European Journal of Agricultural and Rural Education (EJARE)
Available Online at: https://www.scholarzest.com
Vol. 6 No. 03 March 2025
ISSN: 2660-5643

EFFECT OF MOISTURE LEVELS ON THE PHYSIOLOGICAL CHARACTERISTICS OF SORGHUM

Ozoda Toirovna Jo`rayeva
PhD, Doctor of Philosophy in Biological Sciences
Bukhara State University, Uzbekistan
E-mail: ozodajorayeva74@gmail.com
https://orcid.org/0000-0002-0526-5003

Article history:

Received: 24th January 2025

Accepted: 20th February 2025

Abstract:

The intensity of transpiration in plants depends on several external factors, including air temperature, wind, relative humidity, soil and climate conditions, solar radiation, soil moisture levels, plant growth stages, and cultivar characteristics. Determining the total water content in leaves is one of the key indicators of plant water supply. If this indicator is studied in conjunction with other processes characterizing the water regime, broader information can be obtained. Studying water exchange in plants in arid regions helps determine the physiological activity based on the reserve water content in the leaves.

Keywords: transpiration intensity, total leaf water content, free and bound water content, moderate and limited moisture, tillering, booting, flowering phases, water stress.

INTRODUCTION

The rate of transpiration in plants depends on multiple external factors such as relative humidity, air temperature, soil and climate conditions, wind, and solar radiation. In addition to evaporation through leaves, transpiration also facilitates the adsorption of water and the movement of water and dissolved substances throughout the plant. Moreover, the intensity of transpiration is influenced by the amount of metabolic and bound water in the plant, as well as the colloidal properties of the cell protoplasm.

Scientific studies were conducted on the transpiration intensity of locally adapted sorghum varieties, including Qorabosh, Massino, Samurai, Uzbekistan Dwarf, and Uzbekistan-18, under two different moisture conditions—moderate and limited—during the tillering, booting, and flowering stages.

MATERIALS AND METHODS

Research findings indicate that the transpiration intensity was higher in plants grown under moderate moisture conditions compared to those in limited moisture conditions. It was observed that transpiration intensity increased from the tillering stage to the flowering stage across all sorghum varieties. Under moderate moisture conditions, transpiration rates were recorded as follows:

- Tillering stage: 174.6 - 191.0 mg/m² per minute
- Booting stage: 176.0 - 203.6 mg/m² per minute
- Flowering stage: 192.0 - 215.0 mg/m² per minute

Under limited moisture conditions, transpiration rates followed a similar trend but were lower.

No.	Types	Soil moisture	Tillering TJ, mg/m² min.	Booting TJ, mg/m² min.	Flowering TJ, mg/m² min.
1	Qorabosh	moderate	191,0±1,11	203,6±0,71	215,0±1,83
		limited	171,3±2,09	182,8±1,38	190,4±1,91
2	Massino	moderate	168,2±1,71	176,0±2,19	192,0±1,66
		limited	145,0±3,23	151,6±2,43	165,0±1,23
3	Samurai	moderate	174,6±2,65	182,3±3,31	200,2±1,57
		limited	157,2±1,92	161,6±2,28	168,5±1,18
4	Uzbekistan Dwarf	moderate	176,8±1,51	186,3±2,19	192,3±1,79

		limited	164,7±2,12	172,7±1,55	178,4±1,52
5	Uzbekistan-18	moderate	185,0±1,43	192,5±1,17	205,2±2,12
		limited	172,1±2,25	178,5±1,28	187,9±2,11

Under moderate humidity conditions, the transpiration rate was positive in the Massino and Samurai varieties, and in these varieties it was found that in the tube stage, it was 168.2 mg/m2 min in the Massino variety, 176.0 mg/m2 min in the flowering stage, and 192.0 mg/m2 min in the flowering stage. In the Samurai variety, it was 174.6 mg/m2 min in the tube stage, 182.3 mg/m2 min in the flowering stage, and 200.2 mg/m2 min in the flowering stage.

If we analyze the value of this indicator by variety, a negative indicator was recorded in the Korabosh variety, Uzbekistan Dwarf and Uzbekistan-18 varieties, and the transpiration rate in these varieties was different, in particular, it was found that the Korabosh variety was 191.0 mg/m2 min at the tuber stage, 203.6 mg/m2 min at the tillering stage, and 215.0 mg/m2 min at the flowering stage, i.e. at the same time.

