**Relationship between leaf and stem growths of a tropical timber tree, *Shorea leprosula*, in the family Dipterocarpaceae**

Dipterocarpaceae is an important timber family in Southeast Asia. Dipterocarp species flower at irregular intervals from three to ten years, hindering the collection of seeds and provision of good planting materials. Furthermore, there is an urgent need to understand the effects of climate change on the production of these timber

species. Because stem elongation is a basis for seedling growth and timber production, it is important to elucidate how stem elongation is regulated in dipterocarps to solve these problems. However, the regulation of stem elongation is still not clear yet in dipterocarps.

To reveal it, we studied the regulation of stem elongation by focusing on the relationship between stem elongation and leaf growth. Through weekly observations of *S. leprosula* branches, we found that the branches have two clear growth phases, the active growth and the growth-arrested phases (Fig. 1). Although it has been discussed that branches of dipterocarps grow continuously or intermittently, this result indicates intermittent branch growths in *S. leprosula*. During the active growth phase, stems and young leaves coordinately grew (Fig. 1). Young leaves rapidly grew and were unfolded when stems showed clear elongations. Furthermore, internodes became significantly shorter if a young growing leaf was removed from the internodes (Fig. 2), suggesting that growing leaves positively regulate internode elongation.

Our previous study showed that small changes in ambient temperature regulate the timing of leaf growth in dipterocarps (Research Highlights 2020, C07). Thus, the observed regulation of stem growth by leaves would suggest that temperature changes also affect the timing of stem growth in *S. leprosula*. Considering the effect of temperature on stem growth in dipterocarps, our results will contribute to a stable supply of planting materials by controlling the growth of dipterocarp seedlings using multiple nurseries in different temperature conditions. Besides, we will be able to use the relationship between temperature and stem growth observed in this study when evaluating the effects of global warming on sustainable timber production of dipterocarps. Furthermore, because the removal of young growing leaves suppresses stem growth, damages on growing leaves could negatively affect the stem growth in dipterocarps. If climate change increases the damage on young leaves by insect attacks and droughts, these damages will have negative impacts on seedling growth and timber production of dipterocarps. Further studies are required to evaluate more precisely these negative effects on dipterocarp forestry.

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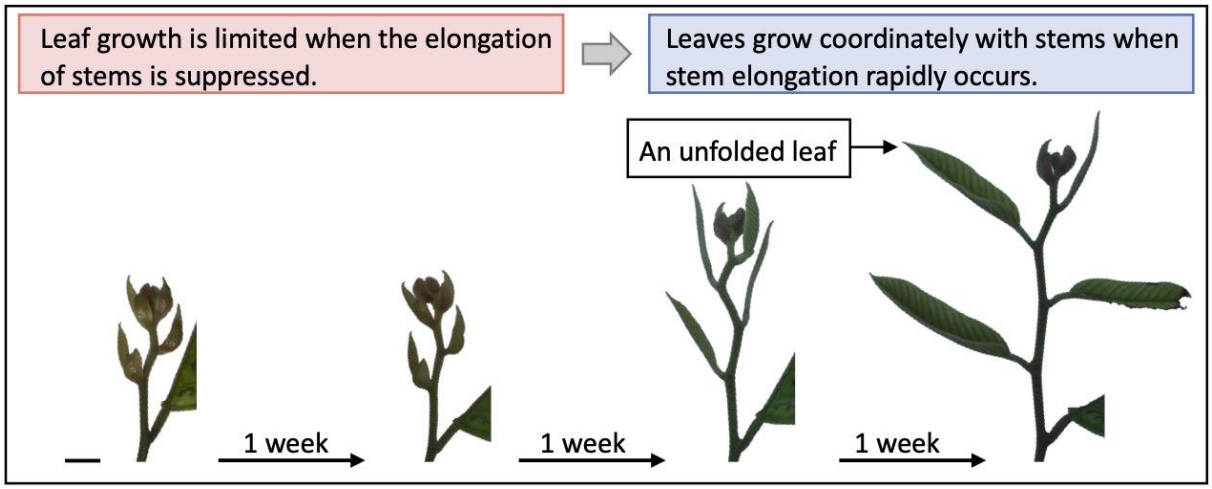


**Fig. 1. The leaf and stem growths on an intermittently growing *S. leprosula* branch**
The figure shows the result of weekly observation of an *S. leprosula* branch. As shown in the two pictures on the left, *S. leprosula* branches show a growth-arrested phase for several weeks. However, during an active growth phase as shown in the two pictures on the right, the rapid growth of branches is observed. Due to the active growth and growth-arrested phases, *S. leprosula* branches grow intermittently. Leaves and stems coordinately grow on *S. leprosula* branches. Young leaves rapidly grow and are unfolded when stems show clear elongations. Scale bar indicates 1 cm.

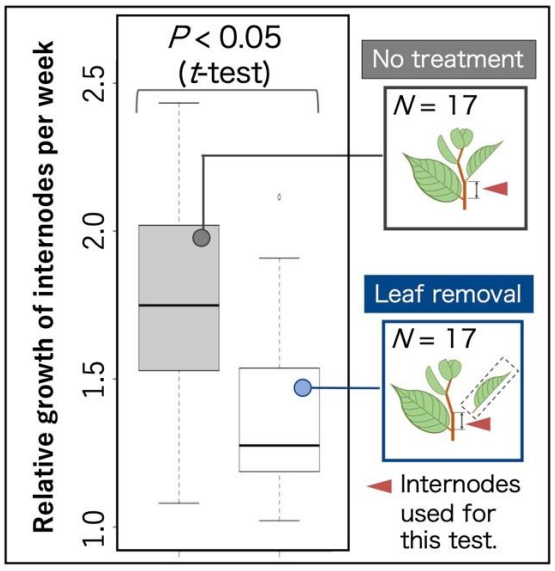


**Fig. 2. The effect of growing leaves on the internode growths of *S. leprosula***
The relative growths of the internodes whose growing leaves were experimentally removed (right) were significantly smaller than those of the control (left). The red arrowhead indicates the position of internodes measured to test the changes in growth rate. N represents the number of branches used for the experiment.

Reference : Kobayashi et al. (2021) *JARQ* 55(3):273–283