BRIEF COMMUNICATION

Recovery of net photosynthetic rate after SO_2 fumigation in *Quercus acutissima, Pinus densiflora, Populus alba×glandulosa,* and *Acanthopanax sessiliflorus*

S.Y. WOO[*], K.W. KWON[**], J.C. LEE[***], J.H. CHOI[**], and B.S. KANG[**]

Department of Environmental Horticulture, University of Seoul, Seoul, 130-743, Republic of Korea[*]
Department of Forest Resources, Chungnam National University, Daejeon, 305-764, Republic of Korea[**]
Department of Genetic Resources, Korea Forest Research Institute, Suwon 441-350, Republic of Korea[***]

Abstract

After SO_2 fumigation, *Quercus acutissima* and *Pinus densiflora* maintained high net photosynthetic rate (P_N) and did not show visible symptoms of damage. In contrast, *Populus alba×glandulosa* and *Acanthopanax sessiliflorus* had significantly reduced P_N and showed visible necrosis.

Additional key words: compensation; recovery; resistance; sulphur dioxide.

Among air pollutants, sulphur dioxide (SO_2) is one of the major environmental inhibitors of tree growth and development (Reich *et al*. 1983, Mooney *et al*. 1988). This study examined the response of leaf net photosynthetic rate (P_N) of four species to SO_2: *Quercus acutissima, Pinus densiflora, Populus alba×glandulosa,* and *Acanthopanax sessiliflorus*. These species are important in Korea both as ornamentals in urban area and components of natural ecosystems in rural area. They occupy temperate regions throughout Japan and China. Physiological compensation has been observed to maintain biomass production in some trees exposed to air pollution (Winner 1994). Increased P_N and stimulated apical growth are typical examples of compensation. However, less is known about compensation strategy on these important species in Korea. The objective of this study was to compare the recovery of P_N after SO_2 fumigation in the above mentioned species. They were grown in the greenhouse at temperature between 23 and 25 °C during the experimental period. The relative humidity was 70 % at seedling height. Five replicates of each species (2 years old) were randomly assigned to the fumigation chambers [500 mg(SO_2) kg^{-1}] and control chambers. Plants were allowed to acclimate to the chambers for one week before the treatment. Twenty days later, the SO_2 exposure was stopped and plants were placed in the clean air for measuring P_N. The concentration of SO_2 was monitored for 3 min in every hour. Plants were exposed to SO_2 for about 6 h per day (10:00-16:00) for 20 d. P_N was measured on fully expanded, mature leaf number 4 counted from each shoot apex with a broad-leaf cuvette of the *Licor-6400* Portable Photosynthesis System (*Li-Cor*, USA). The leaf was sealed and CO_2 concentration was maintained at ambient level. Air-flow through the analyser was adjusted to maintain leaf cuvette relative humidity near ambient (60–70 %) during the measurements. The average cuvette temperature was maintained at 25 °C.

P. alba×glandulosa and *A. sessiliflorus* had significant reduction of P_N after SO_2 exposure and showed visible necrosis (45 and 55 %, respectively). In contrast, *Q. acutissima* and *P. densiflora* maintained relatively high P_N and did not show visible symptoms after SO_2 exposure (Fig. 1).

Plants frequently physiologically adjust to an environmental stress. Reducing root-to-shoot ratio and accelerated rates of leaf maturation are examples of these adjustments. Many changes in physiology and growth are the results of biological compensatory responses to

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[*]Corresponding author; fax:(+82) 2 22458302, e-mail: wsy@uos.ac.kr
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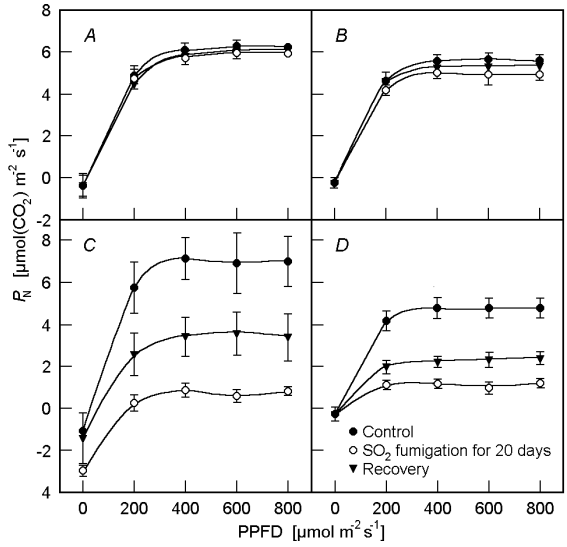

Fig. 1. Irradiance (PPFD) response curves of net photosynthetic rate (P_N) of *Quercus acutissima* (*A*), *Pinus densiflora* (*B*), *Populus alba*×*glandulosa* (*C*), and *Acanthopanax sessiliflorus* (*D*) fumigated with SO_2 for 20 d (○) and after recovery in clean air for further 20 d (▼) in comparison with control (●). *Bars* indicate standard deviation.

an environmental stress (Winner 1994) minimising the damage. Thus SO_2 can reduce biomass but trees may increase photosynthetic capacity of different leaves in order to maintain productivity.

Selection of SO_2-sensitive and -resistant plants was based on the visible symptoms and recovery of photosynthesis (Fig. 1). P_N was given a greater consideration than other study variables for two reasons. First, it is a reliable predictor and an excellent sensitive integrator of plant function under stress. Second, high P_N is one of the main goals of selection of air-pollution resistant species for urban area (Reich *et al*. 1984). *Q. acutissima* and *P. densiflora* are SO_2 resistant species. *P. alba*× *glandulosa* and *A. sessiliflorus* are sensitive to SO_2 exposure based on the recovery of P_N (Fig. 1). These different recoveries of P_N suggest the different compensation abilities (Kangasjarvi *et al*. 1994). *Q. acutissima* and *P. densiflora* had a very high P_N under SO_2 treatment, and were able to maintain high P_N in clean air after SO_2 exposure. Their response may be an example of an ability to adjust to or compensate for SO_2 damage. These two species may be suitable for phytoremediation in air-polluted areas such as urban area and near the industrial facilities.

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