchange and ion balance are disrupted, photosynthetic processes and respiration are disrupted, and, ultimately, productivity is reduced [2,3].

The adaptation of plants to extreme environmental factors depends on the genotype that determines the morphological, biochemical, and physiological mechanisms that ensure the growth and development of plants under adverse conditions [4].

High concentrations of NaCl cause ionic equilibrium and hyperosmotic stress as well as oxidative stress, which is accompanied by membrane destruction and chlorophyll degradation [5,6].

Numerous studies have shown that cultivated plant varieties characterized by a high initial level of antioxidant activity or the ability to rapidly increase it are more resistant to oxidative damage under stress, including stress resulting from salinization [7].

Salinity stress usually leads to a significant slowdown in growth, until it stops completely, but in many cases this effect is consistent with changes in other physiological processes. For example, under salinity stress, the rate of transpiration may decrease and the uptake of potassium may be replaced by its output [8,9].

There is evidence that stresses resulting from a decrease in turgor, as well as salt stress, can alter the plant's hormonal balance, promote stomatal closure, reduce root hydrodynamic resistance, and ultimately lead to premature leaf aging [10,9]. However, changes in the composition of phytohormones (ABA, cytokinins, ethylene) involved in the regulation of water balance occur rapidly and significantly [11].

The accumulation of large amounts of sodium and chloride ions in the cytoplasm, which are necessary for the root system to maintain its ability to absorb water, can lead to disruption of cell metabolism [12].

The effects of soil salinity depend on many factors: plant genetic characteristics, growth and development phase (i.e., ontogenetic stage), precipitation, temperature, salinity type, soil fertility, and agrotechnical measures [13,14,15].

For example, cereals are more sensitive to salinity than sugar beets and sunflowers. However, in the group of cereals, there are also significant differences in soil salinity: barley is more resistant than wheat [17], and hexaploid wheat is more resistant to tetraploids [18].

Another aspect of the negative impact of salinity on plants is that in order for water to enter plants, it is necessary to maintain the difference in water balance between plant cells and the environment, which is blocked by a decrease in water potential [19].

According to the literature, there are also varietal differences in the response of plants. For example, the growth of seedlings of salt-tolerant and sensitive varieties of wheat has slowed to varying degrees. Low accumulation of dry matter has been identified in varieties susceptible to salinity [20].

In recent years, in order to develop the economy of the republic, to provide the population with quality food products, great attention is paid to the agricultural sector. In order to meet the needs of the population for quality food products, the main goal is to obtain high and quality yields of winter wheat varieties even in conditions of soil salinity. Climate change will inevitably lead to a deterioration of the ecological situation, and a decrease in the area of fertile soils will in turn lead to a further increase in salinity and a consequent decrease in the weight and quality of the crop.

The soil climate of Bukhara region is unique, the climate is changeable - continental. The total area of the province is 3,380,863 hectares, of which 219,824 hectares are arable land. These arable lands are saline to varying degrees, and high yields from these areas require 2-3 times of saline washes during the winter.

The agro-ameliorative method is a key factor in the prevention of soil salinity. However, even with this method, soil salinity cannot be completely eliminated. In particular, the heavy labor, cost, and consumption of large volumes of fresh water in the saline washing process indicate the seriousness of the problem. In addition to harmful salts with high concentrations in the soil during saline washing, macro and microelements, which are essential for plants, are also filtered and added to groundwater and sewage. It also causes significant damage to the complex of soil microflora, which acts to increase soil fertility [21-30].

The study of the impact of salinity on the growth and development of wheat varieties in the saline soil conditions of Bukhara region and the scientific substantiation of specific adaptive responses of varieties are of great theoretical and practical importance.

OBJECT AND METHODS OF RESEARCH

Starshina, Pervitsa, Grom, Asr, Alekseevich, Krasnodarskaya-99, Vassa and Antonina varieties of winter wheat were used during the experiments. The experiments were conducted in areas where soil salinity is low and moderately-strongly saline meadow-alluvial soil type. In the course of the research, some physiological indicators characterizing the water exchange and salinity adaptation of the varieties were identified.

Observations and biometric measurements are performed on model plants in odd returns. Phenological observations are carried out according to the methodology of Variety Testing of Agricultural Crops Inspection. In all experiments, the variants are placed in tiers on a sequential basis, with three repetitions. Irrigation norms were determined based on the lack of soil moisture.

RESULTS OF THE RESEARCH AND ITS DISCUSSION

The strongest negative impact of soil salinity falls on the water-demanding-critical period of wheat, i.e. the flowering stage. At the same time, the lack of water in the soil due to salinity and high air temperatures together adversely affect the intensity of physiological and biochemical processes. Therefore, it is important to zoning wheat varieties that are resistant to such adverse factors based on specific soil and climatic conditions.

According to the data obtained during the study, the attitude of the studied wheat varieties to soil salinity levels varied. In the control variant, the growth and development of all varieties of wheat grown, the activation of the sum of physiological processes were determined. In the variants with weak and moderate-salinity levels of soil salinity, the values of the physiological parameters studied in wheat varieties differed sharply from each other.

With the increase in soil salinity, a slowing of transpiration intensity was observed in all varieties and an increase in the degree of turgidity of leaf tissue. In all experimental variants of control, an increase in the value of water deficiency in the leaf of cultivars was found. It was noted that such changes in the cross-section of varieties vary depending on their biological and individual characteristics. It was found that the value of the above indicators in winter wheat varieties is directly related to the physiological activity and salt tolerance characteristics of the varieties. According to the results obtained, the degree of adaptation of wheat to salinity stress relative to the control in Starshina, Krasnodarskaya-99, Grom and Antonina varieties was higher than in other studied varieties.

CONCLUSION

Thus, the negative impact of salinity on the level of physiological activity and adaptation of all studied varieties in the conditions of saline meadow-alluvial soils of different levels was observed. It was noted during experiments that such negative impact strength was less in Starshina, Krasnodarskaya-99, Grom and Antonina varieties.

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