

# Age related changes in water and nitrogen use strategies of crop trees and understory vegetation in a hinoki cypress plantation forest in Kochi city

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Long-term changes of water and nitrogen utilization of crop and understory vegetation in a hinoki cypress plantation forest was investigated from 21 to 46 years old in Kochi city, southern Japan. Nitrogen concentration in leaf litter of hinoki cypress was tend to decrease in relation to forest age. Leaf  $\delta^{15}\text{N}$  of hinoki cypress was related with a quadratic function and had a maximum value at 26 years old. These results suggest that older hinoki cypress utilize soil nitrogen sources having lower  $\delta^{15}\text{N}$  value and the competition for soil nitrogen with understory vegetation should be severer. Carbon isotope discrimination ( $\Delta^{13}\text{C}$ ) and intrinsic water use efficiency (iWUE) in hinoki cypress was related with a quadratic function and  $\Delta^{13}\text{C}$  had a minimum value at 30 years old whereas iWUE had a maximum value at 36 years old. The results suggest that hinoki cypress in the earlier time increased iWUE by reducing stomatal opening. In the later time WUE was decreasing by lower photosynthetic capacity. By contract, in understory vegetation stomatal opening increased due to higher soil water availability with decreasing stand density of crop trees. These results suggest that increase of iWUE in hinoki cypress in response to elevated atmospheric carbon dioxide should be smaller in the later time because of severer competition with understory vegetation for soil nitrogen resources.

Keywords: hinoki cypress, understory vegetation, stable isotopes, nitrogen, water use efficiency, carbon dioxide