The roles of DNA repair and epigenetic regulation in plant longevity: Systematic comparisons of copy number variation of genes and seasonal gene expression dynamics

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（植物の寿命における DNA 修復とエピジェネティック制御の役割：遺伝子コピー数の網羅的な比較解析、及び野外に生育する樹木の遺伝子発現動態の解析）

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論 文 内 容 の 要 旨

Trees generally have long lifespans, and some tree species can live for hundreds or even thousands of years. How do long-lived trees survive for a long time? Long-lived trees are exposed many exogenous and endogenous stresses, and an accumulation of DNA damage and alteration of epigenetic states due to stresses disrupt genome and epigenome integrity, accelerating aging. Therefore, maintaining genome and epigenome integrity and homeostasis is important for long-lived trees to survive for a long time. In this thesis, we focused on the copy number variation in genes and gene expression to response to environmental stress in plants, and performed systematic comparative analyses of copy number variation of genes associated with DNA repair and epigenetic regulation using a genome database and seasonal expression dynamics of DNA repair and epigenetic regulatory genes among trees, *Quercus glauca* and *Lithocarpus edulis*, under natural conditions.

Systematic comparative analyses of copy number variation revealed significant increased copy number of Poly(ADP-ribose) polymerase (*PARP*), *BRUSHY1/TONSOKU/MGOUN3* (*BRU1/TSK/MGO3*) and *SILENCING DEFECTIVE 3* (*SDE3*) gene families in trees than in annual and perennial herbs. These play important roles in genome and epigenome integrity and antipathogen defense and is likely to be favored in tree longevity. The analysis of time-series gene expression data demonstrated the seasonal expression dynamics of DNA repair and epigenetic regulatory genes. Genes associated with DNA replication, DNA modification and chromatin remodeling exhibited similar seasonal expression dynamics among species. Genes encoding polycomb-group proteins and involved in control of development and transition from vegetative to reproductive phase exhibited different seasonal expression dynamics among species. The results of this thesis reveal the roles of DNA repair and epigenetics in tree longevity, contribute as fundamental in the research to elucidate the longevity of organisms.