

Effects of thinning on stable N and C isotope ratios and nitrogen concentration in leaves of hinoki cypress plantation

INAGAKI, Yoshiyuki^{1*}; NOGUCHI, Kyotaro¹; MIYAMOTO, Kazuki¹; OKUDA, Shiro¹; NOGUCHI, Mahoko¹; ITOU, Takeharu¹

¹Forestry and Forest Products Research Institute

Thinning in hinoki cypress plantations may enhance soil water and nitrogen availabilities and affect water and nitrogen utilization strategy for remaining trees. Nitrogen concentration, $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ are used as indices of nitrogen uptake, sources of soil nitrogen and water use efficiency, respectively and changes of water and nitrogen utilization of remaining trees can be evaluated from these leaf properties. We investigated leaf properties before and after thinning in hinoki cypress plantations in Kochi prefecture. Six treatments with tree replicates were established (no thinning and 50% thinning at a lower-elevation area and no thinning, 35% thinning, 50% thinning and 50% row thinning at a higher elevation area). Thinning was conducted before growing season in 2008 and leaf samples were collected by slingshot in 2007 and 2009. Leaf nitrogen concentration ranged 7.9 to 13.4 mg g^{-1} and from 7.7 to 12.7 mg g^{-1} , in 2007 and 2009, respectively. Changes of nitrogen concentration between two periods ranged -1.2 to +2.1 mg g^{-1} was correlated with nitrogen concentration in 2007 negatively and with percentage of thinning positively. The result suggests that nitrogen uptake of remaining trees should enhance where nitrogen availability is limited before thinning practice. $\delta^{15}\text{N}$ in leaves ranged from -5.9 to -1.6 ‰ and from -6.0 to -2.0 ‰, in 2007 and 2009, respectively. Change of $\delta^{15}\text{N}$ between two periods ranged from -0.6 to 0.8 ‰ but was not related with thinning intensity nor initial nitrogen concentration. The result suggests that soil nitrogen sources are not significantly affected by thinning practice. $\delta^{13}\text{C}$ ranged from -28.6 to -26.9 ‰ and from -28.5 to -26.2 ‰ in 2007 and 2009, respectively. Changes of $\delta^{13}\text{C}$ between two periods ranged from -0.9 to +1.5 ‰ and were correlated with thinning intensity positively, with $\delta^{13}\text{C}$ in 2007 negatively and nitrogen concentration in 2007, negatively. The results indicate that water use efficiency of remaining trees should not decrease in response to increase in soil water availability after thinning. The results suggest that water use efficiency should increase after thinning where water limitation is not severe and leaf photosynthetic ability as indicated by higher nitrogen concentration should increase where nitrogen limitation is severe. From these findings we concluded that thinning in hinoki cypress plantations with low soil nitrogen availability is a suitable management to improve nitrogen nutrition of remaining trees.

Keywords: hinoki cypress, thinning, nitrogen concentration, carbon isotope ratio, nitrogen isotope ratio