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THE EFFECT OF MOISTURE LEVELS ON PRODUCTIVITY INDICATORS OF SORGHUM VARIETIES IN THE CONDITIONS OF BUKHARA REGION

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Abstract
The article presents the data obtained based on the study of productivity characteristics of the Karabash, Massino, Samurai, Uzbek Pakana and Uzbek-18 varieties of sorghum under different moisture conditions. It was determined that some of the indicators that determine the productivity in different moisture conditions - the growth rate of the varieties, the expansion of the leaf surface, the net productivity of photosynthesis, etc., change at different levels in the cross-section of the varieties, depending on the level of their resistance.

Keywords sorghum, cultivars, soil moisture, productivity, growth rate, leaf area, net photosynthetic productivity, adaptation.

INTRODUCTION

The demand for the use of plant resources has increased significantly in the world in recent years. Plant raw materials are grown to provide food, including meat, dairy products and other products to the growing population. In this regard, due to the importance of evaluating the ecophysiological and biochemical properties of new plant species with high productivity and nutritional potential in saline, arid and water-deficient regions, as well as introducing and justifying them into practice, the research being carried out in this direction are considered as urgent tasks.

Sorghum occupies 70-75 million hectares of world agriculture and is the fifth most cultivated area after wheat, rice, corn and barley. Cultivated areas occupy a large area mainly in Asia (49-50%) and Africa (3233%). In America, they make up 15%, and in Australia and Europe only 2-3%. The most widespread is grain sorghum (about 60 million hectares). Other economic groups of sorghum are grown in Australia, South Africa, Argentina, USA and some European countries [1].

Sorghum is a valuable food and fodder crop for areas where wheat and other staple grains cannot grow or produce low yields due to arid climates. As a forage crop, sorghum is extremely important for the arid regions of our country. Due to its high drought resistance and less demanding soil conditions, sorghum surpasses barley and even maize in yield [2].

Sorghum is a multi-purpose crop. Grain is a valuable concentrated feed for all types of animals and poultry. Sorghum harvested at the stage of milky and waxy ripening is used to prepare grain feed. The green mass of sweet corn is used as animal feed, it is also used to make silage and hay. In 100 kg of green mass 24-26 o.b., in silage 20-22, in the hay 49 o.b. 100 kg of grain contains 65-70% starch, 11-15% lysine-rich protein, and 35-% fat in 119 nutritional units. A syrup with a sugar content of 10-15% can be obtained from the stem of sugar corn varieties [3].

Sorghum is a very promising crop for high-quality silage production in the arid south and southeast regions, where it outperforms corn in terms of green mass yield and digestible protein collection. Sorghum grows well after harvest, the leaves and stems of plants retain their juiciness until the grain is fully ripe [4].

A special feature of sorghum is the ability to stop its growth in particularly unfavourable conditions for growth and development and to remain in an anabiotic state until favourable conditions appear. The biological characteristics of grain sorghum growth and development have been studied by many authors. Panjalash is an important stage in the formation of corn. During this period, not only stem buds are recorded, but also the elements of the crop - the number of grains in it - are formed. From the end of the tillering phase, sorghum grows rapidly, rapidly absorbing nutrients and moisture. During this period, it is especially sensitive to lack of nutrients and moisture. At the beginning of the emergence of spikes, generative organs are fully formed [5].

During the period from the appearance of the seeds to their full ripening, the redistribution of organic and mineral substances occurs in the above-ground organs. As a result of the increase in grain yield, their quantity in leaves and stems decreases with a slight change in the total mass of the plant. Self-pollination prevails in corn plants, natural cross-pollination can reach 6-8%. Special experiments have shown that long-term self-pollination does not lead to depression. In practical breeding, sorghum is considered as a self-pollinating crop [6].

Grain formation is the period on which the nutritional benefits of sorghum depend in many ways. Its duration is closely related to parameters such as weight of 1000 grains, protein, starch and essential amino acids. With full ripening, physiological and biochemical processes associated with post-harvest ripening continue in the grain. Sorghum is a non-demanding crop in terms of moisture conditions. In the process of evolution, it has developed a high adaptability to the lack of moisture and its economical use. The transpiration coefficient is 300. Sorghum is drought-tolerant and one of the most drought-tolerant annual crops. However, despite its drought tolerance, the crop responds well to irrigation in terms of both green mass yield and grain yield [7].

