

Estimation of leaf biomass and nitrogen uptake in a hinoki cypress forest

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Nitrogen uptake by aboveground vegetation in forest ecosystems is determined from nitrogen loss by litterfall plus nitrogen allocated to aboveground biomass increment. Nitrogen in litterfall is accurately estimated by littertrap while that in stem increment is by measurement of tree growth. In contrast, estimation of leaf biomass increment is difficult. Although there is close correlation between leaf biomass and cross-sectional area at lowest live branch in the crown, it is difficult to measure diameter at the lowest live branch. Recently, the simple method to estimate leaf biomass is developed by using tree height, height at lowest live branch and diameter at breast height. The applicability of this method depends on tree species and information about hinoki cypress is not known. In this study, we determined the equation for estimating leaf biomass by this method to hinoki cypress trees in Kochi prefecture, southern Japan. In addition the obtained equation is applied for a hinoki cypress forest where tree biomass and litterfall is measured for 20 years.

In two areas at different altitude in Kochi prefecture, 14 hinoki trees were felled and leaf biomass was measured. The relationship between leaf biomass (W_{leaf}), and tree height (H), height at lowest live branch (H_b), and cross-sectional area at breast height ($A_{1.3}$) was determined by following equation.

$$W_{\text{leaf}} = 1.02[0.0364AB^{1.10}] \quad (r^2=0.926, p<0.0001)$$

$$AB = A_{1.3} [(H - H_b) / (H - 1.3)].$$

This equation is applied for a hinoki cypress forest in Kochi prefecture. Leaf biomass is determined at seven periods between 21 to 41 years old. Leaf production is calculated as leaf-litterfall plus increase of leaf biomass. Nitrogen uptake was calculated as sum of nitrogen in litterfall, increase of nitrogen in leaf and stem biomass. Nitrogen use efficiency of aboveground biomass was calculated as sum of leaf and stem production divided by nitrogen uptake. There was no significant correlation between forest age and leaf biomass, leaf production, stem production, nitrogen uptake and nitrogen use efficiency. However, nitrogen uptake was positively correlated with leaf biomass and leaf production. Nitrogen uptake was not correlated with stem production. These results suggest that nitrogen use of hinoki cypress does not show clear trend in relation to stand age but hinoki cypress utilize nitrogen efficiently to sustain stem production when nitrogen uptake is lower.

Keywords: hinoki cypress, leaf biomass, Stem, nitrogen, forest age