（別紙様式６）
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学位論文の要旨（論文の内容の要旨）
Summary of the Dissertation (Summary of Dissertation Contents)

論　文　題　目
Dissertation title: Application of Exogenous Phenolics for Drought Tolerance Improvement in Rice (*Oryza sativa* L.)

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Water stress in a climate change scenario is one of the major threats for sustainable rice productivity. A certain level of drought can cause considerable rice yield losses. Drought stress often obstructs rice growth mainly by oxidative damage that reduces leaf photosynthesis and evapotranspiration processes in biological cells. Deeply understanding of rice self-defense mechanism through plant secondary metabolites activity will be useful and necessary to help improving drought tolerance of rice. Under stress conditions, plants usually produce a large of secondary compounds containing a phenol group. These phenolics have been known with various physiological functions such as stressful response, protective properties, and allelopathic interaction during the growth of plants. Besides, these compounds also possess many different biological activities, including anti-artherogenic, anti-inflammatory, anti-micobial, anti-allergenic, anti-thrombotic, antioxidation, and cardioprotective and vasodilative effects. Therefore, this research was conducted to externally apply potential drought-related phenolics for enhancing water-stress tolerance property of rice plant.

In this study, responses of rice under drought stress correlating with changes in chemical compositions were examined. Among 20 studied rice cultivars, Q8 was the most tolerant, whereas Q2 was the most susceptible to drought. Total phenols, total flavonoids, and antioxidant activities, and their accumulation in water deficit condition were proportional to drought resistance levels of rice. In detail, total phenols and total flavonoids in Q8 [65.3 mg GAE (gallic acid equivalent) and 37.8 mg RE (rutin equivalent)] were significantly higher than Q2 [33.9 mg GAE/g and 27.4 mg RE/g, respectively] in both control and drought stress groups. Similarly, the antioxidant activities including DPPH radical scavenging, *ß*-carotene bleaching, and lipid peroxidation inhibition in Q8 were also higher than in Q2, and markedly increased in drought stress. In general, contents of individual phenolic acids in Q8 were higher than Q2, and they were significantly increased in drought stress to much greater extents than Q2. However, *p*-hydroxybenzoic acid was found uniquely in Q8 cultivars. In addition, only

vanillic acid was found in water deficit stress in both drought resistant and susceptible rice, suggesting that this phenolic acid, together with *p*-hydroxybenzoic acid may play a key role in drought-tolerance mechanisms of rice. The use of vanillic acid (VA) and *p*-hyroxybenzoic acid (PHBA) may be useful to protect rice production against water shortage stress.

In the next experiment, two rice cultivars including a drought tolerant (Q8) and a drought susceptible (Q2) were foliar applied with exogenous vanillic acid (VA) and *p*-hydroxybenzoic acid (PHBA) to examine their effectiveness on drought-tolerant levels and induction of pigments, antioxidants, phenolics, flavonoids, and phytoalexin momilactones A (MA) and B (MB). Generally, the tolerant level of Q2 was more accelerated than those of Q8. Total contents of phenolics, flavonoids, pigments, and antioxidant activity were positively promoted, although the difference between Q8 and Q2 was negligible. In the quantitative induction of phenolic acids, VA, PHBA, and VA+PHBA showed variable effects and dose-dependent, of which Q2 was much influenced than Q8. In all treatments, PHBA appeared to have a more significant role toward drought tolerance than VA. Although MB was found only in non-treated Q8, treatments of VA+PHBA caused formation of both MA and MB, however the induced quantities of MA and MB varied among applied doses and rice cultivars. This research is the first to show that, besides increasing antioxidant activity and total pigments, phenolics, and flavonoids, application of VA and PHBA induced phytoalexins MA and MB to enhance rice drought tolerance, of which MB may play a greater role than MA.

備考

論文の要旨はＡ４判用紙を使用し，4,000 字以内とする。ただし，英文の場合は 1,500 語以内とする。

Remark: The summary of the dissertation should be written on A4-size pages and should not exceed 4,000 Japanese characters. When written in English, it should not exceed 1,500 words.