Certain Ecophysiological Characteristics of Corn Varieties Under the Conditions of The Bukhara Region

🆔 Kholliev Askar Ergashovich

Doctor of Biological Sciences, Professor, Bukhara State University, Bukhara, Uzbekistan

Bekmurodova Marjona Sherzod qizi

Master's degree student, Bukhara State University, Bukhara, Uzbekistan

Abstract

This article presents the results of a study on the physiological characteristics of water exchange in corn varieties under varying soil moisture conditions. The findings indicate that the physiological activity and water exchange traits of the studied corn varieties differ depending on soil moisture levels and their inherent biological characteristics. Variations were observed in transpiration intensity and overall physiological responses under different moisture regimes. Under water deficit conditions, the Andijon-36 and Yangiobod varieties demonstrated higher productivity compared to other varieties. These results provide a scientific basis for identifying relatively drought-tolerant corn varieties suitable for cultivation under arid and semi-arid conditions.

Cite This Article: Kholliev Askar Ergashovich, & Bekmurodova Marjona Sherzod qizi. (2026). Certain Ecophysiological Characteristics of Corn Varieties Under the Conditions of The Bukhara Region. The American Journal of Agriculture and Biomedical Engineering, 8(2), 10–13. https://doi.org/10.37547/tajabe/Volume08Issue02-02

1. Introduction

In recent years, global demand for plant resources has increased significantly. Population growth necessitates the production of plant-based raw materials to ensure the supply of food products, including meat, dairy, and other essential commodities. In this context, particular attention is being paid to the evaluation, scientific substantiation, and practical implementation of the ecophysiological and biochemical characteristics of new plant varieties with high productivity and nutritional potential, especially in saline, arid, and water-deficient regions. Consequently, research conducted in this direction is regarded as a priority area of scientific inquiry.

The study, regulation, and elucidation of plant tolerance mechanisms to adverse abiotic stress factors represent one of the major theoretical and scientific challenges worldwide. Expanding research in this field is essential for developing methods that enhance plant resistance to water stress, including the application of biologically active substances. Furthermore, considerable emphasis is placed on utilizing stress-tolerant crop germplasm in genetic breeding programs and introducing such developments into agricultural production systems. The necessity of conducting such research is explained by the fact that, under stress conditions, plants activate specific and non-specific physiological and biochemical

mechanisms to mitigate stress effects. In the future, advancing agricultural development will require the application of both conventional and innovative approaches aimed at improving crop resilience [1,2].

Agriculture and climate change are closely interconnected in multiple dimensions, as climate change is a primary driver of both biotic and abiotic stresses that negatively affect regional agricultural systems. Today, food security and ecosystem sustainability remain among the most pressing global challenges. Environmental changes—particularly water scarcity—have had detrimental impacts on agricultural production. With the rapid growth of the global population and increasing concerns regarding environmental stability, demand for food continues to rise accordingly. Drought reduces soil fertility and significantly affects crop productivity due to both direct and indirect impacts of abiotic stress associated with sharp environmental fluctuations [3,4].

Corn adaptation to water-deficient environments is associated with its well-developed root system, the presence of a waxy coating on leaf and stem surfaces, and the specialized structure of stomata within the leaf apparatus, all of which contribute to efficient water conservation. The deep penetration of the corn root system into the soil, along with other morphological traits, has developed over prolonged periods under specific ecological conditions. In arid regions, corn is capable of producing at least 4.8 tons of grain per hectare, 30–35 tons of green biomass per hectare, and up to 12 tons of hay per hectare. Even in years characterized by severe drought, when soil moisture reserves decline to critical levels, corn demonstrates resilience and maintains relatively high productivity.

Water scarcity is the principal limiting factor in regions where corn is cultivated, significantly reducing yield potential and overall productivity. Under conditions of climate change and decreasing water availability, comprehensive ecophysiological studies are required to evaluate the effects of drought stress at various growth and developmental stages on grain and green biomass yields.

Furthermore, corn can withstand prolonged drought conditions and subsequently recover, resuming normal growth and development while accumulating substantial yields. The investigation of drought tolerance in corn has considerable practical importance, particularly for farms located in arid zones. In such regions, water resources are consistently limited, and corn serves as a primary forage crop for livestock production. Achieving high and high-quality yields from any crop requires the creation of optimal growing conditions, one of the most important factors being irrigation. Although corn is recognized as highly drought-tolerant, timely irrigation is essential for obtaining high grain and silage yields [5].

In irrigated agricultural areas, the development of advanced agronomic practices is based on a thorough understanding of the biological characteristics of the cultivated crop, soil and climatic conditions, regional water availability, and the water conveyance capacity of irrigation systems. Irrigation regimes (including rates, timing, and frequency) are designed by taking into account crop requirements, irrigation scheduling, and the specific characteristics of the hydromodular zone. Efficient use of irrigation water is a critical consideration in this process [6].

Long-term experimental studies have demonstrated that corn is inherently drought-tolerant and, even with a single pre-sowing irrigation, can produce up to 40 tons of silage mass per hectare. Therefore, wherever suitable conditions can be established, it is recommended to include corn among cultivated crops. In particular, areas unsuitable for cotton production, as well as fields that are dry, affected by hot winds, prone to soil salinity, or located in foothill and mountainous rainfed zones, may be allocated for corn cultivation [7].

Corn is one of the most important technical crops supplying raw materials for various sectors of production. Achieving the required level of output necessitates optimizing factors aimed at preserving yield. In our country, measurable progress has been made in improving the agro-meliorative condition of irrigated lands, preventing water scarcity and soil salinization, refining ecophysiological and agronomic measures, identifying and developing stress-adapted crop varieties, and scientifically substantiating the tolerance and productivity levels of corn varieties under stress conditions. Determining the ecophysiological, productivity, and tolerance characteristics of plants under water-deficit conditions, as well as introducing genotypes adapted to arid and saline soils into agricultural practice, remains a relevant and essential task.

