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*Article*

# Study of Changes in Water Regime and Physiological Indicators of Rice (Oryza Sativa L.) Varieties "Lazurniy" and "Sadaf" Under the Influence of Environmental Factors

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**Abstract:** This article examines the changes in the water regime and key physiological parameters of rice (*Oryza sativa* L.) varieties "Lazurniy" and "Sadaf" under the influence of environmental factors. According to the research results, the "Lazurniy" variety belongs to the intensive type and demonstrates high productivity under favorable agrotechnical conditions. In contrast, the "Sadaf" variety showed a high capacity for water retention in leaves and a high level of physiological adaptability under conditions of water deficit.

**Keywords:** Rice (*Oryza Sativa* L.), Water Regime, Transpiration, Water Retention Capacity, Leaf Water Content, Physiological Parameters.

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## 1. Introduction

In recent years, due to global climate change and population growth, water availability has become a critical issue for agriculture, which is the largest consumer of water worldwide. It is well known that more than 70% of global water resources are used in agriculture. Although irrigated agricultural lands account for only 20% of the total cultivated area, they produce about 40% of the world's food supply. In addition, crop yields from irrigated lands are at least twice as high as those from rainfed areas [1].

Water typically constitutes 50–90% of plant cell content. Of this amount, 60–90% is located within the cell, while the remaining portion is mainly found in the cell walls [2]. Therefore, maintaining growth and productivity under ecological stress conditions such as water deficit is one of the major challenges of modern agriculture, including rice cultivation [3].

Global climate change leads to various natural disasters. In particular, floods have negatively affected the productivity of approximately 22 million hectares of rice fields worldwide, with about half of this area located in eastern India [4]. Although rice (*Oryza sativa* L.) requires large amounts of water, excess water beyond the optimal level also negatively affects yield. This is explained by limited oxygen exchange in submerged tissues and oxygen deficiency ($O_2 < 21\%$) [5], [6].

Under water deficit stress conditions, signaling processes in the cell membrane are activated, and resistance is formed through physiological mechanisms and stress-responsive genes. During this process, significant changes are observed in photosynthesis

and gas exchange [7], [8], degradation of cellular components, alterations in membrane lipids [9], translocation of nutrients [10], transcriptional activity of genes and transposable elements [11], lipid signaling pathways [12], metabolites and proteins [13], as well as antioxidant systems [14]. Physiological and biochemical imbalances caused by water deficit redirect a significant portion of energy and nutrients toward protective mechanisms, leading to reduced growth, development, formation of generative organs, and biomass accumulation. At the same time, under water deficit conditions, changes occur in the antioxidant defense system, disrupting protection against reactive oxygen species (ROS) [15]. At the molecular level, water deficit affects the expression of stress-sensitive genes, enhancing the synthesis of enzymes such as ascorbate peroxidase (APX) and heat shock proteins (HSPs) [16].

## 2. Materials and Methods

The research was conducted in the experimental fields of the Rice Research Institute. The rice varieties “Sadaf” and “Lazurniy” were used as research material. During the growing period, physiological indicators of water balance in the rice varieties were evaluated, including flag leaf water content, transpiration rate, water retention capacity, and leaf dry weight.

To determine the total water content and water retention capacity of the leaves, five leaves were sampled from each treatment.

Their fresh weight was measured using an electronic balance and then kept under room conditions. After a 2-hour exposure, the leaves were weighed again. Subsequently, the samples were dried in a drying oven at 100–105°C for 72 hours, after which the dry weight of the leaves was determined.

Based on these measurements, the total water content and water retention capacity of the leaves were calculated. The study was carried out in accordance with the methods described in “Methods of Field Experiments” (B.A. Dospekhov, 1985) [17]. Transpiration intensity was determined according to the method of L.A. Ivanov [18], and leaf water retention capacity was assessed using the method of A.A. Nichiporovich [19].

## 3. Results and Discussion

Under conditions of optimal water supply, a high total water content in leaves positively affects the normal formation of generative and vegetative organs. When the total water content in the flag leaves was analyzed across the rice varieties, no statistically significant differences were observed.

Nevertheless, even minimal water reserves in the plant were found to have a noticeable impact on metabolic processes under water deficit conditions. According to the analysis, the highest total leaf water content was observed in the “Sadaf” variety, reaching 94.3%. In the “Lazurniy” variety, this value was 94.2%, showing no significant difference between the two varieties.

