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学 位 論 文 内 容 の 要 旨

博士の専攻分野の名称： 博 士（農学）

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学 位 論 文 題 名

Genetic studies on breeding for heading characteristics and its environmental
response of photo-insensitive rice
(非感光性イネの出穂特性と環境応答性に関する育種遺伝学的研究)

Rice (*Oryza sativa* L.) is one of the main crops in the world, which is a staple food of nearly 50% of the human population. Heading date is the important trait that determines the regional adaptability of rice. Photoperiod and temperature are the main inducers of heading. Although many studies have been carried out on photoperiod sensitivity, relatively few studies have investigated temperature sensitivity in rice. I studied on photo-insensitive (photo-in) rice varieties cultivated in high latitude area to understand temperature sensitivity, because these varieties lack photoperiod sensitivity and expected to be appropriate to understand the effects of temperature. In addition, the extreme natural conditions in the high-latitude region to which the early-heading varieties have adapted may influence not only the heading date but also the heading characteristics. I focused on the unique heading characteristics of photo-in varieties, such as heading synchrony, early heading, and effective tiller production, which elucidate the reproductive adaptation of early-heading rice varieties and the genetic basis of heading traits.

Stable early heading in photoperiod-insensitive rice varieties results from an extremely short photoperiod-sensitive phase and weak temperature sensitivity.

The transitions of the growth phases in photo-In rice varieties have not been precisely defined using conventional methods. I observed leaf emergence and the initiation of the panicle in photo-In rice varieties, which allowed us to determine the duration of the growth phases basic vegetative phase, photoperiod-sensitive phase (PSP), and reproductive phase. I found that the low photosensitivity of the photo-In varieties led to extremely short PSPs compared with the photo-sensitive (photo-Se) varieties, which in turn contributed to their short days to heading (DTH). In addition, the photo-In varieties were tolerant of low temperatures (LT) and showed limited LT-mediated delays in DTH. The photo-Se varieties, which carried either of the functional *Ghd7* or *Ospr37* alleles, were also temperature sensitive and had a prolonged PSP

under both LT and long daylength (LD) condition. Compared with *osprrr37*, I found that *ghd7* is a major contributor to early heading, and shortened PSP occurs in the photo-In varieties carrying the non-functional *ghd7* allele, which may lead to a stable early heading.

Genetic and environmental factors that regulate early heading in photo-insensitive rice varieties influence heading characteristics.

I examined photo-In varieties and evaluated heading traits such as heading synchrony, premature heading and tiller development. These traits varied more in photo-in lines than in photo-Se lines. I studied the associations of these traits with heading earliness and the influence of earliness genes and different latitudes, Sapporo (higher latitude) and Iga (lower latitude). I found that these traits were significantly correlated with earliness of first days to heading (F-DTH) in the photo-in lines. I also found that photo-In lines had a wider range of F-DTH tested in Sapporo than in Iga; LTs and LD in Sapporo delayed heading, whereas high temperatures and short days in Iga caused it to occur earlier, which was confirmed under artificial conditions. I identified five quantitative trait loci (QTL) for F-DTH among the photo-in lines. A QTL with a major effect associated with F-DTH, heading synchrony and premature heading was detected on chromosome 4.