The high drought resistance of the crop is related to the characteristics of the root system, which in the first stages grows strongly ahead of the groundmass. In addition, all 3 types of roots grow and function: germinal (primary), nodular (secondary) and aerial, formed in the stem phase from the lower surface nodes of the stem. Nodal roots can break through the dry layer of the soil, penetrate to a depth of 2 m or more, and reach moist horizons. During severe drought, a protective silicon layer is formed on the roots, which protects them from drying up. The same function is played by a waxy coating on the stems and leaves of plants. In addition, the evaporation surface of leaves is half that of corn. Sorghum uses 15-20% less water to produce a unit of dry matter than corn. If at least some water remains in the soil, the crop will continue to grow despite extreme heat, low humidity and dry winds. When the soil is completely dry, the plants go into a dormant state, stop growing and developing, and start living an active life again after precipitation [8].

The product of the physiological process in plants is the amount of organic matter. This indicator is evaluated with indicators such as productivity or productivity. In turn, productivity is a product of genotype and external environment. A positive combination of external environment and genotype is considered high productivity. For this reason, the study of the influence of the external environment on the genotype is interesting on the one hand and complicated on the other. The abundance of water-soluble salts in the soil affects the growth and development of plants, as well as the processes of photosynthesis, causing a decrease in the quantity and quality of the product. This, in turn, causes serious problems in providing food for the growing population [9].

The nutritional properties of sorghum varieties are related to their biochemical composition. The high content of sugar content compared to other nutritious crops makes it possible to produce high-quality feed from corn. Silage made from sorghum has been reported to be superior to silage made from plants such as corn, sunflower, and soybeans. Because the amount of sugar in this silage was 1.18% in corn, 0.75% in corn and 0.65% in sunflower silage [10].

Drought is a major limiting factor in major sorghum growing areas, significantly reducing yield and hence yield. Effects of drought stress on grain yield and quality of sorghum at different growth and development stages under conditions of climate change and reduced water availability are well documented. Although drought stress at several plant developmental stages is a common occurrence in major sorghum growing regions, most studies have focused only on the effects of drought stress occurring at specific plant growth stages. In general, to avoid the negative effects of drought stress, it is very important to develop drought-tolerant varieties suitable for different agro-climatic conditions, especially in arid and semi-arid regions [11].

METHODS

Ecophysiological basis of sorghum varieties in Bukhara oasis soil and climate conditionsThe research was carried out in the conditions of laboratory and field experiments. Karabash, Massino, Samurai and Uzbek Karlik and Uzbek-18 varieties of sorghum (Sorghum vulgare (Pers.)) were taken as the object of research. These varieties are currently planted in the fields of several regions of our republic. Laboratory experiments were carried out in the Laboratory of Ecological Physiology of Bukhara State University, and small field experiments were conducted in the educational and experimental fields of Bukhara State University and the field fields of the farm "Bukhara Bohor Obad Erlari" of Bukhara Region.

During the experiments, the expansion of the leaf surface in the varieties by phases (by the method of sections) [12], and the net photosynthetic productivity (13) were taken into account.

During the entire period of growth and development of corn varieties, it was watered 6 times in the control options and 3 times in the experimental options. Depending on the annual weather conditions, the rate of irrigation was 500-600 m3/ha, and the rate of irrigation during the entire growth and development period was 2500-3000 m3/hectare. The soil of the experimental areas belongs to the meadow-alluvial type. Pre-irrigation soil moisture was ensured to be 60% relative to field moisture capacity up to the tuber phase of sorghum, 50% during the tuber, budding and flowering phase, and 70% in later phases.

In all field experiments, soil water deficit was studied by determining soil moisture before irrigation, its volumetric weight and field moisture capacity, and irrigation was carried out. Irrigation rates were determined based on soil moisture deficit. All experiments were carried out in two types: 1. Control: (optimal humidity, 70%) and 2. Experiment: (limited humidity, 50%) in arid conditions.

The experiments were conducted in areas belonging to the type of weak-moderately saline meadow-alluvial soils. Observations and biometric measurements are carried out on model plants at odd returns. In all experiments, options were triplicated and placed consistently across tiers. All physiological and phenological observations were made in the experiments at the tuber, budding and flowering stages of sorghum. To determine all indicators, the 3rd-4th moderately developed leaves were taken from the tip of the stem. 10 plants of each sorghum variety were taken and their individual parameters were determined. Phenological observations and calculations in field experiments [14] were carried out based on methods. Each experiment was performed in triplicate biological and triplicate analytical levels.

RESULTS AND DISCUSSION

In our experiments, the effect of two different moisture levels on the growth dynamics of sorghum varieties was studied. The growth rate of all sorghum cultivars increased from the tuber to the flowering stage under moderate and limited moisture conditions. In general, the growth dynamics of all studied cultivars were different depending on the level of water supply and development stages.

