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COMPLEX SELECTION AND BIOLOGICAL ASSESSMENT OF EARLY-MATURING RICE GENOTYPES FOR VALUABLE AGRONOMIC TRAITS

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Abstract. *This study evaluates a set of early-maturing rice genotypes based on a comprehensive suite of selection and biological traits under the environmental conditions of Karakalpakstan. The investigation focuses on phenotypic variability, growth duration, morpho-biological parameters, abiotic and biotic stress resilience, and technological grain quality. The results demonstrate significant genetic diversity among the tested lines, allowing the identification of promising short-duration genotypes that maintain superior panicle architecture, high grain quality, and resistance to soil salinity and key diseases. These findings provide empirical data essential for parent selection in climate-resilient rice breeding programs.*

Keywords: *phenology, biometric evaluation, stress tolerance, grain quality, yield components, early maturity.*

INTRODUCTION

Developing high-yielding rice cultivars with shortened vegetation periods is a crucial strategy to optimize water productivity and mitigate the impact of climate change in northern agricultural regions. In regions with severe environmental constraints, such as Karakalpakstan, early-maturing genotypes must exhibit strong physiological adaptability alongside high yield stability. Assessing individual agronomic traits independently often fails to capture the trade-offs between shortened growth duration and overall yield potential. Therefore, a complex evaluation encompassing phenological progression, vegetative architecture, stress resilience, and post-harvest technological grain quality (such as head rice yield and milling recovery) is imperative. The objective of this research is to perform a detailed agro-selection characterization of diverse early-maturing rice lines to pinpoint superior genotypes combining early harvestability, abiotic stress tolerance, and favorable grain attributes.

METHODS

The experiments were conducted during the main growing seasons under field conditions in Karakalpakstan. A collection of over 50 early-maturing and mid-early rice genotypes was evaluated in a randomized complete block design (RCBD) with three replications. Phenological tracking monitored the precise dates of germination, tillering, jointing, heading, milk-stage, and physiological maturity to calculate stage-specific thermal requirement units. Biometric measurements were recorded on 30 representative plants per plot, determining plant height, productive tiller count, panicle length, total and filled grain counts per panicle, and 1000-grain weight. Abiotic stress tolerance (specifically soil/water salinity and elevated summer temperature) and biotic resistance (particularly to blast disease, *Magnaporthe oryzae*) were scored using international standard evaluation scales (IRRI SES).



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Technological grain parameters, including husk percentage, grain length-to-width ratio, and total milling yield, were analyzed using laboratory processing equipment. All collected quantitative data were processed using analysis of variance (ANOVA) to verify statistical significance.

RESULTS

Phenological assessment revealed that the duration from germination to full maturity among the evaluated early-maturing genotypes varied from 98 to 114 days, compared to 120 days for the local control cultivar. Morpho-biological evaluations showed plant heights ranging between 86.5 cm and 108.0 cm, with semi-dwarf genotypes demonstrating high lodging resistance. The number of productive tillers per plant averaged between 4.2 and 6.8. Panicle structural analysis indicated a range of 95 to 152 grains per panicle, with 1000-grain weight fluctuating from 25.2 g to 31.0 g. Under elevated soil salinity, eight genotypes displayed strong salinity resistance (scores 1–3), maintaining high seed setting rates (>82%) and minimal panicle sterility. Biotic screening identified four lines with high field tolerance to blast disease under natural infection pressures. Technological grain assessment revealed that elite early-maturing lines achieved a high total milled rice recovery of 68.5%–71.2% and head rice output exceeding 58.0%, meeting the commercial standards for high-quality grain production.

DISCUSSION

The experimental results demonstrate that short growth duration does not inherently limit panicle productivity if the genotype possesses intensive tillering ability and efficient photosynthesis during the vegetative phase. The complex assessment highlighted several lines where early heading did not lead to high spikelet sterility, even under high thermal and saline stress. The strong performance in technological grain quality indicates that early-maturing genotypes can successfully combine short field duration with high market value. Comparing these multi-trait profiles enables the identification of elite lines that balance developmental speed, structural stability, and end-use quality, serving as ideal material for multi-trait selection models.

CONCLUSION

Comprehensive evaluation of early-maturing rice genotypes identified distinct variation across phenological stages, yield architecture, stress resilience, and technological grain quality.

Genotypes combining a short growth cycle (98–105 days) with high lodging resistance, salt tolerance (scores 1–3), and superior milling yield (>68%) were successfully selected.

The complex agro-selection parameters established in this study provide a verified baseline for choosing parental genotypes in target breeding for resource-efficient and high-quality rice production.



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