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Effects of thinning intensities on transpiration and productivity of 50-year-old Pinus koraeinsis stands

Juhan Park (1), Taekyu Kim (2), Minkyu Moon (3), Sungsik Cho (1), Daun Ryu (1), Hyun Seok Kim (1,3,4)

(1) Department of Forest Sciences, College of Agriculture and Life Sciences, Seoul National University, Seoul, South Korea, (2) National Institute of Environmental Research, Incheon, South Korea, (3) National Center for AgroMeteorology, Seoul National University, Seoul, South Korea, (4) Research Institute of Agriculture and Life Sciences, Seoul National University, Seoul National University, Seoul, South Korea, (5) Interdisciplinary Program in Agricultural and Forest Meteorology, Seoul National University, Seoul, South Korea

This study investigated the effects of thinning intensities on stand transpiration and productivity of 50-year-old Korean pine forests for two years. Forest thinning, which removes some fraction of trees from stand, is widely conducted for reducing competition between remaining trees, improving tree productivity, reducing the risk of natural fire, and thus maintaining healthy forest. Forest thinning alters the microclimatic conditions such as radiation distribution within canopy, vapor pressure deficit, and amount of available soil water. These changes influence on the tree water use, and related productivity. Thinning was conducted on March, 2012 with two intensities (Control, Light-thinning (20%), and Heavy-thinning (40% of tree density)). Transpiration was estimated from sap flux density, which was measured with Granier-type thermal dissipation sensors. Tree diameter growth was measured with dendrometer, and converted to tree productivity using allometric equations developed specifically in our study sites.

The climatic conditions showed little differences between two years. During the first growing season after thinning, stand transpiration was ca. 20% and 42% lower on light-thinning and heavy-thinning stand, respectively, even though sap flux density were higher in thinned stand. The difference in stand transpiration among treatments showed seasonal trends, so it was larger on summer when soil moisture was abundant due to monsoon, but was diminished on spring and autumn when soil moisture was limited. Tree-level productivity increased ca. 8% and 21% on light-thinning and heavy thinning stand, respectively. However, stand net primary production was ca. 20% lower on light-thinning stand, and ca. 31% on heavy-thinning stand. As a result, water use efficiency increased only in heavy-thinning stand. During the second growing season after thinning, stand transpiration was ca. 19% lower on light-thinning stand, and ca. 37% lower on heavy-thinning stand. The reduction of stand transpiration difference in heavy-thinning stand was caused mainly by increase in sap flux density. Trees in thinned stand showed higher productivity, but the magnitude was ca. 4% on light-thinning stand, and ca. 27% on heavy-thinning stand. Stand net primary production was ca. 23% lower on light-thinning stand, and ca. 28% on heavy-thinning stand. As a result, heavy-thinning stand showed highest water use efficiency. These results indicate that there are differences in biological reactions with thinning intensities.