Seasonal variation in nitrate reductase activity of oak seedlings and Sasa

Karibu Fukuzawa[1]; Miki Ueda[2]; Naoko Tokuchi[3]

[1] Northern Biosphere, Hokkaido Univ.; [2] Agriculture, Kyoto Univ; [3] FSERC., Kyoto Univ.

Uptake of inorganic nitrogen by plant roots is the major pathway in nitrogen cycling in forest ecosystems, and the amount of nitrogen cycled in a forest ecosystem is larger than nitrogen input and output. Hence nitrogen uptake by plants would influence nitrogen leaching to outside of the forest via streams. Annual value of nitrogen uptake by plants had been evaluated but seasonal variation of that had been less understood. Furthermore, since multiple vegetations grow in natural forest ecosystem, it is necessary to evaluate the function of several vegetation groups instead of only one species. Especially in a cool-temperate forest ecosystem, it is reported that understory vegetation, dwarf bamboo (*Sasa* spp.), has larger biomass of fine-root, which takes up nutrient from soil, than trees. Evaluating nitrogen uptake potential of *Sasa* in addition to fine-root dynamics might be crucial for understanding nitrogen dynamics in forest ecosystems. In this study, we measured the seasonal variation in nitrogen reductase activity (NRA) of dominant tree species, oak, and *Sasa* to clarify nitrogen uptake potential of both species. In addition, we discussed the relationship of NRA with leaf and fine-root productions.

We experimented in the Kitashirakawa nursery of Field Science Center, Koyoto University. We cultivated oak (*Quercus crispula*) seedlings and Sasa (*S. veitchii*) by sand in pot. We fertilized 2.1mM N liquid fertilizer every 2 weeks. We harvested in August and October 2008, February 2009 and immediately measured NRA of leaf and fine-root. We separated fine-root by root order to less than three order and more than four order. In the measurement of NRA, we incubated 100 mg of sample in buffer solution (0.1 M KNO_3, 30 ^{o}C, 1 h) and analyzed the amount of NO_2 produced during the incubation. For measurement of fine-root dynamics, we also cultivated plants in transparent rhizoboxes by sand and scanned the roots visible through the side of rhizoboxes every 1 or 2 weeks. Then we traced and measured the length of individual root in images. We defined fine-root production rate as the total increase in root length during observation interval. Furthermore, we counted new leaves every 2 weeks for measurement of above-ground phenology.

In fine-root (less than three order) of oak, NRA in August and October were 0.59, 0.75 micro mol g dw^{-1} h^{-1}, respectively. However in fine-root of *Sasa*, NRA in August and October were 0.28, 0.84 micro mol g dw^{-1} h^{-1}, respectively. NRA in leaf also had similar seasonal pattern with fine-root, showing different seasonal pattern in NRA in both above- and below-ground between oak and *Sasa*. This two species also had different seasonal pattern of above- and below-ground phenology. Oak leaf turned color in October but *Sasa* leaf emerged rapidly in September and October and had green leaf continuously. Fine-root production rate of oak was highest in July and August but that of *Sasa* increased in September to October. These results show the different seasonal pattern in above- and below-ground production between oak and *Sasa*, leading to the different seasonal pattern in nitrogen uptake.