



ASSESSMENT OF COLD TOLERANCE IN RICE VARIETIES UNDER KARAKALPAKSTAN CONDITIONS

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ABSTRACT

This study evaluated the cold tolerance of rice variety samples under Karakalpakstan conditions in laboratory settings.

Seeds were stored in a thermostat at +10 °C, and germination rates were determined as percentages after 10 and 15 days. According to the results, Sanam, D-15 (D-158), and Guliston varieties showed high tolerance in cold conditions (75–86%), while D-4 (14-04-3) had the lowest indicator (54%). These results demonstrate that certain varieties possess stable germination capacity even under low temperature conditions, serving as an important resource in breeding processes for creating varieties adapted to cold climate conditions.

Introduction

Rice (*Oryza sativa* L.) is one of the most important grain crops in the world and plays a fundamental role in ensuring food security for humanity. However, climatic factors, particularly low temperature problems, remain serious obstacles in rice cultivation. Low temperatures slow seed germination, lead to thinning of seedlings, and ultimately negatively affect productivity.

As noted in scientific literature, the issue of cold tolerance differs at various growth stages. Yoshida's (1981) research indicated that temperatures below +20 °C slow the rapid and uniform germination of rice seeds and delay crop maturation [1]. Blum (1988) interpreted cold tolerance as adaptability to stress conditions and emphasized that this trait is closely related to plant genetic characteristics [2].

In subsequent studies, various methodologies have been developed to determine rice varieties' cold tolerance at the seed stage. For example, Cruz and Milach (2004) showed that seed germination rate and seedling vigor can be used as main criteria in assessing rice cold tolerance at the germination stage [3]. Furthermore, Cruz and colleagues (2006) determined the genetic heritability of this trait and noted its potential use in breeding work [4].



The genetic basis of cold tolerance has also been extensively studied. Andaya and Mackill (2003) identified QTLs (Quantitative Trait Loci) determining cold tolerance during the vegetative stage of rice growth, showing that this trait is under complex genetic control [5]. These scientific sources indicate that studying rice varieties' cold tolerance has not only agronomic but also genetic and breeding significance.

The Republic of Karakalpakstan has a sharply continental climate, with late frosts and low temperatures frequently observed during spring periods. In such conditions, assessing rice varieties' cold tolerance and identifying suitable varieties is an important direction for developing sustainable rice cultivation in the region. The purpose of this study is to assess the seed germination capacity of rice variety samples under low temperature (+10 °C) conditions in Karakalpakstan and to identify promising varieties for breeding.

Materials and Methods

Research work was conducted on rice variety samples adapted to the conditions of the Republic of Karakalpakstan. Experiments were performed in laboratory conditions at the Scientific Production Association of Grain and Rice.

The following rice varieties and breeding samples were used for the study: Sanam, Guliston, D-38 (D-133), D-16 (D138), D-15 (D-158), D-39 (otb. 1/10), D-11 (D-205), D-4 (14-04-3), and D-44 (C65-02-2).

One hundred seeds from each variety were taken and initial cleaning work was performed in the laboratory. Seeds were soaked in distilled water for 24 hours. They were then placed on moist filters in thermostat conditions.

A thermostat at +10 °C was used to assess seeds' cold tolerance. The experiment was conducted in two stages:

- After 10 days, the germination rate was calculated
- After 15 days, the final germination rate was determined

As a control, the overall germination capacity of seeds in laboratory conditions (in %) was also recorded.

Seed germination was determined as a percentage according to the following formula:

Germination rate (%) = $(n/N) \times 100$ where:

- n – number of germinated seeds N – total number of sown seeds
- Each experiment was conducted in 3 replications, and average values were calculated for statistical analysis.

Results and Discussion

The results of research conducted in laboratory conditions showed that rice varieties' seed germination capacity under low temperature (+10 °C) conditions differed significantly (Table 1).

Table 1

Germination capacity of rice variety samples under low temperature (+10 °C) conditions

No	Variety sample	Overall germination (%), laboratory	+10°C
		After 10 days %	After 15 days %



1Sanam	97	12	75
2Gulistan	96	14	84
3D-38 (D-133)	98	7	65
4D-16 (D-138)	97	-	-
5D-15 (D-158)	96	14	86
6D-39 (otb. 1/10)	98	13	74
7D-11 (D-205)	96	11	63
8D-4 (14-04-3)	95	7	54
9D-44 (C65-02-2)	96	11	81

Analysis of the results shows that Sanam, D-15 (D-158), and Guliston varieties demonstrated high germination capacity even under low temperature conditions. Specifically, the D-15 variety recorded the highest result among all varieties, showing 86% germination after 15 days. Guliston and Sanam varieties also achieved indicators of 84% and 75% respectively, confirming their capacity for stable germination in cold climate conditions.

In contrast, the lowest indicator (54%) was recorded for the D-4 (14-04-3) variety. This variety's sensitivity to low temperature indicates limitations in its adaptability to climate conditions. D-11 (63%) and D-38 (65%) varieties also had relatively low indicators, showing weak germination capacity in cold climate conditions.

The overall trend shows that germination rate at 10 days was very low (7–14%), indicating that seed germination proceeds slowly under low temperature conditions. However, by 15 days, indicators increased sharply in some varieties. This indicates variable degrees of cold tolerance in rice varieties.

The results are consistent with international research. For example, Yoshida (1981) noted a significant decrease in rice seed germination rate and percentage under low temperature conditions [1]. Cruz and Milach (2004) also noted high percentage germination in cold-tolerant varieties, albeit delayed [3]. The same situation was observed in our results: while slow germination was observed during the first 10 days, tolerant varieties showed high results at 15 days.

Additionally, Andaya and Mackill's (2003) research showed the existence of genetic bases for cold tolerance and that this trait is expressed differently in different varieties [5]. In our study as well, significant genotypic differences were recorded among rice varieties, which provides the opportunity to select tolerant varieties in the breeding process.

Conclusion

Research results showed that rice varieties have significant differences in seed germination capacity under low temperature (+10 °C) conditions. **D-15 (D-158), Guliston, and Sanam** varieties demonstrated high tolerance (75–86%), while **D-4** and **D-11** had low indicators. These results provide the opportunity to select cold-tolerant varieties under Karakalpakstan conditions and use them effectively in breeding work.



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