Growth and respiration of mycorrhizal fungal hyphae in the soils of Japanese konara oak (*Quercus serrata*) and hinoki cypress (*Chamaecyparis obtusa*) stands

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1. INTRODUCTION

Mycorrhizal fungi use a network of hyphae to supply inorganic nutrients from the soil to their symbiotic host plants, while, in return, receiving photosynthetically assimilated organic compounds. In forest ecosystems, up to 30% of carbon assimilated by symbiotic trees is allocated to mycorrhizal fungi. Especially mycorrhizal fungal hyphae can become a large below-ground carbon storage and constitute a high proportion of soil CO_2 efflux by their respiration. The objective of this study was to estimate and compare hyphal growth and respiration in *C. obtusa* (arbuscular mycorrhizal/AM symbiont) and *Q. serrata* (ectomycorrhizal/EM symbiont) dominated warm-temperate forest stands in Western Japan.

2. MATERIALS AND METHODS

To examine mycorrhizal fungal hyphal growth, sand-filled in-growth mesh bags (N = 84) were placed in the upper soil of two *C. obtusa* (CO1, CO2) and two *Q. serrata* (QS2, QS3) plots in May 2015 and harvested two months later. Total hyphal growth was determined by measuring the length of hyphae extracted from mesh bag sand. To determine growth of EM and AM fungal hyphae, separately, the amounts of two phospholipid-derived fatty acids (PLFA), which served as fungal type-specific indicators, were quantified by gas chromatography. Hyphal respiration was estimated by measuring CO_2 efflux from mesh bag sand using an infrared gas analyzer. Hyphal growth and respiration in plots and forest types were compared by ANOVA, respectively.

3. RESULTS & 4. DISCUSSION

Averages of total hyphal length growth per day in each plot ranged from 7.1 to 10.5 mm cm^{-3} day^{-1} (*Figure 1*). These values are higher than in many European temperate deciduous forests, but lower than in boreal conifer stands (Ekblad et al., 2013). Significantly higher total hyphal growth ($p = 0.066$) was found in *Q. serrata* dominated stands when comparing the two forest types, which indicates a difference in carbon allocation to mycorrhizal fungi by forest type. Although higher growth of EM fungal hyphae was found in *Q. serrata* stands ($p = 0.063$), large non-mycorrhizal microbial backgrounds for this indicator limit validity of the results. Growth of AM fungal hyphae was higher ($p = 0.004$) in *C. obtusa* stands, but was also high in QS3, indicating that a difference in carbon allocation between forest types is not related to the fungal type. CO_2 efflux from mycorrhizal hyphae ranged between 0.055 to 0.065 $mgCO_2$ m^{-2} s^{-1} in *Q. serrata* stands which would constitute a proportion of 20 to 30% of total soil CO_2 efflux in the stands, similar to results of past studies in European temperate forests.

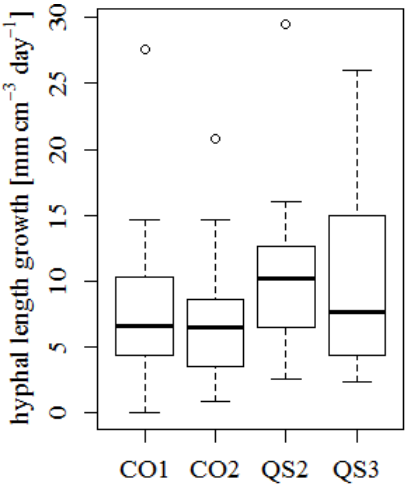

Figure 1: Mycorrhizal hyphal length growth in *C. obtusa* (CO1, CO2) and *Q. serrata* (QS2, QS3) plots

5. CONCLUSION

Carbon allocation to mycorrhizal hyphae in *C. obtusa* and *Q. serrata* dominated forest stands in Japan shows similar extent as in European stands. Also evidence was found for a difference in growth of mycorrhizal hyphae by forest type, but further research is needed including other hyphal growth indicators and growth variation by season.

6. REFERENCES

Ekblad et al. (2013). The production and turnover of extramatrical mycelium of ectomycorrhizal fungi in forest soils: role in carbon cycling. *Plant and Soil*, *366*(1-2), 1-27.