Optimal water supply in leaves is known to ensure normal photosynthesis and other metabolic processes. Another important physiological parameter examined in our study was water retention capacity, which depends on soil moisture as well as the morphological, anatomical, biological, and genetic characteristics of the plant. Water retention capacity is assessed by the percentage of water lost over a specific period (2 hours) relative to the initial water content. A lower value indicates a higher ability of the leaf to retain water.

In our results, the “Lazurniy” variety showed a water loss of 64.3%, indicating relatively low water retention capacity. In contrast, the “Sadaf” variety exhibited a lower

water loss of 55.2%, demonstrating higher water retention ability. The high total water content and transpiration intensity observed in "Sadaf" leaves can primarily be explained by a well-developed root system and the variety's high adaptability to environmental stress factors. Additionally, "Sadaf" leaves are distinguished by their larger size.

Our findings also indicate that under water deficit, the increase in leaf water retention corresponds to a higher proportion of water fractions that are more difficult to lose under stress conditions. Further analysis of dry leaf weight showed that the flag leaf dry weight in "Lazurniy" was 14.1 mg, whereas in "Sadaf" it was 10.6 mg. The higher dry weight in "Lazurniy" may be due to intensive photosynthesis and the synthesis of a larger amount of organic substances transported from the roots to all organs.

**Table 1.** Water-related parameters of rice varieties.

| № | Rice Variety Шоли нави | Total Water Content (%) | Water Loss (%) | Water Retention Capacity |
|---|---|---|---|---|
| 1 | **"Sadaf"** | 94,3 | 55,2 | High |
| 2 | **"Lazurniy"** | 94,2 | 64,3 | Low |

Biochemical and Physiological Basis of Biomass Accumulation and Transpiration in Rice. The productivity of a given genotype, expressed as dry matter accumulation, is determined by biochemical reactions in plant tissues, enzyme activity, hormone levels, and the rate of certain physiological processes. Dry matter accumulation in plants depends on the rate of assimilation processes and the efficiency of inorganic and organic substance synthesis. A positive correlation between productivity and accumulated dry biomass has been reported in numerous studies [20].

Transpiration is one of the key physiological parameters, playing a major role in plant water exchange. It is a primary process in the regulation of plant water balance. Transpiration rate is defined as the amount of water evaporated from plant leaves per hour (mg $H_2O$ per 1 g of fresh leaf × 1 hour).

In our experiments, the transpiration rate differed between varieties: it was 398.5 mg in "Sadaf" and 335.5 mg in "Lazurniy," indicating a relative difference. It is known that under water deficit conditions, reduced transpiration in plants is associated with a decrease in total and free water content in the leaves, loss of turgor, and leaf wilting.

## 4. Conclusion

In the studied rice varieties, key physiological indicators of water balance—transpiration rate, leaf water retention capacity, and leaf dry weight—did not show significant differences. Neither the "Sadaf" nor the "Lazurniy" variety demonstrated a pronounced advantage in these physiological processes. The "Lazurniy" variety belongs to the intensive type and exhibits high yield under favorable agro-conditions, while the "Sadaf" variety showed higher tolerance to water deficit stress.

## REFERENCES

[1] Food and Agriculture Organization of the United Nations. Overcoming water challenges in agriculture. In The State of Food and Agriculture 2020. FAO: Rome, Italy, 2020. Available online: https://www.fao.org

[2] Salehi-Lisar S.Y., Motafakkerazad R., Hossain M.M., Rahman I.M. Water stress in plants: Causes, effects and responses. In Water Stress. InTech Croatia, 2012; V.8. P.1–14. https://www.intechopen.com

[3] Kabbadj A., Makoudi B., Mouradi M., Pauly N., Frendo P., Ghoulam C. Physiological and biochemical responses involved in water deficit tolerance of nitrogen-fixing Vicia faba. PLoS ONE. 2017. V.12. P.84. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.017

[4] Dar M.H., Chakravorty R., Waza S.A., et al. Transforming rice cultivation in flood prone coastal Odisha to ensure food and economic security. Food Sec. 2017. V.9. P.711–722. https://link.springer.com/article/10.1007/s12571-017-0678-3

