学 位 論 文 要 旨

Study on reaction wood anatomy in angiosperms and its diversity
木本被子植物におけるあて材の組織とその多様性に関する研究

環境資源共生科学専攻　森林資源物質科学大講座
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Woody plants develop the specific secondary xylem to restore their inclined and/or crooked stems or branches. The specific secondary xylem is called as reaction wood. In general, based on the differences in the position with forming reaction wood, reaction woods of gymnosperms and angiosperms are called as compression wood and tension wood, respectively. However, reaction woods formed in some gymnosperms and angiosperms do not show the same anatomical and chemical characteristics to those in compression and tension woods. Reaction woods formed in those species are known as 'specific' type. Although many researchers have been considered that diversity of reaction wood is related to the evolutional trends of woody plants, the reason why angiosperms show large diversity for the type of reaction wood has not been fully clarified. Therefore, in the present study, anatomical and chemical characteristics of reaction wood in several angiosperms including vessel-less angiosperms and gymnosperm with vessel element in secondary xylem, and relationship between reaction wood and tree size in temperate and tropical angiosperms were investigated to clarify the factors which contribute the diversity in type of reaction woods in angiosperms.

In Chapters 2 to 6, anatomical characteristics and lignin distribution of reaction wood in *Gardenia jasminoides*, *Sarcandra glabra*, *Tetracentron sinense*, *Gnetum gnemon*, *Falcataria moluccana*, and *Acacia auriculiformis* were investigated. *S. glabra* and *T. sinense* are known as vessel-less angiosperms. On the other hand, *G. gnemon* is known as gymnosperms, but the secondary xylem contains vessel elements. In this study, artificially inclined stems of *G. jasminoides*, *S. glabra*, *F. moluccana*, and *A. auriculiformis* were used, whereas naturally inclined stems or branches in *T. sinense* and *G. gnemon* were used. As the results, excessive positive values of surface-released strain were measured on the lower side of inclined stems in *G. jasminoides* and *S. glabra*. In addition, these two species showed increases in microfibril angle of S_2 layer and lignin concentration in wood fiber and tracheid walls, suggesting that anatomical and chemical characteristics of reaction woods in these two species were similar to those of the compression wood in gymnosperms. Therefore, these reaction wood is considered as 'compression-wood-like-reaction wood'. In contrast, *T. sinense* and *G. gnemon* showed significant decreases in microfibril angle of S_2 layer and lignin concentration in tracheid and fiber tracheid walls on the upper sides of inclined samples, whereas there were no G-layer formation on the upper side. In addition, visible-light absorbance after lignin color reactions in tracheid and fiber tracheid walls significantly decreased on the upper side in almost all samples. This qualifies the reaction wood of *T. sinense* and *G. gnemon* as 'tension wood-like'. On the other hand, a distinct G-layer was observed both *F. moluccana* and *A. auriculiformis*. Compared to normal wood, the anatomical and chemical characteristics, except for the vessel frequency, were significantly different in reaction wood of *F. moluccana* and *A. auriculiformis*, suggesting that 'typical' tension wood was formed on the inclined stems of both species.

In Chapters 7 and 8, to clarify the relationship between tree sizes (arbor, subarbor, and shrub) and diversity of reaction wood, the anatomical, chemical, and physical characteristics of reaction wood in naturally inclined stems or branches in 23 temperate angiosperms and 28 tropical angiosperms were investigated. Compared to the temperate angiosperms, occurrence percentage of G-fibers were very low in tropical angiosperms. In addition, based on the results of principal component analysis and cluster analysis, in temperate angiosperms, shrub species were classified into the different groups from arbor and subarbor groups. However, there was no tendency to be classified into the same group in each tree size in tropical angiosperms. Therefore, changes in anatomical and chemical characteristics which contribute to reaction wood formation might differ between tropical and temperate angiosperms.

Based on the results, it is concluded that the diversity of reaction wood in angiosperms might be related to lignin composition in cells functioned for mechanical support, such as tracheids or fibers as well as evolutional trend of tracheary elements and cells with mechanical support functions. In addition, it is also concluded that tree size is related to the diversity of reaction wood in angiosperms.