# SUBMERGENCE TOLERANCE IN SELECTED RICE VARIETIES OF SRI LANKA: AN EVALUATION OF *Oryza sativa* L. ACROSS DIVERSE WATER SOURCES

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Submergence poses a major challenge to rice cultivation, significantly reducing harvest outcomes. Therefore, the adoption of rice varieties with enhanced tolerance to submergence is crucial. This study examines how water quality and environmental conditions influence the submergence tolerance of selected improved rice varieties (*Oryza sativa L.*) in Sri Lanka. After 24 hours pretreatment procedure, LD 376, LD 253, LD 368, and LD 408 selected rice varieties were submerged for 12 days with Well water, Canal water and Chlorinated tap water from 6 different locations. During the pretreatment, each sample was submerged in corresponding water of each location for 24 hours followed by the weight treatment for 24 hours. Then, cultivation was carried out using Well water obtained from Walasmulla (L1) and Udugama (L2) locations, Canal water from Embilipitiya (L3) and Hambantota (L4) locations and chlorinated tap water from Tangalle (L5) and Galle (L6) locations. SPAD readings were obtained from randomly selected rice plants after 12 days, while bud length was measured daily with respective water samples. According to analyzed data, LD 408 variety showed the highest bud growth rate in Canal water which has high conductivity values and also LD 408 rice sample which was submerged in Canal water in Location 3 & 4 has relatively high SPAD values. Thus, LD 408 rice variety exhibited resilience to Canal water with high conductivity, resulting from dissolved soil minerals such as NaCl and $CaSO_4$ as well as sewage, maintaining rapid bud growth and elevated SPAD values, which indicates strong tolerance to submergence and ionic stress. It implies its suitability for cultivation in flash-flood-prone areas and other marginal environments with saline or nutrient-rich water in Sri Lanka.

*Keywords*: submergence tolerance, improved rice varieties

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## INTRODUCTION

Rice is the main food source in Sri Lanka. Therefore, paddy cultivation has become the main agricultural activity in the country. In rice cultivation, improved rice varieties should exhibit submergence tolerance due to the flash flood conditions that occur during the Southwest monsoon in the southern part of Sri Lanka (Millawithanachchi et al., 2022), where most paddy fields are entirely submerged in floodwater. Submergence tolerance is an essential trait for rice varieties cultivated in flood–prone areas. It refers to the ability of a plant to survive and maintain growth when fully or partially submerged under water for prolonged periods. Prolonged submersion leads to hypoxic and anoxic conditions. Hypoxic conditions mean low oxygen condition and anoxic condition refers to no oxygen. In the absence of oxygen, rice seeds rely on fermentation metabolism to produce energy. This involves the breakdown of stored carbohydrates into ethanol and lactic acid (Khanal et al., 2024), whereas warmer floodwater will have greater damaging effects during submergence (Das et al., 2009). The main purpose of this research is to investigate the effect of water quality and environmental conditions on the submergence tolerance of selected improved rice varieties in Sri Lanka. During this experiment, well water, canal water and chlorinated tap water were utilized as the treatments for the rice varieties LD408, LD368, LD253 and LD376.

## METHODOLOGY

The rice varieties LD408, LD368, LD253, LD376 were soaked in water for 24 hours, followed by a 24-hour weight treatment to facilitate germination, and the cultivation was carried out using well water obtained from Walasmulla (L1) and Udugama (L2) locations, Canal water from Embilipitiya (L3) and Hambantota (L4), and the Chlorinated tap water from Tangalle (L5) and Galle city (L6) locations. After the pre-treatment, each sample was divided into 2 similar portions, one portion of each sample for the control and the other for the submergence. Both control and submerged samples were exposed to similar weather and light conditions, allowing them to grow for 12 days. The results regarding seed

germination and bud formation of the submergence and control groups were recorded daily. Here, the seeds of the submergence group were placed in a 10cm fixed water column and the length of three randomly selected germinating seeds, chosen from the eight rice seeds in each pot, was measured to monitor their growth. Measurements were taken for 12 days from the submergence and control groups, which were placed outdoors and exposed to natural environmental conditions.

## RESULTS AND DISCUSSION

After the submerging process, LD408 has the highest upward bud growth rate and cell elongation, even in the highest temperature areas like Hambantota (L4) and also SPAD readings of LD408 have further confirmed that highest chlorophyll content and highest photosynthetic potential when compared to other varieties.

According to the results of bud length, LD 376 in Well water has less submerge tolerance, LD 368 in Canal water from Embilipitiya location (L3) had shown less submerge range and also LD 368 in Canal water sample from Hambantota location (L4) had shown less submerge tolerance. Then LD 368 in Chlorinated water samples from L5 & L6 showed less tolerance compared to other varieties.