[5] Lee Y., Kende H. Expression of β-expansins is correlated with internodal elongation in deepwater rice. Plant Physiology. 2001. V.125. P.645–654. https://academic.oup.com/plphys/article/125/2/645/6119553

[6] Sasidharan R., Bailey-Serres J., Ashikari M., Atwell B.J., et al. Community recommendations on terminology and procedures used in flooding and low oxygen stress research. New Phytologist. 2017. 214(4). P.1403–1407. https://nph.onlinelibrary.wiley.com/doi/10.1111/nph.14528

[7] Menezes-Silva P.E., Sanglard L.M., Ávila R.T., Morais L.E., Martins S.C., Nobres P., Patreze C.M., Ferreira M.A., Araújo W.L., Fernie A.R. Photosynthetic and metabolic acclimation to repeated drought events play key roles in drought tolerance in coffee. J. Exp. Bot. 2017. V.68. P.4309–4322. https://academic.oup.com/jxb/article/68/17/4309/3873646

[8] Bryant C., Fuenzalida T.I., Brothers N., Mencuccini M., Sack L., Binks O., Ball M.C. Shifting access to pools of shoot water sustains gas exchange and increases stem hydraulic safety during seasonal atmospheric drought. Plant Cell Environ. 2021. V.44. P.2898–2911. https://onlinelibrary.wiley.com/doi/10.1111/pce.14167

[9] Tenhaken R. Cell wall remodeling under abiotic stress. Front. Plant Sci. 2014. V.5. P.771. https://www.frontiersin.org/articles/10.3389/fpls.2014.00771/full

[10] Demidchik V. Mechanisms of oxidative stress in plants: From classical chemistry to cell biology. Environ. Exp. Bot. 2015. 109. P.212–228. https://www.sciencedirect.com/science/article/abs/pii/S0098847215000967

[11] Makarevitch I., Waters A.J., West P.T., Stitzer M., Hirsch C.N., Ross-Ibarra J., Springer N.M. Transposable elements contribute to activation of maize genes in response to abiotic stress. PLoS Genet. 2015. V.11. https://journals.plos.org/plosgenetics/article?id=10.1371/journal.pgen.1004915

[12] Hou.Q., Ufer G., Bartels D. Lipid signalling in plant responses to abiotic stress. Plant Cell Environ. 2016. V.39. P.1029–1048. https://onlinelibrary.wiley.com/doi/10.1111/pce.12601

[13] Nakabayashi R., Saito K. Integrated metabolomics for abiotic stress responses in plants. Curr. Opin. Plant Biol. 2015. V.24. P.10–16. https://www.sciencedirect.com/science/article/pii/S1369526614001096

[14] Choudhury.F.K., Rivero R.M., Blumwald E., Mittler R. Reactive Oxygen species, abiotic stress and stress combination. Plant J. 2017. V.90. P.856–867. https://onlinelibrary.wiley.com/doi/10.1111/tpj.13299

[15] Faize M., Burgos L., Faize L., Piqueras A., et al. Involvement of cytosolic ascorbate peroxidase and Cu/Zn superoxide dismutase for improved tolerance against drought stress. J. Exp. Bot. 2011. V.62(8). P.2599–2613. https://academic.oup.com/jxb/article/62/8/2599/463417

[16] Oliveira. C., Agostinetto D., Langaro A., et al. Physiological and molecular responses in rice, weedy rice and barnyardgrass exposed to supra-optimal temperatures. Planta Daninha. 2019. V.37. https://www.scielo.br/j/pd

[17] Доспехов Б.А. Методика полевого опыта. Москва: Колос, 1985. С.50–423.

[18] Иванов.Л.А., Силина.А.А., Цельникер.Ю.Л. О методе быстрого взвешивания для определения транспирации в естественных условиях. Ботанический журнал. 1950. Т.35, №2. С.171–185.

[19] Ничипорович. А.А. О потере воды срезанными растениями в процессе завядания. Журнал опытной агрономии Юго-Востока. 1926. Т.3, Вып.1. С.76–78.

[20] Виноградов.Д.В. Сравнительная оценка различных сортов ярового рапса в условиях Рязанской области. Вестник Рязанского ГАТУ. 2009. №1. С.54–55.