氏　　名	MUJIONO Kadis
授与した学位	博　士
専攻分野の名称	農　学
学位授与番号	博甲第　　６２７６　　号
学位授与の日付	２０２０年　９月２５日
学位授与の要件	環境生命科学研究科　　農生命科学専攻 （学位規則第４条第１項該当）
学位論文の題目	The role of hormonal signaling in rice defense against herbivores with focus on ethylene function （イネの植食性昆虫防御におけるエチレン機能に注目したホルモンシグナルの役割）
論文審査委員	教授　　ガリス　イバン　　教授　　鈴木　信弘　　准教授　谷　明夫

学位論文内容の要旨

Autotrophic plants serve as a nutrition for all other heterotrophic herbivorous organisms on the planet. As countermeasures against ubiquitous damage from insect herbivores, plants evolved various reactions collectively known as defense responses. In general, a subset of plant defense metabolites, known as volatile organic compounds (VOCs), is released to external environment, acting as attractants of natural enemies of herbivores, playing essential roles in so called “tritrophic interactions” between plants, herbivores, and natural enemies of herbivores.

Similar to other plants, rice (*Oryza sativa*) is also known to produce many volatile compounds in response to stress, including mechanical damage and insect attack. These compounds can be classified into three main metabolic groups, terpenoids, phenylpropanoids, and fatty acid derivatives but their accumulation and release from rice leaves are poorly understood. In this thesis, control mechanisms involved in VOC release in rice have been investigated, showing that jasmonate signaling pathway is crucial for rice volatile production. This was demonstrated by impaired VOC levels in two independent jasmonate signaling mutants, *hebiba* (mutated in allene oxide cyclase, AOC) and *Osjar1* (mutated in jasmonate resistant 1, JAR1). Subsequently, two basic types (accumulation patterns) of rice VOCs have been identified, with linalool as main representative of inducible volatiles, and caryophyllene as representative of diurnally regulated VOCs. Furthermore, expression analysis of known VOC biosynthetic genes in rice reveled that these genes follow the volatile accumulation patterns in both inducible and diurnal groups, and in both cases, they are dependent on jasmonic acid signaling. In attempt to detect oscillations of jasmonates in diurnal fashion, as functional base for observed diurnal volatile gene regulation, it was found that JA and JA-Ile only accumulate in very small amounts in the untreated rice plants. However, both hormones displayed weak diurnal oscillation pattern that was dependent on light. Furthermore, dynamics between internally produced volatiles and those released into headspace of rice plants have been investigated.

Finally, identification of additional regulatory factors in control of volatiles in rice plants was performed. It was discovered that ethylene acts as a negative regulator of rice volatiles, which happens at transcriptional level of volatile biosynthetic genes. It is also shown that ethylene controls volatiles in ontogeny of rice as well as during flooding stress that naturally involves accumulation of ethylene in the submerged rice plants. In summary, a comprehensive study on regulatory mechanisms involved in control of volatile production in rice was conducted. Such knowledge can be particularly useful in future design of natural protection measures for control of herbivore damage in crops based in integrated pest management (IPM) approach.

論文審査結果の要旨

The student conducted an independent study on endogenous mechanisms involved in control and release of volatile organic compounds from rice plants. This research made an important contribution to understanding of multiple roles of jasmonic acid pathway in control of rice plant volatile release upon attack from chewing type of insect herbivores. In particular, it has been shown that ethylene works as a negative regulator of rice volatile synthesis. Furthermore, the role of ethylene was extended to physiological and ecological experiments using rice plants at different ontogenetic stages and plants subjected to water submergence stress. All abovementioned results have been compiled in PhD thesis, and one part has already been published in peer review paper in Journal of Experimental Botany.

All PhD course work and lectures, mid-term presentation, and final defense have already been completed as required by graduate school regulations. Student reported his results in 3 conferences as main author, one of them being an international event (The 2018 Annual Meeting of International Society of Chemical Ecology in Budapest, Hungary). During his PhD study, Mr. Mujiono has actively contributed to 5 additional publications as a co-author.

Overall, the academic and research performance of the student have been very satisfactory and examination committee therefore recommends award of PhD (Agriculture) degree according to regulations of the Okayama University Graduate School of Environmental and Life Science.