The highest rate was observed at the flowering stage for all cultivars under two different humidity conditions. It was noted that the rate of height growth of sorghum varieties under conditions of limited moisture is much lower than that of plants with moderate moisture.

The observed differences in this indicator among the cultivars were different depending on their individual, biological and physiological characteristics. During our experiments, the height of the sorghum varieties varied. In particular, in the fruiting stage, the height of the stem is 199.8 in the Karabash variety under conditions of moderate humidity, 173.2 under conditions of limited humidity, 136.6 under conditions of moderate humidity in the Massino variety, 127.3 under conditions of limited humidity, 117.8 under conditions of moderate humidity in the variety Samurai, 117.8 under conditions of limited humidity in conditions of 114.6, in the Pakana variety of Uzbekistan it was 106.0 in conditions of moderate humidity, 92.6 in conditions of limited humidity, and in the variety of Uzbekistan-18 it was 121.4 in conditions of moderate humidity and 112.0 cm in conditions of limited humidity. At the flowering stage, the height of the stem in the Karabash variety under conditions of moderate humidity is 215.0, and under limited humidity conditions is 189.1, in the Massino variety under moderate humidity conditions, 150.8, under limited humidity conditions, 137.8, in the Samurai variety under moderate humidity conditions, 129.5, and under limited humidity conditions, 120.8, in Uzbekistan Pakana variety was 115.3 in moderate humidity conditions, 105.4 in limited humidity conditions, and in Uzbekistan-18 variety in moderate humidity conditions, it was 121.4, in limited humidity conditions, was 121.6 cm.

According to the rate of growth of the varieties, the highest rate was taken by the Karabash and Massino varieties, the intermediate place was occupied by the Samurai and Uzbekistan-18 varieties, and the lowest place was occupied by the Pakana variety of Uzbekistan. It can be seen that Massino and Samurai cultivars have higher adaptability and endurance compared to other cultivars under limited moisture conditions.

The formation of leaves in plants and their development levels are of great importance in characterizing all life processes in the body of plants, especially photosynthetic properties. During our experiments, we also studied the change of the leaf surface depending on the moisture levels, which is one of the parameters characterizing the productivity of plants.

Our data on the effect of moisture levels on leaf area change are presented in Table 2 below. All sorghum cultivars accelerated leaf expansion under moderate moisture conditions. Under the influence of limited moisture, a significant reduction of leaf surfaces was noted in all varieties. It was observed that the level of reduction of leaf surfaces was different depending on the biological characteristics of the varieties.

It can be observed that the expansion of the leaf level during the period from the tubing stage to flowering is highly increased in all varieties and ridges when the leaf level in the tubing, roasting and flowering stages of the experiment is studied in Sorghum varieties under moderate conditions. During the period from roasting to the flowering stage, the expansion of the leaf level continued, and the largest leaf level was noted in the Karabash Variety at the stage of roasting and flowering. Its leaf level averaged 1318.7; 1403.9 cm2 in the roasting phase and 1389, and 1489.3 cm2 in the flowering phase.

The smallest leaf area was recorded in the Samurai variety, their leaf area was 1143.8-1215 cm2 in the fruiting stage, and 1239.5-1308.4 cm2 in the flowering stage, while in the Massino variety, the leaf area was 1239, 1239, 0-1318.2 cm2, and at the flowering stage it was 1331.2-1422.0 cm2. It was found that the indicators of the leaf level of Uzbekistan Pakana and Uzbekistan-18 varieties were close to each other. It was noted that the leaf area in the tuber stage of all studied varieties was smaller compared to the budding and flowering stages.

In conditions of moderate humidity, the expansion of the leaf surface of all varieties accelerated. Limited humidity, that is under the influence of water shortage, it was noted that the leaf levels were small in all varieties. It was observed that the level of reduction of leaf surfaces was different depending on the biological characteristics of the varieties. It was noted that the leaf levels reached the highest level in the flowering stage of all sorghum cultivars under moderate moisture conditions. It was observed that the leaf area and dry matter accumulation of plants grown under the influence of water deficit decreased compared to those under moderate humidity. The obtained data show that the leaf levels of all sorghum varieties are directly related to soil moisture levels. Leaf levels of all cultivars were observed to have higher values in moderate moisture options.

