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Influences of nitrogen load on the growth and photosynthetic responses of *Quercus serrata* seedlings to O₃

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Abstract The objectives of this study were to clarify the influences of nitrogen (N) load on the growth and photosynthetic responses of *Quercus serrata* seedlings to O₃ and to obtain basic data for evaluating the critical levels of O₃ for protecting *Q. serrata* forests in Japan. The effects of O₃ and/or N load on growth and photosynthetic activity of *Q. serrata* seedlings were investigated during the two growing seasons. Two-year-old seedlings were assigned to 12 experimental treatments, which were comprised of the combination of four gas treatments (charcoal-filtered air and three levels of O₃

at 1.0, 1.5 and 2.0 times ambient concentration) and three N treatments (0, 20 and 50 kg ha⁻¹ year⁻¹). During the second growing season, no significant interactive effects of O₃ and N load on the growth and net photosynthetic rate of the seedlings were detected. Therefore, we concluded that N supply to the soil at <50 kg ha⁻¹ year⁻¹ does not significantly influence the growth and photosynthetic responses of *Q. serrata* seedlings to O₃. Based on the O₃ exposure-response relationships for the whole-plant growth of the seedlings, the critical level of O₃ for *Q. serrata* was estimated to be approximately 36 nmol mol⁻¹ as the average 15-h O₃ concentration during the one growing season.

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Introduction

In East Asia, gaseous air pollution resulting from increasing energy demands due to rapid economic growth, industrialization and urbanization poses a serious environmental problem (International Energy Agency 2002; Zheng and Shimizu 2003; Jianhui et al. 2005). Recently, relatively high concentrations of ozone (O₃), a main component of photochemical oxidants, have been observed at several sites in East Asia (Zheng and Shimizu 2003; Jianhui et al. 2005; Network Center for EANET 2005). In Japan, relatively high concentrations of O₃ above 100 nmol mol⁻¹ have been frequently detected not only in the suburbs of big cities such as Tokyo and Osaka, but also in several mountainous areas where O₃ and its precursors are