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SELECTION AND AGROBIOLOGICAL ASSESSMENT OF RICE
GENOTYPES UNDER THE ENVIRONMENTAL CONDITIONS OF
KARAKALPAKSTAN

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Abstract: *This study focuses on the agrobiological and selection assessment of rice (*Oryza sativa* L.) genotypes under the extreme soil and climatic conditions of Karakalpakstan. Given the intensifying global climate change and acute water scarcity in the Aral Sea basin, developing early-maturing, salt-tolerant, and high-yielding rice cultivars is of paramount importance. A collection of local and international rice genotypes was evaluated for vegetation period, morpho-biological characteristics, yield components, and tolerance to abiotic stresses. The integrated methodological approach combining field phenology, biometric analysis, and stress tolerance scoring allowed the identification of valuable donor lines for future breeding programs in northern Uzbekistan.*

Keywords: *Oryza sativa* L., selection, early maturity, Karakalpakstan, abiotic stress, yield components, phenology, biometric analysis.

INTRODUCTION

Global climate change, sharp thermal fluctuations, and increasing deficits of irrigation water pose significant challenges to agricultural sustainability in the Aral Sea region. Rice (*Oryza sativa* L.) is a staple crop in Karakalpakstan, yet traditional cultivation practices encounter severe environmental constraints, including soil salinization, high atmospheric aridity, and limited water allocation. Developing short-duration, resource-efficient, and stress-resilient rice genotypes represents a strategic solution to secure yield stability and enable sustainable land utilization. Recent global and national rice breeding trends emphasize shortening the vegetation period (100–115 days) while maintaining high yield potential. However, a negative correlation often exists between early maturity and individual plant productivity. Therefore, comprehensive agrobiological and selection assessment of diverse rice genotypes under Karakalpakstan's specific soil-climatic regime is essential for uncovering genetic variability and selecting elite parent materials. The principal objective of this research is to evaluate a collection of early-maturing rice genotypes based on a complex set of morpho-biological and agronomic traits, identify inheritance patterns, and select promising donors for regional breeding programs.

METHODS

Field and laboratory experiments were conducted in the experimental plots of Karakalpakstan under sharply continental climatic conditions characterized by elevated summer temperatures, low atmospheric humidity, and soil-water salinity. Meteorological parameters and soil salinity levels were monitored continuously throughout the growth seasons. The research material comprised more than 50 early and mid-early rice genotypes (*Oryza sativa* L.) originating from local selection lines and international collections (IRRI,



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VIR), alongside regionally adapted standard cultivars as controls. Field trials were laid out in a randomized complete block design (RCBD) with three replications under uniform agrotechnical management. Phenological observations recorded key developmental stages: germination, tillering, jointing, heading, milk-ripe, and full maturity. Biometric evaluations were performed on 30 randomly selected plants per genotype to determine plant height, effective tillering, panicle length, filled and unfilled grains per panicle, 1000-grain weight, and grain yield per plant according to standard evaluation systems (IRRI SES). Tolerance to salinity and thermal stress was assessed using scoring scales. Experimental data were subjected to analysis of variance (ANOVA) according to B.A. Dospekhov's methodology to ensure statistical reliability.

RESULTS

Phenological observations revealed significant variation in the duration of the growth period among the studied genotypes, ranging from 98 to 118 days. Twelve early-maturing genotypes were identified that reached full maturity 8–15 days earlier than the regional standard cultivar. The rate of heading and grain filling stages showed strong dependence on ambient temperature and relative air humidity. Morphobiological analysis indicated that plant height ranged between 85.0 cm and 112.5 cm, with several semi-dwarf lines (90–100 cm) exhibiting high lodging resistance. Effective tillering capacity averaged 3.8 to 6.2 tillers per plant. Panicle productivity metrics showed 92 to 148 grains per panicle, with 1000-grain weight fluctuating between 24.5 g and 31.2 g. Early-maturing lines exhibited a vegetation period of 98–105 days, plant height of 88.5–95.0 cm, panicle grain count of 105–125, 1000-grain weight of 26.0–28.5 g, and salt tolerance scores of 3–4 points. In contrast, mid-early genotypes recorded 106–114 days, 92.0–102.0 cm, 118–142 grains, 27.5–30.2 g, and 4–5 points, respectively. The control standard cultivar recorded a 118–122 day growth cycle, 105.0 cm height, 135 grains per panicle, 28.0 g 1000-grain weight, and 3-point salt tolerance. Under saline conditions, 5 specific genotypes demonstrated superior germination energy and initial seedling vigor, confirming their high adaptive potential.

DISCUSSION

The findings demonstrate that selecting for early maturity alone is insufficient to ensure commercial viability in Karakalpakstan; breeders must simultaneously select for rapid grain filling rates and panicle density to compensate for shortened vegetative duration. The integration of phenological tracking, biometric profiling, and stress-screening protocols effectively facilitated the early detection of superior breeding lines. The identified genotypes with combined early maturity and salinity resilience provide valuable genetic sources to break the negative linkage between short growth duration and low yield potential. Furthermore, quantifying trait variability and phenotypic correlations establishes a robust empirical foundation for applying multivariate statistical techniques, such as cluster analysis and principal component analysis (PCA), in subsequent breeding cycles.

CONCLUSION

The comprehensive agrobiological and selection assessment methodology adapted for Karakalpakstan's soil-climatic conditions proved highly reliable and effective for screening rice genotypes.

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Promising early-maturing genotypes with a growth cycle of 98–105 days, optimal plant architecture, stable panicle productivity, and high abiotic stress tolerance were identified.

The selected elite genotypes serve as suitable parental lines and genetic donors for breeding new high-yielding, water-efficient, and climate-resilient rice cultivars tailored for the Aral Sea region.

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