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STRESS-RELATED GENES SUPPORT GROWTH AND SURVIVAL ABILITY OF RICE IN THE MARTIAN REGOLITH

Abstract

As human space exploration advances, the importance of utilizing resources available on other planets, known as In-Situ Resource Utilization (ISRU), becomes increasingly vital. This approach is essential to reduce the cost of resupply missions by developing practical and economical ways of utilizing resources on other planets. On Mars, resources such as water, regolith, light, and CO2 can be used to grow food, and previous studies have demonstrated the possibility of growing Arabidopsis thaliana, Lactuca sativa, and bean plants in Martian regolith simulants such as JSC-1 and MMS-1. This study focuses on the growth of rice plants in MMS1 and presents the results, including the impact of stress-related genes and the influence of perturbations of OsSnRK1a gene and OsTOR gene on the ability of rice to grow under the challenging conditions of Martian regolith. The experiment involved the germination and growth of rice in MMS1, potting mix (PM), and a combination of both. The results showed that plants grown in MMS1 alone had stunted growth, poor root morphology, and lower photosynthetic activity, but the addition of any proportion of PM in MMS1 improved growth and root characteristics compared to pure MMS1. While the rice plants showed signs of stress under MMS1, the study suggests that the physical and chemical characteristics of MMS1 can support their growth, provided the levels of (Mg(ClO4)2) are kept in check. Additionally, the study suggests that editing SnRK1a could potentially provide an approach to develop a stable rice line that can germinate and grow in MMS1 with (Mg(ClO4)2). Overall, the results of this study demonstrate that it is possible to grow rice plants in Martian regolith and highlight the importance of utilizing ISRU to reduce the cost of resupply missions in future space exploration.