

Exploration of suitable rice cultivars for close mixed-planting with upland-adapted cereal crop

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Abstract

In semi-arid countries such as Namibia, the flooding unexpectedly happens in a rainy season, causing losses in the yield of upland-adapted cereal crop. In flooding conditions, rice roots sequentially form aerenchyma and a barrier to radial oxygen loss (ROL), and oxygen is released into the rhizosphere near the root tips. Iijima et al. (2016) and Awala et al. (2016) reported that close mixed-planting with rice can mitigate the flood stress of co-growing upland-adapted cereal crop by modifying their rhizosphere microenvironments via the oxygen released from the rice roots. Moreover, by using the model system of hydroponic culture, it was confirmed that oxygen from rice roots was transferred to co-growing upland-adapted cereal crop in close mixed planting system (Kawato et al., 2016). However, it is not sure whether the ability of oxygen release varies among rice cultivars, because Kawato et al. (2016) used only one *japonica* cultivar, Nipponbare (*Oryza sativa*). The objective of this study was to compare the ability of oxygen release in rhizosphere among rice cultivars. The experiment was conducted in a climate chamber in Kindai University. We used 10 rice cultivars from three different rice species (*O. sativa* (var. *japonica* (2), var. *indica* (3)), *Oryza glaberrima* Steud. (2) and their interspecific progenies (3)) to compare the ability of oxygen release from the roots. According to the method by Kawato et al. (2016), the dissolved oxygen concentration of phase I (with shoot) and phase II (without shoot) were measured by a fiber optic oxygen-sensing probe. The oxygen released from rice roots was calculated from the difference of the measurements between phase I and phase II. The result in this study indicated that all of the rice cultivars released oxygen from their roots, and the amount of released oxygen was significantly correlated with the above-ground biomass ($r = 0.710$). The ability of oxygen release (the amount of the oxygen release per fresh root weight) of *indica* cultivars (*O. sativa*) tended to be higher as compared with the other cultivars. On the other hand, that of African rice (*O. glaberrima*) and the interspecific progenies tended to be lower. These results suggested that the ability of oxygen release widely varies among rice cultivars, and some of *indica* cultivars (*O. sativa*) may be suitable for close mixed-planting to mitigate flood stress of upland-adapted cereal crop.

Keywords: rice, oxygen release, cultivar difference, flood stress

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