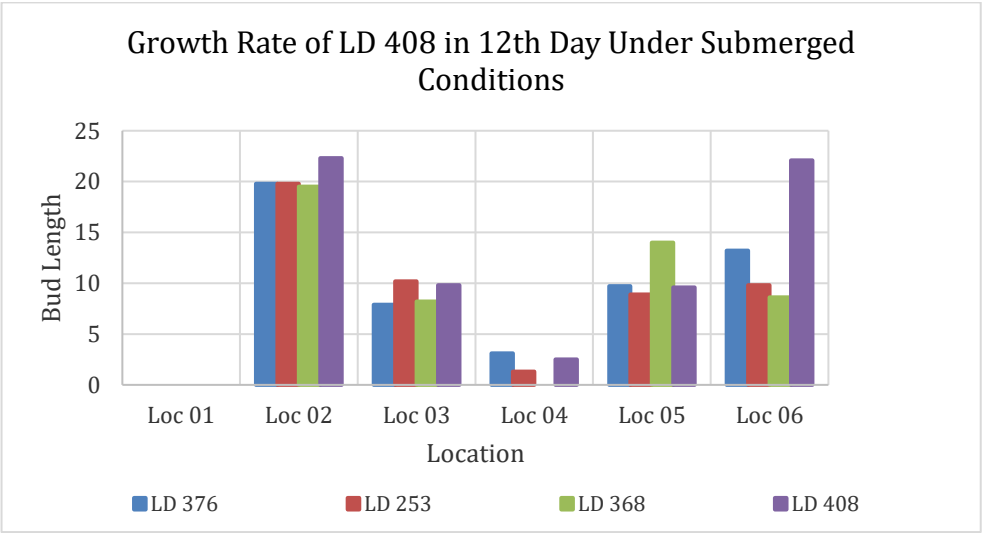


Figure 1 : Growth Rate of LD 408 in 12th Day Under Submerged Conditions in all Locations

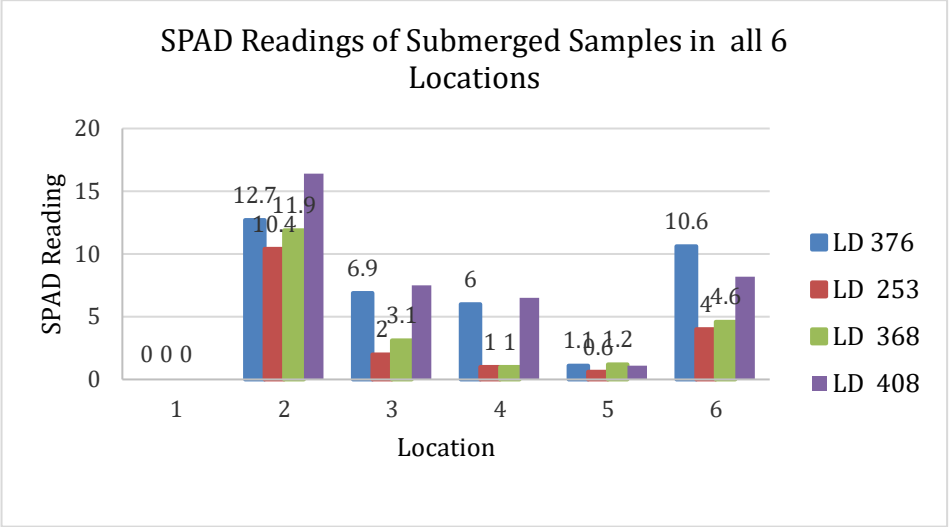


Figure 2: SPAD Readings of Submerged Samples in 6 Locations After 12 Days

According to SPAD readings, the LD408 variety in Locations 3 & 4 has relatively high SPAD values. It indicates an increased chlorophyll content, suggesting that this cultivar sustains efficient photosynthetic performance even under conditions of elevated water conductivity.

These findings (Figure 1) highlighted that LD 408 is the most suitable rice variety among the selected improved rice varieties to cultivate in flood-prone areas. LD 368 consistently exhibited the least submergence tolerance across multiple water sources and locations, making it less adaptable to hypoxic conditions caused by flooding. Also, LD 408 shows proper bud length increasing under submerged in Chlorinated tap water.

## CONCLUSIONS/RECOMMENDATIONS

LD 408 rice cultivar exhibits physiological adaptability and a moderate level of tolerance to saline conditions. According to SPAD reading values LD 408 rice variety shows submerge tolerance under Well water, tap water and Canal water, which has high conductivity values approximately to flood water. This indicates its potential suitability for cultivation in marginal agro-ecosystems of Sri Lanka where irrigation water contains elevated ionic concentrations. Finally for rice cultivation, the most suitable water sources are those which have low conductivity values such as well water.

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