Acclimation and Adaptation Capacity of Northern Silver birch (*Betula pendula*) Populations to Climate Change

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Boreal regions are currently undergoing extensive climate change. For Finland, climate change scenarios for the end of this century project an about 1-7 ℃ increase in average temperature which is estimated to be higher during winter and fastest in the Northern Finland. The growing season will become longer and warmer. At this pace, climate zones will shift northwards at a greater speed than long-living trees can migrate. To be able to avoid the adverse effects of these changes, plants will have to either acclimate (in the short term) or adapt (in the long term) to the new conditions.

While temperature, CO_2 concentration, air humidity and many other factors change due to global warming, photoperiod remains the same. Plants that cover a wide geographic range need to cope with the different photoperiods. Silver birch (*Betula pendula* Roth) is a widely distributed pioneer tree species in boreal forests in Europe and Asia. In Finland, its latitudinal and longitudinal distribution is spanning almost the whole country, which makes silver birch an excellent model tree for studying local adaptation and acclimation capacity to different environments.

We have studied Finnish silver birch provenances from latitudes 60° to 67°N for their geographical variation in common garden experiment and in controlled experiments in response to temperature and photoperiods. The provenances can be separated into two groups, northern and southern, by their genetic background and by differences in leaf traits, photosynthesis (gas exchange and chlorophyll a fluorescence), phenology, growth, and biomass allocation patterns. In general, the northern provenances show higher photosynthetic capacity per leaf area (higher rates of net photosynthesis, higher maximum quantum yield of photosystem II photochemistry, Fv/Fm), higher stomatal conductance and lower water use efficiency than the southern provenances. The provenances show similar temperature response of photosynthesis, but the northern provenances require a longer photoperiod for the higher growth rate and biomass allocation than the southern provenances. The biomass allocation pattern also differs among the provenances; northern provenances invest relatively more to the below-ground fraction whereas southern provenances have more leaves, branches, and stem biomass.

In conclusion, the provenances seem to be able to acclimate to a common growth temperature and thus the carbon assimilation of the birch trees may not be significantly affected by rising temperatures alone. The requirement for long day conditions in the northern provenance suggests adaptation to local environment.

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