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TRANSPIRATION INTENSITY OF "RAVOT" AND "MAHSULDOR" BEAN VARIETIES IN THE CONDITIONS OF THE SAMARKAND REGION

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Abstract. High-yielding bean varieties are widely cultivated in Uzbekistan. However, the water requirements of many of these varieties have not been fully studied. Therefore, investigating their water exchange characteristics under specific climatic conditions and utilizing the resulting data is a matter of current importance.

Keywords: Transpiration, transpiration intensity, "Ravot", "Mahsuldor", developmental stages, Uzgumi, Edagum CM, Gumel Lyuks.

Introduction. In recent years, the common bean (Phaseolus vulgaris L.) has been cultivated on an area of 27 million hectares worldwide. Global bean production amounts to 23.6 million tons. India, Brazil, China, Myanmar, and the USA are the leading producers in terms of cultivation area. These top five producing nations account for more than 60% of global production—specifically, 18.7 million tons out of the total 23.6 million tons [2].

In order to ensure the implementation of Decree No. PF-5853 of the President of the Republic of Uzbekistan dated October 23, 2019, "On Approval of the Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020–2030," large-scale efforts are underway in the country to cultivate short-growing-season grain legumes as a second crop. In particular, adjusting the composition of cultivated areas to meet the demands of market relations is serving as a basis for increasing the volume of vegetable and potato production, as well as expanding the variety and assortment of grain and legume crops. In this context, developing the physiological and biochemical foundations for the use of bioactive substances in bean cultivation is a pressing issue. Analysis of relevant literature. Transpiration is one of the most vital processes in plants. Through the evaporation of water, plant organs are integrated into a unified system, facilitating the transport of mineral and—to some extent—organic substances via the continuous movement of water from the root system to the leaves [1, 2].

Furthermore, transpiration serves to protect the plant body from overheating and dehydration by increasing the rate of water evaporation through stomata, thereby maintaining the optimal temperature required for normal physiological processes [3, 4].

The intensity of transpiration depends on environmental factors; by regulating the degree of stomatal opening, it balances the rate of water evaporation with the influx of carbon dioxide into the leaf, thereby contributing to drought and moisture tolerance and helping to ensure stable crop yields regardless of weather conditions [6, 7].

Copper (Cu) is a component of several enzymes, including ascorbate oxidase, polyphenol oxidase, orthophenol oxidase, and tyrosinase. This microelement plays a role in nitrogen metabolism. By activating vitamins and enhancing carbohydrate and protein metabolism, copper increases the plant's resistance to drought and heat. Molybdenum (Mo) is a crucial component of the nitrogenase enzyme's active site—found in the bacteroids of legume roots—where it facilitates molecular nitrogen fixation and enhances the enzyme's activity; it is also a constituent of the nitroreductase enzyme. If soil molybdenum levels are critically low, nitrates accumulate in plant tissues, root nodule bacteria fail to develop in legumes, plant growth is disrupted, and stems and leaf blades become deformed; consequently, the number of stomata on the leaf blades decreases, which in turn slows down the processes of photosynthesis and respiration [5].

The process of transpiration aids in CO2 assimilation. This occurs because stomata remain open during water evaporation, serving as channels for CO2 to enter the leaves. Therefore, stomatal conductance facilitates transpiration and supports efficient photosynthesis. Thus, measuring plant transpiration rates and stomatal conductance is of great importance for both scientific research and agricultural studies, particularly in horticulture and forestry [8].

Enzymes such as xanthine oxidase and phosphatase play a crucial role in various processes of plant growth and development, accelerating seed germination, root system formation, leaf blade development, flowering, and fertilization.

Cobalt (Co) participates in leaf cell proliferation (increasing the thickness and volume of the mesophyll, as well as the size and number of cells in the palisade and spongy leaf parenchyma). Furthermore, cobalt increases the total water content in plants, thereby helping to enhance crop drought resistance [10].

Sulfur (S) deficiency slows down protein synthesis; consequently, the symptoms of sulfur deficiency resemble those of nitrogen starvation. Plant growth and development are retarded, leaf size decreases, and stems become elongated.

Potassium (K) is involved in carbohydrate and protein metabolism, enhancing sugar formation in leaves and its translocation to other plant organs. Additionally, potassium improves water influx into plant cells and reduces transpiration, thereby increasing the plant's drought resistance [11].

Bioactive substances (such as Uzgumi, Edagum SM, and Gumel Lyuks) contain the aforementioned elements as well as humic and fulvic acids, which activate numerous enzymes. Consequently, many positive changes occur within the plants.

Research methodology. Field and laboratory experiments were conducted using generally accepted methods; field trials followed guidelines such as “Методика полевого опыта”, “Dala tajribalarini o‘tkazish uslublari” while laboratory measurements of plant transpiration intensity utilized the "torsion balance" method. Transpiration intensity was assessed across different plant development stages and at four-hour intervals throughout the day.

Analysis and results. The "Ravot" and "Mahsuldor" bean varieties served as the subjects of our research. These varieties are cultivated over extensive areas in the Samarkand region.

The daily transpiration intensity of the beans was measured starting in the morning at four-hour intervals: 05:00, 09:00, 13:00, 17:00, and 21:00. Air temperature was also measured during these times.

Analyses conducted during the branching (budding) phase revealed that transpiration intensity was relatively low in the early morning (5:00 AM), ranging from 158.54 to 169.94 g/m²·h. It intensified by 9:00 AM (reaching 312.05–323.26 g/m²·h) but subsequently decreased to 175.13–186.45 g/m²·h by 1:00 PM due to stomatal closure. In the afternoon, transpiration intensified again at 5:00 PM (269.54–280.75 g/m²·h) before dropping once more at 9:00 PM (116.29–127.52 g/m²·h).

A similar trend was observed across all developmental phases. When analyzing transpiration intensity by developmental stage, it was found to increase from the branching phase to the flowering phase, with the highest rates recorded during flowering. From the pod-formation phase through to the ripening phase, a decline in transpiration intensity was observed. The results revealed that the transpiration rate was higher in the “Mahsuldor” variety compared to the “Ravot” variety.

Conclusion. The observation that leaf transpiration intensity in both varieties increases from the branching phase to the flowering phase—peaking during the flowering stage—is attributed to the intensification of plant metabolic and photosynthetic processes driven by the formation of buds and flowers, as well as the application of biologically active substances to the leaves during the interval between branching and flowering; the potassium within these substances improves water flow into plant cells and reduces transpiration, thereby enhancing drought resistance. Elements such as K, Cu, Mo, Mn, and Co increase total plant water content, improve water flow into cells, reduce transpiration, and ensure heat tolerance, thereby boosting the plants' resistance to drought.

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