2. Methods

The investigation of the ecophysiological foundations of corn varieties under the soil and climatic conditions of

the Bukhara oasis was conducted through both laboratory and field experiments. The research objects included the Yangiobod, Turon-1, Nurli, and Andijon-36 corn varieties. These varieties are currently cultivated across extensive areas in several regions of the Republic.

Laboratory experiments were carried out in the Ecological Physiology Laboratory of Bukhara State University, while small-scale field trials were conducted at the university's experimental research fields.

In all field experiments, soil water deficit was assessed by determining pre-irrigation soil moisture content, soil bulk density, and field moisture capacity. Irrigation practices were implemented based on the measured soil moisture deficit. Irrigation rates were established according to the degree of soil moisture limitation. All experiments were conducted under two moisture regimes: a control treatment (optimal moisture, 70% of field capacity) and an experimental treatment (limited moisture, 50% of field capacity).

Observations and biometric measurements were performed on selected model plants within odd-numbered replicates. All treatments were arranged in three replicates following a systematic tiered design. Physiological and phenological assessments were carried out at the stem elongation (shooting), tasseling, and flowering stages of corn development. To determine the studied parameters, the third to fourth fully developed leaves from the upper portion of the stem were sampled. For each corn variety, 10 plants were selected, and their individual characteristics were evaluated.

3. Results and Discussion

Under optimal moisture conditions, all studied varieties demonstrated intensified leaf surface expansion. In contrast, under limited moisture conditions (water deficit), a reduction in leaf area was recorded across all varieties. The degree of leaf area reduction varied depending on the biological characteristics of each variety. Under optimal moisture, the maximum leaf area was observed at the flowering stage in all corn varieties.

Based on the results obtained during the study, a drought tolerance index for corn varieties was developed. The proposed index enables the evaluation of varieties across multiple parameters. It was determined that limited moisture conditions directly affect the physiological processes of corn varieties and exert a significant negative impact.

Significant differences among the varieties were identified with respect to the studied indicators. Under limited moisture conditions, the adaptive and protective responses to unfavorable environmental factors were found to depend on the biological traits of the varieties. The Andijon-36 and Yangiobod varieties exhibited higher grain weight compared to the other varieties.

Under the saline soil and water-deficit conditions of the Bukhara region, the physiological characteristics and water exchange processes of corn varieties were examined in relation to varying moisture levels. Transpiration rate, total leaf water content, daytime and residual leaf water deficit were comparatively assessed among varieties under water stress conditions. To evaluate the photosynthetic potential of corn varieties, field experiments were conducted to determine the relationship between net photosynthetic productivity and total biomass accumulation under different moisture regimes.

An analysis of the influence of soil moisture levels on productivity indicators revealed differences in growth rate, leaf area expansion, net photosynthetic productivity, yield, and yield quality between drought-tolerant and drought-sensitive varieties. The Andijon-36 and Yangiobod varieties demonstrated higher adaptability to water deficit conditions. Compared to the control treatment, the increase in water deficit under experimental conditions at the flowering stage was determined to be 15.6% and 17.4%, respectively.

Throughout the experiments, variations in physiological and productivity-related parameters among varieties were found to depend on environmental conditions and their ecophysiological traits. The superior physiological tolerance of the Andijon-36 and Yangiobod varieties to water stress was scientifically substantiated. It was estimated that, when cultivated in water-deficient regions, these varieties can produce 8–10% higher grain yields compared to other varieties.

4. Conclusion

Under the soil and climatic conditions of the Bukhara region, characterized by water scarcity, soil salinity, and other extreme environmental factors, the nutritional properties and practical suitability of certain corn varieties as forage crops have been scientifically substantiated. Varieties demonstrating high productivity and superior quality indicators, along with tolerance to water deficit and salinity, were identified.

Given that corn serves as both a food and industrial crop, its drought and salinity tolerance allows for cultivation on low-productivity lands while still ensuring stable and relatively high yields. In addition, the by-products of corn processing may be effectively utilized as raw materials in the feed industry for livestock, poultry, and aquaculture. The large-scale cultivation of early-maturing varieties as secondary crops is also recommended to enhance agricultural efficiency.

For the arid zones of the Bukhara oasis, the Andijon-36 and Yangiobod corn varieties are recommended due to their high levels of stress tolerance and adaptive capacity under water-deficient conditions.

References

1. Tollenaar, M., & Lee, E. A. (2002). Yield potential, yield stability and stress tolerance in maize. Field Crops Research, 75(2–3), 161–169.
2. Ming, L., et al. (2018). Phenological growth stages of maize (Zea mays L.) according to the extended BBCH scale. Journal of Agronomy, 117(3), 120–129.
3. Arunanondchai, P., Fei, C., Fisher, A., McCarl, B. A., Wang, W., & Yang, Y. (2018). How does climate change affect agriculture. In The Routledge Handbook of Agricultural Economics. Routledge.
4. Noya, I., González-García, S., Bacenetti, J., Fiala, M., & Moreira, M. T. (2018). Environmental impacts of the cultivation-phase associated with agricultural crops for feed production. Journal of Cleaner Production, 172, 3721–3733.
5. Bänziger, M., Edmeades, G. O., Beck, D., & Bellon, M. (2000). Breeding for drought and nitrogen stress tolerance in maize: From theory to practice. CIMMYT.
6. Watson, S. A., & Ramstad, P. E. (2016). Corn: Chemistry and technology. American Association of Cereal Chemists.
7. Karimov, F. (2016). Donli ekinlar fiziologiyasi va ekologiyasi. O'zMU nashriyoti.