



Initial growth of first-year *Pinus densiflora* and *Larix kaempferi* seedlings under open-field artificial warming and precipitation manipulation

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Seedling stage is important for tree growth since it is particularly sensitive to environmental conditions such as air temperature and soil moisture. The initial growth of seedling is known to influence the survival rate and future seedling growth. This study was conducted to investigate the impacts of rising air temperature and changing amount of precipitation on the initial growth of *Pinus densiflora* and *Larix kaempferi* seedlings. In April, 2018 *P. densiflora* and *L. kaempferi* seeds were sown separately in each plot, which was composed of three replication sets of six treatments; (temperature control (TC) and warming (TW)) × (precipitation control (PC), precipitation increase (PI), and precipitation decrease (PD)). The warming plots have been heated with infrared lamps to make 3 °C higher air temperature compared with the temperature control plots. Precipitation was blocked with transparent panels in the PD plots (-40%), and the blocked precipitation was pumped into PI plots (+40%). Root collar diameter (RCD; mm), seedling height (cm), and their ratio (H/D; cm/mm) were measured in August and December, 2018 (n=3). Results varied by the species and the treatments. For *P. densiflora*, there was no significant difference in seedling growth among the treatments in August, while only seedling height decreased by the warming treatment in December (TC: 10.27±0.74, TW: 8.09±0.65; p=0.0470). For *L. kaempferi*, RCD was higher in the PD plots than in the PC and PI plots in August (PC: 0.69±0.06, PD: 0.88±0.05, PI: 0.71±0.18; p=0.0391). Seedling height decreased in the TW plots in December (TC: 8.07±0.47, TW: 6.37±0.51; p=0.0498). H/D also decreased by the warming treatment both in August (TC: 7.39±0.25, TW: 6.71±0.42; p=0.0430) and December (TC: 4.92±0.20, TW: 4.15±0.22; p=0.0334), and it showed lower values in order of PD (6.09±0.38), PI (7.12±0.18), and PC (7.95±0.34) plots in August (p=0.0010). Average air temperature in July and August of 2018 (28.28 °C) was 2.32 °C higher than that of the last 10 years, and in addition to this, the warming treatment might cause heat stress on seedling height growth for both species. RCD seems to increase to respond to the precipitation decrease treatment for *L. kaempferi* which is known to react by increasing root growth to drought stress. H/D, an indicator of seedling quality was determined by each treatment effect, and it was species-specific.

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