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Genetics, Physiological Mechanism and Breeding for Tolerance against Submergence, Salinity, and Saline-Submergence Stress in Rice (Oryza sativa L.)

(2023) *Plant Science Today*, 10, pp. 235-242.

DOI: 10.14719/pst.2536

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Abstract
Rice is a staple food and one of the most crucial crops globally, providing sustenance for more than half of the world's population. Climate change has a crucial impact on the agricultural sector, particularly rice cultivation, due to the increase in abiotic stress incidences. Salinity is one of the most severe abiotic stresses on rice production globally. Salt stress significantly reduces growth performance, affecting various metabolic and physiological processes in rice. Submergence is another type of abiotic stress affecting rice growth and yield. Recently, a newly emerged abiotic stress called saline submergence may also jeopardize rice production. Seawater intrusion into rice fields located nearby coastal areas may cause saline flash floods, especially during monsoon season. Rice cultivated in coastal areas is prone to saline-submergence stress, leading to a significantly lower yield. Although Sub1 and Saltol QTLs are widely used in developing rice cultivars with submergence and salinity tolerance, there is a lack of studies conducted to explore the potential performance of breeding lines with Sub1 and Saltol QTLs under saline-submergence stress. It has been hypothesized that the introgression of Sub1 and Saltol QTLs into elite rice cultivars might result in potentially tolerant breeding lines to saline-submergence stress. Further breeding projects, however, need to be conducted to prove this postulation. The present mini-review deals with genetics, physiological mechanisms, and breeding achievements for submergence and salinity-tolerant rice while at the same time highlighting saline-submergence as an emerging type of abiotic stress in rice cultivation. © The Author(s).

Author Keywords
Flood; Marker-assisted selection; Quantitative trait loci; Saltol; Sub1

Funding details
Ministry of Higher Education, MalaysiaMOHE
International Islamic University MalaysiaIIUMRMCG20-012-0012

This study was supported by the Fundamental Research Grant Scheme (FRGS) Project (FRGS/1/2019/WAB01/ UIAM/01/1) of the Ministry of Higher Education Malaysia (MOHE) and the International Islamic University Malaysia (IIUM) Research Management Grant (RMCG20-012-0012). We are grateful to the Kulliyyah of Science, IIUM Kuantan and Centre for Marker Discovery and Validation (CMDV), Malaysian Agricultural and Research Development Institute (MARDI) for providing research facilities.

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Publisher: Horizon e-Publishing Group

ISSN: 23481900
Language of Original Document: English
Abbreviated Source Title: Plant Sci. Today
2-s2.0-85174970171
Document Type: Review
Publication Stage: Final
Source: Scopus