

Year to year variations in larch growth and their controlling factors in taiga-tundra boundary ecosystem, NE Siberia

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Eastern Eurasia is covered by permafrost which is the largest and the deepest in the world. In its arctic region of lowland of Indigirka River, taiga-tundra boundary ecosystem covers the area. For better understanding of this boundary ecosystem, it is important to understand controlling factors on the growth of larch trees which is the dominate tree species of taiga. Larch growth can vary spatially and temporally. In spatial variation, we found that high soil moisture influences mortality of the larch trees and N availability explains differences in trees ability of C assimilation among the sites. To know the controlling factors on temporal variation of larch growth, we conducted field measurements on photosynthesis, needle nitrogen (N) content, needle mass and isotopic ratios in larch needle and stem in every summer from 2009 to 2013 at four sites in the Indigirka River Basin, near Chokurdakh (70°37'N, 147°53'E), northeastern Siberia.

There was no seasonal variation in needle mass during the growing season after needles were fully open, while needle N content showed seasonality. Needle N content in the year positively correlated with July air temperature and stem $\delta^{13}\text{C}$ and following year needle $\delta^{13}\text{C}$. These results indicate that, in the year with higher July air temperature, more N was allocated to needle and larch trees exhibited higher photosynthetic rate and photosynthetic C used for needle production was one year delayed. Higher air temperature in the year possibly indicates higher solar radiation based on positive correlation between July temperature and sun hours. Therefore, it can be said that larch growth shows strong dependence on solar radiation. In terms of temperature itself, we found higher temperature could limit photosynthetic rate. In addition, wet event, occurred at some sites in 2011 and 2012, caused low photosynthetic rate and low needle N content in 2012, and higher needle $\delta^{13}\text{C}$ in 2012 and 2013. These results indicate that high soil moisture could limit larch photosynthesis and reduce N uptake and cause stomata closure as well.

Our observational results indicate that solar radiation is one of the most important controlling factors on larch growth, and high soil moisture and high temperature can limit larch growth.

Keywords: Carbon and nitrogen isotopes, Needle N content, Photosynthesis, Air temperature and solar radiation, Soil moisture, Vegetation change