Intraspecific leaf trait variations across climate gradients in a typical alpine tree, *Betula ermanii*, sapling

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Introduction

In rapidly changing climate conditions, it is essential for plant species to adapt to new climate condition to survive. Understanding the magnitude of ability to adjust of ecological traits of leaves will help improve their performance in the new climate condition. Intraspecific variations of leaf traits factors are important in terms of adaption and evolution. One of the approaches to reveal this is by 'common garden experiments' where plants from different populations are exposed to a common environment. A common garden experiment focused on *Betula ermanii* (birch) species, a typical alpine tree was initiated to demonstrate range of intraspecific variations across climate gradients. *B. ermanii* is native to xeric Hokkaido region in Japan and in alpine regions around the world. This species has a high adaptive capacity, but, some of these climatic factors might exceed their capacity. Thus, the objective of this study is to demonstrate the plasticity of *B. ermanii* leaf traits to understand their performance in future climate condition.

Material & Methods

The common garden experiments were conducted in two experimental stations located in Tsukuba (TSK) and Yatsugatake (YGT) in Japan. A total of 183 *B. ermanii* saplings originating from 7 sites were transplanted to these two stations. The seven origin sites are shown in Fig.1. Morphological traits and photosynthesis properties were observed in mid-August in Tsukuba and in the beginning of September in Yatsugatake. Morphological traits were calculated for three replicates for each plant from each origin site, and this data was compared between the two stations. Pmax was measured using photosynthesis system (LC-pro-SD, UK).

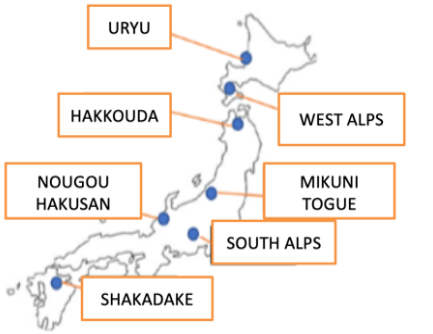

Fig 1 : Original locations of B. ermanii saplings used in common garden experiment.

Discussion

Morphological traits such as plant height and shoot diameter of the saplings in TSK showed better properties compared to those in YGT (Fig.2). More intraspecific variation within saplings was seen in TSK (Fig. 2A, B). Pmax, decreased substantially for most saplings as temperature increased to 30°C. URU saplings performed best in terms of morphological traits. SHA saplings performed most poorly in YGT. As for morphological traits, elevated temperatures improved growth and biomass accumulation. On an intraspecific level, there is great variation seen with each of the seven samples, but the overall trend in both sites is similar. Meanwhile, the reduction in photosynthetic capacity showed a marked seasonal effect, which was at a maximum toward the end of the growing season. Results show that leaf trait plasticity is an important mechanism for enabling plants to persist within communities and to better tolerate changing environmental conditions under climate change. It can be hypothesized that the warmer temperature elongated the growth period. Takahashi et.al. (2005) also showed that photosynthetic rates of Japanese birch dropped considerably as temperatures increased in excess of 25 °C.

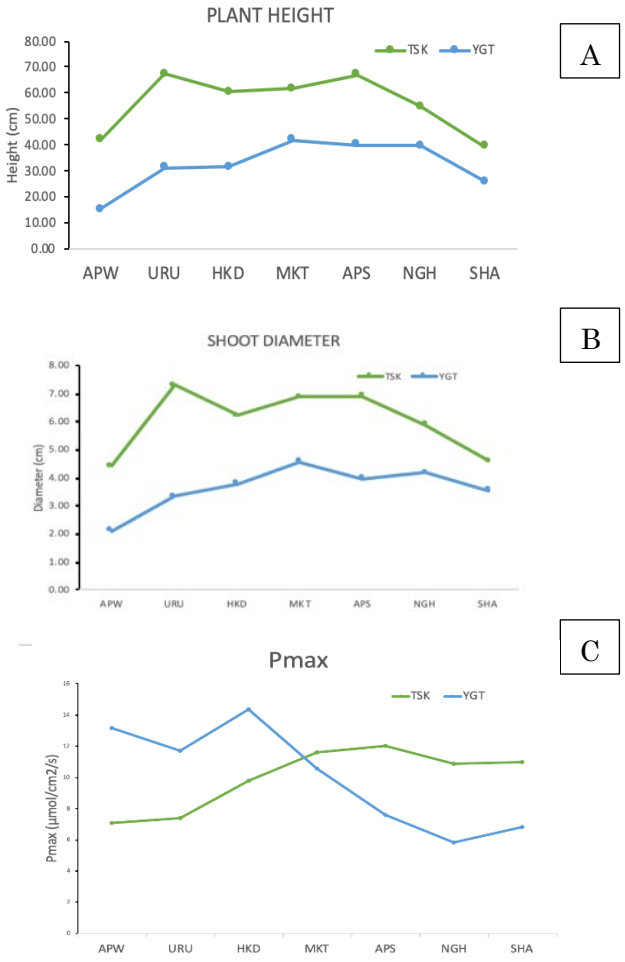

Fig 2: Comparison of sapling in Tsukuba and Yatsugatake for : (A) - plant height; (B)- shoot diameter; (C) Pmax values

Reference

Takahashi et al,(2005),Climatic factors affecting the tree- ring width of Betula ermanii at the timberline on Mount Norikura, Ecol Re 20,445