RECENT RESEARCH ACTIVITIES

Development of a model system for tree growth under shortened annual cycle condition using artificial climate chambers

(Laboratory of Biomass Morphogenesis and Information, RISH, Kyoto University)

Kei'ichi Baba

Generally, wood forms annual rings in the temperate region. The wood structures in a ring are synchronized to seasons. For example, large vessels of ring-porous wood are formed in the spring but thick-walled tracheids in conifer wood are formed in late summer to autumn. Such an annual rhythm of tree growth offers researchers only one chance each year to harvest and/or apply treatments to the stem for the formation of specific type of cells or structures. This forces researchers to accomplish all their research activities within a short experimental window or prolong their experiments to multiple years to accomplish their study objectives. Wood research would progress tremendously if such time constraints could be alleviated.

We established a shortened annual cycle system using growth chambers with leaf changes as the indicator [1]. It comprises three stages and includes dormancy and dormancy-breaks every 4-5 months. Thus, we compared the three cycles to examine annual rings and wood tissue formed in the shortened system with those formed in the field conditions and when lacking dormancy with fixed condition in the growth room [2]. The wood tissue grown under the shortened system consisted of three growth rings. Similar structures were observed around the ring-boundaries of the wood in a field-grown stem but were missing in the wood grown in conditions lacking dormancy even with growth periods similar to those of the shortened system. This result suggests that this shortened system could be adopted as a model for physiological research of wood and studying annual ring formation.

Tree shape in a shortened system could be useful as a model of tree aging. Miniaturized poplar trees with a multiple branching architecture similar to that of much older field-grown trees were developed using the shortened annual cycle system [3]. Poplars grown under the non-dormant condition had no branches and formed a simple shape with a single stem and leaves. In the shortened system, we observed the simultaneous breaking of dormancy of several buds, resulting in architectural complexity. Our results suggest that apical dominance is lost in the shortened annual system as dormancy is broken. In contrast, apical dominance persisted in the trees grown under the condition without dormancy. Moreover, observation of the phloem structure of the trees grown under the shortened system showed a more matured structure in the bast fiber cluster than that seen in trees grown under conditions without dormancy [4].

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