Plant tissues must be supplied with sufficient water for normal physiological processes. The sum of these physiological processes is inextricably linked with plant productivity, and its level depends on the water regime and drought resistance of plants. The importance of net photosynthetic productivity in plant life, growth and development, and productivity is immeasurable. The basis of the dry mass of plants is organic matter. A certain part of these organic substances is sorted into the formation of generative organs. Due to the lack of water in the soil due to unfavourable factors of the external environment, the duration of the net productivity of photosynthesis is shortened, as a result, the assimilative productivity of the plant also decreases.

Based on the data obtained on the net productivity of photosynthesis, it was found that the value of this indicator is different depending on the development stages of corn varieties and moisture levels. It was found that the value of this indicator increases from the tuber stage to the flowering stage. A decrease in the net productivity of photosynthesis was also noted in all varieties with a decrease in humidity. This process has become of great importance in the formation of biological and economic crops mainly in plants. The rate of accumulation of dry matter in sorghum varieties is directly related to the level of moisture in the soil, and the decrease in the level of moisture in the soil led to a decrease in dry mass. When all the conditions for the growth and development of plants are sufficient, a small amount of water is used for the synthesis of dry matter, that is, an increase in the coefficient of effective use of water was noted.

It was determined that the net productivity of photosynthesis in the tuber stage of the studied corn varieties was 3.35-4.61 g/m2 day within the varieties under moderate humidity conditions. In conditions of limited humidity, the net productivity of photosynthesis was 3.00-4.13 g/m2 day, respectively. It was found that the value of the net productivity of photosynthesis increases from the budding stage to the flowering stage. In particular, 3.51 g/m2 per day in moderate humidity, 3.71 in flowering, 3.33 in the fertilization phase in limited humidity, and 3.43 g/m2 in the flowering phase of the Karabosh variety.

In the Massino variety, 5.24 in moderate humidity conditions of the roasting phase, 6.86 in flowering, 4.73 in the roasting phase, respectively in limited humidity, 6.21 g/m2 in flowering, 4.42 in moderate humidity conditions of the roasting phase in the Samurai variety, 5.03 in flowering, 4.05 in the roasting phase in limited humidity, 4.74 g/m2 in flowering. 4.16 in moderate humidity conditions of the roasting phase in the Pakana variety of Uzbekistan, 4.39 in flowering, 3.88 in the roasting phase at limited humidity, 4.22 g/m2 in flowering and 3.77 in moderate humidity conditions of the roasting phase in the Uzbekistan-18 variety, 4.06 in flowering, 3.39 in the roasting phase at limited humidity, 3.17 g/m2 in flowering.

According to our scientific results, there is an organic connection between the net productivity of photosynthesis and the biological yield, and it was studied during the experiments that water shortage leads to a sharp decrease in the value of these indicators.

According to this indicator, high results for all varieties were observed at moderate humidity. With the decrease in moisture level, the value of net photosynthetic productivity decreased in all cultivars, and the lowest results were found in plants grown under limited moisture conditions of the tuber phase. With a decrease in the number of irrigations, that is, with an increase in the level of water deficit in the soil, it was observed that the value of the net productivity of photosynthesis decreased in all varieties. It was noted that the value of the net productivity of photosynthesis in the studied varieties depends on their moisture level. In the Massino and Samurai varieties, the decrease in the value of this indicator was slower than in other varieties.

CONCLUSIONS

According to the above scientific sources, due to its biological characteristics, the corn crop is well adapted to arid climatic conditions, is not very demanding on soil fertility, is well resistant to salinity, and uses soil moisture sparingly. However, the unfavourable agro-climatic conditions that have arisen in a large area of our country have a negative effect on obtaining a high and stable harvest of corn.

Sorghum is mainly grown in arid and semi-arid regions of the world. Water deficit resistance of sorghum is due to the well-developed root system, the presence of a waxy coating on the leaves and stems, the structure of the oral apparatus and the epidermis, and the ability of the plants to go into suspended anabiosis until it is more favourable. Drought stress is considered to be the most frequent abiotic stress faced by sorghum in its main production areas. As a result, much attention has been paid to understanding the effects of drought stress in sorghum and its mechanisms of stress tolerance as part of efforts to apply strategies for the effective development of tolerant cultivars in sorghum breeding.

Water scarcity is a major limiting factor in sorghum growing areas, significantly reducing yield and hence yield. Effects of drought stress on grain yield and quality of sorghum at different growth and development stages under conditions of climate change and reduced water availability are well documented. Therefore, well-planned and detailed, especially ecophysiological, studies covering all stages of plant growth and development are required to gain a clearer understanding of the general effects of water deficit on sorghum and the characteristics of plant responses to drought.

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