学 位 論 文 審 査 の 要 旨

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Dynamics of different branching units in crowns of
Sakhalin spruce, *Picea glehnii* (F. Schmidt) Mast.
（アカエゾマツ *Picea glehnii* (F. Schmidt) Mast.の樹冠における異なる分枝ユニットの動態）

Growth and death of branches largely determine the structure of tree crown, which in turn strongly affects growth and survival of trees. As branches form the crown, it is crucial to identify the factors controlling branch growth and death within a tree crown. Although light is known as an important factor affecting overall structure of the crown in various tree species, the role of light in the growth and survival of component branches is still poorly understood, especially at different levels of branching units within a tree crown.

In this study, effects of light intensity and other morphological factors on the growth and death of branches and the growth of epicormic shoots were investigated for trees in a plantation of *Picea glehnii* (F. Schmidt) Mast. (Sakhalin spruce) in the Sapporo Experimental Forest of Hokkaido University, Sapporo, Japan. In this study the branches forking from the main trunk were defined as the primary branches, and those from a primary branch as the secondary branches. An epicormic shoot is a shoot initiated from a bud that had been dormant underneath the bark of a branch. Local light intensity was represented by relative photosynthetically-active photon flux density (rPPFD) recorded above each branch. Trees were categorized into the sunlit and the shaded trees according to their rPPFD above the treetop.

The rPPFD above a branch had a significantly positive effect on the number of current-year shoots (shoot number) and the length of current-year shoots (shoot length) of both the primary and secondary branches. However, the effects of rPPFD exhibited several differences between the primary and secondary branches, and between sunlit trees and shaded trees. For the primary branches, the differences between shaded and sunlit trees of shoot number and mean shoot length were not significant. In contrast, the secondary branches on the distal part of a primary branch on shaded trees produced significantly more current-year shoots than those on sunlit trees when branches under similar light levels were compared, but the shoot number increased more sharply on sunlit trees than on shaded trees as rPPFD increased.

Furthermore, local light intensity also had a significant effect on the probability of death of both the primary and secondary branches. In the primary branches, local light intensity was the major factor affecting shoot number and shoot length, whereas both local light intensity and the position of a primary branch equally influenced the probability of death of a primary branch. As for the secondary branches, the relative influence of local light intensity on shoot production, shoot length and the death of secondary branches all exceeded 65%, indicating that both the growth and survival of a secondary branch mainly depended on its own photosynthetic capability.

The primary branches on shaded trees produced more current-year epicormic shoots than those on sunlit trees. The result suggests that the production of epicormic shoots occurs in Sakhalin spruce as a normal process of crown maintenance that serves for less vigorous Sakhalin spruce trees to prolong tree longevity.

The examination committee recognized that this study would contribute to better understanding of the dynamics of branches within an evergreen conifer crown. In particular, the finding that the location of a branch can affect death of branches deserves attention for the study of crown development. Considering the scientific achievements and the ability of conducting intensive fieldwork, the committee thereby concluded that the applicant is eligible for the degree of Doctor of Philosophy (Environmental Science).