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Utilizing Chromosome Segment Substitution Lines (CSSLs) for Evaluation of Root Responses to Transient Moisture Stresses in Rice

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Abstract: Drought and waterlogging that occur sequentially under field conditions are important abiotic stresses affecting plant growth and development. The ability to maintain the root system development during the contrasting moisture stresses may be one of the key traits for plant adaptation. This study aimed to identify the key root traits that contributed to the above ability by comparatively examining the effects of the two moisture stresses in succession on root system development. The chromosome segment substitution lines (CSSLs) from the crosses between the *japonica* rice cultivar Nipponbare and *indica* rice cultivar Kasalath were used for precise comparison of root system development. The rice seedlings were grown by hydroponics under a continuously well-aerated condition for 14 days (non-stressed), a drought condition for 7 days followed by an oxygen (O_2)-deficient (stagnant) condition for 7 days (drought-to-stagnant, D-S), or a stagnant condition for 7 days followed by drought condition for 7 days (stagnant-to-drought, S-D). CSSL43 and 47 did not show any significant differences in growth from Nipponbare under the non-stressed condition, but exhibited greater lateral root production under the stresses. Lateral root production was most closely related to faster seminal root elongation mediated by higher aerenchyma formation in the D-S condition, and to more branching of lateral roots on the seminal root axis in the S-D condition. The D-S condition severely affected lateral root production due to reduced seminal root elongation and aerenchyma formation. These results confirmed the fact that those root traits previously identified using different cultivars greatly contribute to plant adaptation. Oxygen deficiency preceded by drought (D-S) was more stressful to roots than drought preceded by O2 deficiency (S-D), because drought reduced root aerenchyma formation during the subsequent stagnant condition.

Keywords: Aerenchyma, Chromosome segment substitution line (CSSL), Drought, Lateral roots, *Oryza sativa*, Rice, Soil moisture, Stagnant

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