PREFACE

Physiological ecology of woody species in response to air pollution and climate changes

Preface

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Growing concern about the sustainability of forest resources and ecosystems increases the demand for multidisciplinary research and stimulates the need for understanding forest response to climate change and transboundary air pollution—such as tropospheric ozone (O₃) and nitrogen (N) deposition—associated with the use of fossil fuels (Matyssek et al. 2013; Mills et al. 2018). As trees live a long time, questions are raised about how this changing environment will affect forest resiliency and if forests can continue carrying out their functional diversity and provide their ecosystem services to the society. Trees may acclimate to the changing environment by showing phenotypic plasticity and by adjusting their physiological and biochemical processes.

In this special issue of JPR symposium entitled “Physiological ecology of woody species in response to air pollution and climate changes”, we present three original articles. The articles in this JPR symposium are chosen from the talks given at the 28th IUFRO biennial conference of the Research Group 7.01 “Impacts of Air Pollution and Climate Change on Forest Ecosystems” entitled “Actions for Sustainable Forest Ecosystems under Air Pollution and Climate Change”, which was held in Fuchu, Japan, 22–26 October, 2017. IUFRO (International Union of Forest Research Organizations) is the largest international network of forest scientists, and promotes global cooperation in forest-related research and enhances the understanding of the ecological and environmental aspects of forests and trees. This biennial meeting represents an opportunity of discussion for specialists in air pollution, climate change and forest ecosystems.

The following briefly introduces these articles in this special issue.

Watanabe et al. (2018) explicitly examined photosynthetic parameters including mesophyll conductance for CO₂ diffusion (g_m) in leaves of Siebold’s beech (*Fagus crenata*) seedlings in response to O₃. Ozone is generally known to induce tree growth (Matyssek et al. 2013). The reduction in tree growth following O₃ exposure is closely related to lower photosynthetic activity (Matyssek and Sandermann 2003). It has been reported that the O₃-induced reduction in photosynthetic rates is mainly due to a biochemical limitation associated with reduced ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco) activity (e.g., Fiscus et al. 2005). The loss of Rubisco activity is commonly estimated from decreases in the maximum rate of carboxylation (V_{cmax}), as indicated by a decrease in the initial slope of a net photosynthetic rate (A) to intercellular CO₂ concentration (C_i) (A/C_i curve) assuming that g_m is infinite (e.g., Long and Bernacchi 2003). However, it has been reported that g_m is finite, and may limit A to the same extent as stomatal limitations to CO₂ transport (Terashima et al. 1995; Warren et al. 2003). Therefore, such a decrease of C_i -based V_{cmax} is attributed to a decreased g_m or degradation of Rubisco activity (Loreto et al. 1994). In this issue, Watanabe et al. (2018) aimed to answer if O₃-induced reduction in C_i -based V_{cmax} would be a result of the decrease in g_m or not.

In recent decades, in addition to O₃ pollution, anthropogenic N deposition has been a further concern and may change nutritional conditions for plants (Peñuelas et al. 2012). One of the important questions is whether the traditional carbon-nutrient balance hypothesis (Bryant et al. 1983) could explain the metabolic capacity for coping with O₃ stress (Schulze 1989), although this hypothesis explains mainly behavior of phenolic compounds (Koricheva 2002). In fact, a recent finding indicates that tree growth may be limited by O₃ and that a significant interaction exists with nutrition such as N and phosphorus (P) (Braun et al. 2017). However, our knowledge of plant responses to O₃ under

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various nutritional conditions is limited. In this special issue, Zhang et al. (2018) addressed this subject concerning the interactive impacts of O₃, N and P on the photosynthetic characteristics for the first time.

Studies of physiological ecology could also contribute to providing perspectives for forest management and breeding in future climate change. Wang et al. (2018) addressed the effects of forest thinning and wood quality on wood decomposition in a Chinese pine (*Pinus tabulaeformis* Carrière) plantation in northern China, where high N deposition rates were observed ($> 50 \text{ kg ha}^{-1} \text{ year}^{-1}$) (Reay et al. 2008). The changes in soil nutrients due to anthropogenic N deposition may also affect wood decomposition on the surface of the litter layer and in mineral soil (Ganjegunte et al. 2004). Wood decomposition has been considered an important factor to determine forest C- and N-cycles (e.g., Campbell et al. 2009). Wang et al. (2018) discuss the role of thinning treatments and its interaction with the changes in soil environment.

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