W17

Improving the drought tolerance in rice (*Oryza sativa* L.) by exogenous application of vanillic acid and *p*-hydroxybenzoic acid

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Abstract

Water stress obstructs rice growth mainly by oxidative damage in biological cells to cause a reduction of leaf photosynthesis and evapotranspiration processes. In this study, exogenous application of vanillic acid (VA) and *p*-hydroxybenzoic acid (PHBA) to improve drought tolerance of two *Oryza sativa* cultivars, Q2 and Q8 was tested. The drought evaluation based on leaf phenotypes to show that both Q2 and Q8 resulted in remarkable water-stress tolerance induced by leaf spraying pretreatment of mixed solution of 50 μM VA + 50 μM PHBA. The mixtures of 25 μM VA + 25 μM PHBA and 50 μM VA + 50 μM PHBA treated on Q2 and Q8 in water deficit condition also indicated that total phenols, total flavonoids, and DPPH radical scavenging activity were significantly greater their controls. In general, the accumulation of individual phenolic acids was increased in exogenous phenolic treatments, as compared with controls. Particularly, Q2 obtained a considerable amount of endogenous PHBA after application of 50 μM VA, 25 μM VA + 25 μM PHBA, and 50 μM VA + 50 μM PHBA (0.18 mg/g DW, 0.71 mg/g DW, and 1.41 mg/g DW, respectively); and a negligible content of VA (0.003 mg/g DW) appeared uniquely in the treatment of 50 μM VA. Similarly, Q8 also absorbed a significant quantity of PHBA in 50 μM PHBA, 25 μM VA + 25 μM PHBA, and 50 μM VA + 50 μM PHBA treatments (0.15 mg/g DW, 0.15 mg/g DW, and 0.22 mg/g DW, respectively). In addition, the spraying 50 μM PHBA and 25 μM VA + 25 μM PHBA on Q8 leaves induced similar amount of VA (0.04 mg/g DW). Meanwhile, there were no trace of VA and PHBA found in controls. The levels of drought tolerance of Q2 and Q8 were improved, paralleled with the increased amounts of endogenous phenolics revealed that VA and PHBA played an important role to enhance drought tolerance in rice.

Keywords: phenolic acids, drought stress, *Oryza sativa*, vanillic acid, *p*-hydroxybenzoic acid

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