During the research observations, changes in the total water content in the tissue cells of the leaves of the Johori species were studied during the stages of tubular formation, ovule formation, and flowering under conditions of limited and moderate humidity. According to the analysis of data obtained under moderate humidity conditions, the total water content at the seedling stage in all studied varieties ranged from 75.1% to 71.6%, with positive indicators at this humidity level being recorded in the Massino and Samurai varieties. **Figure 1.1.**

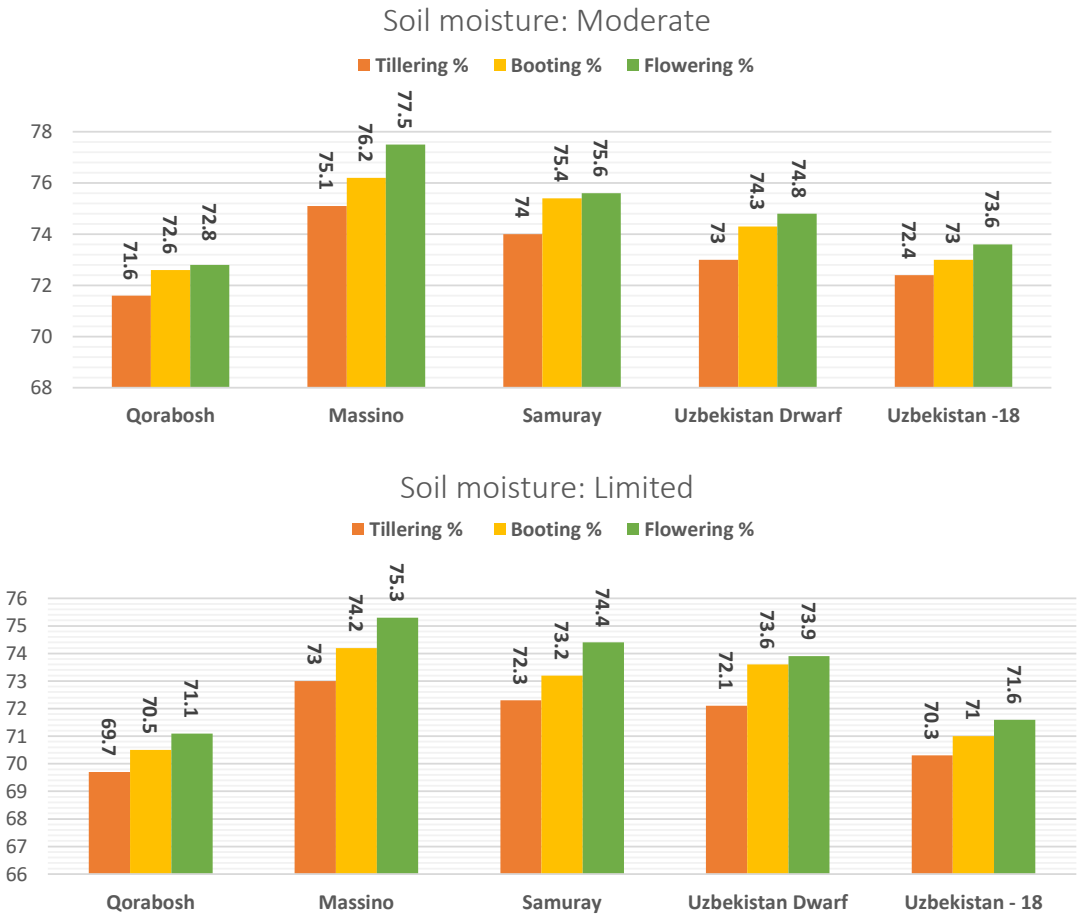

Figure 1.1. Effect of humidity levels on total water content in leaves

The total water content of all the studied cultivars was observed to be 72.6 - 75.4% at the budding stage, respectively. It was found that the total water content of the leaves in these cultivars at the flowering stage was in the range of 72.8% - 77.5%. It was noted that the positive indicator was the Massino variety (77.5%) and the Samurai variety (75.6%).

It was observed that the total water content of the leaves was high at the tubular stage, and that these indicators decreased relatively at the leafing and flowering stages. This situation was also observed under conditions of limited moisture, and it was noted that the total water content in the leaves of all varieties studied was higher during the flowering stages.

RESULTS AND DISCUSSION

The study revealed that the total leaf water content fluctuated throughout the different growth stages. During the generative phase, tissues and cells require high water content. The dynamics of total water content in leaves serve as an important indicator of daily changes in water exchange processes. In plant physiology, water in plants is categorized into two groups: free and bound water. Free water participates in metabolic processes, whereas bound water does not, as it is associated with high-molecular-weight compounds.

The total water content in leaves was highest during the tillering stage and decreased slightly during booting and flowering. Under moderate moisture conditions, the total water content varied between 71.6% and 77.5%, with Massino and Samurai varieties showing the highest values. Under limited moisture conditions, a similar trend was observed, but total leaf water content was generally lower.

The highest transpiration rates under limited moisture conditions were recorded in Qorabosh and Uzbekistan-18 varieties, indicating their greater susceptibility to water stress. In contrast, Massino and Samurai varieties demonstrated higher leaf water retention, suggesting better tolerance to drought conditions.

CONCLUSION

1. The study confirmed that the physiological indicators of sorghum varieties are directly influenced by soil moisture levels.
2. Analysis of transpiration intensity and total leaf water content revealed significant variation among different sorghum varieties under both moderate and limited moisture conditions.

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